TARRYALL DAM AND RECREATION IMPROVEMENTS

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A report submitted to the University of Colorado at Denver, Civil Engineering Department in partial fulfillment of the Senior Design course.

Spring 2021
May 11, 2021
May 7, 2021

Mr. Dmitry Tepo, P.M. and Mr. Taylor Scott, P.E.

Colorado Parks and Wildlife

6060 Broadway

Denver, Colorado 80216

Re: Final Report of Findings and Recommendations

Tarryall Dam Improvements

County Road 77 (Tarryall Road), Jefferson, CO 80456

Dear Mr Tepo, and Mr Scott,

JJS LD Consulting would like to thank you for the privilege of working with your office during the Tarryall Dam Improvements as part of our Senior Design Capstone. Our understanding of this project is to research and design a new water flow measuring flume, a reservoir analysis, and a dam assessment at the Tarryall Reservoir State Wildlife Area (SWA). Our initial site visit was with Dmitry Tepo and occurred on February 5, 2021 and the purpose was to tour the site and informally inspect and survey the existing dam, flume, and spillway conditions. We then conducted a virtual meeting on February 11, 2021 and the purpose was to gather background information, ask questions, and determine the project deliverables. The observations and data obtained during our site visits, as well as past reports and inspection documents provided to us by your office were utilized to perform our engineering analysis.
Our analysis consisted of surveying and designing a flume that feeds into Tarryall reservoir, performing an inspection on the existing dam structure, and evaluating and providing options for improving the existing spillway to meet the flow requirement.

Within the report our team has proposed recommendations regarding the spillway. Our team has assembled draft plans for installing and implementing the new concrete flume as well as a standard dam inspection report. The following report contains our findings, conclusions, and recommendation for the dam and flume within the Tarryall Reservoir State Wildlife Area. We appreciate your time and involvement with our team as part of our Senior Design Project Course.
1. Project Background

1.1 Client Background Information

The following is Colorado Parks and Wildlife’s mission statement as taken from their website:

“Colorado Parks and Wildlife (CPW) is a nationally recognized leader in conservation, outdoor recreation and wildlife management. The agency manages 41 state parks, all of Colorado's wildlife, more than 350 state wildlife areas and a host of recreational programs. CPW issues hunting and fishing licenses, conducts research to improve wildlife management activities, protects high priority wildlife habitat through acquisitions and partnerships, provides technical assistance to private and other public landowners concerning wildlife and habitat management and develops programs to understand, protect and recover threatened and endangered species. CPW also administers the state's trail program and registers boats, snowmobiles, off-highway vehicles, and river outfitters. Parks and Wildlife employees and their partners work together to provide ongoing and outstanding customer service through recreational programs, amenities, and services. Regulations are established by the Colorado Parks and Wildlife Commission.”

Colorado Parks and Wildlife have a specific strategic plan that identifies their six attainable goals for the preservation and conservation of wildlife areas in the state of Colorado. These are to ensure quality outdoor environments for wildlife and the general public to enjoy. The strategic plan goals from the Colorado Parks and Wildlife are as follows:
1. Conserve wildlife and habitat to ensure healthy sustainable populations and ecosystem.

2. Manage state parks for world class outdoor recreation.

3. Achieve and maintain financial sustainability.

4. Maintain dedicated personnel and volunteers.

5. Increase awareness and trust for CPW.

6. Connect People to Colorado’s Outdoors.

(Retrieved from Colorado Parks and Wildlife).
1.2 Project Background Summary:

We have divided the scope of this project into three specific sections:

1. Flume design.
2. Existing dam inspection.
3. Analysis of the existing spillway.

The flume is located about 1 - 2 miles upstream from the parking entrance to Tarryall reservoir. The flume was constructed using thin sheet metal to direct and control the flow of water through this particular section next to the roadway. This flume has not stood up against the test of time, it is flimsy and the metal is bending out of place, in turn, this is not providing an accurate representation of the flow of water. The goal of this section of the project is to create plans for a new flume using concrete. This is to ensure durability for many years to come.

The dam inspection component of this project is to ensure the dam is well maintained and to document any visual ques that the dam may need repairs or maintenance. Previous reports have documented issues throughout the years and we will be noting any new issues and any ongoing issues that have been documented previously.

The final part of this project is to evaluate and provide suggestions for improving the spillway. The spillway currently does not allow for an adequate cubic feet per second to flow through it. We will be looking into options to improve the spillway which include widening the spillway or altering the shape.

We wanted to be sure to include the core values of the Colorado Parks and Wildlife and stick to their mission statement which reads:
“The mission of Colorado Parks and Wildlife is to perpetuate the wildlife resources of the state, to provide a quality state parks system, and to provide enjoyable and sustainable outdoor recreation opportunities that educate and inspire current and future generations to serve as active stewards of Colorado’s natural resources.”

- Colorado Park’s and Wildlife
1.3 Site Description and Background

Miners were the people who got to name this spot as Tarryall (ghost town). In 1859, they found the gold in decent amounts in this river, and called it 'Tarryall' for a while. After approval by the state in 1925, the Tarryall Dam was built in order to create the Tarryall Reservoir between 1929 and 1931. The reservoir was planned to be a fish hatchery, of which remains are still visible today. The reservoir is located on Tarryall Road, the center of the Rural Historic District of Tarryall, a 27861-acre property. The State Wildlife Area of Tarryall Reservoir is full of built facilities and less than 2 hours from Denver which makes it easily available. This is why the area is famous during high tide season.

An excellent 4-mile segment just below Tarryall Reservoir's outlet. The property provides a winding water stream of rocky pocket water. Browns and rainbows are between 10 and 14 inches in height, some of them much bigger. A strong dry flow with intense skies and constant clear streams in the summer. The Tarryall Dam is a small concrete dam named 'High Danger,' which may result in loss of human life or considerable damage of property. It measures approximately 37 feet high and 263 feet long with a 6-foot crest width and a crest height of 8,860 feet (about twice the elevation of Denver, Colorado).

The resulting reservoir has a surface area of 165 acres and is 1963 acres long. The dam is on the north-east side of the reservoir. It is 30 feet tall and can accommodate 15,000 cubic feet per second. The dam drainage is 227,360 acres. The dam is 7.2 feet high in freeboard. The spill has many deficiencies with its current configuration, based upon dam inspection by the State Engineer Division of the Water Resources Dam Safety
Division. The outpouring is too minimal because a 5-year storm has come to an end. It is also likely to cause a rockfall that could lead to an even higher water level during a flood event. The dam maintains a measuring height of 32 feet due to damage to the upstream face of the dam.

Recreational changes must be carried out to keep people satisfied with all the activities that are being provided at the site of their interest. Tarryall Dam on the reservoir in Colorado has been an amusement and recreational spot for people for decades and it is our responsibility to make any amendments to all the recreational services and facilities that are available and being provided currently. Current recreational services that are being provided here include camping, fishing, boating, picnicking, mountain biking, wildlife adventure and mountain hiking. The whole area has also been crowded with various safety signs and booths to help people out in the times of need and to ensure the security and safety of anyone who visits Tarryall reservoir with his loved ones. In this study, all the activities will be discussed related to the recreational theme at the Tarryall dam and findings will also be added in further sections of the report.
1.4 Dam Description

The Tarryall Dam is a relatively small concrete dam classified as ‘High Hazard,’ meaning that failure or mis-operation could cause loss of human life and/or significant property destruction. Measuring at about 37 feet tall and 263 feet long with a crest width of 6 feet and a crest elevation of 8860 feet. The resulting reservoir holds 1963 acre-ft of water and has a surface area of 165 acres. The dam’s spillway is located to the north/east of the dam. This spillway is 30 ft wide and with a capacity of 15000 cubic feet per second. The drainage area of the dam is 227,360 acres. The dam has a freeboard height of 7.2 feet. According to dam inspections by the Office of the State Engineer Division of Water Resources Dam Safety Branch, the spillway has several inadequacies with its current design. The spillway is too small, being known to overtop with a 5-year storm. It is also prone to rockfall which could cause water levels to rise even further during a flood event. A gauge height of 32 feet is maintained at the dam due to damages on the upstream face of the dam.
1.5 Past Modifications and History

According to Colorado’s Decision Support Systems by the Colorado Water Conservation Board and the Division of Water resources, the design plans were approved in 1929. They redrew the design plans and had those approved in 1978. The construction data for what occurred between 1929 and 1978 is not currently in their files. However, Tarryall dam experienced problems in the foundation anchor stabilization of the right abutment and had construction occurring from November of 2002 up until September of 2004. Recently Tarryall dam had a hydrology study that began in November of 2020 and has been returned to the engineer for corrections as recently as January 29th of 2021. Inspections of Tarryall dam have been conducted on record as far back as 1978. These inspections have been conducted every year since 2002 expect for the years of 2003 and 2012. Restrictions have been placed on Tarryall dam just four times in the recorded history of the dam. The first restriction was place in 2001 due to a crack in the dam. Another restriction was imposed in 2002 due to the dam being unstable during overtopping of the dam. A restriction had to be set in 2004 again because the dam needed to stabilize the right gravity section. The last restriction was put on Tarryall dam in 2015 due to heavy seepage our of a joint just to the right of the outlet and spall.
2. Purpose

The existing flume upstream from Tarryall Reservoir is insufficient because of the original material used to construct it. The flume was initially built using thin sheet metal. During the frigid winter months, the soil surrounding the flume will expand, in turn, this bends and warps the thin walls of the metal flume changing the overall flow of water that can pass through. The purpose of this section of the project is to design a new flume made from a more durable material (in this particular case, concrete) that will replace the existing flume.

The dam inspection that we are to perform on this project is to help summarize the past findings and document any findings that have yet to be addressed and possibly find new issues with the current existing dam at Tarryall Reservoir. We will be researching to see if the current design meets the requirements of the state engineering office and we will potentially have to provide solutions for any deficiencies associated with the current dam structure.

The spillway that accompanies Tarryall Reservoir Dam is insufficient for the desired flow that has been predicted by the 1 percent Annual Exceedance Probability. The current spillway can only support 900 cubic feet per second of flow and to meet the Annual Exceedance Probability, the spillway needs to support at least 3,721 cubic feet per second of flow out of the primary spillway. The current purpose is to provide plans for an alternative spillway by either changing the width of the spillway or the shape of the spillway to allow a greater flow. The biggest requirement to keep in mind is that the client does not desire to make the spillway deeper than it currently is. If the spillway is deeper, it will compromise the overall water capacity of the reservoir.
3. Jurisdiction(s) Having Authority

Tarryall Dam is classified as a high-hazard dam that is owned and operated by Colorado Parks and Wildlife. The jurisdiction having authority include:

- Colorado Department of Natural Resources: Colorado Parks and Wildlife.
- Colorado Department of Natural Resources: Water Resources Division: Office of the State Engineer.
- Colorado Department of Public Health and Environment.
4. Applicable Building Codes

There are two documents that govern the operation, maintenance, and construction of dams in the State of Colorado, both of which are published by the Office of the State Engineer:


The flume design is governed by a document published by the US Department of the Interior Bureau of Reclamation:


The dam spillway design parameters are governed by a document published by US Department of the Interior Bureau of Reclamation:

5. Findings

5.1 Summary of Engineering Inspection Reports

The most current engineer’s inspection report took place on March 10th, 2020. The report outlines the following items: Upstream slope, crest, downstream slope, seepage, outlet, spillway, monitoring, and maintenance and repairs before giving the overall view of the dam structure.

Based on the most recent report, here are the following findings:

The upstream slope of the dam (this is the face of the dam that faces the reservoir) looked safe and intact and the owners have done an awesome job maintaining the dam and opening the gates if the water level gets too high.

The crest of the dam has two parapet walls that are only about 6 to 12 inches in height with some snow, water, and ice trapped on top of the dam without adequate drainage. This would be a safety hazard to anyone walking on top of the dam.

The downstream slope (opposite of upstream slope, faces the opposite direction of the reservoir) has some areas cracking and seepage. Nothing seems to be structurally compromised, further analysis would be required. The face of the dam will need to be continually monitored.

The seepage portion of the report seemed to have two areas of interest. The first being the 3rd monolithic join on the arch dam and the second being the rock abutment. These two areas were of interest but not of great concern.

There were no issues with the outlet or the gates. These have been tested in previous years and there have been no issues found thus far.
The spillway is inadequate for a 2000-year event and the engineer believes that this needs to be addressed to accommodate adequate flow through the spillway.

The engineer of record recommends to survey and monitor the dam a minimum of two times per year especially after extreme temperatures changes which could affect the dam structure and spillway.

Maintenance and repairs include the following: routinely exercise gates to ensure continued operability, keeping rock channel spillway clear of rockfall, keep vegetation from growing in the cracks in the gravity buttress section, and develop a plan to seal the surface of the keyed joint exposure at the dam crest.

The engineer of record deemed all parts of the structure to be acceptable and there were no signs of joint deterioration that would dictate further investigation on the structure, except the spillway he marked as being under poor condition.
5.2 Site Survey and Existing Conditions

Two limited scope site survey visits were performed by JJSLD Consulting at Tarryall Reservoir on Friday, February 2, 2021 and Friday, February 12, 2021. The initial site visit was to meet with Mr. Dmitry Tepo to discuss the scope of work and to perform a site walk. We first looked at the flume and discussed the criteria for design and construction of this scope of work. The flume was in worse shape than we had originally anticipated. Next, Dmitry brought us over to the dam and spillway. He showed us the safest route to get to the top of the dam and showed us the location of the spillway and other access points to the site so that we could perform our analysis.

During our second visit to Tarryall Reservoir we brought surveying equipment along with tools used to clear out the ice and snow from the flume. We performed work with a builder’s level and tape measures to find the elevations of the flume and the area surrounding the flume. We documented our findings and proceeded to the dam and spillway. First, we found the elevation of the top of the dam and compared it to the elevation underneath the bridge above the spillway so that we could figure out the height of the water when the reservoir was at capacity.

Next, we performed an inspection of the dam, we initially went through an old report and noted items that had not been changed since the previous report was filed. Next, we began to walk around attempting to document any changes or items that we did not see documented in the report or on the drawing set provided by Colorado Park’s and Wildlife.
The findings of our surveying at the site of the flume showed a slope of between 3.47% (on the side of the flume located further from the road) and 4.07% (on the side closer to the road).

The dimensions of the current flume are 6 feet 7.5 inches long, 2 feet 6 inches wide, and 2 feet 2 inches deep. These measurements do not include the throat at the entrance of the existing flume. The flume is surrounded by soil prone to expansion, which has caused the damage to the walls of the flume. On both sides of the site of the flume the ground has a steep slope with grades consistently over 10%, exceeding 30% in some points.
5.3 Engineering Analysis

The flume design process was performed using surveying and a software called Winflume. The purpose of the design technique is to decide the necessary measurements of a flow-measuring flume that will work according to the specifications defined. That is, it can reliably assess discharge over the entire spectrum of flows to be measured. Design is also an iterative operation, and a large number of flumes work properly in many situations. This design technique provides a simple, easy to build and accurate flume.

The first thing we had to do was acquire data on the existing flume site. According to the National Weather Service’s Advanced Hydraulic Prediction Service, the overall conditions upstream of the reservoir does not have a lot of data on water heights and flooding conditions. There does not seem to be a great risk in differing the sizing of the flume based on the lack of flooding records and the photographs of the existing conditions of the current flume. The flume does not overtop with water, and for many months of the year, there is no water in the flume at all.

Our design team went out to the flume site to take measurements and perform surveying work to check overall elevations of the existing conditions. We came up with an average slope for the runoff of water of 0.23 feet of fall for every 6 feet of length. This gives us a slope of 0.035 ft/ft. The flow that results from this is most definitely laminar based on conditions up and down stream as well as the photos we were provided from a different time in the year. The water though this stream flows very slowly, hence the laminar flow condition. It will essentially be standing water because of the low velocity of the stream.

The design method differs slightly according to the channel conditions and the source of rating and flume knowledge (i.e. when the theory and calculations are designed, with ratings
The fundamental steps in the method are outlined briefly in the following parts and explored in greater depth. This is effectively a test and error operation, although it can be speeded up significantly by the methods to determine the amount of contraction needed. The flume design steps for the WinFlume software were as follows:

1. Get channel and flow info, including the range of flows ($Q_{\text{min}}$ and $Q_{\text{max}}$) to be determined and related tailwater volumes ($y_{2\text{min}}$ and $y_{2\text{max}}$).

2. Decide the freeboard amount required ($F_1$).

3. Decide the allowable flow estimation errors ($X_{Q_{\text{min}}}$, $X_{Q_{\text{max}}}$) at the minimum and maximum flow rate and evaluate the ranking table errors ($X_{c_{\text{min}}}$ and $X_{c_{\text{max}}}$).

4. Decide on the procedure and related precision of the head identification ($\delta h_1$), and define the head necessary to meet the requirements of accuracy.

5. Choose the original form for the control section and decide how it will initially be modified during the design process.

6. Choose the volume and the length of the initial flume (if needed).

7. Determine upstream heads for this contraction in the tests ($h_{1\text{max}}$ and $h_{2\text{min}}$, $\Delta H_{\text{min}}$, $\Delta H_{\text{max}}$) and the necessary head loss at ($Q_{\text{min}}$ and $Q_{\text{max}}$).

8. Compare the findings with the design criterion of this test. Select separate contraction levels if design requirements are not fulfilled and repeat steps 7 and 8 before design criteria and goals are met.

9. Finish the linear flume or weir by criteria.
5.4 Concrete Selection

For the concrete selection for the flume, the county of Tarryall dam and reservoir will play an important role in the selection criteria. Because our flume is in Park County, the 2020 building code for Park County gives a minimum frost depth of 24”. This means that the flume foundational footing needs to be at minimum 24” to meet the frost depth so that our flume won’t experience frost heave. Frost heave is the upward swelling of soil during freezing conditions due to the increase in volume that water takes when freezing. By designing our flume with a depth of 36” we can exceed the frost depth and better protect our flume from the damages cause by frost heave. Based upon the location of our Flume we were able to research and find reliable geotechnical streamflow and water quality report from USGS. With this report we can accurately depict what chemicals are contained in the soils and aggregates in the surrounding area are.

<table>
<thead>
<tr>
<th>Constituent or physical property</th>
<th>Number of detections/samples</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicarbonate</td>
<td>30/30</td>
<td>85</td>
<td>144</td>
<td>112</td>
</tr>
<tr>
<td>Calcium</td>
<td>32/32</td>
<td>27</td>
<td>45</td>
<td>32</td>
</tr>
<tr>
<td>Chloride</td>
<td>32/32</td>
<td>0.2</td>
<td>2.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Fluoride</td>
<td>10/32</td>
<td>&lt;0.1</td>
<td>0.2</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Magnesium</td>
<td>32/32</td>
<td>4.6</td>
<td>13</td>
<td>5.9</td>
</tr>
<tr>
<td>Potassium</td>
<td>32/32</td>
<td>0.4</td>
<td>3.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Silica</td>
<td>32/32</td>
<td>2.4</td>
<td>11</td>
<td>8.4</td>
</tr>
<tr>
<td>Sodium</td>
<td>32/32</td>
<td>2.5</td>
<td>16</td>
<td>3.6</td>
</tr>
<tr>
<td>Sulfate</td>
<td>32/32</td>
<td>9.7</td>
<td>72</td>
<td>16</td>
</tr>
<tr>
<td>Solids, dissolved</td>
<td>32/32</td>
<td>112</td>
<td>258</td>
<td>132</td>
</tr>
</tbody>
</table>

Based off figure 5.3 we could begin to understand what is contained in the soils of Park County. With the soils report, selection criteria for concrete shortened. We now needed to decide what type of concrete works best for the types of chemicals in our area. After
conversations with a licensed professional structural engineer (Scott Barton of Barton Consulting), we were made aware that type 2 or type 3 concrete works best for frost prevention. After some research on the different types of concrete we were able to narrow down our decision. Type 2 concrete is known to be sulfate resistant, which will be crucial for the design of our flume, because USGS found 32 detections of sulfate in 32 different samples. Type 3 concrete is much like type 2 however it has a high early strength giving better early compressive strength.

This means that the concrete overall contains many of its strength properties throughout the drying process. With these considerations we recommend choosing type 3 concrete to better handle the chemicals found in the soils as well as dealing with the varying ranges of frost heave. The minimum thickness of our foundational concrete slab will be 8”. We could size that slab up to make it stronger however because our flume experiences little to no load it would be redundant to size up the slab. When we visited the site to survey there was no water flowing through the flume, meaning the flume doesn’t carry a load for 4-6 months out of the year. Even when the flume does experience load, it is primarily a light load and at max a couple feet of waters worth of weight. Based on the minimal load on the flume no structural analysis is needed.

Based on Canon #2 of the ASCE handbook we did not feel that we had any competence in how to design the reinforcement for our concrete. For reinforcement, we contacted a professional structural engineer (Scott Barton with Barton Consulting) who deals with concrete footings and slabs on a regular basis and concluded that we recommend two #5 rebar top and bottom with #4 rebar spanning the length. This is based on general foundational footing requirements.
Figure 5.4 Plan Layout of Existing & New

Figure 5.5 Front Elevation of Existing & New
5.5 Spillway Design

For the spillway, there will be a great amount of excavation required. The existing width should be increased by 370% to accommodate an adequate discharge of water through the spillway. Based on the existing conditions of the spillway, and the data we have received, the spillway can only accommodate for 900 cubic feet per second of flow. The spillway needs to allow for at least 3721 cubic feet per second of flow in case a flooding event. The excavation that will be necessary will not deepen the current elevation of the spillway; it will only make it wider. The spillway is currently 19 feet wide at the narrowest point and will need to be increased to 70 feet at the narrowest point. It would be most beneficial to get an accurate flow reading if it is 70 feet wide throughout the entire length of the spillway.

The side slopes of the new spillway should have a slope of 0.73 to accommodate both for the flow and to prevent debris from falling into the spillway as easily. This will prevent frequent maintenance on the spillway.
Table 5.6 Analysis of Spillway

Table 5.7 Overview of Existing Spillway
Another option would be to increase the width of the dam, but only by 20 to 30 feet. This would require additional monitoring of the reservoir and flooding conditions. If flooding is expected, they would need to open the gates on the dam to drain the reservoir down by 10 to 15 feet. This way, if a flood occurs it will need to fill a significant portion of the reservoir before the spillway is even needed. The downside to this is that if the flooding is not as intense as predicted, the reservoir capacity will take a long time to fill back up. This could possibly frustrate individuals who use the reservoir for recreation purposes.
## Engineer's Inspection Report

<table>
<thead>
<tr>
<th><strong>DAM NAME:</strong> TARRYALL</th>
<th><strong>DAM HEIGHT (FT):</strong> 37.0</th>
<th><strong>COUNTY:</strong> PARK</th>
<th><strong>DATE OF INSPECTION:</strong> 2/5/2021</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAM ID:</strong> 230208</td>
<td><strong>DAM LENGTH (FT):</strong> 263.0</td>
<td><strong>PREVIOUS INSPECTION:</strong> 3/10/2020</td>
<td></td>
</tr>
<tr>
<td><strong>CLASS:</strong> High Hazard</td>
<td><strong>SPILLWAY WIDTH (FT):</strong> 30.0</td>
<td><strong>NORMAL STORAGE (AF):</strong> 1963.0</td>
<td></td>
</tr>
<tr>
<td><strong>DIV:</strong> 1</td>
<td><strong>SPILLWAY CAPACITY (FT):</strong> 15000.0</td>
<td><strong>SURFACE AREA (AC):</strong> 165.0</td>
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<tr>
<td><strong>EAP:</strong> 1/5/2016</td>
<td><strong>CREST ELEV (FT):</strong> 8860.0</td>
<td><strong>DRAINAGE AREA (AC):</strong> 227380.0</td>
<td></td>
</tr>
</tbody>
</table>

### Upstream Slope

**PROBLEMS NOTED:**

- NONE

**OTHER NOTES:**

We did not have the ability to see the face of the upstream slope of the dam due to the water level being too high and lack of protective equipment to inspect under the water. Based on the March 2020 inspection, the notes included: detreated joints and the strip liner height was too low. No changes were observed based on our review of the previous inspections.

### Crest

**PROBLEMS NOTED:**

- NONE

**OTHER NOTES:**

We recommend performing some concrete work to ensure that there is sufficient slope in the concrete to guide surface water towards the drains to prevent water freezing and seeping into the cracks. Due to the improper drainage, it is causing spalling concrete. There is a safety concern for ice on the crest of the dam for anybody walking on top. They could potentially slip and fall on the concrete or potentially off the dam. A railing instead of a 6” parapet would also be beneficial to install.

### Downstream Slope

**PROBLEMS NOTED:**

- LIVESTOCK DAMAGE

**OTHER NOTES:**

Based on the current conditions, there did not seem to be any additional issues with the downstream slope. The cracks and deterioration of the joints have not gotten any worse since the last inspection. The cracks were an inch deep at the most and were not close to the previously inspection requirement of being less than 18” deep. If they get close to 18” then the structural integrity of the dam may be at risk. Regular maintenance of these joints is recommended.

### Conditions Observed

- Acceptable / Poor

- Acceptable

- None

- Rutts or puddles

- Erosion

- Cracks - with displacement

- Sinkholes

- Not wide enough

- Low area

- Misalignment

- Improper surface drainage

- Other

- Other notes:

- Based on the current conditions, there did not seem to be any additional issues with the downstream slope. The cracks and deterioration of the joints have not gotten any worse since the last inspection. The cracks were an inch deep at the most and were not close to the previously inspection requirement of being less than 18” deep. If they get close to 18” then the structural integrity of the dam may be at risk. Regular maintenance of these joints is recommended.
### Seepage

<table>
<thead>
<tr>
<th>PROBLEMS NOTED:</th>
<th>OTHER NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Seepage was not observed along joints of the arch dam, however stains were observed and have been previously noted in previous inspections. Seepage was also noticed along the rock wall or left abutment. This seepage was pretty consistent, however does not pose a major concern. Routine inspections, observations and possibly maintenance along to join seepage may be necessary to limit the joint deterioration.</td>
</tr>
</tbody>
</table>

### Outlet

<table>
<thead>
<tr>
<th>PROBLEMS NOTED:</th>
<th>OTHER NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No outlet found</td>
<td>No issues were noted with respect to outlet works. However an inspection is recommended on the outlet works once operational.</td>
</tr>
</tbody>
</table>

### Spillway

<table>
<thead>
<tr>
<th>PROBLEMS NOTED:</th>
<th>OTHER NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>There was minimal debris in the spillway which does not raise a concern. The concrete parapet wall at the mouth of the spillway needs to be replaced or maintained. The overall size of the spillway only accommodates for 900 cfs of the required 3721 cfs based on the hydrology report. We recommend one of two options: expanding the width to nearly 70 feet in width or keeping watch of weather reports and draining the reservoir approximately 20 feet so that the spillway will not need to be used.</td>
</tr>
</tbody>
</table>

### Monitoring

<table>
<thead>
<tr>
<th>PROBLEMS NOTED:</th>
<th>OTHER NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Primarily routine inspections and monitoring of gages will need to occur to limit the any more deress. If increased signs of seepage, concrete damage, or any differential movement in cracks or joints needs to be reported. Previous inspection reports recommend that survey monitoring restarts. After our own inspection, we agree that survey monitoring should be continued two times a year during the temperature extremes. If big changes in elevation is noticed other recommendations may be enforced.</td>
</tr>
</tbody>
</table>

### Maintenance and Repairs

<table>
<thead>
<tr>
<th>PROBLEMS NOTED:</th>
<th>OTHER NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Routinely verify that the gate is operable. Routinely maintain debris that has fallen into the spillway. Ensure vegetation is not growing through the buttress sections on either side of the dam. Continue to seal and maintain cracks in the dam downstream slope.</td>
</tr>
</tbody>
</table>

---

### Conditions Observed

**Seepage**

- Minimal debris in spillway
- Concrete parapet wall at mouth of spillway needs to be replaced or maintained

**Outlet**

- Acceptable

**Spillway**

- Acceptable

**Monitoring**

- Poor

**Maintenance and Repairs**

- Acceptable

---

**Overall Conditions**

Due to the dam class being a high hazard dam and based on our own inspection we have listed action items that should take place:

1. Maintain routine inspections and maintenance on deteriorated joints and cracks
2. Perform concrete work along the crest to eliminate standing water and divert water to drains
3. Add railing or tie off points along the crest
4. Perform routine inspections and possibly maintenance along major seepage areas along joints
5. Ensure proper operation of the gated outlet
6. Increase width of spillway and monitor potential flooding and drain reservoir whenever necessary for potential flooding
7. Routine inspections of gages and operability, maintenance and repairs when necessary
6. Recommendations

6.1 Concrete Flume

For the concrete flume we recommend the shape to remain the same as the metal framed flume already in place. By maintaining the original structure there will be no need to change the existing measuring scale for the flow rate of water. This will allow for easy comparable notes with previous year flowrates, without changing the overall measuring calculations. We also recommend that the concrete slab base foundation to be at minimum 24” but more precisely 36” to meet the minimum frost depth to avoid frost heave. Type 3 is the recommended concrete to deal with the sulfate in the soil as well as to help maintain the concretes overall strength. However, type 2 concrete should be just as sufficient. The slab should be at minimum 8” thick, a smaller thickness would not suffice in maintaining the overall strength. We also recommend two #5 rebars top and bottom as well as #4 rebars spanning the length of the slab. Lastly for the concrete flume to maintain and expand its life expectancy we recommend using Water Stop technology along the seams of the concrete. Water stop is a rubber material that can be inserted along seams or cracks of concrete to no longer allow water to seep into these areas. Without this recommendation over time water will slowly seep into the seams, freeze and expand thus breaking up the concrete.
Figure 6.1 Water Stop Technology
6.2 Spillway Analysis

We recommend increasing the width from 19 feet to 70 feet with a side slope of 0.73 to meet the overall discharge capacity for the spillway during flooding conditions. This will allow the spillway to discharge 3721 cubic feet per second as suggested per the hydraulic loading requirements provided by Colorado Park’s and Wildlife. Regular maintenance should be performed to ensure that rock debris does not fall and remain in the spillway. This could restrict the flow of water if not properly cleared out. This work will be performed by excavation and blasting of the rock formations around the spillway.
6.3 Dam Inspection

We recommend continuing with annual inspections of the dam structure to observe if the conditions worsen. The main areas of interest for the inspection should include but not be limited to the following: Upstream and downstream slope, abutments, crest, seepage, outlet, gages, and the spillway. We would also like to see yearly maintenance performed on the cracks in the form of epoxy filler, grouting, concrete sealer, or using a water stop product to ensure no additional seepage occurs. Earth dams often have Permeation Grouting in the soil to prevent seepage through the soils around the dam. This could be performed on both sides of the concrete structure to keep water from seeping around the dam. There should also be concrete work performed on the crest of the dam to ensure proper drainage of standing water.
6.4 Recommendations Summary

The concrete flume should be constructed using type 2 or 3 concrete and #3 and #4 rebar based on the drawings provided. The spillway should be increased from 19 feet to 70 feet with a side slope of 0.73 to meet the overall discharge capacity for the spillway. Regular maintenance should occur on the dam using a water stop, epoxy, or grout product to ensure that it remains water tight to mitigate future seepage.
7. Construction Sequence (or) Implementation Sequence (or) Study Sequence

Per a meeting with Colorado Parks and Wildlife on February 15, 2021, construction sequencing is not typically provided to the contractor. The contractor provides their own construction sequencing and determines the best methods for the safety of their workers. The following sequence is intended only to provide a general overview of what activities are part of the proposed plans.

7.1 Flume Construction

Flumes currently installed are damaged by frost heave that causes soil to swallow in the winter season. The thin plates of the current flumes are being bended and wrapped. The problem was faced because the flume foundation was not below the frost depth of the soil. This designed flume that is to be installed are designed in such a way that it would have concrete foundation below the 36” inch while the frost depth is 24” for the soil. This will completely save the flume from the effect of the frost heave. The concrete type 3 should be used which primarily most suitable for the soil type and chemicals composition in it. It will also prevent the frost heaving effect of the soil due to its high reaction capacity and early strength. The slabs of the concrete should have minimum of 8” thickness and recommended to use the Rebar #5 for top and bottom, while Rebar #4 for the spanning length.

The table below shown the design parameters which are to be followed during the installation of the new flume.
<table>
<thead>
<tr>
<th>Design Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of concrete</td>
<td>36”</td>
</tr>
<tr>
<td>Concrete Type</td>
<td>Type 3</td>
</tr>
<tr>
<td>Rebar type</td>
<td>Rebar Type#4, 5</td>
</tr>
<tr>
<td>Slab Thickness</td>
<td>8”</td>
</tr>
</tbody>
</table>

**Figure 7.1 Flume Design Parameters**

General list of steps to be followed are:

1. Mobilization to the construction site.
2. Clearing and grubbing as well as excavation.
3. Surveying to ensure correct elevations of the installation.
4. Drop in precast concrete flume.
5. Surveying to ensure installation is correct.
6. Backfill excavation work.
7.2 Spillway Construction

The spillway widening project overall purpose is to enhance the safety of upstream and reduced the risk of catastrophic flooding.

The current condition of the spillway is such that it does not allow the adequate flow of water through it, which may a real hazard during the severe flood. Spillway is among the one of the major and critical safety precautions used to save the structure of the dam during the severe flood.

If it cannot provide the water a way the dam structure would have greater load and it may can get damaged. Currently spillway is 19ft wider with a flow capacity of 900 Cubic-ft/sec. The outcome and recommendations of this study is to make the spillway 70 ft wider so that it can support 3721 cubic-ft/sec of water flow. So, focus is to widen the spillway 51 ft wider from current. It may be done by different techniques used by the project executor engineer.

The general steps involved for carrying out the project includes but not limited to

1. Mobilization to the construction site.
2. Clearing and grubbing.
3. Setting up safety measures for excavation of the spillway.
4. Excavation work to increase the width of the spillway.
5. Surveying to ensure correct elevations excavation.
6. Any backfill excavation work that may be required.
7.3 Dam Maintenance

Dam inspection is the crucial and more critical to measure the life and potential threats to a dam. For the purpose to know the recent complications and problems which were not recently addressed literature review of the latest report published on the dam and tours for visual inspection were carried out. The literature review we did was based on reading the recent reports and dam inspections submitted. Findings were that there were no potential threats to dam structure, but it was recommended that dam inspection shall be carried out every year to ensure the safety.

There are many types of inspection which are carried out on dam safety and structures. That includes Formal dam inspection, Periodic dam inspection Routine dam inspection, Special or Emergency inspection but we are mainly concerned about the formal and routine dam inspections.

Formal dam inspection is thorough inspection of design and construction of the dam and it is compared to the current condition of the dam and potential dam problems are identified which cannot be seen or observed by visual inspection. More attention is to be given to the areas which are identified with some problems. All features are inspected thoroughly e.g., the structure, design load, seepage etc.

Preparing an inspection plan that may include but not limited to:

1. Inspection outline or checklist.
2. Inspection objectives.
3. Inspection plan.
4. Arrangement of Equipment’s.
5. General safety guidance.
Typical dam inspection manual is shown below:

**CONCRETE DAM**

| This section should be completed only when inspecting a concrete dam. |
| --- | --- |
| Upstream Face |  |
| Downstream Face |  |
| General Condition |  |
| Seepage |  |
| Crest |  |
| Offsets |  |
| Roadway |  |
| Walks |  |
| Parapet Wall |  |
| Lighting, etc. |  |
| Galleries |  |
| Concrete |  |
| Metalwork |  |
| Electrical |  |
| Ventilator |  |
| Seepage |  |
| Drains and Drainage (all drains should be open) |  |
| Frequency of Cleaning or Probing |  |
| Foundation Tunnels |  |
| General |  |
| Seepage |  |
| Instrumentation |  |
| Reservoir-Level Gage |  |
| Structural |  |
| Seepage |  |

**Routine Dam Inspection:**

This type of inspection is carried by the personnel which are currently operating at the site. Objective of this type of inspection is the current conditions of the dam. It can be a structured or unstructured inspection depending on the inspector’s familiarity of dams and its features. Commonly structured inspection is carried out weekly or monthly while the unstructured inspection is carried out during routine task. E.g. During recording of reading from the weir at the toe, entire toe can be inspected and recorded on checklist.
8. Costs

The cost estimate is based on information that was provided by Peter Marxhausen in the CVEN 4067 syllabus. It is difficult to obtain pricing that is representative of the true cost due to the high variability in costs of labor, material, and mobilization, all of which also vary by location. This is a rudimentary estimate and, as stated in the disclosure, should not be used for fiscal planning or budgeting purposes. The total estimated cost estimate for this project is $713,000.00. A complete breakdown of the cost estimate is provided in Exhibit 6.
9. Future Work/Study

All work contained in this report should be reviewed by a licensed Professional Engineer before performing any scopes of work on this project. While JJSLD Consulting provided many calculations and studies, it is best practice to be reviewed by a licensed Professional Engineer.

JJSLD Consulting recommends that you do additional inspections and flow studies before performing any work on the spillway to ensure best use of financial resources. Although it seems as if the spillway needs to be wider. It would be beneficial to determine the likeliness of a flood occurring.
10. References


11. Disclaimer

The assumptions, findings, calculations, and conclusions expressed and described in this report and its exhibits were developed by undergraduate civil engineering students who are not licensed, professional engineers. This report was prepared as an academic exercise as partial fulfillment of the Civil Engineering Senior Design course. Pursuant to C.R.S. §12-25, no part of this report should be used for planning, budgeting, construction, or related fiscal decisions without a complete review and written endorsement from an independent, qualified, and licensed engineer who can assume responsible charge of the project and who is willing and able to become the engineer of record for all aspects of the study, calculations, findings, recommendations, and the project in part and in whole.

A complete copy of this report was provided to the client without any financial reimbursement to its authors or the University of Colorado. The client may keep one copy of the report and is hereby given permission to copy and share the report as their needs dictate; however, a copy of this disclaimer shall accompany all copies made. By the acceptance of and/or use of this report and the exhibits hereto, the client and all reviewers of the content included herein shall indemnify and hold harmless the University of Colorado; the College of Engineering, Design and Computing; University employees; and the authors of this report from any and all liability, of whatsoever nature, that may result from such review, acceptance, or use.
12. Conclusion and Summary

To summarize, for different flumes and weirs, cross sections. With regard to channel width, the wide-strung weir was too high and the flow was too large and shallow to achieve precision goals. With a lower flow, Flume-1 was narrower, which increased the flow calculation precision and fulfilled the design criteria. For the lower depth of the channel, the shallow throat configuration (Flume-2) was so narrow that the conditions for freeboard and submersion cannot be met simultaneously. Finally, we were able to create a design which satisfied all design requirements by adding a different transformation.

Colorado Parks and Wildlife tasked JJSLD Consulting with a redesign and implementation of a new flume, dam inspection report, and a spillway analysis as well as how to better improve the spillway. Tarryall Dam is a gravity roller-compacted concrete dam with an earthen emergency spillway located in the rural mountains in Jefferson county. The dam and reservoir are the main attraction of Tarryall Reservoir State Wildlife Area which is used primarily for recreational purposes. The purpose of the redesign of the flume is to improve the stability and flow of water and material through the flume. The dam inspection was to ensure safety for the residents and wildlife downstream.

JJSLD Consulting believes that performing the implementation of a new concrete flume as detailed in this document will allow an acceptable flow of water and materials through the flume without the buildup of material that the previous flume allowed for. We also believe that our recommendations for the spillway will provide the recommended flow rate. Lastly, JJSLD Consulting believes that we provided a sufficient dam inspection that can be used by the Colorado Parks and Wildlife for the year 2021.
12.1 Salutation Paragraphs

On behalf of all the members of the JJS LD Consulting team, we would like to extend our
gratitude to Colorado Parks and Wildlife for presenting our team with the opportunity to
participate in the Tarryall Dam improvements at Tarryall Reservoir. Special thanks to Dmitry
Tepo, Taylor Scott, and Dr. Chengyu Li for providing guidance to our team. We hope this
report will provide aid in the completion of this improvement project; if there are any
questions or concerns, please feel free to contact any members of the team.

Sincerely,

________________________________
Jacob DeMers
720-257-2287

________________________________
Richard Dalton Klepper
720-315-9471

________________________________
Lucas Kennedy
720-383-2250

________________________________
Jenan Gerashi
402-999-2006

________________________________
Saleh Al Marri
720-779-7607
Exhibits

Exhibit 1: Site Map
Exhibit 2: Aerial Photos
Exhibit 3: Site Photographs
### Symbol's Key

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Velocity</td>
<td>ft/s</td>
</tr>
<tr>
<td>Q</td>
<td>Discharge</td>
<td>cfs</td>
</tr>
<tr>
<td>b</td>
<td>Base</td>
<td>ft</td>
</tr>
<tr>
<td>h</td>
<td>Water Height</td>
<td>ft</td>
</tr>
</tbody>
</table>

### Values obtained from "Tarryall Hydraulic Loading Document"

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Water Surface Elevation</td>
<td>8872.6</td>
<td>ft  Feet</td>
</tr>
<tr>
<td>Parapet Wall Crest</td>
<td>8877.75</td>
<td>ft  Feet</td>
</tr>
<tr>
<td>Dam Crest</td>
<td>8870</td>
<td>ft  Feet</td>
</tr>
<tr>
<td>Spillway Crest</td>
<td>8863</td>
<td>ft  Feet</td>
</tr>
<tr>
<td>Existing Spillway Capacity</td>
<td>900</td>
<td>cfs Cubic Feet per Second</td>
</tr>
<tr>
<td>Desired Spillway Capacity</td>
<td>3721</td>
<td>cfs Cubic Feet per Second</td>
</tr>
</tbody>
</table>

### Field Measured Values

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<tbody>
<tr>
<td>Width of Spillway</td>
<td>19</td>
<td>ft  Feet</td>
</tr>
<tr>
<td>Parapet Wall Crest</td>
<td>12.6</td>
<td>ft  Feet</td>
</tr>
<tr>
<td>Spillway Crest</td>
<td>26.2</td>
<td>ft  Feet</td>
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### Calculated Values based on Annual Exceedance Probability Event (AEP)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Top of Dam Elevation</strong></td>
<td>8877.75 ft</td>
</tr>
<tr>
<td><strong>Hydraulic Loading Report</strong></td>
<td>14.32 ft</td>
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<td><strong>Spillway Elevation</strong></td>
<td>8865.87 ft</td>
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<tr>
<td><strong>Height of Water</strong></td>
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</table>

<table>
<thead>
<tr>
<th>h</th>
<th>Height of Water</th>
<th>11.88 ft</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>b₀</td>
<td>Width of Spillway</td>
<td>19 ft</td>
<td>Feet</td>
</tr>
<tr>
<td>Q</td>
<td>Existing Spillway Capacity</td>
<td>900 cfs</td>
<td>Cubic Feet per Second</td>
</tr>
</tbody>
</table>

**Equation:**

\[
v = \frac{Q_0}{b_0 h}
\]

| V | Velocity of the water | 3.987241 ft/s | Feet per Second |
### Calculated Values based on Annual Exceedance Probability Event (AEP)

<table>
<thead>
<tr>
<th></th>
<th>Desired Spillway Capacity</th>
<th>3721 cfs</th>
<th>Cubic Feet per Second</th>
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<tbody>
<tr>
<td>V</td>
<td>Velocity of the water</td>
<td>3.987241 ft/s</td>
<td>Feet per Second</td>
</tr>
<tr>
<td>h</td>
<td>Height of Water</td>
<td>11.88 ft</td>
<td>Feet</td>
</tr>
</tbody>
</table>

Equation:

\[
b_1 = \frac{Q_1}{Vh}
\]

| New Spillway Width | 78.55444 ft | Feet |

### Current Condition

<table>
<thead>
<tr>
<th>Bottom Width</th>
<th>Side Slope</th>
<th>Top Width</th>
<th>Area</th>
<th>Height of Water</th>
<th>Wetted Perimeter</th>
<th>Hydraulic Radius</th>
<th>Hydraulic Depth</th>
<th>Froude Number</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Z</td>
<td>T</td>
<td>A</td>
<td>Y</td>
<td>P</td>
<td>R</td>
<td>D</td>
<td>Fr</td>
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</table>

### New Width and Side Slope

<table>
<thead>
<tr>
<th>Bottom Width</th>
<th>Side Slope</th>
<th>Top Width</th>
<th>Area</th>
<th>Height of Water</th>
<th>Wetted Perimeter</th>
<th>Hydraulic Radius</th>
<th>Hydraulic Depth</th>
<th>Froude Number</th>
<th>Velocity</th>
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</thead>
<tbody>
<tr>
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<td>Y</td>
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<td>D</td>
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<td>U</td>
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<tr>
<td>70</td>
<td>0.73</td>
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<table>
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<tr>
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Exhibit 5: Sketches/Diagrams/Plans/Drawings
### Spillway Improvements

<table>
<thead>
<tr>
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<th>Cost per Unit</th>
<th>Total Cost</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
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<td>-</td>
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<td>CY</td>
</tr>
<tr>
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<td>$10</td>
<td>$ 151,828.80</td>
<td>USD</td>
</tr>
<tr>
<td><strong>Construction Labor:</strong></td>
<td>40%</td>
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<td>USD</td>
</tr>
<tr>
<td><strong>Permit Costs:</strong></td>
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<tr>
<td><strong>Geotech Design Labor:</strong></td>
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<td>$ 153,347.09</td>
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<tr>
<td><strong>TOTAL COST:</strong></td>
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### Flume Improvements

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<th>Unit</th>
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## Dam Maintenance

<table>
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<th>Cost/Quantity</th>
<th>Unit</th>
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<tr>
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</tr>
<tr>
<td>Quantity:</td>
<td>-</td>
<td></td>
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<tr>
<td><strong>Epoxy Filler Quantity:</strong></td>
<td>-</td>
<td>60</td>
<td>LF</td>
</tr>
<tr>
<td><strong>Water Stop Quantity:</strong></td>
<td>-</td>
<td>60</td>
<td>LF</td>
</tr>
<tr>
<td><strong>Concrete /Grout Cost:</strong></td>
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<td><strong>Permit Costs:</strong></td>
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<td>USD</td>
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<td><strong>TOTAL COST:</strong></td>
<td>-</td>
<td>$ 15,714.75</td>
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</table>

### Total Cost of All Projects

| Total Cost of All Projects | $ | 712,919.29 |
Exhibit 7: Referenced Materials


Exhibit 8: Team Member Resumes

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Jacob DeMers  
Westminster, CO 80031 ☎️ (720) 257-2287 ☄️ jp2demers@gmail.com

Professional Summary
I am a full-time college student who has worked the past three summers as a slide inspector with successful experience calculating flows and discharge of large water slides. Enthusiastic as well as eager to contribute to team success through hard work, attention to detail and excellent organizational skills. Clear understanding of Excel and AutoCAD and training in engineering surveying. Many tools acquired from my civil engineering courses, and ready to implement them with my career. Motivated to learn, grow and excel in the engineering industry.

Skills
- CAD Design  
- Field Data Collection  
- Hands On Construction  
- Excel Spreadsheet  
- Engineering Surveying  
- Power tools

Work History
Construction Worker, 05/2015 to 12/2019
Barret Construction - Centennial, CO
- Efficiently prepared job sites by removing debris and setting up materials and tools
- Brought materials and tools from trucks and storage facilities to work site locations and organized for expected needs.
- Used required tools to complete jobs, including hammers, saws, squares, levels, and fastening devices.
- Boosted team efficiency and project requirements by correctly operating site equipment.
- Recognized and reported potential project challenges and assisted with solutions.
- Interpreted job site supervisor’s orders and technical documentation to complete accurate work.
- Prepared and cleaned surfaces for rebuilding purposes by removing damaged tiles, brick, and mortar.
- Worked independently in a fast-paced environment while meeting productivity and quality expectations.

Slide Inspector, 06/2017 to 08/2019
Hyland Hills Park & Recreation District - Westminster, Colorado
- Worked with fellow employees to inspect and resolve minor problems, improve operations and provide needed maintenance to water slides.
- Developed an exceptional attendance record with special attention to punctuality and preparation to work upon arrival.
- Led slide inspection team in delivery of an acceleration project requiring close cooperation among members to share information and prepare a written report on all slide accelerations.

Education
University of Colorado Denver - Denver, Colorado
Associate of Science: Major: Civil Engineering, Minor: Construction Management, Expected: Spring 2021
Brighton High School - Brighton, Colorado
High School Diploma: 05/2016
RICHARD “DALTON” KLEPPER
5201 Fairfield Circle – Castle Rock, Colorado 80104
Cell: 720.315.9471 | Email: rdalton98@gmail.com | www.linkedin.com/in/dalton-klepper
Bachelors in Civil Engineering; Minor in Construction Management

OBJECTIVE
I am seeking an opportunity with a construction or engineering firm to further my professional and educational goals of becoming a licensed engineer.

WORK EXPERIENCE
October 2019 – Present (Part time Project Engineer)
May 2018 – October 2019 (Internship)
Howell Construction, 8085 E Harvard Avenue, Denver, CO 80231
Position(s): Project Engineer Intern, Field Engineer, Project Engineer

Responsibilities involve maintaining procurement logs with submittals, RFI’s, lead times, estimated ship dates for multiple projects at a time to ensure that they all stay on schedule. Additional tasks involved change orders, meeting minutes, applying for and picking up permits, and conversing with different jurisdiction’s building departments, architects, clients, and subcontractors regarding a variety of details relating to design and construction.

Learning Experiences: Design and Construction Industry
How the design and construction process works
Work experience with Microsoft Office, Bluebeam, and Viewpoint
The importance of staying on schedule
How to interact with clients and the design team on a professional and collaborative level

February 2016 – May 2018
Insight Vision Group, 11961 Lioness Way Suite 190, Parker, CO 80134
Position: Patient Care Coordinator, Medical Records, Light Building Maintenance

Responsibilities include organizing and collecting the correct patient information to ensure that our doctors can treat their patients with the best care possible. Additional responsibilities include contacting referring ophthalmologists and patients to gather patient’s records to be reviewed by the doctor, ensuring that the collection and dispense of these records to referred ophthalmologists comply with the Health Insurance Portability and Accountability Act (HIPPA) regulations, as well as performing small projects around the office such as: hanging pictures, assembling shelving, fixing cabinet doors, and other miscellaneous maintenance and repair duties.

Learning Experiences: Professional Service Industry
How a professional service-based company works
The importance of planning and working ahead
How to work with other physician and insurance offices

February 2015 – February 2016
Papa Murphy’s Pizza, 754 S Perry St F, Castle Rock, CO 80104
Position: Crew Member

Responsibilities included greeting and interacting with customers, making pizzas, taking orders, preparing ingredients for the food line, counting the daily revenue, making trips to the bank, placing the inventory order, unloading the food truck, washing dishes, cleaning the bathroom, sweeping and mopping the floors, and washing windows.

Learning Experiences: Customer Service Industry
How a consumer service-based company works
Friendly customer service
Timeliness and attention to details
Quality of the product
Working with demanding and difficult people
Humility – mopping floors, washing dishes, and cleaning toilets
RICHARD “DALTON” KLEPPER

EDUCATION

2018 - 2021
CU Denver / Major: Bachelor of Science in Civil Engineering
Minor: Construction Management
University of Colorado Denver
Denver, CO 80204

2015 - 2018
Arapahoe Community College
Completion of 59 college credit hours including: Calculus 1, 2 & 3, Physics 1 & 2, and Chemistry

REFERENCES
Joanna Cruz
Medical Records Manager
Insight Vision Group
Phone: 720.285.7806
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Brian Rutland
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Southside Bible Church
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