Water

Government of Yukon

Former Clinton Creek Mine Emergency Drop Structure Repairs Construction Activity Report - 2011

Prepared by:

AECOM
17203 – 103rd Avenue
Edmonton, AB, Canada T5S 1J4
www.aecom.com

780 488 6800 tel
780 488 2121 fax

Project Number:

60217901 (402.19.2)

Date:

February, 2012

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("Consultant") for the benefit of the client ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents Consultant's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to Consultant which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by Consultant represent Consultant's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since Consultant has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, Consultant, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by Consultant and Client; (2) as required by law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2012-01-06

AECOM
17007 – 107th Avenue
Edmonton, AB, Canada T5S 1G3
www.aecom.com

780 486 7000 tel
780 486 7070 fax

February 7, 2012

Mr. Brett Hartshorne
Assessment and Abandoned Mines Branch
Department of Energy, Mines and Resources
Yukon Government
Box 2703, K-419
Whitehorse, Yukon Y1A 2C6

Dear Brett:

Project No: **60217901 (402.19.2)**

Regarding: **Former Clinton Creek Mine**
Emergency Drop Structure Repairs
Construction Activity Report – 2011

AECOM Canada Ltd. (AECOM) is pleased to submit the final Construction Activity Report for the repair works to the Gabion Drop Structures and Channel at the Former Clinton Creek Asbestos Mine.

If you have any questions or comments, please call or email.

Sincerely,
AECOM Canada Ltd.

Andrew Smith, P.Eng
Water Resources Engineer
Andrew.smith3@aecom.com

AS:sw
cc: Rolf Aslund – AECOM
Tom Wingrove – AECOM
Gil Robinson – Dyregrov Robinson

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
3	1	Government of Yukon

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	Andrew Smith	December 15, 2011	Draft
2	Andrew Smith	February 7, 2012	Final

AECOM Signatures

Report Prepared By:

Andrew Smith, P.Eng.
Water Resources Engineer

PERMIT TO PRACTICE
Signature
Date 7/02/12
PERMIT NUMBER: PP066
Association of Professional Engineers of Yukon

Report Reviewed By:

Tom Wingrove, P.Eng.
Executive Vice-President
Deputy Operations Director
North America, Environment

PROFESSIONAL ENGINEER
YUKON
TOM WINGROVE
TERRITORY
7/02/12

Table of Contents

Statement of Qualifications and Limitations
Letter of Transmittal
Distribution List

page

Statement of Qualifications and Limitations 2

1. Introduction 1

2. Original Construction of Gabion Drop Structures 2

3. 2010 Damage Assessment and Proposed Construction 4

4. Construction Activities 6

5. Equipment and Material Remaining 9

6. Asbestos Air Quality Testing 10

List of Figures

Figure 1: Clinton Creek Channel Stabilization Works (2004) 2
Figure 2: Hudgeon Lake Outlet, August 19th, 2010 4
Figure 3: Looking Upstream at Drop Structure #4, August 19th, 2010 5

List of Tables

Table 4.1: Gabion Fill and Riprap Quantities Onsite 6
Table 5.1 Construction Material Inventory 9
Table 6.1 Summary of Asbestos Air Quality Results 10

Appendices

Appendix A August 2010 Site Inspection
Appendix B Rehabilitation to Drop Structures and Channel
Appendix C Photographs Taken During Construction Activities
Appendix D Asbestos Air Sample Results – ALS Laboratory Group

1. Introduction

During the fall of 2011, work took place at the Former Clinton Creek Asbestos Mine (the site) to repair damage sustained at drop structures 1, 2 and 3 during the summer of 2010. Work began on September 5 and continued until September 25, an approximate three-week period. An initial repair plan was developed based on the condition of the structures observed during AECOM's site visit in the summer of 2010 and another visit on May 31, 2011.

Construction was undertaken by Copcan Contracting Ltd. (the Contractor) from Nanaimo, B.C.. Resident inspection services were provided by Andrew Smith of AECOM.

This report details the construction activities including:

- Progress of Work;
- Summary of Work completed;
- Air quality sampling conducted during construction; and
- Equipment and excess material remaining.

2. Original Construction of Gabion Drop Structures

Based on evidence of on-going deterioration of the Hudgeon Lake outlet, creek stabilization measures consisting of four gabion drop structures were constructed from 2002 to 2004 (Figure 01). Because the waste rock was still undergoing creep movements, and may do so for many more years, gabion drop structures were selected for the channel stabilization measures because they can accommodate some movements of the waste rock pile and remain functional. The gabion drop structures serve as grade control points connecting nearly flat channel sections. The exception is Drop Structure #4 which does not have a tailwater pond as it discharges directly into the steep channel downstream. The result is shallower and higher channel flow velocities than would occur between the other drop structures.

The use of rock sills constructed of large boulders were considered during the initial assessment, but rejected due to the lack of large boulders in the area and the inherent instability of rock sills.

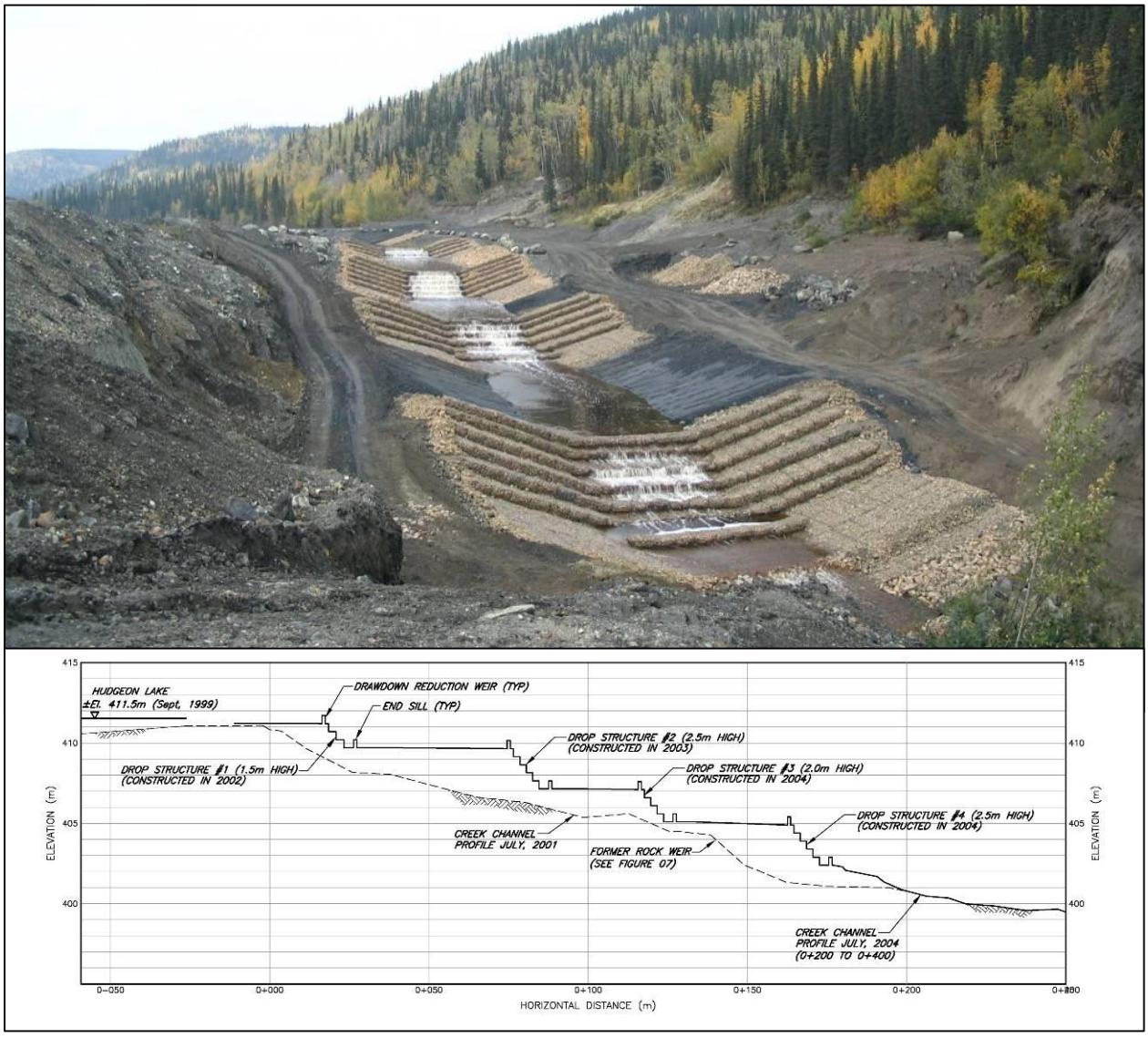


Figure 1: Clinton Creek Channel Stabilization Works (2004)

Each drop structure step has a rise of 0.5 m and a run of 2.0 m. The structures were constructed of 0.5 m thick, 1.0 m wide and 3.0 m long gabions with 1.0 m gabion overlap between steps. Each gabion basket has three 0.5 x 1.0 x 1.0 m compartments separated by partition walls made of the same material as the gabion basket. The top lid of the basket can be opened, to place the rock fill, and the lid is “hinged” along the long side of the gabion basket.

During construction, the gabions for each step were placed side-by-side with the long sides parallel to the direction of flow and tied together using C-rings. The C-rings are C-shaped stainless steel wire fasteners that are crimped into a ring using a pneumatic crimping tool. After the adjacent gabion baskets were tied together, the baskets were filled with rock and the lids were folded down and the three free sides of the gabion lids secured with either C-rings. In addition, the lids are secured with C-rings to the internal partition walls that separate the gabion compartments.

Some minor loss of gabion fill material from the baskets was observed following the first spring freshet event after construction. The problem was most notable on the flat section of each tier subject to high flow velocities in the spring. The loss of fill was believed attributable to consolidation of the rock fill within the baskets in combination with the loss of some of the smaller pieces of rock (less than 75 mm diameter) through the basket openings. This problem was alleviated by opening up the baskets and topping them off with rock fill at least 100 mm in diameter. The last such maintenance work was carried out in 2009.

3. 2010 Damage Assessment and Proposed Construction

In the summer of 2010, significant damage occurred at the outlet of Hudgeon Lake. From field reports, it was concluded that a major precipitation event had taken place in the headwaters of Clinton Creek (AECOM, 2010). On August 23, 2010 The Yukon Government's Assessment and Abandoned Mines Branch and AECOM conducted a site reconnaissance to inspect the damage. A letter report was produced by AECOM to document the damage and proposed solution to protect the structures which is included in Appendix A.

The most significant damage at the outlet had occurred at Drop Structure #4. Immediately downstream of the structure, the channel had downgraded 4 to 5 metres and undercut the structure's apron. The apron was hanging from the structure and appeared to be supported by the waste rock underneath closest to the original lowest step. A plunge pool had developed where water drops from the structure to the new bed elevation below. No significant damage at the other three drop structures was observed, though the higher flow in the channel made it difficult to assess each structure.

Damage had also occurred within the channel between the structures. Along the left channel slope, bank erosion had occurred along the unarmoured portions of the channel. Along the right channel slope upstream of Drop Structure #3, bank erosion had occurred similar to the left bank. A detailed assessment of the channel bottom could not be made due to the high water depths.

Figure 2: Hudgeon Lake Outlet, August 19th, 2010

Figure 3: Looking Upstream at Drop Structure #4, August 19th, 2010

The proposed solution was to create a ramp at the downstream end of Drop Structure #4, from the top of the hanging apron to the downstream bed. The ramp would consist of waste rock fill overlain by a 2 metre thick cap of boulders.

Tr'ondeck Heavy Equipment was contracted to complete the proposed repairs including repairs to the mine access road. The work started October 10th, 2010 and had to be suspended on October 24th 2010 because the Yukon River ferry at Dawson City was to be removed from the river the next day for the season. No work was completed in the channel.

On May 31, 2011 a site reconnaissance was conducted by Yukon Government Assessment and Abandoned Mines and AECOM (Brett Hartshorne from the Yukon Government, Andrew Smith from AECOM and Gil Robinson from Dyregrov Robinson) to assess any further damage at the Hudgeon Lake Outlet from the 2011 spring freshet. After the site reconnaissance, proposed rehabilitation at the site was discussed and it was decided not to do any works downstream of Drop Structure #4 due to: a lack of sufficient boulder material; and no safe access to the downstream end of the structure; to place material at that location. The revised repair strategy was to leave Drop Structure #4 as it was and to protect Drop Structure #3 from further channel degradation by lengthening the downstream apron of Structure #3 by 9 meters (3 gabions). Additional work was proposed and included:

- Repair and fill partially empty gabions within Drop Structures #1, #2 and #3;
- Remove the damaged end sill at Drop Structure #3 and replace with a new end gabion end sill;
- Over excavate the left channel slope between #1 and #2 and place rip rap;
- Over excavate the right channel slope between #2 and #3 and place rip rap;
- Infill eroded areas on the left channel slope between #2 and #3 with rip rap;
- Infill eroded areas on both channel slopes between #3 and #4 with rip rap;
- Restore channel bottom between drop structures #1, #2 and #3; and
- Restore the 3 metre wide rip rap sections at the downstream end of drop structures #2 and #3 and the upstream end of Drop Structure #3.

4. Construction Activities

On the July 26, 2011, Gillespie Equipment Rentals was contracted to provide rock rip rap and gabion material at the site for use during the construction rehabilitation activities that were to occur in September. From July 27th to August 8th rock material was ripped from the cliff face at the east side of Wolverine Creek. The rock material was processed to screen out fine material and create stockpiles of gabion fill and rock rip rap. Rip rap size varied from 0.3 m to 1.0 m.

In addition to this new granular material, stockpiles of gabion fill and rock rip rap left over from the Fall 2009 construction activities was located adjacent the east side of Hudgeon Lake at the lake outlet. The material was extracted from the same location as the new processed material and hauled to Hudgeon Lake in 2009. The material was used as fill for new and empty gabion baskets and to add riprap to sections within the channel. A survey was completed in August that included volume measurements of all the stockpiled material. Table 4.1 presents the amount of granular material stockpiled at both Hudgeon Lake and Wolverine Creek prior to the 2011 construction.

Table 4.1: Gabion Fill and Riprap Quantities Onsite

Material / Location	Quantity (m^3)
Gabion fill at Wolverine Creek	517
Gabion fill at Hudgeon Lake	306
Total amount of gabion fill	823
Rip rap at Wolverine Creek	338
Rip rap at Hudgeon Lake	112
Total quantity of rip rap	450

Construction was undertaken by Copcan Contracting Ltd. (the Contractor). Construction Activities began on September 5, 2010 and included:

- Mobilization to the site;
- Construction of a bypass ditch and coffer dams to divert flows from construction areas;
- Removal of debris that had accumulated at the drop structures;
- Repairing and refilling empty gabion baskets within drop structures #1, #2 and #3;
- Removal and replacement of the damaged end sill at Drop Structure #3;
- Placed a 9 metre wide section of wire mesh overtop the existing gabions of Drop Structure #3;
- Extended Drop Structure #3 by 3 gabion lengths (9 m) on the downstream end;
- Fill and compaction of the diversion ditch to original ground; and
- Site cleanup and demobilization from the site.

Work at the site, each week, is described below. The construction period was 21 days. Pictures taken during construction are presented in Appendix C.

<u>Week 1 – Week Ending September 11</u>

The contractor mobilized to site on September 5, 2011 and work began in Week 1 that included:

- Equipment was brought to the site including a dump truck, two small Deere 135 excavators, one generator and one compressor. Six people were onsite including labourers, equipment operators and 1 foreman;
- Mobilization of material to the site including the 0.5 m and 0.3 m tall gabion baskets;
- Moving granular material from the east side of Wolverine Creek to the edge of Hudgeon Lake;
- Started the 0.5 metre gabion basket assembly .Baskets were stockpiled adjacent the end of Hudgeon Lake; and

- A bypass ditch was excavated adjacent the east side of the gabion structures, from the downstream end of Drop Structure #1 to the top of Drop Structure #4. The ditch was lined with polyehtylene sheets.

The bypass ditch was excavated to allow work to begin in the channel because the diversion pumps had not arrived at the site. Material and equipment being brought to the site from southern British Columbia had been delayed due to highway access in northern British Columbia. The material and equipment had to be transported into Alberta and up along the Alaska Highway. The pumps that were to be used to maintain the minimum flow downstream of the construction site were included in the delayed equipment.

Week 2 – Week Ending September 18

The remaining equipment and material arrived onsite the night of September 12th. The material included the 4 rolls of Armtec 350 nonwoven geotextile (91.0 by 4.6 m each roll). Additional equipment included a Hitachi 200 Excavator with a 45 ft reach, 4 – 6.0 kW pumps and 3 smaller portable pumps. Eight people were now onsite working for the contractor. Work continued through the week that included:

- A cofferdam was installed on September 13th between drop structures #2 and #3. The structure was compacted only by the tracks of the excavator as there was no compaction equipment onsite;
- Gabion baskets were assembled and were ready to be placed on the downstream end of Drop Structure #3;
- Filling partially empty baskets and repairing gabion wire mesh at drop structures #2 and #3;
- Removal of the damaged end sill at Drop Structure #3;
- A width of 9 metres of gabion wire mesh was rolled out to cover Drop Structure #3, centred along the middle of the channel. C-rings were used to secure the new mesh to the existing structure;
- The channel between drop structures #3 and #4 was reshaped as excess material was removed from the channel bottom and rock material placed along the side slopes;
- Gabion baskets were placed along the bottom width at the downstream edge of Drop Structure #3. The baskets were filled with rock and most of the lids closed.

On September 11th, seepage was discovered from the diversion channel adjacent the downstream end of Drop Structure #3 on the left bank. A plug of soil was placed at the inlet of the diversion channel and work undertaken to seal the channel at the seepage location. Rock material was removed and soil was placed and compacted using the excavator's bucket. Additional layers of polyethylene were placed in the channel from the upstream end of Drop Structure #3 through to the downstream end of the diversion channel. The plug was pulled at the diversion channel inlet on September 12th to allow flows from Hudgeon Lake into the diversion. For the remainder of construction, seepage at this location was not an issue.

Week 3 – Week Ending September 25

Work for Week 3 included:

- Installation of the remaining gabion baskets at the downstream end of Drop Structure #3, 3 gabions long (9 m length) and 23 gabions wide (23 m width). 72 gabions were placed at Drop Structure #3, including the end sill;
- Construction of the new end sill for Drop Structure #3;
- Filling partially empty baskets and repairing gabion wire mesh at Drop Structure #1;
- Backfilling soil in the diversion channel and compacting with a vibratory compactor to bring the surface back to the original grade; and
- Site clean-up and demobilization from site.

At the end of the day on September 19th work was completed downstream of the coffer dam between drop structures #1 and #2 and the cofferdam was removed. Another cofferdam was installed upstream of Drop Structure #1 to allow work on that structure and the channel between drop structures #1 and #2. By the end of the day on September 22nd, work was complete in the channel and the coffer dam was removed.

Andrew Smith of AECOM left the site on September 20th. Frank Patch of the Yukon Government Assessment and Abandoned Mines left the site September 23rd. Site cleanup and demobilization continued through the last part of week 3. The contractor left site by the end of the day on September 25th.

5. Equipment and Material Remaining

All left over material was taken to either Rick Gillespie's Yard or the Mackenzie Yard (HAN Construction Yard), both in the Callison Subdivision east of Dawson City. Table 5.1 presents a description of the material left, including quantity and location. The two pneumatic crimping tools were taken back to the Assessment and Abandoned Mines Branch Office of the Yukon Government on September 23rd.

Table 5.1 Construction Material Inventory

Description	Material Remaining	Location	UTM Coordinates (Zone 7)	
			Northing	Easting
0.3 m Gabion Baskets (2 x 1 x 0.3 m)	25	Gillespie Yard	7102241	580483
PVC Coated Mesh Rolls (30 x 3 m)	4	Gillespie Yard	7102241	580483
Box of C-rings (1600 per box)	2	Gillespie Yard	7102251	580587
0.5 m Old Gabion Baskets (3 x 1 x 0.5 m)	50	Mackenzie Yard, HAN Construction	7101839	580251

6. Asbestos Air Quality Testing

The main health risk for the channel stabilization work is the inhalation of airborne asbestos fibres (UMA, 2003). Air samples were collected throughout the duration of the project to verify air quality results taken during construction in previous years. Air monitoring results collected during 2002 and 2003 were at least an order of magnitude less than the permissible asbestos exposure of 0.5 fibres per ml in an 8-Hour period. The permissible asbestos exposure was taken from the Occupational Health and Safety Handbook prepared by Yukon Workers Compensation Board (UMA, 2003). During the 2004 construction, levels of airborne fibres were also well below the allowable limit (UMA, 2003).

Two, Sensidyne GilAir-3 air sampling pumps were used to sample at the site. Each air sample was collected using a 25 mm Asbestos PCM Cassette with a 0.8 μm filter material. The sample rate was 3 litres per minute.

Samples were taken at locations where the Contractor was working during the day. Four different sets of samples from each sampling interval were couriered to ALS Laboratories for PCM analysis for Asbestos. A summary of the results are presented in Table 6.1. All samples are below the Yukon Personal Exposure Limit of 0.5 fibres per ml of air. Laboratory results are presented in Appendix D.

Table 6.1 Summary of Asbestos Air Quality Results

Sample ID #	Date	Duration (min)	Location	Results* (fibres/ml)	Weather
L1065227-1	13-Sept-09	481	Drop Structure #3	0.004	Clear Sky, Dry, No Wind
L1065227-2	15-Sept-09	429	Drop Structure #2	0.004	Clear Sky, Dry, No Wind
L1065227-3	18-Sept-09	510	Drop Structure #3	0.004	Clear Sky, Dry, No Wind
L1065227-4	19-Sept-09	408	Drop Structure #3	0.005	Clear Sky, Dry, No Wind

**Analysis Detection Limit is 0.001 fibres/ml*

Note: The Yukon Government's Personal Exposure Limit for airborne asbestos is 0.5 fibres per ml of air.

References

AECOM, 2010. "Former Clinton Creek Asbestos Mine – Site Inspection on 23 August, 2010", September 2010.

UMA Engineering Ltd., 2003. "Government of Yukon, Clinton Creek Channel Stabilization (Stage II), Construction Report", December 2003.

UMA Engineering Ltd., 2005. "Government of Yukon, Clinton Creek Channel Stabilization (Stage 3), Construction Report", February 2005.

Appendix A

August 2010 Site Inspection

AECOM
17203 103 Avenue
Edmonton, AB, Canada T5S 1J4
www.aecom.com

780 488 6800 tel
780 488 2121 fax

September 7, 2010

Brett Hartshrone
Project Manager
Assessment and Abandoned Mines Branch
Energy, Mines and Resources
Government of Yukon
PO Box 2703 (K-419)
Whitehorse, YT Y1A 2C6

Dear Brett:

Project No: 60160515

Regarding: Former Clinton Creek Asbestos Mine - Site Inspection on 23 August, 2010

Background

The Clinton Creek drop structures and channel at the outlet of Hudgeon Lake were inspected as part of the Long Term Performance Monitoring program at the mine site on 20 July, 2010. At that time, the structures were found to be in good condition and no significant changes were observed in the Clinton Creek channel through the waste rock dump downstream of the structures.

Dawson District Renewable Resource Council (DDRRC) members who tried to reach the Clinton Creek area on Monday 9 August reported that streams were flowing at high levels and a slide blocked the access road. During a subsequent ground inspection along the access road, by Al von Finster on Wednesday 11 August, several slides were found and one developed during the time of the ground inspection. Based on the field observations, it was concluded that a major precipitation event had taken place in the Clinton Creek headwaters.

As a result of the reported events at the Clinton Creek access road, Brett Hartshorne of Yukon EMR Assessment and Abandoned Mines conducted a site reconnaissance by helicopter on Thursday 19 August, 2010. During the inspection it was noticed that the channel downstream of the structure had eroded significantly and Drop Structure #4 (the drop structure farthest downstream) was severely undercut. The step drop portion of the structure appeared to be reasonably intact while the downstream apron had bent down and was hanging at a steep angle. The sacrificial apron downstream of the structure apron was gone.

During a conference call in the afternoon of Thursday 19 August, the observed damages were discussed and it was decided that a formal field inspection of the structures was required. The conference call was attended by Brett Hartshorne and Frank Patch (both of Yukon EMR Assessment and Abandoned Mines) and Ken Skaftfeld, Gil Robinson, Andrew Smith and Rolf Aslund (all of AECOM).

On Monday 23 August 2010, Brett Hartshorne and David Barrett of Yukon EMR Assessment and Abandoned Mines and Andrew Smith and Rolf Aslund of AECOM (Edmonton) inspected the drop structures on Clinton Creek. The site was reached by helicopter from Dawson City. During the site inspection, Brett Hartshorne and David Barrett concentrated on the area away from the structures while Andrew Smith and Rolf Aslund concentrated on the drop structures, the channel between the structures and the channel immediately downstream of Drop Structure #4.

Field Observations

At the time of inspection the flow was approximately 0.2 m deep over weir crest gabions, which made it necessary to wear hip waders when crossing the structures.

Hudgeon Lake

- HWMs (High Water Marks) observed on the shore to the right of the lake outlet. The HWMs were in the form of duff deposits, bent grass and sediment deposition at the ford.
- The duff deposition HWM on the lake shore was surveyed and found to be at Elevation 412.54 m

Drop Structure #1 (at lake outlet)

- Driftwood and tree trunks have accumulated on the weir crest and have trapped a floating mat of duff.
- No significant gabion damage was seen.
- No evidence of flow by-passing the structure was seen.

Drop Structure #2

- Weir crest was generally free of driftwood. One larger piece of driftwood on the left side slope of the crest and one tree trunk on the steps on the right side. Minor driftwood deposited on the left apron side slope.
- No significant gabion damage was seen.
- No evidence of flow by-passing the structure was seen.

Drop Structure #3

- One tree trunk was seen floating in the water and stuck on the left half of the weir crest. One tree trunk caught on the right side slope of the weir crest. Minor debris deposition on the steps on the left side. Two larger pieces of driftwood caught on the steps on the right side slope. Minor driftwood deposition on the left apron side slope.
- No significant gabion damage was seen.
- No evidence of flow by-passing the structure was seen.

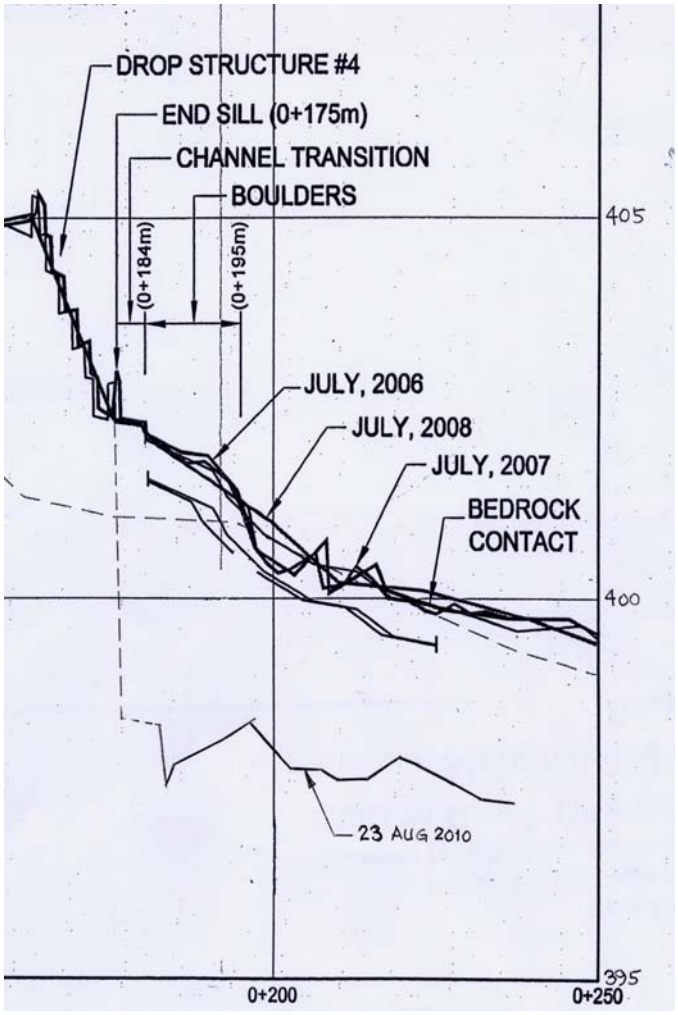
Drop Structure #4 (farthest downstream)

- No significant driftwood deposition on the weir crest. A couple of smaller pieces of driftwood caught on the left and right side slopes of the steps.
- No significant damage to the gabion steps was seen.
- Immediately downstream of the structure, the channel has degraded 4-5 m and undercut the structure apron. The undercutting extends to approximately 1-2 m downstream of the original lowest step. The material observed under the now hanging gabion apron appeared to consist of waste rock material that was surprisingly dry – minor seepage were observed in a few isolated spots. The 1-2 m of the apron closest to the original lowest step appeared to be supported by waste rock material.
- The water flowed over the relatively intact step drop portion of the structure and then flows down the hanging gabion apron portion to then drop down to the new creek bed level. It was suggested that this may now be the highest waterfall in Yukon.
- A plunge pool has developed where the water drops from the apron. The pool spans the full width of the original channel and the water depth was close to a metre deep.

- On the left side of the channel, a short distance downstream of the structure, the erosion has generated what appeared to be a one metre high vertical fractured rock face.
- The waste rock side slope along the right side of the Clinton Creek channel, between Drop Structure #4 and the old ford, is very steep and is currently unstable. The access road is washed out in places and, in places, tension cracks were seen in the middle of remnants of the former access road. Given that the waste rock side slope towards Clinton Creek is currently unstable in many places, I believe it is not advisable for any vehicles to travel along the existing access road across the waste rock pile during current conditions. Due to the washed out waste rock side slope, the theoretical stable slope from the current creek bed level may now extend to the top of the waste rock pile. Therefore it may not be possible to reconstruct the access road along the existing alignment of the access road and a completely new route across the top of waste rock pile may have to be selected.
- There are a large number of boulders in the channel immediately downstream of the structure. While it cannot be verified, it is believed that some of these boulders were part of the boulder field that was placed downstream of the structure in the past to (a) increase the tailwater level and (b) to reduce the risk of channel bed and bank erosion progressing up to the structure. The lack of high tailwater downstream of the structure has always been a concern.
- The bed profile of the channel immediately downstream of Drop Structure #4 was surveyed to get a better understanding of the current conditions. The surveyed profile is listed in the table below and plotted in the following figure.

STA	Elevation (m)
STA 0+182	398.34
STA 0+183	397.53
STA 0+184	397.83
STA 0+192	398.17
STA 0+196	398.36
STA 0+202	397.79
STA 0+207	397.74

STA	Elevation (m)
STA 0+210	397.63
STA 0+214	397.62
STA 0+219	397.93
STA 0+222	397.81
STA 0+227	397.61
STA 0+232	397.35
STA 0+237	397.32



Channel between Structures

- Along the left channel side slope, bank erosion has occurred along the un-armoured portions of the channel between the drop structures. The erosion is more severe downstream of Drop Structure #1, most likely due to the flow concentration along the left side that is caused by the curve in Drop Structure #1.
- Along the right channel side slope, the general bank erosion is similar to that along the left side. Immediately upstream of Drop Structure #3, the bank erosion is locally severe and resembles slumping.
- To assess the channel bed material, and attempt was made to wade across the channel with hip waders but this was not possible due to the large water depth. However, it was noticed that the channel bed was firm and rocky and no sediment deposition was detected.

Proposed Protection of Drop Structure #4

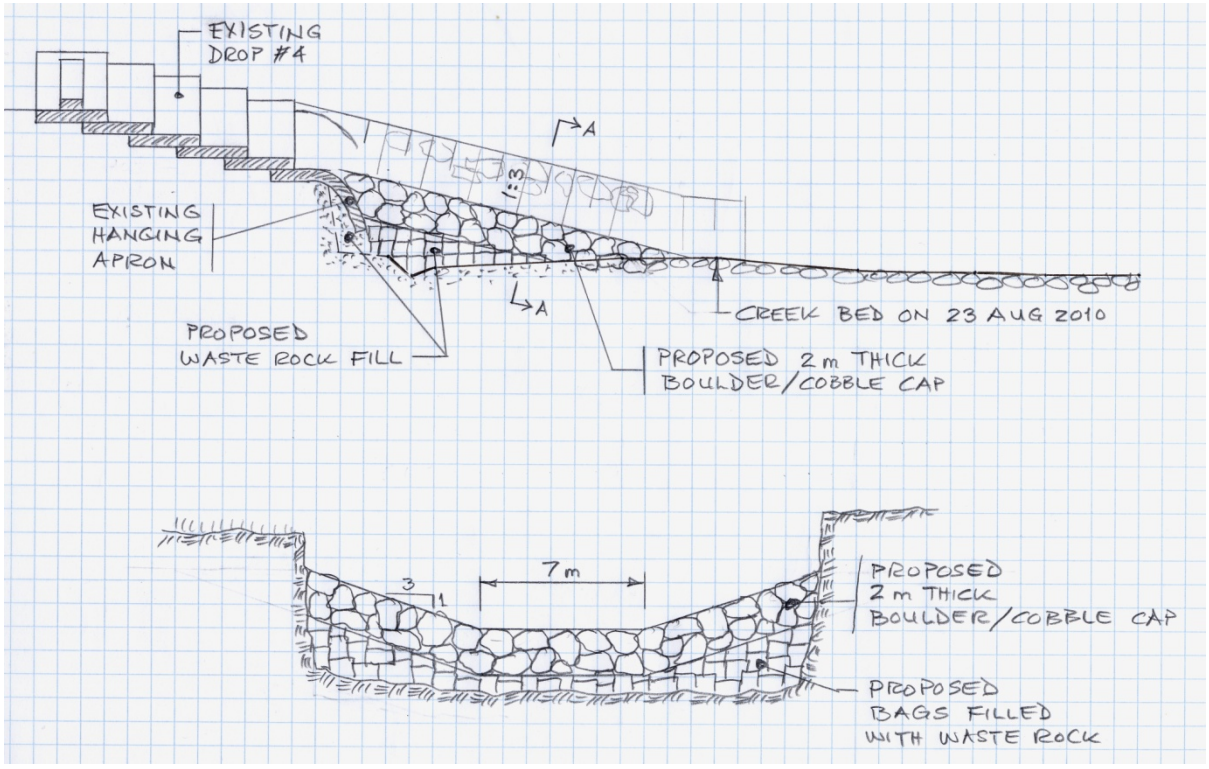
Drop Structure #4 has to be protected from total failure, to prevent a complete washout of the stabilized channel reach. At the moment, the upper portion of Drop Structure #4 is functioning well and the hanging apron protects the fill under the structure from erosion by flowing water.

Downstream of the structure, the channel bed is 4-5 m lower than before the recent flood event. There are a large number of boulders immediately downstream of the structure. The sizes of these boulders are indicative of the size of boulders that are required to resist the flood flow that occurred. As the upper portion of the structure is functioning well, that part of the structure shall be secured in place. To convey the flow from the original apron level and down to the current creek bed level, a channel transition has to be constructed. The material used in the transition has to be able to withstand the flow velocities that will occur and these velocities are a function of the channel bed slope; the steeper the slope the larger the size of the material required. In this case, the material has to be large in size to be able to have the bed slope of the transition intersect the downstream channel bed over a short length.

The proposed primary material consists of angular boulders with a diameter of approximately one metre. Concrete lock-blocks were considered as an alternative but these units are inferior to angular boulders, as they do not have the same inter-locking characteristics due to their smooth sides. To fill the voids between the boulders, it proposed that a mix of smaller boulders and cobble-sized material (such as riprap screening reject material) and waste rock material be dumped on the boulders during the construction.

The proposed transition should be constructed a steep trapezoidal channel with a bed width of 7 m, 1:3 (V:H) side slopes and a bed profile slope no steeper than 1:4 (V:H), which is the profile slope of the step drop portion of the current structure. If sufficient quantities of boulders can be secured, The eroded area was estimated to be approximately 22 m wide. Using this width and an estimated 5 m height at Drop Structure #4, the required quantity of fill was estimated for different channel profile slopes. It was found that the required volume of fill was significant and it may be difficult to find that quantity of boulders in the area.

As an alternative to using only boulders and cobbles as fill, the proposed transition was revised to have a 2 m thick lining of boulders and cobbles placed over common waste rock material. As it would be difficult to place the waste rock material in the flowing water, it is proposed to use large geosynthetic bags that are filled with waste rock material that are then placed by a crane in the water to build up a base. As the flow is slowed down by other filled bags, loose waste rock can be dumped to fill the voids between the bags before the next layer of waste rock filled bags is placed.



When the layers of waste rock filled bags are placed, the space between the upstream bags and the remnants of Drop Structure #4 will be filled with loose waste rock material. The placement of filled bags shall be placed to a level that is 2 m below the finished trapezoidal channel cross-section. To increase the stability of the stacked waste rock filled bags, it may be advisable to place geogrid between each layer of bags. The trapezoidal channel section would be capped with a 2 m thick layer of boulders and cobbles.

Using an estimated eroded channel top width of 22 m and an estimated 5 m height at Drop Structure #4, the required quantity of fill was estimated for different channel profile slopes. The estimated quantities are summarised below.

Bed Slope (V:H)	Waste Rock (m^3)	2 m Boulder Cap (m^3)	Total Volume (m^3)
1:4	630	870	1500
1:5	790	1100	1890
1:6	940	1300	2240
1:7	1100	1520	2620

Large boulders may be available from the old Porcupine Waste Rock dump although an access trail may have to be constructed to reach that location. Otherwise it may be necessary to pick through the waste rock material in the Clinton dump.

The need for protection of Drop Structure #4 is urgent, as it is possible that the structure may fail during next year's freshet. That would most likely lead to a sequential failure of the channels and structures upstream of Drop Structure #4 that could cause a rapid draw-down of Hudgeon Lake.

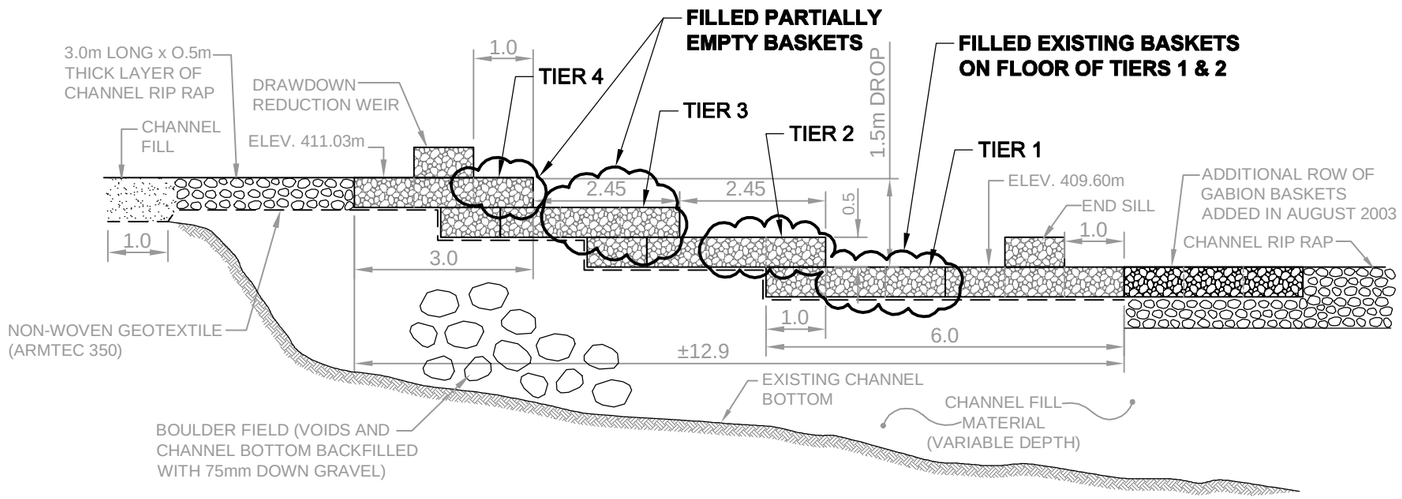
Sincerely,
AECOM Canada Ltd.

Rolf Aslund, P.Eng.
Senior Water Resources Engineer
Rolf.Aslund@aecom.com

RA:sw

Appendix B

Rehabilitation to Drop Structures and Channel

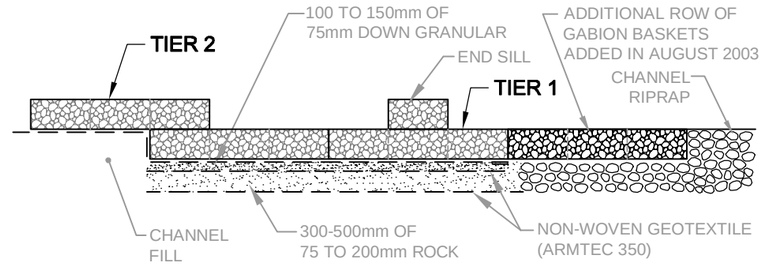


CENTERLINE PROFILE A-A 01

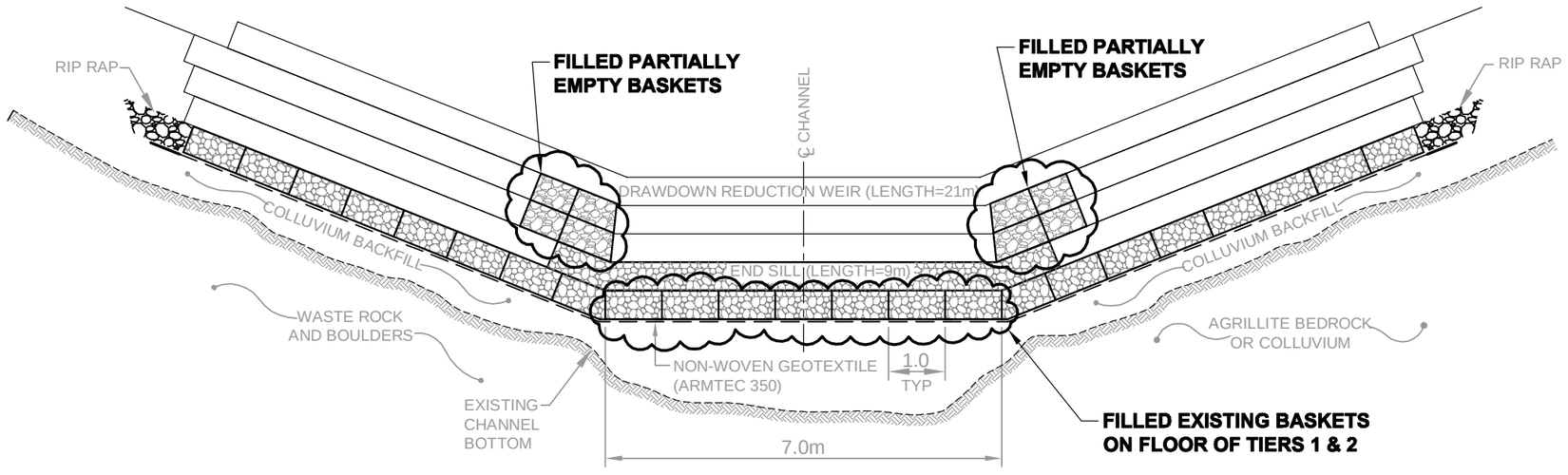
0 1 2 m SCALE 1:100

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.



DETAIL OF BLANKET DRAIN CONSTRUCTED UNDER THE FLOOR OF TIER #1



CENTERLINE PROFILE B-B 01

0 1 2 m SCALE 1:100

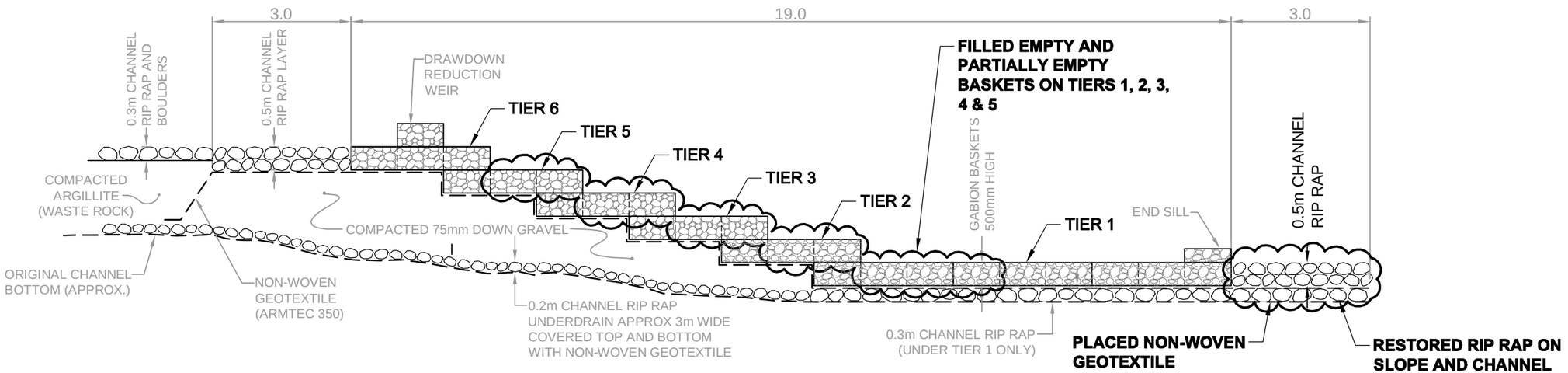
AECOM

Government of Yukon - Energy, Mines and Resources
Former Clinton Creek Mine Site, Yukon
Construction Activity Report - 2011

Drop Structure #1 Details Drawing - 01

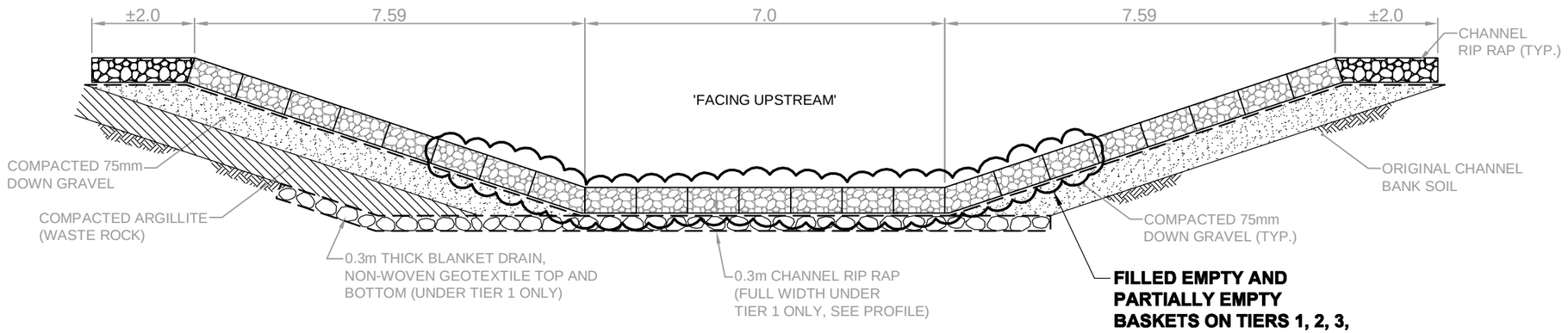
GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.



CENTERLINE PROFILE A-A (02)

0 1 2 m SCALE 1:100



CENTERLINE PROFILE B-B (02)

0 1 2 m SCALE 1:100

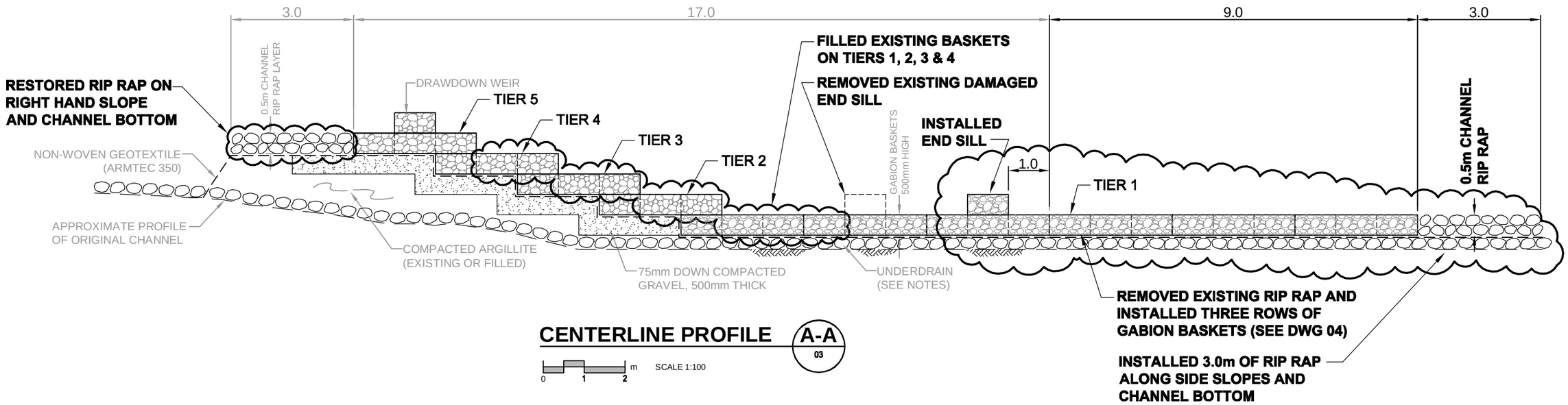
Government of Yukon - Energy, Mines and Resources
Former Clinton Creek Mine Site, Yukon
Construction Activity Report - 2011

Drop Structure #2
Details
Drawing - 02

AECOM

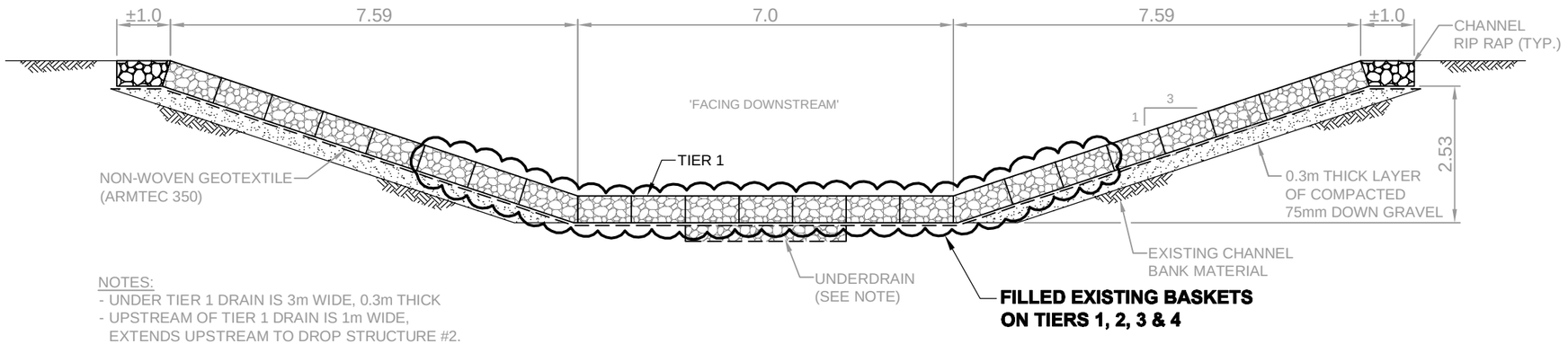
GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.



CENTERLINE PROFILE A-A (03)

0 1 2 m SCALE 1:100



NOTES:
- UNDER TIER 1 DRAIN IS 3m WIDE, 0.3m THICK
- UPSTREAM OF TIER 1 DRAIN IS 1m WIDE, EXTENDS UPSTREAM TO DROP STRUCTURE #2.
- DRAIN CONSTRUCTED USING GABION FILL MATERIAL AND IS COVERED TOP AND BOTTOM WITH NON-WOVEN GEOTEXTILE

CENTERLINE PROFILE B-B (03)

0 1 2 m SCALE 1:100

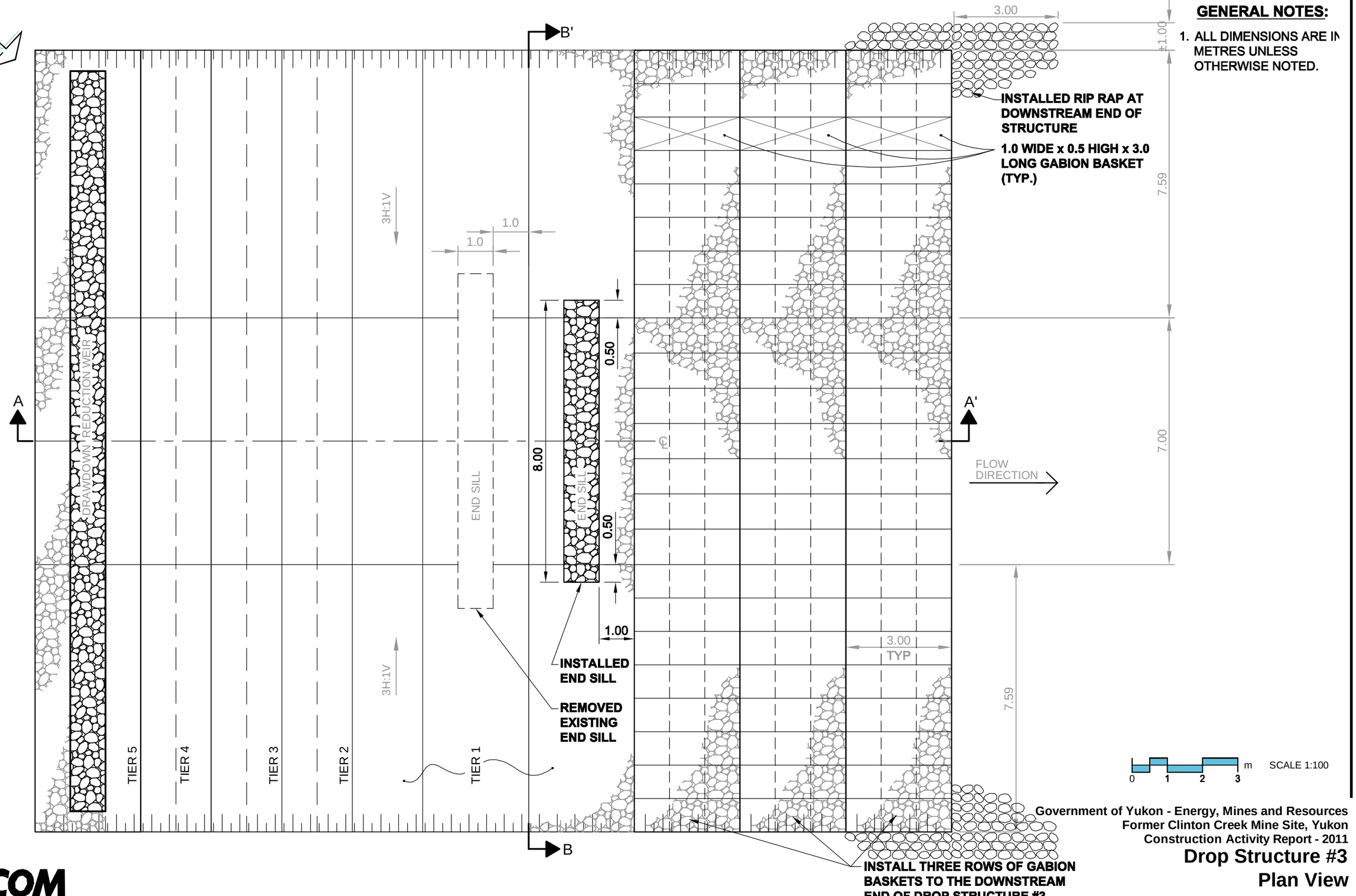
Government of Yukon - Energy, Mines and Resources
Former Clinton Creek Mine Site, Yukon
Construction Activity Report - 2011

Drop Structure #3
Details
Drawing - 03

AECOM

GENERAL NOTES:

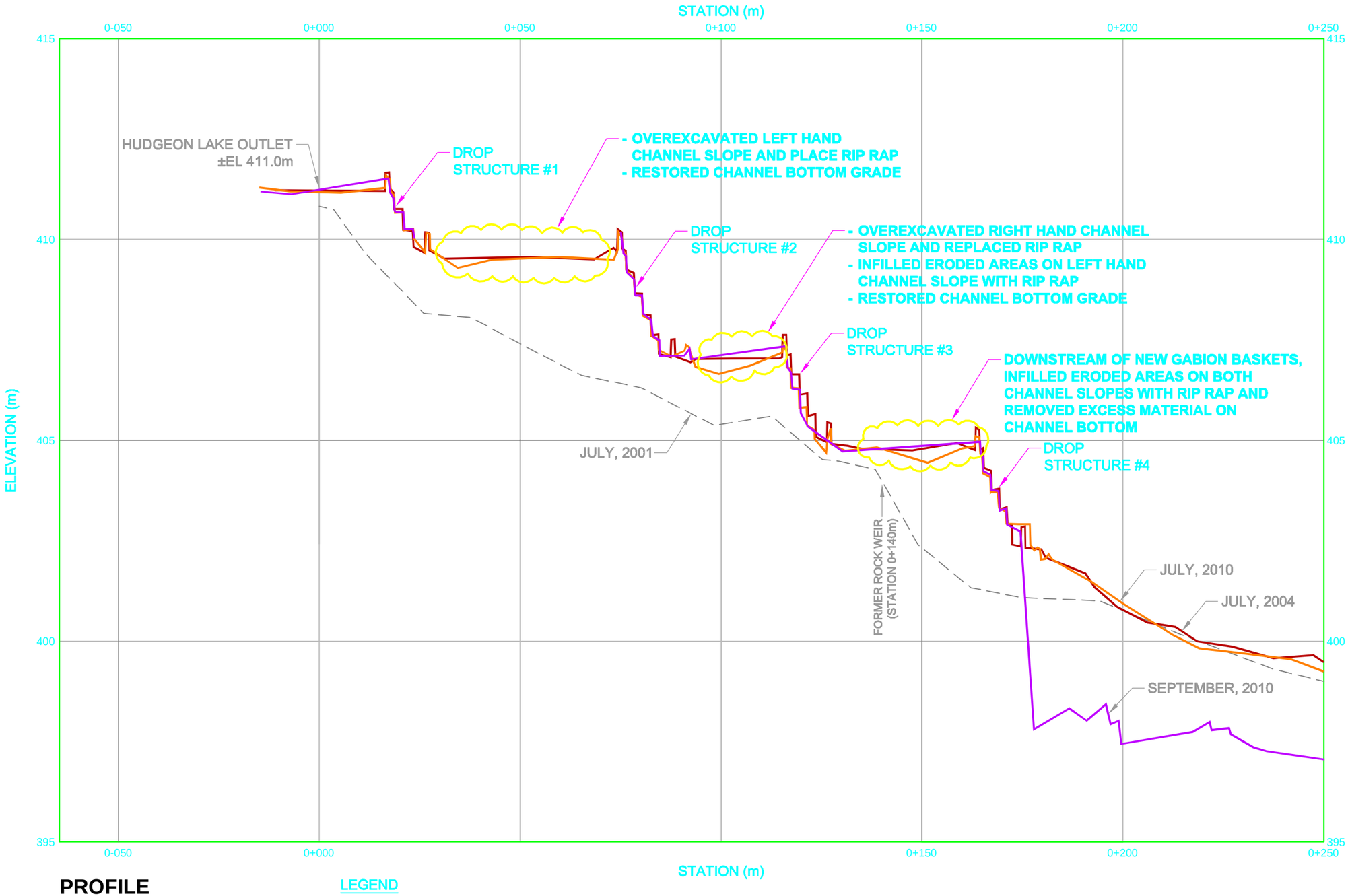
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.



Government of Yukon - Energy, Mines and Resources
Former Clinton Creek Mine Site, Yukon
Construction Activity Report - 2011

Drop Structure #3
Plan View
Drawing - 04

AECOM



PROFILE

0 10 20 m H=1:1000
0 1 2 V=1:100

0-50 to 0+250

LEGEND

- PROFILE 2001
- PROFILE 2004
- PROFILE 2010, JULY
- PROFILE 2010, SEPTEMBER

AECOM

Government of Yukon - Energy, Mines and Resources
Former Clinton Creek Mine Site, Yukon
Construction Activity Report - 2011

Clinton Creek Channel Profile
Station 0+000 to 0+250
Drawing - 05

Appendix C

Photographs Taken During Construction Activities

Photo 1. Drop Structure #1, looking to the right bank as construction begins. Minor Rock fill and repair to the gabion mesh at the drops and floor required.

Photo 2. Drop Structure #2, looking to the left bank before construction. Gabions within the steps and at the floor require rock fill and patching of the wire mesh.

Photo 3. Drop Structure #3, looking to right bank. Partially empty compartments and damaged wire mesh prior to construction.

Photo 4. Drop Structure #3. Partially empty gabions and damaged wire mesh at the structure floor.

Photo 5. Drop Structure #4 looking to the left bank. The right channel bank had slumped in. No construction occurred at Drop Structure #4

Photo 6. Diversion channel adjacent Drop Structure #2 looking downstream.

Photo 7. Diversion channel adjacent Drop Structure #4 looking upstream

Photo 8. Outlet of the diversion channel at Drop Structure #4

Photo 9. First coffer dam located between drop structures #1 and #2, looking towards the right bank.

Photo 10. Second coffer dam located upstream of Drop Structure #1, looking upstream. The second coffer dam was placed after the first dam was removed to allow work on Drop Structure #1 and the downstream channel between structures #1 and #2.

Photo 11. Pumps used when the second cofferdam was in place and discharge through the diversion channel was cut off.

Photo 12. 135 Deere and 200 Hitatchi excavators reshaping the channel downstream of Drop Structure #4.

Photo 13. 200 Hitatchi Excavator placing boulder material at the downstream end of Drop Structure #4. Other than two test boulders, no material was placed at the downstream end of Structure #4.

Photo 14. Gabion baskets refilled with rock and mesh material repaired at Drop Structure #2

Photo 15. Gabion baskets being filled with rock at the downstream end of Drop Structure #3. New gabion end sill being filled with rock at the left side of the picture.

Photo 16. Gabion baskets refilled and gabion mesh repaired at Drop Structure #3. Gabion wire mesh rolled overtop of the exisitng gabion baskets and secured with C-rings.

Photo 17. Channel side slopes reshaped and fill material placed to the original design elevation within the channel bottom between drop structures #2 and #3.

Photo 18. Channel side slopes reshaped with rock rip rap and channel bottom excavated to original design elevation. A Three metre wide rip rap section placed adjacent the downstream end of Drop Structure #3.

Appendix D

Asbestos Air Sample Results – ALS Laboratory Group

GOVERNMENT OF YUKON - EMR
ATTN: BRETT HARTSHORNE
BOX 2703 K-419
WHITEHORSE YT Y1A2C6

Date Received: 29-SEP-11
Report Date: 02-DEC-11 10:02 (MT)
Version: FINAL REV. 2

Client Phone: 867-456-6179

Certificate of Analysis

Lab Work Order #: L1065227
Project P.O. #: C00010486
Job Reference: CLINTON CREEK
C of C Numbers:
Legal Site Desc:

Comments:

02-DEC-11: Report Revised: Volumes corrected.

Susan Clark
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1065227-1	L1065227-2	L1065227-3	L1065227-4	
	Description	PCM	PCM	PCM	PCM	
	Sampled Date	13-SEP-11	15-SEP-11	18-SEP-11	19-SEP-11	
	Sampled Time	08:01	09:09	08:30	06:48	
	Client ID	AT GS#3 - SEPT 13/11	AT GS#2 - SEPT 15/11	AT GS#3 - SEPT 18/11	AT GS#3 - SEPT 19/11	
Grouping	**Analyte**					
FILTER						
Asbestos/Quartz/ Other Fibres	Fibre Concentration (fibres/mL)	0.004	0.004	0.004	0.005	
	Fibre Density (Fibres/mm2)	15	13	18	16	
	Fibres/Filter (Fibres)	6000	5000	7000	6000	
	Field Blank Correction (f/field)	<0.5	<0.5	<0.5	<0.5	
	Sample Volume (L)	1443	1287	1530	1224	

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments
L1065227-1	Filter	Note: change air volume	
L1065227-2	Filter	Note: change air volume	
L1065227-3	Filter	Note: change air volume	
L1065227-4	Filter	Note: change air volume	

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASBESTOS-FBRS/FLT-ED	Filter	Fibre Density	NIOSH 7400A

A measured volume of air is pumped through a cellulose ester filter to collect fibres. The filter is dissolved in hot acetone fumes, leaving fibres visible on a microscope slide. All fibres longer than 5um are counted, using NIOSH 7400(A Rules). The method does not differentiate between asbestos and other fibres.
-Sample results are corrected using field blank results.
-When there is no field blank submitted <0.5 f/field is entered.

Sr values:
5-20 0.11
>20-50 0.075
>50-100 0.10

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Page ____ of ____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	YUKON GOV. -EMR- ABANDONED MINES BRANCH	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	BRETT HARTSHORNE	☐ PDF ☑ Excel ☑ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	BOX 2703 K-419 WHITEHORSE YUKON Y1A 2C6	Email 1: BRETT.HARTSHORNE@GOV.YK.CA	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	CONTRACT C0001Ø486	Email 2:	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	867-456-6179 Fax: 867-456-6780	Email 3:	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
	Hardcopy of Invoice with Report? ☐ Yes ☑ No	Job #: CLINTON CREEK 2011	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)	L1065227	ALS Contact:	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Asbestos in filter	Number of Containers
1	AT GS#3 - SEPT. 13/11	130911	08:01	PCM		
2	AT GS#2 - SEPT. 15/11	150911	07:09	PCM		
3	AT GS#3 - SEPT. 18/11	180911	08:30	PCM		
4	AT GS#3 - SEPT. 19/11	190911	06:48	PCM		

L1065227-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF