KARLENG
Karl Engineering Consultants Ltd.

File: 2008-1002 (call out) Date: Nov 1, 2010

Alberta Transportation
#301, 9621 – 96 Avenue
Bag 900, Box 29
Peace River, AB
T8S 1T4

Attention: Mr. Ed Szmata
Sr. Construction Technologist

Re: **Call-out Inspection Report (GP-30a) –Slide Repair**
Hwy 43:12 –Iosegun River West Backslope (Catchwater ditch) slide
Overview Summary of Slide Repair Work (1) Designed by Karl Eng (2) Construction Managed by AMEC

As requested, Karl Engineering Consultants Ltd. (KarlEng) collaborated with AMEC Consultants (AMEC) to construct the repair works for the captioned slide. KarlEng provided the design of the slide repair. Since AMEC was undertaking a paving construction contract for AT in the area, it was agreed that the construction supervision of slide repair can be incorporated into AMEC's assignment and KarlEng was to provide overview guidance.

The repair works was completed as of Nov 21, 2010 (Final Inspection attended by Ian Cosh of AT and Glenn Newman of AMEC and InLine Contractors). This letter provides a short overview summary of the works, complete with site photos (before and after construction) and a copy of the design (Fig 1a,b,c) of the repair.

1.0 Main Causes of Slide and Design of Slide Repair

Causes of Slide

As submitted earlier to AT, it was assessed that the main causes of slide were of the followings:

- Shallow seated failure of the cut slope occurred and was primarily caused by soil wettening+saturation of slope from overspill of a shallow catchwater (of about 300m in length) located along top of the backslope. The gentle (flat) gradeline and nominal channel size (draft and width) of ditch was considered inadequate to provide hydraulic capacity of the catchwater ditch flow. Thus, the hydraulic inadequacy of ditch caused water overspill onto the slope below. In addition, another flow source added to hydraulic burden of the ditch.
    - An additional flow source is from a natural draw located at the top head of the slide area. This draw joins (at right angle to juncture with) to flow into this shallow catchwater ditch. It was very likely that the water flow from this draw can overshoot the catchwater ditch to overspill down the slope and cause wettening of slope face soils especially likely at times of wet weather events.
- Also, seepage from soils can be likely as secondary trigger to weaken the slope.

Design of Repair

The design of repair for slide was submitted by KarlEng in earlier correspondence but is herewith attached. It entails the following.

- Install a buried downdrain pipe to carry and channel the confined flow downslope. The inlet of downdrain is to position at the terminus of a draw (at top of slide) which junctures with the catchwater ditch. The inlet is designed as a low point (a catch-basin along the catchwater ditch) to collect flows from both sides of ditch. Down the face of slope, the length of downdrain pipe is to be buried (1m soil cover over top of pipe) and to be aligned at a slant down slope face so that its outlet is aligned in line with and outflow onto the highway ditch. About 90m-100m of downdrain pipe is to be constructed. The downdrain outlet is to rest ontop of gabion mat to allow outfall in line with ditch.

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- Along the backslope ditch, its channel gradeline will be re-graded to provide a 1% minimum channel gradeline to allow efficient flow and its channel size will be enlarged to provide flow capacity.

2.0 Construction Progress and Overviews

The repair design was overviewed on site with AT and AMEC by KarlEng on several occasions prior to and during construction.

- (1st) June 25, 2010, a pre-construction site meeting was convened with AMEC (Glenn Newman) and AT (Ian Cosh and Ed. Szmata), KarlEng (Karl Li) and InLine Contractors to clarify the design of slide repair and initiate the construction works process. A copy of design was provided by KarlEng to AMEC. It was estimated that the ordering and supply of material will require a couple of months to allow construction to start.
- (2nd) Oct 4, 2010, a construction startup site meeting was convened and attended by AMEC (Glenn Newman, Grant), AT (Ed Szmata and Bruce Henderson) and KarlEng (Karl Li), and InLine Contractors. A supply stock of "Big O" 900mm dia corrugated pipe (at 10 feet sections) was delivered on site. The site conditions and relevant issues were reviewed and discussed prior to actual start.

  Upon site discussions, it was decided
  - to add anchorage (hangers) to tie down the bottom sections (4-5) due to shallow burial depths along the lower portion of the slope.
  - to use metal steel bandits to "more strongly" strap down the overlap connections at the joints of each pipe sections which were presently manufactured as flush ends. (Flush end pipe are very susceptible to leakage when its wrapping connector loosens.) Such "strong steel bandits" strappings will allow a stronger connections to be constructed thus, minimizing the chances of joint loosening and thus leakage at the pipe (flush end) connections
    - For better leakage proof, it is more preferable that "male to female couple connections' can be designed and manufactured and supplied in the future. The coupling connection design can allow funneling of pipe flow down into the subsequent pipe sections (downgrade) without serious concern (worry) of pipe loosening as in case of flush end pipe sections. The loosening of flush end pipes can arise due to conditions of drastic weather temperature cyclic changes (causing shrinkage loosening of wrap connector materials) especially when pipes are exposed and/or under shallow burial depths.

- (3rd) Oct 6, 2010 a site meeting was convened to further review construction progress. AT (Ed Szmata, Bruce Henderson and Roger Skirrow), AMEC (site manager), KarlEng (Karl Li) and InLine Contractors attended the meeting.
  - Construction progress was considered satisfactory.
- (4th) Oct 21, 2010 Final Inspection of completed works. The inspection was carried out by AT (Ian Cosh), AMEC (Glenn Newman) and InLine Contractors. AMEC (Glenn Newman) briefed KarlEng (Karl Li) on final inspection outcome that the construction was inspected as satisfactorily completed. Site photos were provided by AMEC.

2.1 Completed Works

Based on site overviews and the debrief provided by AMEC on final inspection, the following works were reported completed. It is understood that a report on quantities and cost will be reported by AMEC in due course.

- Installation of about 90m-100m of buried downdrain (900 mm dia. Corrugated Big O connected by overlap wrap connectors.) Top of pipe burial depths were generally at 1m below ground surface. Along bottom of slope where shallow burial depth prevailed, tie-down anchors were installed to 1m below bottom of pipe to tie down the pipe sections at its connector locations.
- The inlet of downdrain were positioned along the catchwater ditch at its confluence junction with the natural draw upslope. This disposition of downdrain inlet will allow direct flow from the natural draw to enter the downdrain pipe.
- Re-grading of catchwater ditch (minimal 1% grade) and heightening of its dyke was constructed for the catchwater ditch as improvement to its channel gradeline and its flow capacity. This will likely prevent overspill of flow in the future.

- Finger drains (2 pcs) were installed to tap to seepage zones located during construction. Perforated pipe and free draining gravel were utilized for finger drains.
- The scarps of this shallow seated slide was simonized and landscaped to a smooth surface. The slope face was top soiled and seeded.

3.0 Performance of Repair and Risk Assessment of Site

It is preferable to review the performance of this repair at a later date in the coming Slide Tour in 2011, allowing half a year and sufficient time to observe its effectiveness. It is anticipated that the risk assessment of the site will be reviewed at such time as well.

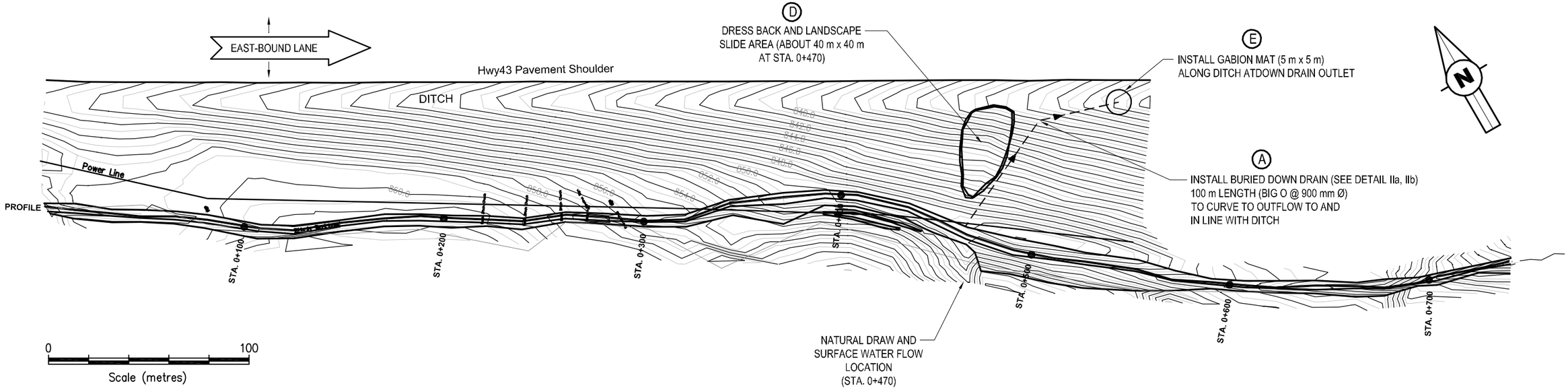
5.0 CLOSURE

We appreciate the opportunity to provide the above information. Should you require further information, please contact the undersigned.

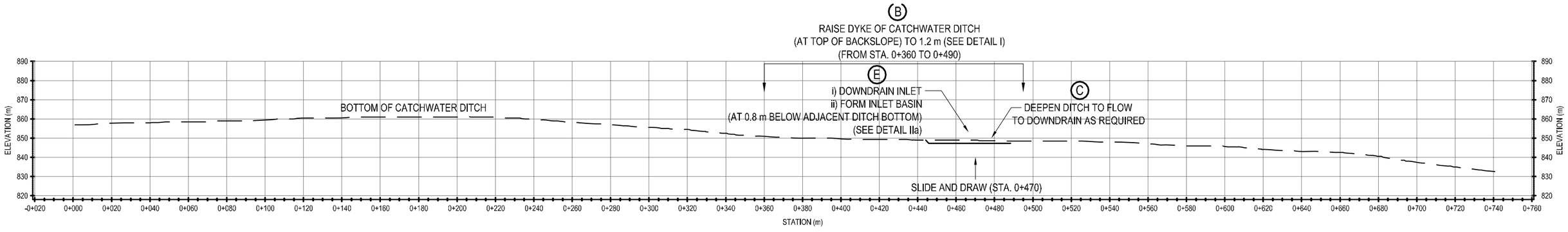
Karl Li, P.Eng.
Senior Geotechnical Engineer

cc. Roger Skirrow, P.Eng. AIT Twin Atria

Attachment: -(A) Figure 1a,b,c – (B) Site Photos



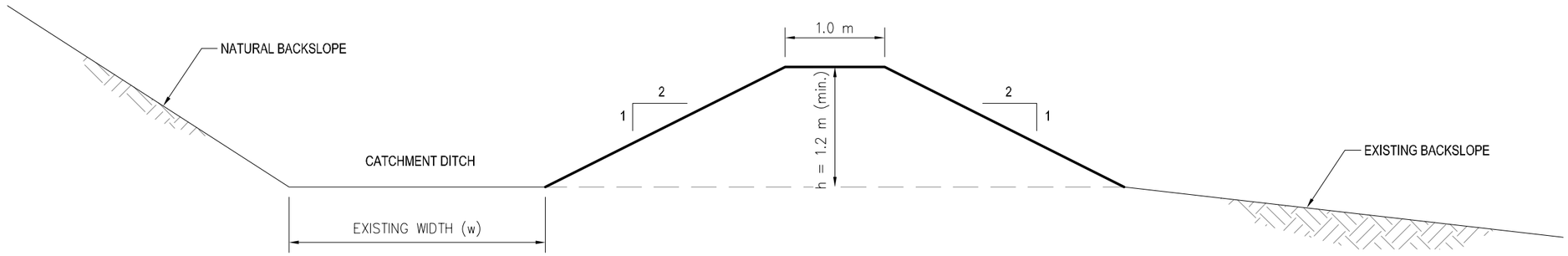
PLAN



PROFILE

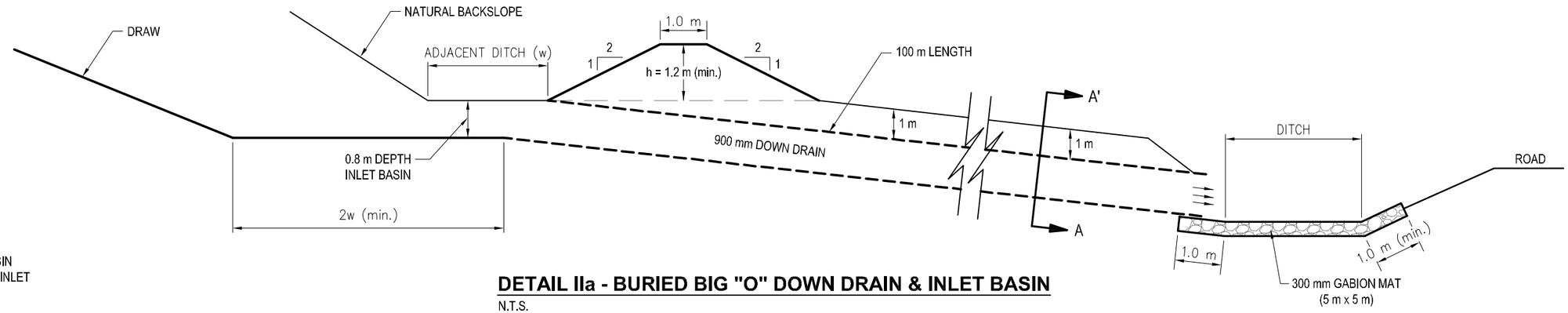
Figure 1a - Plan and Section
Hwy 43:12, Iosegun West Backslope
Slope Slide Repair and Drainage Works (A to E)

i) Downdrain
ii) Catchwater Ditching Improvements
iii) Slope Relandscape



DETAIL I - RAISED DYKE (STA. 0+360 TO 0+490)

N.T.S.

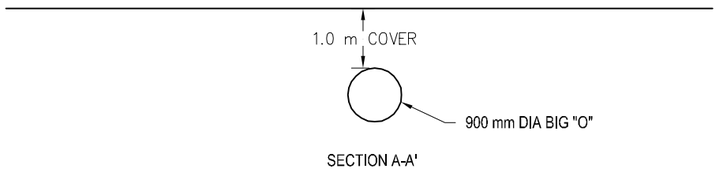


OPTION:

INSTALL RIPRAP AT
- INLET BASIN
- CULVERT INLET

DETAIL IIa - BURIED BIG "O" DOWN DRAIN & INLET BASIN

N.T.S.



DETAIL IIb - BURIED BIG "O" DOWN DRAIN

N.T.S.

GENERAL NOTES:

i) INSTALLATION OF A DOWNDRAIN PIPE TO OUTFALL FLOW FROM CATCHWATER DITCH DOWN BACKSLOPE AND INSTALL ARMOUR PROTECTED PIPE ENDS

ii) HEIGHTEN DYKE OF EXISTING CATCHWATER DITCH AND DEEPEN DITCH (AS REQUIRED) AND CONSTRUCT AN INLET BASIN TO ALLOW FLOW OUTFALL TO DOWNDRAIN PIPE

iii) DRESS BACK AND LANDSCAPE SLIDE AREA TO A SMOOTH SURFACE

iv) RETOP SOIL AND SEED FINISHED SLOPE SURFACE

v) FINAL LINES AND GRADES OF CONSTRUCTION WILL BE DECIDED ON SITE BY GEOTECHNICAL ENGINEER

QUANTITIES

A) DOWNDRAIN (BURIED) PIPE – 100 m

B) RAISING OF DYKE – 130 m

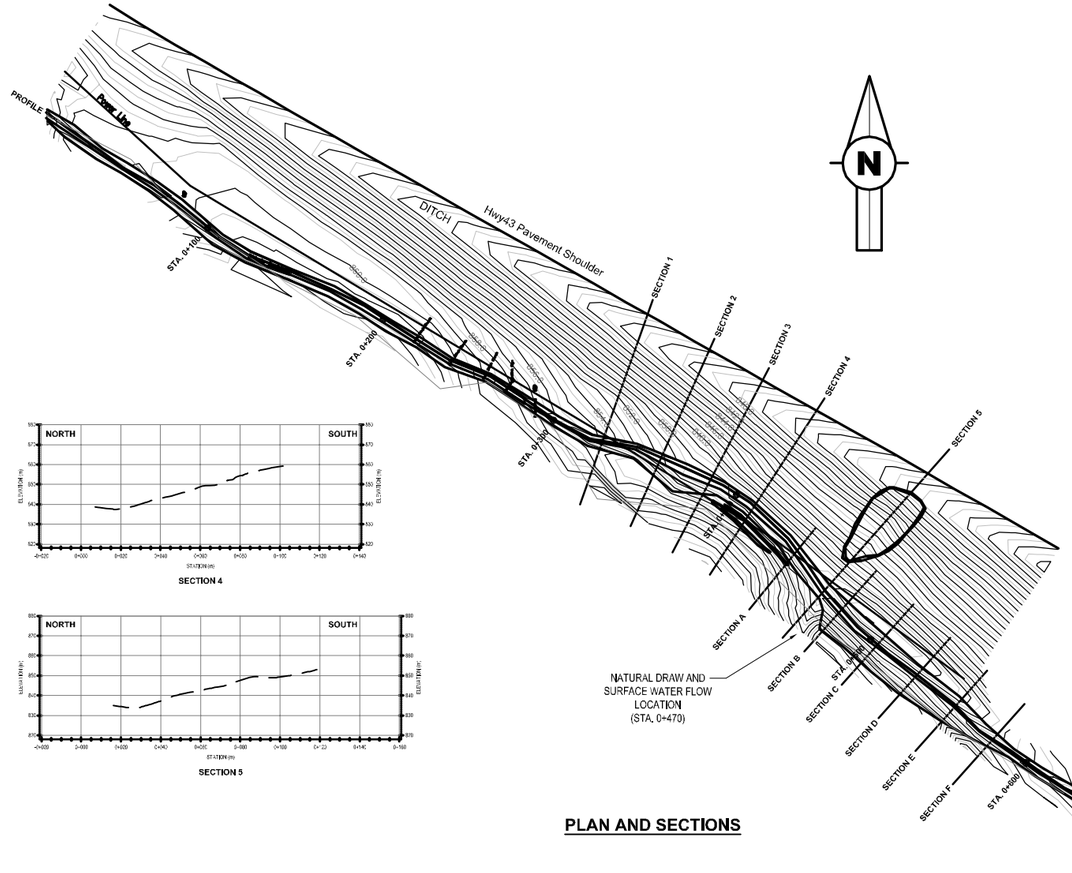
C) DEEPENING OF DITCH – NOMINAL

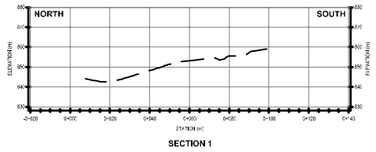
D) SLOPE LANDSCAPING AND DRESS BACK AND RESEEDING – 40 m x 40 m

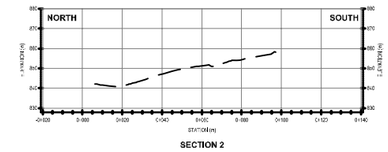
E) RIPRAP (5 m x 5 m) EROSION PROTECTION AT CULVERT INLET AND GABION (5 m x 5 m) WALL AT OUTLET

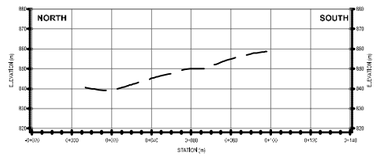
Figure 1b - Details
Hwy 43:12, Iosegun West Backslope
Slope Slide Repair and Drainage Works

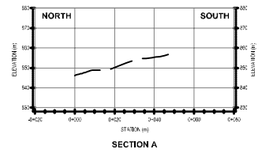
i) Downdrain
ii) Catchwater Ditching Improvements
iii) Slope Relandscape

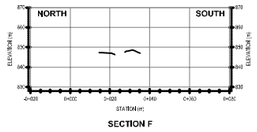


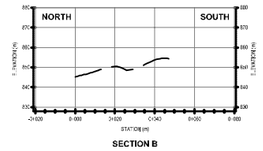


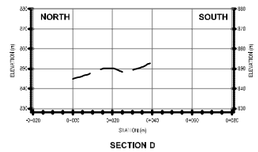


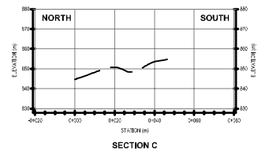


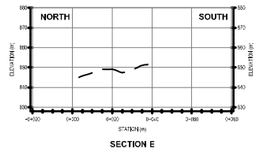






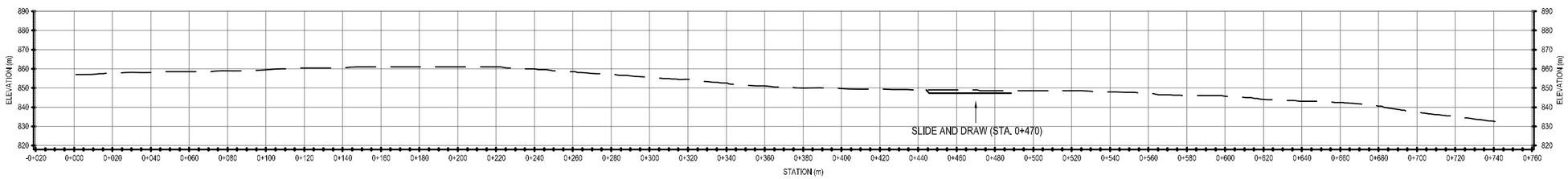






PLAN AND SECTIONS

0 100
Scale (metres)



PROFILE

0 100
Scale (metres)

Figure 1c - Plan and Section
Hwy 43:12, Iosegun West Backslope
Existing Dyke along Catchwater Ditch
and Backslope Gradients
(For Information)
(Surveyed in 2009)

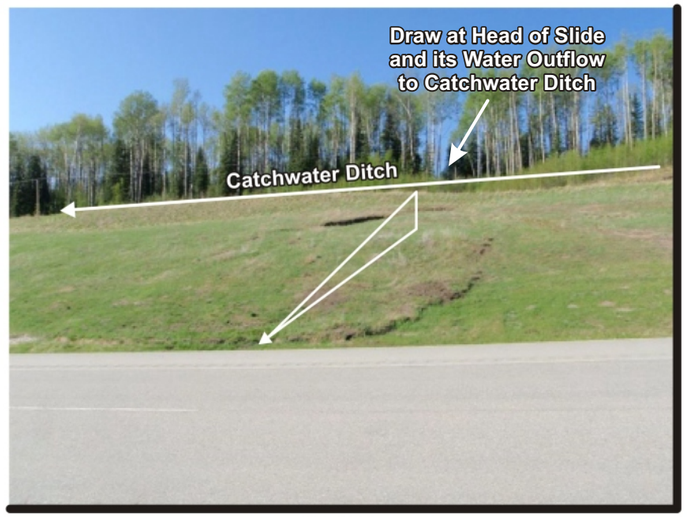


Photo 1
Looking east downgrade at backslope along eastbound lane
- Slide located at below a catchwater ditch
- Headscarp just below catchwater ditch
- Toe bulge not affecting ditch yet

Photo 1a
Looking east and south downgrade
- Another view of slide

Note: Photos taken on June 2009

GP 30a
Slide Conditions prior to October 2010 Repair Construction

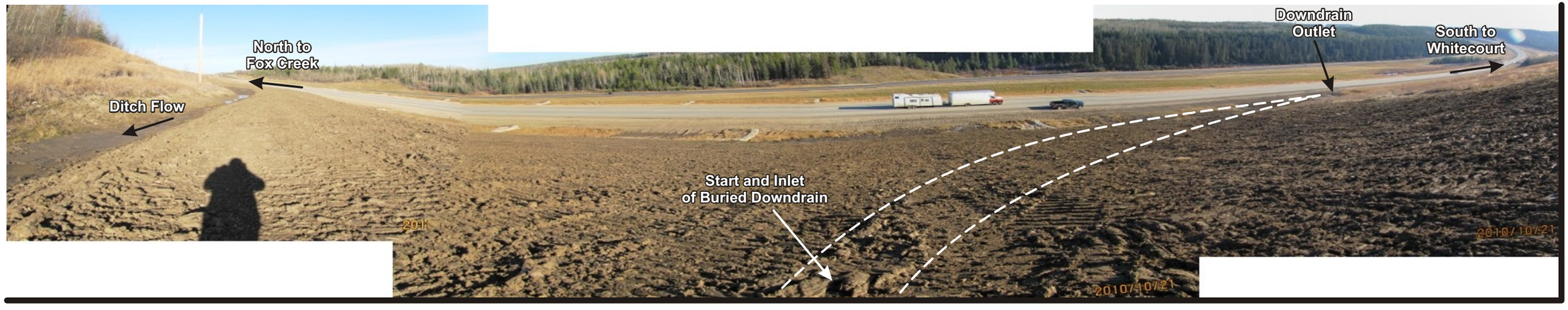


Photo 2

Looking west and east down slide area (from top slope at inlet of downdrain)

- Downdrain pipe is slanted to run down slope face and aligned to outfall with its outlet in-line with ditch onto a new gabion splash pad
- Inlet of downdrain is located at centre of photo (just outside photo)
- Catchwater ditch is dyked up and regraded to provide adequate hydraulic flow conditions to allow inflow into buried downdrain
- Slide is regraded and shallow scarps simonized to a landscape surface

Photo 2a

Looking east (towards WhiteCourt) at catchwater ditch-during construction

- Inlet area of downdrain, both west and east approach of ditch is graded to flow towards the downdrain.

Photo 2b

Looking east (towards WhiteCourt) at catchwater ditch-during construction

- Inlet area of downdrain, both west and east approach of ditch is graded to flow towards the downdrain.

Note: Photos taken on October 2010

GP 30a
Slide Conditions after October 2010 Repair Construction

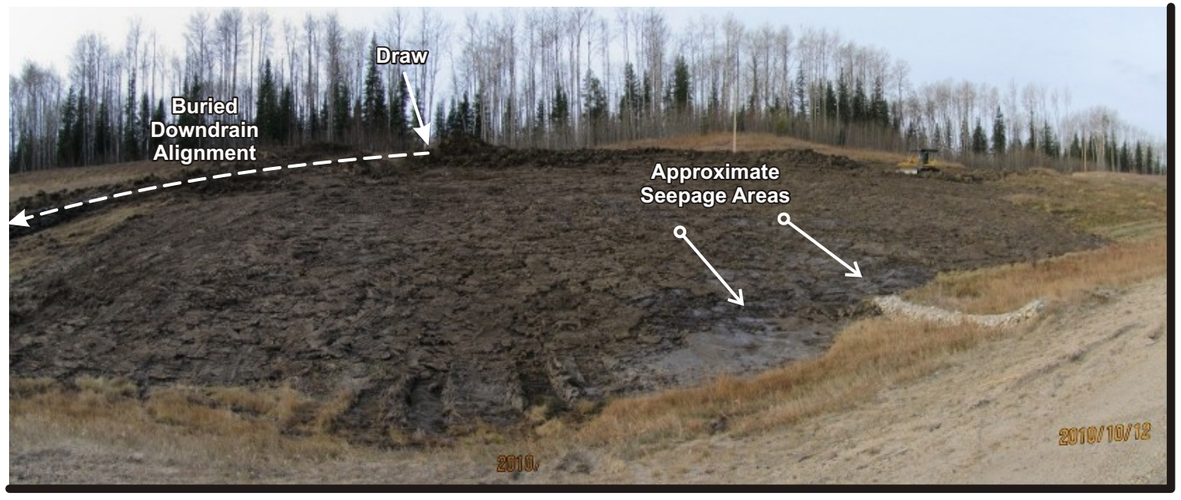


Photo 3
Looking at front of repaired slide after Oct 2010 repair
- Slide scarp simonized and re-landscaped. Slope reconstructed.
- Finger drains (gravel+perforated pipe) installed to tap to seepage zones

Photo 3a
Looking north along highway ditch (towards upland) from bottom of slope
- Marked up alignment of downdrain prior to its construction

Photo 3b
Looking north along highway ditch (towards upland) from bottom of slope
- Downdrain outlet and splash pad

Note: Photos taken on October 2010

GP 30a
Slide Conditions after October 2010 Repair Construction

Photo 3c

Downdrain pipe in trench before backfill

- Metal bracelet to tie down the joint locations (of 10 feet sections of pipes) and to anchor (screw) down at 1m below pipe bottom. This anchorage was constructed along bottom 4 outlet sections which are of shallow burial depths.

Photo 3d

Corrugated pipe section ends connected by a wide plastic wrap to overlap the joints

- The plastic overlap wrap also tied down by steel bandits.

Photo 3e

Metal anchor (hanger)

- Metal bracelet tied to hanger anchor (with screw anchor to 1m below bottom of pipe)

Note: Photos taken on October 2010

GP 30a
Slide Conditions after October 2010 Repair Construction