Natural Resources Department
END OF PROJECT REPORT

Project #2014-02-022 **Repair and Rehabilitation of Montezuma Valley Irrigation Company Flume No.6- McElmo Creek Flume –Flume #6**

Grant Recipient: Montezuma County Colorado.

Project Coordinator: James Dietrich (970) 565-7402

The Montezuma County Repair and Rehabilitation of the McElmo Flume No. 6 has been an exciting and challenging project. The project is the third phase of larger five phase concept to create an interpretative stop and parking area off of Highway 160. Montezuma County administered the SHF (phase three) and the Federal Highways Administration (FWHA) project (phase four) concurrently so that the public could gain access to the site roughly at the same time the rehabilitation efforts are completed.

This project has already been a great tool for raising awareness of the importance of preserving, maintaining, and interpreting our local heritage. Though Montezuma County is famous for its rich Ancestral Puebloan archaeological resources, most notably Mesa Verde, Montezuma County also has wealth of historic resources that are often overshadowed by Puebloan archaeology and forgotten about.

This project has raised awareness for a chapter of history that is fast disappearing from our landscape and demonstrated the urgency of preserving some of these remaining features for future generations. As a result, the Board of County Commissioners have formalized the County's commitment to heritage stewardship by adopting a Resolution to create a *"Montezuma County Historic Registry Designating Historic Landmarks or Districts."* Under this Resolution the Commissioners are now in the process of soliciting members of the public for consideration for appointment to an *Advisory Board on Historic Preservation.* These two steps are significant milestones in the efforts to preserve local heritage as well as in strengthening the partnership with the State of Colorado in the same purpose.

Most projects have their share of challenges to overcome and this project was no exception. The McElmo Flume is located just off of Highway 160 at the Montezuma County Fairgrounds. The structure spans an arroyo which lies along the property boundary between CDOT ROW and County property. The CDOT ROW fence in this location is not uniform because of the arroyo and the ROW is visually deceptive as a result. It was initially assumed it was a County owned structure on County property. Cost estimates were prepared and a grant submitted to SHF under that assumption.

As previously mentioned the County was also working with CDOT on the Interpretive Stop and Parking Area for the Flume. While onsite for the CDOT parking area project kickoff meeting, CDOT engineers noted that the CDOT ROW was not uniform this area and the fence-line demarking the CDOT ROW was missing for several hundred feet because of the arroyo. It brought into question whether or not the structure was located on county property or CDOT property. At this point CDOT refused to move forward with either project until the ROW was formally delineated. In effort to resolve the question the

County commissioned a local surveyor for $2,092 (county contribution), to survey the site and make a determination. The survey determined that the structure was roughly 50% in CDOT ROW and 50% on County owned property. As a result CDOT was brought into the picture for the flume rehabilitation project and the process of securing necessary permits and environmental clearances was begun. These unanticipated challenges added considerable time and complexity to the project.

To move the project forward, Trail of the Ancients Scenic Byway (TOTA) agreed to cover the additional $3,668.00 cost of the Environmental Clearances in order to secure the CDOT Special Uses/ Utilities Permit. A local consulting firm was commissioned to provide the necessary NEPA review and secure the Army Corps of Engineers (ACOE) permit for doing work on the foundation structures in the Arroyo.

Once the appropriate clearances and permitting was secured through CDOT & ACOE a Request for Proposals RFP was prepared and advertised. Montezuma County released an RFP to advertise to prospective contractors in June 2015 but received no responses. Montezuma County then worked with the engineers to develop a list of specific contractors that we felt may be interested in bidding on the project and made special outreach effort. Montezuma County re-released the RFP again in the first week of July 2015 and again received no responses, despite having contacted several contractors who indicated they may have interest. After contacting our list of contractors to quiz them on why they did not respond to the RFP most reported that they were simply overbooked for the summer construction season and did not have time for a small scale project.

By this time the McElmo Flume Parking Lot project had also made its way through the CDOT permitting and design process and an RFP was ready to be advertised for that project as well. It was decided to try to release another RFP advertisement for the flume rehabilitation in conjunction with the parking lot project RFP in September of 2015. The hope was that we could bring the project to bid at a time when contractors were wrapping up summer projects and that the two projects combined would be more attractive to a bidder looking for a larger project.

This strategy worked relatively well and we received bids from three qualified bidders in October 2015. At the bid opening we had two low bidders for one for each project but from different contractors. Western Triad Constructors, a local contractor, was the low bidder for the flume reconstruction project and D &L Construction, another local contractor, was the low bidder for the parking area project. D & L also bid on the flume rehabilitation but was narrowly out bid by Western Triad Constructors.

At this point both projects were racing against the clock to begin construction before the winter weather set in. Western Triad Constructors was a longtime construction firm in the area which for many years specialized in doing work for oil and gas development. Since the downturn in oil and gas limited the available work Western Triad began to bid on historic reconstruction projects and had completed several similar projects in southern Colorado and New Mexico earlier in 2015. This benefitted the McElmo Flume Project because Western Triad was able to mobilize immediately and focus on the flume project with no other distractions.

The downside was that we still needed to schedule the pre-construction meeting with SHF and Mrs. Bailey was by then on maternity leave until mid- November and no other SHF staff were available on short notice to fill in for Mrs. Baily. Simultaneously, the parking lot project also came to the point where a preconstruction meeting was needed with CDOT to begin that project. Fortunately we were finally able to schedule both preconstruction meetings at the same time, and get all parties together in one place to discuss the advancement of the construction. This was also the day of the first snowstorm in Southwest Colorado.

After waiting for a couple of days for the first snowfall to melt and dry out, Western Triad was able to access the arroyo bottom and begin construction activities. Mrs. Patricia Lacey, a retired Archaeologist from Mesa Verde National Park graciously agreed to observe the construction process and document all artifacts which were uncovered. Her daily reports and final archaeological report are included in the deliverables package.

Progress on the flume proceeded rapidly for about a week and then snowstorms began to hit our area on a regular basis and the temperatures drop precipitously causing several days of delays through the end of December. By January our area had received record amounts of snow fall and an extended period of subzero temperatures. Western Triad continued with their construction activities though weather was a significant impediment to their progress as access into the arroyo was often impossible. On the upside, the low temperatures did keep the ground frozen until later in the afternoon which was a saving grace as the muddy conditions in the bottom of the arroyo would have been almost untenable for work to continue.

Deteriorated concrete and corroded steel

Formwork and steel preparation for new concrete

Despite the significant challenges brought on by one of the heaviest winters our area has had in recent years Western Triad did an exemplary job keeping the project on track and ensuring that protections such as tenting and propane heaters were in use while continuing with the concrete repairs through the winter months.

Final Construction before spring thaw

Preparing bedding for rip rap

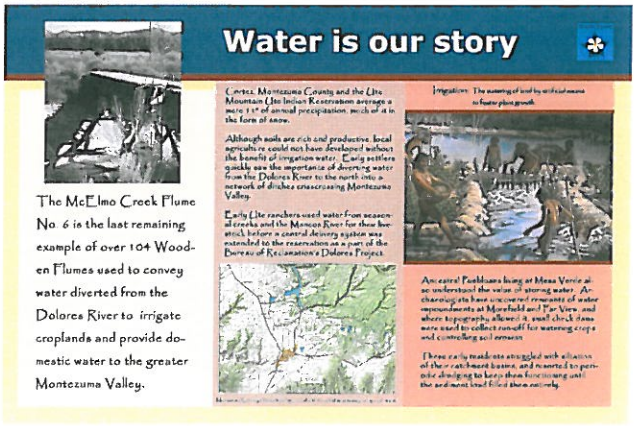
Western Triad completed all of the contracted items in March just before the spring thaw began to bring more water down the arroyo. One of the take away lessons we learned from this experience is that winter months are actually ideal for working in the bottom of ephemeral streams. Given the amount of snow the area received the McElmo drainage would have been almost impossible to work in during the spring runoff. This gives us a pretty good idea of how to schedule the next phase of reconstruction activity for the flume.

Before: Severely eroded foundation

After: New Footers and protective rip rap.

We were very pleased with Western Triad Constructors and were very hopeful that Western Triad would be available to bid on the reconstruction of the wooden portion of the flume which is currently under consideration by SHF for funding. Unfortunately Western Triad Constructors was hit very hard by the loss of oil and gas contracts and they have been forced to close their business. This was the last job they worked and it was outstanding work but it was not quite enough to save them. On a positive note however their employees have been able to find work with other local contractors such as the tribal owned and operated Weminuche Construction. Their experience with historic reconstruction will likely create new opportunities with contractors that expressed reluctance to bid on the project initially because of their lack of experience with this specialized niche market.

Overview of new Trail of the Ancients Scenic Byways Interpretive stop for the Flume. Flume overlook is at top of picture.



One of 3 interpretive panels that will tell the story of water at the Flume Overlook

FUNDING PARTNERS

Montezuma County is very pleased to have a successful project and we believe a great deal of the success is due the great partners that we have had during this process. Our funding partners included;

Primary funding partner	**SHF Budgeted amount (Exhibit B)**
2014 State Historic Fund	**$ 123,840.00**

Grant Request	**75%**	**$123,840**
Local Agency Cash Match Required	**25%**	**$41,280**

Local Agency matching fund partners	
Ballentine Family Fund	$ 4,000.00
Montezuma County	$ 2,500.00
Southwest Water Conservancy District	$ 15,000.00
Montezuma County Historic Society	$ 1,500.00
SW Basin Roundtable	**$ 20,000.00**

Total Local Agency Matching Funds **$ 43,000.00 ($1,720 overmatch)**

PROJECT BUDGET

A) CONSTRUCTION TASK	**BUDGETED AMOUNT**
1.) Stabilize Flume	$15,000
2.) Foundation Repairs	$39,000
3.) Concrete Repairs	$44,000
4.) Steel Repairs	$30,000
Subtotal Construction Activities	***$128,000***
B) General Conditions Overhead & Profit	$6,100
C) Owners Representative	$19,500
Project Subtotal	***$153,600***
Contingency	$11,520
Total SHF Project Budget	**$165,120**

TOTAL PROJECT EXPENDITURES

PAYEE NAME	BUDGETED TASK *as listed in Exhibit B of Contract*	DATE PAID	WARRANT or CHECK #	AMOUNT **PAID**
Atkinson-Noland	C	5/13/2015	226	$3,055.00
Atkinson-Noland	C	7/13/2015	241	$2,015.00
Wal-Mart & Mane Shipping	B	6/15/2015	232	$20.77
Montezuma Valley Publishing	B	7/13/2015	245	$52.94
Montezuma Valley Publishing	B	10/13/2015	245	$256.83
Triad Western Constructors	A-1, A-2	12/4/2015	286	$28,810.99
Atkinson-Noland	C	12/14/2015	290	$5,586.07
Triad Western Constructors	A-1, A-2, A-3, A-4	1/12/2016	302	$32,763.51
Triad Western Constructors	A-1, A-2, A-3, A-4	1/31/2016	315	$ 29,115.00
Triad Western Constructors	A-1, A-2, A-3, A-4	3/14/2016	318	$19,167.48
Triad Western Constructors	A-1, A-2, A-3, A-4	3/14/2016	326	$12,206.33
Atkinson-Noland	C	3/18/2016	329	$6,456.03
Atkinson-Noland	C	3/18/2016	330	$2,387.9

I hereby certify that all expenses reported above have been PAID and that all of the information is correct and that any false or misrepresented information may require immediate repayment of any or all funds.		1st Interim Financial Report Total	0
		2nd Interim Financial Report Total	0
		Final Financial Report Total	$141,893.85
		Project Total	**$141,893.85**

Despite some unforeseen costs associated with environmental clearances and including a change order from the contractor, the total project cost was still **$12,857.34** less than the project budget.

ADDITIONAL CONTRIBUTIONS NOT ELIGIBLE FOR REIMBURSEMENT BUT NECESSARY FOR THE PROJECT TO MOVE FORWARD

Additional project contributions included the following;

Montezuma County surveying fees

Pre IGA non- reimbursable		**$ 2,092.00**

Funding for Environmental Clearances

Trail of the Ancients (TOTA)		**$ 3,668.00**

Volunteer contributions

Mrs. Linda Towle (project coordination) 41.5 hours	@ 22.30	**$ 925.45**
Mrs. Patricia Lacey (Archaeological Monitoring) 148 Hrs.	@ 22.30	**$ 3,300.40**
Total non-reimbursable contributions		**$ 9,985.85**

WSRA INVOICE/ FINAL PAYMENT REQUEST:

Because cash-flow for a project of this size is not a problem for the County, Montezuma County has opted to invoice CWCB at the completion of the project rather than to request any interim payments.

The Flume Foundation and Steel Rehabilitation Project is 100% completed and accepted by Montezuma County. Montezuma County therefore respectfully makes the final financial request/invoice in the amount of **$20,000.00** for the WSRA Grant approved May 22nd, 2014.

We would like to thank the Colorado Water Conservation Board for their contribution to this project. It is difficult to understate the value of financial support from CWCB for this project. The financial commitment from CWCB provided not only the resources for implementation but more importantly provided the required matching funds to move the project forward. We eagerly look forward to continuing our relationship with CWCB during the wooden rehabilitation phase and we sincerely hope that CWCB will again support the final push to protect this valuable cultural resource.

This project could not have happened without your generous financial support. On behalf of the Montezuma County Board of County Commissioners and TOTA we thank you again!

Sincerely,

James Dietrich 8-15-16

James Dietrich
Montezuma County Project Coordinator

McELMO CREEK FLUME
MONTEZUMA COUNTY, COLORADO

1 McELMO CREEK FLUME - **SITE PLAN**
SCALE: 1" = 40'

N

SHEET INDEX

GENERAL NOTES

DOCUMENTATION FOR THIS PROJECT WAS COMPLETED BY RON ANTHONY (ANTHONY + ASSOCIATES), KIM DUGAN (ANTHONY + ASSOCIATES), DOUG PORTER (PORTER AND ASSOCIATES), KERI STEVENSON (PORTER AND ASSOCIATES), CARLO CITTO (ATKINSON-NOLAND + ASSOCIATES), AND THE CENTER FOR PRESERVATION RESEARCH (UNIVERSITY OF COLORADO, DENVER). DRAWINGS IN THIS SET ARE BASED ON FIELD MEASUREMENTS TAKEN IN JULY 2012 AND MAY 2013 AND ON LIDAR SCAN DATA COLLECTED BY THE CENTER FOR PRESERVATION RESEARCH IN AUGUST 2012.

ALL DRAWINGS (WITH THE EXCEPTION OF CC-01 - CC-03) DEPICT THE 'AS-BUILT' STATE OF THE McELMO FLUME AS INFERRED FROM SURVIVING FEATURES. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD. THIS DRAWING SET WAS PRODUCED BY PORTER AND ASSOCIATES FOR ANTHONY AND ASSOCIATES IN JULY 2013.

REPAIR SHEETS REFERENCE RECOMMENDATIONS MADE IN THE FOLLOWING REPORTS:

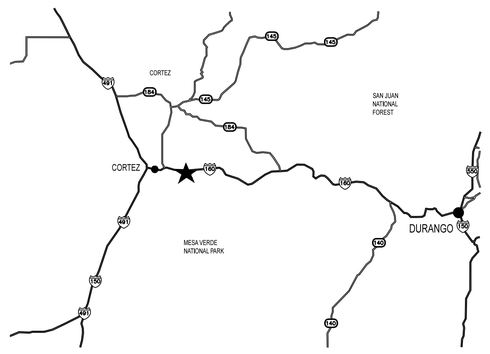
ATKINSON-NOLAND + ASSOCIATES, INC. *STEEL AND CONCRETE INVESTIGATION REPORT, McELMO FLUME.* JUNE 2013.

ANTHONY + ASSOCIATES. *ARCHAEOLOGICAL ASSESSMENT AND LIMITED CONDITION ASSESSMENT OF MONTEZUMA VALLEY IRRIGATION COMPANY FLUME NO. 6 (5MT20000), MONTEZUMA COUNTY, COLORADO.* SEPTEMBER 2012.

DUGAN, KIMBERLY. RECOMMENDATIONS FOR THE McELMO FLUME (LETTER TO LINDA TOWLE). MARCH 21, 2011.

FISHER, PRESTON. *INITIAL STRUCTURAL OBSERVATIONS AND RECOMMENDATIONS FOR McELMO FLUME.* MARCH 2011.

2 VICINITY MAP
N.T.S.



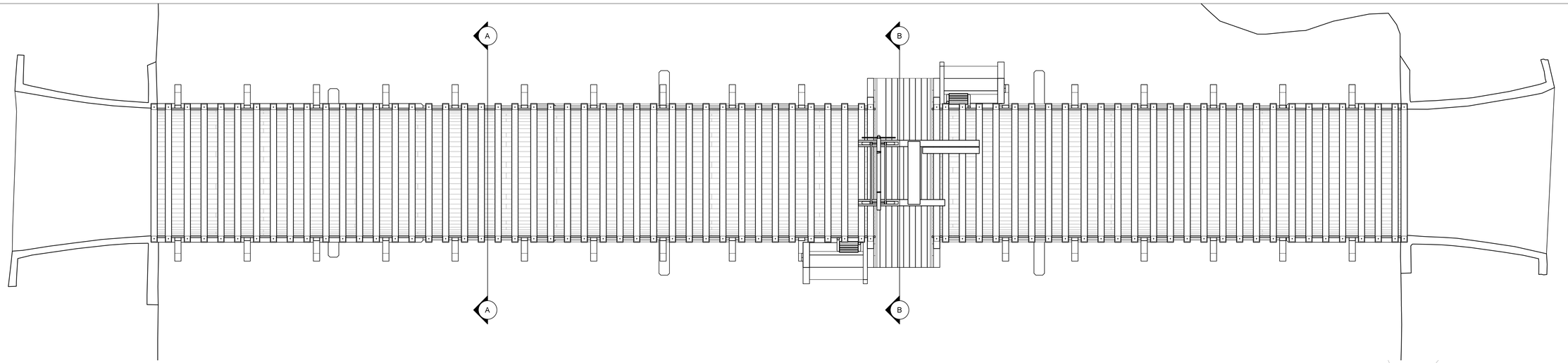
3 LOCATION MAP
N.T.S.

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

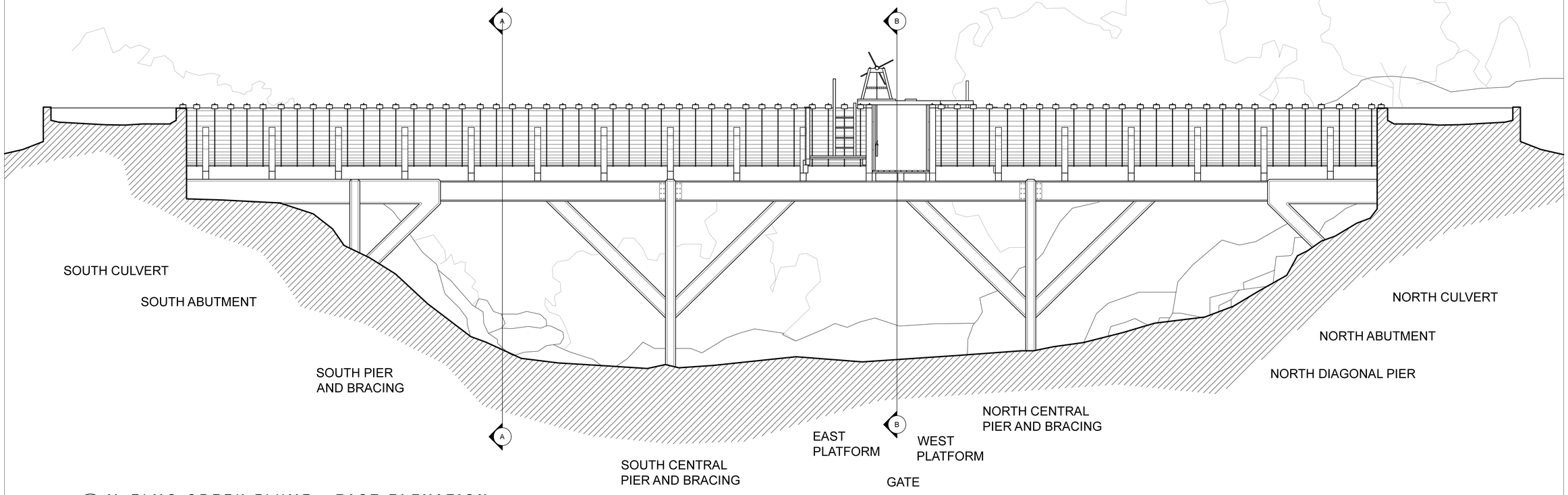
DATE: 07/17/13

01



1 McELMO CREEK FLUME - **PLAN VIEW**
SCALE: 1/4" = 1'-0"

N



2 McELMO CREEK FLUME - **EAST ELEVATION**
SCALE: 1/4" = 1'-0"

NOTES:

1. DIMENSIONS ARE BASED ON FIELD MEASUREMENTS TAKEN IN MAY 2013. ALL DRAWINGS ARE REPRESENTATIVE OF THE FLUME STRUCTURE IN AN 'AS-BUILT' STATE, AS INFERRED FROM SURVIVING FEATURES, AND DO NOT NECESSARILY REFLECT CURRENT CONDITIONS. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD.

McELMO CREEK FLUME - **PLAN AND ELEVATION**

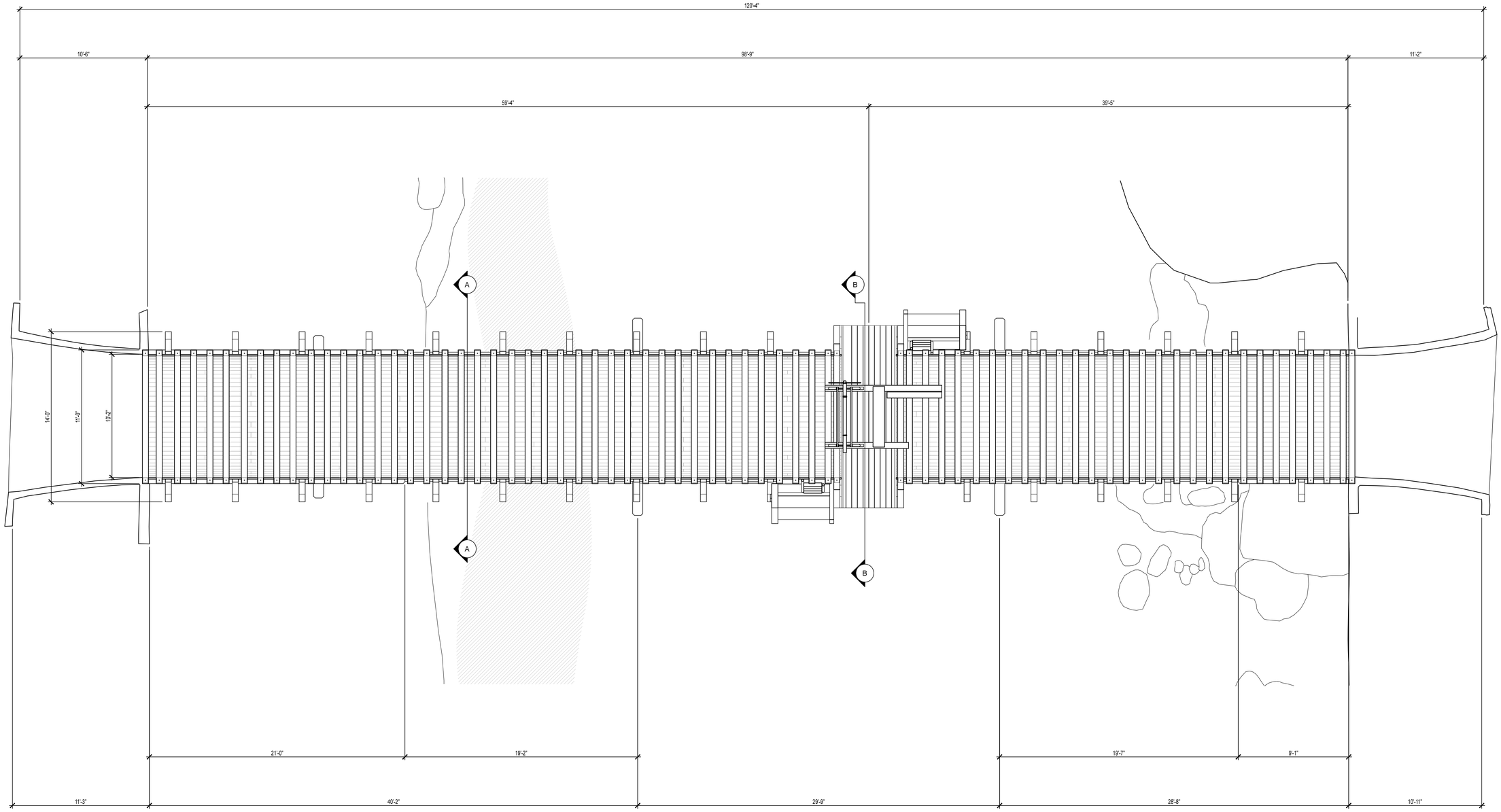
SCALE: 1/4" = 1'-0"

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

DATE: 07/17/13

02



1 McELMO CREEK FLUME - **PLAN VIEW**
SCALE: 1/4" = 1'-0"

N

McELMO CREEK FLUME - **DIMENSIONED PLAN**
SCALE: 1/4" = 1'-0"

NOTES:

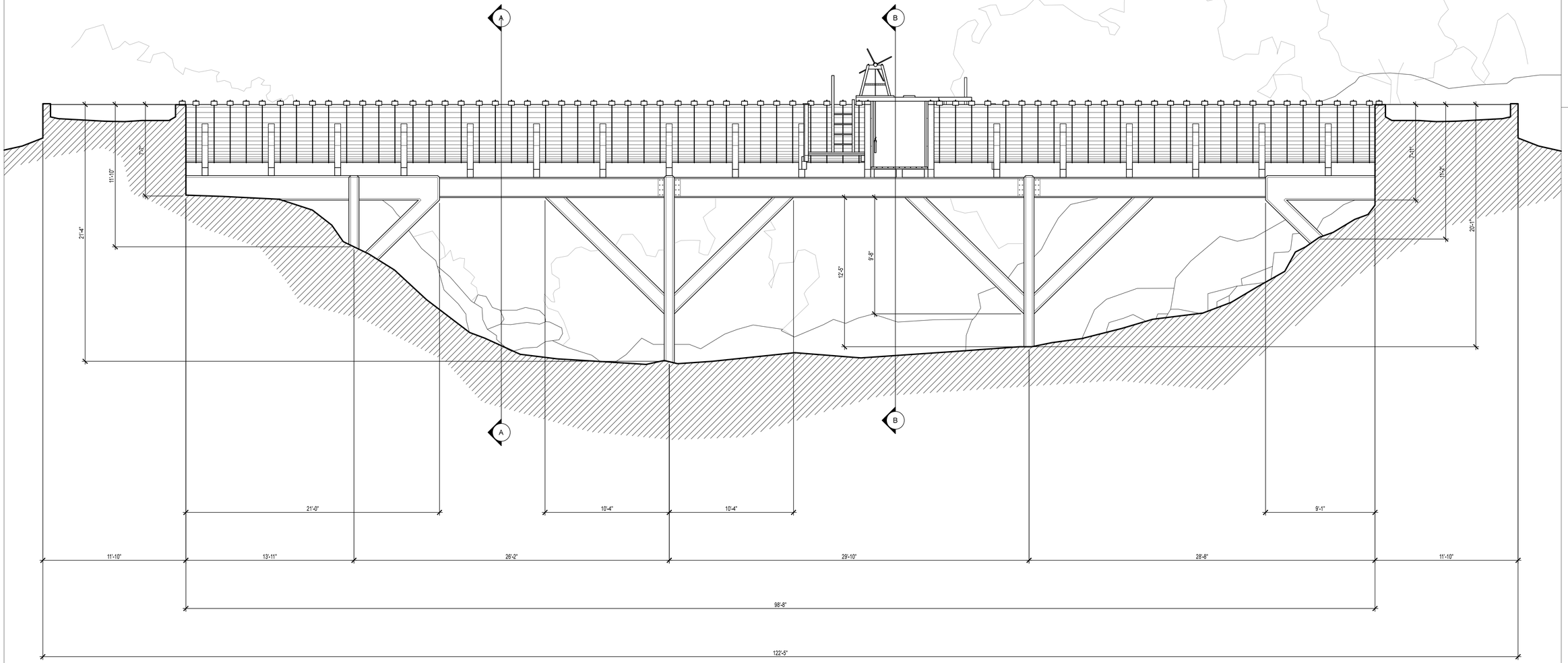
1. DIMENSIONS ARE BASED ON FIELD MEASUREMENTS TAKEN IN MAY 2013. ALL DRAWINGS ARE REPRESENTATIVE OF THE FLUME STRUCTURE IN AN 'AS-BUILT' STATE, AS INFERRED FROM SURVIVING FEATURES, AND DO NOT NECESSARILY REFLECT CURRENT CONDITIONS. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD.

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

DATE: 07/17/13

03



1 McELMO CREEK FLUME - **EAST ELEVATION**
SCALE: 1/4" = 1'-0"

McELMO CREEK FLUME - **DIMENSIONED ELEVATION**
SCALE: 1/4" = 1'-0"

NOTES:

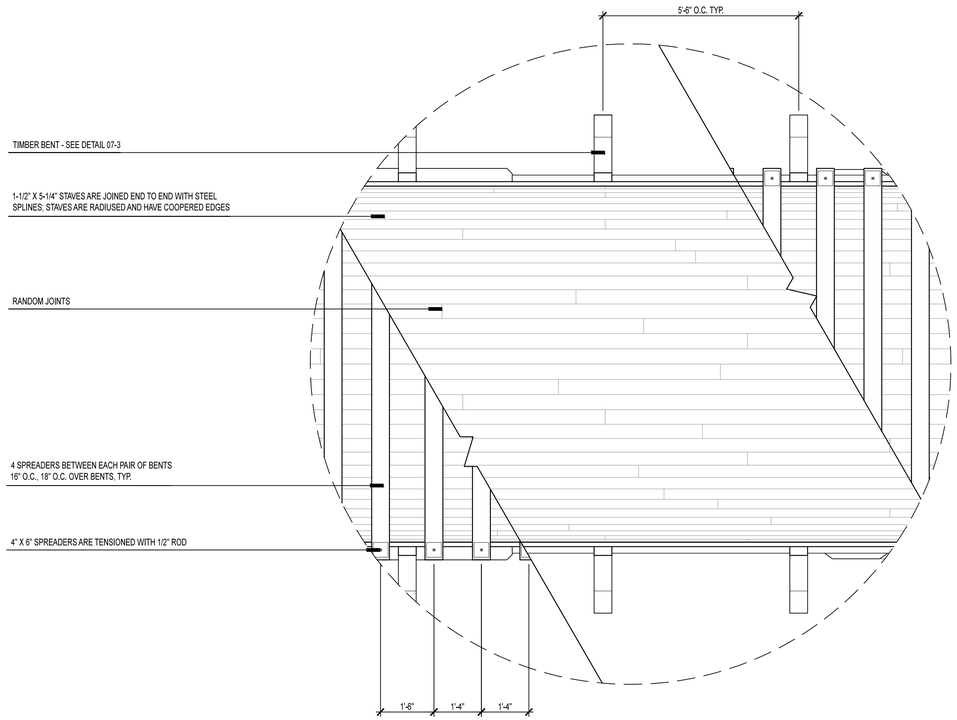
1. DIMENSIONS ARE BASED ON FIELD MEASUREMENTS TAKEN IN MAY 2013. ALL DRAWINGS ARE REPRESENTATIVE OF THE FLUME STRUCTURE IN AN 'AS-BUILT' STATE, AS INFERRED FROM SURVIVING FEATURES, AND DO NOT NECESSARILY REFLECT CURRENT CONDITIONS. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD.

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

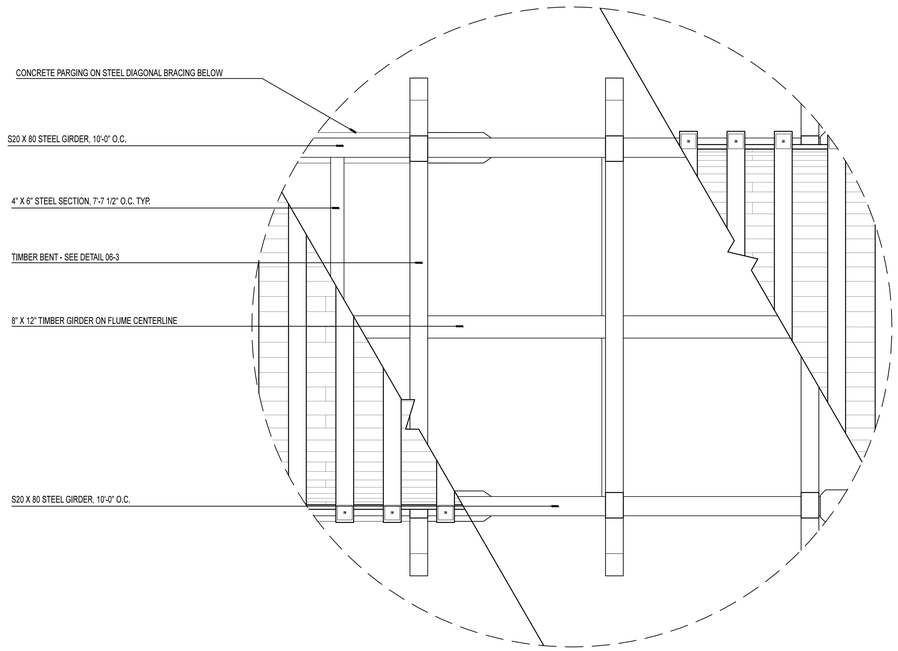
McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

DATE: 07/17/13

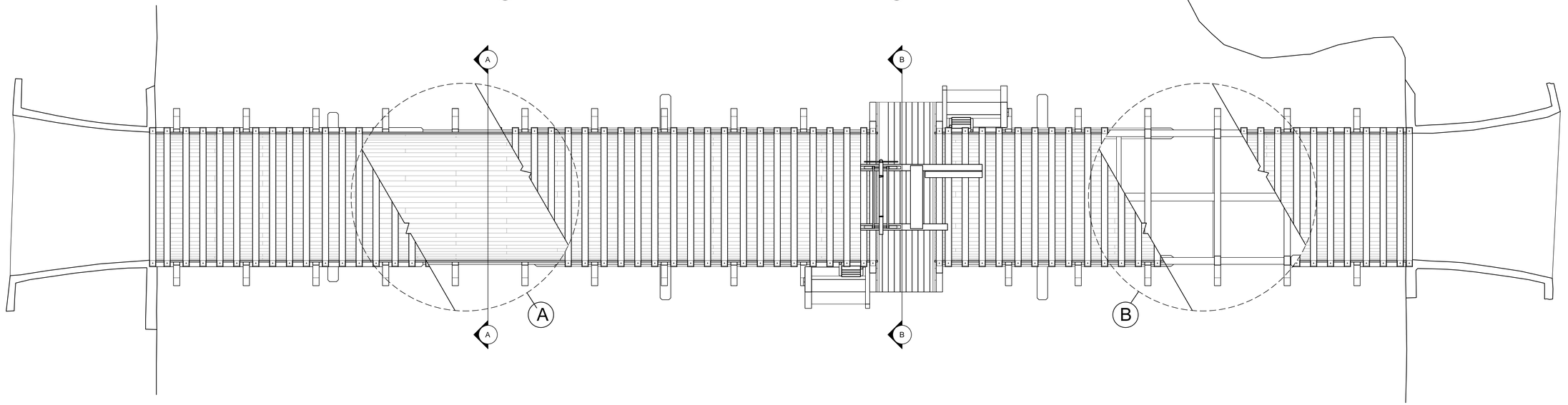
04



A DETAIL OF STAVES AT "A" BELOW
SCALE: 1/2" = 1'-0"



B DETAIL OF FRAMING AT "B" BELOW
SCALE: 1/2" = 1'-0"



1 McELMO CREEK FLUME - **CUT-AWAY PLAN VIEW**
SCALE: 1/4" = 1'-0"

N

NOTES:

1. DIMENSIONS ARE BASED ON FIELD MEASUREMENTS TAKEN IN MAY 2013. ALL DRAWINGS ARE REPRESENTATIVE OF THE FLUME STRUCTURE IN AN 'AS-BUILT' STATE, AS INFERRED FROM SURVIVING FEATURES, AND DO NOT NECESSARILY REFLECT CURRENT CONDITIONS. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD.

McELMO CREEK FLUME - **PLAN DETAILS**

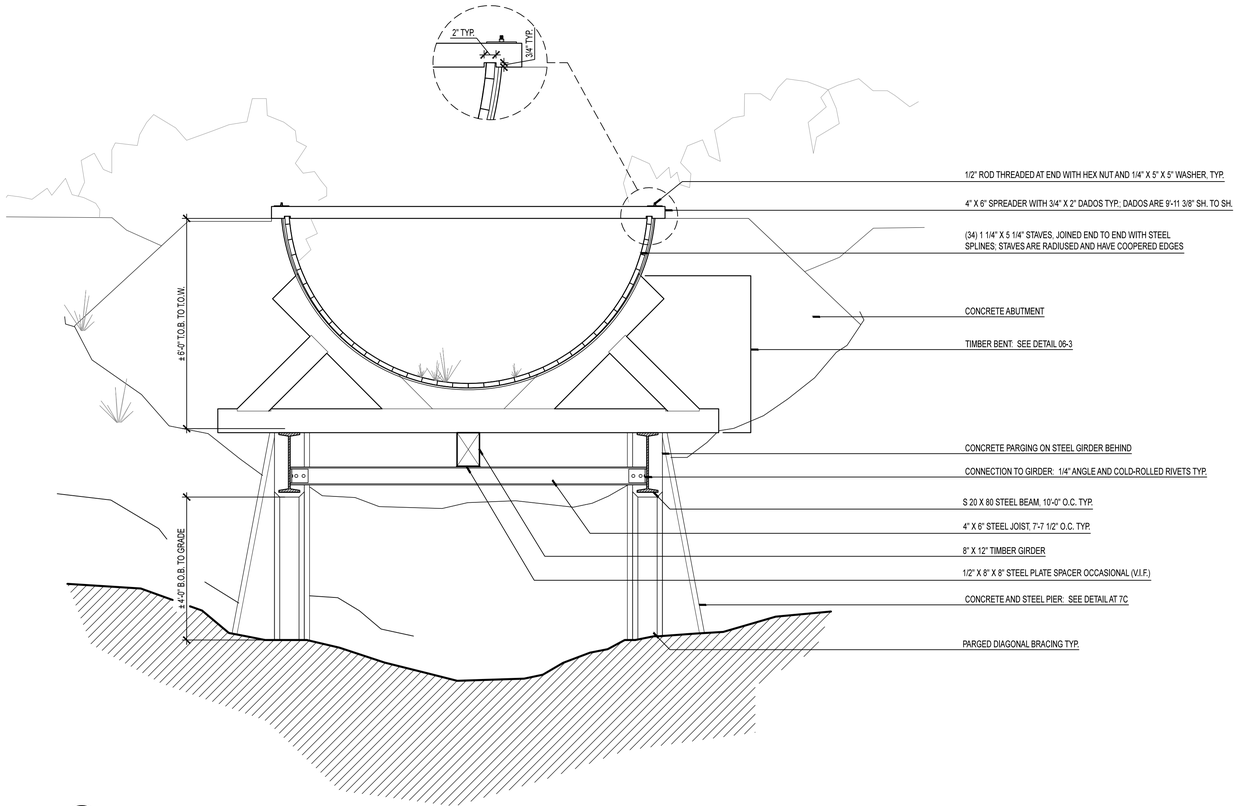
SCALE: 1/4" = 1'-0"

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

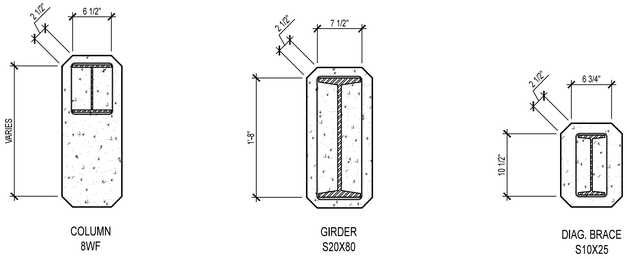
McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

DATE: 07/17/13

05



1 SOUTH PIER AND ABUTMENT: **SECTION B-B**
SCALE: 1/2" = 1'-0"

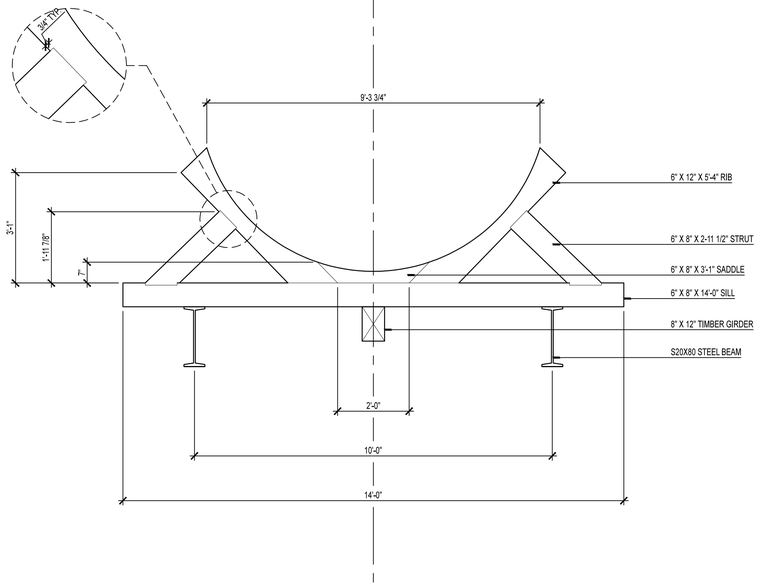


*STEEL SECTIONS ARE WRAPPED WITH SPIRAL-TYPE METAL TIES AND EMBEDDED IN CAST-IN-PLACE CONCRETE.

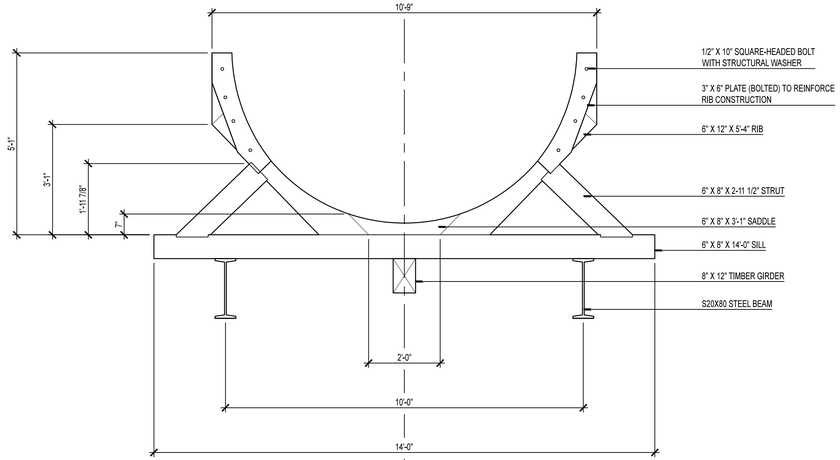
2 PARGED STEEL MEMBERS - **TYPICAL SECTIONS**
SCALE: 1" = 1'-0"

NOTES:

1. DIMENSIONS ARE BASED ON FIELD MEASUREMENTS TAKEN IN MAY 2013. ALL DRAWINGS ARE REPRESENTATIVE OF THE FLUME STRUCTURE IN AN 'AS-BUILT' STATE, AS INFERRED FROM SURVIVING FEATURES, AND DO NOT NECESSARILY REFLECT CURRENT CONDITIONS. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD.



3 TIMBER BENT: **TYPICAL ELEVATION**
SCALE: 1/2" = 1'-0"



4 TIMBER BENT AT GATE: **ELEVATION**
SCALE: 1/2" = 1'-0"

McELMO CREEK FLUME - **SECTIONS AND DETAILS**

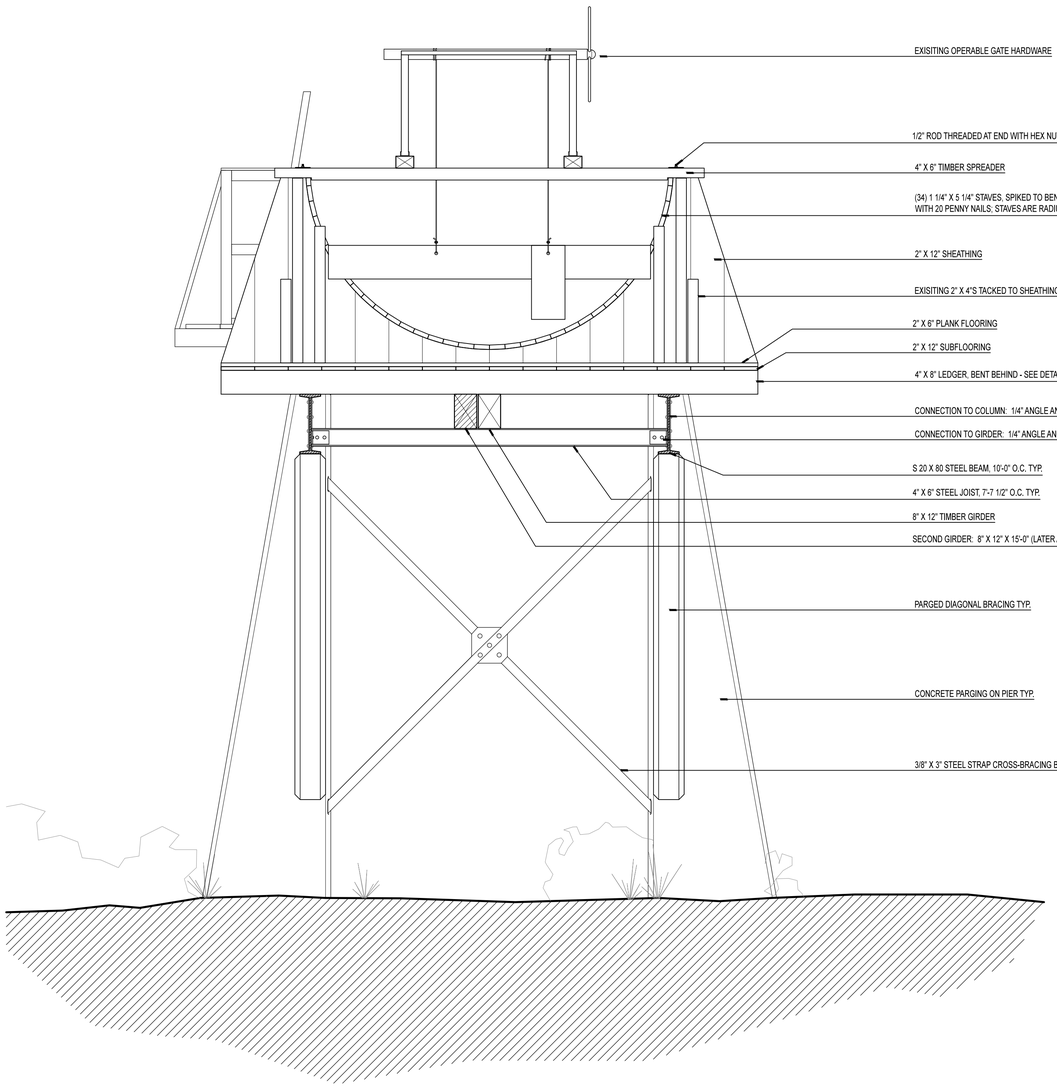
SCALE: 1/2" = 1'-0"

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

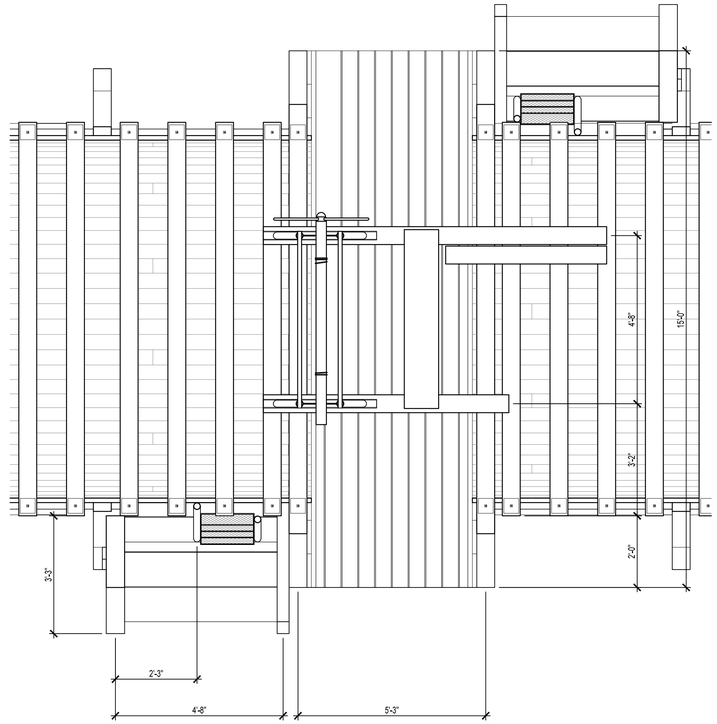
McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

DATE: 07/17/13

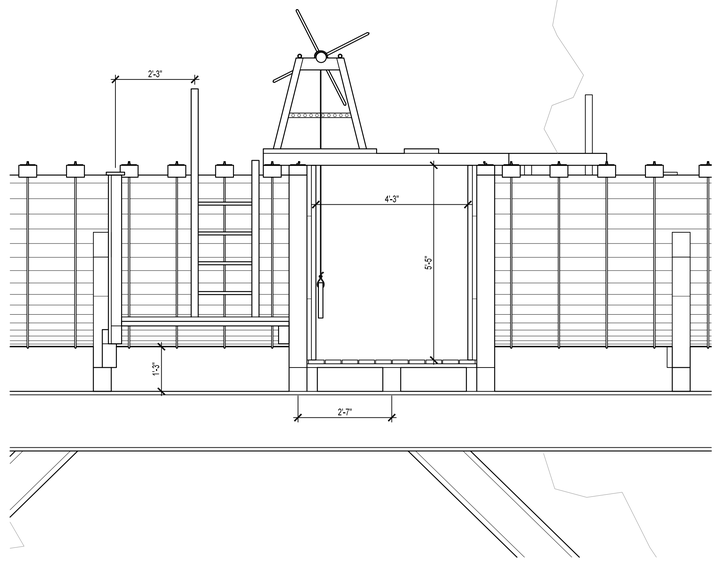
06



1 SOUTH CENTRAL PIERS AND GATE: **SECTION A-A THROUGH GATE**
SCALE: 1/2" = 1'-0"



2 GATE AND PLATFORMS - **ENLARGED PLAN**
SCALE: 1/2" = 1'-0"



3 GATE AND PLATFORMS - **ENLARGED ELEVATION**
SCALE: 1/2" = 1'-0"

NOTES:

1. DIMENSIONS ARE BASED ON FIELD MEASUREMENTS TAKEN IN MAY 2013. ALL DRAWINGS ARE REPRESENTATIVE OF THE FLUME STRUCTURE IN AN 'AS-BUILT' STATE, AS INFERRED FROM SURVIVING FEATURES, AND DO NOT NECESSARILY REFLECT CURRENT CONDITIONS. EXISTING CONDITIONS SHOULD BE VERIFIED IN FIELD.

McELMO CREEK FLUME - **SECTIONS AND DETAILS**

SCALE: 1/2" = 1'-0"

PORTER AND ASSOCIATES
ARCHITECTURAL CONSERVATION
PO BOX 3002, BURLINGTON, VT
T: (802) 324-7528
DRAWINGS PREPARED BY: KERI L. STEVENSON

McELMO CREEK FLUME
CONDITION ASSESSMENT, STABILIZATION, AND REPAIR
HIGHWAY 160, 3 MI EAST OF CORTEZ, MONTEZUMA COUNTY, COLORADO

DATE: 07/17/13

07

STRUCTURAL NOTES

1. GENERAL NOTES

A. DO NOT SCALE CONTRACT DRAWINGS FOR THE PURPOSE OF ESTABLISHING DIMENSIONS.

B. VERIFY EXISTING CONDITIONS AND DIMENSIONS PRIOR TO BEGINNING WORK OR FABRICATING OF MATERIALS. NOTIFY ENGINEER OF DISCREPANCIES BEFORE PROCEEDING WITH ANY PHASE OF WORK.

C. THE CONTRACT STRUCTURAL DRAWINGS REPRESENT THE FINISHED STRUCTURE. THE CONTRACTOR IS RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION. PROVIDE ALL MEASURES REQUIRED TO PROTECT THE STRUCTURE, WORKMEN, AND OTHER PERSONS DURING CONSTRUCTION; INCLUDING BRACING, SHORING FOR CONSTRUCTION EQUIPMENT, SHORING FOR THE STRUCTURE, FORMS AND SCAFFOLDING, SHORING OF RETAINING WALLS AND OTHER TEMPORARY SUPPORTS AS REQUIRED.

D. THE CONTRACTOR SHALL REVIEW AND BECOME FAMILIAR WITH THE CONTENT OF THE FOLLOWING DOCUMENTS, WHICH DESCRIBE THE EXISTING CONDITIONS OF THE FLUME:

- *STEEL AND CONCRETE INVESTIGATION REPORT, McELMO FLUME,* ATKINSON-NOLAND AND ASSOCIATES, INC., JUNE 2013.
- *McELMO CREEK FLUME: CONDITION ASSESSMENT, STABILIZATION, AND REPAIR,* PORTER AND ASSOCIATES, JULY2013.
- *ARCHAEOLOGICAL ASSESSMENT AND LIMITED CONDITION ASSESSMENT OF MONTEZUMA VALLEY IRRIGATION COMPANY FLUME No. 6 (5MT20000) MONTEZUMA COUNTY, COLORADO,* ANTHONY & ASSOCIATES, INC., SEPTEMBER 2012.

2. DESIGN CRITERIA

A. APPLICABLE CODES AND GUIDES:

- 2009 INTERNATIONAL BUILDING CODE (IBC) WITH AMENDMENTS.
- MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES (ASCE 7-05).
- AISC "MANUAL OF STEEL CONSTRUCTION" 13TH EDITIONS
- BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318-08).
- ACI MANUAL OF CONCRETE PRACTICE, LATEST EDITION.

3. FLUME PROTECTION

A. PRIOR TO ANY WORK, THE CONTRACTOR SHALL COLLECT AND SAFELY STORE ALL LOOSE AND DISPLACED ELEMENTS OF THE EXISTING FLUME FOUND IN THE CONSTRUCTION AREA.

B. PRIOR TO ANY WORK AND DURING THE ENTIRE DURATION OF THE PROJECT, THE CONTRACTOR SHALL PROVIDE MASKING TO PREVENT DAMAGE TO THE FRAGILE WOODEN FLUME ELEMENTS.

4. SHORING

A. PRIOR TO ANY DEMOLITION AND EXCAVATION WORK, THE CONTRACTOR SHALL PROVIDE SHORING TO THE EXISTING STRUCTURE AND DETERMINE THE EXTENT OF SHORING REQUIRED BASED ON HIS OWN MEANS AND METHODS.

5. CLEAN UP NOTES

A. THE CONTRACTOR SHALL KEEP THE WORK SITE FREE AT ALL TIMES FROM ACCUMULATIONS OF WASTE MATERIALS.

B. VOLATILE WASTES SHALL BE PROPERLY STORED IN COVERED METAL CONTAINERS AND REMOVED DAILY.

C. EXCESS FILL DIRT THAT MAY BE GENERATED SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF BY THE CONTRACTOR.

D. WASTES SHALL NOT BE BURIED OR BURNED ON THE SITE OR DISPOSED OF INTO STORM DRAINS, STREAMS, OR WATERWAYS. ALL WASTES SHALL BE REMOVED FROM THE SITE AND DISPOSED OF IN A MANNER COMPLYING WITH LOCAL ORDINANCES AND ANTI-POLLUTION LAWS.

E. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RESTORING ALL DISTURBED SURFACES AND RELATED STRUCTURES, INCLUDING BUT NOT LIMITED TO, DRIVEWAYS, CURBS, GUTTERS, WALKS, AND BITUMINOUS PAVEMENTS TO ORIGINAL CONDITIONS (OR BETTER).

6. CONCRETE

F. PROVIDE CONCRETE AS SHOWN BELOW. PROVIDE BATCH MIXING, TRANSPORTATION, PLACING AND CURING OF CONCRETE IN ACCORDANCE WITH RECOMMENDATIONS OF ACI 301, ACI 318, ACI 304R, AND ASTM C94. PROVIDE ADMIXTURES AND SPECIAL REQUIREMENTS AS SPECIFIED.

G. PREPARE CONCRETE MIX DESIGNS FOR EACH TYPE AND STRENGTH OF CONCRETE. SUBMIT WRITTEN REPORT TO ENGINEER OF EACH PROPOSED MIX DESIGN AT LEAST 15 DAYS PRIOR TO START OF WORK. DO NOT BEGIN CONCRETE PRODUCTION UNTIL ENGINEER HAS REVIEWED MIX DESIGNS.

H. NEW CONCRETE TO MATCH THE ORIGINAL WITH RESPECT TO COLOR, AGGREGATES, AND SURFACE TEXTURE.

I. CONCRETE SHALL BE NORMAL WEIGHT CONCRETE (145 PCF) WITH 28-DAY COMPRESSIVE STRENGTH (f'c) NOT LESS THAN 4,500 PSI AND NOT GREATER THAN 5,500 PSI.

J. CONCRETE MIXES USED ON THE PROJECT SHALL BE PROPORTIONED TO SATISFY THE DURABILITY REQUIREMENTS IN TABLE 1.

K. UNLESS OTHERWISE NOTED, PROVIDE ¾" MINIMUM CLEAR CONCRETE COVER FOR REINFORCING BARS AND EMBEDDED STEEL ELEMENTS.

H. CONSOLIDATE ALL CONCRETE DURING PLACEMENT AND THOROUGHLY WORK AROUND REINFORCING AND EMBEDDED ITEMS AND INTO CORNERS OF FORMS FOLLOWING ACI RECOMMENDATIONS.

I. WHEN CONCRETE PLACEMENT IS INTERRUPTED, NOTIFY THE STRUCTURAL ENGINEER FOR RECOMMENDATIONS. UNLESS NOTED OTHERWISE, PROVIDE A CONSTRUCTION JOINT BY ROUGHENING THE CONCRETE SURFACE TO AN AMPLITUDE OF ¼".

7. REINFORCING STEEL

A. REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60. REINFORCING TO BE WELDED OR FIELD BENT SHALL BE ASTM A706, GRADE 60. EPOXY-COATED REINFORCING STEEL SHALL CONFORM TO ASTM A775 AND SHALL BE COATED PRIOR TO FABRICATION.

B. DEFORMED WIRE SHALL CONFORM TO ASTM A1064, GRADE 60. EPOXY-COATED WIRES SHALL CONFORM TO ASTM A884 AND SHALL BE COATED PRIOR TO FABRICATION.

C. FIELD BEND REINFORCEMENT IN ACCORDANCE WITH ACI 301 SECTION 3.3.2.8 AND DETAILS 1/S5 AND 2/S5.

D. DO NOT FIELD BEND REINFORCEMENT PARTIALLY EMBEDDED IN CONCRETE UNLESS SPECIFICALLY SHOWN OR APPROVED BY THE STRUCTURAL ENGINEER.

E. PROVIDE ALL ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AT POSITIONS SHOWN ON PLANS AND DETAILS.

F. WET-STABBING OF REINFORCING OR EMBEDS INTO PREVIOUSLY PLACED CONCRETE IS NOT ALLOWED.

G. DETAIL BARS IN ACCORDANCE WITH THE LATEST EDITIONS OF THE ACI DETAILING MANUAL AND ACI BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE.

6. STRUCTURAL STEEL

A. ALL FABRICATION AND ERECTION SHALL CONFORM TO THE LATEST EDITION OF THE AISC MANUAL OF STEEL CONSTRUCTION.

B. UNLESS OTHERWISE NOTED, STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING:

- ANGLES & CHANNELS. ASTM A36, fy = 36 KSI
- PLATES, ASTM A36, fy = 36 KSI
- COMMON BOLTS, ASTM A307, fy = 60 KSI

C. STRUCTURAL STEEL DETAILS AND CONNECTIONS SHALL CONFORM TO THE STANDARDS OF THE AISC "MANUAL OF STEEL CONSTRUCTION", LATEST EDITION.

I. PROVIDE E70XX ELECTRODES FOR ALL WELDING UNLESS OTHERWISE NOTED.

J. WELDING:

- THE CONTRACTOR SHALL SUBMIT A WELDING PLAN FOR APPROVAL BY THE STRUCTURAL ENGINEER. THE PLAN SHOULD INCLUDE MEASURES TO MINIMIZE THE RISK OF FIRE DAMAGE TO THE EXISTING WOODEN FLUME.
- AT ALL TIMES DURING WELDING THE CONTRACTOR SHALL HAVE ADEQUATE FIRE FIGHTING EQUIPMENT READY FOR USE AT LOCATION OF WELDING. THE WELDING PROCESS SHALL BE CLOSELY MONITORED BY THE CONTRACTOR TO PREVENT IGNITING OF ANY COMBUSTIBLES IN THE CONSTRUCTION AREA.

7. CONCRETE REMOVAL AND PREPARATION

A. REMOVAL OR DEMOLITION OF EXISTING DETERIORATED CONCRETE AND PREPARATION OF CONCRETE SURFACE SHALL BE IN ACCORDANCE WITH ACI 536R CONCRETE REPAIR GUIDE.

B. REMOVE CONCRETE USING A SMALL CHIPPING HAMMER (15 LB MAX.) OR HAND TOOLS ONLY. CARE SHOULD BE EXERCISED NOT TO DAMAGE THE SURROUNDING CONCRETE AND EMBEDDED STEEL INTENDED TO REMAIN.

C. REMOVE CONCRETE UNTIL SOUND MATERIAL IS FOUND. EXPOSED CONCRETE SURFACE TO BE INSPECTED BY STRUCTURAL ENGINEER PRIOR TO PLACEMENT OF NEW CONCRETE.

D. PREPARE CONCRETE SURFACES THAT ARE INTENDED TO RECEIVE NEW MATERIAL AS FOLLOWS:

- USE SANDBLASTING TO REMOVE APPROXIMATELY ¼" TO ½" DEEP CONCRETE FROM SURFACE. ROUGH CONCRETE SURFACE TO AN AMPLITUDE OF ¼".
- CLEAN SURFACE FROM DEBRIS, DUST OR OTHER CONTAMINANTS THAT WILL PREVENT BOND USING COMPRESSED AIR AND BRUSH.
- FINAL CLEANING WILL USE A LIGHT WATER SPRAY IMMEDIATELY PRIOR TO CONCRETE APPLICATION.

9. STEEL CLEANING AND COATING

A. CLEAN ALL EXPOSED STEEL SURFACES THOROUGHLY OF ALL LOOSE CONCRETE, RUST, AND OTHER CONTAMINANTS BY SANDBLASTING. FOR LIMITED AREAS WITH MINOR CORROSION, WIRE BRUSHING OR OTHER HAND METHODS MAY BE ACCEPTABLE.

B. AFTER CLEANING, ALL EXPOSED STEEL SURFACE SHALL BE INSPECTED BY THE STRUCTURAL ENGINEER TO QUANTIFY THE EXTENT OF SECTION LOSS AND NEED FOR STRENGTHENING OR REPLACEMENT.

C. PROTECT ALL CLEANED STEEL SURFACE WITH A ZINC RICH PRIMER, SUCH AS SHERWIN-WILLIAMS COROTHANE 1 OR APPROVED EQUAL. INSTALL PER MANUF. REC.

D. PRIOR TO APPLICATION, TEST PRODUCT ON A SMALL AREA TO DEMONSTRATE AESTHETIC EFFECTS. MOCKUP TO BE INSPECTED AND APPROVED BY STRUCTURAL ENGINEER.

10. SANDBLASTING

A. USE LOW-PRESSURE SANDBLASTING (125-150 PSI MAX.) FOR CONCRETE REMOVAL, SURFACE PREPARATION, AND STEEL CLEANING.

B. DRY SANDBLASTING PROCEDURE PRODUCES LARGE VOLUMES OF DUST. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING DUST CONTAINMENT AND WASTE DISPOSAL.

TABLE 1

DURABILITY REQUIREMENTS

CONCRETE USE AND / OR EXPOSURE	FREEZE-THAW (ACI 318, 4.2.1)	PERMEABILITY (ACI 318, 4.2.1)	CORROSION (ACI 318, 4.2.1)	SULFATES (ACI 318, 4.2.1)
BEAMS, COLUMNS, AND BRACES	F1	P0	C1	S0

DRAWING INDEX

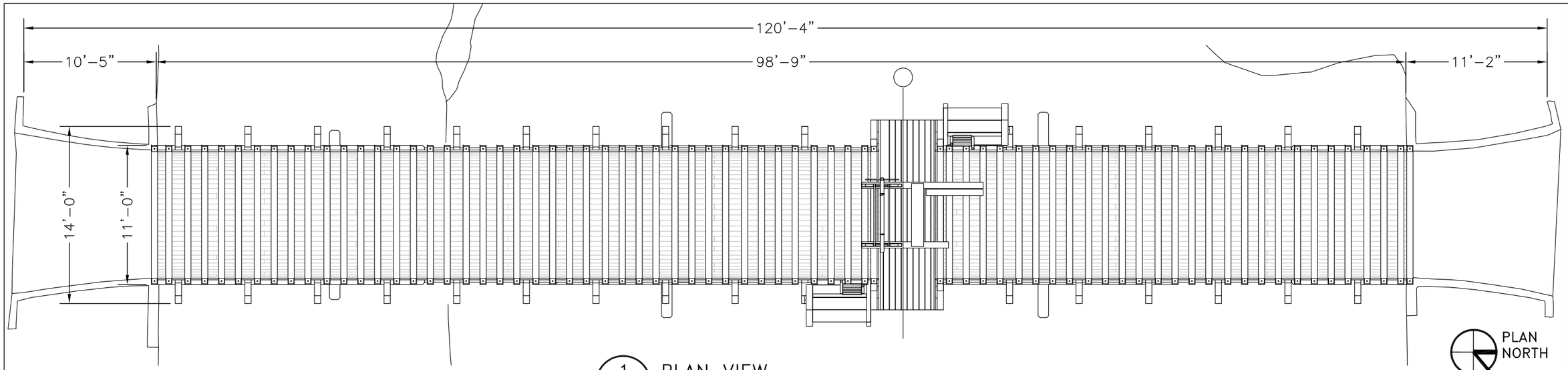
DRAWN BY CAC
DATE 05/28/15
CKD. BY DBW
REV.
REV.
REV.
REV.

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME
CONCRETE AND STEEL REPAIR
STRUCTURAL NOTES

SCALE: AS NOTED
JOB NO. 14-179
SHEET:
S1



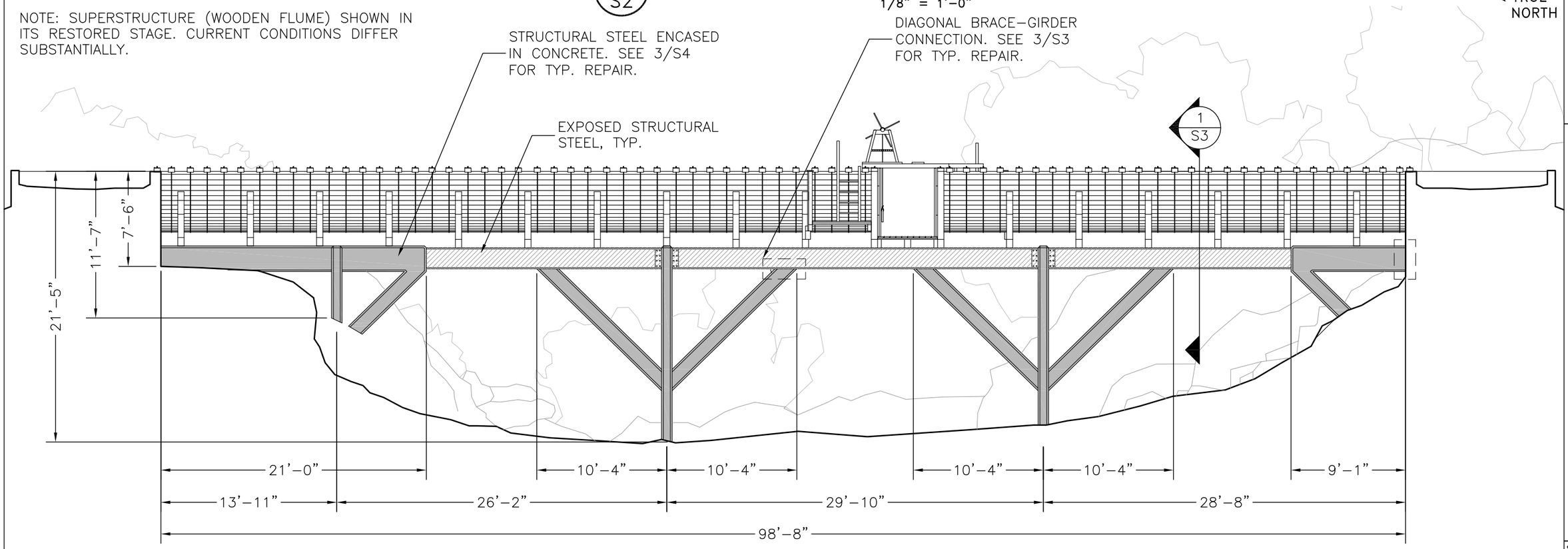
1/S2 PLAN VIEW

1/8" = 1'–0"

NOTE: SUPERSTRUCTURE (WOODEN FLUME) SHOWN IN ITS RESTORED STAGE. CURRENT CONDITIONS DIFFER SUBSTANTIALLY.

PLAN NORTH

TRUE NORTH



2/S2 EAST ELEVATION

1/8" = 1'–0"

Atkinson–Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444–3620
www.ana–usa.com

DRAWN BY	CAC
DATE	05/28/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570–9494

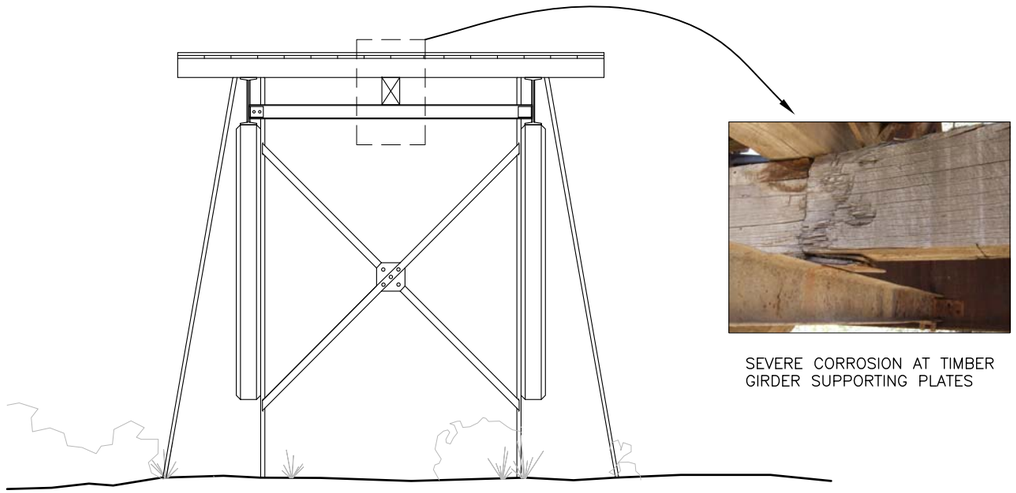
McELMO CREEK FLUME
CONCRETE AND STEEL REPAIR
PLAN AND ELEVATION

SCALE: AS NOTED

JOB NO. 14–179

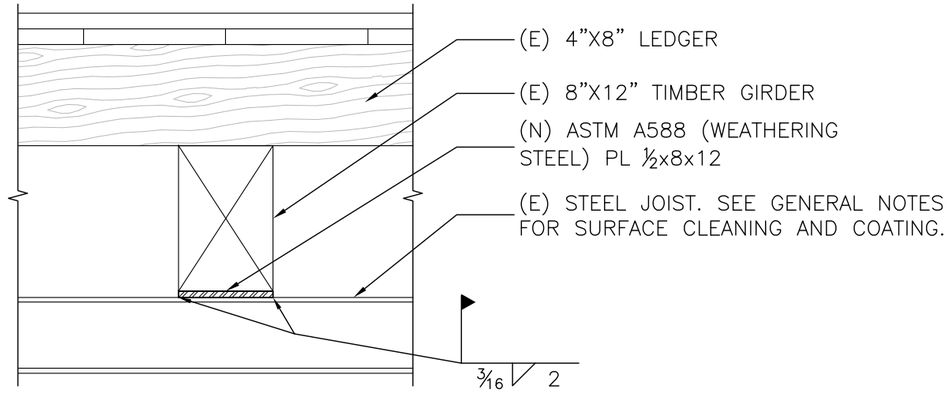
SHEET:

S2



SEVERE CORROSION AT TIMBER GIRDER SUPPORTING PLATES

1 / S3 BEARING PLATE AT TIMBER GIRDER
CURRENT CONDITION 3/16" = 1'-0"



2 / S3 BEARING PLATE AT TIMBER GIRDER
REPAIR 1" = 1'-0"

DIAGONAL BRACE–GIRDER CONNECTION REPAIR

- EXPOSE ALL DIAGONAL BRACE–GIRDER CONNECTIONS TO BE INSPECTED BY THE STRUCTURAL ENGINEER.
- REMOVE EXISTING STEEL ANGLES TO ALLOW CLEANING AND PROTECTION OF THE CORRODED SURFACES.
- REPLACE EXISTING ANGLES WITH NEW ASTM A36 ANGLES. NEW ANGLES TO MATCH ORIGINALS WITH RESPECT TO SIZE AND NUMBER.
- REPLACE EXISTING RIVETS WITH ASTM A307 Gr. A ROUND HEAD BOLTS. NEW BOLTS TO MATCH ORIGINALS WITH RESPECT TO SIZE AND NUMBER.
- PROTECT ALL STEEL SURFACES WITH APPROPRIATE COATING (SEE GENERAL NOTES).

3 / S3 DIAGONAL BRACE–GIRDER CONNECTION
REPAIR 1" = 1'-0"

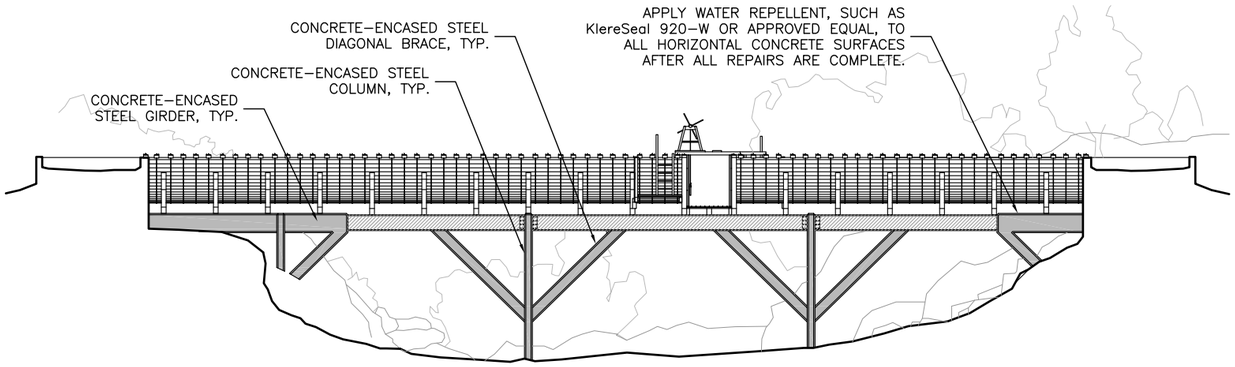
Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

DRAWN BY	CAC
DATE	05/28/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME
CONCRETE AND STEEL REPAIR
STEEL DETAILS

SCALE: AS NOTED
JOB NO. 14-179
SHEET:
S3



1/S4 TYPICAL ELEVATION

N.T.S.

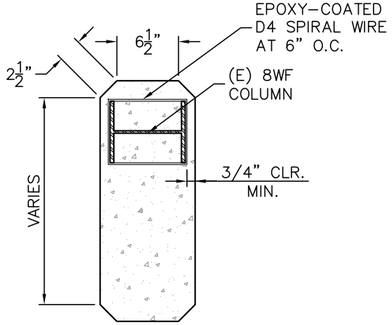
GIRDER

DIAGONAL BRACE

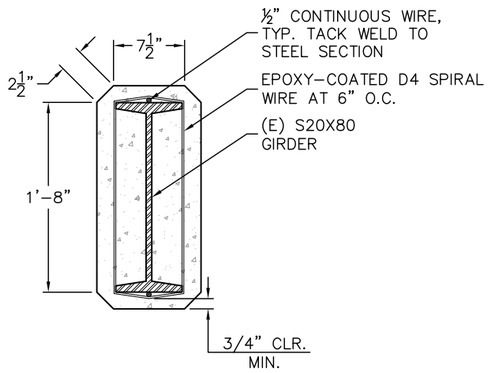
COLUMN

2/S4 TYPICAL CONCRETE CRACKING AND SPALLING

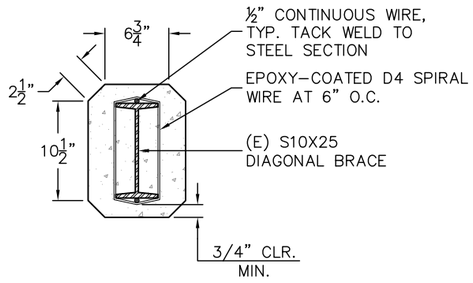
N.T.S.



COLUMN



GIRDER

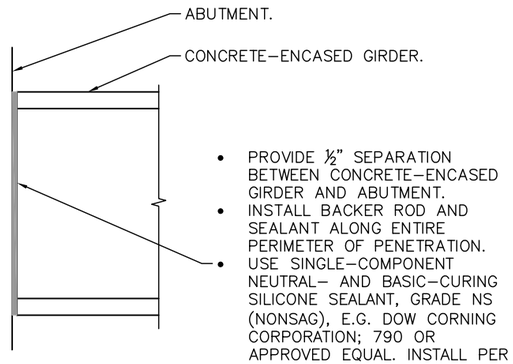


DIAGONAL BRACE

NOTES:
1. PRIOR TO ANY CONCRETE REMOVAL, CONTRACTOR SHALL DOCUMENT DIMENSIONS OF EXISTING CONCRETE–ENCASED STEEL SECTIONS. NOTIFY ENGINEER OF ANY DISCREPANCIES WITH STRUCTURAL DRAWINGS.
2. REMOVE DAMAGED CONCRETE AND PREPARE CONCRETE SURFACE IN ACCORDANCE WITH PROCEDURE DESCRIBED IN STRUCTURAL NOTES.
3. CLEAN ALL EXPOSED STEEL SURFACES AND APPLY PROTECTIVE COATING IN ACCORDANCE WITH PROCEDURE DESCRIBED IN STRUCTURAL NOTES.
4. CAST NEW CONCRETE TO RESTORE CROSS–SECTION OF CONCRETE–ENCASED STEEL GIRDERS, COLUMNS, AND DIAGONAL BRACES. NEW SECTIONS TO MATCH THE EXISTING WITH RESPECT TO SIZE AND SHAPE.

3/S4 RESTORED CONCRETE–ENCASED SECTIONS

3/4" = 1'–0"



- PROVIDE ½" SEPARATION BETWEEN CONCRETE–ENCASED GIRDER AND ABUTMENT.
- INSTALL BACKER ROD AND SEALANT ALONG ENTIRE PERIMETER OF PENETRATION.
- USE SINGLE–COMPONENT NEUTRAL– AND BASIC–CURING SILICONE SEALANT, GRADE NS (NONSAG), E.G. DOW CORNING CORPORATION; 790 OR APPROVED EQUAL. INSTALL PER MANUF. REC.

4/S4 JOINTS AT GIRDER–ABUTMENT
SOUTH ABUTMENT

N.T.S.

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570–9494

DRAWN BY	CAC
DATE	05/28/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Atkinson–Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444–3620
www.ana–usa.com

McELMO CREEK FLUME CONCRETE AND STEEL REPAIR CONCRETE DETAILS

SCALE: AS NOTED

JOB NO. 14–179

SHEET:

S4

STRUCTURAL NOTES

1. GENERAL NOTES

A. DO NOT SCALE CONTRACT DRAWINGS FOR THE PURPOSE OF ESTABLISHING DIMENSIONS.

B. VERIFY EXISTING CONDITIONS AND DIMENSIONS PRIOR TO BEGINNING WORK OR FABRICATING OF MATERIALS. NOTIFY ENGINEER OF DISCREPANCIES BEFORE PROCEEDING WITH ANY PHASE OF WORK.

C. THE CONTRACT STRUCTURAL DRAWINGS REPRESENT THE FINISHED STRUCTURE. THE CONTRACTOR IS RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION. PROVIDE ALL MEASURES REQUIRED TO PROTECT THE STRUCTURE, WORKMEN, AND OTHER PERSONS DURING CONSTRUCTION; INCLUDING BRACING, SHORING FOR CONSTRUCTION EQUIPMENT, SHORING FOR THE BUILDING, FORMS AND SCAFFOLDING, SHORING OF RETAINING WALLS AND OTHER TEMPORARY SUPPORTS AS REQUIRED.

2. DESIGN CRITERIA

A. APPLICABLE CODES AND GUIDES

- 2009 INTERNATIONAL BUILDING CODE (IBC) WITH AMENDMENTS.
- MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES (ASCE 7-05).
- AISC "MANUAL OF STEEL CONSTRUCTION" 13TH EDITIONS
- BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318-08).
- ACI MANUAL OF CONCRETE PRACTICE, LATEST EDITION.

3. FLUME PROTECTION

A. PRIOR TO ANY WORK, THE CONTRACTOR SHALL COLLECT AND SAFELY STORE ALL LOOSE AND DISPLACED ELEMENTS OF THE EXISTING FLUME FOUND IN THE CONSTRUCTION AREA.

B. PRIOR TO ANY WORK AND DURING THE ENTIRE DURATION OF THE PROJECT, THE CONTRACTOR SHALL PROVIDE MASKING TO PREVENT DAMAGE TO THE FRAGILE WOODEN FLUME ELEMENTS.

4. SHORING

A. PRIOR TO ANY DEMOLITION AND EXCAVATION WORK, THE CONTRACTOR SHALL PROVIDE SHORING TO THE EXISTING STRUCTURE AND DETERMINE THE EXTENT OF SHORING REQUIRED BASED ON HIS OWN MEANS AND METHODS.

5. EXCAVATION

A. WHILE HAZARDOUS MATERIALS ARE NOT ANTICIPATED AT THIS SITE, THE CONTRACTOR IS RESPONSIBLE FOR THE DISCOVERY, PRESENCE, HANDLING, REMOVAL, OR DISPOSAL OF OR EXPOSURE OF ANY PERSONS TO HAZARDOUS MATERIALS OR TOXIC SUBSTANCES IN ANY FORM AT THE PROJECT SITE.

B. PRIOR TO ANY WORK AND DURING THE ENTIRE DURATION OF THE PROJECT, THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING EROSION AND SEDIMENT CONTROL.

C. THE CONTRACTOR SHALL PROVIDE EXCAVATION WORK BASED ON HIS OWN MEANS AND METHODS AND IN ACCORDANCE WITH THESE NOTES. THE CONTRACTOR SHALL DETERMINE THE FULL EXTENT OF EXCAVATION FROM STRUCTURAL DRAWINGS.

D. EXCAVATIONS SHALL BE SLOPED OR SHORED TO MEET LOCAL, STATE, AND FEDERAL SAFETY REGULATIONS.

6. CLEAN UP NOTES

A. THE CONTRACTOR SHALL KEEP THE WORK SITE FREE AT ALL TIMES FROM ACCUMULATIONS OF WASTE MATERIALS.

B. VOLATILE WASTES SHALL BE PROPERLY STORED IN COVERED METAL CONTAINERS AND REMOVED DAILY.

C. EXCESS FILL DIRT THAT MAY BE GENERATED SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF BY THE CONTRACTOR.

D. WASTES SHALL NOT BE BURIED OR BURNED ON THE SITE OR DISPOSED OF INTO STORM DRAINS, STREAMS, OR WATERWAYS. ALL WASTES SHALL BE REMOVED FROM THE SITE AND DISPOSED OF IN A MANNER COMPLYING WITH LOCAL ORDINANCES AND ANTI-POLLUTION LAWS.

E. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RESTORING ALL DISTURBED SURFACES AND RELATED STRUCTURES, INCLUDING BUT NOT LIMITED TO, DRIVEWAYS, CURBS, GUTTERS, WALKS, AND BITUMINOUS PAVEMENTS TO ORIGINAL CONDITIONS (OR BETTER)

7. FOUNDATION

A. THE CONTRACTOR SHALL EXPOSE THE EXISTING BEDROCK UPON WHICH THE NEW FOOTING IS CAST. NOTIFY THE STRUCTURAL ENGINEER IF BEDROCK IS NOT FOUND WITHIN THE EXCAVATION LIMIT SHOWN IN THESE DRAWINGS.

B. EXPOSED BEDROCK SHALL BE OBSERVED AND APPROVED BY THE STRUCTURAL ENGINEER. SHOULD THE BEDROCK BE NOT STABLE, MICROPILES OR HELICAL PIERS WILL BE USED TO SUPPORT THE NEW FOOTING.

C. ASSUMED DESIGN BEARING PRESSURE..... 2000 PSF

8. RIPRAP

A. RIPRAP SHALL CONSIST OF HARD, DENSE, DURABLE STONE, ANGULAR IN SHAPE AND RESISTANT TO WEATHERING. ROUNDED STONE OR BOULDERS SHALL NOT BE USED AS RIPRAP MATERIAL. THE STONE SHALL HAVE A SPECIFIC GRAVITY OF AT LEAST 2.5. EACH PIECE SHALL HAVE ITS GREATEST DIMENSION NOT GREATER THAN THREE TIMES ITS LEAST DIMENSION.

B. MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH SECTION 506 OF CDOT'S STANDARD SPECIFICATIONS. MINIMUM REQUIREMENTS FOR ABRASION RESISTANCE AND COMPRESSIVE STRENGTH ARE AS FOLLOWS:

- 50% LOSS, MAX .WHEN TESTED IN ACCORDANCE WITH ASTM C535.
- 2,500 PSI, MIN. WHEN TESTED IN ACCORDANCE WITH AASHTO T 24.

B. BROKEN CONCRETE OR ASPHALT PAVEMENT SHALL NOT BE ACCEPTABLE FOR USE IN THE WORK.

C. RIPRAP SHALL CONSIST OF TYPE H (RE: TABLE 1), PLACED ON 6" MIN. TYPE II BEDDING (CLASS A). THE THICKNESS OF RIPRAP SHALL BE A MINIMUM OF 1.5 x D50.

D. GRANULAR BEDDING FOR RIPRAP SHALL MEET THE REQUIREMENTS OF SECTION 703.09 OF CDOT'S STANDARD SPECIFICATIONS FOR CLASS A FILTER MATERIAL

9. CONCRETE

A. PROVIDE CONCRETE AS SHOWN BELOW. PROVIDE BATCH MIXING, TRANSPORTATION, PLACING AND CURING OF CONCRETE IN ACCORDANCE WITH RECOMMENDATIONS OF ACI 301, ACI 318, ACI 304R, AND ASTM C94. PROVIDE ADMIXTURES AND SPECIAL REQUIREMENTS AS SPECIFIED.

B. PREPARE CONCRETE MIX DESIGNS FOR EACH TYPE AND STRENGTH OF CONCRETE. SUBMIT WRITTEN REPORT TO ENGINEER OF EACH PROPOSED MIX DESIGN AT LEAST 15 DAYS PRIOR TO START OF WORK. DO NOT BEGIN CONCRETE PRODUCTION UNTIL ENGINEER HAS REVIEWED MIX DESIGNS.

C. NEW CONCRETE TO MATCH THE ORIGINAL WITH RESPECT TO COLOR AND SURFACE TEXTURE.

D. CONCRETE SHALL BE NORMAL WEIGHT CONCRETE (145 PCF) AND DEVELOP A MINIMUM 28-DAY COMPRESSIVE STRENGTH (f'c) AS FOLLOWS:

- FOUNDATIONS (FOOTINGS, WALLS, PILASTERS, PIER CAPS)..... 4,500 PSI
- BEAMS, COLUMNS, AND BRACES..... 4,500 PSI

F. CONCRETE MIXES USED ON THE PROJECT SHALL BE PROPORTIONED TO SATISFY THE DURABILITY REQUIREMENTS IN TABLE 2.

G. UNLESS OTHERWISE NOTED, MINIMUM CLEAR CONCRETE COVER FOR REINFORCING BARS SHALL BE AS FOLLOWS:

- CONCRETE CAST AGAINST EARTH..... 3"
- CONCRETE EXPOSED TO EARTH OR WEATHER
  - -- #5 BARS AND SMALLER..... 1½"
  - -- #6 BARS AND LARGER..... 2"

H. CONSOLIDATE ALL CONCRETE DURING PLACEMENT AND THOROUGHLY WORK AROUND REINFORCING AND EMBEDDED ITEMS AND INTO CORNERS OF FORMS FOLLOWING ACI RECOMMENDATIONS.

I. WHEN CONCRETE PLACEMENT IS INTERRUPTED, NOTIFY THE STRUCTURAL ENGINEER FOR RECOMMENDATIONS. UNLESS NOTED OTHERWISE, PROVIDE A CONSTRUCTION JOINT BY ROUGHENING THE CONCRETE SURFACE TO AN AMPLITUDE OF ¼".

J. NON-SHRINK GROUT SHALL CONFORM TO ASTM C1107 AND HAVE A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI AFTER ONE DAY AND 7,000 PSI AFTER 28 DAYS. NON-SHRINK GROUT SHALL BE NON-CORROSIVE, NON-METALLIC AND NON-STANING.

10. REINFORCING STEEL

A. REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60. REINFORCING TO BE WELDED OR FIELD BENT SHALL BE ASTM A706, GRADE 60. EPOXY-COATED REINFORCING STEEL SHALL CONFORM TO ASTM A775 AND SHALL BE COATED PRIOR TO FABRICATION.

B. FIELD BEND REINFORCEMENT IN ACCORDANCE WITH ACI 301 SECTION 3.3.2.8 AND DETAILS 1/S5 AND 2/S5.

C. DO NOT FIELD BEND REINFORCEMENT PARTIALLY EMBEDDED IN CONCRETE UNLESS SPECIFICALLY SHOWN OR APPROVED BY THE STRUCTURAL ENGINEER.

D. PROVIDE ALL ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AT POSITIONS SHOWN ON PLANS AND DETAILS.

E. WET-STABBING OF REINFORCING OR EMBEDS INTO PREVIOUSLY PLACED CONCRETE IS NOT ALLOWED.

F. DETAIL BARS IN ACCORDANCE WITH THE LATEST EDITIONS OF THE ACI DETAILING MANUAL AND ACI BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE.

11. CONCRETE REMOVAL AND PREPARATION

A. REMOVAL OR DEMOLITION OF EXISTING DETERIORATED CONCRETE AND PREPARATION OF CONCRETE SURFACE SHALL BE IN ACCORDANCE WITH ACI 536R CONCRETE REPAIR GUIDE.

B. REMOVE CONCRETE USING A SMALL CHIPPING HAMMER (15 LB MAX.) OR HAND TOOLS ONLY. CARE SHOULD BE EXERCISED NOT TO DAMAGE THE SURROUNDING CONCRETE AND EMBEDDED STEEL INTENDED TO REMAIN.

C. PREPARE CONCRETE SURFACES THAT ARE INTENDED TO RECEIVE NEW MATERIAL AS FOLLOWS:

- USE SANDBLASTING TO REMOVE APPROXIMATELY ¼" TO ½" DEEP CONCRETE FROM SURFACE. ROUGH CONCRETE SURFACE TO AN AMPLITUDE OF ¼".
- CLEAN SURFACE FROM DEBRIS, DUST OR OTHER CONTAMINANTS THAT WILL PREVENT BOND USING COMPRESSED AIR AND BRUSH.
- FINAL CLEANING WILL USE A LIGHT WATER SPRAY IMMEDIATELY PRIOR TO NON-SHRINK GROUT APPLICATION.

12. STEEL CLEANING

A. CLEAN ALL EXPOSED STEEL SURFACES THOROUGHLY OF ALL LOOSE CONCRETE, RUST, AND OTHER CONTAMINANTS BY SANDBLASTING. FOR LIMITED AREAS WITH MINOR CORROSION, WIRE BRUSHING OR OTHER HAND METHODS MAY BE ACCEPTABLE.

13. SANDBLASTING

A. USE LOW-PRESSURE SANDBLASTING (125-150 PSI MAX.) FOR CONCRETE REMOVAL, SURFACE PREPARATION, AND STEEL CLEANING.

B. DRY SANDBLASTING PROCEDURE PRODUCES LARGE VOLUMES OF DUST. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING DUST CONTAINMENT AND WASTE DISPOSAL.

DRAWING INDEX

TABLE 1

RIPRAP

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (IN)	d50* (IN)
TYPE VL	70 - 100	12	6
	50 - 70	9	
	35 - 50	6	
	2 - 10	2	
TYPE L	70 - 100	15	9
	50 - 70	12	
	35 - 50	9	
	2 - 10	3	
TYPE M	70 - 100	21	12
	50 - 70	18	
	35 - 50	12	
	2 - 10	4	
TYPE H	70 - 100	30	18
	50 - 70	24	
	35 - 50	18	
	2 - 10	6	
TYPE VH	70 - 100	41	24
	50 - 70	33	
	35 - 50	24	
	2 - 10	9	

*d50 = Mean Particle Size

TABLE 2

DURABILITY REQUIREMENTS

CONCRETE USE AND / OR EXPOSURE	FREEZE-THAW (ACI 318, 4.2.1)	PERMEABILITY (ACI 318, 4.2.1)	CORROSION (ACI 318, 4.2.1)	SULFATES (ACI 318, 4.2.1)
FOUNDATIONS (FOOTINGS, WALLS, PILASTERS, PIER CAPS)	F1	P0	C1	S1
BEAMS, COLUMNS, AND BRACES	F1	P0	C1	S0

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

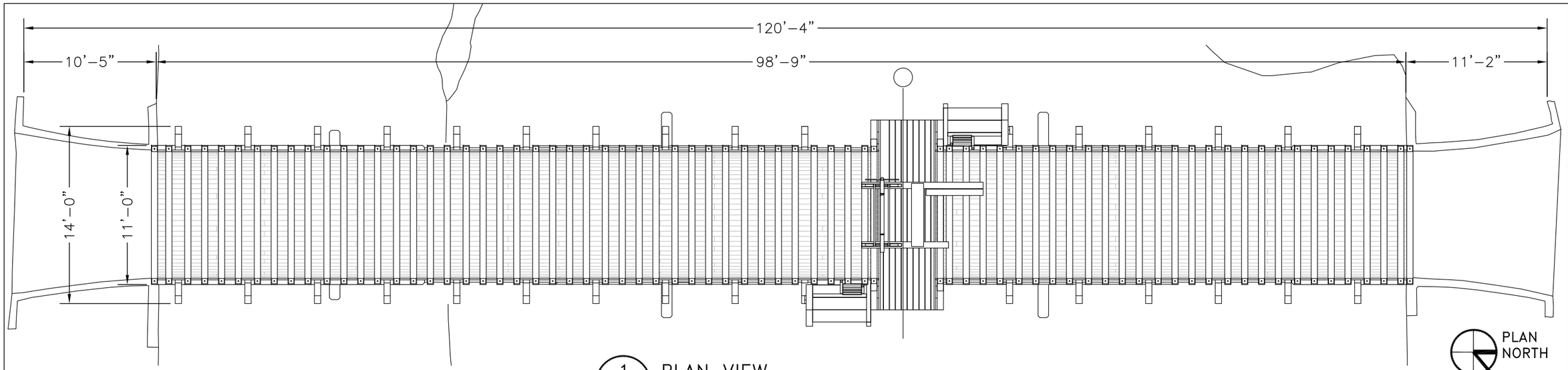
DRAWN BY | CAC
DATE | 01/26/15
CKD. BY | DBW
REV.
REV.
REV.
REV.

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME
FOUNDATION STABILIZATION
GENERAL NOTES

SCALE: AS NOTED
JOB NO. 14-179
SHEET:

S1



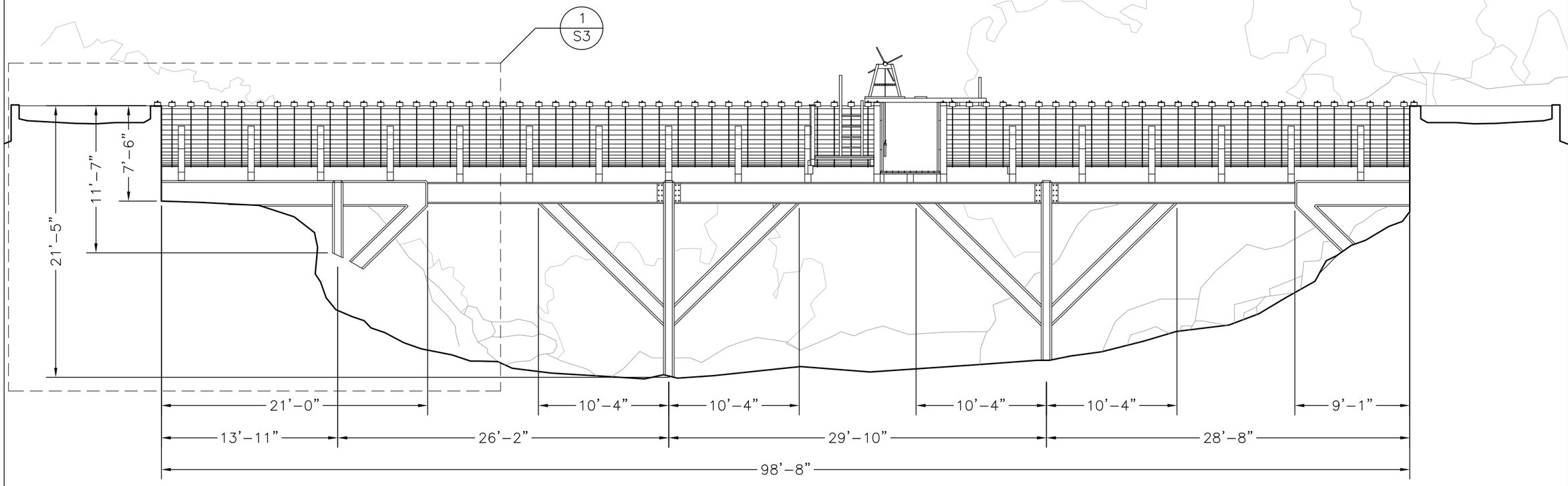
1/S2 PLAN VIEW

1/8" = 1'–0"

PLAN NORTH

TRUE NORTH

NOTE: SUPERSTRUCTURE (WOODEN FLUME) SHOWN IN ITS RESTORED STAGE. CURRENT CONDITIONS DIFFER SUBSTANTIALLY.



2/S2 EAST ELEVATION

1/8" = 1'–0"

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

DRAWN BY	CAC	
DATE	01/26/15	
CKD. BY	DBW	
REV.		
REV.		
REV.		
REV.		

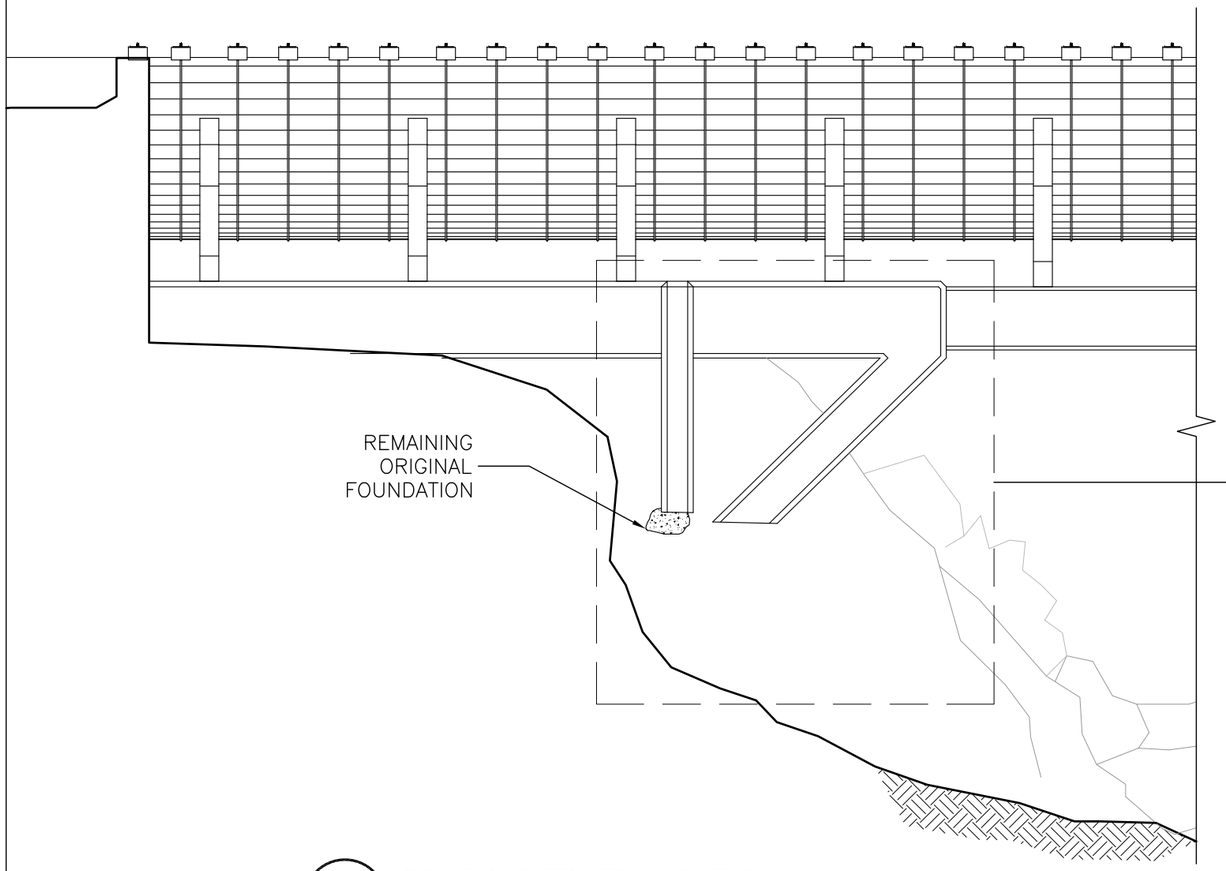
McELMO CREEK FLUME FOUNDATION STABILIZATION PLAN AND ELEVATION

SCALE: AS NOTED

JOB NO. 14-179

SHEET:

S2



1/S3 SOUTH PIER FOUNDATION
CURRENT CONDITIONS N.T.S.

UNSUPPORTED PIERS AND DIAGONAL BRACES AT SOUTH END OF FLUME DUE TO SCOUR.

COLLECT AND SAFELY STORE ALL LOOSE AND DISPLACED ELEMENTS OF THE EXISTING FLUME AROUND CONSTRUCTION AREA

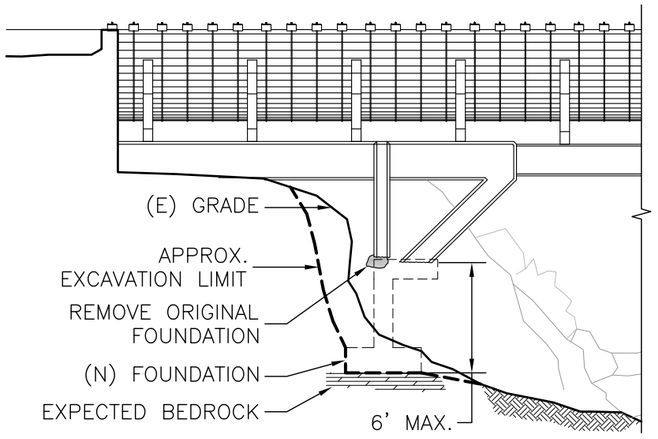
Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

DRAWN BY	CAC
DATE	01/26/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

McELMO CREEK FLUME FOUNDATION STABILIZATION CURRENT CONDITIONS

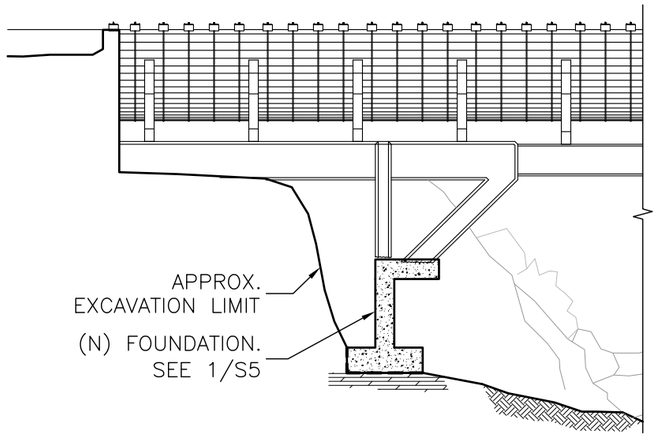
SCALE: AS NOTED
JOB NO. 14-179
SHEET:
S3



CONSTRUCTION PHASE 1

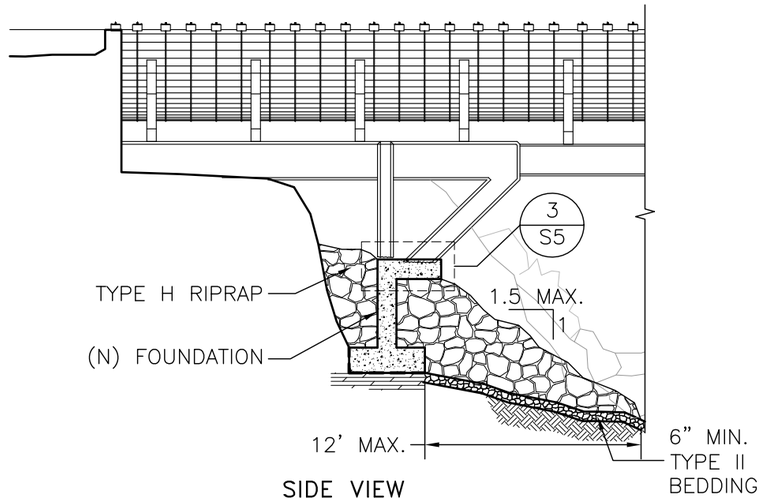
1. WORK SEQUENCE
   A. SHORING.
   B. FLUME PROTECTION.
   C. EXCAVATION.
   D. CONCRETE REMOVAL.

NOTE:
BEDROCK IS EXPECTED AT THE ANTICIPATED FOUNDATION LEVEL. EXPOSED BEDROCK TO BE OBSERVED AND APPROVED BY THE STRUCTURAL ENGINEER. IF SOUND BEDROCK IS NOT FOUND WITHIN 6 FEET FROM THE BOTTOM OF THE UNSUPPORTED STRUCTURE, A NEW FOUNDATION DESIGN WILL BE REQUIRED. MICROPILES OR HELICAL PIERS WILL BE USED TO SUPPORT THE NEW FOOTING.

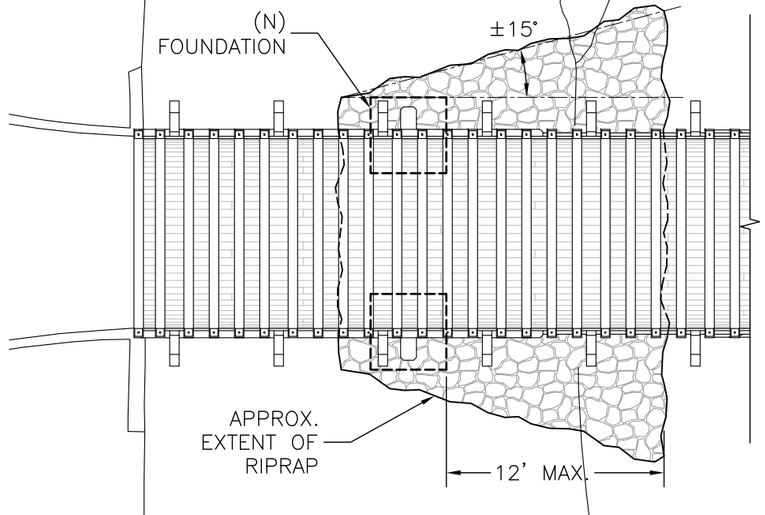


CONSTRUCTION PHASE 2

1. WORK SEQUENCE
   A. NEW FOUNDATION.



SIDE VIEW



PLAN VIEW

CONSTRUCTION PHASE 3

1. WORK SEQUENCE
   A. RIPRAP.
   B. INSTALLATION OF NON-SHRINK GROUT.

1/S4 CONSTRUCTION PHASING

1/8" = 1'-0"

DRAWN BY	CAC
DATE	01/26/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

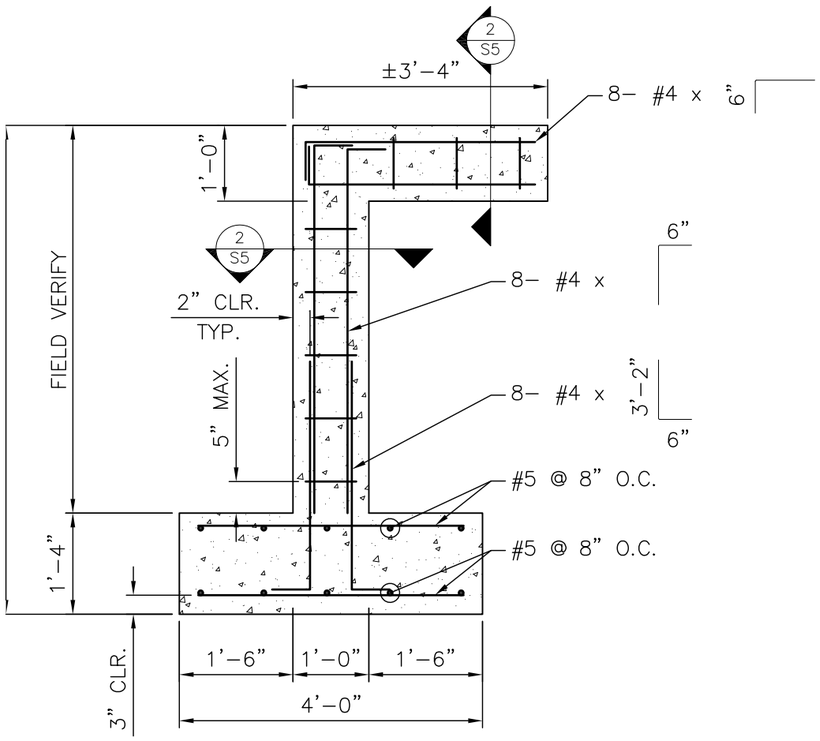
Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME FOUNDATION STABILIZATION CONSTRUCTION PHASING

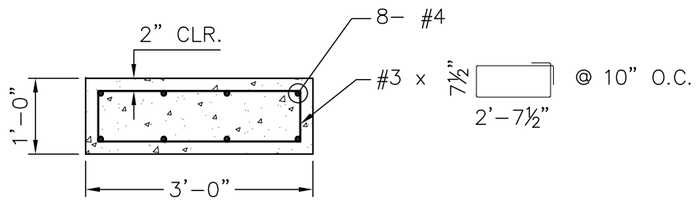
SCALE: AS NOTED
JOB NO. 14-179
SHEET:

S4



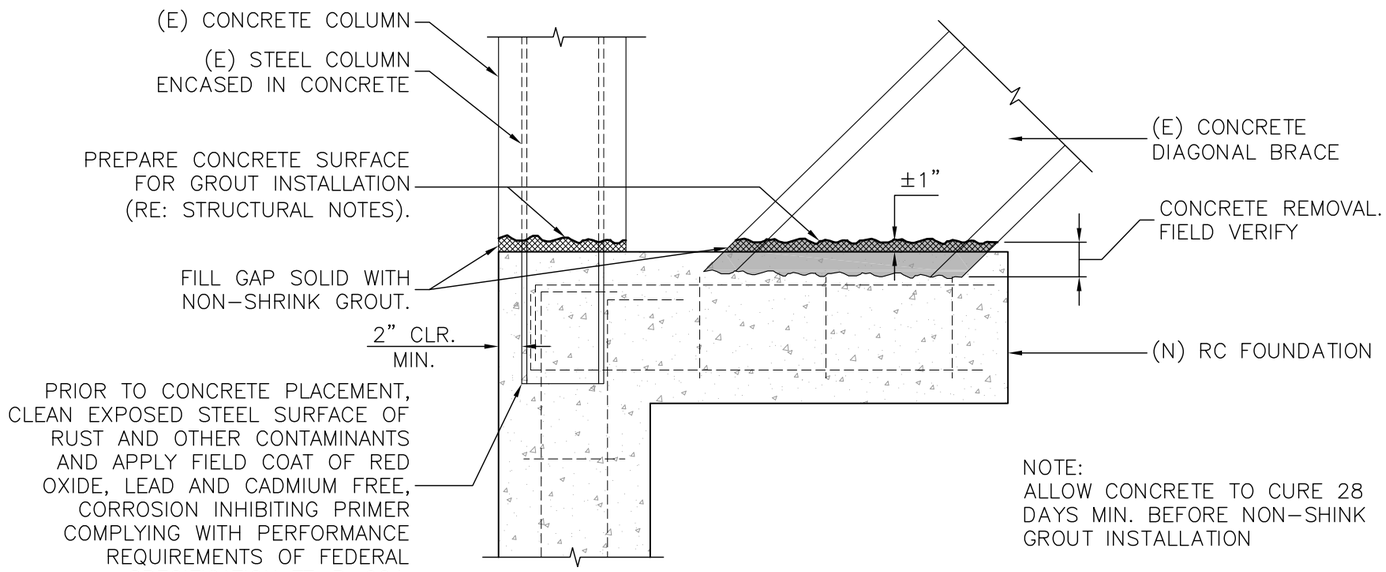
1 S5 TYPICAL FOUNDATION SECTION

1/2" = 1'-0"



2 S5 SECTION

1/2" = 1'-0"



3 S5 GROUTING DETAIL

1" = 1'-0"

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

DRAWN BY	CAC
DATE	01/26/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME FOUNDATION STABILIZATION TYPICAL DETAILS

SCALE: AS NOTED

JOB NO. 14-179

SHEET:

S5

STRUCTURAL NOTES

1. GENERAL NOTES

A. DO NOT SCALE CONTRACT DRAWINGS FOR THE PURPOSE OF ESTABLISHING DIMENSIONS.

B. VERIFY EXISTING CONDITIONS AND DIMENSIONS PRIOR TO BEGINNING WORK OR FABRICATING OF MATERIALS. NOTIFY ENGINEER OF DISCREPANCIES BEFORE PROCEEDING WITH ANY PHASE OF WORK.

C. THE CONTRACT STRUCTURAL DRAWINGS REPRESENT THE FINISHED STRUCTURE. THE CONTRACTOR IS RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION. PROVIDE ALL MEASURES REQUIRED TO PROTECT THE STRUCTURE, WORKMEN, AND OTHER PERSONS DURING CONSTRUCTION; INCLUDING BRACING, SHORING FOR CONSTRUCTION EQUIPMENT, SHORING FOR THE BUILDING, FORMS AND SCAFFOLDING, SHORING OF RETAINING WALLS AND OTHER TEMPORARY SUPPORTS AS REQUIRED.

2. DESIGN CRITERIA

A. APPLICABLE CODES AND GUIDES

- 2009 INTERNATIONAL BUILDING CODE (IBC) WITH AMENDMENTS.
- MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES (ASCE 7-05).
- AISC "MANUAL OF STEEL CONSTRUCTION" 13TH EDITIONS
- BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318-08).
- ACI MANUAL OF CONCRETE PRACTICE, LATEST EDITION.

3. FLUME PROTECTION

A. PRIOR TO ANY WORK, THE CONTRACTOR SHALL COLLECT AND SAFELY STORE ALL LOOSE AND DISPLACED ELEMENTS OF THE EXISTING FLUME FOUND IN THE CONSTRUCTION AREA.

B. PRIOR TO ANY WORK AND DURING THE ENTIRE DURATION OF THE PROJECT, THE CONTRACTOR SHALL PROVIDE MASKING TO PREVENT DAMAGE TO THE FRAGILE WOODEN FLUME ELEMENTS.

4. SHORING

A. PRIOR TO ANY DEMOLITION AND EXCAVATION WORK, THE CONTRACTOR SHALL PROVIDE SHORING TO THE EXISTING STRUCTURE AND DETERMINE THE EXTENT OF SHORING REQUIRED BASED ON HIS OWN MEANS AND METHODS.

5. EXCAVATION

A. WHILE HAZARDOUS MATERIALS ARE NOT ANTICIPATED AT THIS SITE, THE CONTRACTOR IS RESPONSIBLE FOR THE DISCOVERY, PRESENCE, HANDLING, REMOVAL, OR DISPOSAL OF OR EXPOSURE OF ANY PERSONS TO HAZARDOUS MATERIALS OR TOXIC SUBSTANCES IN ANY FORM AT THE PROJECT SITE.

B. PRIOR TO ANY WORK AND DURING THE ENTIRE DURATION OF THE PROJECT, THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING EROSION AND SEDIMENT CONTROL.

C. THE CONTRACTOR SHALL PROVIDE EXCAVATION WORK BASED ON HIS OWN MEANS AND METHODS AND IN ACCORDANCE WITH THESE NOTES. THE CONTRACTOR SHALL DETERMINE THE FULL EXTENT OF EXCAVATION FROM STRUCTURAL DRAWINGS.

D. EXCAVATIONS SHALL BE SLOPED OR SHORED TO MEET LOCAL, STATE, AND FEDERAL SAFETY REGULATIONS.

6. CLEAN UP NOTES

A. THE CONTRACTOR SHALL KEEP THE WORK SITE FREE AT ALL TIMES FROM ACCUMULATIONS OF WASTE MATERIALS.

B. VOLATILE WASTES SHALL BE PROPERLY STORED IN COVERED METAL CONTAINERS AND REMOVED DAILY.

C. EXCESS FILL DIRT THAT MAY BE GENERATED SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF BY THE CONTRACTOR.

D. WASTES SHALL NOT BE BURIED OR BURNED ON THE SITE OR DISPOSED OF INTO STORM DRAINS, STREAMS, OR WATERWAYS. ALL WASTES SHALL BE REMOVED FROM THE SITE AND DISPOSED OF IN A MANNER COMPLYING WITH LOCAL ORDINANCES AND ANTI-POLLUTION LAWS.

E. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RESTORING ALL DISTURBED SURFACES AND RELATED STRUCTURES, INCLUDING BUT NOT LIMITED TO, DRIVEWAYS, CURBS, GUTTERS, WALKS, AND BITUMINOUS PAVEMENTS TO ORIGINAL CONDITIONS (OR BETTER)

7. FOUNDATION

A. THE CONTRACTOR SHALL EXPOSE THE EXISTING BEDROCK UPON WHICH THE NEW FOOTING IS CAST. NOTIFY THE STRUCTURAL ENGINEER IF BEDROCK IS NOT FOUND WITHIN THE EXCAVATION LIMIT SHOWN IN THESE DRAWINGS.

B. EXPOSED BEDROCK SHALL BE OBSERVED AND APPROVED BY THE STRUCTURAL ENGINEER. SHOULD THE BEDROCK BE NOT STABLE, MICROPILES OR HELICAL PIERS WILL BE USED TO SUPPORT THE NEW FOOTING.

C. ASSUMED DESIGN BEARING PRESSURE..... 2000 PSF

8. RIPRAP

A. RIPRAP SHALL CONSIST OF HARD, DENSE, DURABLE STONE, ANGULAR IN SHAPE AND RESISTANT TO WEATHERING. ROUNDED STONE OR BOULDERS SHALL NOT BE USED AS RIPRAP MATERIAL. THE STONE SHALL HAVE A SPECIFIC GRAVITY OF AT LEAST 2.5. EACH PIECE SHALL HAVE ITS GREATEST DIMENSION NOT GREATER THAN THREE TIMES ITS LEAST DIMENSION.

B. MATERIALS AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH SECTION 506 OF CDOT'S STANDARD SPECIFICATIONS. MINIMUM REQUIREMENTS FOR ABRASION RESISTANCE AND COMPRESSIVE STRENGTH ARE AS FOLLOWS:

- 50% LOSS, MAX .WHEN TESTED IN ACCORDANCE WITH ASTM C535.
- 2,500 PSI, MIN. WHEN TESTED IN ACCORDANCE WITH AASHTO T 24.

B. BROKEN CONCRETE OR ASPHALT PAVEMENT SHALL NOT BE ACCEPTABLE FOR USE IN THE WORK.

C. RIPRAP SHALL CONSIST OF TYPE H (RE: TABLE 1), PLACED ON 6" MIN. TYPE II BEDDING (CLASS A). THE THICKNESS OF RIPRAP SHALL BE A MINIMUM OF 1.5 x D50.

D. GRANULAR BEDDING FOR RIPRAP SHALL MEET THE REQUIREMENTS OF SECTION 703.09 OF CDOT'S STANDARD SPECIFICATIONS FOR CLASS A FILTER MATERIAL

9. CONCRETE

A. PROVIDE CONCRETE AS SHOWN BELOW. PROVIDE BATCH MIXING, TRANSPORTATION, PLACING AND CURING OF CONCRETE IN ACCORDANCE WITH RECOMMENDATIONS OF ACI 301, ACI 318, ACI 304R, AND ASTM C94. PROVIDE ADMIXTURES AND SPECIAL REQUIREMENTS AS SPECIFIED.

B. PREPARE CONCRETE MIX DESIGNS FOR EACH TYPE AND STRENGTH OF CONCRETE. SUBMIT WRITTEN REPORT TO ENGINEER OF EACH PROPOSED MIX DESIGN AT LEAST 15 DAYS PRIOR TO START OF WORK. DO NOT BEGIN CONCRETE PRODUCTION UNTIL ENGINEER HAS REVIEWED MIX DESIGNS.

C. NEW CONCRETE TO MATCH THE ORIGINAL WITH RESPECT TO COLOR AND SURFACE TEXTURE.

D. CONCRETE SHALL BE NORMAL WEIGHT CONCRETE (145 PCF) AND DEVELOP A MINIMUM 28-DAY COMPRESSIVE STRENGTH (f'c) AS FOLLOWS:

- FOUNDATIONS (FOOTINGS, WALLS, PILASTERS, PIER CAPS)..... 4,500 PSI
- BEAMS, COLUMNS, AND BRACES..... 4,500 PSI

F. CONCRETE MIXES USED ON THE PROJECT SHALL BE PROPORTIONED TO SATISFY THE DURABILITY REQUIREMENTS IN TABLE 2.

G. UNLESS OTHERWISE NOTED, MINIMUM CLEAR CONCRETE COVER FOR REINFORCING BARS SHALL BE AS FOLLOWS:

- CONCRETE CAST AGAINST EARTH..... 3"
- CONCRETE EXPOSED TO EARTH OR WEATHER
  - -- #5 BARS AND SMALLER..... 1½"
  - -- #6 BARS AND LARGER..... 2"

H. CONSOLIDATE ALL CONCRETE DURING PLACEMENT AND THOROUGHLY WORK AROUND REINFORCING AND EMBEDDED ITEMS AND INTO CORNERS OF FORMS FOLLOWING ACI RECOMMENDATIONS.

I. WHEN CONCRETE PLACEMENT IS INTERRUPTED, NOTIFY THE STRUCTURAL ENGINEER FOR RECOMMENDATIONS. UNLESS NOTED OTHERWISE, PROVIDE A CONSTRUCTION JOINT BY ROUGHENING THE CONCRETE SURFACE TO AN AMPLITUDE OF ¼".

J. NON-SHRINK GROUT SHALL CONFORM TO ASTM C1107 AND HAVE A MINIMUM COMPRESSIVE STRENGTH OF 2,500 PSI AFTER ONE DAY AND 7,000 PSI AFTER 28 DAYS. NON-SHRINK GROUT SHALL BE NON-CORROSIVE, NON-METALLIC AND NON-STANING.

10. REINFORCING STEEL

A. REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60. REINFORCING TO BE WELDED OR FIELD BENT SHALL BE ASTM A706, GRADE 60. EPOXY-COATED REINFORCING STEEL SHALL CONFORM TO ASTM A775 AND SHALL BE COATED PRIOR TO FABRICATION.

B. FIELD BEND REINFORCEMENT IN ACCORDANCE WITH ACI 301 SECTION 3.3.2.8 AND DETAILS 1/S5 AND 2/S5.

C. DO NOT FIELD BEND REINFORCEMENT PARTIALLY EMBEDDED IN CONCRETE UNLESS SPECIFICALLY SHOWN OR APPROVED BY THE STRUCTURAL ENGINEER.

D. PROVIDE ALL ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AT POSITIONS SHOWN ON PLANS AND DETAILS.

E. WET-STABBING OF REINFORCING OR EMBEDS INTO PREVIOUSLY PLACED CONCRETE IS NOT ALLOWED.

F. DETAIL BARS IN ACCORDANCE WITH THE LATEST EDITIONS OF THE ACI DETAILING MANUAL AND ACI BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE.

11. CONCRETE REMOVAL AND PREPARATION

A. REMOVAL OR DEMOLITION OF EXISTING DETERIORATED CONCRETE AND PREPARATION OF CONCRETE SURFACE SHALL BE IN ACCORDANCE WITH ACI 536R CONCRETE REPAIR GUIDE.

B. REMOVE CONCRETE USING A SMALL CHIPPING HAMMER (15 LB MAX.) OR HAND TOOLS ONLY. CARE SHOULD BE EXERCISED NOT TO DAMAGE THE SURROUNDING CONCRETE AND EMBEDDED STEEL INTENDED TO REMAIN.

C. PREPARE CONCRETE SURFACES THAT ARE INTENDED TO RECEIVE NEW MATERIAL AS FOLLOWS:

- USE SANDBLASTING TO REMOVE APPROXIMATELY ¼" TO ½" DEEP CONCRETE FROM SURFACE. ROUGH CONCRETE SURFACE TO AN AMPLITUDE OF ¼".
- CLEAN SURFACE FROM DEBRIS, DUST OR OTHER CONTAMINANTS THAT WILL PREVENT BOND USING COMPRESSED AIR AND BRUSH.
- FINAL CLEANING WILL USE A LIGHT WATER SPRAY IMMEDIATELY PRIOR TO NON-SHRINK GROUT APPLICATION.

12. STEEL CLEANING

A. CLEAN ALL EXPOSED STEEL SURFACES THOROUGHLY OF ALL LOOSE CONCRETE, RUST, AND OTHER CONTAMINANTS BY SANDBLASTING. FOR LIMITED AREAS WITH MINOR CORROSION, WIRE BRUSHING OR OTHER HAND METHODS MAY BE ACCEPTABLE.

13. SANDBLASTING

A. USE LOW-PRESSURE SANDBLASTING (125-150 PSI MAX.) FOR CONCRETE REMOVAL, SURFACE PREPARATION, AND STEEL CLEANING.

B. DRY SANDBLASTING PROCEDURE PRODUCES LARGE VOLUMES OF DUST. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING DUST CONTAINMENT AND WASTE DISPOSAL.

DRAWING INDEX

TABLE 1

RIPRAP

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (IN)	d50* (IN)
TYPE VL	70 - 100	12	6
	50 - 70	9	
	35 - 50	6	
	2 - 10	2	
TYPE L	70 - 100	15	9
	50 - 70	12	
	35 - 50	9	
	2 - 10	3	
TYPE M	70 - 100	21	12
	50 - 70	18	
	35 - 50	12	
	2 - 10	4	
TYPE H	70 - 100	30	18
	50 - 70	24	
	35 - 50	18	
	2 - 10	6	
TYPE VH	70 - 100	41	24
	50 - 70	33	
	35 - 50	24	
	2 - 10	9	

*d50 = Mean Particle Size

TABLE 2

DURABILITY REQUIREMENTS

CONCRETE USE AND / OR EXPOSURE	FREEZE-THAW (ACI 318, 4.2.1)	PERMEABILITY (ACI 318, 4.2.1)	CORROSION (ACI 318, 4.2.1)	SULFATES (ACI 318, 4.2.1)
FOUNDATIONS (FOOTINGS, WALLS, PILASTERS, PIER CAPS)	F1	P0	C1	S1
BEAMS, COLUMNS, AND BRACES	F1	P0	C1	S0

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

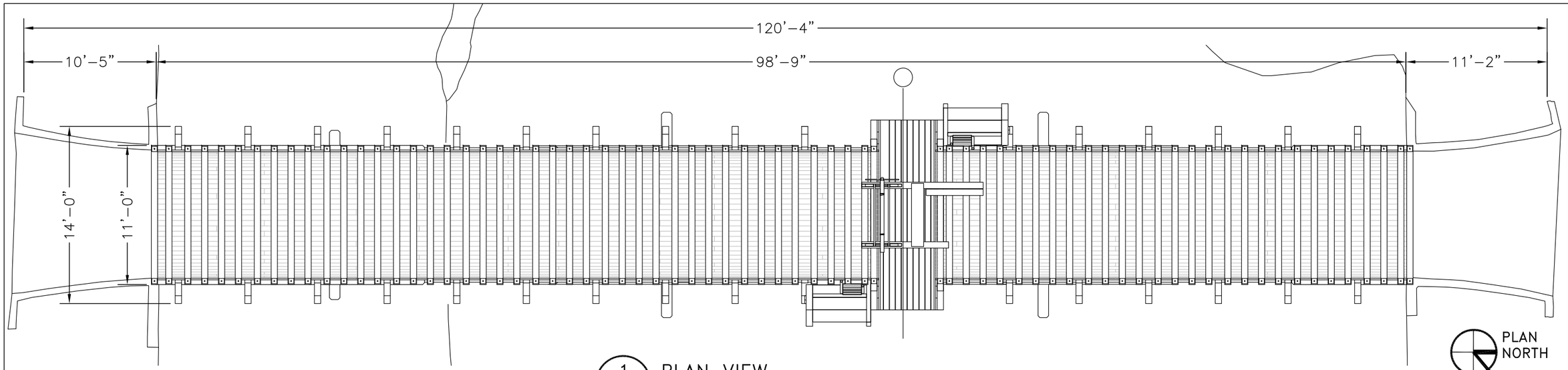
DRAWN BY | CAC
DATE | 01/26/15
CKD. BY | DBW
REV.
REV.
REV.
REV.

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME
FOUNDATION STABILIZATION
GENERAL NOTES

SCALE: AS NOTED
JOB NO. 14-179
SHEET:

S1



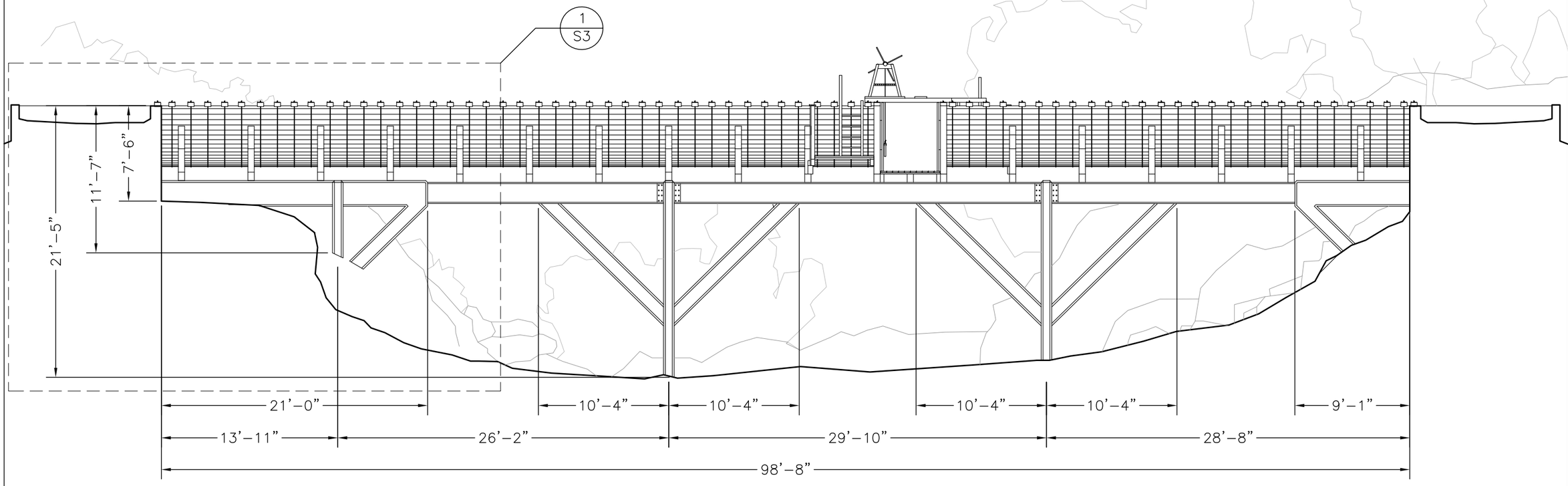
1/S2 PLAN VIEW

1/8" = 1'–0"

PLAN NORTH

TRUE NORTH

NOTE: SUPERSTRUCTURE (WOODEN FLUME) SHOWN IN ITS RESTORED STAGE. CURRENT CONDITIONS DIFFER SUBSTANTIALLY.



2/S2 EAST ELEVATION

1/8" = 1'–0"

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

DRAWN BY	CAC	
DATE	01/26/15	
CKD. BY	DBW	
REV.		
REV.		
REV.		
REV.		

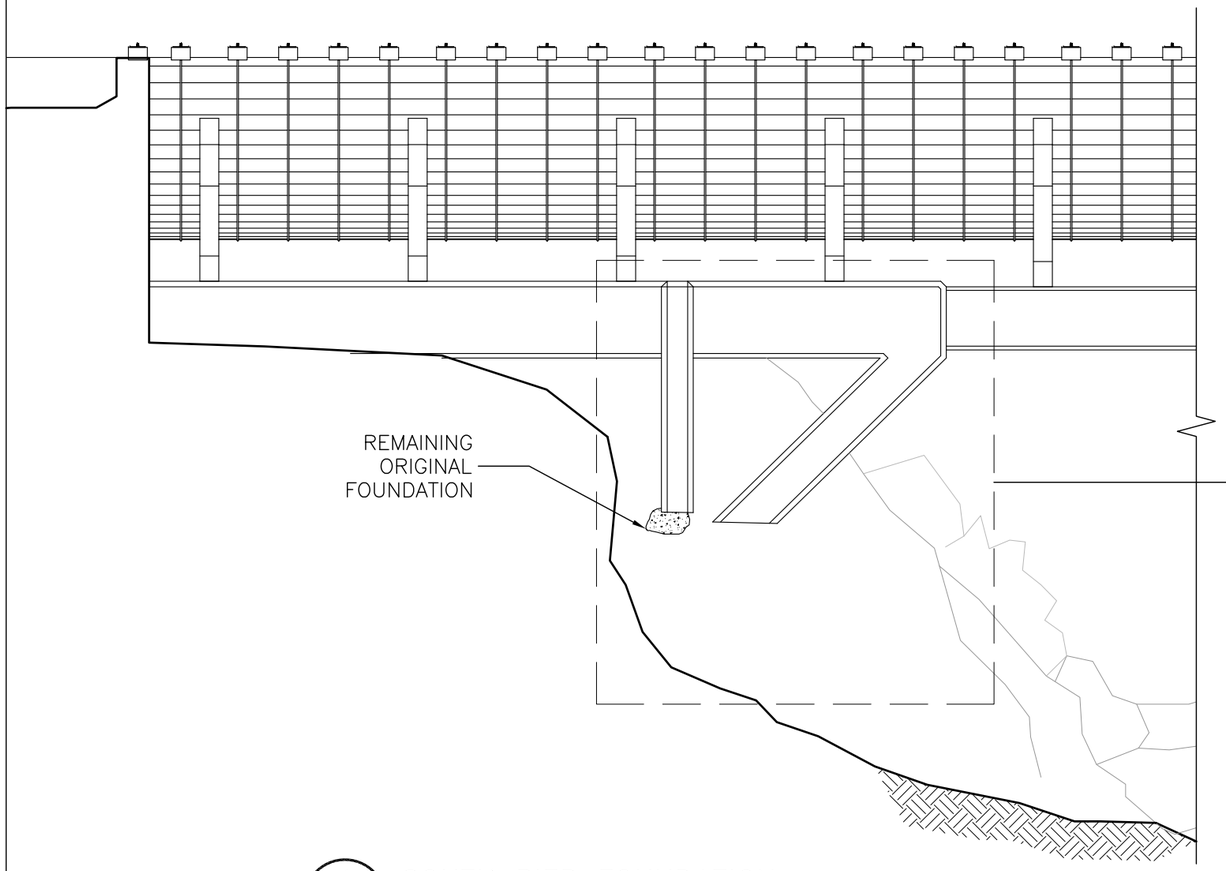
McELMO CREEK FLUME FOUNDATION STABILIZATION PLAN AND ELEVATION

SCALE: AS NOTED

JOB NO. 14-179

SHEET:

S2



1/S3 SOUTH PIER FOUNDATION
CURRENT CONDITIONS N.T.S.

UNSUPPORTED PIERS AND DIAGONAL BRACES AT SOUTH END OF FLUME DUE TO SCOUR.

COLLECT AND SAFELY STORE ALL LOOSE AND DISPLACED ELEMENTS OF THE EXISTING FLUME AROUND CONSTRUCTION AREA

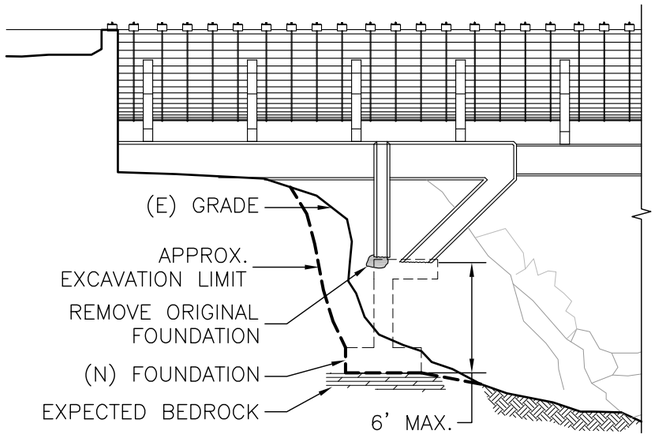
Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

DRAWN BY	CAC
DATE	01/26/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

McELMO CREEK FLUME FOUNDATION STABILIZATION CURRENT CONDITIONS

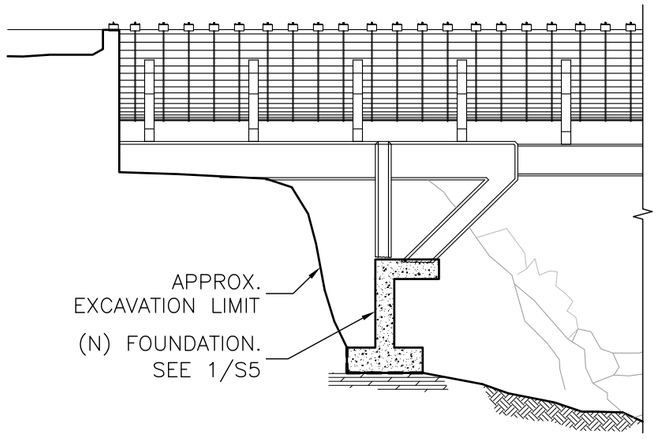
SCALE: AS NOTED
JOB NO. 14-179
SHEET:
S3



CONSTRUCTION PHASE 1

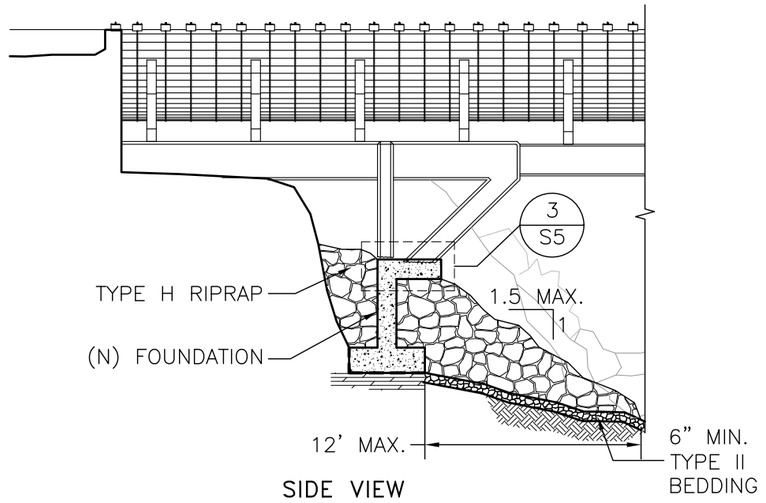
1. WORK SEQUENCE
   A. SHORING.
   B. FLUME PROTECTION.
   C. EXCAVATION.
   D. CONCRETE REMOVAL.

NOTE:
BEDROCK IS EXPECTED AT THE ANTICIPATED FOUNDATION LEVEL. EXPOSED BEDROCK TO BE OBSERVED AND APPROVED BY THE STRUCTURAL ENGINEER. IF SOUND BEDROCK IS NOT FOUND WITHIN 6 FEET FROM THE BOTTOM OF THE UNSUPPORTED STRUCTURE, A NEW FOUNDATION DESIGN WILL BE REQUIRED. MICROPILES OR HELICAL PIERS WILL BE USED TO SUPPORT THE NEW FOOTING.

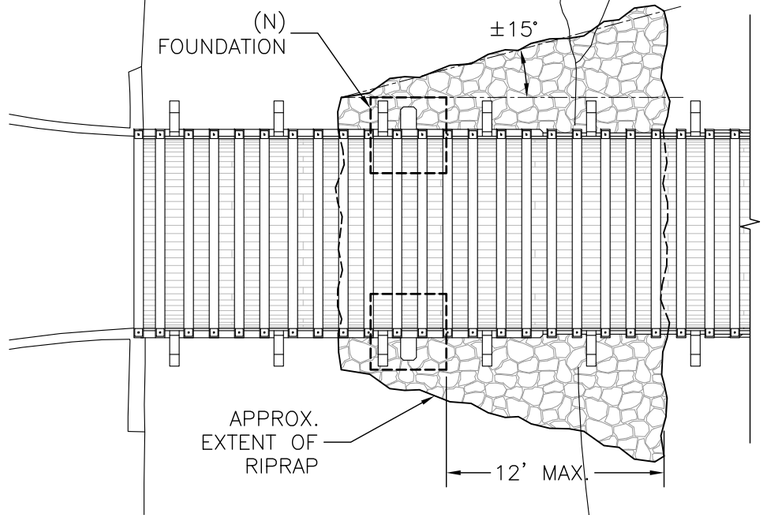


CONSTRUCTION PHASE 2

1. WORK SEQUENCE
   A. NEW FOUNDATION.



SIDE VIEW



PLAN VIEW

CONSTRUCTION PHASE 3

1. WORK SEQUENCE
   A. RIPRAP.
   B. INSTALLATION OF NON-SHRINK GROUT.

1/S4 CONSTRUCTION PHASING

1/8" = 1'-0"

DRAWN BY	CAC
DATE	01/26/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

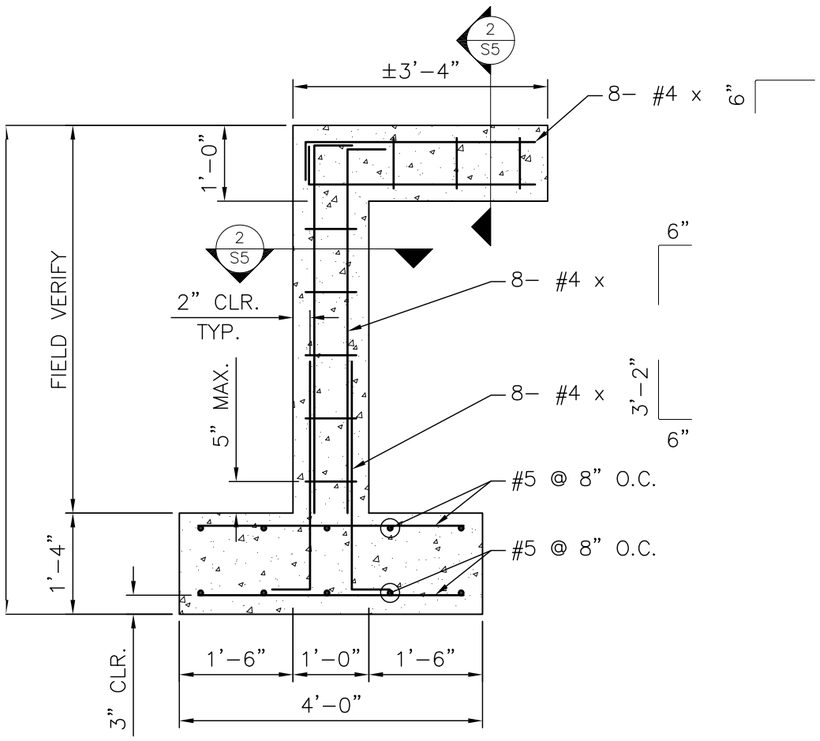
Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME FOUNDATION STABILIZATION CONSTRUCTION PHASING

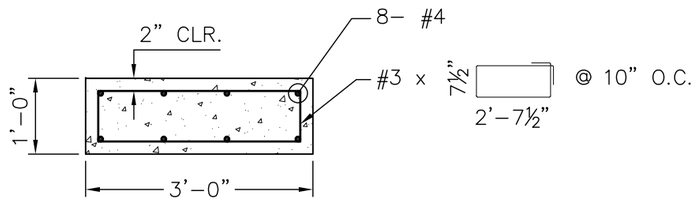
SCALE: AS NOTED
JOB NO. 14-179
SHEET:

S4



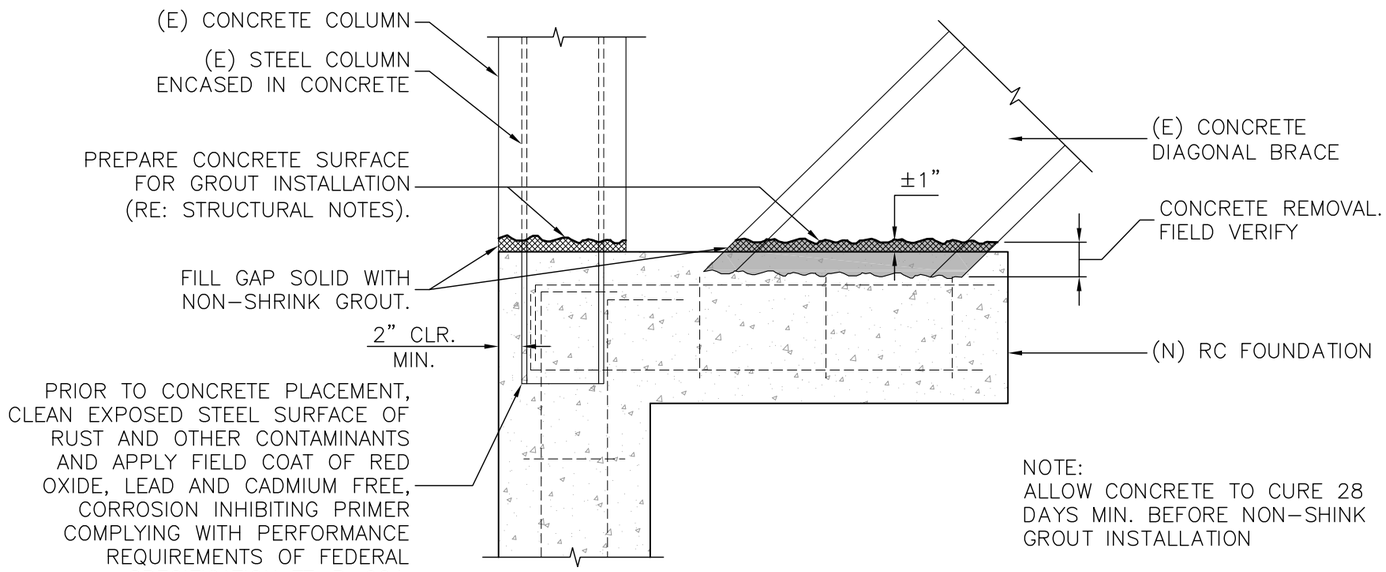
1 S5 TYPICAL FOUNDATION SECTION

1/2" = 1'-0"



2 S5 SECTION

1/2" = 1'-0"



3 S5 GROUTING DETAIL

1" = 1'-0"

Montezuma County
Montezuma County Courthouse
109 West Main
Cortez, CO, 81321
Phone: (970) 570-9494

DRAWN BY	CAC
DATE	01/26/15
CKD. BY	DBW
REV.	
REV.	
REV.	
REV.	

Atkinson-Noland & Associates, Inc.
Consulting Engineers
2619 Spruce Street
Boulder, CO 80302
(303) 444-3620
www.ana-usa.com

McELMO CREEK FLUME FOUNDATION STABILIZATION TYPICAL DETAILS

SCALE: AS NOTED

JOB NO. 14-179

SHEET:

S5

STEEL AND CONCRETE INVESTIGATION REPORT

MCELMO FLUME

MONTEZUMA COUNTY

COLORADO

Prepared for:

Anthony & Associates, Inc.

P.O. Box 271400
Fort Collins, CO 80527

Prepared by:

Atkinson-Noland & Assoc., Inc.
Consulting Engineers

2619 Spruce Street
Boulder, CO 80302
(303) 444-3620

41 East 11th Street Suite 310
New York, NY 10003
(917) 647 9530

Job No. 12-114
June 14, 2013

1.0 INTRODUCTION

Atkinson-Noland & Associates (ANA) conducted a one-day site visit at the McElmo Flume (Flume) near Cortez, Colorado to assess the integrity of the concrete and steel structural elements and to evaluate stabilization and repair options. Engineer Carlo Citto of ANA conducted site work on May 16, 2013. The structure consists of a semicircular wood-stave flume supported by a concrete and steel substructure (Figure 1). A plan view of the Flume is shown in Figure 2.

Figure 1. Overall view of McElmo Flume, looking east.

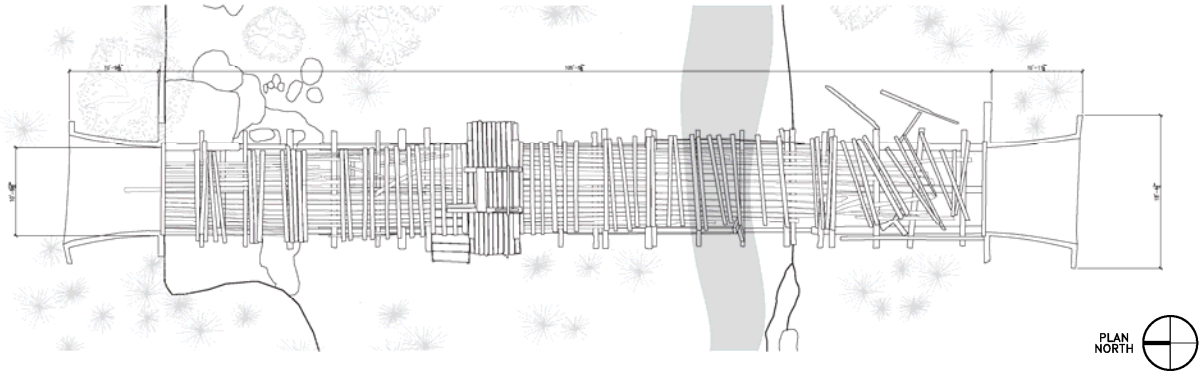


Figure 2. Plan view of the Flume (image from LIDAR scanning conducted by the Center of Historic Preservation Research, University of Colorado Denver)

The wood condition assessment was previously conducted by Anthony and Associates, Inc. The investigation conducted by ANA was limited to the steel and concrete structures. The work was primarily based on visual methods supplemented by appropriate nondestructive techniques. Sounding of the concrete was done on representative elements to determine the presence and extent of any delaminations within the cross sections. The following techniques were used during the field investigation to gather the information about the condition of the structural steel.

Pachometer Scanning
A metal-detecting pachometer was used to scan concrete elements in order to locate embedded metals such as ties and reinforcement. A Proceq Profometer 5 was used at select areas of the concrete supports.

Steel Ultrasonic Scanning
A Panametrics–NDT ultrasonic thickness meter was used to measure thickness of the existing structural steel elements used as part of the concrete-steel structure supporting the wooden flume. The objectives of the testing were to determine typical thicknesses of beam and column flanges and evaluate the degree of section loss due to corrosion.

2.0 OBSERVATIONS AND DISCUSSIONS

As a result of the structural assessment conducted at the Flume, distress conditions affecting the steel and concrete structures were characterized as follows:

- Concrete cracking and spalling
- Steel corrosion
- Foundation erosion

The extent of damage observed ranged from moderate to severe.

2.1 Concrete Cracking and Spalling

Concrete was used to encase steel elements to generate a composite section with greater capacity. This approach was used in the construction of the columns, diagonal braces, and a section of the horizontal girders near the abutments. Extensive concrete spalling and cracking was observed at the Flume, as shown in Figure 3 through Figure 12. The distress is particularly severe at the diagonal braces: of the four frames, the northern two are damaged the most. At these locations, the concrete at the southern braces had spalled around the entire perimeter and for the full length of the steel element (Figure 7). Spalling was also observed at the base of the four columns (Figure 5 and Figure 6) and at the encased portions of the girders, near the abutments (Figure 3and Figure 4). Concrete columns were also affected by vertical cracking, typically found along the embedded steel columns (Figure 9 through Figure 11). Concrete at the braces of the southern frames appears to be in good conditions.

The distress is primarily caused by the corrosion of the steel. As the steel is exposed to water and oxygen, it oxidizes and produces corrosion. After the process has started, the oxidized metal can expand up to 7 to 10 times its original volume, causing intense bursting forces in the surrounding concrete, which will eventually crack and spall. The concrete used to construct the composite section can also function as a protective layer for the encased steel. For steel exposed to weather however, the clear concrete cover outside of any steel surface should not be lesser than 1½ " to be effective. At some locations, the cover was only ¾". Furthermore, because the steel girders are not entirely encased in concrete, corrosion of exposed steel will likely initiate cracks in the adjacent concrete. Once the concrete is damaged, moisture and water will collect in the open cracks, with the potential of causing more corrosion.

Metal ties were consistently observed at locations of damaged concrete. The primary function of these ties is to absorb tensile stresses in the concrete, substantially reducing material cracking. To do this, the ties need to be completely surrounded by concrete in order to develop enough bond to carry the tensile stresses. However, at the Flume the ties didn't accomplish this task as they were incorrectly installed in contact with the steel flanges.

Figure 3. North end of western girder showing typical concrete cracking and spalling at top flange of encased steel beam.

Figure 4. North end of eastern girder showing typical concrete cracking and spalling at bottom flange of encased steel beam.

Figure 5. Spalling and concrete deterioration at base of columns. At left: northwestern column. At right: northeastern column. Severe distress conditions were observed at these locations.


Figure 6. Spalling and concrete deterioration at base of columns. At left: southwestern column. At right: southeastern column.

Figure 7. South diagonal brace of northwestern frame showing severe concrete spalling. Both top and bottom flanges are fully exposed.

Figure 8. Typical spalling and concrete cracking at top of diagonal braces of southern frames.

Figure 9. Typical concrete cracking (marked with red lines) at column-girder connection.

Figure 10. Typical vertical cracks (marked with red lines) at concrete columns. This photo shows the southwest frame, looking west.

Figure 11. Large vertical crack at west side of northwestern column. The crack is likely due to corrosion of the vertical steel reinforcement that was located by Pachometer scanning.

Figure 12. Concrete crack near top flange of encased steel element at north brace of northeastern frame. The crack extends for approximately 6 ft. Similar crack was observed at the north brace of the northwestern frame.

2.2 Steel Corrosion

Corrosion of the steel structures was observed throughout the Flume. The level of corrosion varied from minor (surface pitting) to moderate (flaking, less than 15% loss of original material) and severe (flaking, more than 15% loss of original material).

Overall, girders are in fair to good condition, with minor surface corrosion (Figure 13). However, moderate corrosion was observed at locations where the girders are encased in concrete (Figure 14). At these locations, it is likely that the steel experienced prolonged exposure to water trapped in concrete cracks. Corrosion was also observed at the steel inside the beam pocket. The cavity at the northwest end appeared empty (Figure 15), while the pocket at the north-east end appeared to be filled with an elastic material. ANA did not conduct additional investigation to determine the nature of the filling material.

The steel at the south frames appears to be good condition. The only steel exposed at the time of this investigation was at the base of the columns, where minor to moderate corrosion was observed (Figure 17). Severe corrosion was generally observed at the columns and braces of the north frames, as shown in Figure 16 and Figure 18. At locations were the concrete has spalled off and the steel was exposed, spiral-type metal ties were observed. These ties were installed in contact with the steel members. The ties were in poor condition, showing severe corrosion due to long exposure to weather. Ties are shown in Figure 14 through Figure 19.

Extensive corrosion damage was observed at all of the plates that provide support for the wooden stringers, as shown in Figure 20. In some cases, the corrosion of these elements produced substantial uplift of the stringers. Severe corrosion damage was also observed at the connection

between the diagonal brace and the girder. This condition was observed at the two north braces of the northern frames and is shown in Figure 19. The corrosion is particularly severe at the bottom surface of the girder's flange and at the angle used to connect the two structural elements. The corrosion reduced the thickness of the angle to approximately 0.15". However, it was not possible to estimate the original thickness at the time of this investigation. It is common for these types of connection to have an angle with thickness of ¼" or greater. This would result in a loss of original thickness of 40%. Furthermore, corrosion was observed between the angle and the bottom flange. Considering that corrosion produces volumetric expansion of the metal, this condition has the potential of introducing additional tension in the rivets used in the connection.

Figure 13. Minor surface corrosion affecting the majority of the steel girders exposed surface.

Figure 14. Moderate corrosion was observed at the portions of girders encased in concrete. This photo shows corrosion at the bottom flange of the east girder, near the north abutment. Note severe corrosion of metal ties.

Figure 15. Corrosion at the girder inside the bearing pocket was observed. The empty cavity is likely to trap water and moisture, which will accelerate the corrosion process.

Figure 16. Severe corrosion at the south diagonal brace of the northeastern frame. 25% loss of original top flange thickness was measured at this location.

Figure 17. Typical minor corrosion at base of southern columns. At these locations, extensive concrete cracking with some spalling was observed.

Figure 18. Severe corrosion at the flange of the encased column at the northeastern frame. 55% loss of original thickness was measured at this location.

Figure 19. Typical corrosion at the diagonal brace-girder connection. The corrosion is particularly severe at the bottom surface of the girder's flange and the angle used to connect the two structural elements.

Figure 20. Typical severe corrosion affecting the stringers supporting plates. Note the amount of uplift experienced by the stringer due to the increase in steel volume.

A Panametrics–NDT ultrasonic thickness meter and a digital caliper were used to measure the thickness of the existing structural steel elements and evaluate the degree of section loss due to corrosion. Results are summarized in Table 1.The thickness loss due to corrosion as a percent of the original thickness is quantified in the last column of the table. The original flange thickness used for comparison is based on values found in the *AISC Rehabilitation and Retrofit Guide* for elements with similar geometry and typically manufactured during the same years the supporting structures were constructed at the Flume. Field measurements were used to find the original sections in the AISC Guide. The matching sections are shown in Figure 21.

This investigation confirmed that the sections of girders encased in concrete are generally affected by moderate corrosion, with an average loss of thickness of 12%. The diagonal braces at the north frames are affected by severe corrosion, with thickness loss as high as 25%. The steel columns are the elements that are damaged most by corrosion. While corrosion has reduced the original thickness up to 25% for the two southern columns, the material loss for the northern columns is as high as 55%.

Table 1. Summary of thickness measurements taken at existing steel elements.

Location	D_A * (inches)	Original Thickness (inches)	Measured Thickness (inches)	Thickness Loss (%)
North end of east girder, 16” from abutment, bottom flange	0	0.650	0.575	12
	1.75	0.923	0.800	13
North end of east girder, 16” from abutment, bottom flange	0	0.650	0.550	15
	1.75	0.923	0.840	9
South brace of northwestern frame, top flange near column	0.25	0.402	0.300	25
South brace of northwestern frame, bottom flange near column	0.25	0.402	0.380	5
Column of northwestern frame, below diagonal braces, north flange	0.25	0.398	0.298	25
Column of northwestern frame, below diagonal braces, south flange	0.25	0.398	0.225	43
Column of southwestern frame, below diagonal braces, north flange	0.25	0.398	0.354	11
Column of southwestern frame, below diagonal braces, south flange	0.25	0.398	0.300	25
Column of southeastern frame, below diagonal braces, north flange	0.25	0.398	0.350	12
Column of northeastern frame, below diagonal braces, north flange	0.25	0.398	0.280	30
Column of northeastern frame, below diagonal braces, south flange	0.25	0.398	0.180	55
South brace of northeastern frame, top flange near column	0.25	0.402	0.330	18
South brace of northeastern frame, bottom flange near column	0.25	0.402	0.300	25
* Indicates the location of the measured point from the edge of the flange				

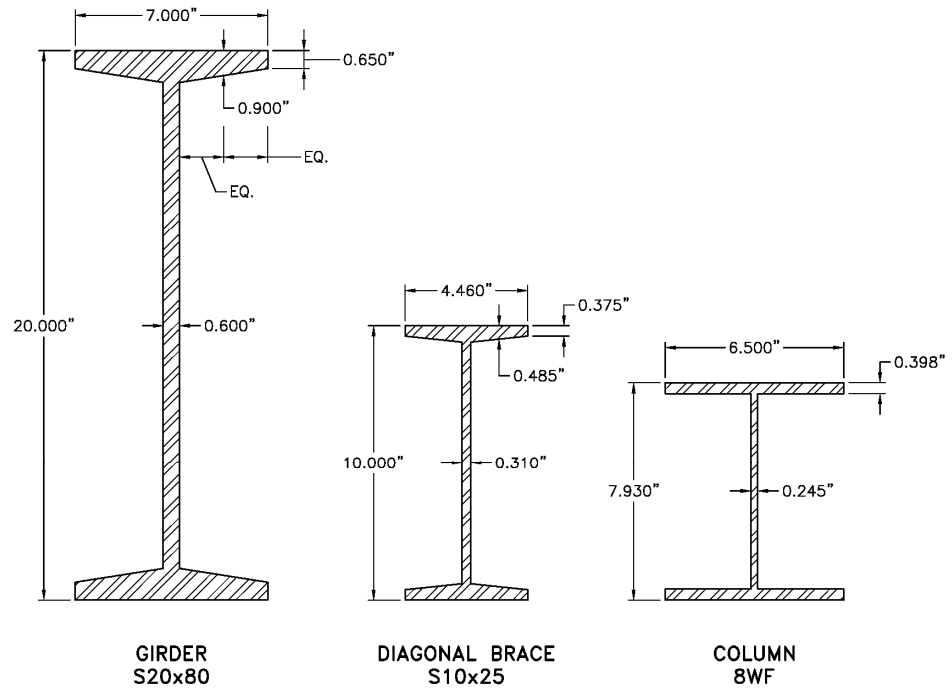


Figure 21. Shape and dimensions of original steel sections from *AISC Rehabilitation and Retrofit Guide*.

2.3 Foundation Support

The concrete piers and diagonal braces at the south end of the flume don't have a foundation system (Figure 22). The soil and bedrock that once provided support to the piers have eroded six to eight feet below the base of the piers. While the existing girders were able to overcome the lack of support without any substantial failure or collapse, the original design assumptions at this location appear compromised. The lack of vertical support produced vertical cracks at the intersection of concrete pier and girder (Figure 23). Being narrower at the top and wider at the bottom, the cracks can be considered flexural cracks. However, it is likely that the pier-girder connection was not designed and constructed to resist flexural moments. The steel girder is not continuous over the pier. Furthermore, a smaller steel section was used to construct the south beam, which spans between the pier and the abutment. The top of this beam was visible at a location where the concrete had spalled off. The connection between the encased steel beams and column is likely a shear connection and is not suitable for carrying flexural stresses.

A different configuration was observed at the north end of the flume, where concrete piers were not used to provide additional support to the girders near the abutment. A diagonal brace was only used at the east girder and the bottom support is compromised (Figure 24). However, the steel beams are continuous at this location and don't show any signs of distress directly related to the missing support.

Figure 22. Unsupported piers and diagonal braces at south end of flume due to soil erosion.

Figure 23. Flexural cracks at pier-girder connection at the south end of the flume. A smaller steel beam was used in the construction of the south beam that spans from the pier to the abutment (steel sections shown in red). The connection between the encased steel beams and column is likely a shear connection. Similar cracks were observed at the opposite pier.

Figure 24. Diagonal brace without support at north end of east girder.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the extent of damage observed to date and assuming that the Flume will not be used to carry water in the future, the structural stability of the existing structure does not appear compromised. Stresses in the deteriorated portions of the structures have redistributed to accommodate section losses. As a result, the structure found a new load path to effectively support the empty wooden flume. However, existing distress should be addressed to prevent future damage from undermining the stability of the structural elements supporting the Flume. Because the rate of corrosion increases over time, repair actions need to be implemented in the near future to stabilize the structure and avoid the risk of catastrophic collapse. Furthermore, the extent of damage requires that public access to the Flume be restricted to preservation activities.

The following repair approaches are recommended to address the distress conditions at the Flume.

3.1 Concrete Repair

- Deteriorated, damaged, or defective concrete should be removed until sound material is reached. Care should be taken in the removal process to not damage the embedded steel.
- All exposed steel surfaces should be thoroughly cleaned of all loose concrete, rust, and other contaminants by sandblasting. For limited areas with minor corrosion, wire brushing or other hand methods may be acceptable.
- Surface of sound concrete should be prepared to receive the repair material by removing thin layers of surface concrete. Use sandblasting or other equivalent methods.

- A repair material compatible with the existing concrete substrate should be used to restore the original cross section. Conventional concrete composed of portland cement, aggregates, and water is acceptable.

3.2 Steel Corrosion Repair

- All exposed steel surfaces should be thoroughly cleaned of rust and other contaminants by sandblasting. For limited areas with surface corrosion, wire brushing or other hand methods may be acceptable.
- Cleaned steel should be protected with appropriate coating. A zinc rich primer, e.g. Sherwin-Williams Corothane 1 or equivalent is recommended.
- Diagonal brace-girder connections at the northern frames should be fully exposed. Because of the corrosion between the angle and the girder bottom flange, the existing angle needs to be removed to allow cleaning and protection of the corroded surfaces as described above. Based on the extent of damage observed at the existing angles, these elements should be replaced with new ones.
- The girder bearing pockets should be filled with sealant to prevent moisture and water from collecting inside the pocket. If compatible with the preservation approach, a flashing could be installed at the top of the beam to shed water away from the concrete.
- All of the steel plates that provide support to the wooden stringers should be replaced. The new plates should be protected with appropriate coating. As an alternative, a self-weathering steel (COR-TEN) could be used for the replacement plates. When expose to weather, this material forms a stable layer at the surface with a rust-like appearance that functions as a protective layer for the steel.

3.3 Foundation Repair

- The existing piers and diagonal braces at the south end of the Flume should be supported with a new foundation system.
- The existing bedrock should be exposed and evaluated. If sound rock is found, a new spread footing can be cast on top of it. Should the bedrock be not stable, micropiles or helical piers could be used to support the new footing.
- A concrete column or wall should extend from the footing to the base of the piers. A concrete cap should be used to provide support to both the piers and diagonal braces.
- Erosion protection should also be provided at the base of the new footing. A rip-rap structure of a wire enclosed rock gabion system would work.