June 20, 2018

Mr. Peter Hays
Colorado Division of Reclamation, Mining and Safety
1313 Sherman St., Room 215
Denver, CO 80203

Re: Response to Comments TR-01 Second Adequacy Review
City of Greeley's 25th Ave Site (Poudre Ponds); File No. M-2002-020

Dear Mr. Hays:

The City of Greeley (City) and its Consultant, Wenck Associates, Inc. (Wenck) appreciate your comments regarding the City's 25th Avenue Site (Permit No. M-2002-020), commonly referred to as the Poudre Ponds. This letter addresses the Division's (DRMS) comments dated June 4, 2018, on the Poudre Ponds technical revision submitted by the City on July 28, 2017.

The Project Team has prepared the following responses to each of the Division's comments:

Comment 1a: *P. 2, bottom paragraph, attachment reference: The response references Attachment A2. The submittal mislabeled this attachment as "Appendix 2, Approach Velocity Sensitivity Analysis". If there was a more recent version of this attachment, please provide it. Otherwise the DRMS will assume Appendix 2 was mislabeled and no response is necessary.*

Response to Comment 1a:

Correct, the provided figure was mislabeled as "Appendix 2" and should read "Attachment 2."

Comment 1b: *P. 3, second paragraph, drawing reference: The response references Sheet No. C-102. The only drawing received with the submittal was Sheet No. C-501. Drawing C-501has apparent anomalies (see Comments 1d, and 3b below). Was the Division supposed to receive Sheet No. C-102 or C-501?*

Response to Comment 1b:

Text references to C-102 were in error and should have referred to Sheet C-501, which was included.

Comment 1c: *P. 4, first paragraph, shear stress and permissible velocities: Although no reference to Attachment B2 is made here, Attachment B2 appears to be the source for the maximum permissible velocity and shear stress for graded riprap. As such, it appears the two values were flip-flopped for the design criteria. According to Attachment B2 (second page) boulders (medium, >20-inch diameter) have an allowable shear of 9.3 psf, and a maximum permissible*

velocity of 14 fps. The calculated shear is reported to be 11.51 psf, which clearly exceeds the 9.3 psf allowed. Please redesign the graded riprap portion of the spillway to meet the shear stress criterion.

Response to Comment 1c:

The design of the graded riprap portion of the spillway was presented in response to the original request by the CDRMS[1] to "*demonstrate how the proposed spillway design is designed in accordance with the Urban Drainage and Flood Control District criteria.*" Our response[2] detailed the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual design approach for riprap sizing of steep slope conditions. Our use of additional criteria (**Attachments B1** and **B2**) were included in part because we had them, and in part because they agreed with our design. We feel the design criteria of the UDFCD are more robust and more relevant to the spillway proposed for Poudre Ponds.

The following is a direct answer to Comment 1c:

Correct, we did transpose the maximum allowable velocity and shear stress values, they should be 9.3 psf and 14 fps. The shear stress was conservatively calculated using open-channel flow conditions using the equation $\tau_w = \gamma R_h S_o$, where τ_w is the channel wall shear stress, γ is the specific gravity of water, R_h is the calculated hydraulic radius of the channel, and S_o is the channel bottom slope. This method maximizes the calculated shear stress in comparison to other empirical shear stress calculation methods for fully developed turbulent flow.
The graded riprap portion of the spillway, which extends from the two-thirds capacity water surface elevation of 4657 ft (NAVD 88), down to the minimum pond elevation of 4649 ft (NAVD 88), represents approximately 600 acre-feet of storage capacity within Poudre Ponds. At the maximum spillway flowrate of 933 cfs (based on the 100-year Cache la Poudre flows), this capacity will fill within 8 hours and the graded riprap portion of the spillway will be submerged. Given the adherence to UDFCD design criteria for riprap sizing of steep slope conditions and the relatively minimal time it will be subject to maximum flowrates, we feel the susceptibility of this portion of the spillway to erode is negligible for the 100-year event.

Comment 1d: *P. 4, second bullet, design standards: the third line cites UDFCD's standard of leaving the top third of grouted boulders ungrouted (to provide roughness for energy dissipation). However, Sheet No. C-501, Grouted Riprap Detail shows only the top 25% of the grouted riprap layer (4 ft minus 3 ft) being ungrouted. This same detail shows multiple boulders in the "layer" of grouted riprap. Pursuant to Figure 9-15 of the UDFCD manual (Vol. 2) referenced on p. 6, third paragraph of this submittal (and Figure 2.7 of the also referenced CWCB's Floodplain and Stormwater Criteria Manual), the grouted riprap armoring should be a single layer of boulders grouted to within one third of the top of the rock. This is not how the design is depicted in this detail on Sheet No. C-501 and is critical in demonstrating to the construction contractor how the spillway is to be constructed. Please revise the appropriate drawing to meet he design standard.*

[1] Colorado Division of Reclamation, Mining and Safety, Letter to City of Greeley (TR-01) Adequacy Review dated August 30, 2017
[2] *Response to Comments, City of Greeley's 25th Ave Site (Poudre Ponds)*, Colorado Division of Reclamation, Mining and Safety, April 5, 2018

Response to Comment 1d:

Sheet C-501 has been updated to more clearly reflect the d_{50} = 24 in chosen rock size with the associated gradation. The depth of top of grout from rock surface is specified as 1/3 of the d_{50} dimension. The total thickness of 4 ft is twice the d_{50} dimension to accommodate the chosen gradation.

Comment 1e: *P. 4, third bullet, design standards: the discussion on iterating the Manning's roughness coefficient states the roughness was evaluated assuming the upper half of the grouted boulder is left ungrouted, again contradicting the top third design standard. Please re-evaluate.*

Response to Comment 1e:

Correct, the text was in error. The analysis was performed assuming the depth of top of grout of 1/3 d_{50}.

Comment 2: *The response was adequate.*

Response to Comment 2:

Noted.

Comment 3a: *P. 6, third paragraph, drawing reference: See Comment 1b above.*

Response to Comment 3a:

See Response to Comment 1b above.

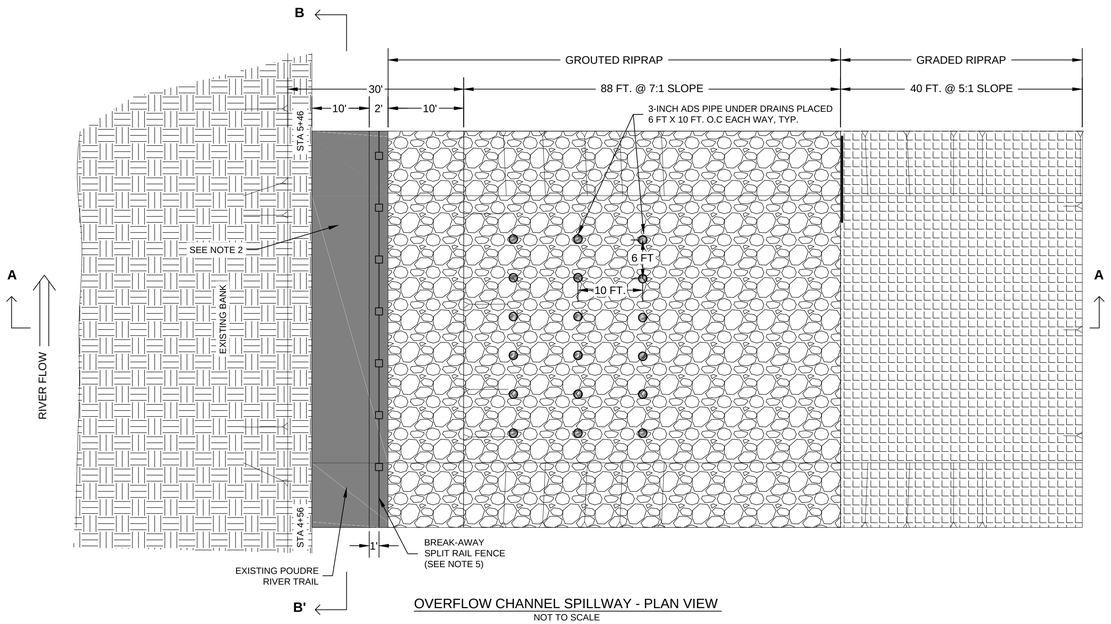
Comment 3b: *P. 6, third paragraph, drawing reference: The last sentence references "concrete cutoffs" for the design. Sheet No. C-501 Section A-A' and Key In/Anchor Detail both show a shaded rectangle where one would expect the cutoff wall, but it is not labeled. Please show and label as such the concrete cutoff wall on the appropriate drawing.*

Response to Comment 3b:

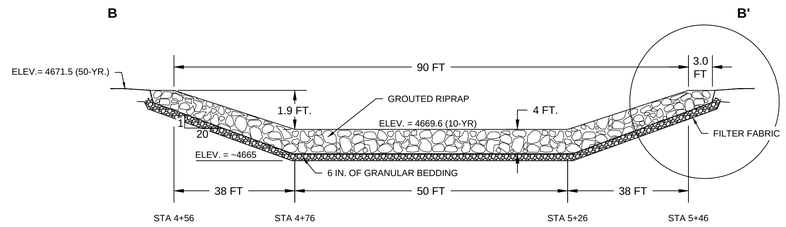
Sheet C-501 has been updated to further identify the concrete cutoff.

Sincerely,

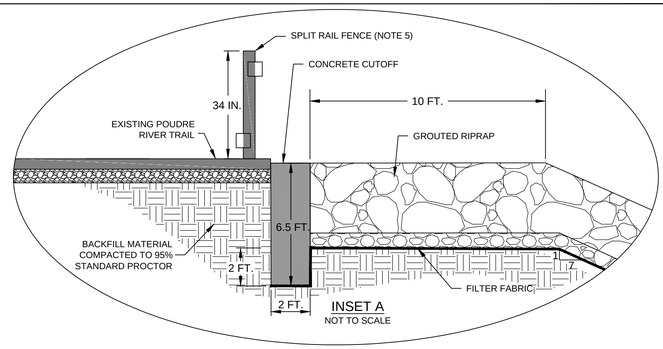
Pamela A.K. Massaro, P.E.
Wenck Associates, Inc. – Water Resources Engineer



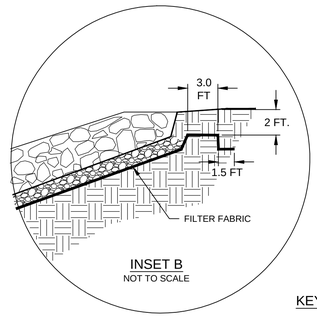
OVERFLOW CHANNEL SPILLWAY - PLAN VIEW
NOT TO SCALE



OVERFLOW CHANNEL SPILLWAY - SECTION B - B'
NOT TO SCALE



INSET A
NOT TO SCALE



INSET B
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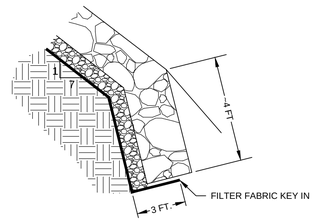
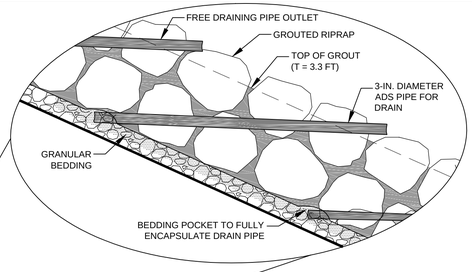
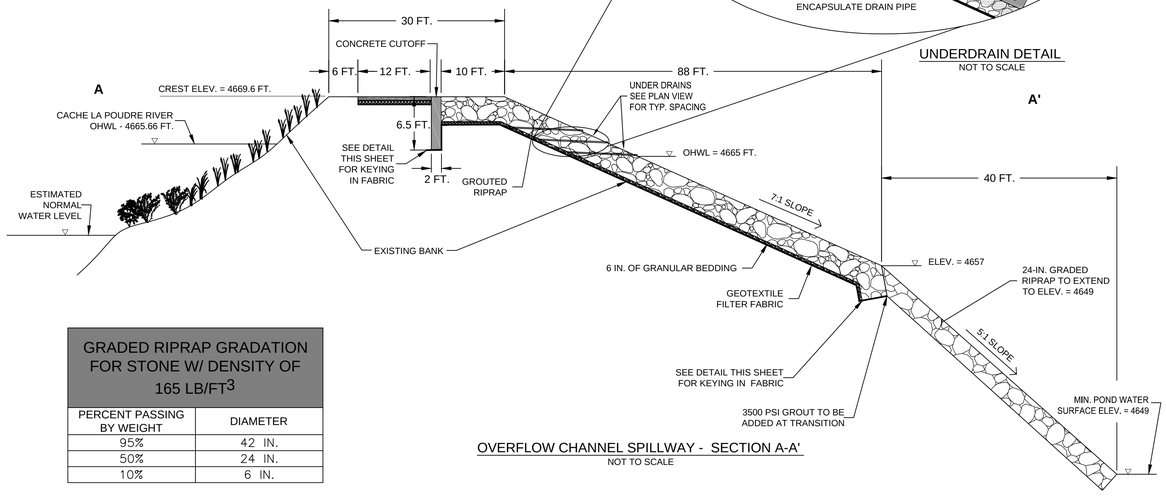


KEY IN/ANCHOR DETAIL
NOT TO SCALE



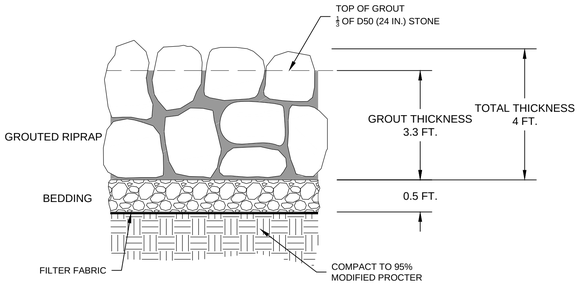
UNDERDRAIN DETAIL
NOT TO SCALE



OVERFLOW CHANNEL SPILLWAY - SECTION A-A'
NOT TO SCALE

GRADED RIPRAP GRADATION FOR STONE W/ DENSITY OF 165 LB/FT^3	
PERCENT PASSING BY WEIGHT	DIAMETER
95%	42 IN.
50%	24 IN.
10%	6 IN.

GROUTED RIPRAP GRADATION FOR STONE W/ DENSITY OF 165 LB/FT^3	
PERCENT PASSING BY WEIGHT	DIAMETER
95%	42 IN.
50%	24 IN.
10%	9 IN.
BEDDING	
PERCENT PASSING BY WEIGHT	SIZE
100%	1 IN.
85%	.75 IN.
50%	.25 IN.
15%	NO. 10
5%	NO. 200



* URBAN DRAINAGE RIPRAP DESIGNATION TYPE VH
CDOT RIPRAP CLASS 0.5 TON

GROUTED RIPRAP DETAIL
NOT TO SCALE

GENERAL NOTES:

1. WARNING SIGNS SHALL BE POSTED AT THE PROJECT LOCATION PRIOR TO CONSTRUCTION.
2. THE EXISTING POUDRE RIVER TRAIL IN THE VICINITY OF THE PROJECT AREA SHALL BE REMOVED PRIOR TO CONSTRUCTION. UPON COMPLETION OF THE SPILL STRUCTURE, THE TRAIL SHALL BE REPLACED AS SPECIFIED IN THE SPECIFICATIONS.
3. THE TOE OF THE SPILLWAY SIDE SLOPES SHALL BE ROUNDED ON THE TRAIL FOR BIKING/PEDESTRIANS.
4. AFTER CONSTRUCTION, THE REMOVED TRAIL SECTION SHALL BE REPLACED WITH FIBER-MESH REINFORCED CONCRETE.
5. A TWO-RAIL SPLIT RAIL FENCE FOLLOWING CITY OF GREELEY'S STANDARDS WILL BE CONSTRUCTED ALONG THE REPACED TRAIL SECTION PER THE PROJECT SPECIFICATIONS.

ELEVATION DATUM: NAVD 88

REV	REVISION DESCRIPTION	DWN	APP	REV DATE

CLIENT

CITY OF GREELEY
WATER AND SEWER DEPARTMENT

PRIME CONSULTANT

Lidstone and Associates, Inc.
WENCK
Lidstone and Associates - A Wenck Company

SUB CONSULTANT

SEAL

PROJECT TITLE

POUDRE PONDS SCOUR PROTECTION PROJECT

SHEET TITLE

GROUTED RIPRAP SPILLWAY DETAIL

DWN BY	CHK'D	APP'D	DWG DATE 6/6/18
DJW	ZSB	PAKM	SCALE

PROJECT NO.	SHEET NO.	REV NO.
COCOG105	C-501	