GERRARD
Developing A Common Future

27486 County Road 13 / Loveland, CO 80534
office 970.669.1463 / fax 970.669.1964

August 7, 2014

Mr. Johnathan Hernandez, P.E.
CWCB Water Project Loan Program
1313 Sherman St., Rm. 721
Denver, CO 80203

RE: Emergency Consolidated Home Supply Ditch and Reservoir Company ("CHSDRC"), Loan Contract #**C150375** - Additional Loan Amount for Big Dam Flood Repairs and Mitigation.

Dear Mr. Hernandez:

On behalf of the Consolidated Home Supply Ditch and Reservoir Company (CHSDRC), this is a formal request for additional funding to the loan amount for the Big Dam Structure Repair related to the September, 2013 flooding.

BACKGROUND

CHSDRC applied for and received a loan from CWCB in November, 2013 in the amount of $1,600,000. The scope of work is identified in the loan proposal, dated October 15, 2013, and attached as **Figure 1.** The repair scope was divided into Phase 1 and Phase 2. Phase 1 is the repairs to the damaged section of the Big Dam, which includes refacing the dam with new and existing masonry stones, installing abutments and a concrete arch upstream of the masonry dam for reinforcement and protection of the masonry dam. Phase 2 is the repointing of the downstream face of the masonry structure.

Work on Phase 1 was stopped in mid-April to ensure that all repairs completed up to that point, could be finalized and protected during run-off. Phase 1 repairs have been inspected after spring run-off; little to no damage was encountered during the inspection. Approximately 75% of the Phase1 improvements have been completed. The remaining Phase 1 improvements are scheduled to begin in mid-August and will be completed this year.

Phase 2 of the project is scheduled to be completed in 2015, weather and flows permitting.

FUNDING SUMMARY

As noted above, CHSDRC has received a $1,600,000 loan from CWCB for Phase 1 and Phase 2 repairs. CHSDRC also received a $25,000 grant from CWCB for flood repairs. In addition to the CWCB funding, CHSDRC has been issued a PW in the amount of $1,545,507, **Figure 2**. The money authorized under the PW can only be used for Phase 1 repairs.

CHSDRC also entered into an agreement with the City of Loveland for Loveland to cost share in the repairs. The Big Dam structure is a vital component of the City's water supply system. The City agreed to fund 50% of the Phase 1 improvements up to $400,000, **Figure 3**. Loveland's amount will vary depending on the amount of grants received and eligible cost, as defined in the Agreement.

FEMA has also authorized $454,000 in 406 mitigation funding. The 406 mitigation money is to be used to mitigate future damages from flooding.

Table 1 provides a summary of funding and expenditures to date. CHSDRC anticipates that Phase 1 repairs will be completed on budget.

PROPOSED WORK ITEM ADDITIONS TO PHASE 1 AND PHASE 2

Flood Mitigation

As part of the design and evaluation process of the repairs, CHSDRC worked with FEMA regarding mitigating the damages during future flooding events. During this process, FEMA, CHSDRC, Deere and Ault, and Gerrard evaluated potential mitigation alternatives. The initial alternative approved by FEMA was in increase the amount of flood flows diverted through the Home Supply head gate and spilled back to the river through existing sand out-gates, spill-gates, and weir between the river gate and control gate. The enlarged head gate, when combined with automation, would allow Home Supply to pass a majority of the excess river flows through the head gate and back to river, protecting the "Big Dam" from flood flows and debris. FEMA approved this plan and issued a 406 Mitigation report and funding of $454,000 to complete the work, **Figure 4.** However, during spring run-off, it became apparent that this would not be a viable solution. The amount of debris being transported by the run-off forced the Home Supply to close the head gates several times to clean and removed debris. Even with the larger head gates, debris would still be a problem. CHSDRC, Gerrard, and Deere and Ault again evaluated the alternatives. The additional analysis of the structure looked back at how the dam was constructed and operated in the past, **Figure 5.** The historic document also has an original drawing of the dam with a spillway on the north side of the structure.

The City of Loveland diverts water from the north side of the Big Dam structure, and at some point, the City of Loveland filled in the spillway, which enabled Loveland to check water and to increase Loveland's ability to divert water to the treatment plant using the structure, **Figure 6.** However, this forces all excess flows over the dam crest onto the dam face more frequently.

Through the alternative analysis, Deere & Ault has designed a spillway that will check water for the City of Loveland's diversion and allows CHSDRC to control water from over topping the structure and keep debris out of the head gate. The final design incorporates a 5' x 30' Obermeyer gate. The spill capacity is estimated at 800 CFS. The Obermeyer will be automated. CHSDRC and Loveland are currently in discussions regarding integration into the City of Loveland's Water Treatment Plant for power and operation. CHSDRC and Loveland are also in discussion related to Loveland paying for the cost of the spillway, **Figure** 7.

Estimated Cost for Spillway - $737,000.00

Masonry Block

Additional masonry block will need to be replaced. During the flood, approximately 40 masonry blocks were either damaged or washed away. During construction, approximately 25 masonry stones were removed for reuse; however, Deere & Ault and CHSDRC have concluded that reusing the masonry stones is not feasible. These masonry stones will need to be replaced as shown in **Figure 8.**

Estimated Cost for Additional Masonry Block - $172,000.00

Head Gate Repairs

The river head gates sustained minor damage during the flood. The existing structure consists of 3 – 5' manually operated slide gates. Several options have been evaluated, as mentioned above, related to flood mitigation and additional automation. During the big dam repairs, the right (south) abutment for the concrete arch dam was to be placed outside the head gate structure on granite out cropping, **Figure 9**; however, during the design build analysis of the repairs it was determined that the abutment would need to be moved. At that time, the plan was revised to place the right abutment inside the Home Supply ditch. This would require the removal of the north most head gate. As the spillway plans progressed the plans for the headgates changed as well. The Obermeyer spillway will now serve as the spillway structure for the dam allowing a redesign of the headgates for normal operation and additional spill capacity and not the primary. The new headgates will be 2 - **7.5' x 9'** headgates replace the existing structure and will allow for additional flood flows to be diverted and spilled back to the river via the sand gates and over flow weir. The additional spill capacity will be at 400 - 500 CFS to the 800 CFS from the spillway. The total spill capacity would be approximately 1,200 CFS before the flood water would top the crest of the Big Dam structure. Also included in this scope of work is the potential for automation and integration of the structure with the flume and sandout gates. An access road with retaining wall will be added from the county road to the head gate structure the access road will allow equipment to access the front of the headgate for maintenance and debris clearing. Ditch rider catwalk at the headgate that have been damaged or are otherwise unsafe will also be replaced for safety reasons, **Figure 10**.

Estimated Cost for Headgate Repairs - $438,000.00

Flume

The existing 12' parshall flume and recorder house will be removed and replaced, **Figure 11**. Although still in operable, the flume is in need of replacement as it is heavily scoured and cracking. Additional instrumentation will be added as well as the potential to integrate the flume into automated operations. Ditch rider catwalk at the sandgates will be replace to easier access and safety reasons

Estimated Cost for 12' Parshall Flume Replacement - $225,000.00

Home Supply and Handy Interconnect

In order to provide operational flexibility the Handy Ditch Company has agreed to provide an alternate means to deliver water to the Consolidated Home Supply Ditch downstream of the Home Supply's river diversion facilities. This delivery system requires a new diversion from the Handy Ditch to the Home Supply Ditch. The diversion will consist of a stop log check structure in the Handy Ditch. The diversion structure will consist of a 4' by 4' box culvert discharging to stair stepped concrete chute and stilling basin. The box culvert will have an inlet structure and a 4'by 4' stainless steel fabricated slide gate. Grouted riprap and plain riprap will be placed downstream the stilling basin for erosion protection. For safety, a chain link fence will be placed around the concrete stair stepped chute.

The Handy and Home Supply have cooperated in the past with a joint ditch system south of Loveland. The interconnect would only be used in emergency situations when one or the other company could not

divert at its head gates. The interconnect would mostly be used during the winter fill season; however, it could be used at other times during the year. The companies have agreed to cost share in the design and construction of the interconnects, **Figure 12**

Estimated Cost for Interconnects - **$300,000.00**

Additional Funds Request

CHSDRC is requesting the additional funds from CWCB for interim and long term funding. CHSDRC will continue to work with CEMA/FEMA to secure additional grant funding. CHSDRC will also continue the partnership with Loveland on funding the spillway and other repairs to the Big Dam structure.

The total amount of additional long term and short term funding being requested by CHSDRC is **$1,872,000.** The following table anticipates the amount of short and long term funding related to the additional projects.

CHSDRC sincerely appreciates the CWCB Board and staff's support during the last year to assist in funding this project as well as other flood related projects. Without the CWCB as a funding source the CHSDRC and other ditch companies would not be able to complete the flood repairs.

CHSDRC is proud to say that no water was lost to the system or shareholders after the flood and during the repairs. This would not have been the case without the CWCB.

Sincerely,

Thomas D. Donkle
Project Manager
On behalf of the Consolidated Home Supply Ditch and Reservoir Company

GERRARD
Developing A Common Future

27486 County Road 13 / Loveland, CO 80534
office 970.669.1463 / fax 970.669.1964

August 25, 2014

Mr. Johnathan Hernandez, P.E.
CWCB Water Project Loan Program
1313 Sherman St., Rm. 721
Denver, CO 80203

RE: **Supplemental Request** - Emergency Consolidated Home Supply Ditch and Reservoir Company ("CHSDRC"), Loan Contract #**C150375** - Additional Loan Amount for Big Dam Flood Repairs and Mitigation.

Dear Mr. Hernandez:

On behalf of the Consolidated Home Supply Ditch and Reservoir Company (CHSDRC), this is a supplement to the formal request for additional funding to the loan amount for the Big Dam Structure Repair related to the September 2013 flooding.

SUPPLEMENTAL INFORMATION

The following letter is to supplement the request for an increase in loan amount sent August 7th. Since that time the CHSDRC and Gerrard have been evaluating each of the items in the original request. The interconnect between the Home Supply Ditch and Hand Ditch is not financially feasible to construct. The request for $300,000 for the interconnect is being withdrawn. Additionally, although needed at some point CHSDRC has determined that the replacement of the Parshall Flume be withdrawn at this time. The estimated amount of the flume replacement was $225,000. At some point in the future CHSDRC may come back to CWCB with the request to replace the Parshall Flume. The estimated cost of these two projects total $525,000.

Additonally, the amount requested for the additional masonry blocks has been reduced substantially from the August 7th request letter. The initial cost estimate for the additional blocks was based on an extrapolated amount from the original bid from the stonemason for removal and replacement. However, through the design build process with the engineer, Deere & Ault, and mason, Lou DeAngelis, additional saving can be realized by not reusing existing blocks and the economies of scale by doing the removal of existing blocks in coordination with the placement of the new masonry blocks. The costs will be handled through a minor change order to the existing contract. The requested amount of $172,000 will be removed.

The original CWCB loan amount of $1,600,000 included the flood repairs, Phase 1, and repointing the downstream face of the dam, Phsae 2. The cost at that time was to be split equally, $800,000 between the dam repairs and repointing. CHSDRC and Gerrard anticipate that both phases of the work can be completed under that amount. The present cost estimated to complete the Phase 1 is $1,110,000. The scope of Phase 2 repointing is still to be determined, however, the estimated cost to complete the repointing is anticipated to be well below the Engineer's cost estimate of $800,000. The dam repairs will be completed this fall and the repointing in the spring of 2015.

The requested amounts for the Obermeyer Spillway and Headgate repairs will not change. However, CHSDRC and the City of Loveland have agreed to cost share these projects equally, as well as the repointing of the downstream dam face further reducing the CHSDRC funding needs from the CWCB.

LOAN INCREASE AMOUNT REQUESTED

At this time CHSDRC respectfully requests a 15% increase over of the original loan amount or $240,000 plus the 1% origination fee.

CHSDRC is requesting the additional funds from CWCB for interim and long term funding. CHSDRC will continue to work with CEMA/FEMA to secure additional grant funding. CHSDRC will also continue the partnership with Loveland on funding the spillway and other repairs to the Big Dam structure.

CHSDRC sincerely appreciates the CWCB Board and staff's support during the last year to assist in funding this project as well as other flood related projects. Without the CWCB as a funding source the CHSDRC and other ditch companies would not be able to complete the flood repairs.

Sincerely,

Thomas D. Donkle
Project Manager
On behalf of the Consolidated Home Supply Ditch and Reservoir Company

FIGURE 1

DEERE & AULT
CONSULTANTS, INC.

October 15, 2013

- DRAFT -

Ms. Minerva Lee
Consolidated Home Supply Ditch and Reservoir Company
c/o Northern Colorado Water Conservancy District
220 Water Avenue
Berthoud, Colorado 80513

Re: Big Dam Diversion Structure, Examination and Proposed Repair;
D&A Job No. CG-0122.019.00

Dear Ms. Lee:

This letter report presents our observations and recommendations for the proposed repair of Big Dam on the Big Thompson River. The top five feet of the dam was washed out during the flooding of September 11 through 15, 2013. Peak flows may have been of the order of 15,000 to 20,000 cfs with maximum overtopping of the structure of the order of 10 feet.

Our recommendations are based upon the examination of conditions during our site visit of October 7, 2013. The examination was conducted by Don W. Deere, P.E. and Colby Hayden, P.E. of our Longmont office. We were met on-site by Board Member, Gary Gerrard.

DIVERSION DAM CONDITIONS

The Big Dam is primarily a masonry thin arch dam constructed in 1895 by the Consolidated Home Supply Ditch Company to provide diversion off the Big Thompson River. The main arch dam is approximately 65 feet high, 70 feet long, and five feet wide at the crest. The arch dam transitions into a short gravity dam on the left, or north, abutment. An aerial photograph of the dam is shown on **Figure 1**. We understand that the dam is not considered a jurisdictional dam because the reservoir area has been filled with alluvial deposits resulting in only a few acre-feet of water storage. The dam serves as a diversion structure for the Consolidated Home Supply Ditch and Reservoir Company and the City of Loveland.

The left 50 feet of the diversion dam is a straight gravity section only three to six feet high. The gravity and arch sections are separated by a masonry and concrete buttress thrust block. The intake and headgate to the Consolidated Home Supply Canal are located on the right, or south, abutment, and the City of Loveland's intake is on the left abutment.

Visible damage caused by the flood includes:

1. Loss of the top five feet of the crest along 75 percent of the arch dam section
2. Severe damage to the left abutment concrete buttress

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 ● Fax: 303-651-1469

3. Creation of a moderate sized hole on the left abutment dam/rock contact about 20 feet below the crest
4. Minor damage to gunite facing of gravity dam
5. Increased loss of mortar between masonry blocks on downstream face

Figures 2 and **3** compare 2004 and October 2013 photographs of the dam's downstream face near the crest. As shown on the figures, four vertical courses of masonry were lost. A fifth course was damaged and chipped locally.

As can be seen on **Figures 2** and **3**, the failed section corresponds closely with an apparent seep line seen in the 2004 photographs. Remnants of the upstream gunite face (sprayed concrete with fine aggregate) can be seen on **Figure 2**. It appears the one to two-inch thick gunite facing, that is believed was installed in the 1960s, only extends about five feet below the original crest. During the flooding, the courses of masonry blocks below the gunite probably experienced uplift forces, which contributed to failure.

The damage to the arch dam's left abutment buttress is shown on the upper photograph of **Figure 4**. This area may be where failure initiated in the upper dam masonry courses. Most of the arch dam is confined within the narrow slot canyon in very good quality Colorado Red Granite. A coherent arch in compression is formed throughout most of the dam structure, making it a strong and robust structure. The exception to this is the top few feet of the dam, which because of the topography, relies on this artificial buttress thrust block to engage full arching action in the upper dam courses.

Review of flood videos revealed very turbulent flow in the area of the flow restriction caused by the buttress. Masonry blocks in the buttress and adjoining arch dam were probably the first blocks to fail and resulted in loss of arching action for remaining blocks in the upper dam masonry courses. This loss of arching action, combined with hydrostatic uplift, flow velocity and depth, cavitation, and debris impact all contributed to the failure.

A moderate sized hole at the left abutment rock/dam contact is shown on **Figure 4** (lower photograph). This area contains smooth and shiny masonry blocks as it is a major impact zone for cascading water. The rock mass is locally closely jointed in this area, and water has plucked out both abutment rock and dam masonry. The hole needs to be inspected up closer, but appears to be two to three feet deep. The photographs also show that most of the mortar between masonry blocks has been removed on the downstream face over time by the water flow and freeze-thaw action. Our examination of the crest indicates that mortar loss of about six inches in depth may be common. Since the typical outer face masonry blocks are 18 inches thick, about one-third of the block to block contact has been lost over time. Closer examination of the downstream face is needed to verify this conclusion. Additionally, it appears that there may be similar openings in the rock/dam contact at lower portions of the right abutment. Further examinations of this area, as well as the plunge pool at the toe of the dam are warranted.

Figure 5 shows the downstream face of the gravity dam section in the lower photograph. Much of the gunite facing has been lost. The small upper level outlet gate may be inoperable.

PROPOSED REPAIR

We have divided the repair project into two phases. Phase 1 essential work is that required to make the dam and diversion structure operational for next spring's irrigation season. Phase 2 work includes additional warm weather repairs that should be performed during the fall of 2014.

Phase 1

Phase 1 repairs include the following items:

1. Rebuild crest utilizing masonry block and concrete
2. Rebuild left abutment buttress
3. Repair hole on left abutment

The proposed crest repair is shown on **Figure 6**. The repair consists of rebuilding the downstream face utilizing matching quartzite blocks. This will retain the historic appearance of the structure, as well as provide a durable downstream face. The blocks will also provide a forming base for the remaining concrete placements.

The remainder of the crest will be built using cast-in-place concrete. This includes a mass concrete block with a reinforced concrete upstream face wall and crest cap.

The left abutment buttress thrust block needs to be reconstructed. Additional inspection is required once all trash is removed. It could require demolition of some or all of the existing concrete buttress and rebuilding with reinforced concrete. Alternatively, it may be repaired utilizing shotcrete, placement of rock anchors, and grouting.

The purpose of the above repairs is to restore the full arching action of the top eight feet of the dam. This zone has loosened due to topography, freeze/thaw, and ultimately flood overtopping.

The hole in the downstream left rock abutment contact should be filled with reinforced shotcrete and then grouted. Further inspection will allow us to evaluate if this repair is critical for operation or can be moved into next year's Phase 2 work.

Phase 2

We recommend repointing of masonry blocks on the downstream dam face. Small drain pipes will be installed in the mortar joints to continue to allow drainage to occur. Special care is needed along the rock/masonry contact.

Other holes at the abutment contact may need to be shotcreted and grouted. As mentioned, there appears to be a hole at the lower right abutment contact that requires filling.

COSTS

The total estimated cost of repair is approximately $1.536 million, which includes a 20 percent contingency. The costs are itemized on **Table 1**. Engineering costs are estimated at $174,590 and are itemized on **Table 2**.

SCHEDULE

Surveying of the structure should be completed by October 25, 2013. Ninety percent plans and specifications for repair will be completed by Thanksgiving. Phase 1 repair is expected to be completed in 60 days this winter. An additional 60 days of construction is expected for Phase 2 in the fall of 2014.

CONCLUSIONS

The proposed repairs should allow this well designed structure to regain its original function. These repairs are designed to restore the full arching action of the dam, so it can withstand the powerful forces of overtopping river flows.

Please call if you have any questions or comments.

Sincerely,

DEERE & AULT CONSULTANTS, INC.

Don W. Deere, P.E.
Principal

DWD:sp

Attachments

TABLE 1

COSTS TO REPAIR BIG DAM DIVERSION
CONSOLIDATED HOME SUPPLY DITCH COMPANY
October 15, 2013

Description	Quantity	Unit	Rate	Total
Phase 1				
Diversion and Care of the River	1	LS	$ 90,000	$ 90,000
Masonry Wall (60 ' x 5')	180	SF	$ 250	$ 45,000
Concrete Work	100	CY	$ 1,800	$ 180,000
Shotcrete Repairs	20	CY	$ 3,000	$ 60,000
Anchor Bars	8	Each	$ 2,000	$ 16,000
Grouting	1	LS	$ 25,000	$ 25,000
			Subtotal	$ 416,000
Cold Weather/Safety Premium @ 25%				$ 104,000
Mobilization @ 5%				$ 20,800
Miscellaneous and Unlisted @ 5%				$ 20,800
			Total Phase 1	$ 561,600
Phase 2				
Diversion and Care of the River	1	LS	$ 90,000	$ 90,000
Repoint - Downstream Face	1	LS	$ 200,000	$ 200,000
Grouting	1	LS	$ 25,000	$ 25,000
Shotcrete Repairs	40	CY	$ 3,000	$ 120,000
			Subtotal	$ 435,000
Special Safety Costs @ 15%				$ 65,250
Mobilization @ 5%				$ 21,750
Miscellaneous and Unlisted @ 5%				$ 21,750
			Total Phase 2	$ 543,750
			SUBTOTAL CONSTRUCTION	$ 1,105,350
			Engineering	$ 174,590
			Contingency @ 20%	$ 255,988
			TOTAL ESTIMATED COST (rounded to nearest $1,000)	$ 1,536,000

TABLE 2

ENGINEERING COSTS TO REPAIR BIG DAM DIVERSION
CONSOLIDATED HOME SUPPLY DITCH COMPANY
October 15, 2013

Description	Quantity	Unit	Rate	Total
Design				
Don Deere	100	Hours	$ 250.00	$ 25,000
Colby Hayden	40	Hours	$ 180.00	$ 7,200
Glen Church	120	Hours	$ 135.00	$ 16,200
Grant Horeczy	60	Hours	$ 130.00	$ 7,800
Laura Campbell	120	Hours	$ 76.00	$ 9,120
CAD Technician	120	Hours	$ 88.00	$ 10,560
Clerical	40	Hours	$ 84.00	$ 3,360
Surveying	1	LS	$ 4,950.00	$ 4,950
Miscellaneous expenses				$ 3,000
			Total Design	$ 87,190
Meetings (as needed)	Allowance			$ 10,000
Construction Engineering per Phase (assuming a 60-day construction period)				
Don Deere	40	Hours	$ 250.00	$ 10,000
Colby Hayden	80	Hours	$ 180.00	$ 14,400
Derek Foster	100	Hours	$ 103.00	$ 10,300
Miscellaneous expenses and testing				$ 4,000
			Total Construction Phase 1	$ 38,700
			Total Construction Phase 2	$ 38,700
			TOTAL ENGINEERING	$ 174,590

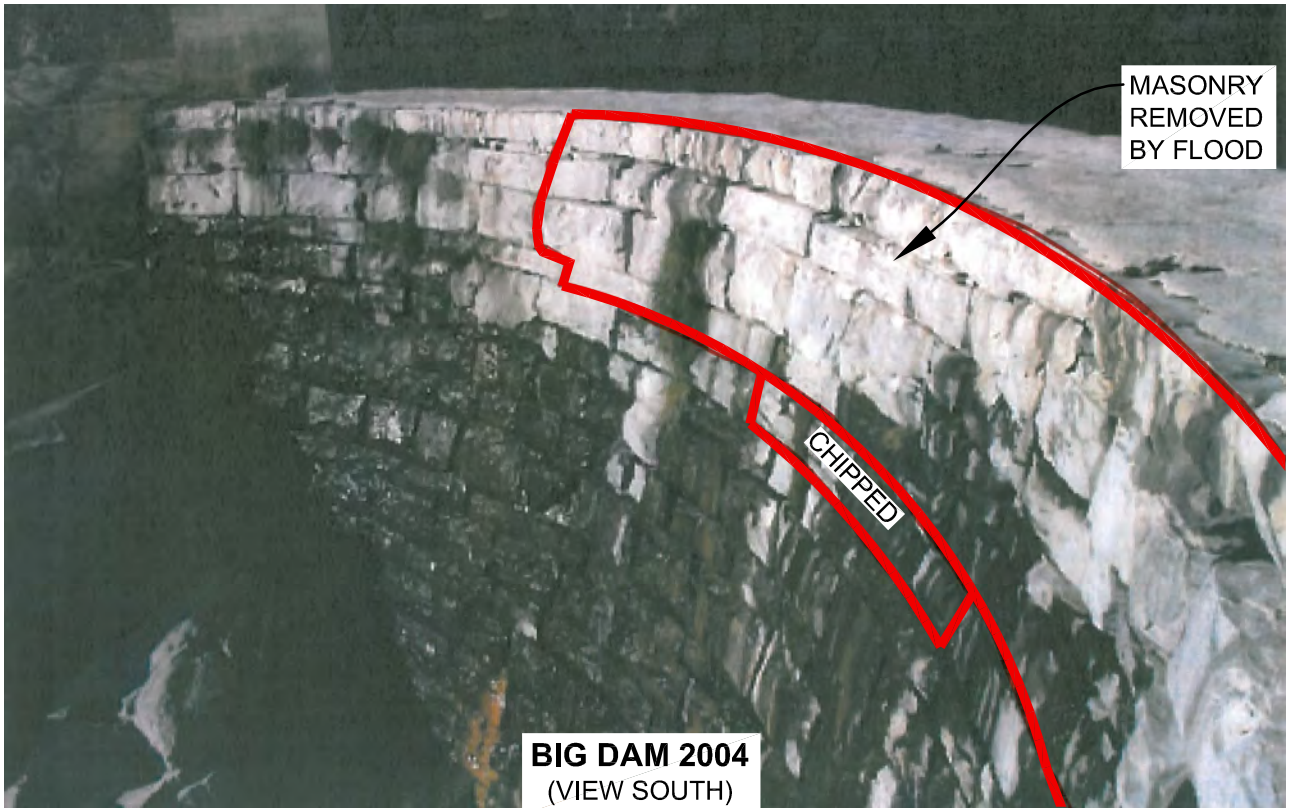
DEERE & AULT CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

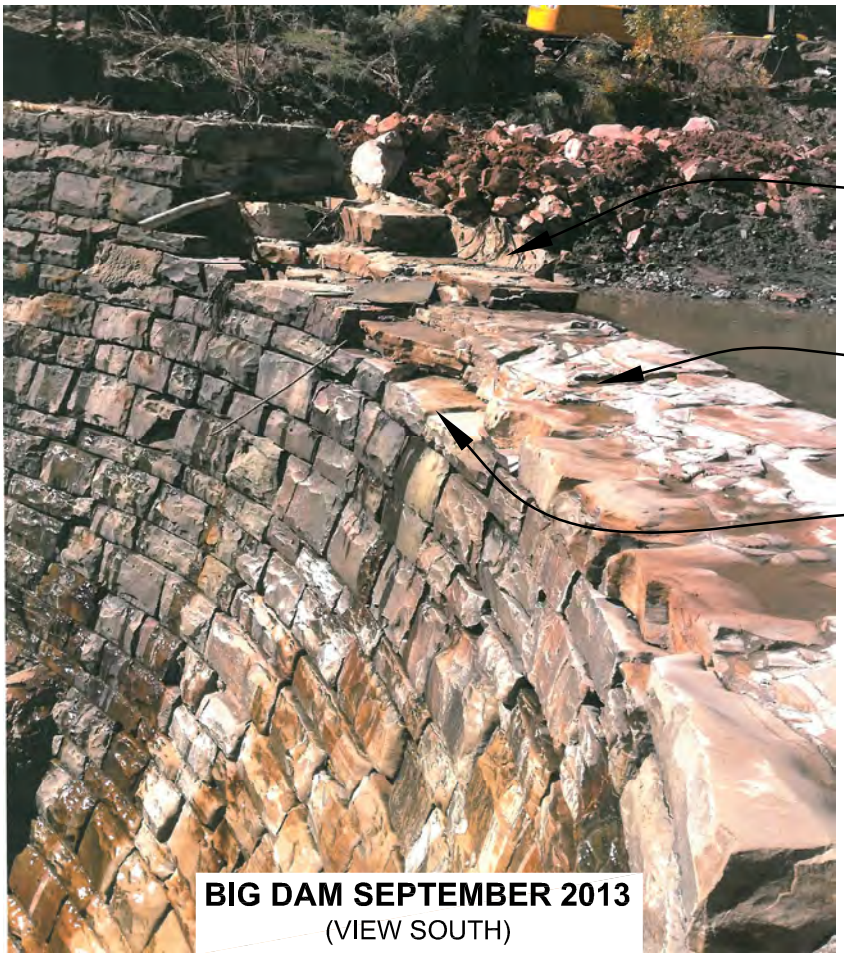
FIGURE NO. 1

JOB NO. 0122.019.00

SCALE: 1" = 30'



BIG DAM 2004
(VIEW SOUTH)

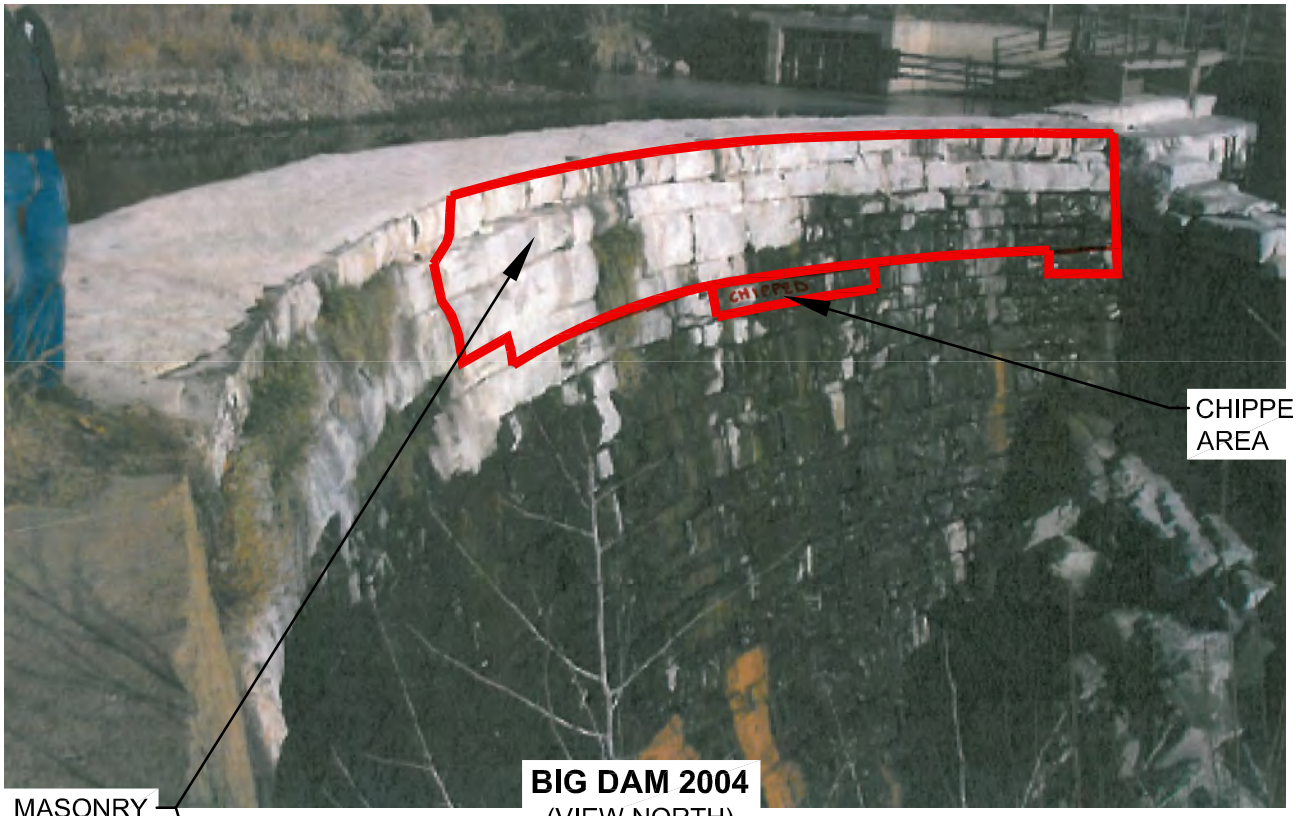


BIG DAM SEPTEMBER 2013
(VIEW SOUTH)

DEERE & AULT CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

JOB NO.	SCALE:	FIGURE NO.
0122.019.00	AS NOTED	2



BIG DAM 2004
(VIEW NORTH)

MASONRY REMOVED BY FLOOD

BIG DAM SEPTEMBER 2013
(VIEW NORTH)

DEERE & AULT CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

JOB NO.	0122.019.00	SCALE:	AS NOTED

FIGURE NO. 3

DAMAGED LEFT ABUTMENT BUTTRESS

HOLE ON DOWNSTREAM LEFT ABUTMENT CONTACT APPROXIMATE 20FT BELOW CREST

DOWNSTREAM MASONRY BLOCKS IN NEED OF MORTAR REPOINTING

DEERE & AULT CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

FIGURE NO. 4

JOB NO. 0122.019.00

SCALE: AS NOTED

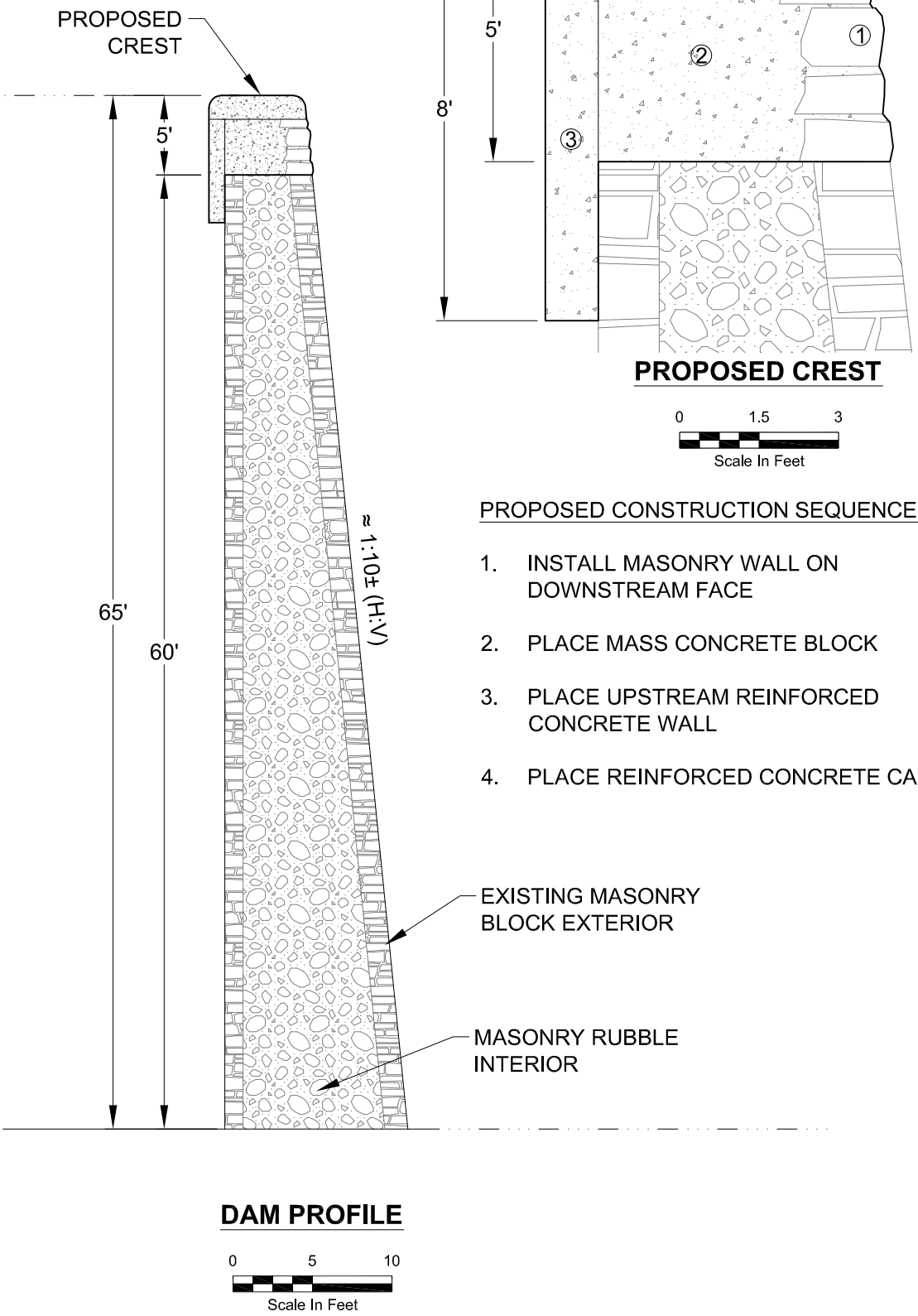
CREST WITH
MASONRY RUBBLE

VIEW UPSTREAM OF LOW GRAVITY DAM SECTION

DEERE & AULT
CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

JOB NO.	SCALE:	FIGURE NO.
0122.019.00	AS NOTED	5



DAM PROFILE

PROPOSED CREST

PROPOSED CONSTRUCTION SEQUENCE:

1. INSTALL MASONRY WALL ON DOWNSTREAM FACE
2. PLACE MASS CONCRETE BLOCK
3. PLACE UPSTREAM REINFORCED CONCRETE WALL
4. PLACE REINFORCED CONCRETE CAP

DEERE & AULT CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

JOB NO.	SCALE:	FIGURE NO.
0122.019.00	AS NOTED	6

FIGURE 2

P	
Applicant Name:	Application Title:
CONSOLIDATED HOME SUPPLY DITCH	COHSD01 - Nelsons Big Dam Damage
Period of Performance Start:	Period of Performance End:
	03-14-2015

Bundle Reference # (Amendment #)	Date Awarded

Subgrant Application - FEMA Form 90-91

FEDERAL EMERGENCY MANAGEMENT AGENCY
PROJECT WORKSHEET

DISASTER	PROJECT NO.	PA ID NO.	DATE	CATEGORY
FEMA 4145 - DR -CO	COHSD01	069-00899-00	01-17-2014	D

APPLICANT: CONSOLIDATED HOME SUPPLY DITCH

WORK COMPLETE AS OF: 01-02-2014 : 0 %

Site 1 of 1

DAMAGED FACILITY:

COHSD01 Nelsons Big Dam

COUNTY: Larimer

LOCATION:

Current Version:

Adjacent to the City of Loveland Water Treatment Plant on County Road 29
GPS: Latitude 40.42476, Longitude -105.21062

LATITUDE: 40.42476

LONGITUDE: -105.21062

DAMAGE DESCRIPTION AND DIMENSIONS:

Current Version:

During the incident period September 11, 2013 through September 30, 2013 severe storms caused high velocities and flooding of the Big Thompson River at the applicant's owned (Consolidated Home Supply Ditch and Reservoir Company) and maintained Big Dam Diversion Structure located at latitude 40.42476, longitude -105.21062 in Larimer County, CO. The Big Dam is a masonry thin arch dam constructed in 1895 by the Consolidated Supply Ditch Company to provide diversion of the Big Thompson River. The main arch dam is approximately 65 feet high, 70 feet long x 5 foot wide at the crest. The arch dam transitions into a shot gravity dam on the north abutment. The dam serves as a diversion structure for the Consolidated Home Supply Ditch and Reservoir Company, the City of Johnstown and the City of Loveland Water Supply.

The Big Dam Diversion Structure was overtopped by approximately 10 feet of high-velocity flood water which washed-away the top 5 feet of the stacked stone arch dam and damaged an additional 1.5 feet of stacked stone. The concrete thrust block/buttress was probably the first component to fail and resulted in loss of arching action for remaining blocks in the upper dam masonry courses. The loss of arching action, combined with hydrostatic uplift, flow velocity, and depth, cavitation, and debris impact all contributed to the failure. The peak flows experienced by the dam were estimated at 15,000 - 20,000 CFS.

Erosion occurred on the north abutment caused by high velocity water and scouring. The concrete fascia was washed off the face of the gravity section of the dam which probably occurred by scouring and debris impacts.

A 30 inch diameter metal head gate was damaged during the incident period. The gate controlled flow through a pipe which was used to remove sediment from behind the dam.

The following is a summary of the damage sustained by the Big Dam Diversion Structure:
(1) Loss of top five (6.5) feet of the stacked stone crest along 75% of the arch dam section - Dimension 60ftx4.2ft.
(2) Loss of concrete cap (60ftx5ftx1.5ft) covering the crest and upstream face of the dam (60ftx8ftx1.5ft) - (See Specific Dimension Break-Out on attached dimension sheet)
(3) Damage to north abutment concrete buttress. - Dimensions 10ftx6ftx6f - (See Specific Dimension Break-Out on attached dimension sheet)
(4) Moderate size washout (Hole) on the dam/rock interface approximately 20 feet below the crest on the south abutment - Dimension 22ftx8ftx3ft=528cf/27=19.6cy
(5) Minor damage to concrete upstream face of the gravity section of the dam - Dimensions 70ftx6ft=420sf
(6) A 30 inch diameter metal head gate was lost

SCOPE OF WORK:

Current Version:

WORK TO BE COMPLETED - The applicant using a contractor will make the following storm damage repairs to the Big Dam Diversion Structure.
(1) Rebuild top five (5) feet of crest utilizing masonry stone blocks and concrete - Dimension 60ftx4.2ft=252sf
(2) Replace concrete cap covering crest (60ftx5ftx1.5ft) and upstream face of the masonry arch - Dimensions 60ftx8ftx1.5ft - (See Specific Dimension Break-Out on attached dimension sheet)
(3) Replace damaged north abutment thrust block/buttress using concrete and reinforcing anchor bars - Dimensions 10ftx6ftx6ft - (See Specific Dimension Break-Out on attached dimension sheet)
(4) Repair hole on south abutment utilizing concrete and grout - Dimensions 22ftx8ftx3ft=528cf/27=19.6cy - (See Specific Dimension Break-Out on attached dimension sheet)
(5) Replace concrete on the face of the gravity section of the dam - Dimensions 70ftx6ft=420sf.
(6) Abandon in place the 30in head gate and silt removal pipe. The pipe will be sealed with concrete – Dimension 2.5ft x 25ft
Costs Validation for Cost Reasonableness;
The applicant's engineer provided a repair estimate with the hard construction scope and costs, and the soft scope and costs. These costs were validated for cost reasonableness as follows:
1) Construction Costs Validation Analysis - The engineer's combined construction costs (phase one, $454,300 + $385,000 phase two,) = $839,300. The engineer's soft costs were not included in the cost validation, as any soft costs applicable will be added in the CEF Factors. The engineer's combined construction estimate of $839,300.00 is <12% of the R.S. Means CostWorks estimate and is cost reasonable. See attached PW COHSD01 Big Dam Cost Validation Spreadsheet & Engineer's estimate "Big Dam Diversion Repairs" dated 12/04/13.
2) Soft Costs Validation Analysis - To validate the engineer's soft costs the validated engineer's construction cost of $839,300.00 was entered into a CEF and applicable factors were applied. The total of the CEF cost is $1,564,507.00. The engineers combined construction costs and soft costs are $1,536,000.00, 98.2% of the CEF estimate, or otherwise stated 1.8% less than the CEF estimate. The engineer's estimate is cost reasonable. See attached CEF and Engineer's estimate "Big Dam Diversion Repairs" dated 12/04/13.
Documentation Retention: Pursuant to 44 CFR 13.42, Grantees and Sub grantees are required to retain records, including source documentation, to support expenditures/costs incurred against the grant award, for 3 years from the date of submission to FEMA of the final Financial Status Report.
PROCUREMENT: The applicant is required to adhere to State and Federal Government Procurement rules and regulations and maintain adequate records to support the basis for all purchasing of goods and materials and contracting services for projects approved under the Public Assistance program, as stated in 44 CFR 13.36. The applicant has been advised they have/will follow their normal procurement procedures.
PERMITS: The applicant must obtain all required federal, state, and local permits prior to the commencement of work.
DIRECT ADMINISTRATIVE COSTS: Pursuant to DAP9525.9, applicant is not requesting direct administrative costs.
HAZARD MITIGATION: Project was reviewed for 406 Hazard Mitigation and a copy of 406 HMP proposal(s) is attached with this project.
INSURANCE: The applicant is aware that all projects are subject to an insurance review as stated in 44 C.F.R. Sections 206.252 and 206.253. If applicable, an insurance determination will be made either as anticipated proceeds or actual proceeds in accordance with the applicant's insurance policy that may affect the total amount of the project.
NOTES
Big Dam is a masonry thin arch dam constructed in 1895 by the Consolidated Home Supply Ditch Company to provide diversion of the Big Thompson River. The main arch dam is approximately 65 feet high, 70 feet long and 5 foot wide at the crest. The arch dam transitions into a short gravity dam on north abutment. The dam is not considered a jurisdictional dam because the reservoir area has been filled with alluvial deposits (Silt) resulting in only a few acre-feet of water storage. The dam was silted-up prior to the storm. The dam serves as a diversion structure for the Consolidated Home Supply Ditch and Reservoir Company, the City of Johnstown and the City of Loveland Water Supply.
The left 50 feet of the diversion dam is a straight gravity section only three to six feet high. The gravity and arch sections are separated by a concrete thrust block/buttress. The intake and head gate to the Consolidated Home Supply ditches and City of Johnstown water supply are located on the south abutment and the City of Loveland's intake is on the north abutment. Repair to the Loveland water intake structure is addressed in PW LOVEL09.
The contractor will encounter severe weather conditions, slip and fall hazards, and lack of easy access to the work site. The contractor will place a rip rap diversion berm to deflect the water from the work area. They will have to move the diversion berm at least 3 times to dewater the specific area under repair. The placement and movement of the rip rap diversion berm adds to the expense of the repair.
Nelson's Big Dam is located in a narrow ravine. The topography of the repair area limits the contractor's ability to make repairs in one effort. The applicant and their consulting engineer envisions making repairs to a small section of the dam and once that repair is complete moving on to the next area of effort. Before each area is complete the contractor will have to construct a temporary diversion berm to dewater the area, construct safety work platforms and tie offs, and mobilize equipment to the area under repair. Once the repair is complete the equipment will require movement to the next area of repair, the diversion berm will be removed from the completed area and reconstructed in the next area of repair concentration. The cost of the project increases due to the effort required to prepare each section of the dam before the work can be initiated. The applicant's engineer envisions 4 mobilizations, demobilizations, construction of safety measures, and removal/construction of the diversion berm.
Another contributing factor to the high cost of the repair to Nelson's Big Dam is the fact the work is being completed 60-70 feet above the downstream water surface. The risk to the health and safety of the personnel making repairs is a factor which must be addressed. The elaborate safety measures required for the repairs to Nelson's Big Dam drives the cost of the PW higher. Repair personnel will be working on the crest of a thin arch dam which has a width of 5 feet. Before the workers can begin work they must clear ice and snow from the work area each morning. This will probably involve 2-3 hours of effort prior to beginning repair work. When demolishing the thrust block/buttress the repair personnel are working on the downstream face of the dam. A set of temporary steps with tie offs and guard rail will be constructed to protect the repair personnel in this area. For the masons working on the upstream fascia of the dam a temporary concrete footer will be poured and a temporary work platform with tie offs constructed to prevent injury or death.
As mentioned above segments of the dam structure will be repaired prior to moving to the next segment, due to having to divert the river away from the repair locations prior to making repairs. It is estimated this work will take place in 4 segments.
First they plan to dewater the area adjacent to the north embankment. They will demolish the damaged concrete thrust block/buttress then form and pour the replacement thrust block/buttress in up to 7 possible lifts. They also plan repair the concrete fascia of the gravity portion of the dam, grout closed the existing sediment discharge tunnel, and make repairs to the concrete wall portion of the concrete gravity section of the dam. Also while this area is dewatered they plant to pour a concrete footer for attachment of a temporary work platform complete with safety ties for the masons working on the repair to the upstream face of the dam.

Secondly they plan to dewater the area adjacent to the south embankment of the dam. In this area they are going to demolish portions of the existing concrete thrust block/buttress and pour a new thrust block/buttress adjacent to the water supply ditches. This work will require a relocation of the head gates for the water supply ditch. Also while this area is dewatered they plant to pour a concrete footer for attachment of a temporary work platform complete with safety ties for the masons working on the repair to the upstream face of the dam.

Thirdly the contractor plans to reface the upstream face of the dam structure. The safety platform mentioned above will be used for the masons working along the upstream face of the dam. The concrete fascia being replaced extends from the crest of the dam to a depth of 8 feet. The concrete fascia will be 18 inches thick and 70 feet long. The fascia will be secured to the upstream face of the dam with rebar ties.

Fourth the contractor will place the cut stone which matches the existing stone construction. The stone that matches the original stone used in the construction of the dam is available from a nearby quarry and will be used to make the repairs. This specific stone is being used to maintain the historic integrity of the structure. The replacement stone will not be available until later this year mainly due to the weather conditions and requirements to cut the stone. The contractor states they are going to take measurements and have the stone cut to the exact dimensions to avoid any deviation in the historical appearance of the structure. Once the replacement stone is in place it will be repointed and capped with concrete to complete the structure repair. Once the repair is complete the contractor will remove the rip rap diversion berm and use the stone to replace lost embankment armoring.

The concrete repair cannot be made in a single pour. Prior to placement of the concrete the contractor has to remove snow and ice, clean, scour, and sandblast the bonding surface prior to each pour. The ice removal and surface preparation will probably account for 2-3 work hours each day. All planned concrete placements will be relatively small placements. This will require more preparatory work prior to each placement

Another factor which drives up the cost for the repairs to Nelson's Big Dam is the fact all form work will be very difficult and potentially hazardous. Standard formwork kicking, tiebacks, whalers and bracing from all sides of the concrete placement are not possible. Formwork will essentially have to be supported from one side of the placement. This is not a common forming practice and will take careful planning, materials, and construction. The form work will require a methodical approach and will be slow to complete. The current form plan is bolting several 8 ft. tall W6X20 "S" beams to the existing abutment to hold the formwork in place. Welding each of the supports into place will be required. Due to the specialized nature of the formwork at this site, the formwork design will require assistance from a Professional Engineer.

Concrete will be very difficult to deliver to the site. All concrete will have to be pumped, with special care given to avoid the overhead power lines. Concrete mixer truck access to the pump truck is expected to be slow and difficult as well.

The Big Thompson River is a "live" river that typically runs directly over the top of Nelson's Big Dam. The valley at this location is very narrow with relatively steep side slopes, thus not lending itself to large amounts of room to accommodate diversions and work areas. Maintaining control of the continuously flowing river during the construction period will require a continuing daily effort throughout the construction period. Items that typically go into diverting a live flowing river are diversion berms, sump pits, pumps and discharge pipes, dewatering wells, etc. Typically for many projects that require working in a live river the diversion can be established initially and not need extensive adjusting during the duration of the project. This is not the case at Big Dam. Partially due to the narrow valley, the diversion berm will need to be re-located 4 times to allow construction of individual sections of the dam structure.

The Big Thompson River has been diverted around the working area at Nelson's Big Dam with a primary diversion berm.illary coffer dam. The primary diversion berm is approximately 200 lf long and constructed with rip rap and soil. The rip rap was hauled from off site. The construction equipment used to build this included 4 end-dumps, a front-end loader, a Caterpillar excavator and two men.

Due to the historic significance and uniqueness of Nelson's Big Dam the damage site has been visited by Kevin Helland, Critical Infrastructure Task Force Lead, Mark Shugart, Mitigation Lead, Nick Kripakov, QA/QC, Jack Malone, Mitigation Specialist, and Rose Foshe, Historic Preservation, David Graham, FEMA Project Specialist, Salem Sylvestre, FEMA Project Specialist, and Ron Hamilton FEMA Project Specialist.

When asked about the cost to replace the 30 inch head gate Glen Church of Deere and Ault engineer stated "The 90% construction plans intended for a 30 inch gate to be installed. At this point the slide gate will not be part of the work so these costs will not be incurred. Instead the outlet pipe will be abandoned in place and filled with grout. The volume of grout required to abandon the outlet pipe is approximately 6 to 8 CY.

When the applicant was asked about their procurement policy the following response was received: "We have no procurement policy. We only two contractors we use on a regular basis...usually on a time and materials basis. The Big Dam will require specialized workers and single source materials in some cases. Therefore we have selected contractors through an interview process based on their willingness to provide a quote and that the quote that falls near the engineers estimate, their ability to perform the job and their ability to complete the work within the very narrow time frame of construction."

The applicant is working on a mitigation proposal which they wish to submit sometime in the future. They are requesting a version be written to address the mitigation proposal. The applicant wants their consulting engineers to concentrate on the repairs to the dam because they are rapidly approaching "water season" and the dam has to be operational to meet their water supply commitments. Once "water season" is over they will concentrate on the mitigation.

Does the Scope of Work change the pre-disaster conditions at the site? ☐ Yes ☑ No	Special Considerations included? ☑ Yes ☐ No
Hazard Mitigation proposal included? ☑ Yes ☐ No	Is there insurance coverage on this facility? ☐ Yes ☑ No

PROJECT COST

ITEM	CODE	NARRATIVE	QUANTITY/UNIT	UNIT PRICE	COST
		*** Version 0 ***			
		Other			
1	0000	Work to be Completed	0/LS	$ 0.00	$ 0.00
2	9000	CEF Cost Estimate (See Attached Spreadsheet)	1/LS	$ 1,564,507.00	$ 1,564,507.00

3	0909	Hazard Mitigation Proposal	1/LS	$ 0.00	$ 0.00
				TOTAL COST	$ 1,564,507.00
PREPARED BY Ron Hamilton		TITLE Project Specialist		SIGNATURE	
APPLICANT REP. Minervia G Lee		TITLE President		SIGNATURE	

FIGURE 3

AGREEMENT
For Home Supply Big Dam Flood Repair

This Agreement for Home Supply Big Dam Flood Repair ("**Agreement**") is made and entered into this **15th** day of **January, 2014**, by and between the **City of Loveland,** a Colorado municipal corporation ("**City**"), and **The Consolidated Home Supply Ditch And Reservoir Company**, a Colorado mutual irrigation company ("**Home Supply**").

1. **Background.** The September 2013 flood ("**Flood**") significantly damaged the diversion structure owned and operated by Home Supply on the Big Thompson River adjacent to N. County Road 29 and the City's Chasteen's Grove Water Treatment Plant known as the Big Dam ("**Big Dam**"). The Big Dam is used by Home Supply and the City, which diverts water from the Big Thompson River at the Big Dam pursuant to a December 19, 1895 Agreement with Home Supply, a copy of which is attached hereto as **Exhibit A** and incorporated herein by reference ("**1895 Agreement**"). Home Supply and the City need to repair the Big Dam as soon as possible so that the parties' respective water diversions can be made on a consistent and reliable basis. The 1895 Agreement obligates the City to pay a portion of the costs required to repair the Big Dam (calculated by the parties to be 11.36%). Because operation of the Big Dam is critical to the City's municipal water supply, the City has agreed that it is in the City's best interest to increase its contribution toward the costs required to repair damage sustained by the Big Dam as a result of the Flood on the terms and conditions set forth herein.

2. **Project Scope.** This Agreement shall be limited to work required to repair damage sustained by the Big Dam as a result of the Flood ("**Project**"), which is generally described as "Phase 1" in the October 16, 2013 report from Deere & Ault Consultants, Inc. ("**Deere & Ault Report**"), a copy of which is attached hereto as **Exhibit B** and incorporated herein by reference. This Agreement does not and shall not be construed to include work required to address deferred operating and maintenance costs for the Big Dam, which are generally described as "Phase 2" in the Deere & Ault Report.

3. **Responsibilities of Home Supply.**

a. Home Supply shall accomplish the Project according to the requirements of the Federal Emergency Management Agency ("**FEMA**") in order to maximize potential reimbursement for the Project, and the requirements of the Colorado Water Conservation Board ("**CWCB**") to ensure compliance with the requirements of the loan received by Home Supply from the CWCB for the Project.

b. Home Supply shall require its contractor to carry general liability insurance in an amount sufficient to fully insure the Project, and to name the City as an additional insured under such policy.

c. Home Supply shall provide the City and its agents with unrestricted access to the Project site at all times for purposes of Project observation and inspection. Said inspection shall be for City purposes only and shall not be for the purpose of approving or accepting any work performed by Home Supply's contractor.

d. Home Supply shall provide the City and its agents with full and timely access to all Project contracts, designs, drawings, reports, invoices, and cost documentation.

e. Home Supply shall invoice the City for its Reimbursement Obligation, defined below, not more frequently than monthly. Each invoice shall be accompanied by documentation sufficient to support the requested payment as determined by the City. Home Supply's failure to provide sufficient supporting documentation upon 30 days' written request from the City shall be grounds for delayed payment or nonpayment of the unsupported payment request.

f. Home Supply shall provide the City and its agents with reasonable access to the Project site and Home Supply's adjacent property for the purpose of performing any work necessary to repair the City's intake located on the left (north) abutment of the Big Dam.

4. Responsibilities of City.

a. The City shall reimburse Home Supply for 50% of all Eligible Costs up to a total not-to-exceed amount of $400,000 ("**Reimbursement Obligation**"). For the purposes of this Agreement, "Eligible Costs" shall mean those costs incurred by Home Supply to complete the Project, minus any grants received by Home Supply from FEMA and other grant sources. For the purpose of this paragraph, "grant" shall mean any funding the terms of which do not require repayment by Home Supply. The City's Reimbursement Obligation shall expire on December 31, 2015 unless extended by the parties in writing prior to said date.

b. Except as otherwise provided in this Agreement, the City shall pay Home Supply within 30 days of receipt of each invoice.

c. The City shall be responsible for the safety of its personnel and agents at the Project site and shall follow all applicable laws and regulations for construction site safety.

5. Full Satisfaction of City's Project Cost Contributions Under the 1895 Agreement. The City's promise to pay the Reimbursement Obligation on the terms and conditions set forth herein shall discharge and release the City from any obligation for financial contribution to the Project under the 1895 Agreement. In other words, the City shall not be required to pay Home Supply an additional 11.36% of Project costs above and beyond the Reimbursement Obligation.

6. Overpayments by City. If, after final accounting of all Project costs, the City determines that it paid Home Supply monies in excess of the City's Reimbursement Obligation, the City shall notify Home Supply of such overpayment in writing and request a refund. Home

Supply shall refund all such overpayments to the City within 30 days of receiving written notice from the City.

7. **Term.** Unless earlier terminated by either party as permitted herein, this Agreement shall be effective from the date set forth above through December 31, 2015, or until all refunds due to the City from Home Supply pursuant to paragraph 6 of this Agreement are received, whichever is later.

8. **Appropriation.** To the extent this Agreement constitutes a multiple fiscal year debt or financial obligation of the City, it shall be subject to annual appropriation pursuant to the City of Loveland Municipal Charter Section 11-6 and Article X, Section 20 of the Colorado Constitution. The City shall have no obligation to continue this Agreement in any fiscal year in which no such appropriation is made.

9. **Time of the Essence.** Time is of the essence for this Agreement and for each and every term and condition herein.

10. **Default; Termination.** Each and every term and condition hereof shall be deemed to be a material element of this Agreement. In the event either party fails to perform according to the terms of this Agreement, such party may be declared in default. If the defaulting party does not cure said breach within ten days of written notice thereof, the non-defaulting party may terminate this Agreement immediately upon written notice of termination to the other. In the event of such termination by the City, the City shall be liable to pay its share of Eligible Costs incurred by Home Supply up to the date of termination, but the City shall not be liable to pay any portion of Eligible Costs incurred by Home Supply beyond that date.

11. **Future Cooperation on Phase 2 Work.** Following successful completion of the Project, and conditioned upon the parties' full satisfaction of their respective obligations under this Agreement, representatives of the City and Home Supply shall meet to discuss potential contributions by the City above and beyond those required in the 1895 Agreement for deferred operating and maintenance costs for the Big Dam, which are generally described as "Phase 2" in the Deere & Ault Report; provided, however, that nothing in this Agreement is intended or shall be construed to commit the City to pay any costs for Phase 2 work above and beyond the amount set forth in the 1895 Agreement.

12. **Notices.** Written notices shall be directed as follows and shall be deemed received when hand-delivered or emailed, or three days after being sent by certified mail, return receipt requested:

To the City:
Stephen C. Adams
Loveland Water & Power
200 N. Wilson Avenue
Loveland, CO 80537
steve.adams@cityofloveland.org

To Home Supply:
Minerva Lee
President, Home Supply
PO Box 1548
Berthoud, CO 80513
consolidatedhomesupplyditch@gmail.com

13. Governmental Immunity Act. No term or condition of this Agreement shall be construed or interpreted as a waiver, express or implied, of any of the notices, requirements, immunities, rights, benefits, protections, limitations of liability, and other provisions of the Colorado Governmental Immunity Act, C.R.S. § 24-10-101 *et seq.* and under any other applicable law.

14. Miscellaneous. This Agreement contains the entire agreement of the parties relating to the subject matter hereof and, except as provided herein, may not be modified or amended except by written agreement of the parties. In the event a court of competent jurisdiction holds any provision of this Agreement invalid or unenforceable, such holding shall not invalidate or render unenforceable any other provision of this Agreement. Home Supply shall not assign this Agreement without the City's prior written consent. This Agreement shall be governed by the laws of the State of Colorado, and venue shall only be in the County of Larimer, State of Colorado.

Signed by the parties on the date first above written.

CITY OF LOVELAND SEAL COLORADO

City of Loveland, Colorado

By: William D Cahill

Title: William D. Cahill, City Manager

ATTEST: Teresa A Andrews
City Clerk

APPROVED AS TO FORM:
Assistant City Attorney

STATE OF COLORADO)
) ss
COUNTY OF LARIMER)

The foregoing instrument was acknowledged before me this 16th day of January, 2014 by William D. Cahill as City Manager of the City of Loveland, Colorado.

Witness my official seal.
My commission expires: 8-8-2017

(SEAL)

HEIDI J LEATHERWOOD
Notary Public
State of Colorado
NOTARY ID 20134047790
MY COMMISSION EXPIRES August 8, 2017

Notary Public Signature

The Consolidated Home Supply Ditch And Reservoir Company

By: Minerva Lee

Title: Minerva Lee, President

STATE OF COLORADO)
) ss
COUNTY OF LARIMER)

The foregoing instrument was acknowledged before me this 15th day of January, 2014 by Minerva Lee as President of The Consolidated Home Supply Ditch And Reservoir Company.

Witness my official seal.
My commission expires: July 30, 2016

(SEAL)

REBECCA D MORRIS
Notary Public
State of Colorado
Commission # 19964016647
My Commission Expires Jul 30, 2016

SIGN HERE

Rebecca D. Morris

Notary Public Signature

EXHIBIT

tabbies

A

THIS AGREEMENT, made and entered into, This 19th day of December A.D. 1895, by and between THE CONSOLIDATED HOME-SUPPLY DITCH & RESERVOIR COMPANY, a Corporation, of the County of Larimer and State of Colorado, of the first part, and THE TOWN of LOVELAND, a Municipal Corporation, of said County and State aforesaid of the second part,

WITNESSETH:- That whereas, the said party of the first part is the owner of a certain DAM in the Big Thompson River, in said County and State, known as"THE HOME-SUPPLY DAM" used by said first party to raise the water in said river to the head-gate of first parties Ditch, whereby a Reservoir is created in said river, and

Whereas, the said party of the second part has a system of water-works, consisting of a Pipe-line, the same extending into said Reservoir as its source of supply, and

Whereas, the said party of the first part has a Gate in said Dam, for the purpose of drawing off the water of said Reservoir, whereby the said source of supply of said second party is rendered unavailable when the said Reservoir is lowered below the said pipe-line,

Now Therefore, in consideration of the sum of TWELVE Hundred And Fifty Dollars in hand paid by the party of the second part to the said party of the first part, the receipt of which is hereby acknowledged, and the further consideration of the covenants and agreements herein mentioned to be kept and performed, the said party of the first part hereby agrees for itself, its successors and assigns, to keep the said Gate in said Dam closed, and never hereafter to draw off the water of said Reservoir by itself, agents or employes, or allow or permit the same to be done otherwise than through its Ditch as now located, whereby the said party of the second part may be deprived of taking water

through its said pipe-line, nor will the said party of the first part ever hereafter interfere with, or in any wise prevent the said second party from having access to said water in said reservoir with its supply pipe.

And it is further agreed and understood, that if at any time after the said Dam shall be completely finished by said first party, it shall be deemed necessary by both parties hereto to draw off the water in the said Reservoir for the purpose of making alterations or repairs, the water may be drawn off for that purpose, and such alterations or repair if water be turned off for the purpose, shall be made without un-necessary delay, and the work prosecuted with reasonable dispatch.

And it is further agreed and understood, that if at any time it shall be deemed necessary for the interests of both parties hereto to make alterations or repairs upon said Dam, that the expense of said alterations or repairs shall be borne by both parties, in the proportion as the consideration herein is to the whole cost of the Dam, namely Eleven Thousand Dollars.

In Witness Whereof, the said party of the first part has caused these presents to be executed by its President and Secretary, and to be sealed with its seal, and the said party of the second part has caused the same to be executed by the Mayor and Recorder of the said Corporation and the seal of said corporation to be affixed, the day and year first above written. in duplicate

THE COW, ROAD-SUPPLY DITCH & RESERVOIR COMPANY.

By W A Hawkins President By G P Klein Sec'y

THE TOWN OF LOVELAND.

Attest J. M. Seamans Recorder. By W. L. Beckfield Mayor.

DEERE & AULT
CONSULTANTS, INC.

October 16, 2013

Ms. Minerva Lee
Consolidated Home Supply Ditch and Reservoir Company
c/o Northern Colorado Water Conservancy District
220 Water Avenue
Berthoud, Colorado 80513

Re: Big Dam Diversion Structure, Examination and Proposed Repair;
D&A Job No. CG-0122.019.00

Dear Ms. Lee:

This letter report presents our observations and recommendations for the proposed repair of Big Dam on the Big Thompson River. The top five feet of the dam was washed out during the flooding of September 11 through 15, 2013. Peak flows may have been of the order of 15,000 to 20,000 cfs with maximum overtopping of the structure of the order of 10 feet.

Our recommendations are based upon the examination of conditions during our site visit of October 7, 2013. The examination was conducted by Don W. Deere, P.E. and Colby Hayden, P.E. of our Longmont office. We were met on-site by Board Member, Gary Gerrard.

DIVERSION DAM CONDITIONS

The Big Dam is primarily a masonry thin arch dam constructed in 1895 by the Consolidated Home Supply Ditch Company to provide diversion off the Big Thompson River. The main arch dam is approximately 65 feet high, 70 feet long, and five feet wide at the crest. The arch dam transitions into a short gravity dam on the left, or north, abutment. An aerial photograph of the dam is shown on **Figure 1**. We understand that the dam is not considered a jurisdictional dam because the reservoir area has been filled with alluvial deposits resulting in only a few acre-feet of water storage. The dam serves as a diversion structure for the Consolidated Home Supply Ditch and Reservoir Company and the City of Loveland.

The left 50 feet of the diversion dam is a straight gravity section only three to six feet high. The gravity and arch sections are separated by a masonry and concrete buttress thrust block. The intake and headgate to the Consolidated Home Supply Canal are located on the right, or south, abutment, and the City of Loveland's intake is on the left abutment.

Visible damage caused by the flood includes:

1. Loss of the top five feet of the crest along 75 percent of the arch dam section
2. Severe damage to the left abutment concrete buttress

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 • Fax: 303-651-1469

3. Creation of a moderate sized hole on the left abutment dam/rock contact about 20 feet below the crest
4. Minor damage to gunite facing of gravity dam
5. Increased loss of mortar between masonry blocks on downstream face

Figures 2 and **3** compare 2004 and October 2013 photographs of the dam's downstream face near the crest. As shown on the figures, four vertical courses of masonry were lost. A fifth course was damaged and chipped locally.

As can be seen on **Figures 2** and **3**, the failed section corresponds closely with an apparent seep line seen in the 2004 photographs. Remnants of the upstream gunite face (sprayed concrete with fine aggregate) can be seen on **Figure 2**. It appears the one to two-inch thick gunite facing, that is believed was installed in the 1960s, only extends about five feet below the original crest. During the flooding, the courses of masonry blocks below the gunite probably experienced uplift forces, which contributed to failure.

The damage to the arch dam's left abutment buttress is shown on the upper photograph of **Figure 4**. This area may be where failure initiated in the upper dam masonry courses. Most of the arch dam is confined within the narrow slot canyon in very good quality Colorado Red Granite. A coherent arch in compression is formed throughout most of the dam structure, making it a strong and robust structure. The exception to this is the top few feet of the dam, which because of the topography, relies on this artificial buttress thrust block to engage full arching action in the upper dam courses.

Review of flood videos revealed very turbulent flow in the area of the flow restriction caused by the buttress. Masonry blocks in the buttress and adjoining arch dam were probably the first blocks to fail and resulted in loss of arching action for remaining blocks in the upper dam masonry courses. This loss of arching action, combined with hydrostatic uplift, flow velocity and depth, cavitation, and debris impact all contributed to the failure.

A moderate sized hole at the left abutment rock/dam contact is shown on **Figure 4** (lower photograph). This area contains smooth and shiny masonry blocks as it is a major impact zone for cascading water. The rock mass is locally closely jointed in this area, and water has plucked out both abutment rock and dam masonry. The hole needs to be inspected up closer, but appears to be two to three feet deep. The photographs also show that most of the mortar between masonry blocks has been removed on the downstream face over time by the water flow and freeze-thaw action. Our examination of the crest indicates that mortar loss of about six inches in depth may be common. Since the typical outer face masonry blocks are 18 inches thick, about one-third of the block to block contact has been lost over time. Closer examination of the downstream face is needed to verify this conclusion. Additionally, it appears that there may be similar openings in the rock/dam contact at lower portions of the right abutment. Further examinations of this area, as well as the plunge pool at the toe of the dam are warranted.

Figure 5 shows the downstream face of the gravity dam section in the lower photograph. Much of the gunite facing has been lost. The small upper level outlet gate may be inoperable.

PROPOSED REPAIR

We have divided the repair project into two phases. Phase 1 essential work is that required to make the dam and diversion structure operational for next spring's irrigation season. Phase 2 work includes additional warm weather repairs that should be performed during the fall of 2014.

Phase 1

Phase 1 repairs include the following items:

1. Rebuild crest utilizing masonry block and concrete
2. Rebuild left abutment buttress
3. Repair hole on left abutment

The proposed crest repair is shown on **Figure 6**. The repair consists of rebuilding the downstream face utilizing matching quartzite blocks. This will retain the historic appearance of the structure, as well as provide a durable downstream face. The blocks will also provide a forming base for the remaining concrete placements.

The remainder of the crest will be built using cast-in-place concrete. This includes a mass concrete block with a reinforced concrete upstream face wall and crest cap.

The left abutment buttress thrust block needs to be reconstructed. Additional inspection is required once all trash is removed. It could require demolition of some or all of the existing concrete buttress and rebuilding with reinforced concrete. Alternatively, it may be repaired utilizing shotcrete, placement of rock anchors, and grouting.

The purpose of the above repairs is to restore the full arching action of the top eight feet of the dam. This zone has loosened due to topography, freeze/thaw, and ultimately flood overtopping.

The hole in the downstream left rock abutment contact should be filled with reinforced shotcrete and then grouted. Further inspection will allow us to evaluate if this repair is critical for operation or can be moved into next year's Phase 2 work.

Phase 2

We recommend repointing of masonry blocks on the downstream dam face. Small drain pipes will be installed in the mortar joints to continue to allow drainage to occur. Special care is needed along the rock/masonry contact.

Other holes at the abutment contact may need to be shotcreted and grouted. As mentioned, there appears to be a hole at the lower right abutment contact that requires filling.

COSTS

The total estimated cost of repair is approximately $1.536 million, which includes a 20 percent contingency. The costs are itemized on **Table 1**. Engineering costs are estimated at $174,590 and are itemized on **Table 2**.

SCHEDULE

Surveying of the structure should be completed by October 25, 2013. Ninety percent plans and specifications for repair will be completed by Thanksgiving. Phase 1 repair is expected to be completed in 60 days this winter. An additional 60 days of construction is expected for Phase 2 in the fall of 2014.

CONCLUSIONS

The proposed repairs should allow this well designed structure to regain its original function. These repairs are designed to restore the full arching action of the dam, so it can withstand the powerful forces of overtopping river flows.

Please call if you have any questions or comments.

Sincerely,

DEERE & AULT CONSULTANTS, INC.

Don W. Deere, P.E.
Principal

DWD:sp

Attachments

P \0122 Consolidated Home Supply\0122 019 Flood Repair\Flood 2013\Repair Ltr Docx

TABLE 1

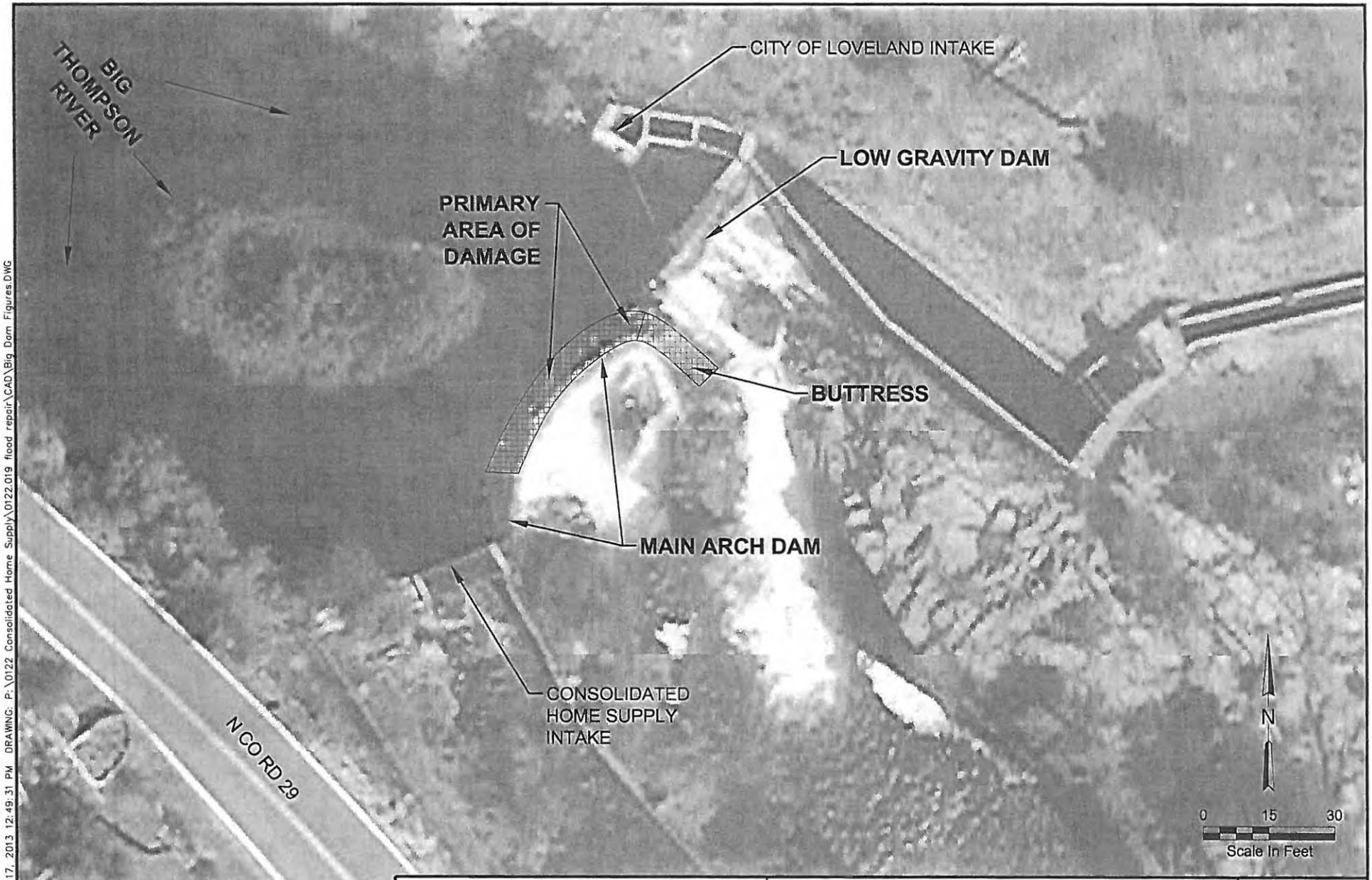
COSTS TO REPAIR BIG DAM DIVERSION
CONSOLIDATED HOME SUPPLY DITCH COMPANY
October 16, 2013

Description	Quantity	Unit	Rate	Total
Phase 1				
Diversion and Care of the River	1	LS	$ 90,000	$ 90,000
Masonry Wall (60 ' x 5')	180	SF	$ 250	$ 45,000
Concrete Work	100	CY	$ 1,800	$ 180,000
Shotcrete Repairs	20	CY	$ 3,000	$ 60,000
Anchor Bars	8	Each	$ 2,000	$ 16,000
Grouting	1	LS	$ 25,000	$ 25,000
			Subtotal	$ 416,000
Cold Weather/Safety Premium @ 25%				$ 104,000
Mobilization @ 5%				$ 20,800
Miscellaneous and Unlisted @ 5%				$ 20,800
			Total Phase 1	**$ 561,600**
Phase 2				
Diversion and Care of the River	1	LS	$ 90,000	$ 90,000
Repoint - Downstream Face	1	LS	$ 200,000	$ 200,000
Grouting	1	LS	$ 25,000	$ 25,000
Shotcrete Repairs	40	CY	$ 3,000	$ 120,000
			Subtotal	$ 435,000
Special Safety Costs @ 15%				$ 65,250
Mobilization @ 5%				$ 21,750
Miscellaneous and Unlisted @ 5%				$ 21,750
			Total Phase 2	**$ 543,750**
			SUBTOTAL CONSTRUCTION	**$ 1,105,350**
			Engineering	$ 174,590
			Contingency @ 20%	$ 255,988
			TOTAL ESTIMATED COST (rounded to nearest $1,000)	**$ 1,536,000**

TABLE 2

ENGINEERING COSTS TO REPAIR BIG DAM DIVERSION
CONSOLIDATED HOME SUPPLY DITCH COMPANY
October 16, 2013

Description	Quantity	Unit	Rate	Total
Design				
Don Deere	100	Hours	$ 250.00	$ 25,000
Colby Hayden	40	Hours	$ 180.00	$ 7,200
Glen Church	120	Hours	$ 135.00	$ 16,200
Grant Horeczy	60	Hours	$ 130.00	$ 7,800
Laura Campbell	120	Hours	$ 76.00	$ 9,120
CAD Technician	120	Hours	$ 88.00	$ 10,560
Clerical	40	Hours	$ 84.00	$ 3,360
Surveying	1	LS	$ 4,950.00	$ 4,950
Miscellaneous expenses				$ 3,000
			Total Design	$ 87,190
Meetings (as needed)	Allowance			$ 10,000
Construction Engineering per Phase (assuming a 60-day construction period)				
Don Deere	40	Hours	$ 250.00	$ 10,000
Colby Hayden	80	Hours	$ 180.00	$ 14,400
Derek Foster	100	Hours	$ 103.00	$ 10,300
Miscellaneous expenses and testing				$ 4,000
			Total Construction Phase 1	$ 38,700
			Total Construction Phase 2	$ 38,700
			TOTAL ENGINEERING	$ 174,590



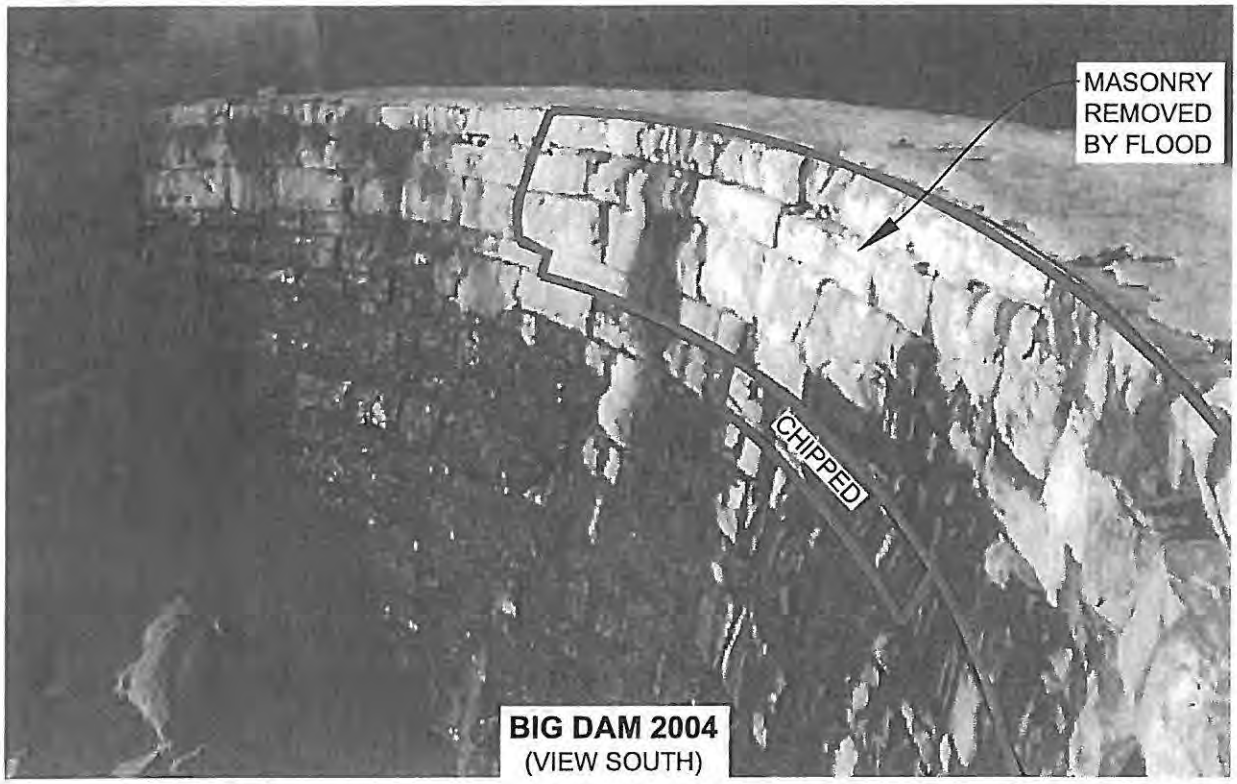
DEERE & AULT CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

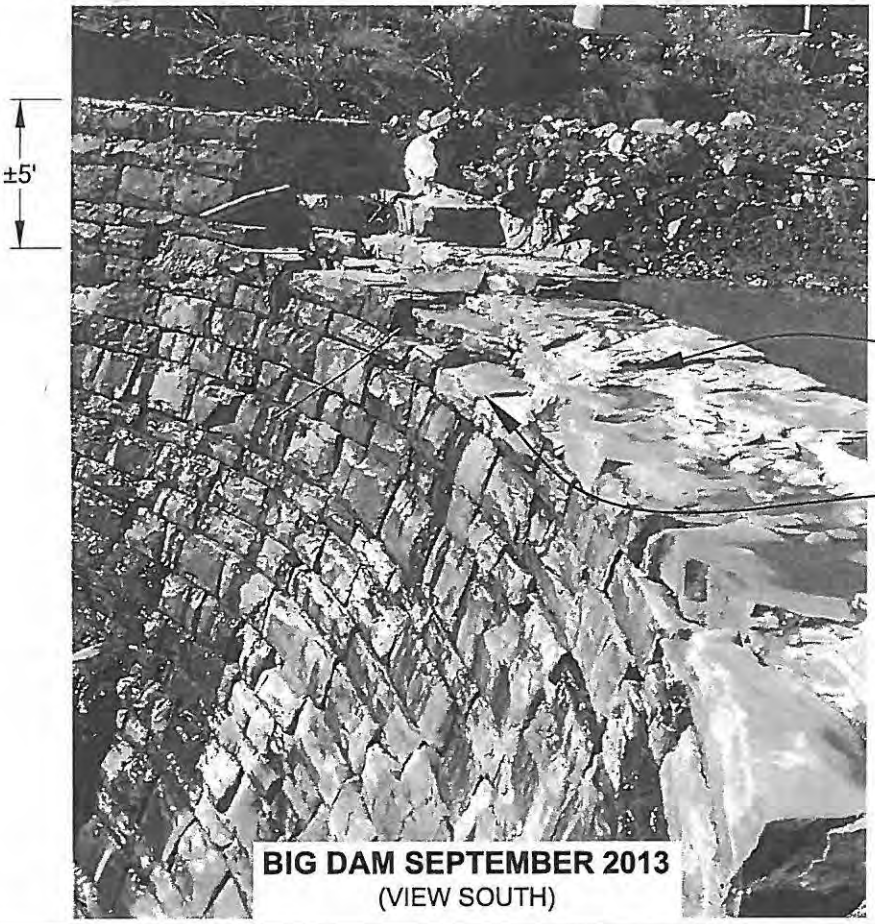
FIGURE NO. 1

JOB NO. 0122.019.00

SCALE: 1" = 30'



BIG DAM 2004
(VIEW SOUTH)

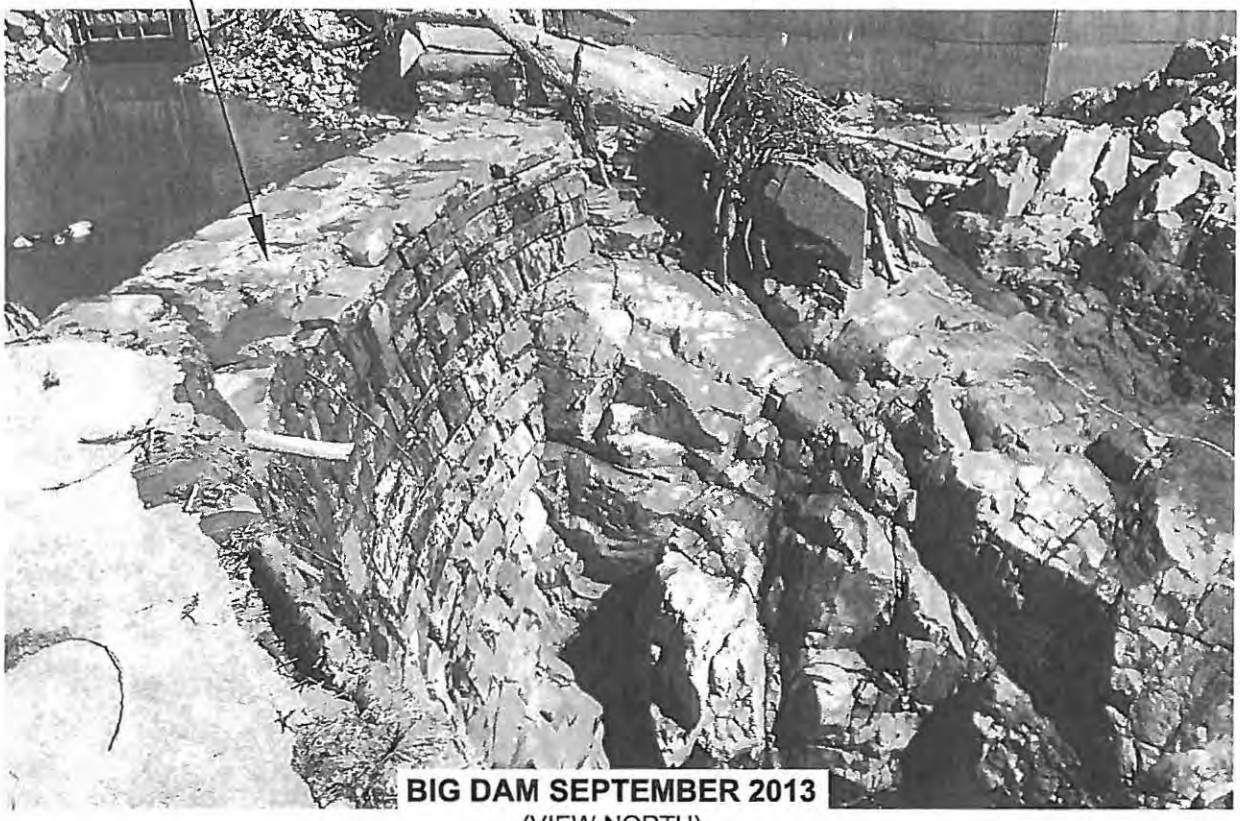


BIG DAM SEPTEMBER 2013
(VIEW SOUTH)

DEERE & AULT CONSULTANTS, INC.	**BIG DAM ON THE BIG THOMPSON RIVER**		**FIGURE NO.** 2
	JOB NO. 0122.019.00	**SCALE:** AS NOTED	

BIG DAM 2004
(VIEW NORTH)

MASONRY
REMOVED
BY FLOOD



BIG DAM SEPTEMBER 2013
(VIEW NORTH)

DEERE & AULT CONSULTANTS, INC.	BIG DAM ON THE BIG THOMPSON RIVER		FIGURE NO. 3
	JOB NO. 0122.019.00	SCALE: AS NOTED	

DAMAGED LEFT ABUTMENT BUTTRESS

HOLE ON DOWNSTREAM LEFT ABUTMENT CONTACT APPROXIMATE 20FT BELOW CREST

DOWNSTREAM MASONRY BLOCKS IN NEED OF MORTAR REPOINTING

DEERE & AULT CONSULTANTS, INC.	**BIG DAM ON THE BIG THOMPSON RIVER**		**FIGURE NO.** 4
	JOB NO. 0122.019.00	**SCALE:** AS NOTED	

CREST WITH
MASONRY RUBBLE

VIEW UPSTREAM OF LOW GRAVITY DAM SECTION

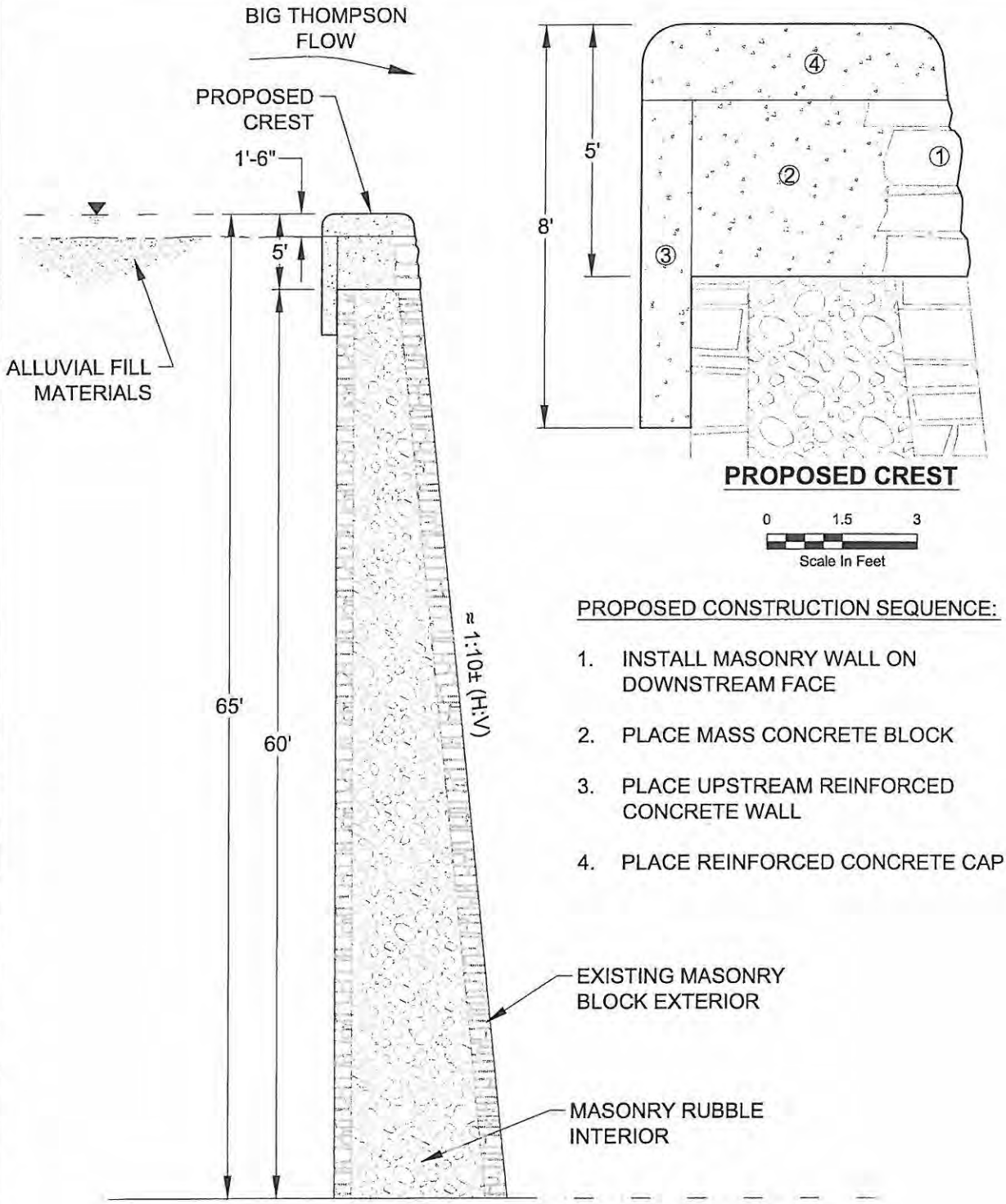
DEERE & AULT
CONSULTANTS, INC.

BIG DAM ON THE BIG THOMPSON RIVER

JOB NO. 0122.019.00

SCALE: AS NOTED

FIGURE NO. 5



DAM PROFILE

PROPOSED CREST

PROPOSED CONSTRUCTION SEQUENCE:

1. INSTALL MASONRY WALL ON DOWNSTREAM FACE
2. PLACE MASS CONCRETE BLOCK
3. PLACE UPSTREAM REINFORCED CONCRETE WALL
4. PLACE REINFORCED CONCRETE CAP

DEERE & AULT CONSULTANTS, INC.	BIG DAM ON THE BIG THOMPSON RIVER		FIGURE NO. 6
	JOB NO. 0122.019.00	SCALE: AS NOTED	

FIGURE 4

DEERE & AULT
CONSULTANTS, INC.

January 8, 2014

Ms. Minerva Lee
Consolidated Home Supply Ditch and Reservoir Company
c/o Northern Colorado Water Conservancy District
P.O. Box 1548
Berthoud, Colorado 80513

Re: 406 Mitigation Repairs to Big Dam Diversion; D&A Job No. CG-0122.019.01

Dear Ms. Lee:

This letter report presents our observations and recommendations for the proposed mitigation repairs to the Consolidated Home Supply Ditch headworks. The mitigation work focuses on the diversion system at the Big Dam on the Big Thompson River, west of Loveland, Colorado. The headworks structure and diversion gates were damaged during the September 2013 flood event. Operation of the gates was unsafe during the flooding event and did not allow the Ditch Company the opportunity to mitigate continuing damage being caused to the Big Dam as the flood waters receded.

GENERAL

The Big Dam and associated Consolidated Home Supply Ditch headworks diversion system are located on the Big Thompson River west of Loveland, Colorado. More specifically, the dam and headworks are located in Section 2, Township 5 North, Range 70 West. The dam and headworks location is shown on **Figure 1**.

The Big Dam is primarily a masonry, thick arch dam constructed in 1895 by the Consolidated Home Supply Ditch Company. The dam allows water to be diverted into the ditch system through the ditch headworks diversion system. The Ditch Company's headworks diversion system are located directly next to the Big Thompson River on the south side of the dam. Water diverted through the Consolidated Home Supply headworks diversion system irrigates approximately 17,000 acres of crop land and provides raw water for municipal use to the Town of Johnstown, Colorado. Diverted water is also delivered to several raw water storage reservoirs. Additionally, the City of Loveland also diverts water from the Big Thompson River using the Big Dam. Loveland's water is diverted from the north side of the dam via a 50-inch tall by 84-inch wide sluice gate. The water directly feeds their water treatment plant and provides up to 60 percent of the City's annual water supply.

The Consolidated Home Supply Ditch headworks diversion system near the Big Dam consists of essentially five items:

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 ● Fax: 303-651-1469

1. Concrete diversion structure and river headgates
2. Concrete sand out channel and training walls
3. Sand out gates that allow diverted water to be discharged back to the Big Thompson River
4. Control gates for maintaining consistent flows down the ditch
5. Concrete measuring flume

The ditch diversion system, various gates, and measuring flume are shown on **Figure 2**.

The concrete diversion structure supports three metal, hand operated headgates. Each gate is approximately 48 inches tall by 61 inches wide. The structure appears to have been constructed in 1915. The gates are operated using a manually operated hand crank where the operator must physically crank the gate open and closed by turning a gear with a bar. Downstream of the headgates, the water is conveyed in a concrete sand out channel constructed on the steep canyon slope to the sand out gates. The sand out gates consist of four metal, hand operated slide gates that allow water diverted into the ditch through the headgates to be returned to the river through openings in the concrete sand out channel training walls. The sand out gates allow sand and other sediment from the Big Thompson River to be flushed out of the ditch system and back to the river. A steel walkway elevated above the concrete sand out channel (**Figure 2**, **Photo C**) provides access to a platform used to operate the sand out gates. To control ditch flow rates, the sand out gates are usually used in tandem with the control gates. The control gates are located just down-ditch of the sand out gates, and consist of three 48-inch by 48-inch hand operated, metal slide gates orientated across the canal. The control gates regulate the amount of water to be released down the Consolidated Home Supply system. Water is released through the control gates and measured just downstream at a concrete flume. The existing flow measurement device is a 12-foot wide concrete Parshall flume. Flow rates through the concrete flume are measured and recorded in a nearby stilling well structure. Generally, excess water is not allowed to pass by the control gates and is released back into the river through the sand out gates.

SEPTEMBER 2013 FLOOD

The September 2013 flood on the Big Thompson River occurred during the week of September 9. The Big Dam, as well as the Consolidated Home Supply diversion structure, was damaged during the flooding. Peak flows on the Big Thompson River of 15,000 to 20,000 cfs have been estimated during this time frame. High flows of up to several thousand cfs continued for one to two weeks after the storm. Water depths of up to 10 feet were estimated to have overtopped the Big Dam. It is suspected that the continued flows after the peak flood event over the Big Dam continued to cause damage.

The Consolidated Home Supply Ditch diversion structure headgates were essentially inoperable during the flooding event. The high water from the flooding prevented anyone from safely accessing and operating the three headgates and the four sand out gates. The manual operators for the gates were under water during the flood, and the access walkways were unsafe for employees to attempt to access the gates. Because these gates were open when the flood hit and could not be operated remotely during the flood, the sand out channel filled with debris and sediment rendering

the system inoperable. Photos of the concrete irrigation channel and sand out gates shortly after the flood are shown on **Figure 3**.

If the headgates could have been operated remotely to close during the peak flows of the flood, then most of the debris and sediment would have passed over the dam at an elevation that would not damage the structure. The headgates and sand out gates could have been remotely opened after the first 24 hours of flooding to keep the sand out channel clean by opening the sand out gates remotely. This would have allowed the system to remain in operation so that as flows receded we could have safely raised all of our diversion gates while leaving the sand out gates open to divert a large portion of the flood flows around the dam and back to the river for the next week or two, mitigating much of the damage caused to the structure after the storm. Additionally, excess water of up to 250 cfs could have been conveyed down the ditch past the sand out and control gates and stored within the Ditch Company's reservoir systems. This would have also helped mitigate continuing damage to the dam and infrastructure further downstream.

PROPOSED MITIGATION IMPROVEMENTS

In the future during high flows or flooding on the Big Thompson River, proposed mitigation improvements at the Consolidated Home Supply headworks diversion system will reduce the potential for damages to the Big Dam, as well as the diversion structure. If the ditch headworks diversion system can be operated remotely during the peak of a flood, the gates can be closed to prevent the initial surge of debris and sediment from closing off the sand out channel. After the main surge has receded, the gates can be remotely operated to open and divert a portion of the flow in the creek through the headgates before they overtop the Big Dam crest. The water diverted into the sand out channel can then be discharged back to river through the sand out gates. This would effectively make a by-pass spillway around the dam to relieve the total amount of water overtopping the dam. This system would require the existing headgates and sand out gates to be replaced with new gates and operators. The existing gates are outdated and will not operate with modern electric actuators that can operate the gates from a remote location. This system will also allow the Ditch Company to safely operate the gates during a flood event without having to put personnel physically at the gate.

1. Structure Rehabilitation:

    a. Due to damage to the structure during the flood, we recommend the headgate structure be demolished and reconstructed with reinforced concrete to accommodate a new headwall with three new headgates. The sand out gate structure can be rehabilitated and reused to mount the new gates.

2. New slide gates

    a. Headgate structure: 3 gates – 5 feet wide by 4 feet tall

    b. Sand out Structure: 4 gates – 3 feet wide by 5 feet tall

c. The new actuators will allow Ditch Company personnel to operate the headgate and sand out gates without having to physically be at the gate during dangerous flood conditions. The actuators should be mounted at an elevation above the 100-year storm water line or the height of this past event.

3. Electrical and Communication Service:

a. There is overhead electric and phone service available at this location. A 3-phase electrical service with a meter, disconnects, service panel, etc. will need to be established to provide power to the system. A hard line phone or cellular service will also be required to communicate with the headworks from a remote location.

b. Electrical and communication wires and conduits will need to connect the gate actuators and water level sensors to a Remote Terminal Unit (RTU) or Program Logic Control (PLC) unit that will be located above the 100-year flood elevation.

c. System Integration–RTU/PLC, enclosures, data logger, modem, etc. along with programming and field testing to provide a complete operable system.

d. Start up and training of Ditch Company personnel.

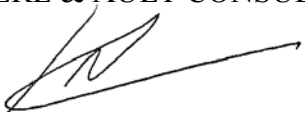
COSTS

The estimated construction cost is approximately $418,000, and is summarized on Table 1. To develop the estimated construction costs, we have used local experience, recent bids, and quoted costs from similar projects. The supportive cost information is attached.

Please call if you have any questions or comments.

Sincerely,

DEERE & AULT CONSULTANTS, INC.



Glen G. Chuch, P.E.
Principal, Project Manager

GGC:sp

Attachments

TABLE 1

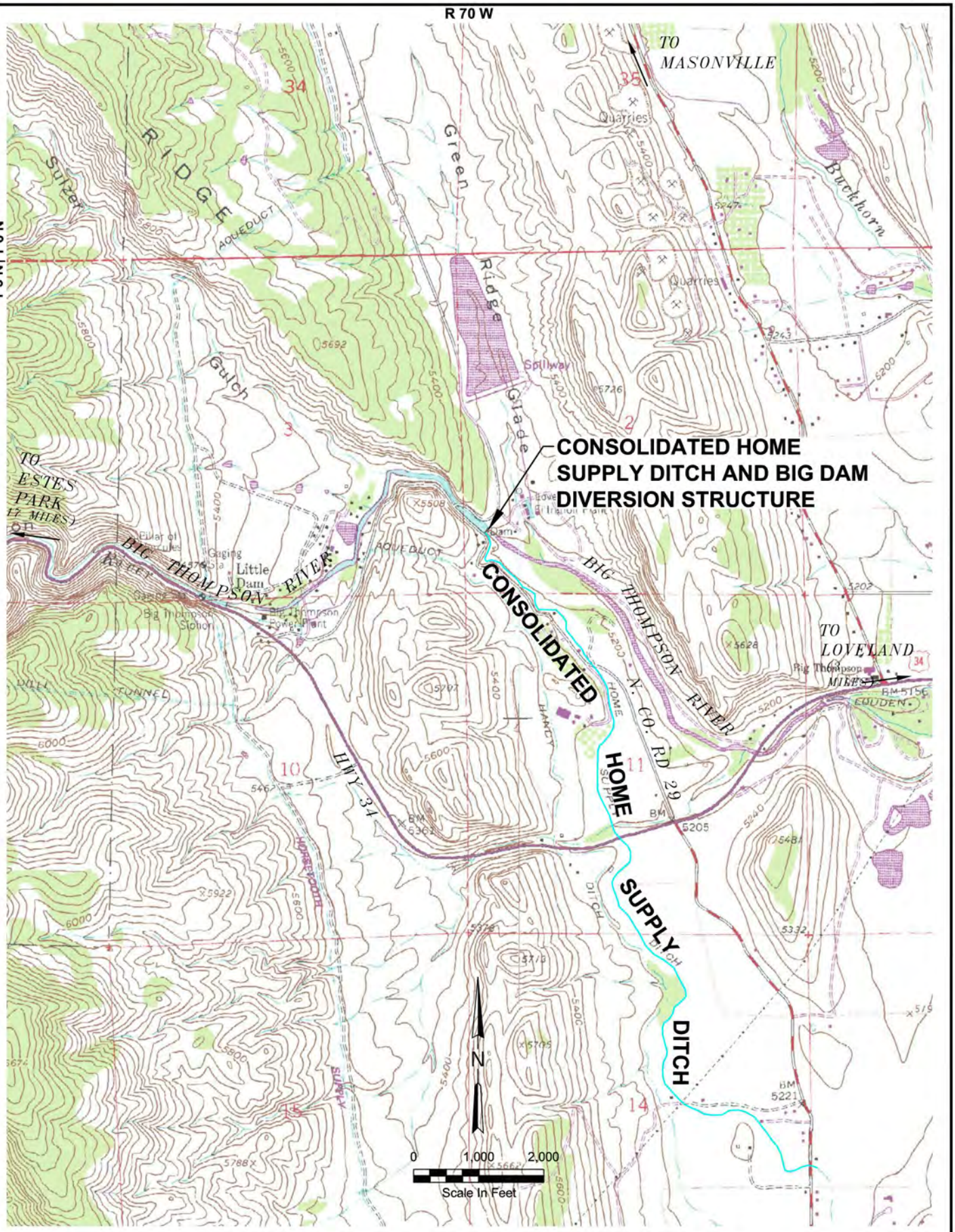
CONSOLIDATED HOME SUPPLY DITCH HEADWORKS SYSTEM
BASIC MITIGATION ITEMS

CONSOLIDATED HOME SUPPLY DITCH COMPANY

ENGINEERING OPINION OF CONSTRUCTION COSTS

January 8, 2014

Item #	Description	Quantity	Unit	Rate	Total
2	Construction Access/ Earthwork	1	LS	$ 7,000	$ 7,000
3	Demolition	1	LS	$ 20,000	$ 20,000
	Structural Concrete				
4	Headgate Structure	20	CY	$ 1,000	$ 20,000
	Concrete Rehabilitation				
5	Sandout Gate	1	LS	$ 10,000	$ 10,000
	SS Fabricated Slide Gates w/ Actuators and Walkways				
7	Headgates	3	EA	$ 32,000	$ 96,000
8	Sandout Gate	4	EA	$ 30,000	$ 120,000
	Electrical and Communication Service				
10	Utility Drop Service (Electrical and Phone)	1	LS	$ 10,000	$ 10,000
11	Electrical and Communications (Panels, Wiring, Conduits)	1	LS	$ 75,000	$ 75,000
12	System Integration	1	LS	$ 60,000	$ 60,000
			TOTAL ESTIMATED COST (rounded to nearest $1,000)		$ 418,000



DEERE & AULT CONSULTANTS, INC.

CONSOLIDATED HOME SUPPLY DITCH
Vicinity Map

JOB NO.	0122.019.01	SCALE:	AS NOTED

FIGURE NO. 1

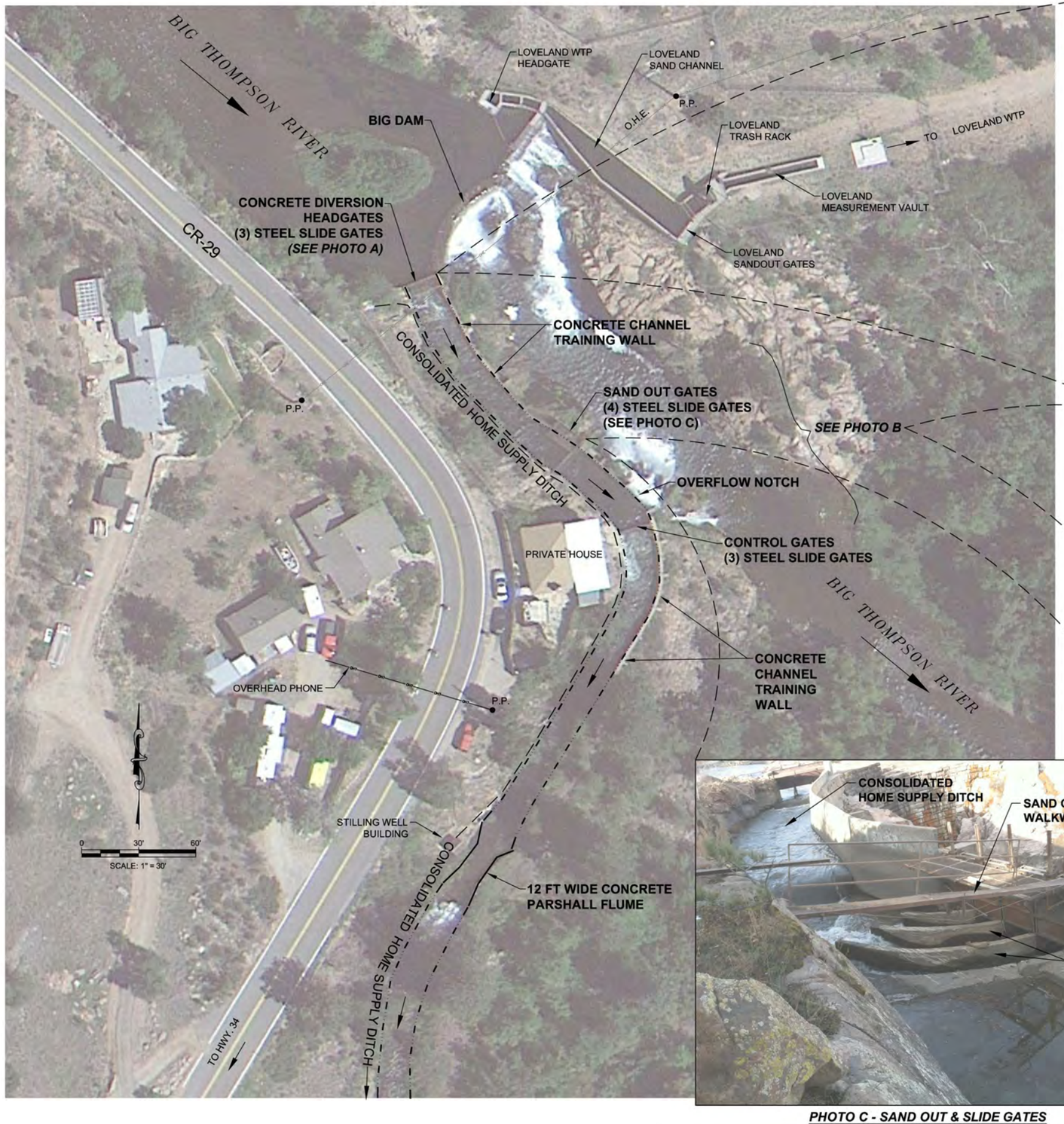


PHOTO A - CONCRETE DIVERSION STRUCTURE

PHOTO C - SAND OUT & SLIDE GATES

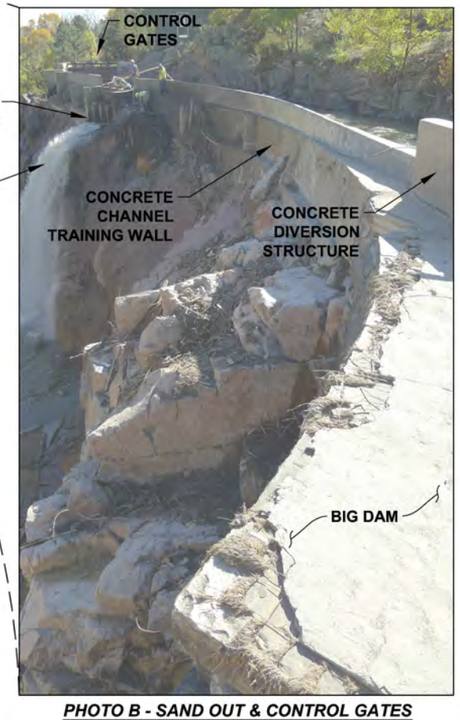


PHOTO B - SAND OUT & CONTROL GATES

JOB NO. 0122.019.01

CONSOLIDATED HOME SUPPLY DITCH

DITCH DIVERSION & GATES

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **2**

DATE: **1/7/2014**

SCALE: **AS NOTED**

Tuesday, January 07, 2014 5:06:42 PM DRAWING: P:\0122 Consolidated Home Supply\CAD\DAC Drawings\Big Dam Drawings\Figures\Headworks System Integration.DWG

PHOTO 1 - DEBRIS AGAINST SAND OUT GATES ACCESS WALKWAY

PHOTO 2 - SEDIMENT FILLED IRRIGATION CHANNEL UPSTREAM OF THE SAND OUT GATES

DEERE & AULT CONSULTANTS, INC.

CONSOLIDATED HOME SUPPLY DITCH

Flooded Photos at Diversion Headworks

JOB NO.	0122.019.01	SCALE:	AS NOTED

FIGURE NO. **3**

COST ESTIMATE BACKUP INFORMATION

ROUGH & READY DITCH DIVERSION RECONSTRUCTION
BID TABULATION
Monday, January 06, 2014

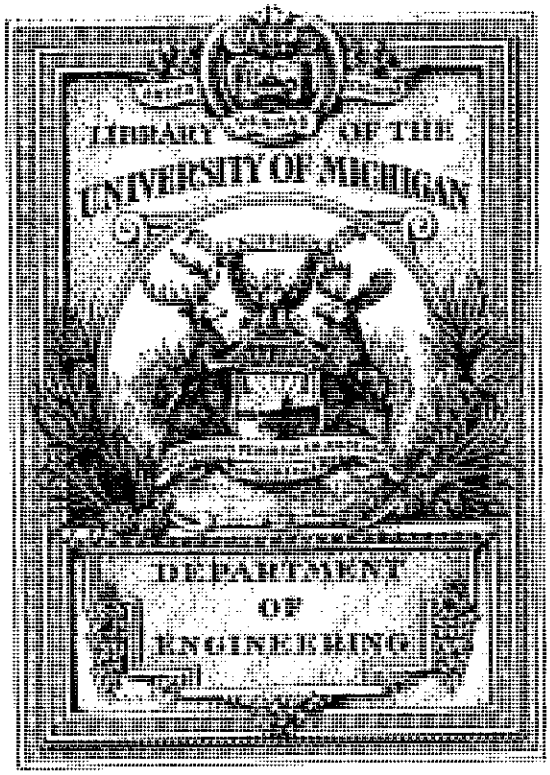
Item	Description	Unit	Quantity	Engineering Estimate			Contractor 1			Contractor 2		
				Unit Cost	Extension	Subtotal	Unit Cost	Extension	Subtotal	Unit Cost	Extension	Subtotal
1	Mobilization @ 5%	1	LS	$60,000	$60,000		$ 45,000.00	$ 45,000.00		$ 30,974.07	$ 30,974.07	
2	Site Preparation/ Access/ Demolition/ Clear and Grub/ Tree Removal	1	LS	$100,000	$100,000		$ 30,000.00	$ 30,000.00		$ 147,571.71	$ 147,571.71	
3	General Earthwork/ Finish Grading/ Revegetation	1	LS	$100,000	$100,000		$ 24,000.00	$ 24,000.00		$ 26,081.26	$ 26,081.26	
4	Temporary River Diversion/ Care of the River/ Dewatering	1	LS	$100,000	$100,000		$ 48,000.00	$ 48,000.00		$ 101,306.15	$ 101,306.15	
5	Concrete Dam Crest Wall	42	CY	$800	$33,600		$ 625.00	$ 26,250.00		$ 910.34	$ 38,234.28	
6	Concrete Approach Apron	28	CY	$800	$22,400		$ 550.00	$ 15,400.00		$ 935.00	$ 26,180.00	
7	Concrete Headgate Structure - Rough & Ready Ditch	50	CY	$800	$40,000		$ 950.00	$ 47,500.00		$ 914.08	$ 45,704.00	
8	Concrete Headgate Structure - Palmerton Ditch	45	CY	$800	$36,000		$ 1,100.00	$ 49,500.00		$ 914.39	$ 41,147.55	
9	Concrete Rivergate Structure	50	CY	$800	$40,000		$ 1,155.00	$ 57,750.00		$ 921.12	$ 46,056.00	
10	Concrete Fish Ladder	29	CY	$800	$23,200		$ 1,500.00	$ 43,500.00		$ 897.25	$ 26,020.25	
11	Concrete Bridge Abutments (2 Ditch Crossings)	2	EA	$20,000	$40,000		$ 45,000.00	$ 90,000.00		$ 36,384.20	$ 72,768.40	
12	5' Concrete Parshall Flume - Rough & Ready Ditch	28	CY	$800	$22,400		$ 985.00	$ 27,580.00		$ 911.64	$ 25,525.92	
13	8' Concrete Parshall Flume - Palmerton Ditch	32	CY	$800	$25,600		$ 991.00	$ 31,712.00		$ 883.84	$ 28,282.88	
14	4' x 6' SS Fabricated Slide Gates (Headgates)	2	EA	$24,000	$48,000		$ 11,865.00	$ 23,730.00		$ 13,416.32	$ 26,832.64	
15	4' x 5' SS Fabricated Slide Gates (Headgates)	2	EA	$22,000	$44,000	**$1,269,950**	$ 11,865.00	$ 23,730.00	**$ 923,474.00**	$ 13,416.32	$ 26,832.64	**$ 1,189,216.21**
16	3' x 5' SS Fabricated Slide Gates (Rivergates)	2	EA	$16,000	$32,000		$ 8,140.00	$ 16,280.00		$ 11,533.61	$ 23,067.22	
17	Handrails, Walkways, and Concrete Pier Plate Protection	1	LS	$50,000	$50,000		$ 16,400.00	$ 16,400.00		$ 9,637.56	$ 9,637.56	
18	Stilling Well and Equipment at Rivergate	1	LS	$11,000	$11,000		$ 4,700.00	$ 4,700.00		$ 7,632.18	$ 7,632.18	
19	Stilling Well & Equipment @ Parshall Flumes	2	EA	$5,000	$10,000		$ 7,500.00	$ 15,000.00		$ 4,088.10	$ 8,176.20	
20	Rough & Ready Culvert Cleanout	1	LS	$15,000	$15,000		$ 4,900.00	$ 4,900.00		$ 813.35	$ 813.35	
21	Palmerton Culvert Cleanout	1	LS	$15,500	$15,500		$ 6,000.00	$ 6,000.00		$ 3,746.76	$ 3,746.76	
22	Type H Grouted Riprap Upstream of Headgate on St. Vrain Creek	52	CY	$250	$13,000		$ 200.00	$ 10,400.00		$ 219.79	$ 11,429.08	
23	Type M Riprap downstream of Headgate on Rough & Ready Ditch	20	CY	$150	$3,000		$ 138.00	$ 2,760.00		$ 165.12	$ 3,302.40	
24	Type M Riprap downstream of Headgate on Palmerton Ditch	18	CY	$150	$2,700		$ 138.00	$ 2,484.00		$ 170.86	$ 3,075.48	
25	Type M Riprap downstream of Parshall Flumes	55	CY	$150	$8,250		$ 138.00	$ 7,590.00		$ 149.14	$ 8,202.70	
26	Type M Riprap downstream Sloping Boulder Dam	145	CY	$150	$21,750		$ 138.00	$ 20,010.00		$ 147.87	$ 21,441.15	
27	Type L Riprap Bedding for Sloping Boulder Diversion Dam	222	CY	$75	$16,650		$ 165.00	$ 36,630.00		$ 103.81	$ 23,045.82	
28	Grouted Sloping Boulder Diversion Dam (3 Foot Boulders)	444	CY	$350	$155,400		$ 197.00	$ 87,468.00		$ 369.74	$ 164,164.56	
29	Rough & Ready and Palmerton Ditch Earthwork	4,300	CY	$35	$150,500		$ 19.00	$ 81,700.00		$ 28.23	$ 121,389.00	
30	Loukonen's Breach Earth Import	2,500	CY	$12	$30,000		$ 11.00	$ 27,500.00		$ 28.23	$ 70,575.00	

Contractor 3			Contractor 4			Contractor 5			AVERAGE		
Unit Cost	**Extension**	**Subtotal**	**Unit Cost**	**Extension**	**Subtotal**	**Unit Cost**	**Extension**	**Subtotal**	**Unit Cost**	**Extension**	**Subtotal**
$ 55,000.00	$ 55,000.00		$ 32,982.66	$ 32,982.66		$ 65,000.00	$ 65,000.00		$ 45,791.35	$ 45,791.35	
$ 86,660.00	$ 86,660.00		$ 52,594.27	$ 52,594.27		$ 65,000.00	$ 65,000.00		$ 76,365.20	$ 76,365.20	
$ 10,640.00	$ 10,640.00		$ 54,626.40	$ 54,626.40		$ 155,000.00	$ 155,000.00		$ 54,069.53	$ 54,069.53	
$ 43,425.00	$ 43,425.00		$ 48,361.32	$ 48,361.32		$ 175,000.00	$ 175,000.00		$ 83,218.49	$ 83,218.49	
$ 840.00	$ 35,280.00		$ 1,039.23	$ 43,647.66		$ 1,050.00	$ 44,100.00		$ 892.91	$ 37,502.39	
$ 630.00	$ 17,640.00		$ 948.12	$ 26,547.36		$ 900.00	$ 25,200.00		$ 792.62	$ 22,193.47	
$ 856.00	$ 42,800.00		$ 1,000.37	$ 50,018.50		$ 1,250.00	$ 62,500.00		$ 994.09	$ 49,704.50	
$ 824.00	$ 37,080.00		$ 1,028.27	$ 46,272.15		$ 1,300.00	$ 58,500.00		$ 1,033.33	$ 46,499.94	
$ 996.00	$ 49,800.00		$ 1,012.92	$ 50,646.00		$ 1,250.00	$ 62,500.00		$ 1,067.01	$ 53,350.40	
$ 795.00	$ 23,055.00		$ 1,002.12	$ 29,061.48		$ 1,050.00	$ 30,450.00		$ 1,048.87	$ 30,417.35	
$ 9,738.00	$ 19,476.00		$ 57,187.30	$ 114,374.60		$ 15,000.00	$ 30,000.00		$ 32,661.90	$ 65,323.80	
$ 934.00	$ 26,152.00		$ 1,197.92	$ 33,541.76		$ 1,300.00	$ 36,400.00		$ 1,065.71	$ 29,839.94	
$ 954.00	$ 30,528.00		$ 1,229.61	$ 39,347.52		$ 1,300.00	$ 41,600.00		$ 1,071.69	$ 34,294.08	
$ 20,638.00	$ 41,276.00		$ 20,849.62	$ 41,699.24		$ 15,000.00	$ 30,000.00		$ 16,353.79	$ 32,707.58	
$ 20,638.00	$ 41,276.00	**$ 1,141,579.00**	$ 20,849.62	$ 41,699.24	**$ 1,079,528.35**	$ 15,000.00	$ 30,000.00	**$ 1,449,180.00**	$ 16,353.79	$ 32,707.58	**$ 1,156,595.51**
$ 19,458.00	$ 38,916.00		$ 18,165.82	$ 36,331.64		$ 15,000.00	$ 30,000.00		$ 14,459.49	$ 28,918.97	
$ 32,623.00	$ 32,623.00		$ 71,145.00	$ 71,145.00		$ 100,000.00	$ 100,000.00		$ 45,961.11	$ 45,961.11	
$ 15,600.00	$ 15,600.00		$ 10,655.61	$ 10,655.61		$ 6,000.00	$ 6,000.00		$ 8,917.56	$ 8,917.56	
$ 14,200.00	$ 28,400.00		$ 10,961.79	$ 21,923.58		$ 6,000.00	$ 12,000.00		$ 8,549.98	$ 17,099.96	
$ 1,900.00	$ 1,900.00		$ 3,370.46	$ 3,370.46		$ 1,000.00	$ 1,000.00		$ 2,396.76	$ 2,396.76	
$ 1,900.00	$ 1,900.00		$ 4,083.70	$ 4,083.70		$ 4,500.00	$ 4,500.00		$ 4,046.09	$ 4,046.09	
$ 116.00	$ 6,032.00		$ 187.43	$ 9,746.36		$ 450.00	$ 23,400.00		$ 234.64	$ 12,201.49	
$ 210.00	$ 4,200.00		$ 93.21	$ 1,864.20		$ 165.00	$ 3,300.00		$ 154.27	$ 3,085.32	
$ 188.00	$ 3,384.00		$ 100.31	$ 1,805.58		$ 165.00	$ 2,970.00		$ 152.43	$ 2,743.81	
$ 188.00	$ 10,340.00		$ 85.13	$ 4,682.15		$ 165.00	$ 9,075.00		$ 145.05	$ 7,977.97	
$ 188.00	$ 27,260.00		$ 84.75	$ 12,288.75		$ 165.00	$ 23,925.00		$ 144.72	$ 20,984.98	
$ 230.00	$ 51,060.00		$ 75.74	$ 16,814.28		$ 155.00	$ 34,410.00		$ 145.91	$ 32,392.02	
$ 329.00	$ 146,076.00		$ 248.02	$ 110,120.88		$ 450.00	$ 199,800.00		$ 318.75	$ 141,525.89	
$ 41.00	$ 176,300.00		$ 7.57	$ 32,551.00		$ 16.00	$ 68,800.00		$ 22.36	$ 96,148.00	
$ 15.00	$ 37,500.00		$ 14.69	$ 36,725.00		$ 7.50	$ 18,750.00		$ 15.28	$ 38,210.00	

FIGURE 5

Storage of water on Cache la Poudre and Big ...

Clarence Everett Bait



U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 134.

A. C. TRUE, Director.

STORAGE OF WATER ON CACHE LA POUDRE AND BIG THOMPSON RIVERS.

BY

C. E. TAIT,

ASSISTANT IN IRRIGATION INVESTIGATIONS.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1903.

OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Ph. D., *Director.*
E. W. ALLEN, Ph. D., *Assistant Director.*

IRRIGATION INVESTIGATIONS.

ELWOOD MEAD, *Chief.*
C. T. JOHNSTON, *Assistant Chief in Charge of Central District.*
SAMUEL FORTIER, *Irrigation Engineer in Charge of Pacific District.*
C. G. ELLIOTT, *Agent and Expert in Charge of Drainage Investigations.*
R. P. TEELE, *Editorial Assistant.*
C. E. TAIT, *Assistant in Charge of Maps and Illustrations.*

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., August 1, 1903.

SIR: I have the honor to transmit herewith and to recommend for publication as a bulletin of this Office a report on the storage of water on the Cache la Poudre and Big Thompson rivers in northern Colorado, prepared under the direction of Prof. Elwood Mead, chief of irrigation investigations, by C. E. Tait, assistant in these investigations.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
IRRIGATION INVESTIGATIONS,
Washington, D. C., August 1, 1903.

SIR: I have the honor to submit for publication a report on the storage of water on the Cache la Poudre and Big Thompson rivers, prepared by Mr. C. E. Tait, assistant in irrigation investigations. The ground covered by this report has been partly gone over in previous reports of this Office, but the supply of some of these reports has been exhausted and, moreover, considerable progress has been made since their publication; it has, therefore, seemed advisable to issue a bulletin showing the results of a more thorough study of these valleys with reference to the storage of water and the use of the stored water in irrigation, going more fully into methods and details of construction than in the former bulletins, and giving much new data regarding the crop returns which are directly attributable to the use of stored water.

Northern Colorado is one of the most advanced agricultural sections in the arid region, and the value of water has led to the construction of reservoirs to store all the water the streams supply in ordinary years, and also of what may be termed "flood reservoirs," to catch the occasional floods which visit the valleys. This work has all been done by the farmers living in the valleys and has been extremely profitable, as is shown by the report. As development proceeds similar conditions will arise in other parts of the West, and the experience gained in Colorado will be suggestive and helpful to irrigators in the newer districts.

Respectfully,

ELWOOD MEAD,
Chief of Irrigation Investigations.

DR. A. C. TRUE, *Director.*

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STORAGE OF WATER ON CACHE LA POUDRE AND BIG THOMPSON RIVERS.

By C. E. TAIT,
Assistant in Irrigation Investigations.

INTRODUCTION.

The purpose of this report is to show the success and value of storage works, constructed by private capital and operated as private enterprises, and to describe the methods employed in their operation in order to encourage and aid the further extension of this form of irrigation development.

With the exception of the fruit districts in southern California, probably in no place is there as scientific and profitable a use of the water available for irrigation as in parts of Colorado. A study has been made of the storage on two streams in the north-central portion of the State—the Cache la Poudre and Big Thompson rivers—where an advanced stage of development has been reached. At present nearly all the water of these two streams not used for direct irrigation is stored, and if progress continues for a few years practically all of it will be used. This has been effected by the construction of numerous reservoirs, comparatively small or medium in size, entirely with private capital, by the irrigators themselves, who now control and operate their own works.

The aim of the report is to show how the farmers proceeded and to present the faults and merits of their plans as brought out by the test of usage, that their experience may benefit others in similar undertakings. The more general and popular questions of storage have been much discussed, but with little reference to the details of construction and operation. An attempt, therefore, was made to collect information regarding all the details of construction, the dimensions of dams and outlets, the efficiency of the works, and the legal conditions of storage, which might be of value to those unfamiliar with such work.

The results in agricultural products for the seasons of 1901 and 1902 are reported. The crops of the former year were slightly above the average, while those of the latter were below it on account of one of the smallest water supplies of which there is any record, and other

unfavorable conditions. When considered together, the results of the two seasons give at least a conservative idea of the value of the reservoirs of northern Colorado.

Only the larger and more important reservoirs on the Cache la Poudre are described, but all on the Big Thompson, regardless of size, were included in the investigation. While the small reservoirs owned by one or more farmers are not specially interesting studied individually, when considered together they show the great extent to which they are used and how they serve the needs of the irrigators. That practical irrigators should use this only partially satisfactory means of securing late water where there are no suitable sites for larger reservoirs supplementing the whole system is in itself convincing evidence of the value of stored water.

CHARACTER OF THE CACHE LA POUDRE AND BIG THOMPSON RIVERS.

The Cache la Poudre and Big Thompson rivers are the most important tributaries of the South Platte River. They drain a portion of north-central Colorado. The former drains about 1,000 square miles in the mountainous region east of the Medicine Bow and Laramie ranges and the latter about 600 square miles between the foothills and the Continental Divide. In the mountainous district the main streams are made up of innumerable streams, but there are few tributaries of importance east of the foothills. The headwaters of the Cache la Poudre are divided into three large branches—the Middle, North, and South forks. What is known as the Big South Poudre is an important stream entering the Middle Fork below Chambers Lake. The Big Thompson is formed by the North and South forks, the latter receiving Fall River. The Little Thompson enters the Big Thompson a few miles above where the latter enters the South Platte and is practically an independent stream as regards irrigation, for there are no ditches of importance below the junction. The Little Thompson is small and no measurements are made on it by the State. Its flow during the summer is made up mainly from seepage from the lands irrigated from the Big Thompson.

Both rivers, receiving their waters from the snows in the mountains, are, like all streams of this character, subject to great fluctuation. The following tables give the average daily discharges of the two streams for the years 1901 and 1902 and the average monthly discharges for the years 1895 to 1902, inclusive. The measurements for the years 1901 and 1902 were furnished by the water commissioners on the streams, while the average monthly discharges for former years were obtained from the reports of the State engineer.

Discharge of Cache la Poudre River in 1901.

Day.	March.	April.	May.	June.	July.	August.	September.	October.	November.
	Cu. feet per sec.	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*
1	95	122	700	2,449	1,253	306	256	106	111
2	99	127	758	2,263	1,274	307	242	103	111
3	99	127	790	2,199	1,274	295	242	101	112
4	79	142	717	2,010	1,140	295	237	104	103
5	80	132	649	1,870	999	298	220	106	111
6	109	117	667	1,875	924	286	174	98	101
7	109	150	771	1,733	804	337	179	108	113
8	108	160	737	1,904	714	374	199	109	110
9	110	165	735	2,240	631	442	183	130	110
10	110	205	772	2,060	965	372	184	149	110
11	95	190	1,097	2,135	812	363	179	136	105
12	100	205	1,132	1,864	887	341	178	144	106
13	100	190	1,217	1,753	727	300	169	138	100
14	100	190	1,352	1,823	297	295	168	116	95
15	101	190	1,590	2,127	657	252	154	106	95
16	96	190	1,740	2,123	595	243	125	109	95
17	101	190	1,975	2,049	508	229	127	109	97
18	106	205	2,180	1,940	495	258	136	109	95
19	106	225	2,410	1,970	494	225	135	110	92
20	106	225	2,620	1,913	465	317	136	114	78
21	106	315	3,850	1,997	408	245	121	118	75
22	106	390	5,100	2,087	400	243	131	111	81
23	101	475	2,460	2,144	378	232	120	104	83
24	101	575	2,008	2,136	362	210	125	112	95
25	102	575	2,236	2,065	357	215	113	111	101
26	107	550	2,321	1,795	458	210	118	109	101
27	112	560	2,422	1,675	410	236	113	110	98
28	112	560	2,500	1,575	400	260	106	111	91
29	107	590	2,570	1,497	368	254	106	105	90
30	117	710	2,216	1,362	352	249	109	112	85
31	127	.....	2,574	.....	332	254	.....	109	.....
Average	103	292	1,770	1,954	650	282	159	113	98

The flow for December, January, and February is estimated at 75 cubic feet per second.

Discharge of Cache la Poudre River in 1902.

Day.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	Cu. ft. per sec.	*Cu. ft. per sec.*	*Cu. ft per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
1	115	63	50	74	200	1,823	595	229	141	215	127	94
2	100	68	71	90	267	1,736	484	199	152	229	132	84
3	100	69	70	89	336	1,558	467	203	138	226	102	89
4	110	68	62	110	366	1,455	491	196	115	228	103	87
5	105	74	58	100	509	1,660	417	192	80	200	102	117
6	110	73	65	110	553	1,512	417	200	76	191	107	127
7	112	78	65	114	583	1,526	374	194	75	199	102	127
8	116	78	70	134	700	1,644	303	187	72	187	105	117
9	95	83	100	135	824	1,623	370	180	72	183	123	127
10	80	83	86	139	897	1,618	372	179	83	183	125	132
11	70	88	74	144	1,042	1,635	353	175	80	162	120	129
12	55	85	70	163	1,143	1,420	314	164	68	162	120	120
13	54	95	73	145	1,370	1,386	349	158	68	168	133	115
14	60	95	78	159	1,269	1,296	244	156	68	163	134	115
15	57	90	80	154	1,518	1,159	200	161	64	163	123	120
16	70	85	39	157	1,502	947	257	152	63	210	128	120
17	80	90	65	165	1,438	917	241	131	68	210	128	107
18	65	91	62	170	1,470	873	378	131	66	177	137	122
19	75	96	84	216	1,281	854	412	126	69	171	137	120
20	90	90	89	240	1,108	793	349	114	71	167	130	122
21	80	71	79	274	887	768	285	117	126	170	137	115
22	76	76	82	176	662	751	253	104	488	170	131	140
23	61	65	85	149	656	724	238	99	478	170	116	140
24	63	62	89	165	603	779	224	109	322	168	126	125
25	63	66	101	162	681	606	271	109	293	170	96	110
26	64	60	100	179	892	601	267	104	241	147	101	135
27	68	78	102	179	1,302	743	276	94	240	164	121	125
28	63	74	103	146	1,521	712	255	109	270	162	126	130
29	63	.....	99	156	1,566	707	245	112	258	147	108	112
30	64	.....	99	191	1,407	729	235	91	256	132	84	87
31	62	.....	101	.....	1,887	.....	243	94	.....	132	.....	92
Average.	79	78	79	152	983	1,152	328	147	155	178	119	116

Average monthly discharge of Cache la Poudre River, 1895–1902.

Year.	March.	April.	May.	June.	July.	August.	September.	October.	November.
	Cu. feet per sec.	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*
1895	.....	.....	1,437	2,497	1,130	495	224	.....	.....
1896	.....	.....	.....	773	458	272	202	.....	.....
1897	.....	727	2,105	1,739	749	371	177	.....	.....
1898	.....	306	671	1,330	481	184	78	59	.....
1899	.....	.....	1,480	2,632	1,441	557	212	117	.....
1900	.....	1,376	2,809	2,042	721	265	149	132	.....
1901	103	292	1,829	1,954	682	282	159	113	98
1902	79	153	983	1,162	328	147	155	178	119
Average	91	571	1,617	1,877	749	322	181	120	109
Average discharge in acre-feet	5,595	33,977	99,426	111,689	46,055	19,799	10,770	7,379	6,486

Discharge of Big Thompson River in 1901.

Day.	June.	July.	August.	September.	October.	Day.	June.	July.	August.	September.	October.
	Cu. ft. per sec.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*		*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
1	.....	975	255	110	45	18	616	425	255	55	45
2	.....	975	255	110	45	19	710	225	220	55	45
3	.....	851	255	95	45	20	810	355	220	55	45
4	.....	811	355	110	45	21	864	355	255	55	45
5	643	741	355	95	44	22	990	355	276	55	55
6	620	725	355	95	44	23	1,092	308	220	55	55
7	626	683	355	110	45	24	1,143	308	180	55	55
8	865	657	355	110	45	25	1,127	308	180	44	55
9	944	557	506	110	45	26	882	355	150	44	55
10	1,260	761	506	80	45	27	864	355	180	44	55
11	980	864	404	80	55	28	810	308	140	44	55
12	895	761	370	80	55	29	810	308	140	44	55
13	870	710	355	80	55	30	790	308	140	44	55
14	900	608	255	70	55	31	.....	255	140	.....	55
15	910	557	276	70	55						
16	740	557	220	60	55	Average.	865	531	269	72	50
17	740	425	220	60	55						

Discharge of Big Thompson River in 1902.

Day.	April.	May.	June.	July.	August.	September.	October.	November.
	Cu. feet per sec.	*Cu. feet. per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*
1	.....	80	710	308	110	55	110	35
2	.....	80	659	263	110	55	220	35
3	.....	80	557	308	110	55	140	35
4	.....	80	659	308	143	55	180	35
5	.....	80	761	263	143	45	110	35
6	.....	110	659	220	110	45	110	35
7	.....	143	659	180	110	45	90	30
8	.....	180	761	150	110	45	80	30
9	.....	220	761	143	110	33	80	30
10	.....	220	810	180	80	33	80	35
11	.....	263	761	180	80	33	110	35
12	.....	308	659	180	80	33	180	35
13	.....	404	608	180	80	33	140	35
14	.....	506	608	180	110	33	140	28
15	.....	506	659	180	110	33	110	28
16	.....	506	659	180	80	28	110	35
17	.....	557	557	180	80	28	80	40
18	.....	557	506	455	80	28	110	35
19	.....	506	455	355	80	28	80	28
20	.....	263	455	220	70	35	80	28
21	.....	220	404	180	55	180	80	30
22	.....	180	404	180	55	263	55	30
23	.....	143	404	180	55	220	55	35
24	.....	143	455	180	80	143	55	35
25	35	143	455	143	80	110	55	35
26	35	143	455	308	55	220	40	30
27	35	404	455	180	55	143	40	30
28	35	659	455	143	55	143	55	30
29	35	455	506	120	55	143	55	.....
30	35	659	404	110	80	110	40	.....
31	.....	710	.....	110	55	.....	35	.....
Average	35	307	577	208	86	82	94	31

Average monthly discharge of Big Thompson River, 1895–1902.

Year.	April.	May.	June.	July.	August.	September.	October.	November.
	Cu. feet per sec.	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*	*Cu. feet per sec.*
1895	.....	318	570	465	319	146	79	.....
1896	37	218	285	225	144	119	66	.....
1897	.....	420	465	267	133	37	17	27
1898	.....	164	377	238	79	36	18	8
1899	140	303	917	653	283	92	64	.....
1900	412	1,382	1,362	349	137	77	.....	.....
1901	.....	.....	865	534	269	72	50	.....
1902	35	307	517	208	81	82	94	32
Average	156	445	670	367	181	83	55	22
Average discharge in acre-feet	9,282	27,362	39,867	22,566	11,129	4,938	3,382	1,309

smaller but similar in form to those used at Lake Loveland (fig. 7, p. 58). In place of the rack there is a steel rod at the top fitted inside the pipe and bolted thereto. This rod, being threaded, works in a brass nut which is the center of a pinion gearing with a worm at right angles to it. The power applied to a large hand wheel turns the worm, the two having a common shaft.

The reservoir is 373 acres in area, and is 16½ feet deep over the outlet. Its capacity is 4,140 acre-feet. The reservoir could be enlarged in capacity 30 per cent by raising and lengthening the dam. The decreed priority of the reservoir is the second on the stream, dating from October 1, 1875, and the amount decreed is for 180,865,000 cubic feet. The preceding priority is for a small amount, so that the chances of the reservoir being filled are very good.

The company paid $6,000 for the site of the Mariano Reservoir and the perpetual right to fill it through the Rist Ditch, which it agrees to enlarge and maintain. The reservoir could be conveniently filled through any of the three other ditches which pass around a point of the foothills at the west end of the reservoir. The highest of these, the Handy Ditch, is within a half mile of the reservoir, and the Home Supply Canal and the South Side Ditch are successively below it. The Rist Ditch has a capacity of only 66 cubic feet per second, but it runs just around the reservoir below the other three, and the water has to be carried only about 3 miles from the river, while if the company's canal were used it would be carried a much greater distance.

The dam of the reservoir cost originally $4,000, and it was riprapped later at a cost of $500, thus making the total cost of the reservoir $10,500, which does not include the cost of enlarging the inlet. The cost per acre-foot stored is $2.54.

HOME SUPPLY DAM.

The Home Supply Dam is located at the mouth of the canyon of the Big Thompson River, and its purpose is to divert the waters of the stream into the head of the Home Supply Canal. The amount of water impounded by the dam is of no consequence, as the canyon above it is very narrow and the fall of the stream great. While the dam was not intended for storage purposes, it is of a type well adapted to mountain streams for either storage or diversion purposes, and it is therefore described in this connection.

The Home Supply Canal was designed to irrigate the greater part of the valuable land between the Big and Little Thompson rivers, and runs near the highest portion of the slight ridge between these two streams, irrigating land both north and south of it. After leaving the river it runs south some distance through the narrow tract of flat land between the mountains and foothills, until it drops 15 feet or more into Cottonwood Creek, a tributary of the Big Thompson River,

and this natural channel is used in passing through the range of foothills. The dam raised the water to the head of the canal, over 40 feet above the channel of the river, and it might seem that this was unnecessary, since a drop is allowed at a lower point; but it was desirable in order that the canal might pass behind the range of foothills instead of along their eastern slope, where a great deal of expensive work

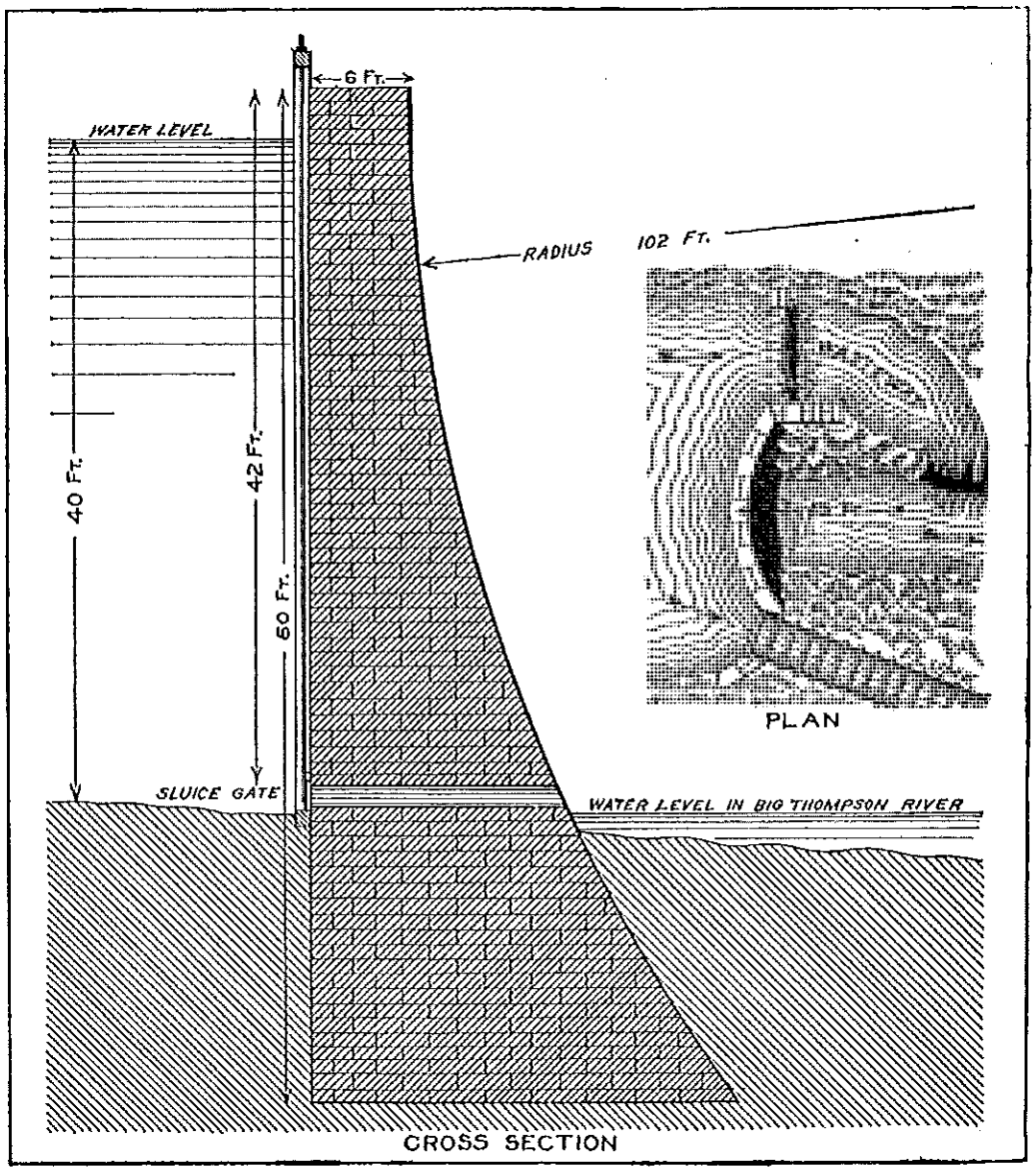


FIG. 8.—Design of Home Supply Dam.

would have to be done in fluming, tunneling, and maintaining the canal. It was desirable also to construct such a dam instead of continuing the canal farther up the stream until it should meet the channel, because the sides of the canyon are nearly perpendicular and of solid rock, and the construction and maintenance of a canal would be difficult.

Two dams have been constructed, the first having been destroyed.

The first dam was of the same type as the present one, but it was not of solid masonry and did not extend to a foundation of bed rock. It was formed by two walls of masonry with a filling of concrete between them, but the main cause of the disaster was the inadequate foundation rather than the material used in the construction. The new dam was constructed of solid masonry founded on bed rock 15 feet or more below the natural channel of the stream and butting against solid rock on both sides of the canyon (fig. 8). The dam is 60 feet long on top, and the radius of curvature horizontally is 45 feet. The upper face of the dam is perpendicular, but the lower face has a vertical curvature with a radius of 102 feet, which increases the thickness of the dam from 6 feet at the top to 26 feet at the base. A sluiceway 15 inches in diameter was made at the natural surface of the stream 42 feet below the top of the dam. The dam is about 15 feet thick at this point. The sluice gate is on the upper side and is controlled from the top of the dam. It is used mainly to lower the water surface to break ice which might endanger the masonry rather than for scouring.

The dam raises the water level over 40 feet, so that it will enter the head gate of the canal, which is on solid rock at the south end of the dam instead of in the dam itself. The water is carried for several hundred feet around the rock at the mouth of the canyon in a flume. The waste way is at the north end of the dam and consists of a low masonry wall 6 feet wide built on the solid rock. It is 3 feet below the top of the dam and 30 feet wide and carries the ordinary surplus flow, but at times water runs over the entire top of the dam. When dams of this type are constructed for storage purposes the waste ways are usually made large enough to carry the greatest surplus flow, so that in times of floods the dam will not be subject to a shock in addition to the pressure of the water against it.

It is well recognized that dams of this type do not act exactly as do bridge arches in sustaining a vertical pressure. The pressure of the water is perpendicular to the face of the dam at any point, but the transmission of this pressure as a thrust on the banks at the ends of the dam is in some measure obstructed by the weight of the dam itself on its foundation. It is quite probable, however, that the dam was designed so that it would withstand a certain steady pressure if it were straight, and that the arch is an additional precautionary measure. The dam contains 1,400 cubic yards of masonry.

OPERATION OF THE SYSTEM.

The system of distribution of the Consolidated Home Supply Company is one that has given universal satisfaction, a condition which exists for two reasons—the unusual liberty allowed the irrigator and the abundant supply of water furnished—for difficulties always arise as soon as water becomes short whether there is any unfairness or not.

The system of distribution has been compared to a banking system. Before turning any water out of the reservoirs the available amount stored is conservatively estimated by the company's superintendent, and each shareholder is credited in that officer's water book with an amount proportional to the stock he owns. He may draw this amount as he chooses, either all at once or in parts, upon application to the superintendent, provided only that the total amount applied for by all the stockholders shall not at any time fall below 20 cubic feet per second. Each man's share is measured to him over a Cippoletti weir in his lateral and an account of it kept by the company, in order that it may not exceed the amount due him. If the first estimate of the amount in the reservoirs is found to be too small, the superintendent always being careful not to make it too high, another is made and a new account opened with each irrigator. If at any time the reservoirs are full and water would otherwise have to be turned down the river, the head gates are kept open and the water is run to the stockholders without charge and no account is kept of the amount. But if there is any room for storage in the reservoirs a charge is made for the water run to the stockholders directly from the river through the canal. Water is never run to any stockholder who may be in arrears with his assessment. A great variety of crops is raised under the system, and the result is that water is run from the reservoirs during most of the season. Water is run at the rate of 1 cubic foot per second to each 15 shares. In 1901 water was first turned out of the reservoir June 1, and it was run continuously for thirty-five days. The gates were opened again for ten days in July and August, and all the remaining water was run out in September. Both reservoirs were full that year, but in 1902 only 10 feet was drawn from Lone Tree Reservoir and 12 feet from Mariano Reservoir, each being considered only one-half full. In one dry year the head gate of the Home Supply Canal was never raised, the reservoirs being depended upon entirely to mature the crops, and the results were good.

The water stored in the Mariano Reservoir is exchanged with some of the ditches on the lower part of the Big Thompson River, the rights of which are earlier than those of the company's canal, an amount equal to that run into the river for them being diverted at the head of the canal. The outlet ditch of the reservoir is about 2 miles long and joins the river above the head gates of the Loveland and Greeley, Farmers' Irrigating, and Hillsborough canals and several small ditches. Lone Tree Reservoir is so little below the Home Supply Canal that, instead of exchanging the water stored, it is used directly from the outlet ditch, which is known as the Home Supply Reservoir Ditch. It runs almost parallel with the main canal, and the small amount of land above it, together with that west of the reservoir, can be supplied from the canal reenforced by the Mariano Reservoir. Another reason

for not exchanging is that if the water had to be used in that manner the amount run might be limited by the amount of water in the river which the lower ditches have to exchange.

The reservoirs together hold 13,142 acre-feet, and their cost was $25,500, which is only $1.94 per acre-foot. The total assessment for maintenance of the entire system in 1901 was $4,000, and one-half of this can be considered the expense for the canal. Three times as much land is irrigated as could be with the canal alone. Land is worth two-fifths more with reservoir rights than without, the value under the company's system being from $40 to $160 per acre. In 1901 the price paid for one share was $90, but in 1902, on account of the increasing demand for water for the irrigation of sugar beets, it advanced to $125 and $150. The price paid for one share in 1903 was $255, which is equivalent to $1,912.50 for an 80-acre water right. Shares are sometimes rented to individuals who are not members of the company. In 1901 the price paid was $12.50 per share, but in 1902 as much as $20 per share was paid in the late season for the irrigation of sugar beets and potatoes. Since one share represents 6.56 acre-feet in the reservoirs, this is practically at the rate of $3.05 per acre-foot, for the water furnished by the canal was so small that it can be omitted in the calculation.

SEVEN LAKES RESERVOIR.

The Seven Lakes Reservoir was completed in the winter of 1900, and consists of six lakes connected and operated as one system. Its owner, the Seven Lakes Reservoir Company, originally intended to acquire Big Thompson Reservoir, or Cemetery Lake, which was to be included in the system as No. 5, but no agreement with the owners was reached, and it is not probable that it will ever be connected. No. 1 of the system was formerly the Louden Reservoir, and is also known as Donath Lake. It was purchased by the company and joined with the remainder of the system. It lies just below the Louden Lateral, the large lateral from the Louden Canal running east and irrigating lands on the Big Thompson slope, and its outlet ditch flows into No. 2, which is one mile south of it. Nos. 3, 4, 6, and 7 are just south of No. 2, and all are drained through the outlet ditch of No. 7 into the Loveland and Greeley Canal just below it. No. 1 has its own outlet works, but all the others are practically one basin, since they are simply connected by open cuts; and, having a common outlet at No. 7, the water stands at the same level in all. No. 2 is the largest in the system and the only one where an embankment was required.

The outlet of No. 1, or Louden Reservoir, was made through natural rock, and above the gate well consists of 150 feet of sewer pipe 2 feet in diameter, while below the gate well it consists of 8 feet of stone arch 2 feet wide and 2½ feet high. Retaining walls of masonry are

FIGURE 6

DEERE & AULT
CONSULTANTS, INC.

December 10, 2013

Ms. Minerva Lee
Consolidated Home Supply Ditch and Reservoir Company
c/o Northern Colorado Water Conservancy District
P.O. Box 1548
Berthoud, Colorado 80513

Re: Historical Modifications to Big Dam Spillway; D&A Job No. CG-0122.019.00

Dear Ms. Lee:

This letter has been prepared at the request of Gary Gerrard, Board Member, to document addition and modifications that have been made to Big Dam since its original construction in 1895. The original dam had a service spillway as shown on **Figure 1**. With a depth of approximately 2.9 feet and a width of approximately 35 feet, the spillway would have carried flows up to about 500 cfs prior to overtopping the arch dam. Sometime, it appears, in the early to mid-1900s, the spillway was omitted by filling it with a concrete parapet wall to the same elevation as the arch dam crest. Thus, instead of being able to pass service flows through a designated spillway section, which is good practice, the arch dam was now required to be overtopped more frequently.

In addition, a flushing outlet gate was constructed in front of the City of Loveland's intake. A bridge pier and walkway bridge were constructed on top of the parapet wall that filled the spillway in order to operate the outlet gate. This was not good practice as the bridge pier and bridge provided additional flow constrictions over the structure.

Figure 2 shows aerial photographs of Big Dam during the 2013 flooding. The photo shows that limited flow was able to pass the old spillway section due to trash and debris that collected in this area due to constrictions. **Figure 3** shows the constrictions in the spillway area (2004 photos) that include the parapet wall, bridge, bridge pier, and hand rails. **Figure 4** shows the debris that collected on the bridge pier and walkway bridge. The boundary of the failure zone of the dam went to the concrete block cast for the flushing outlet addition. **Figure 5** is a close-up after the flood and debris removal that shows the original spillway elevation and the parapet wall addition and bridge pier addition.

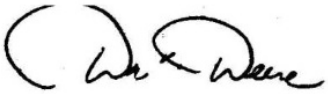
It would be desirable to restore the original spillway section for dam operations to reduce overtopping frequency and required maintenance of the arch dam. However, as shown on our December 6, 2013 90 percent plan set, we are proposing to restore crest elevations to their pre-flood 2013 elevations in order not to effect intake diversion efficiency. We understand that the City of Loveland does not require the flushing outlet or walkway bridge, and this will not be replaced. This will allow for enhanced conveyance of future flood flows.

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 ● Fax: 303-651-1469

Please call if you have any questions or comments.

Sincerely,

DEERE & AULT CONSULTANTS, INC.



Don W. Deere, P.E.
Principal

DWD:sp

Attachments

P:\0122 Consolidated Home Supply\0122.019 Flood Repair Home Supply\Flood 2013\Historical Modifications.Ltr.Docx

PHOTO CIRCA 1900 FIGURE 1

PHOTO DURING SEPTEMBER 2013 FLOODING FIGURE 2

PHOTO 2004 FIGURE 3

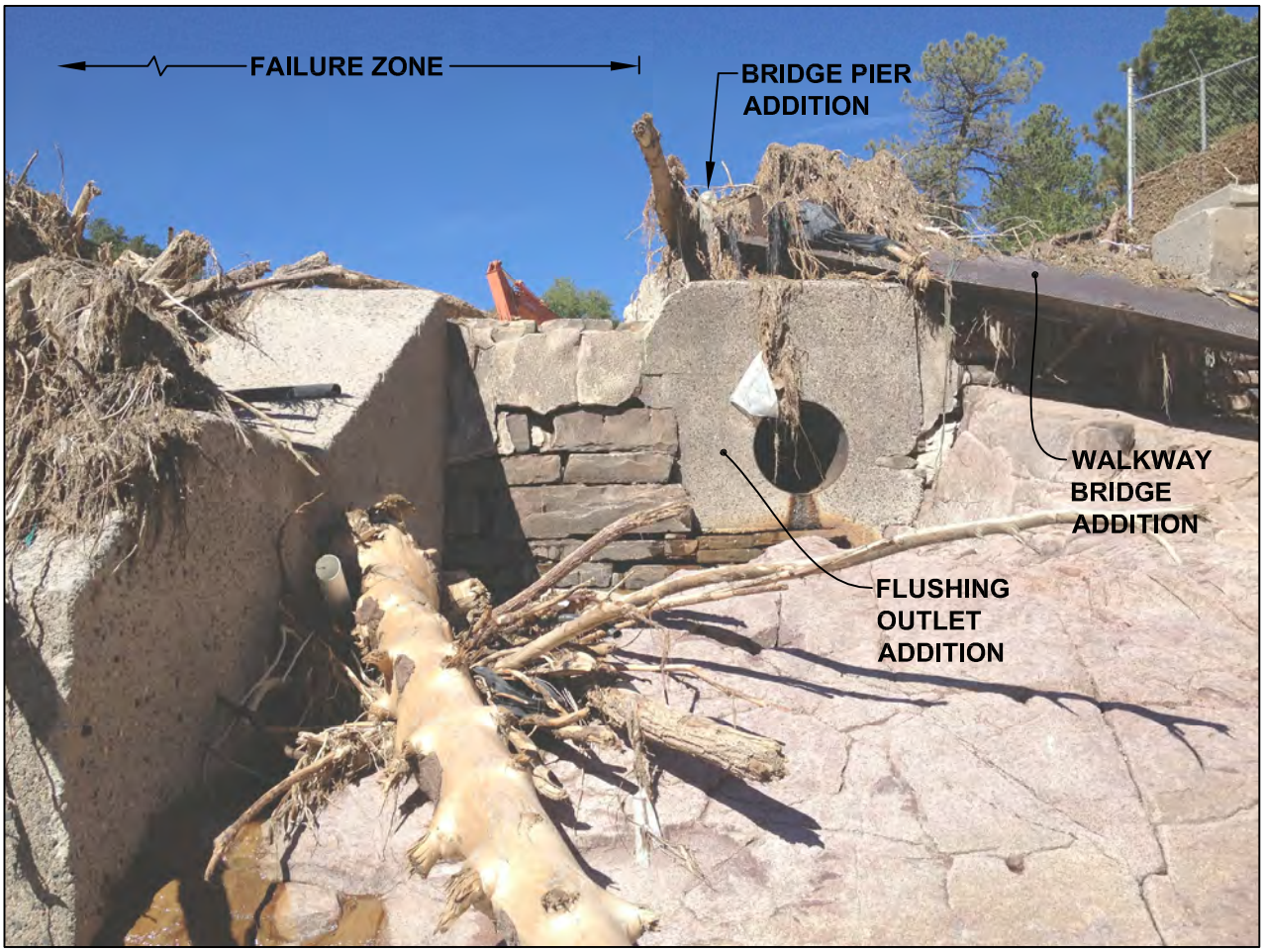


PHOTO POST FLOOD OCTOBER 2013 FIGURE 4

PHOTO POST FLOOD NOVEMBER 2013 FIGURE 5

FIGURE 7

DEERE & AULT
CONSULTANTS, INC.

June 24, 2014

- DRAFT -

Ms. Minerva Lee
Consolidated Home Supply Ditch and Reservoir Company
c/o Northern Colorado Water Conservancy District
P.O. Box 1548
Berthoud, Colorado 80513

Re: 406 Mitigation Repairs to Big Dam Diversion; D&A Job No. CG-0122.019.01

Dear Ms. Lee:

This letter report presents our observations and recommendations for the proposed mitigation to the Consolidated Home Supply Ditch diversion dam (aka, Big Dam) on the Big Thompson River west of Loveland, Colorado. The Big Dam was damaged during the September 2013 flooding event along the Front Range of Colorado. Repairs to Bid Dam were started this past winter and will continue through this summer. The mitigation work to protect the Big Dam repairs focuses on re-establishing a spillway on the Big Dam diversion. The original diversion dam system included a spillway that bypassed flows around the dam to minimize the amount of water during high flow events that would run over the face of the dam. Damage caused to the dam and the gated headworks system during the 2013 flood could have been minimized if a spillway was in-place to divert a portion of the flood flow, debris and sediment away from these structures.

GENERAL

The Big Dam and associated Consolidated Home Supply Ditch headworks diversion system are located on the Big Thompson River west of Loveland, Colorado. More specifically, the dam and headworks are located in Section 2, Township 5 North, Range 70 West. The dam and headworks location is shown on **Figure 1**.

The Big Dam is primarily a masonry, thick arch dam constructed in 1895 by the Consolidated Home Supply Ditch Company. The dam sets a water level in the Big Thompson River that allows water to be diverted into the ditch system through the ditch headgate structure located adjacent to the dam on the south side of the river. Additionally, the water level checked-up by the dam allows the City of Loveland to divert water into their water treatment plant through a gated intake structure on the north side of the river. The existing Big Dam diversion system and various gates are shown on **Figure 2**. Big Dam was originally constructed with a rectangular channel spillway on the north side of the dam. This allowed for normal flow rates in the Big Thompson River, and a large portion of the spring runoff and storm flows to bypass and not overtop the dam structure. The original spillway is shown on **Figure 3**. To provide an adequate water elevation to gravity flow into the City of Loveland's water treatment plant, the spillway was filled with approximately three feet of concrete.

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 ● Fax: 303-651-1469

Water diverted through the Consolidated Home Supply diversion dam system irrigates approximately 17,000 acres of crop land and provides raw water for municipal use to the Town of Johnstown, Colorado. Diverted water is also delivered to several raw water storage reservoirs. The City of Loveland intake structure on the north side of the river provides up to 60 percent of the City's annual water supply.

SEPTEMBER 2013 FLOOD

The September 2013 flood on the Big Thompson River occurred during the week of September 9. The Big Dam, as well as the Consolidated Home Supply diversion structure, was damaged during the flooding. Peak flows on the Big Thompson River of approximately 10,000 cfs have been estimated during this time frame. High flows of up to several thousand cfs continued for several weeks after the storm. Water depths of up to 10 feet were estimated to have overtopped the Big Dam. It is suspected that the continued flows after the peak flood event over the Big Dam continued to cause damage.

At the time of the flood, flood water could not be diverted around the dam and through the Consolidated Home Supply Ditch diversion structure headgate. This system was essentially inoperable during the flooding event because it was not safe to manually operate the gates. During the flood, debris overwhelmed the structure and ultimately got hung up on the various headgate supports and operators, and plugged the gate openings. As a result, the Consolidated Home Supply Ditch channel then filled up with sediment during the flood. This is shown on **Figure 4**. With high flow during the flood and with no functioning way to bypass flow around the dam, several courses of masonry stone were lost off the crest of the dam **Figure 5.**

If a more reliable bypass was in-place during the 2013 flood, such as a spillway, then a large portion of the flood water and associated debris could have been diverted through it and away from the dam and headgate structure. In our opinion, the best location for a spillway on Big Dam is where the original spillway was located. Observations during high runoff this spring confirm that the main river channel flow as it approaches the dam is directed at this location. In order to maintain the water diversion elevations, the spillway will need to be constructed with an overtopping tilting weir type gate. A constant water level can be set to accommodate the head requirements for the existing upstream intake structures for the Consolidated Home Supply and the City of Loveland. During flood events, the gate would be lowered. The overtopping tilting weir style of gate would allow debris and heavy sediment loads to pass through the spillway instead of overtopping the dam. The gated spillway will be remotely operated from a safe position above the river flood levels.

PROPOSED MITIGATION IMPROVEMENTS

In the future, during high flows on the Big Thompson River, the proposed mitigation improvements at the Consolidated Home Supply diversion dam will reduce the potential for damages to Big Dam. The spillway depth will be 5-7 feet lower than the existing dam crest elevation. The final depth will be determined by the expense of excavating the granite subgrade and protecting the existing City of Loveland concrete wall adjacent to the proposed spillway. Our initial hydraulic calculations show

that for a 5-foot tall by 30-foot wide spillway, storm flows of up to 850 cfs can be diverted around Big Dam **Figure 6**. A 7-foot tall by 30-foot wide spillway can bypass roughly 1400 cfs. After the spillway slab and walls are constructed out of structural concrete then an overtopping tilting weir gate will be mounted in the spillway opening. The gate will allow control of the upstream water elevation at the desired level between the invert of the spillway and the existing dam crest elevation.

The following construction items are summarized as follows and will be required to complete the mitigation improvements:

1. Demolition - The proposed spillway would be constructed at the same location as the original spillway. The original spillway section was constructed out of masonry stone, but was subsequently repaired, covered, and filled with concrete to accommodate the City of Loveland Intake water depth requirements. Additionally, in the winter of 2014, reinforced concrete work was placed on this section of the dam to repair damage from the 2013 floods. The winter 2014 concrete was to protect the dam during the spring runoff and insure that the Ditch Company and City of Loveland would be able to divert water during the summer. The 2014 concrete work was completed before the spillway mitigation was pursued as the preferred alternative to mitigate Big Dam from future damage. We have summarized the material volumes, existing masonry, existing concrete, and 2014 concrete that need to be removed to complete the spillway construction. We have included a summary of these items on **Figure 7**.

2. Foundation Preparation - The proposed spillway will be constructed on granite bedrock. The foundation area on the bedrock will need to be prepared to provide a solid competent surface to construct the new reinforced concrete spillway and overtopping gates. We anticipate the concrete will need to be mechanically connected to the rock subgrade with grouted anchor bars.

3. Concrete Slab and Abutment Walls - The gated spillway requires installation of a cast-in-place reinforced concrete slab. The slab thickness will vary with the foundation subgrade, but is expected to be at least 12 inches thick. The sides of the gate will seal against new cast-in-place reinforced concrete abutment walls with steel wear plates. The wear plates are cast in the walls. The slab and abutment walls will vary in thickness to set the spillway crest, we have calculated roughly 55 cubic yards of concrete will be needed to complete a 5-foot tall by 30 foot wide spillway **Figure 6.**

4. Stainless Steel Gated Spillway - We are proposing to install an Obermeyer Gate system within the new spillway. This gate has a stainless steel front plate and is raised and lowered by using an inflatable bladder system. The bladders are filled by using an air compressor with stainless steel tubing connected to the bladders. The air compressor equipment would be located in the control building above the 100-year flood plain.

5. Control Building - The control pre-cast concrete building structure (20 feet by 20 feet) will contain the remote operating system, programming and telemetry equipment, as well as the air compressors used to raise and lower the gates.

6. Electrical and Communication Drop Service - There is overhead electric and phone service available at this location. A 3-phase electrical service with transformers, a meter, disconnects, service panel, etc. will need to be established to provide power to the system. A hard line phone service will also be required to communicate with and monitor the system from a remote location.

7. Electrical and Communication Wires and Conduits - Waterproof connections will need to be made to provide power and communications between the power supply and phone service to the equipment building, gate system, and water level sensors.

8. System Integration - Program Logic Control (PLC) unit, enclosures, data logger, modem, etc. along with programming and field testing to provide a complete operable system. The gates will be programmed to operate in automatic, manual, and local control. This control system will allow Ditch staff the ability to safely operate the gates during flood events without having to be physically at the gates.

9. Start-up and training of Ditch Company personnel.

COSTS

The estimated construction cost is approximately $453,500, and is summarized on **Table 1**. To develop the estimated construction costs, we have used local experience, recent bids, and quoted costs from similar projects. The supportive cost information is attached.

Please call if you have any questions or comments.

Sincerely,

DEERE & AULT CONSULTANTS, INC.

Rhett D. Hines, P.E.
Project Engineer

RDH:sp

Attachments

TABLE 1

CONSOLIDATED HOME SUPPLY DITCH DIVERSION DAM

GATED SPILLWAY - 406 MITIGATION PROJECT

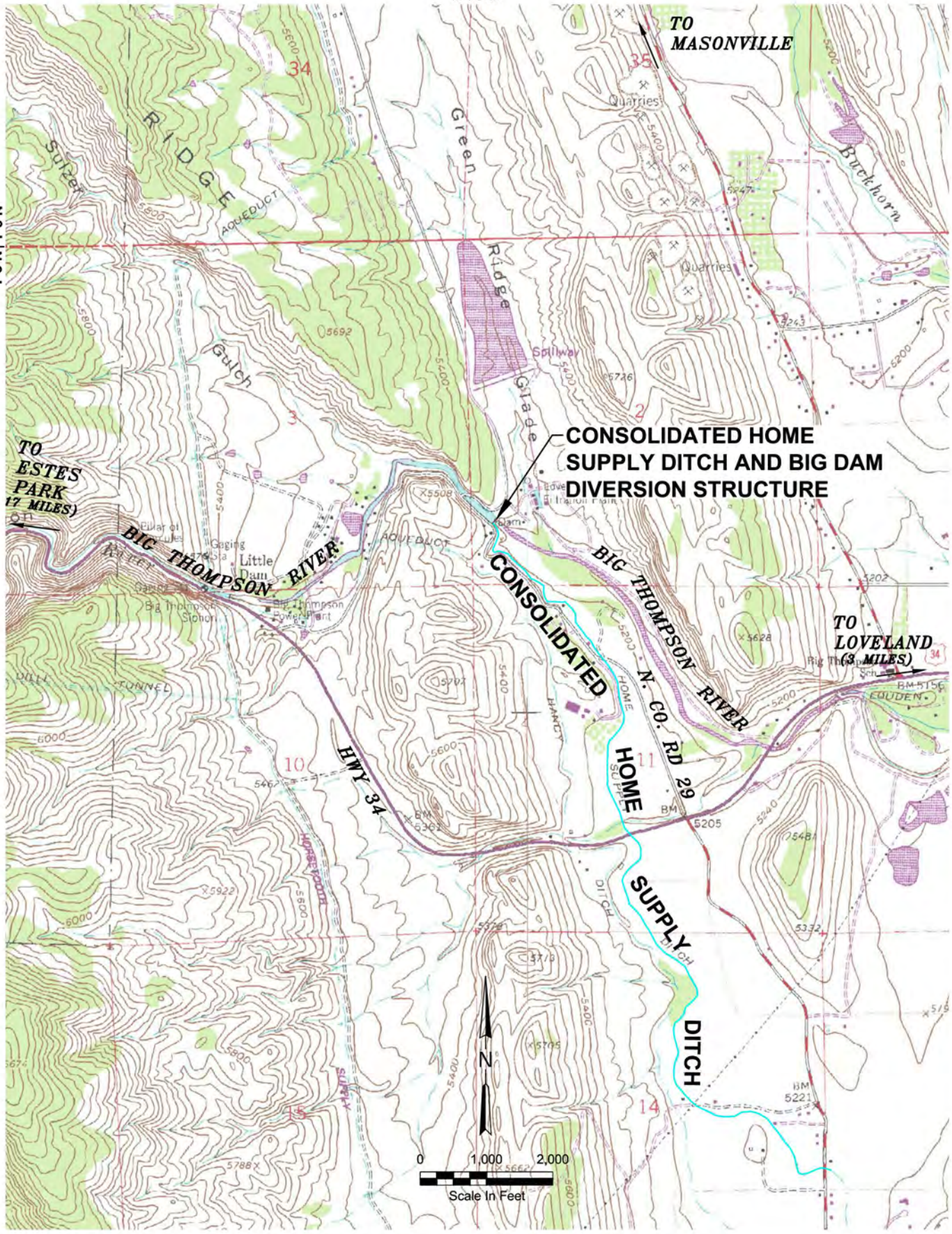
ENGINEERING OPINION OF CONSTRUCTION COSTS

June 20, 2014

DRAFT

Item #	Description	Quantity	Unit	Rate	Extension
1	Diversion and Care of River	1	LS	$ 20,000	$ 20,000
2	Demolition: Existing Masonry and Concrete Dam	50	CY	$ 700	$ 35,000
3	Demolition: Concrete Repair 2014	25	CY	$ 800	$ 20,000
4	Foundation Preparation (10' wide x 30' long)	300	SF	$ 35	$ 10,500
5	Concrete Apron and Abutments	55	CY	$ 1,000	$ 55,000
6	Stainless Steel Spillway Gate (5' tall x 30' long)	150	SF	$ 1,400	$ 210,000
7	Equipment Building	1	EA	$ 28,000	$ 28,000
8	Electrical and Communication Drop	1	LS	$ 15,000	$ 15,000
9	Electrical and Communications (Panels, Wiring, Conduits)	1	LS	$ 25,000	$ 25,000
10	System Integration	1	LS	$ 35,000	$ 35,000

CONSTRUCTION SUB-TOTAL	$ 453,500
Mobilization @ 7.5%	$ 34,013
Survey	$ 4,000
Testing	$ 4,000
Engineering @ 15%	$ 68,025
Construction Management @ 15%	$ 68,025
Contingency @ 20%	$ 90,700
ESTIMATED TOTAL (rounded to nearest $1,000)	$ 722,000



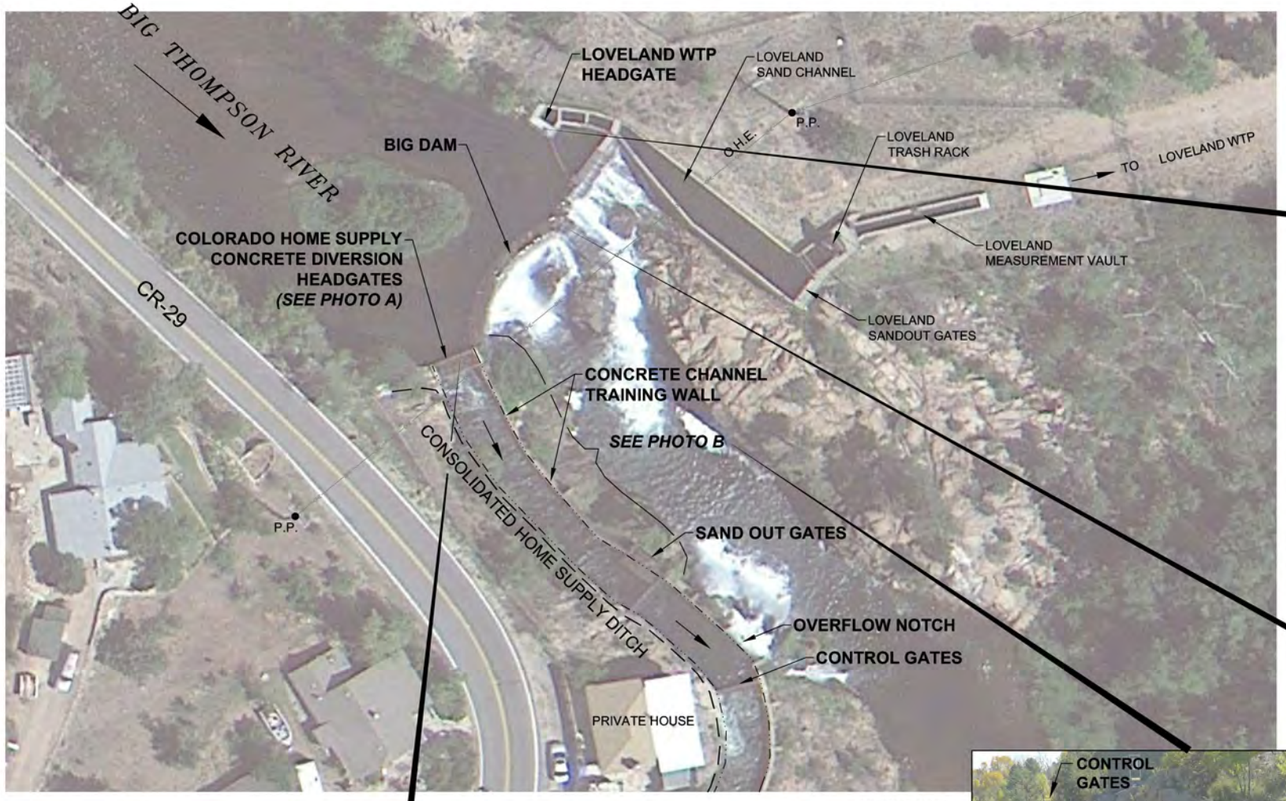
DEERE & AULT CONSULTANTS, INC.

CONSOLIDATED HOME SUPPLY DITCH
Vicinity Map

FIGURE NO. 1

JOB NO. 0122.019.01 **SCALE:** AS NOTED

Friday, June 20, 2014 3:51:13 PM DRAWING: P:\0122 Consolidated Home Supply\0122.019 Flood Repair Home Supply\CAD\DAC Drawings\Big Dam Drawings\Figures\Home Supply Vicinity Map.DWG



CITY OF LOVELAND INTAKE STRUCTURE (LOOKING NORTH)

0 30' 60'
SCALE: 1" = 30'

PHOTO C - DAM AND SPILLWAY(LOOKING UPSTREAM)

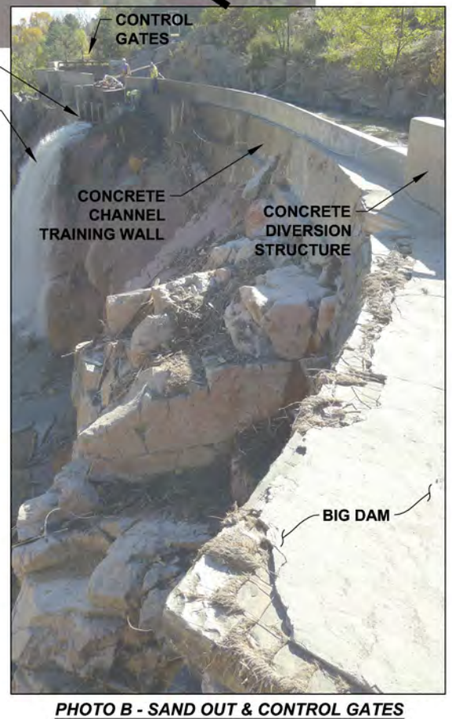


PHOTO B - SAND OUT & CONTROL GATES

PHOTO A - CONSOLIDATED HOME SUPPLY CONCRETE DIVERSION STRUCTURE

JOB NO. 0122.019.01

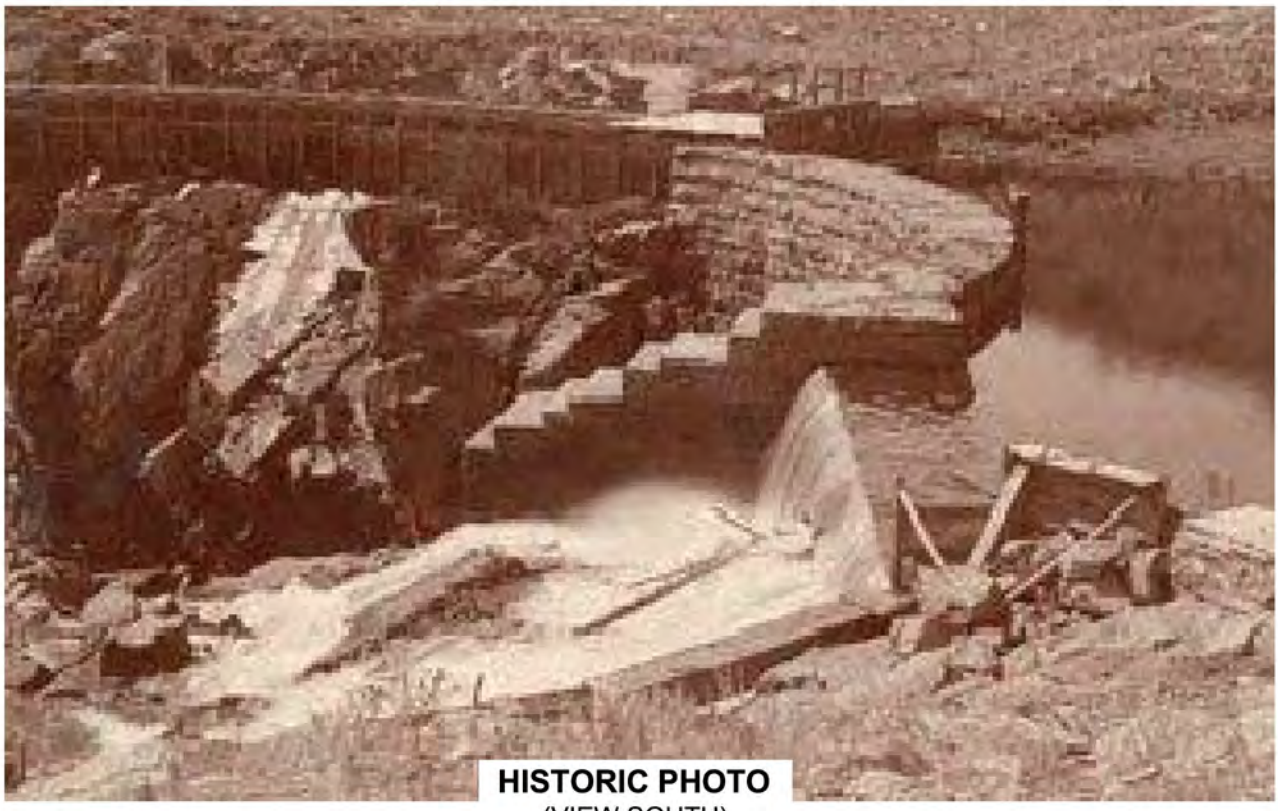
CONSOLIDATED HOME SUPPLY DITCH
DITCH DIVERSION & GATES

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 2

DATE: 6/20/2014

SCALE: AS NOTED



HISTORIC PHOTO
(VIEW SOUTH)

HISTORIC PHOTO
(VIEW WEST)

DEERE & AULT CONSULTANTS, INC.

CONSOLIDATED HOME SUPPLY
HISTORICAL PHOTOGRAPHS SHOWING ORIGINAL SPILLWAY

JOB NO.	SCALE:	FIGURE NO.
0122.019.00	AS NOTED	3

PHOTO 1 - DEBRIS AGAINST SAND OUT GATES ACCESS WALKWAY

PHOTO 2 - SEDIMENT FILLED IRRIGATION CHANNEL UPSTREAM OF THE SAND OUT GATES

DEERE & AULT CONSULTANTS, INC.

CONSOLIDATED HOME SUPPLY DITCH

Flooded Photos at Diversion Headworks

FIGURE NO. 4

JOB NO. 0122.019.01 **SCALE:** AS NOTED

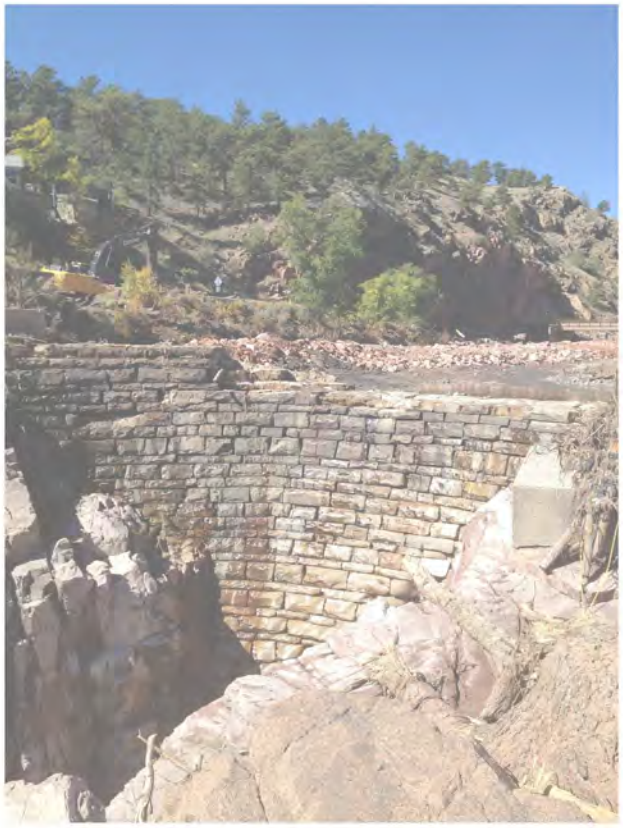
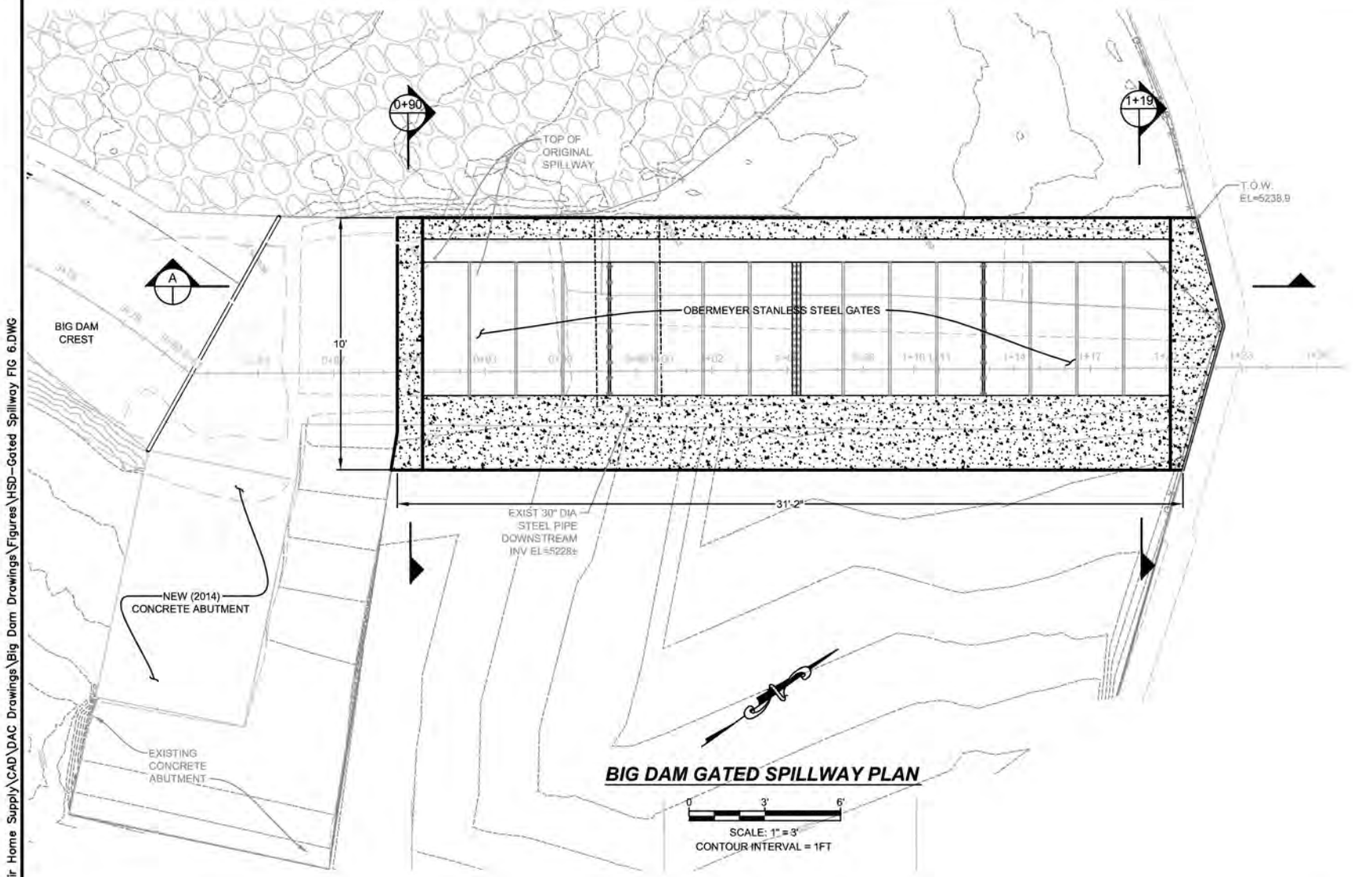


PHOTO 1 - DAMAGE TO BIG DAM (LOOKING UPSTREAM)

PHOTO 2 - DAMAGE TO BIG DAM (LOOKING AT NORTH ABUTMENT)

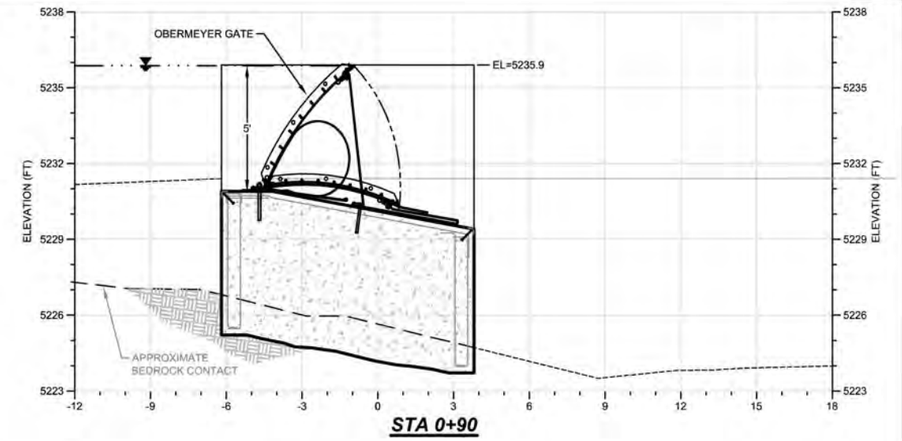
DEERE & AULT CONSULTANTS, INC.	**CONSOLIDATED HOME SUPPLY DITCH** **Flooded Photos at Diversion Headworks**	**FIGURE NO.** **5**
	JOB NO. 0122.019.01 / **SCALE:** AS NOTED	



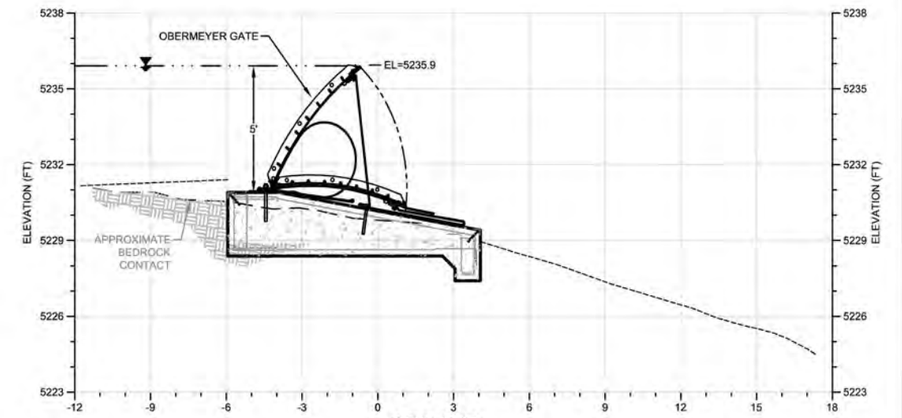
BIG DAM GATED SPILLWAY PLAN

0 3' 6'

SCALE: 1" = 3'
CONTOUR INTERVAL = 1FT



STA 0+90

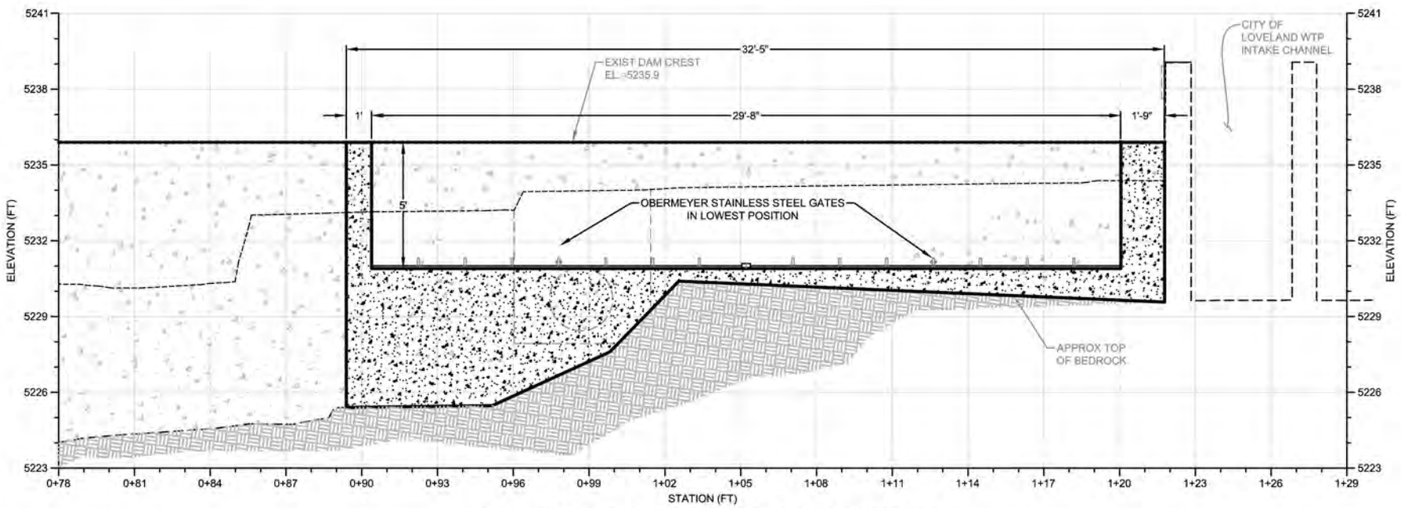


STA 1+19

BIG DAM GATED SPILLWAY SECTIONS

0 3' 6'

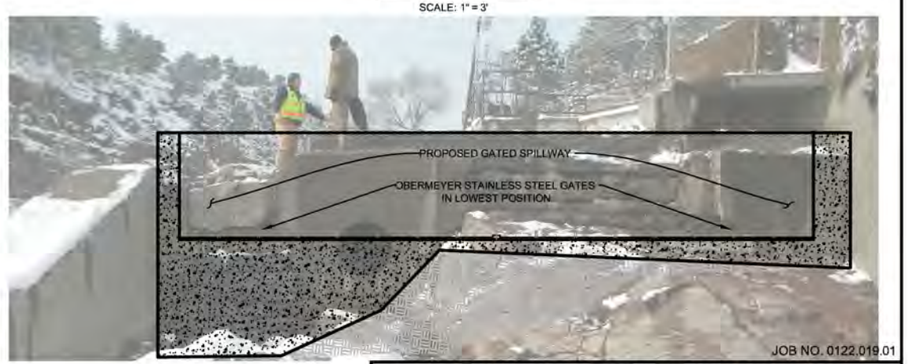
SCALE: 1" = 3'



BIG DAM GATED SPILLWAY PROFILE SECTION A

0 3' 6'

SCALE: 1" = 3'



JOB NO. 0122.019.01

CONSOLIDATED HOME SUPPLY DITCH

GATED SPILLWAY PLAN & PROFILE

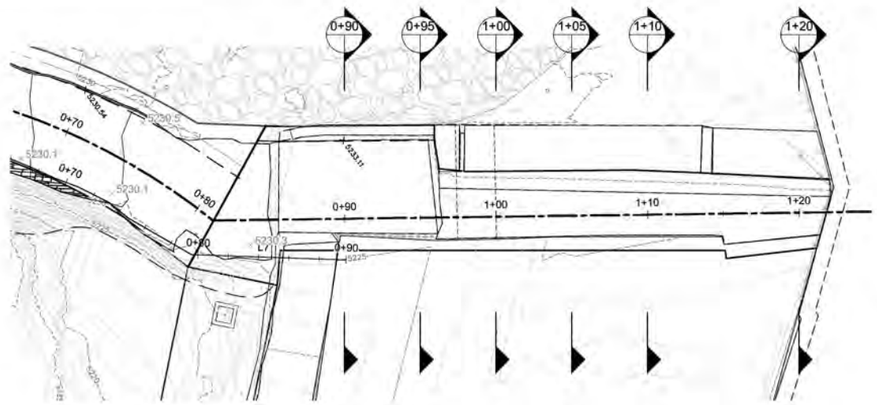
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **6**

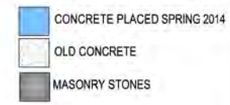
DATE: **6/20/2014**

SCALE: **AS NOTED**

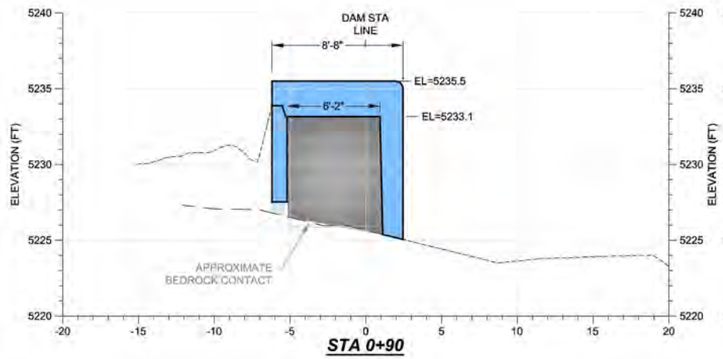
Friday, June 20, 2014 3:54:25 PM DRAWING: P:\0122 Consolidated Home Supply\0122.019 Flood Repair Home Supply\CAD\DAC Drawings\Big Dam Drawings\Figures\HSD-Gated Spillway FIG 6.DWG



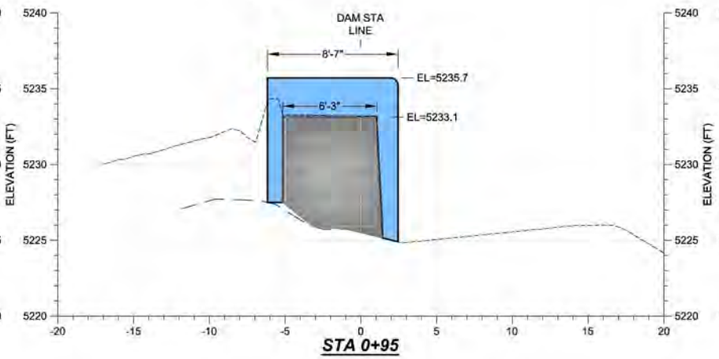
STATION	CONCRETE PLACED SPRING 2014 X-SEC AREA	OLD CONCRETE X-SEC AREA	MASONRY BLOCKS X-SEC AREA
0+90	37.1	0	44.28
0+95	37.5	0	46.1
1+00	18.6	62.6	0
1+05	11.7	16.7	16.7
1+10	12.8	16.3	16.8
1+15	12.6	27.8	20.13
1+20	11.6	22	21.3
	±25 CY	±25 CY	±25 CY



BIG DAM NORTH ABUTMENT



STA 0+90



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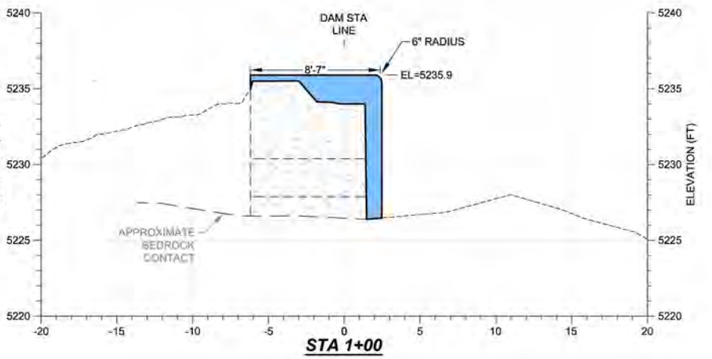
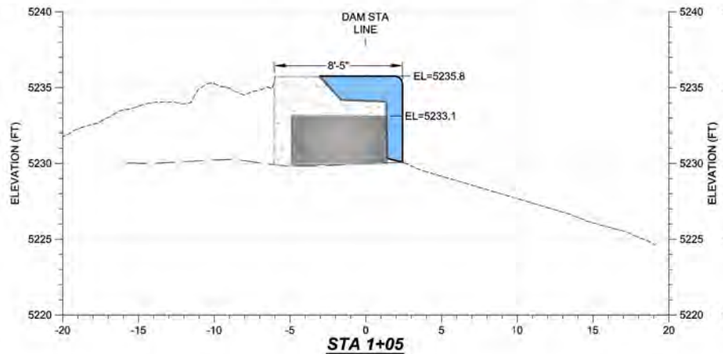
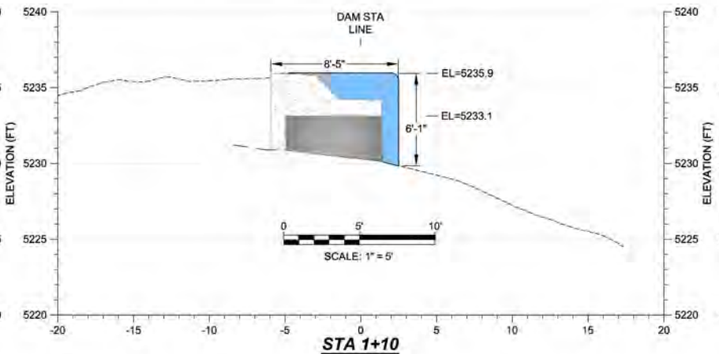


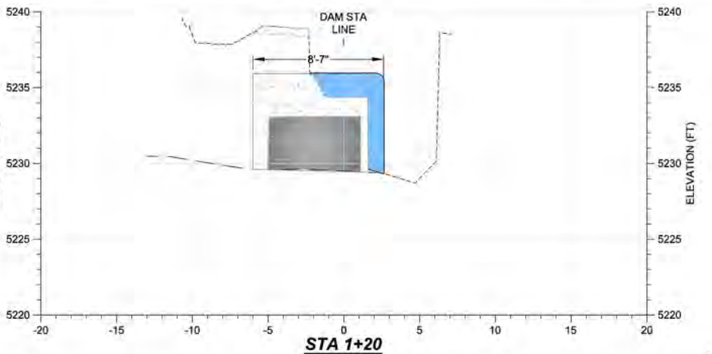
STA 1+00



STA 1+05



STA 1+10



STA 1+20

JOB NO. 0122.019.01

CONSOLIDATED HOME SUPPLY DITCH
BIG DAM SPILLWAY DEMOLITION

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **7**

DATE: **6/20/2014**

SCALE: **AS NOTED**

FIGURE 8

DEERE & AULT
CONSULTANTS, INC.

August 5, 2014

Ms. Minerva Lee
Consolidated Home Supply Ditch and Reservoir Company
c/o Northern Colorado Water Conservancy District
P.O. Box 1548
Berthoud, Colorado 80513

Re: Big Dam Masonry Stones - Additional Stones; D&A Job No. CG-0122.019.00

Dear Ms. Lee:

We met with the mason contractor for the Big Dam Repairs, Mr. Lou DeAngelis, and Mr. Gary Gerrard on July 31, 2014 at Big Dam. The purpose of the meeting was to review the type, number, and the condition of the masonry stones salvaged during the initial portion of the Phase 1 Big Dam Repairs started last spring. The project schedule for placing the masonry stones was also discussed. Based on our review of the existing salvaged stones, their condition, and amount of field work and time that will be required to prepare them for placement, we recommend that new stones be cut at the quarry and used instead of the salvaged stones.

GENERAL

Big Dam is a thick masonry arch dam constructed with locally quarried sandstone blocks. The top five masonry courses of the dam were damaged during the September 2013 flood. The northern two-thirds of the top four masonry courses, or approximately 40-linear feet, were completely washed away. The southern third, or approximately 25-linear feet, of masonry stones remained in place but were quite loose after the flood. The current plan for repairing Big Dam requires reconstructing the top of the dam with reinforced concrete, while only placing masonry stones on the downstream face. This design will update Big Dam to modern design standards while keeping the historic and visible downstream masonry stone face. During the initial Phase 1 repairs at Big Dam, the masonry stones that remained on the southern one-third of the dam were salvaged and stacked nearby for reuse as possible. The stones that were washed away during the flood were replaced with stones cut at the nearby Arkins Quarry. In early summer 2014, we understand that 40 stones were cut to size and the stone faces have been chiseled. These stones are currently stockpiled at the Arkins Quarry.

SALVAGED STONES

The salvaged masonry stones were inspected to determine which stones could suitable for reuse in Big Dam. After reviewing the salvaged stones the following observations were made:

1. The salvaged stones are varied in thickness and shape and would require extensive work and time to shape and place for each course. Field cutting and trimming by the mason will be required to provide clearance for rebar placement in the new reinforced concrete section of the dam. New stones cut at the quarry should reduce this time requirement.

2. All the salvaged stones will need to be "faced" with a chisel and hammer.

3. Some of the salvaged stones were cracking and showing other signs of distress associated with frost and exposure to the Big Thompson River over the past 100 years. A few of the stones were split and broke during removal this spring.

We recommend that new stones be cut at the quarry to complete the four stone masonry courses at Big Dam. This reduces schedule risk and make the repair work consistent and of equal quality.

This will require approximately a total of 28 more new stones to be provided from the quarry. The estimated stone requirements are summarized as follows:

Masonry Course	Total Required	Stones Already Provided	Stones to be Provided
1	19	12	7
2	17	12	5
3a	16	6	10
3b & 4	16	10	6
	68	40	28

The stones and the courses are shown on Figure 1.

We have not included any extra stones to account for breakage or adjustments.

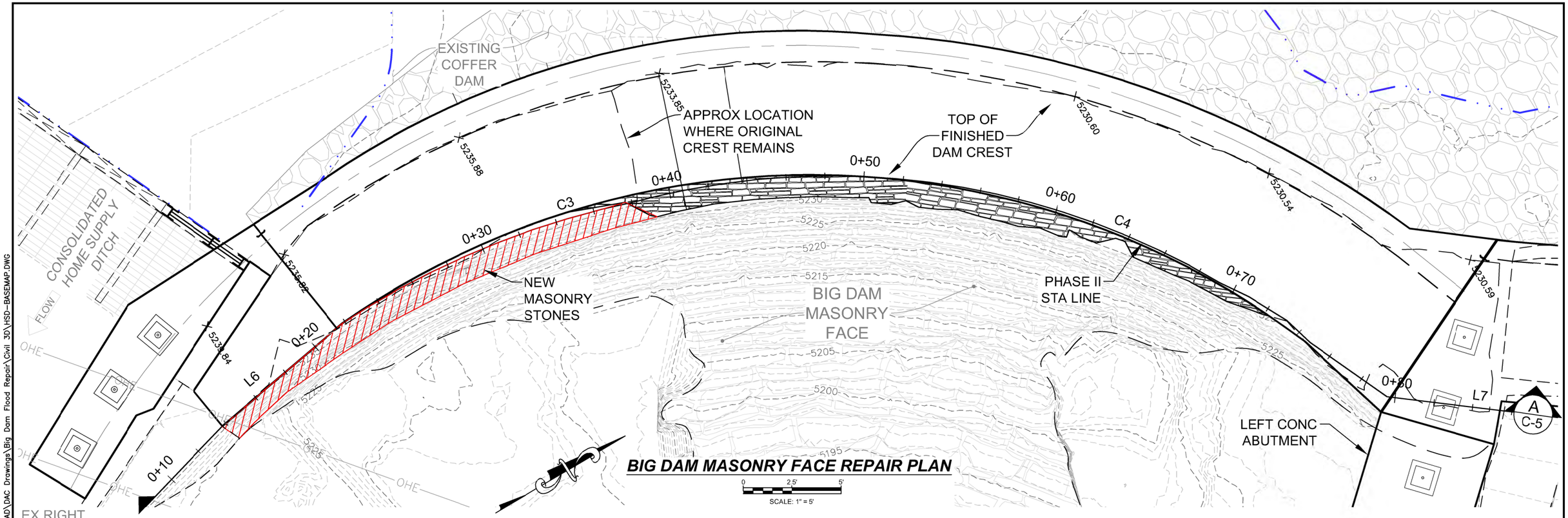
Please call if you have any questions or comments.

Sincerely,

DEERE & AULT CONSULTANTS, INC.

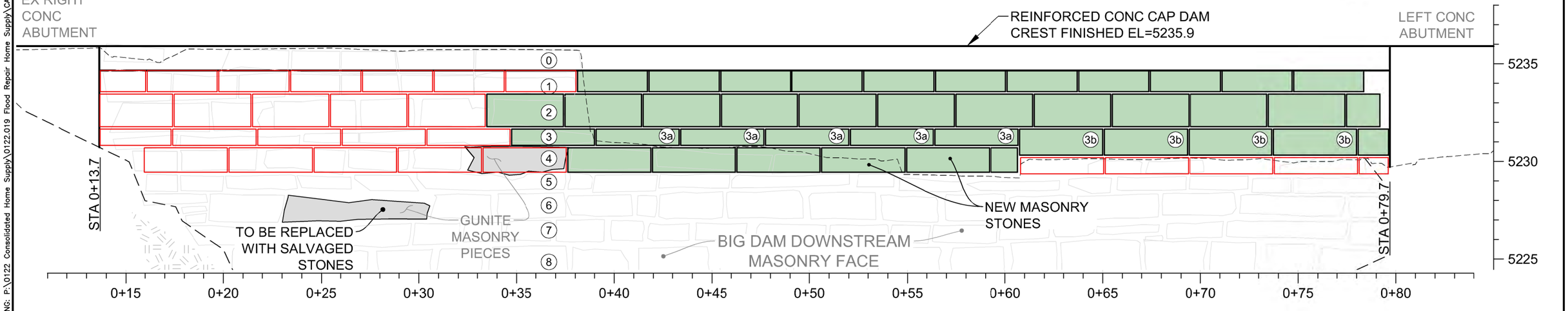
Glen G. Church, P.E.
Principal, Project Manager

Attachment



BIG DAM MASONRY FACE REPAIR PLAN

SCALE: 1" = 5'



BIG DAM MASONRY FACE REPAIR PROFILE

SCALE: 1" = 5'

STONES COMPLETED BY JULY 31, 2014

STONES NEEDED

COURSE NUMBER	TOTAL STONES REQ'D	STONES COMPLETED BY JULY 31, 2014	REMAINING STONES REQ'D
1	19	12	7
2	17	12	5
3a	16	6	10
3b & 4	16	10	6
*TOTAL	68	40	28

*NOTE: DOES NOT INCLUDE ANY EXTRA STONES FOR BREAKING, ETC.

JOB NO. 0122.019.01

CONSOLIDATED HOME SUPPLY BIG DAM DIVERSION STRUCTURE
APPROXIMATE ADDITIONAL STONES

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 1

DATE: 8-4-14

SCALE: AS NOTED

Monday, August 04, 2014 3:53:58 PM DRAWING: P:\0122 Consolidated Home Supply\0122.019 Flood Repair Home Supply\CAD\DAC Drawings\Big Dam Flood Repair\Civil 3D\HSD-BASEMAP.DWG

CONSOLIDATED HOME SUPPLY BIG DAM FLOOD REPAIRS

ADDITIONAL MASONRY BLOCK

CONSOLIDATED HOME SUPPLY DITCH AND RESERVOIR COMPANY

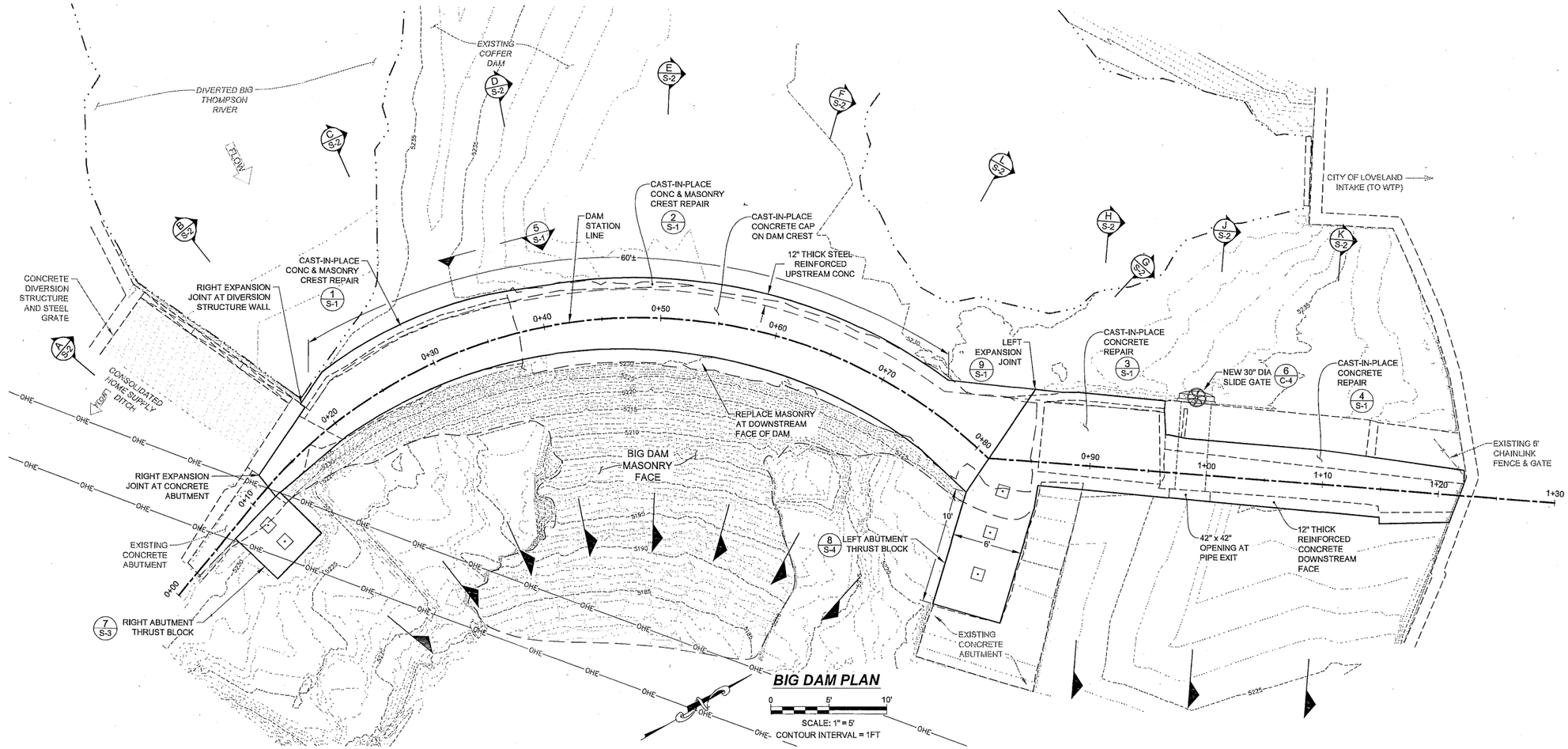
OPION OF CONSTRCUTION COSTS

July 30, 2014

Item #	Description	Quantity	Unit	Rate	Estension
1	Mobilization	1	LS	$ 5,000.00	$ 5,000.00
2	Masonry Block Removal	28	EA	$ 360.00	$ 10,080.00
3	Masonry Block	28	EA	$ 310.00	$ 8,680.00
4	Misc. Materials (sand, grout, straps,)	28	EA	$ 265.00	$ 7,420.00
5	Machine Mixer	1	LS	$ 2,100.00	$ 2,100.00
6	Facing Stone @ Quarry	28	EA	$ 930.00	$ 26,040.00
7	Install Masonry Block	28	EA	$ 2,400.00	$ 67,200.00

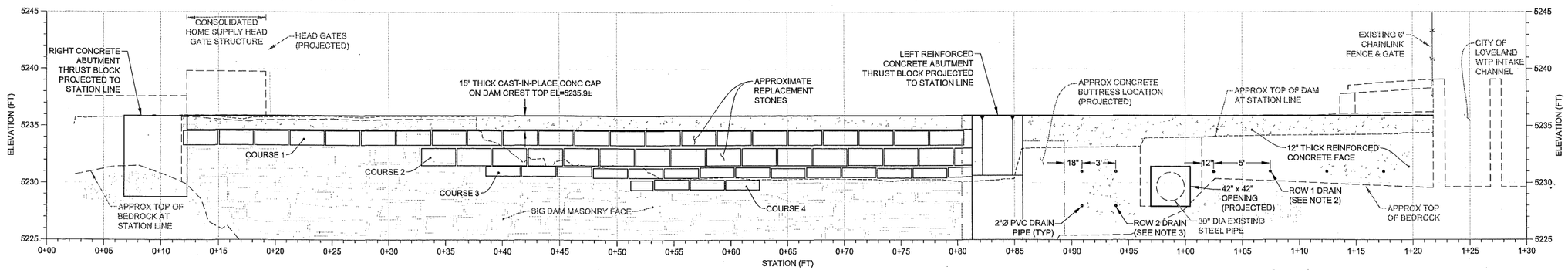
Total Construction Items	$	126,520.00
Contingency @ 20%	$	25,304.00
Engineering (Design and Construction) @ 15%	$	18,978.00
Construction Management@ 15%	$	25,620.30
ESTIMATED TOTAL (rounded to nearest $1,000)	$	196,000.00

FIGURE 9



BIG DAM PLAN

SCALE: 1" = 5'
CONTOUR INTERVAL = 1FT



BIG DAM PROFILE ALONG STATION LINE

SCALE: 1" = 5'

NOTES:

1. FINAL WEEP HOLE DRAIN ELEVATIONS & LOCATIONS MAY BE ADJUSTED LOCALLY IN FIELD WITH ENGINEER'S APPROVAL
2. ROW 1 - DRAIN AT INVERT ELEVATION 5231
3. ROW 2 - DRAIN AT INVERT ELEVATION 5228

REV	DATE	BY	DESCRIPTION
-	DEC. 6/13	D.D.	90% CONSTRUCTION DRAWINGS FOR REVIEW

SCALE: AS NOTED

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED: G. HORECZY/L. CAMPBELL
DRAWN: P. HUNTER/I. RECK
CHECKED: R. ELDRIDGE/D. DEERE

DEERE & AULT CONSULTANTS, INC.
600 SOUTH AIRPORT ROAD, BUILDING A, SUITE 205
LONGMONT, COLORADO 80503
TEL 303.651.1468

DRAFT

CONSOLIDATED HOME SUPPLY BIG DAM DIVERSION STRUCTURE
BIG DAM DIVERSION REPAIR
GENERAL PLAN

SHEET C-2

NOTES:

1. FINAL WEEP HOLE DRAIN ELEVATIONS & LOCATIONS MAY BE ADJUSTED LOCALLY IN FIELD WITH ENGINEER'S APPROVAL.
2. ROW 1 - DRAIN AT INVERT ELEVATION 5231.
3. ROW 2 - DRAIN AT INVERT ELEVATION 5228.
4. OVERHEAD ELECTRIC IS APPROXIMATELY LOCATED.

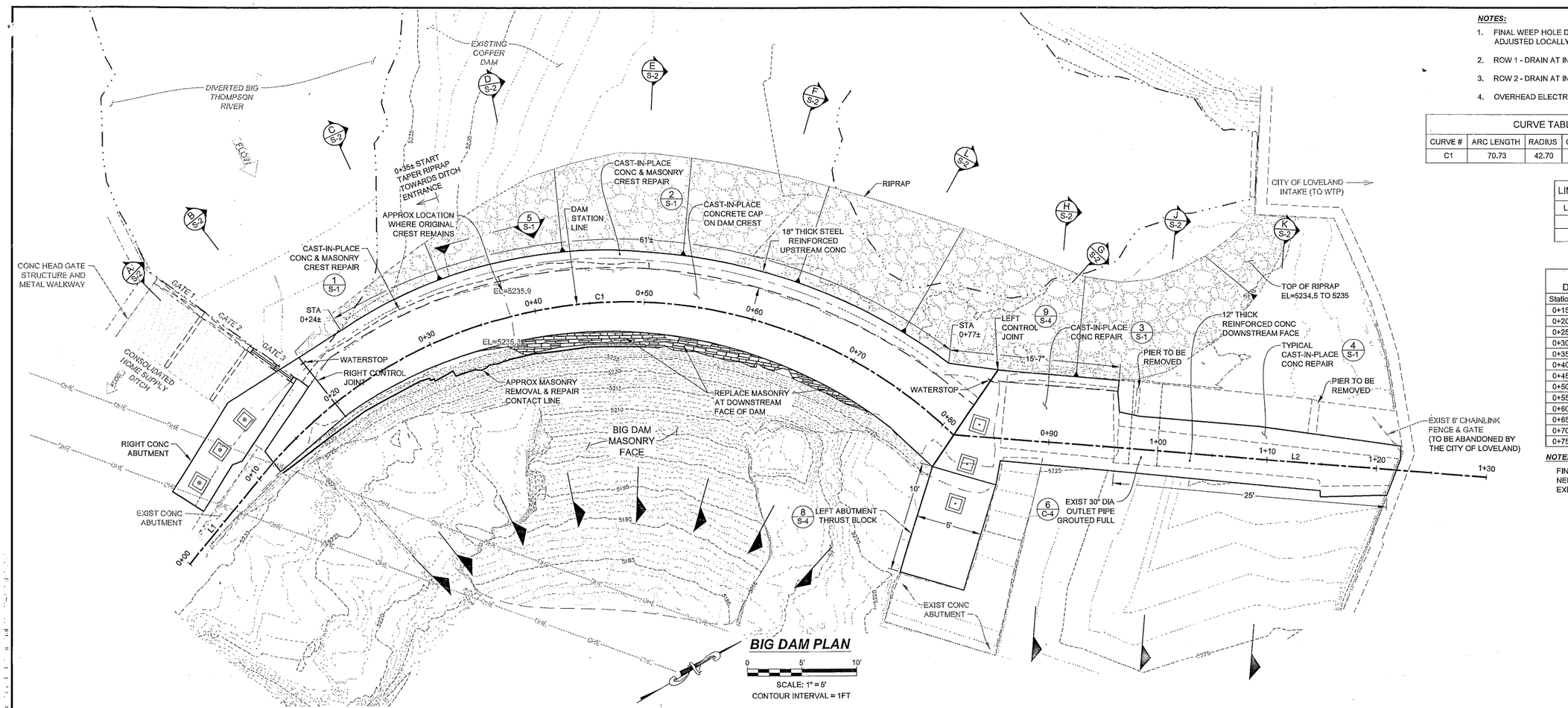
CURVE TABLE: DAM STATION LINE					
CURVE #	ARC LENGTH	RADIUS	CHORD BEARING	CHORD LENGTH	DELTA ANGLE
C1	70.73	42.70	N27°26'08"E	62.92	094°54'45"

LINE TABLE: DAM STATION LINE		
LINE #	BEARING	LENGTH
L1	N20.011452W	10.58
L2	N35.174980E	48.69

DAM STATION LINES DISTANCE TO FINISHED EDGES		
Station	to Upstream edge	to Downstream edge
0+15	2.21	1.33
0+20	4.53	1.48
0+25	4.05	1.73
0+30	4.98	2.03
0+35	4.90	2.20
0+40	4.79	2.41
0+45	4.67	2.60
0+50	4.54	2.77
0+55	4.46	2.91
0+60	4.42	3.04
0+65	4.43	3.13
0+70	4.48	3.20
0+75	4.57	3.23

NOTE:

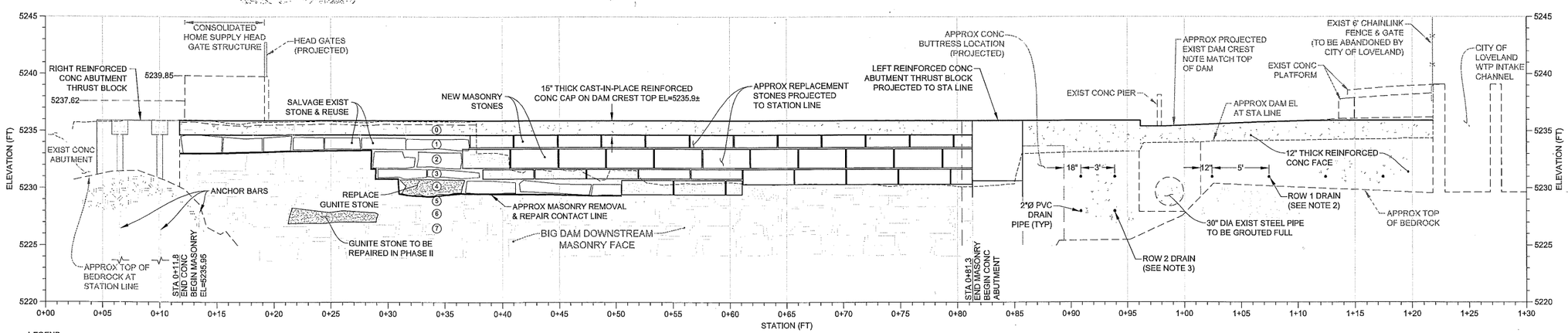
FINAL LOCATION OF UPSTREAM FACE MAY NEED TO BE ADJUSTED DEPENDING ON EXISTING DAM FACE LOCATION.



BIG DAM PLAN

0 5' 10'

SCALE: 1" = 5'
CONTOUR INTERVAL = 1FT



BIG DAM PROFILE ALONG STATION LINE

0 5' 10'

SCALE: 1" = 5'

LEGEND:

④ MASONRY COURSE NUMBER

AREA WHERE DOWNSTREAM STONES ARE REMOVED

REV	DATE	BY	DESCRIPTION
-	12-6-13	D.D.	90% CONSTRUCTION DRAWINGS FOR REVIEW
-	1-28-14	D.D.	CONSTRUCTION DRAWINGS

SCALE: AS NOTED

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED: G. CHURCH/L. CAMPBELL
DRAWN: P. HUNTER/I. RECK
CHECKED: R. ELDRIDGE/D. DEERE

DEERE & AULT CONSULTANTS, INC.
600 SOUTH AIRPORT ROAD, BUILDING A, SUITE 205
LONGMONT, COLORADO 80503
TEL 303.651.1468

CONSOLIDATED HOME SUPPLY BIG DAM DIVERSION STRUCTURE

BIG DAM DIVERSION REPAIR

GENERAL PLAN

SHEET C-2

FIGURE 10

CONSTRUCTION PLANS FOR

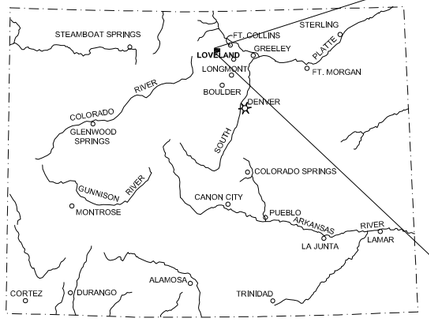
CONSOLIDATED HOME SUPPLY

CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD

LARIMER COUNTY, COLORADO

PREPARED FOR:

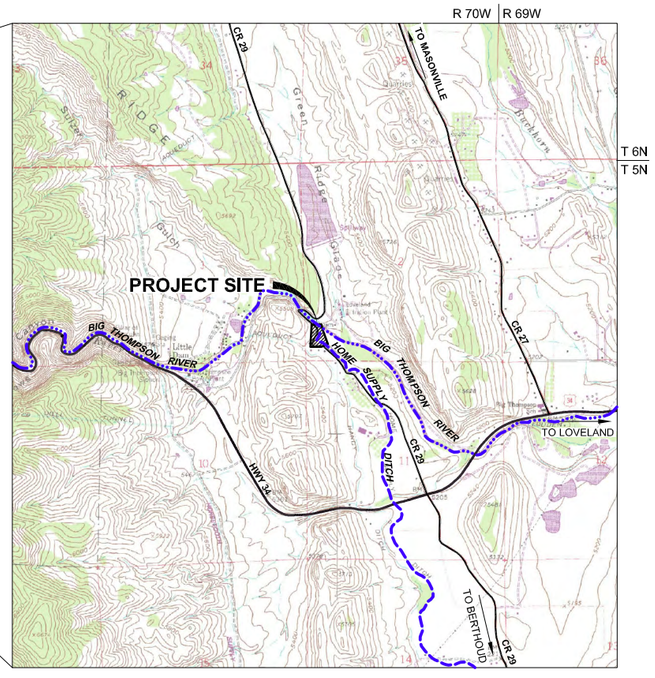
CONSOLIDATED HOME SUPPLY
1650 W 8TH STREET
LOVELAND, CO 80537



STATE OF COLORADO
PROJECT LOCATION MAP

NORTH

SCALE: NONE



PROJECT VICINITY MAP

NORTH

SCALE: 1"=2000'

NOTES:

DEERE AND AULT CONSULTANTS, INC. IS NOT A GUARANTOR OF THE PERFORMANCE OF THE WORK.

DEERE AND AULT CONSULTANTS, INC. IS NOT RESPONSIBLE FOR SAFETY, IN, ON, OR ABOUT THE PROJECT SITE, NOR FOR COMPLIANCE BY THE APPROPRIATE PARTY WITH ANY REGULATIONS RELATED THERETO.

DEERE AND AULT CONSULTANTS, INC. EXERCISES NO CONTROL OVER THE SAFETY OR ADEQUACY OF ANY EQUIPMENT, BUILDING COMPONENTS, FORMS, OR OTHER WORK AIDS USED IN OR ABOUT THE PROJECT, OR OVER THE SUPERINTENDING OF THE SAME.

WRITTEN SCALES ON PLAN ARE FOR FULL SIZED 22" x 34" PLANS AND DO NOT APPLY TO REDUCED PLAN SETS.

811 Know what's **below.** **Call** before you dig.

CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

DEERE & AULT CONSULTANTS, INC. ASSUMES NO RESPONSIBILITY FOR EXISTING UTILITY LOCATIONS (HORIZONTAL AND VERTICAL). THE EXISTING UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS, HOWEVER, THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES.

DRAWING INDEX:

CERTIFICATION:

I HEREBY CERTIFY THAT THESE PLANS FOR THE BIG DAM DIVERSION STRUCTURE REPAIRS WERE PREPARED UNDER MY DIRECT SUPERVISION FOR THE OWNERS THEREOF

BY: _____
RHETT HIENS, P.E.
COLORADO, P.E. #41581

APPROVAL:

APPROVED ON THE _____ DAY OF

_____ 20____

BY: _____
CONSOLIDATED HOME SUPPLY

THESE PLANS REPRESENT THE AS-CONSTRUCTED PLANS FOR THE BIG DAM DIVERSION STRUCTURE REPAIRS TO THE BEST OF OUR KNOWLEDGE AND JUDGMENT. BASED IN PART ON THE INFORMATION FURNISHED BY OTHERS AS OF THE _____ DAY OF _____ 20____

BY: _____
DON W. DEERE, P.E.
COLORADO, P.E.#19930

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

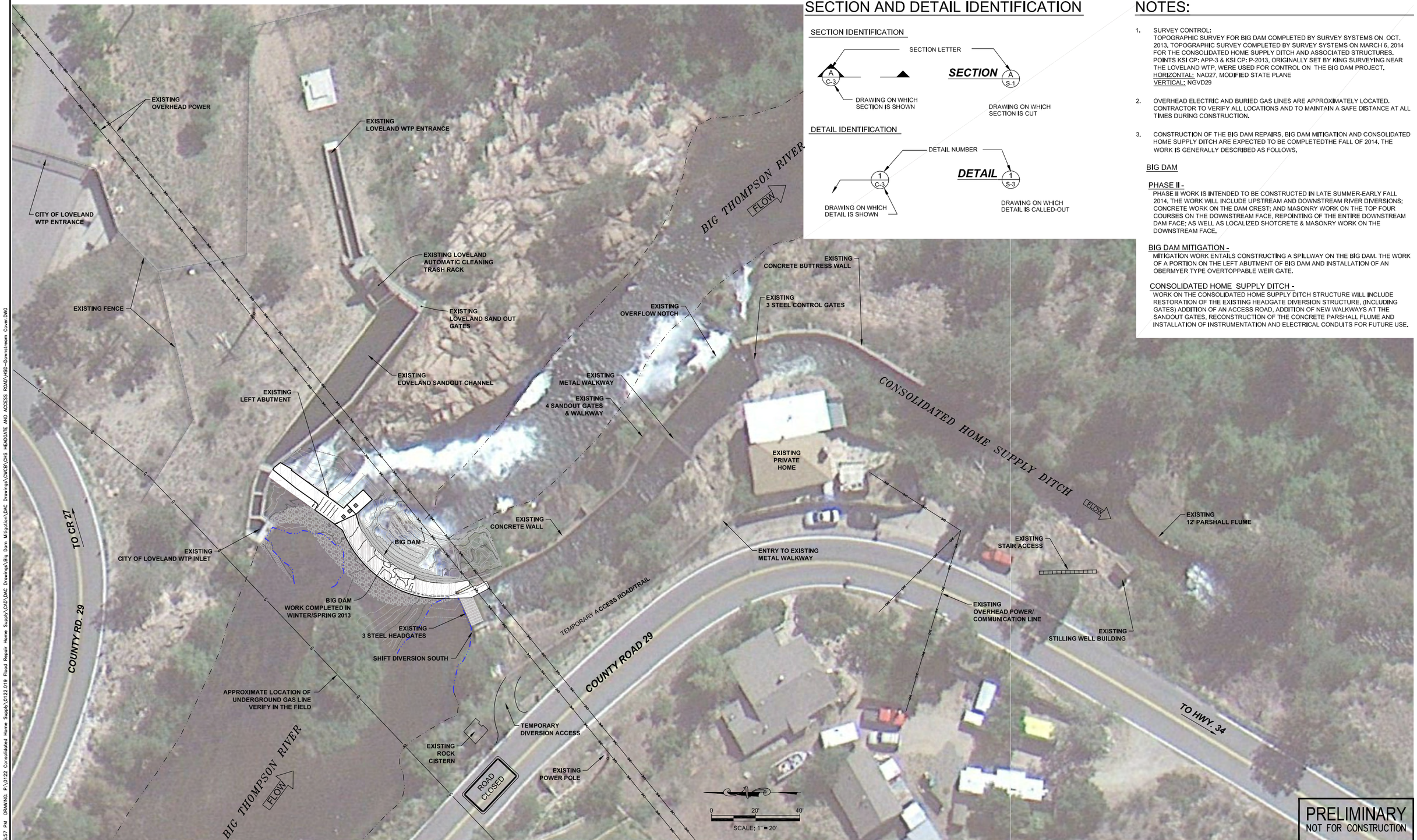
DESIGNED: R.H.
DRAWN: HOG
CHECKED: G.C.

DEERE & AULT CONSULTANTS, INC.
600 SOUTH AIRPORT ROAD, BUILDING A, SUITE 205
LONGMONT, COLORADO 80503
TEL 303.651.1468

PRELIMINARY
NOT FOR CONSTRUCTION

CONSOLIDATED HOME SUPPLY DITCH COMPANY
CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD
COVER SHEET & VICINITY MAP

SHEET
G-1



PRELIMINARY
NOT FOR CONSTRUCTION

SECTION AND DETAIL IDENTIFICATION

SECTION IDENTIFICATION

DETAIL IDENTIFICATION

NOTES:

1. SURVEY CONTROL:
   TOPOGRAPHIC SURVEY FOR BIG DAM COMPLETED BY SURVEY SYSTEMS ON OCT. 2013. TOPOGRAPHIC SURVEY COMPLETED BY SURVEY SYSTEMS ON MARCH 6, 2014 FOR THE CONSOLIDATED HOME SUPPLY DITCH AND ASSOCIATED STRUCTURES. POINTS KSI CP: APP-3 & KSI CP: P-2013, ORIGINALLY SET BY KING SURVEYING NEAR THE LOVELAND WTP, WERE USED FOR CONTROL ON THE BIG DAM PROJECT.
   HORIZONTAL: NAD27, MODIFIED STATE PLANE
   VERTICAL: NGVD29
2. OVERHEAD ELECTRIC AND BURIED GAS LINES ARE APPROXIMATELY LOCATED. CONTRACTOR TO VERIFY ALL LOCATIONS AND TO MAINTAIN A SAFE DISTANCE AT ALL TIMES DURING CONSTRUCTION.
3. CONSTRUCTION OF THE BIG DAM REPAIRS, BIG DAM MITIGATION AND CONSOLIDATED HOME SUPPLY DITCH ARE EXPECTED TO BE COMPLETEDTHE FALL OF 2014. THE WORK IS GENERALLY DESCRIBED AS FOLLOWS.

BIG DAM

PHASE II -
PHASE II WORK IS INTENDED TO BE CONSTRUCTED IN LATE SUMMER-EARLY FALL 2014. THE WORK WILL INCLUDE UPSTREAM AND DOWNSTREAM RIVER DIVERSIONS; CONCRETE WORK ON THE DAM CREST; AND MASONRY WORK ON THE TOP FOUR COURSES ON THE DOWNSTREAM FACE, REPOINTING OF THE ENTIRE DOWNSTREAM DAM FACE; AS WELL AS LOCALIZED SHOTCRETE & MASONRY WORK ON THE DOWNSTREAM FACE.

BIG DAM MITIGATION -
MITIGATION WORK ENTAILS CONSTRUCTING A SPILLWAY ON THE BIG DAM. THE WORK OF A PORTION ON THE LEFT ABUTMENT OF BIG DAM AND INSTALLATION OF AN OBERMYER TYPE OVERTOPPABLE WEIR GATE.

CONSOLIDATED HOME SUPPLY DITCH -
WORK ON THE CONSOLIDATED HOME SUPPLY DITCH STRUCTURE WILL INCLUDE RESTORATION OF THE EXISTING HEADGATE DIVERSION STRUCTURE, (INCLUDING GATES) ADDITION OF AN ACCESS ROAD, ADDITION OF NEW WALKWAYS AT THE SANDOUT GATES, RECONSTRUCTION OF THE CONCRETE PARSHALL FLUME AND INSTALLATION OF INSTRUMENTATION AND ELECTRICAL CONDUITS FOR FUTURE USE.

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED: R.H.
DRAWN: HOG
CHECKED: G.C.

DEERE & AULT
CONSULTANTS, INC.
600 SOUTH AIRPORT ROAD, BUILDING A, SUITE 205
LONGMONT, COLORADO 80503
TEL 303.651.1468

CONSOLIDATED HOME SUPPLY DITCH COMPANY
CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD
EXISTING SITE CONDITIONS

SHEET
G-2

ROAD CLOSED

EXISTING BURIED GAS

EXISTING CISTERN

PROPOSED HEADGATE STRUCTURE (SEE SHEET)

PROPOSED ACCESS ROAD (SEE SHEET)

EXISTING OVERHEAD ELECTRIC

EXISTING OVERHEAD ELECTRIC

BIG THOMPSON RIVER

COUNTY ROAD 29

CITY OF LOVELAND INTAKE (TO WTP)

BIG DAM CREST EL.= 5235.9

BIG DAM MASONRY FACE

CONSOLIDATED HOME SUPPLY DITCH

CITY OF LOVELAND SANDOUT STRUCTURE

EXISTING CONCRETE CHANNEL

EXISTING SANDOUT GATES

EXISTING GRATE FOR SANDOUT STRUCTURE & METAL WALKWAY

EXISTING DRIVEWAY PARKING

EXIST STRUCTURE

TO HWY. 34

EXISTING STILLING WELL HOUSE

CONSOLIDATED HOME SUPPLY DITCH

EXISTING DITCH ACCESS ROAD

EXISTING 12' PARSHALL FLUME

TO C.R. 29

OVERALL SITE PLAN

0 20' 40'

SCALE: 1" = 20'

CONTOUR INTERVAL = 2FT

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
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CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD

OVERALL SITE PLAN

SHEET G-3

EXISTING BURIED GAS

EXISTING HEADGATE STRUCTURE TO BE REMOVED (SEE SHEET C-3)

PROPOSED ACCESS ROAD (SEE SHEET)

EXISTING OVERHEAD ELECTRIC

EXISTING OVERHEAD ELECTRIC

BIG THOMPSON RIVER

CITY OF LOVELAND INTAKE (TO WTP)

BIG DAM CREST EL.= 5235.9

CONSOLIDATED HOME SUPPLY DITCH

COUNTY ROAD 29

EXISTING CONCRETE WALL

BIG THOMPSON RIVER

EXISTING STRUCTURE

EXISTING FENCE

EXISTING CONCRETE OVERFLOW

EXISTING CONTROL GATE STRUCTURE (PRESERVE & PROTECT)

FLOW

EOA

OHE

DEMOLITION PLAN

0 20' 40'

SCALE: 1" = 20'

CONTOUR INTERVAL = 2FT

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
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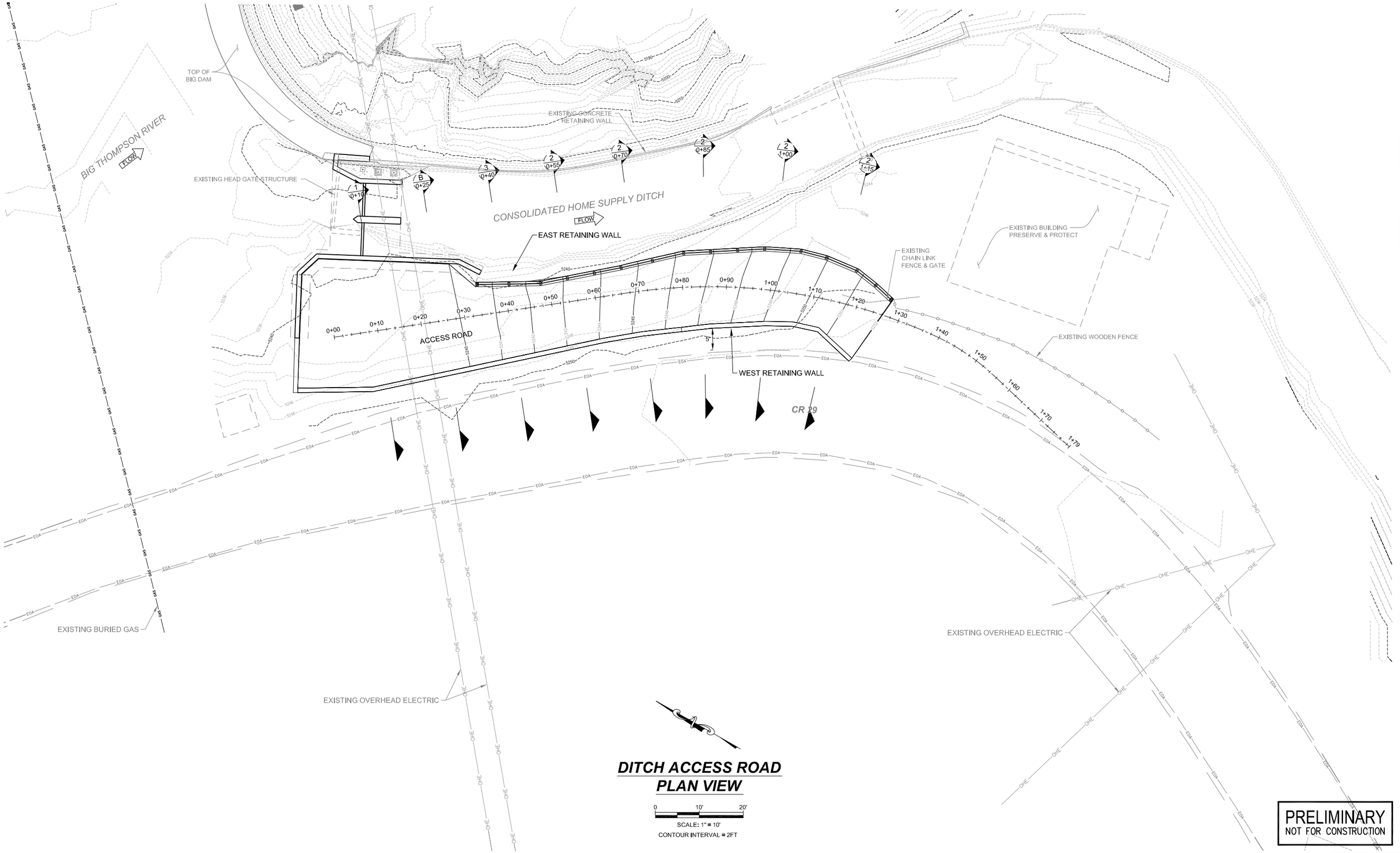
CONSOLIDATED HOME SUPPLY DITCH COMPANY

CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD

DEMOLITION PLAN

SHEET
G-4



DITCH ACCESS ROAD
PLAN VIEW

0 10' 20'

SCALE: 1" = 10'

CONTOUR INTERVAL = 2FT

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

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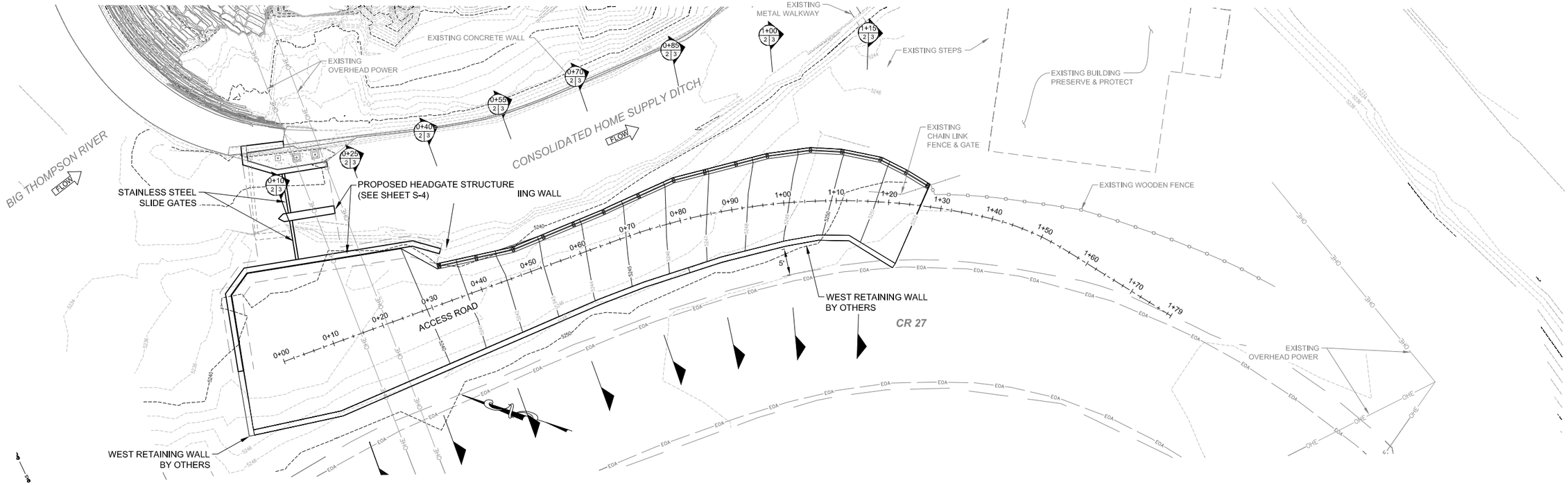
CONSOLIDATED HOME SUPPLY DITCH COMPANY
CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD
OVERALL PLAN

SHEET
S-1

Thursday, August 07, 2014 1:59:53 PM DRAWING: P:\0122 Consolidated Home Supply\0122.019 Flood Repair Home Supply\CAD\DAC Drawings\Big Dam Mitigation\DAC Drawings\CWCB\CHS HEADGATE AND ACCESS ROAD\HSD-Road Grading.DWG

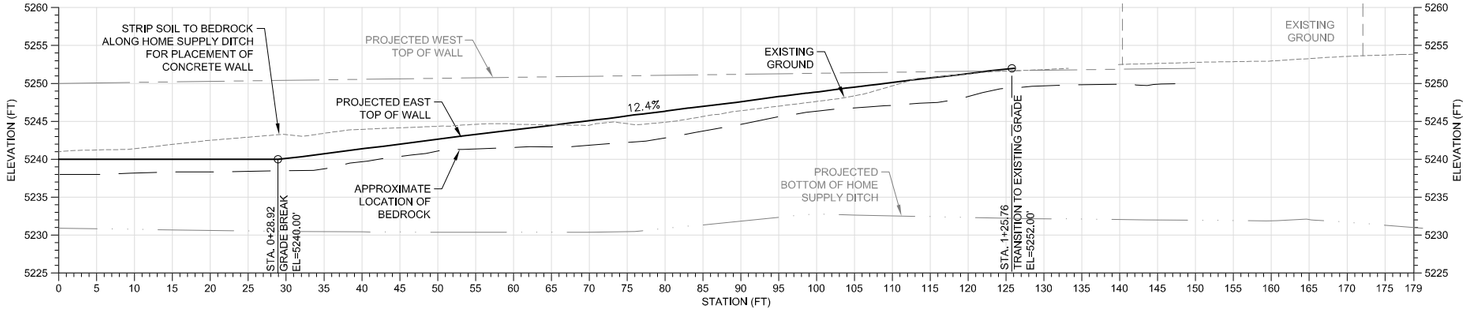


DITCH ACCESS ROAD PLAN VIEW

0 10' 20'

SCALE: 1" = 10'

CONTOUR INTERVAL = 2FT



ACCESS ROAD PROFILE

0 10' 20'

SCALE: 1" = 10'

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

WARNING
0 1/2 1
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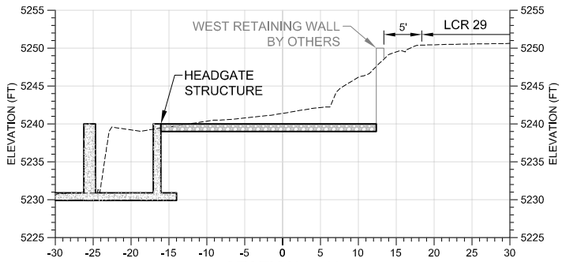
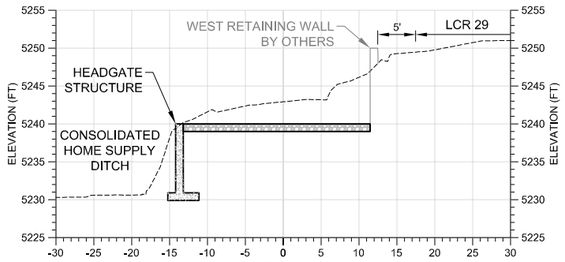
CONSOLIDATED HOME SUPPLY DITCH COMPANY
CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD
SOUTH ACCESS ROAD PLAN & PROFILE

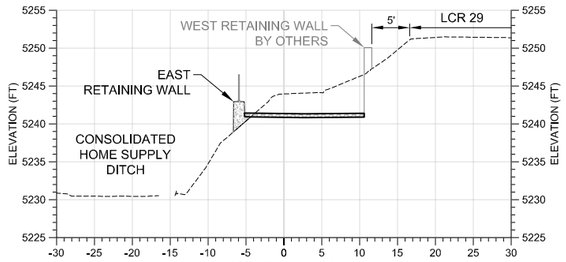
SHEET
S-2



STATION 0+10



STATION 0+25



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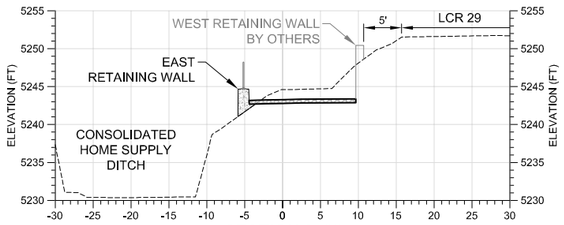
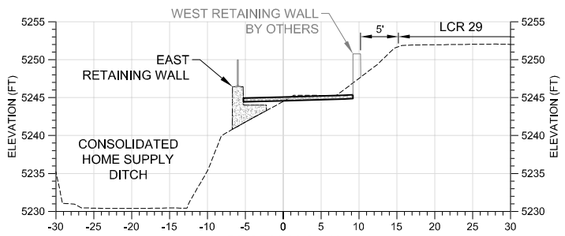
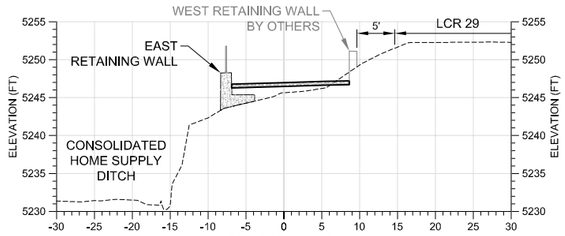


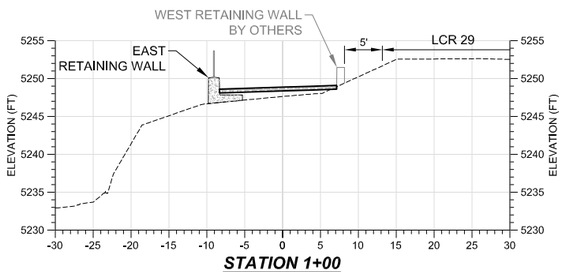
STATION 0+55



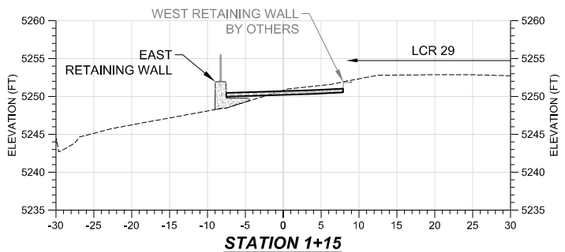
STATION 0+70



STATION 0+85



STATION 1+00

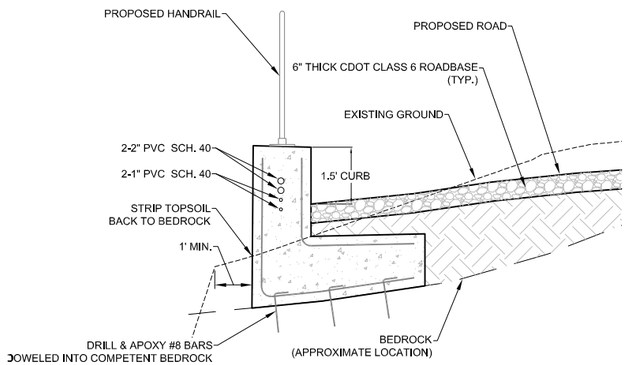


STATION 1+15

ACCESS ROAD SECTIONS

0 10' 20'

SCALE: 1" = 10'



EAST RETAINING WALL SECTION

0 10' 20'

SCALE: 1" = 10'

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

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0 1/2 1
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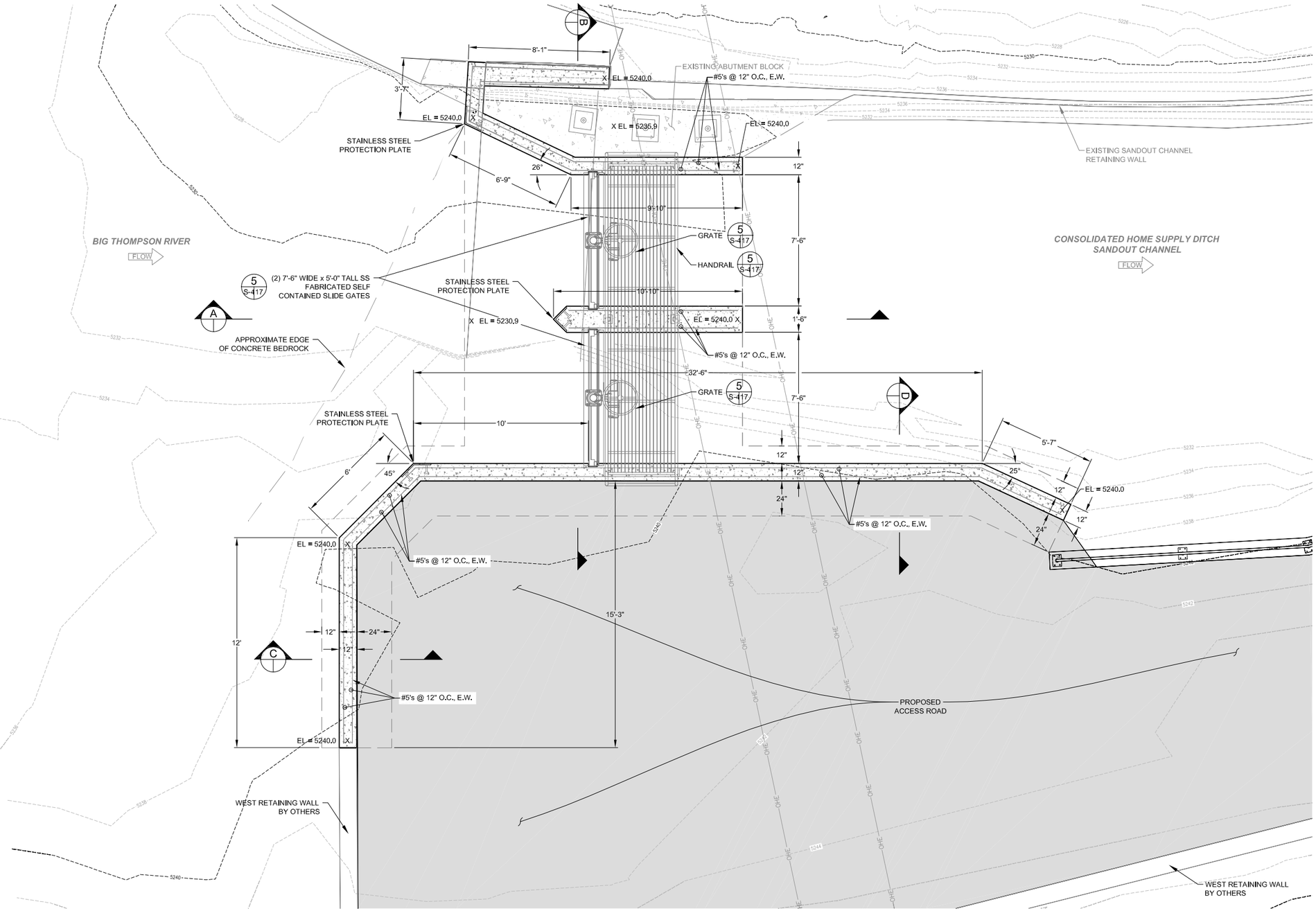
CONSOLIDATED HOME SUPPLY DITCH COMPANY

CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD

SOUTH ACCESS ROAD X-SECTIONS

SHEET
S-3



CONSOLIDATED HOME SUPPLY HEADGATE STRUCTURE PLAN

0 3' 6'

SCALE: 1" = 3'

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

WARNING
0 1/2 1
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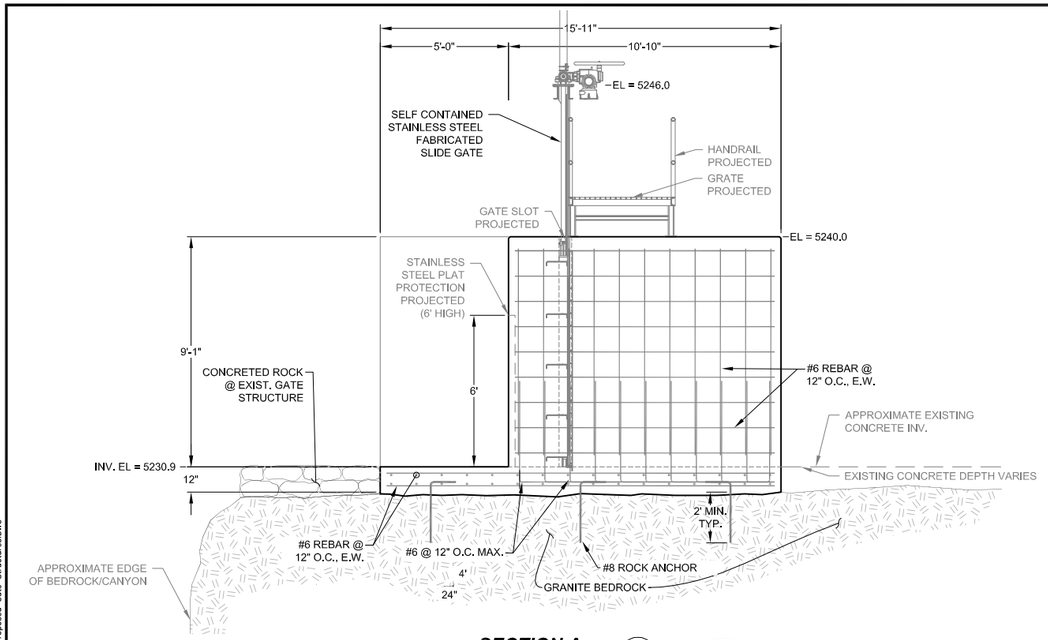
CONSOLIDATED HOME SUPPLY DITCH COMPANY
CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD
HEADGATE PLAN & PROFILE

SHEET
S-4



SECTION A

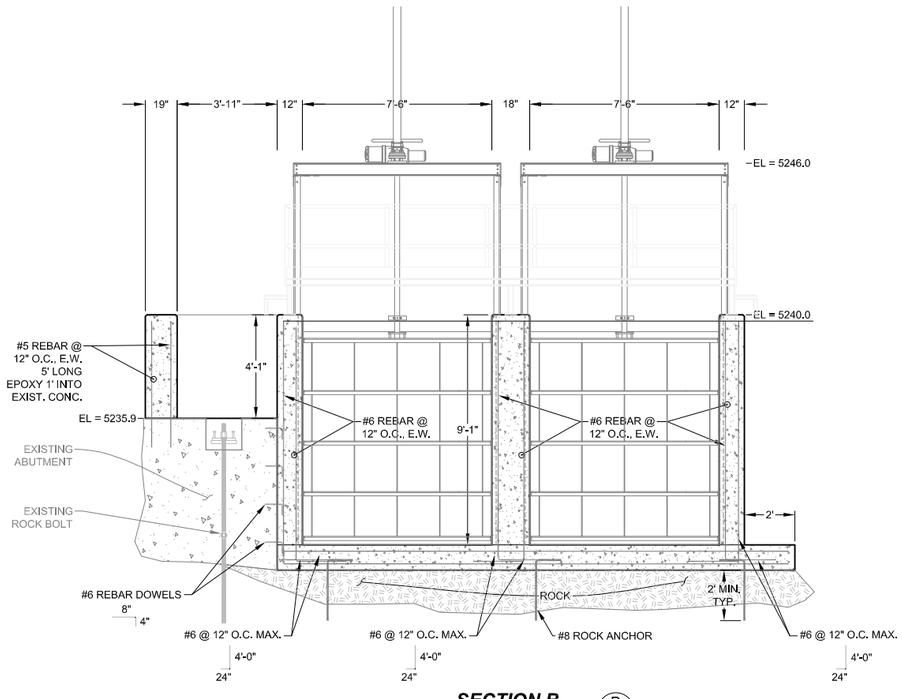
A S-5 4

0 3' 6'

SCALE: 1" = 3'

NOTES:

1. 2'-6" TALL PORCELAIN ENAMELED STYLE 'C' STAFF GAGE MANUFACTURED BY STEVENS WATERMARK (OR APPROVED EQUAL)

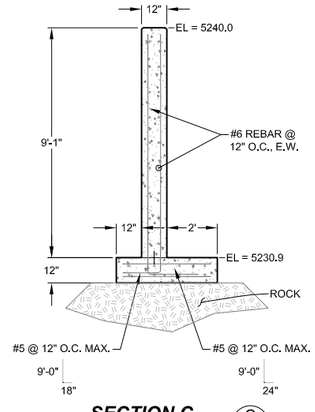


SECTION B

B S-5 4

0 3' 6'

SCALE: 1" = 3'

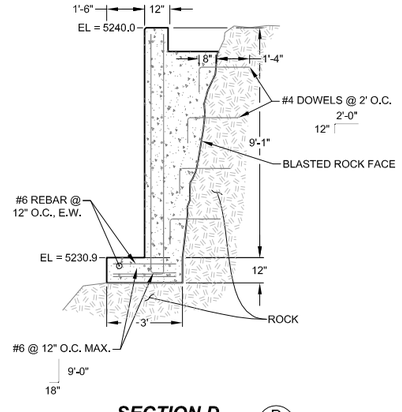


SECTION C

C S-5 4

0 3' 6'

SCALE: 1" = 3'

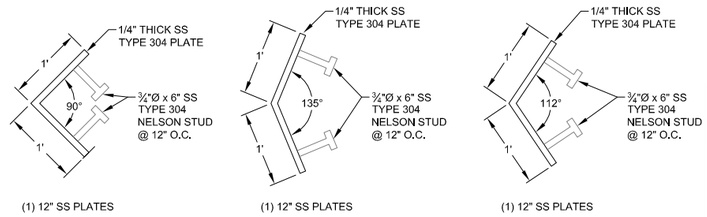


SECTION D

D S-5 4

0 3' 6'

SCALE: 1" = 3'



NOTE
1. ALL CORNER PLATES ARE 6 FEET TALL.

HEADGATE STAINLESS STEEL PLATE (SSP) PROTECTION

0 1' 2'

SCALE: 1" = 1'

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

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0 1/2 1
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CONSOLIDATED HOME SUPPLY DITCH COMPANY
CONSOLIDATED HOME SUPPLY HEADGATE DIVERSION & ACCESS ROAD
HEAD GATE DETAILS

SHEET S-5

CONSOLIDATED HOME SUPPLY DITCH HEADWORKS
HEADGATE AND ACCESS ROAD

CONSOLIDATED HOME SUPPLY DITCH COMPANY

ENGINEERING OPINION OF CONSTRUCTION COSTS

August 7, 2014

Item #	Description	Quantity	Unit	Rate	Total
1	Mobilization, Bonding, Insurance @ 5%	1	LS	$ 13,400	$ 13,400
2	Care of River/ Dewatering	1	LS	$ 20,000	$ 20,000
Access Road					
2	Clearing/Grubbing/Tree Removal	1	LS	$ 4,000	$ 4,000
3	Earthwork for Access Road and Wall	1	LS	$ 12,500	$ 12,500
4	East Concrete Retaining Wall	45	CY	$ 1,000	$ 45,000
5	Handrail	100	LF	$ 75	$ 7,500
5	Road Base	3000	SF	$ 1	$ 3,000
Headgate Structure					
6	Headgate Demolition	1	LS	$ 6,000	$ 6,000
7	Rock excavation/ Blasting	1	LS	$ 10,000	$ 10,000
8	Earthwork/Foundation Prep	1	LS	$ 6,500	$ 6,500
9	Concrete	60	CY	$ 1,000	$ 60,000
10	Walkways, Handrails, Embeds	1	LS	$ 9,000	$ 9,000
11	SS Fabricated Slide Gates	2	EA	$ 40,000	$ 80,000
Electrical					
12	Conduit installation (2-2" and 2-1", pull boxes)	1	LS	$ 5,000	$ 5,000
				Total Construction Items	**$ 281,900**
				Contingency @ 15%	$ 42,000
				Construction Management @ 15%	$ 49,000
				Engineering @ 20%	$ 65,000
				TOTAL ESTIMATED COST (rounded to nearest $1,000)	**$ 438,000**

Notes:

1. Cost for traffic control and permitting are not included

FIGURE 11

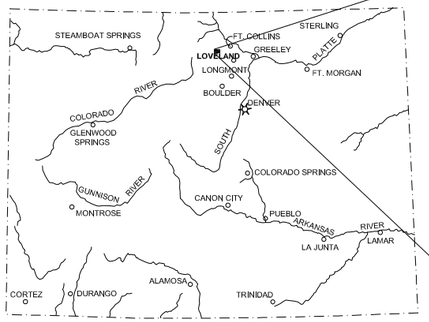
CONSTRUCTION PLANS FOR

CONSOLIDATED HOME SUPPLY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS

LARIMER COUNTY, COLORADO

PREPARED FOR:

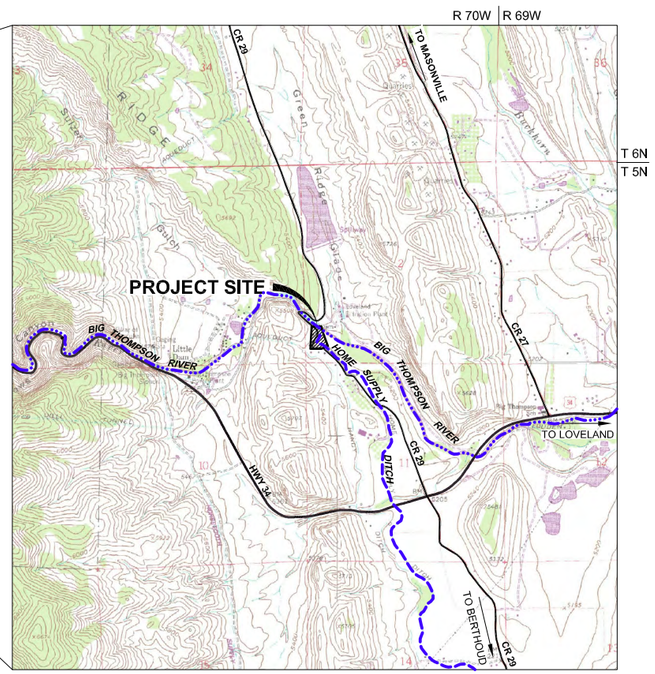
CONSOLIDATED HOME SUPPLY
1650 W 8TH STREET
LOVELAND, CO 80537



STATE OF COLORADO
PROJECT LOCATION MAP

NORTH

SCALE: NONE



PROJECT VICINITY MAP

NORTH

SCALE: 1"=2000'

NOTES:

DEERE AND AULT CONSULTANTS, INC. IS NOT A GUARANTOR OF THE PERFORMANCE OF THE WORK.

DEERE AND AULT CONSULTANTS, INC. IS NOT RESPONSIBLE FOR SAFETY, IN, ON, OR ABOUT THE PROJECT SITE, NOR FOR COMPLIANCE BY THE APPROPRIATE PARTY WITH ANY REGULATIONS RELATED THERETO.

DEERE AND AULT CONSULTANTS, INC. EXERCISES NO CONTROL OVER THE SAFETY OR ADEQUACY OF ANY EQUIPMENT, BUILDING COMPONENTS, FORMS, OR OTHER WORK AIDS USED IN OR ABOUT THE PROJECT, OR OVER THE SUPERINTENDING OF THE SAME.

WRITTEN SCALES ON PLAN ARE FOR FULL SIZED 22" x 34" PLANS AND DO NOT APPLY TO REDUCED PLAN SETS.

811 Know what's **below.** **Call** before you dig.

CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

DEERE & AULT CONSULTANTS, INC. ASSUMES NO RESPONSIBILITY FOR EXISTING UTILITY LOCATIONS (HORIZONTAL AND VERTICAL). THE EXISTING UTILITIES SHOWN ON THIS DRAWING HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS, HOWEVER, THE RESPONSIBILITY OF THE CONTRACTOR TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION ACTIVITIES.

DRAWING INDEX:

CERTIFICATION:

I HEREBY CERTIFY THAT THESE PLANS FOR THE BIG DAM DIVERSION STRUCTURE REPAIRS WERE PREPARED UNDER MY DIRECT SUPERVISION FOR THE OWNERS THEREOF

BY: _____
RHETT HIENS, P.E.
COLORADO, P.E. #41581

APPROVAL:

APPROVED ON THE _____ DAY OF

_____ 20____

BY: _____
CONSOLIDATED HOME SUPPLY

THESE PLANS REPRESENT THE AS-CONSTRUCTED PLANS FOR THE BIG DAM DIVERSION STRUCTURE REPAIRS TO THE BEST OF OUR KNOWLEDGE AND JUDGMENT. BASED IN PART ON THE INFORMATION FURNISHED BY OTHERS AS OF THE _____ DAY OF _____ 20____

BY: _____
DON W. DEERE, P.E.
COLORADO, P.E.#19930

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
0 1/2 1
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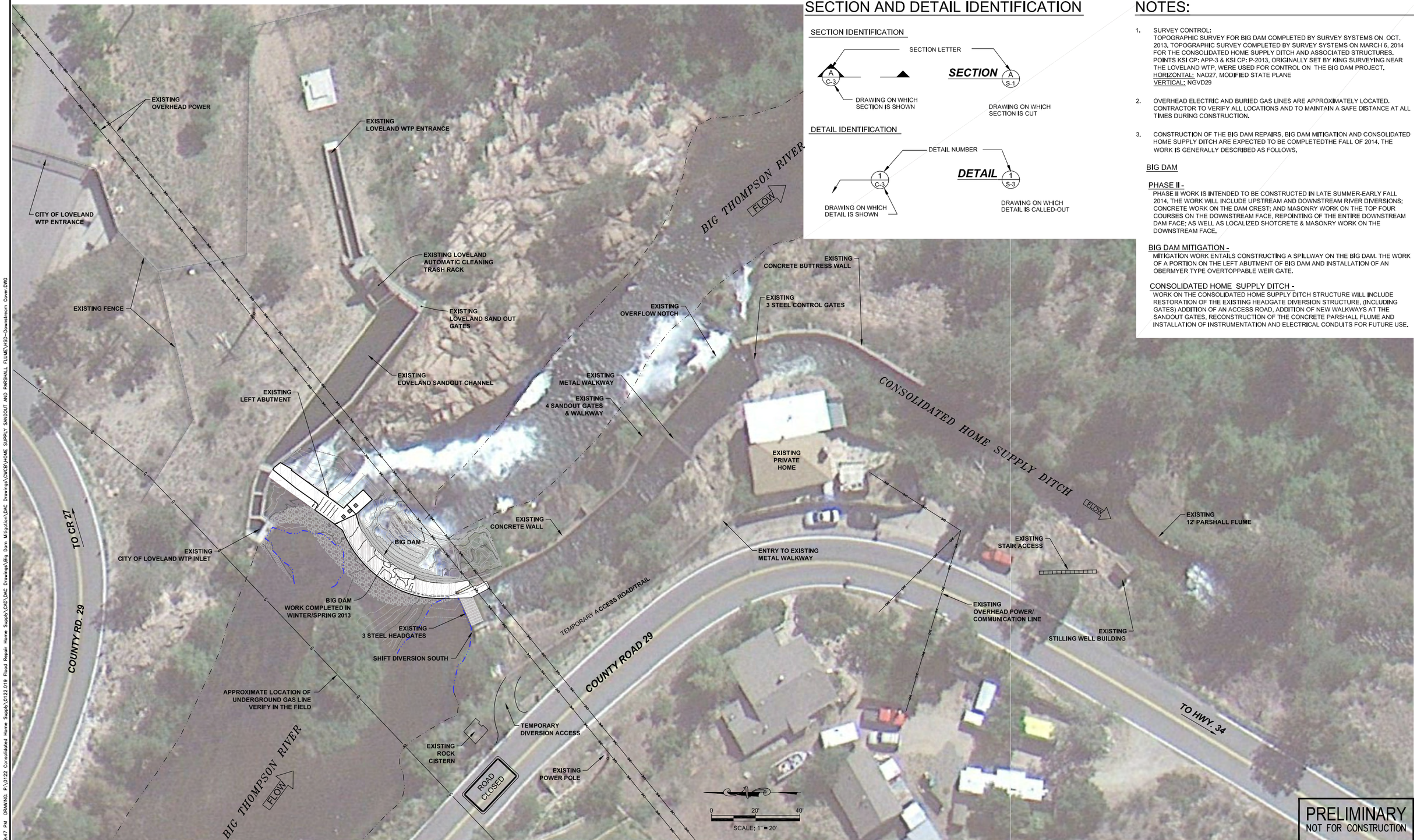
PRELIMINARY
NOT FOR CONSTRUCTION

CONSOLIDATED HOME SUPPLY DITCH COMPANY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS
COVER SHEET & VICINITY MAP

SHEET
G-1



SECTION AND DETAIL IDENTIFICATION

SECTION IDENTIFICATION

DETAIL IDENTIFICATION

NOTES:

1. SURVEY CONTROL:
   TOPOGRAPHIC SURVEY FOR BIG DAM COMPLETED BY SURVEY SYSTEMS ON OCT. 2013. TOPOGRAPHIC SURVEY COMPLETED BY SURVEY SYSTEMS ON MARCH 6, 2014 FOR THE CONSOLIDATED HOME SUPPLY DITCH AND ASSOCIATED STRUCTURES. POINTS KSI CP: APP-3 & KSI CP: P-2013, ORIGINALLY SET BY KING SURVEYING NEAR THE LOVELAND WTP, WERE USED FOR CONTROL ON THE BIG DAM PROJECT.
   HORIZONTAL: NAD27, MODIFIED STATE PLANE
   VERTICAL: NGVD29

2. OVERHEAD ELECTRIC AND BURIED GAS LINES ARE APPROXIMATELY LOCATED. CONTRACTOR TO VERIFY ALL LOCATIONS AND TO MAINTAIN A SAFE DISTANCE AT ALL TIMES DURING CONSTRUCTION.

3. CONSTRUCTION OF THE BIG DAM REPAIRS, BIG DAM MITIGATION AND CONSOLIDATED HOME SUPPLY DITCH ARE EXPECTED TO BE COMPLETEDTHE FALL OF 2014. THE WORK IS GENERALLY DESCRIBED AS FOLLOWS.

BIG DAM

PHASE II -
PHASE II WORK IS INTENDED TO BE CONSTRUCTED IN LATE SUMMER-EARLY FALL 2014. THE WORK WILL INCLUDE UPSTREAM AND DOWNSTREAM RIVER DIVERSIONS; CONCRETE WORK ON THE DAM CREST; AND MASONRY WORK ON THE TOP FOUR COURSES ON THE DOWNSTREAM FACE, REPOINTING OF THE ENTIRE DOWNSTREAM DAM FACE; AS WELL AS LOCALIZED SHOTCRETE & MASONRY WORK ON THE DOWNSTREAM FACE.

BIG DAM MITIGATION -
MITIGATION WORK ENTAILS CONSTRUCTING A SPILLWAY ON THE BIG DAM. THE WORK OF A PORTION ON THE LEFT ABUTMENT OF BIG DAM AND INSTALLATION OF AN OBERMYER TYPE OVERTOPPABLE WEIR GATE.

CONSOLIDATED HOME SUPPLY DITCH -
WORK ON THE CONSOLIDATED HOME SUPPLY DITCH STRUCTURE WILL INCLUDE RESTORATION OF THE EXISTING HEADGATE DIVERSION STRUCTURE, (INCLUDING GATES) ADDITION OF AN ACCESS ROAD, ADDITION OF NEW WALKWAYS AT THE SANDOUT GATES, RECONSTRUCTION OF THE CONCRETE PARSHALL FLUME AND INSTALLATION OF INSTRUMENTATION AND ELECTRICAL CONDUITS FOR FUTURE USE.

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
0 1/2 1
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DRAWN: HOG
CHECKED: G.C.

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CONSOLIDATED HOME SUPPLY DITCH COMPANY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS
EXISTING SITE CONDITIONS

SHEET
G-2

ROAD CLOSED

EXISTING BURIED GAS

EXISTING CISTERN

EXISTING OVERHEAD ELECTRIC

EXISTING OVERHEAD ELECTRIC

BIG THOMPSON RIVER

COUNTY ROAD 29

CITY OF LOVELAND INTAKE (TO WTP)

BIG DAM CREST EL.= 5235.9

BIG DAM MASONRY FACE

CONSOLIDATED HOME SUPPLY DITCH

CITY OF LOVELAND SANDOUT STRUCTURE

EXISTING CONCRETE CHANNEL

EXISTING SANDOUT GATES

PROPOSED GRATING & WALKWAY FOR EXISTING SANDOUT STRUCTURE (SEE SHEET)

EXISTING GRATE FOR SANDOUT STRUCTURE & METAL WALKWAY

EXISTING DRIVEWAY PARKING

EXIST STRUCTURE

TO HWY. 34

PROPOSED 12' PARSHALL FLUME

EXISTING STILLING WELL HOUSE

CONSOLIDATED HOME SUPPLY DITCH

EXISTING DITCH ACCESS ROAD

EXISTING 12' PARSHALL FLUME

TO C.R. 29

OVERALL SITE PLAN

0 20' 40'

SCALE: 1" = 20'

CONTOUR INTERVAL = 2FT

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED: R.H.
DRAWN: HOG
CHECKED: G.C.

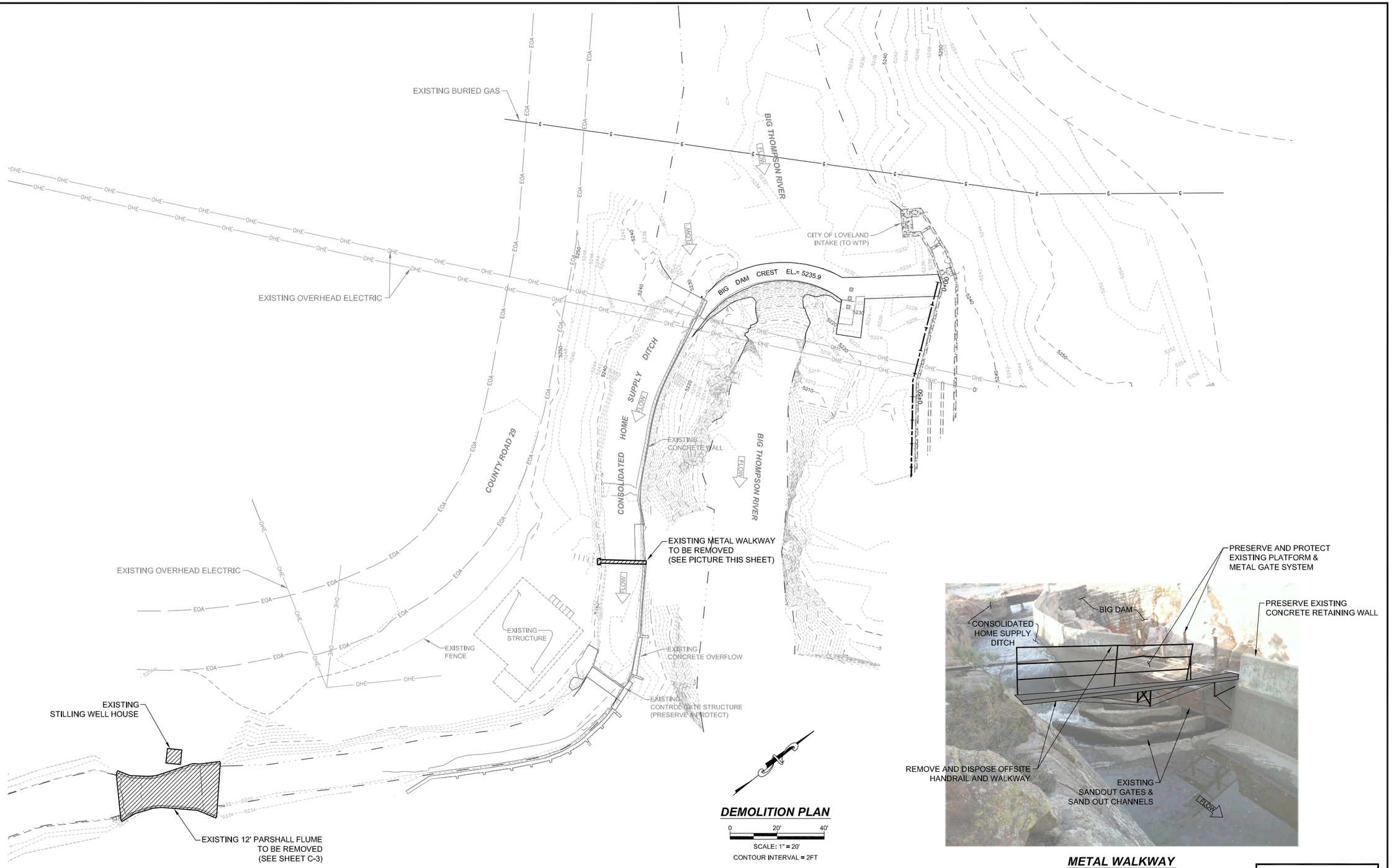
DEERE & AULT
CONSULTANTS, INC.
600 SOUTH AIRPORT ROAD, BUILDING A, SUITE 205
LONGMONT, COLORADO 80503
TEL 303.651.1468

CONSOLIDATED HOME SUPPLY DITCH COMPANY

CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS

OVERALL SITE PLAN

SHEET G-3



DEMOLITION PLAN

0 20' 40'

SCALE: 1" = 20'

CONTOUR INTERVAL = 2FT

METAL WALKWAY

SCALE : NONE

NOTE:

1. PHOTOGRAPH TAKEN NOVEMBER 2013.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

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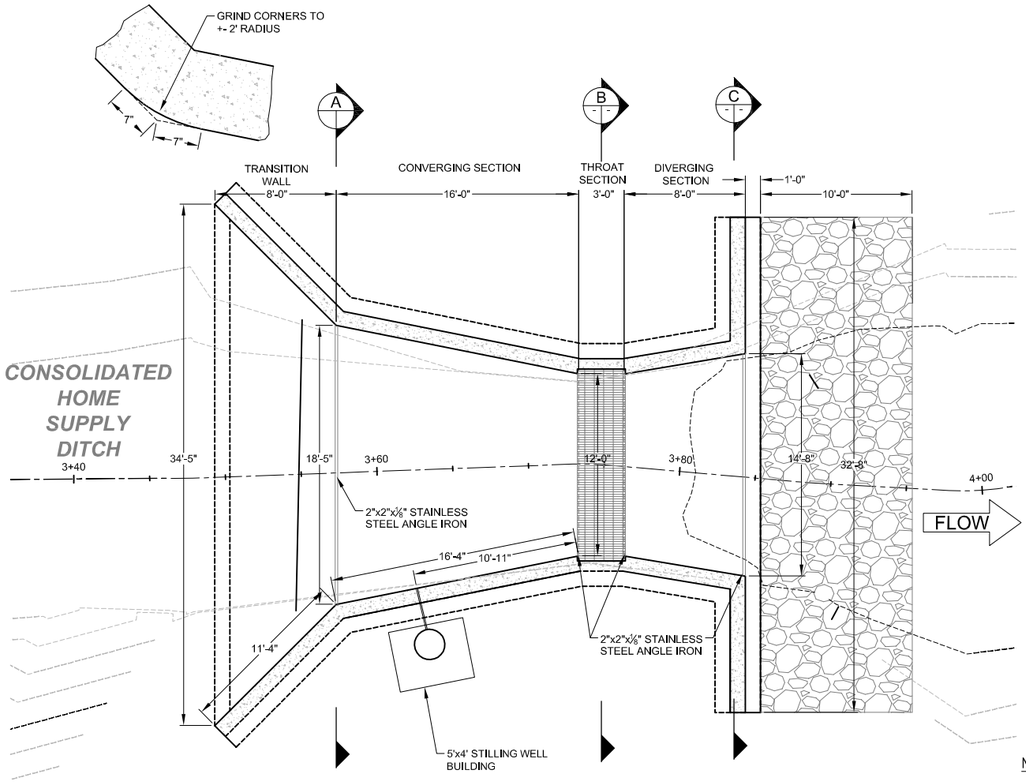
DEMOLITION PLAN

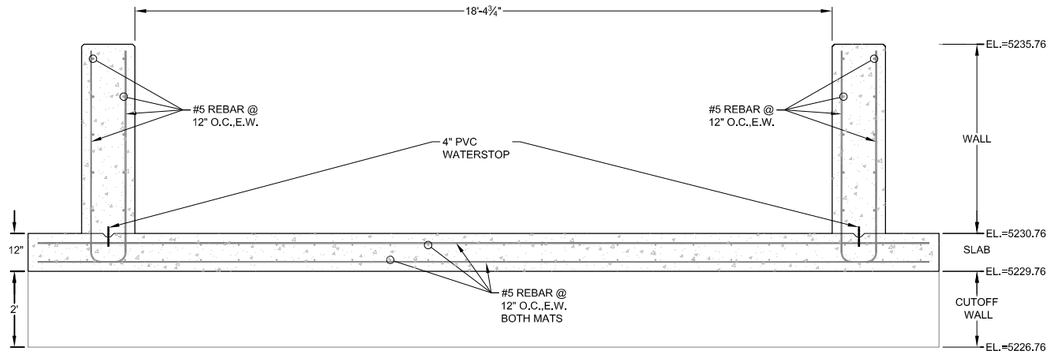
SHEET
G-4



PARSHALL FLUME PLAN VIEW

0 5' 10'

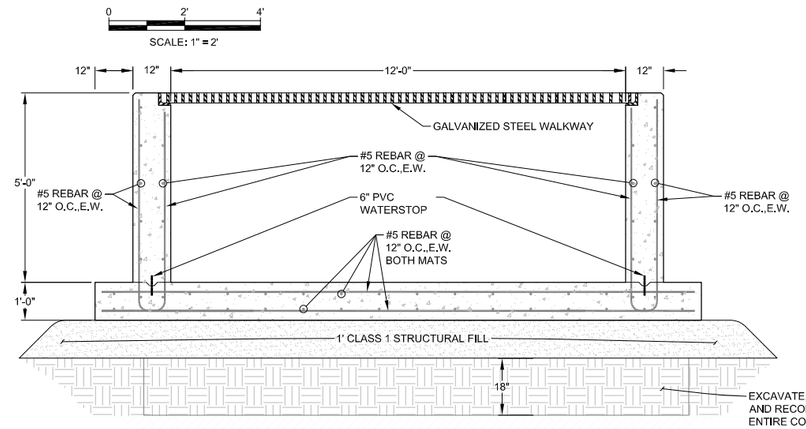
SCALE: 1" = 5'



PARSHALL FLUME SECTION A

0 2' 4'

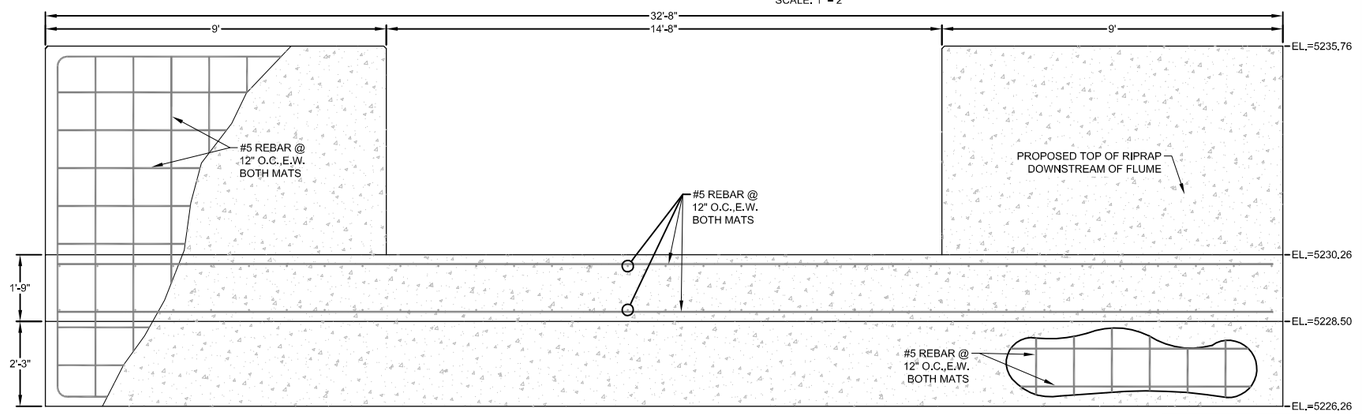
SCALE: 1" = 2'



PARSHALL FLUME SECTION B

0 2' 4'

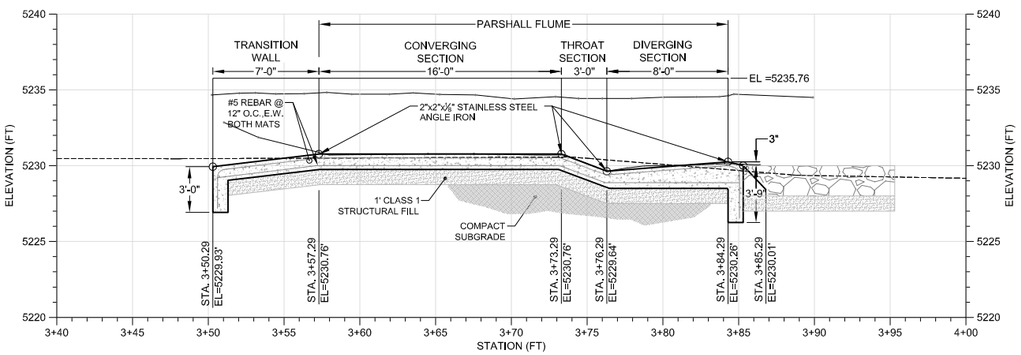
SCALE: 1" = 2'



PARSHALL FLUME SECTION C

0 2' 4'

SCALE: 1" = 2'



PARSHALL FLUME PROFILE VIEW

0 5' 10'

SCALE: 1" = 5'

NOTES:

1. CONCRETE EXPOSED TO EARTH SHALL HAVE A MINIMUM OF 3 INCHES OF COVER REINFORCING STEEL. 2" OF COVER EVERYWHERE ELSE.
2. ALL HORIZONTAL & VERTICAL EXPOSED EDGES ON CONCRETE SHALL HAVE A ¾" CHAMFER.
3. PROVIDE 6" PVC WATERSTOP AT ALL WALL & SLAB POURS.
4. PORTIONS OF THE SLAB EXPOSED TO FLOWING WATER SHALL HAVE A HARD STEEL TROWEL FINISH.
5. INTERIOR CONCRETE WALLS OF FLUME STRUCTURE SHALL BE CONSTRUCTED TO PROVIDE A SMOOTH SURFACE. AFTER THE CONCRETE HAS BEEN PLACED WALLS SHALL BE GROUND SMOOTH AND ALL VOIDS FILLED WITH AN APPROVED GROUT. THE WALLS SHALL BE RUBBED TO PROVIDE A SMOOTH SURFACE.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

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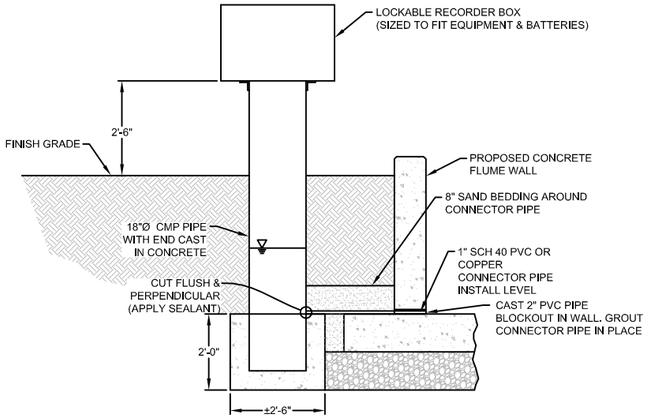
CONSOLIDATED HOME SUPPLY DITCH COMPANY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS
12' PARSHALL FLUME PLAN

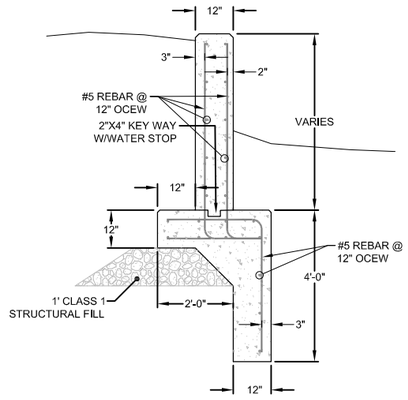
SHEET
S-1



DITCH FLUME STILLING WELL DETAIL (1 | 6 | 17)

0 2 4

Scale In Feet



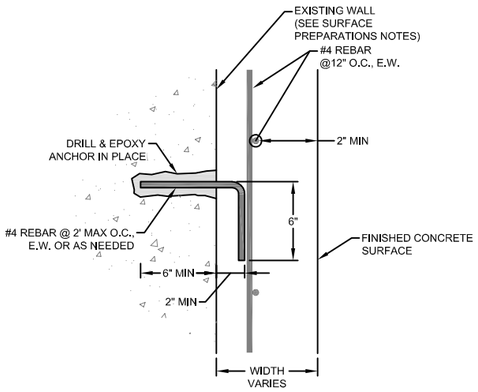
TYPICAL TRANSITION WALL DETAIL

0 2 4

Scale In Feet

CONCRETE SURFACE PREPARATION NOTES (PER SPEC.03300)

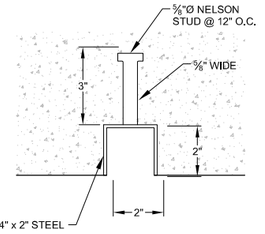
1. PREPARE ALL CONCRETE SURFACES TO PROVIDE A SOLID CONCRETE SURFACE FOR NEW CONCRETE AND SHOTCRETE TO BOND.
2. REMOVE UNSOUND CONCRETE BY SAWCUTTING OR BUSH HAMMERING FOLLOWED BY HYDRO-BLASTING (OR APPROVED METHOD) TO PROVIDE A CONCRETE SURFACE PROFILE (CSP 6) PER THE INTERNATIONAL CONCRETE REPAIR INSTITUTE TECHNICAL GUIDELINES.
3. MAXIMUM 15 lb HAND HELD BUSH HAMMER.
4. MINIMUM 5000 psi HYDRO-BLASTING OF ALL SURFACES. HYDRO-BLASTING IS REQUIRED AFTER AREAS HAVE BEEN PREPARED WITH BUSH HAMMERS TO REMOVE CRACKED & LOOSE CONCRETE.
5. NOTIFY ENGINEER FOR APPROVAL OF ALL CONCRETE SURFACES PRIOR TO PLACEMENT OF CONCRETE ON SHOTCRETE.
6. ALL EXPOSED STEEL SHALL BE CLEANED TO REMOVE ALL FLAKING & LOOSE STEEL.



STEEL REINFORCEMENT ANCHOR DETAIL

0 0.5 1

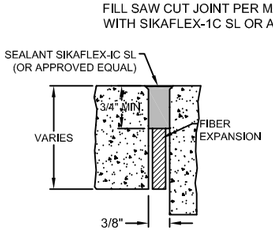
Scale In Feet



1. STOP LOG SLOT HOT DIPPED GALVANIZED STEEL
2. FABRICATE BY CUTTING 4" x 2" STEEL TUBING IN HALF.

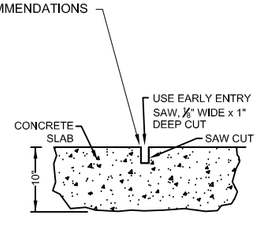
TYPE I STOP LOG SLOT (3 | 6 | 17)

NTS



EXPANSION JOINT

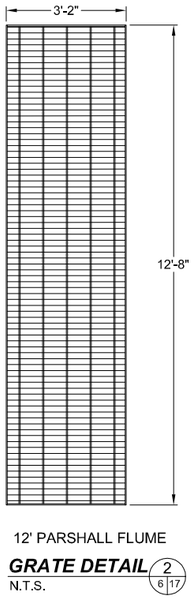
NTS



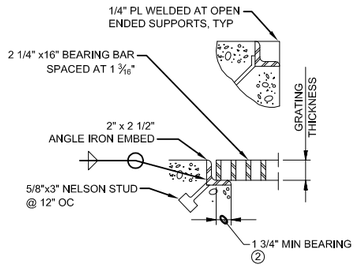
CRACK CONTROL JOINT

NTS

NOTE:
1. CUT JOINTS OF 10' O.C. IN WALLS AND SLAB



12' PARSHALL FLUME

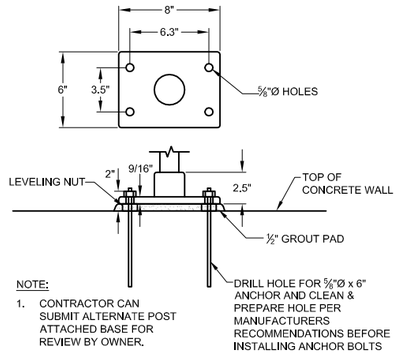


GRATE NOTES:

1. CONTRACTOR TO FIELD VERIFY DIMENSIONS PRIOR TO GRATE FABRICATION. GRATES MAY NEED TO BE ADJUSTED AROUND GATE FRAMES.
2. CONTRACTOR TO SUBMIT TO OWNER FOR REVIEW AND APPROVAL BEFORE FABRICATION.
3. EMBEDS AND GRATING SHALL BE HOT-DIPPED GALVANIZED.
4. FASTENERS, ANCHOR, BOLTS, NUTS & WASHERS SUBJECT TO BE SUBMERGED SHALL BE STAINLESS STEEL.
5. GRATING TO BE INSTALLED FIRMLY IN PLACE USING BAR GRATING ANCHORING CLIPS.

GRATE DETAIL (2 | 6 | 17)

N.T.S.

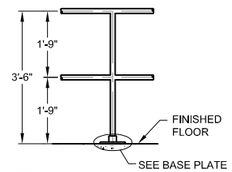


NOTE:
1. CONTRACTOR CAN SUBMIT ALTERNATE POST ATTACHED BASE FOR REVIEW BY OWNER.

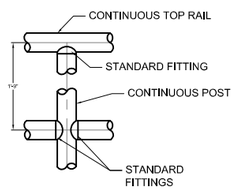
BASE PLATE DETAIL

0 0.5 1

Scale In Feet



NOTE:
RAILS, POSTS & BASE PLATES EXTRUDED 1-1/2" SCH 40 STEEL.



GALVANIZED STEEL HANDRAIL DETAIL (5 | 6 | 17)

NTS

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

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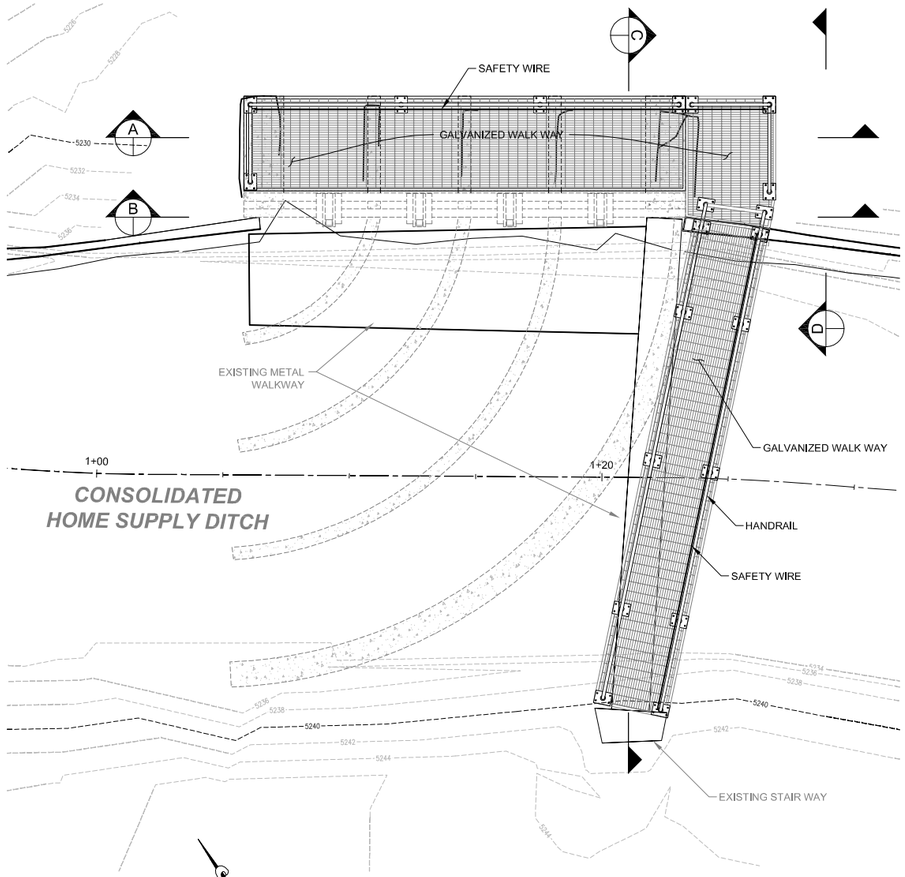
TEL 303.651.1468

CONSOLIDATED HOME SUPPLY DITCH COMPANY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS
PARSHALL FLUME DETAILS

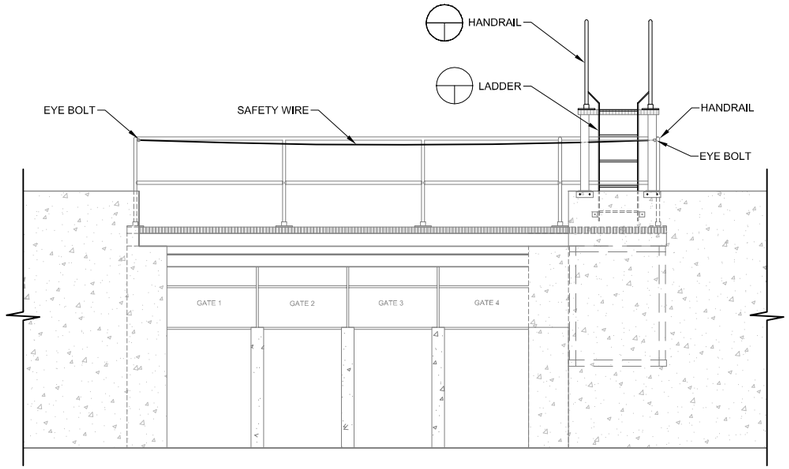
SHEET
S-2



HEADGATE STRUCTURE PLAN

0 3' 6'

SCALE: 1" = 3'



SECTION B (B 10|10)

0 3' 6'

SCALE: 1" = 3'

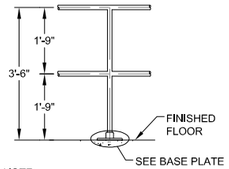
TOP OF CONCRETE WALL

- ½" GROUT PAD
- DRILL HOLE FOR ⅝"Øx6" ANCHOR AND CLEAN & PREPARE HOLE PER MANUFACTURES REMOMONDATIONS BEFORE INSTALLING ANCHOR BOLTS

BASE PLATE DETAIL

0 2' 4'

SCALE: 1" = 2'



1'

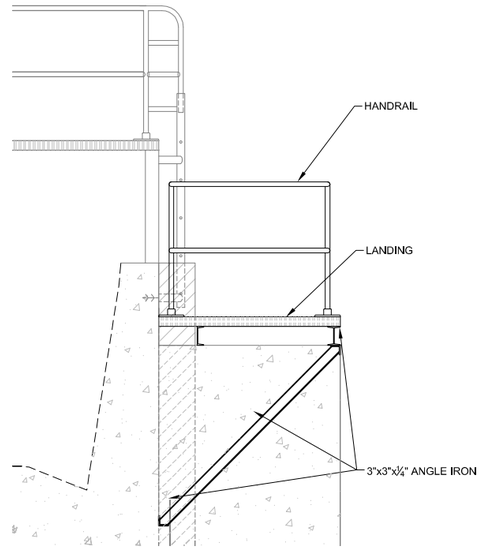
LES

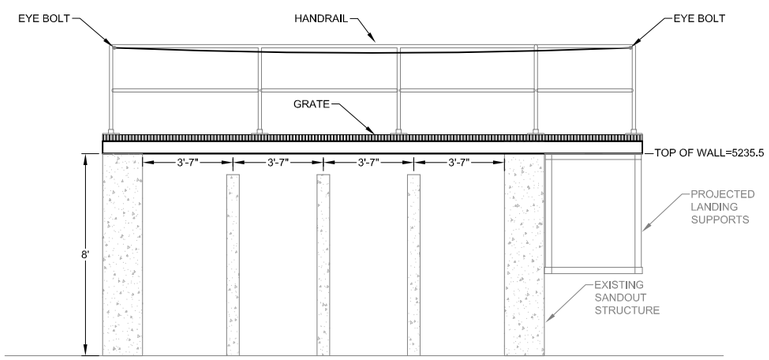
NOTE:

RAILS, POSTS & BASE PLATES EXTRUDED 1-1/2" SCH 40 STEEL.

GALVANIZED STEEL HANDRAIL DETAIL

SCALE: NONE

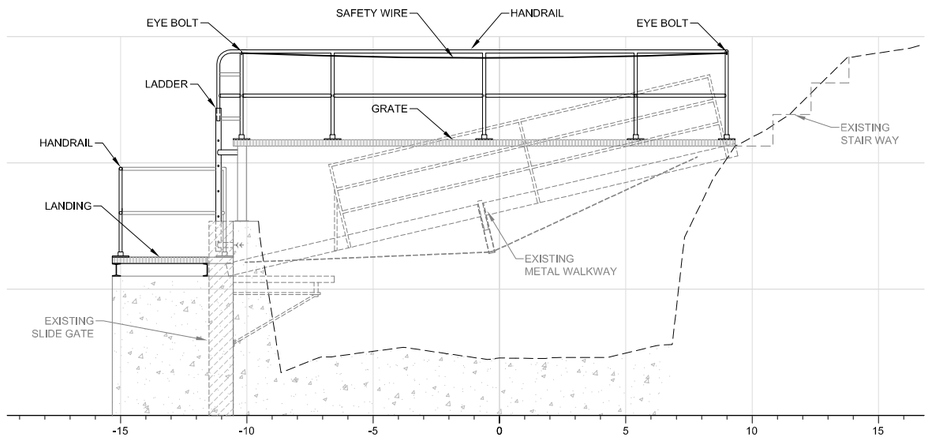




SECTION A (A 10|10)

0 3' 6'

SCALE: 1" = 3'



SECTION C HEADGATE STRUCTURE PROFILE (C 10|10)

0 3' 6'

SCALE: 1" = 3'

LANDING SUPPORT DETAIL (D 10|10)

0 3' 6'

SCALE: 1" = 3'

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

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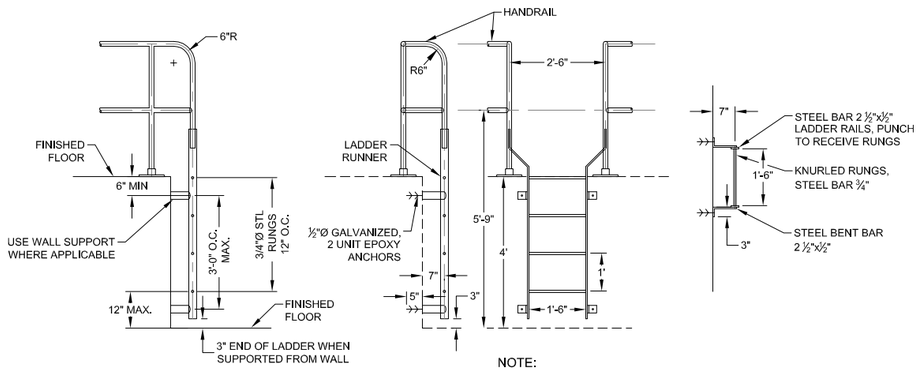
CONSOLIDATED HOME SUPPLY DITCH COMPANY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS
SANDOUT GATE WALKWAY AND LANDING PLAN & PROFILE

SHEET S-3



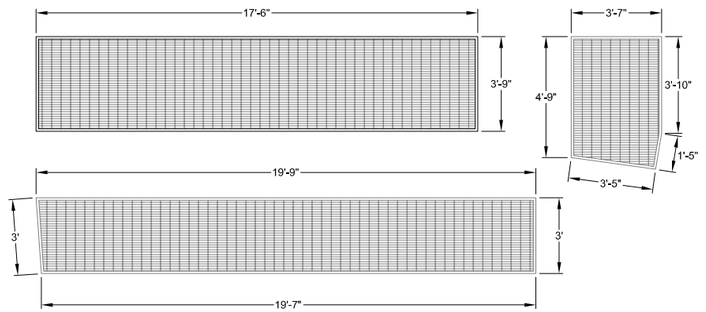
NOTE:

SLOT RAILING FOR LADDER RUNNER AND WELD CONNECTION, GRIND SMOOTH.

LADDER DETAIL

0 2' 4'

SCALE: 1" = 2'

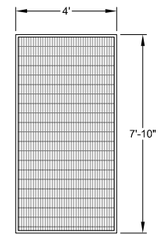


(1 EACH) SANDOUT STRUCTURE

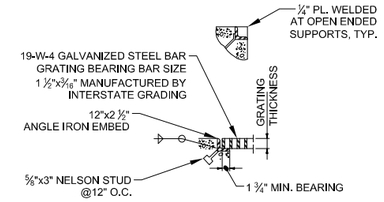
GALVANIZED GRATING DETAIL

0 3' 6'

SCALE: 1" = 3'



(2) HEAD GATES



GRATE NOTES:

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5. GRATING TO BE INSTALLED FIRMLY IN PLACE USING BAR GRATING ANCHORING CLIPS.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
-	-	-	-

SCALE: AS NOTED

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CONSOLIDATED HOME SUPPLY DITCH COMPANY
CHS PARSHALL FLUME REPLACEMENT & SANDOUT GATE ACCESS
MISC. DETAILS

SHEET
S-4

CONSOLIDATED HOME SUPPLY DITCH HEADWORKS
12' CONCRETE PARSHALL FLUME STRUCTURE AND SANDOUT GATE ACCESS

CONSOLIDATED HOME SUPPLY DITCH COMPANY

ENGINEERING OPINION OF CONSTRUCTION COSTS

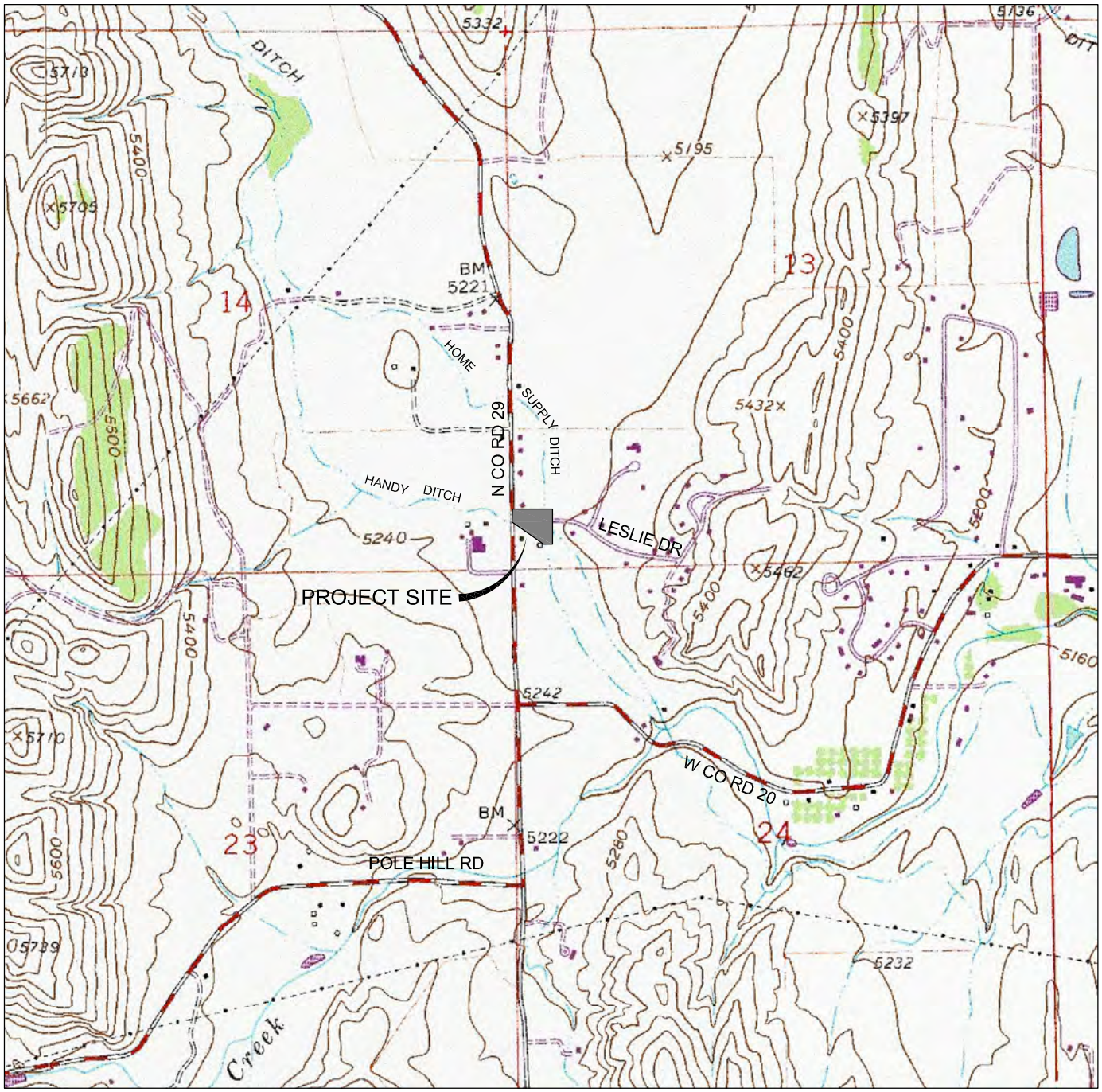
August 7, 2014

Item	Description	Quantity	Unit	Rate	Total
1	Mobilization, Bonding, Insurance @ 5%	1	LS	$ 6,825	$ 6,825
12' Cast In Place Parshall Flume					
2	Construction Access/ Earthwork	1	LS	$ 7,500	$ 7,500
3	Demolition (Existing concrete flume and building)	1	LS	$ 12,000	$ 12,000
4	Concrete	60	CY	$ 1,000	$ 60,000
5	Stilling Well & Equipment	1	LS	$ 9,500	$ 9,500
6	Stilling Basin Building	1	LS	$ 12,000	$ 12,000
Sandout Gate Access Walk way and Handrail					
7	Demilition (Existing walkway)	1	LS	$ 2,500	$ 2,500
8	Existing Concrete Rehabilitation	1	LS	$ 5,000	$ 5,000
9	Galvanized Walkways/Handrails to sandout Gates	1	LS	$ 28,000	$ 28,000
				Total Construction Items	**$ 144,000**
				Contingency @ 15%	$ 22,000
				Construction Management @ 15%	$ 25,000
				Engineering @ 20%	$ 33,200
				TOTAL ESTIMATED COST (rounded to nearest $1,000)	**$ 225,000**

FIGURE 12

R. 70 W | R. 69 W

T. 5 N



0 750' 1500'

SCALE: 1" = 1500'

DRAFT

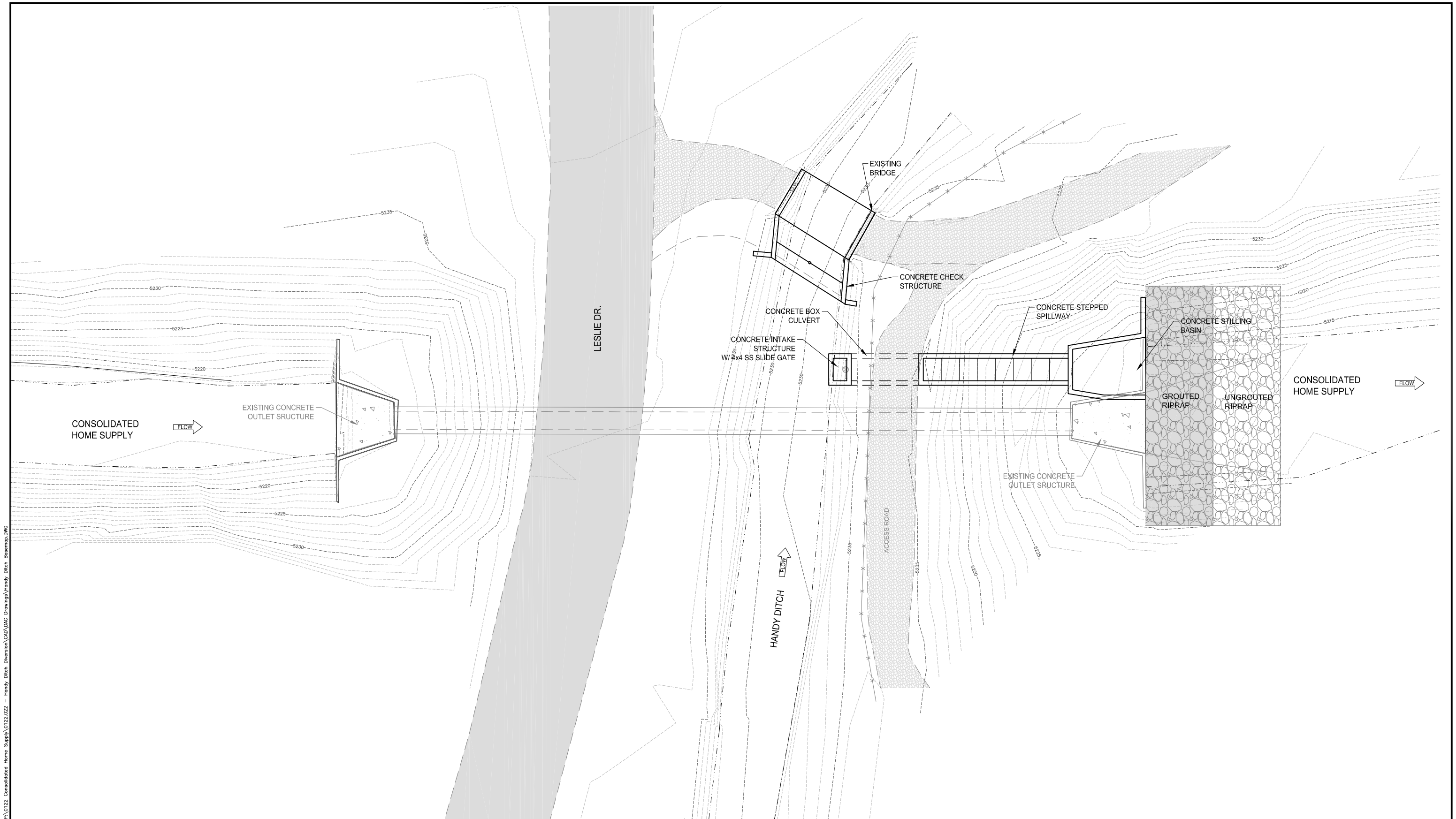
DEERE & AULT CONSULTANTS, INC.

Handy Ditch Diversion

Vicinity Map

JOB NO.	SCALE:	FIGURE NO.
0122.022.00	AS NOTED	1

Thursday, August 07, 2014 3:05:57 PM DRAWING: P:\0122 Consolidated Home Supply\0122.022 – Handy Ditch Diversion\CAD\DAC Drawings\Handy Ditch–Cover.DWG



HANDY TO HOME SUPPLY DITCH DIVERSION STRUCTURE PLAN

0 10' 20'

SCALE: 1" = 10'

JOB NO. 0122.022.00

Handy To Home Supply Ditch Diversion Structure

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **1**

DATE: **AUGUST 2014**

SCALE: **AS NOTED**

Thursday, August 07, 2014 3:30:04 PM DRAWING: P:\0122 Consolidated Home Supply\0122.022 – Handy Ditch Diversion\CAD\DAC Drawings\Handy Ditch Basemap.DWG

CONSOLIDATED HOME SUPPLY DITCH
HANDY TO HOME SUPPLY DITCH DIVERSION PROJECT

CONSOLIDATED HOME SUPPLY DITCH COMPANY

ENGINEERING OPINION OF CONSTRUCTION COSTS

August 7, 2014

Item	Description	Quantity	Unit	Rate	Total
1	Mobilization, Bonding, Insurance @ 5%	1	LS	$9,080	$9,080
2	Clearing & Grubbing	1	LS	$5,000	$5,000
3	Demolition	1	LS	$5,000	$5,000
4	Earthwork/Foundation Prep	1	LS	$15,000	$15,000
5	Concrete Diversion Structure	12	CY	$800	$9,600
6	Concrete Inlet Structure	5	CY	$800	$4,000
7	Concrete Box Culvert	15	CY	$1,000	$15,000
8	Concrete Rundown Channel	40	CY	$1,000	$40,000
9	Concrete Stilling Basin	35	CY	$1,000	$35,000
10	Grouted RR (Type VH) with bedding (Home Supply Ditch)	90	CY	$200	$18,000
11	Riprap (Type VH) with bedding (Home Supply Ditch)	90	CY	$100	$9,000
12	Reveg	1	LS	$1,500	$1,500
13	Collapsible Stop Log Pier	1	EA	$1,000	$1,000
14	Stop Logs	1	LS	$500	$500
15	4' by 4' Stainless Steel Fabricated Slide Gate	1	EA	$20,000	$20,000
16	Chain Link Fence	100	LF	$30	$3,000

Total Construction Items	**$190,000**
Contingency @ 15%	$30,000
Construction Management @ 15%	$33,000
Engineering @ 20%	$44,000
ESTIMATED TOTAL (rounded to nearest $10,000)	**$300,000**

TABLE 1

Consolidated Home Supply Ditch and Reservoir Company
Nelson's Big Dam Repairs and Flood Mitigation Funding and Expenditure Summary

Source	Type	Amount	Available Funds	Expenses to Date	Funds Received
CWCB	Loan	$ 1,600,000.00	$ 1,600,000.00	$ 767,372.01	$ 727,334.09
CWCB	Grant	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00
FEMA	Grant	$ 1,545,507.00	$ -	$ -	$ -
Loveland	Cost Share	$ 400,000.00	$ 400,000.00	$ 361,386.97	$ 353,868.02
FEMA	Grant	$ 454,000.00	$ -	$ -	$ -
Total		$ 4,024,507.00	$ 2,025,000.00	$ 1,153,758.98	$ 1,106,202.11