Detailed Drainage Plan and Terrain Stability Assessment
Winlaw Woodlot
Proposed Silica Mine Forest Road
Winlaw Creek
Map reference 82F070,80

Synopsis

This drainage plan was completed on proposed and existing roads (section of the Silica mine road that will be upgraded to access timber on the Winlaw woodlot. The road is upslope of reaches 2 and 3 of Winlaw Creek and the lower reach of the North Fork of Winlaw Creek. The road is, for the most part, located on gently sloping, dry, south facing terrain upslope of steeper slopes. Previous studies have indicated that this section of the Silica mine road is stable. The large "slide" that occurred in 1971 is an erosion gully that was caused by a unique circumstances including the diversion of a manmade spring. Realignment of the road to avoid the 1971 slide location is not necessary. If culverts are placed as proposed there is a low likelihood of landslide initiation associated with construction of the road.
Presently the water from the manmade spring is flowing under the road and in a cross-ditch that has caused significant erosion and debris slides below the road. The erosion and debris slides have a impact to Winlaw Creek.

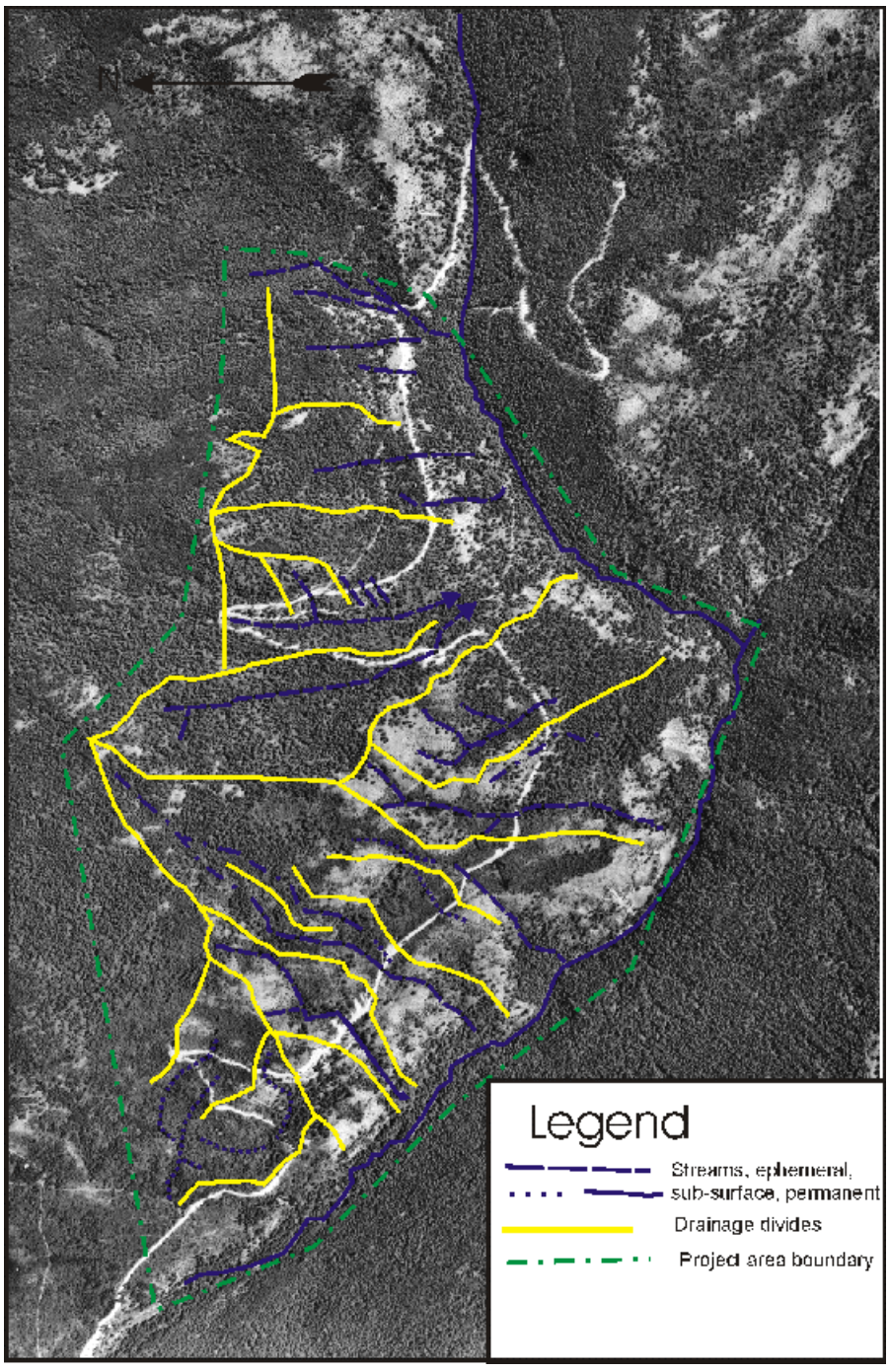
Introduction

Tom Bradley, forest planner for the Winlaw woodlot requested that Apex Geoscience Consultants Ltd. complete a detailed drainage plan of a portion of proposed Forest access road (locally known as the Silica Mine Road) on the north side of Winlaw Creek. A detailed drainage plan was requested because "slides" had occurred off the road and because the road passes through and is upslope of class IV and V terrain stability polygons as defined by detailed terrain mapping (level B - Utzig). Winlaw Creek is fish bearing and a consumptive use watershed which serves the community of Winlaw. There are a 55 water licenses registered on Winlaw Creek. The Resource value at risk is water quality along the lower reaches and fish habitat.

Limitations and Reliability;

The detailed drainage plan made in this report is based on observations made in the field and detailed airphoto interpretation. Terrain stability is determined from observations and inferences of materials in soil pits, road cuts and tree churns along and downslope of the proposed road. The slope drainage pattern is inferred by evidence of waterflow, subtle swales, watercourse channels, and moisture indicator plants in conjunction with the drainage plan map completed for this area. Culvert locations are proposed at areas of surface flow, seeps, by drainage divides (to keep water within the correct sub-basin) and to disperse flows in areas of naturally dispersed flows. If, during road construction, materials or conditions are encountered which are substantially different from those inferred the author should be notified. Stability assessments made in this report assume that all Ministry of Forests/ Forest Practices Code road construction standards are met and

the drainage plan is followed. Even if all standards are met there is still a possibility of landslides. Terrain assessment, good road layout and good construction methods can reduce the risk of landslides not eliminate it.



Methods:

Previous studies reviewed include;

- Detailed terrain stability map (level B) -Utzig,
- Winlaw Creek Channel conditions and Prescriptions Assessment- Apex

- Road Stability Assessment and Prescription Plans Winlaw Creek Forest Service Road - EBA,
- Geotechnical Review, Proposed Level II Road Deactivation Prescriptions Winlaw Creek Forest Service Road Winlaw, B.C (DRAFT).-EBA
- bedrock geology map,
- 1:15,000 scale airphotos,
- and biogeoclimatic maps

Sub-basin Drainage boundaries were defined on 1:15,000 airphotos. Field work was conducted by W. Halleran P.Geo. on May 7 and Sept 6, 2001. The road and proposed road P-line was walked and observations tied into hipchain stations, previous road traverse stations, and EBA road hubs. Proposed culvert locations were marked in the field by pink flagging stamped "CULVERT". Unless otherwise stated the culverts are 450 mm. The drainage boundaries were adjusted on the airphotos to reflect information collected during the field work. Figure 1 shows the boundaries and streams on the airphoto. The culvert locations were tied into the road survey by Mr. T. Bradley, drainage boundaries, streams and culvert locations were digitized by Mr. T. Bradley.

Physiography and Climate.

Winlaw Creek lies within the Moist Climatic Region of the Nelson Forest region. The project area lies within the Warm Dry Interior Cedar-Hemlock Subzone (ICHdw). This area can be expected to have a light snow pack and hot summers.

Observations

Observations are summarised in table 1 in the appendix and figure 1.

Slope drainage: For the most part the terrain crossed by the road is southfacing, rocky, and well drained. The slope is drained by short duration ephemeral streams. At the time of assessment in early May most of the ephemeral streams were dry. The notable exception is the stream at 2+552. The source of this stream is a spring that appears to come to surface through a mineral exploration drill hole. The spring is in a small bowl that is drained by a “cat” road. Presently the flow from the spring flow goes subsurface under the road through the fill. A cross ditch just down road gradient carries significant flows during peak flow periods. There is extensive erosion below the cross-ditch were it discharges onto a 70 percent gully sideslope. The gully has a 58 percent gradient and is well-confined. The stream flows out onto the valley flat 30 meters from Winlaw creek channel.

Terrain stability: Previous studies of the road (EBA) assigned a low likelihood of fillslope failure for the section of road included in this study. The Winlaw channel assessment (Apex) identified only one sediment source along the section of stream downslope of the road sections assessed. This sediment source is an undercut kame terrace on the north side of the stream and is unrelated to the existing road. In this study the following areas of observed terrain instability along or below the proposed road alignment were noted.

1. An old failure scarp below, and slumping cutslope on, the existing road below 0+430 on the proposed road.

2. A series of slumps and slides below station 0+487 are associated with the stacked trail system constructed on ~80% slopes of zsrCb//Rs. The slumps initiate on a trail between the lower trail and road. The road likely sidecast onto the middle trail (which is cut into rock), overloaded it and caused the trail to slump onto the lower trail. The scarp is 2 meters high and is still unstable. There is no stream channel in the valley (Curve Creek).
3. Small fillslope slumps at 0+781 along the road.
4. There are tension cracks along the fill of the road at 2+351, the slope is –45%.
5. There are a number of debris slides and some extensive erosion below the discharge of a stream at 2+552. The stream, presently carried by a cross ditch, is discharged on to the sideslopes of the swale and has eroded a 0.75 meters deep gully to the swale bottom. In addition to the debris slides there are tension cracks along the slope an in the fill material below the road. None of the debris slides reached Winlaw Creek channel. Erosion of the sideslopes does not appear to contribute any significant amount of sediment to Winlaw Creek.
6. The very large “slide” that occurred in 1971 at the corner at 3+410 is an erosion gully caused by the diversion of the stream at 2+552.

The large slide/erosion scar at 3+410 is a significant feature and stakeholders have concerns that the slide could be retriggered by additional development. As a result of this concern the feature was investigated to determine the cause and mechanism of formation. Features on the ground indicate that the feature was formed by erosion caused by the diversion of the stream at 2+552. The likely sequence of events that caused the erosion can be determined by features noted on the ground. The small bowl in which the drill hole was located has a fairly large catchment area. The drill intersected an aquifer below the ground water flow. The water flowed up through the drill hole and pooled in the bowl. It is likely that there was some sort of barrier such as a pile of debris that restricted the water from flowing out of the bowl or that there was a significant increase in the rate of flow from the flow significantly increased out of the drill hole (the drill hole casing may have been capped originally and then the cap was removed) it may have been capped). It appears that there was a short duration very high flow perhaps caused by breaching the barrier (dam burst). The water flowed down the cat trail that was constructed to service the drill pad. Scour from the dam burst event eroded the road bed to cobble sized material (this road bed is now a stream channel). The water was then deflected down the Silica Mine road. There is evidence of extensive scour along the road. There are a number of areas where water flowed off the road and deeply eroded the fillslope and down slope areas depositing cobble cones on lower trails and slopes. Photo #1 below shows a cone that completely covers an old trail. There are numerous old slides and erosion features below the road that appear to be about 30 years old, suggesting that all the features occurred in a relatively short period of time. At first most of the flow was diverted to 3+410 resulting in the large erosion gully (“slide”) in a sandy gravel terrace.

Recommendations

Placement of the proposed culverts will be sufficient to maintain natural drainage patterns. Presently the slope below 2+552 is unstable and is being eroded by flow from the spring,. The placement of the 500 mm culvert in the center of the gully will reduce the amount of sideslope erosion. The fill along here is oversteep and contains an significant amount of organic debris. It is recommended that when the culvert is placed this material (~ 6 meters either side of the crossing) is cleaned of organic debris and the fillslope angle reduced. If additional slides occur along here it is highly unlikely that they would reach Winlaw Creek Channel. Subsequent sediment delivery to the stream channel would be minor. Although the hazard is high, the consequence is low resulting in a moderate risk.

The slides below 0+487 is the result of cutslope/fillslope failures on the old stacked trail/road system. The bottom of the draw (Curve Creek valley) below the slides is wide with no stream channel. Construction of the road will not significantly increase the likelihood of landslide initiation. Presently there is a high hazard, low consequence and moderate risk of impacts to the North Fork of Winlaw Creek resulting from road related instability.

The large slide/erosion gully at 3+410 is an erosion feature that was a result of unique circumstances. There is a low likelihood of a repeat of the events which caused the erosion. With the exception of minor raveling from the steep headwalls, the area is stable. There is no need to re-align the road.

The construction of the proposed road and modification of the section of the Silica Mine road poses a low risk to the water quality and fish habitat of Winlaw Creek.

Closure:

The risk assessment and terrain stability assessment of this report assumes that all culverts will be function properly and that the works recommended by Apex Geoscience Consultants Ltd. will be completed.

Respectfully Submitted

Will Halleran P.Geo

Reviewed by

Kim Green, M.Sc., P.Geo.

Appendix I
Apex Geoscience Consultants Ltd.

Table #1 Culvert Locations Silica Road

Distance	Culvert	Notes
0+00m		POC on proposed road.
0+019.9m	450mm	Small partial swale at edge of paleo-fan
0+072.0m		= 0+623 "road traverse"
0+076m	Grade dip	Swale – no channel-cedar, joins up with larger swale ahead just below road- grade dip from 0+065m to 0+ 105m
0+092.4m	450mm	=0+602 "road traverse" Swale – larger upslope, convergent swales onto bench then below becomes more defined, dead zones should be more visible on newer photos.
0+105.1m		= 0+ 588 "road traverse"
0+ 113 m		shoulder
0+ 143 m		End of shoulder into swale
0+158 m	Optional culvert	Subtle swale, optional culvert, old road just below has no evidence of flows.
0+166 m		Onto old existing road
0+185 m		Change of aspect
0+212 m	450mm	Cedar grove, slope still convex across, large old road downslope
0+279 m		0+ 418 m "road traverse"
0+320 m	450mm	Subtle swale before aspect change.
0+356 m		Open dry slope, old road just below, drainage divide?
0+382 m		No scour on any of the three stacked roads
0+391 m		0+294 "road traverse".
0+410.9 m		Broad "swale" junction of Silica Mine road and old road just below.
0+432.4 m	450mm	Short "gully" swale just above road, minor slumping of cutslope on lower road, feeds old failure scarp, likely okay –cross ditch lower road.
0+453m		Another "swale" old sloughs from 65% slope, some cedar, sgF^{G}
0+487m		Onto Silica mine road (0+193 "road traverse") Blk #2 boundary, slope – 80% cut by old trails, small outcrops and bluffs.
0+507m		Rock cutslope, road grades toward gully.
0+580m	450mm	(? 42) low point in road, wet swale upslope
0+ 629m	450mm	Swale (near drainage boundary)
0+645m		Road in from below
0+658m	450mm?	Gully bottom, divide correct on airphoto
0+662m		Road off down Dumont Creek.
0+682m	450mm	Present cross-ditch location, cutslope seeps, improve ditch to Winlaw side.
0+699m		End of obvious seeps, improve ditch to direct water to culvert at

		682
0+761m		Oversteep fill
0+781 m		Oversteep fill with stumps, old slumps
0+828 m		On ridge between the two gullies.
0+850 m		Road grades down to other gully.
0+889m		Back and forth over divide on top of “ridge” between gullies.
0+944m		Just over divide start down into gully.
0+989m		Ditch on downslope side.
1+038m		Ditch discharges onto gully sideslope (okay), road now cutting gully side slope (55% slope gradient).
1+087m		Wet area on road.
1+091m	450mm	
1+ 161m	600 mm	Road 10 % gradient through crossing (no dip present)
1+162m		? 40 (2+930m)
1+261m	450mm	Back up culvert to ensure divide isn’t crossed, pushout already here.
1+321m		14% road gradient onto face
1+345m		Mahonia in ditch line
1+418m	450mm	Corner and ditchblock (actually ditch ends), new? Cross ditch, minor scour on road down gradient, bench below. (? 38, 2+660m)
1+544m		Some evidence of flow in ditch, low point in road, steep section of road (favourable) just ahead
1+547m	450mm	Willow, subtle swale just past ?36
1+596m	450mm	Evidence of flow in ditch and over forest floor (over cutslope), down road grade evidence of old rutting, ditch is blocked here, partial cross ditch and downed tree, just before corner, (?35), past no ditch, rock cutslope, road had good flow down at one time
1+728m		Crossing rocky slope to here, trails upslope and downslope, gradient change, occasional Cottonwood.
1+762m		Razor back just above road parallel to road.
1+ 796m	450mm	Low point in road, swale upslope, about to enter gentling sloping open terrain (old clear-cut?). ? 33
1+887m		Water on road to 1+907m where it pools, road on edge of 45 to 55% gradient slope, maple willow, birch, cottonwood, poplar.
1+907	450mm	Looks like old channel still moist, just coming around the corner, I can see treed meadows to west, old cross-ditch (wood culvert) just ahead.
1+ 948m		Old crossditch (wood culvert) with evidence of eroded fillslope.
1+970m	450mm	A little water on road, marked with “creek” flag
2+026m	450mm	Swale, cottonwood, ~40%, open meadow just below, cross-ditch (wood culvert). Marked on airphoto.
2+039m		Old wood culvert for flow at 2+026.

2+146m		Dry rocky slope (? 30)
2+165m		Evidence of flow in ditch
2+173m		Water flowing in ditch from seeps along cutslope
2+202m	450mm	Seeps along cutslope to here, maybe place more culverts
2+319m	EBA-450mm	? 28 EBA 450 mm culvert, at pushout upslope, cross ditch (wood culvert) here – evidence of erosion, right on divide
2+351m		Tension cracks in fill, -45%
2+376m	EBA-450mm	? 27 EBA 450 mm culvert, because of old cross drain?
2+410m		EBA – possible borrow pit, ? 26
2+552m	EBA-500mm	EBA 500 mm. Man made creek result of trail construction and exploratory drilling on flats upslope. There are debris slides below road and the fill is failing. There is significant organic debris within the fill. At the time of inspection most of the flow went subsurface below the road, a cross ditch just down road gradient directs flow onto the 70% gradient side slope of the gully during high flows. The discharge from the cross-ditch has eroded down to bedrock, material from the erosion and debris slides are piled up behind trees within a 58% gradient section of the gully. Additional tension cracks are present downslope of the road. Debris slides have occurred both directly below the crossing and below the cross ditch. There is significant old scour down the road, it is obvious that the stream was completely diverted down the road at one time.
2+600m		High rock cutslope
2+616m		Erosion and slides off road where water from diversion at 2+552m
2+642m		Erosion and slides off road where water from diversion at 2+552m
2+648m		Ditch starts still evidence of old scouring of road and ditch
2+713m		High rock cutslope, erosion of fill slope
2+725m		Looks like where a lot of the flow went off, just before corner ? 21
2+775m	EBA	EBA culvert ? 20
2+835m	EBA	EBA culvert ? 19
2+877m	EBA	EBA culvert ? 18, “swale” animal trail rCb
2+915m	EBA	EBA culvert, ? 17 upslope continuation of swale
2+945m	EBA	? 16 EBA culvert, road is directly below
2+990m		? 15 1km board
3+012m		Switchback no flow
3+056.8m	EBA	? 13 EBA culvert swale, lines up with ? 16
3+087m	EBA	? 12 EBA culvert swale, lines up with ? 17
3+122m		Swale downslope no evidence of flow on road
3+ 150m	EBA	? 11 Flow on road, EBA culvert.

3+191m		Round corner
3+199m		Major old erosion feature on fillslope, water may have flowed down old trail
3+217m	EBA	? 10, EBA culvert, large amount of water previously flowed out onto road here. Scour is old no evidence of recent flows.
3+282m	EBA	? 09, EBA culvert, move to 3+297 to catch swale and flow from upslope trail diversions, flow may move over time
3+336m	EBA	? 08 EBA culvert, large swale, old extensive old scour of ditch starts here to 3+410m
3+410 m		Corner, top of erosion – failure gully (1971), ditch feeds into it. Old road lines up with new road, road was likely re-aligned after failure. (when old road crossed swale upslope of present road) it has failed in a number of places, there is no hard evidence of high flows down swale, but there is some old scaring of trees ~30 yrs old.
3+438m		Low point, still on “failure” scarp, little berm on outside edge, failure is V shaped, 77% sideslope gradient in sandy gravel, looks more like an erosion gully.
3+460m		Eot.

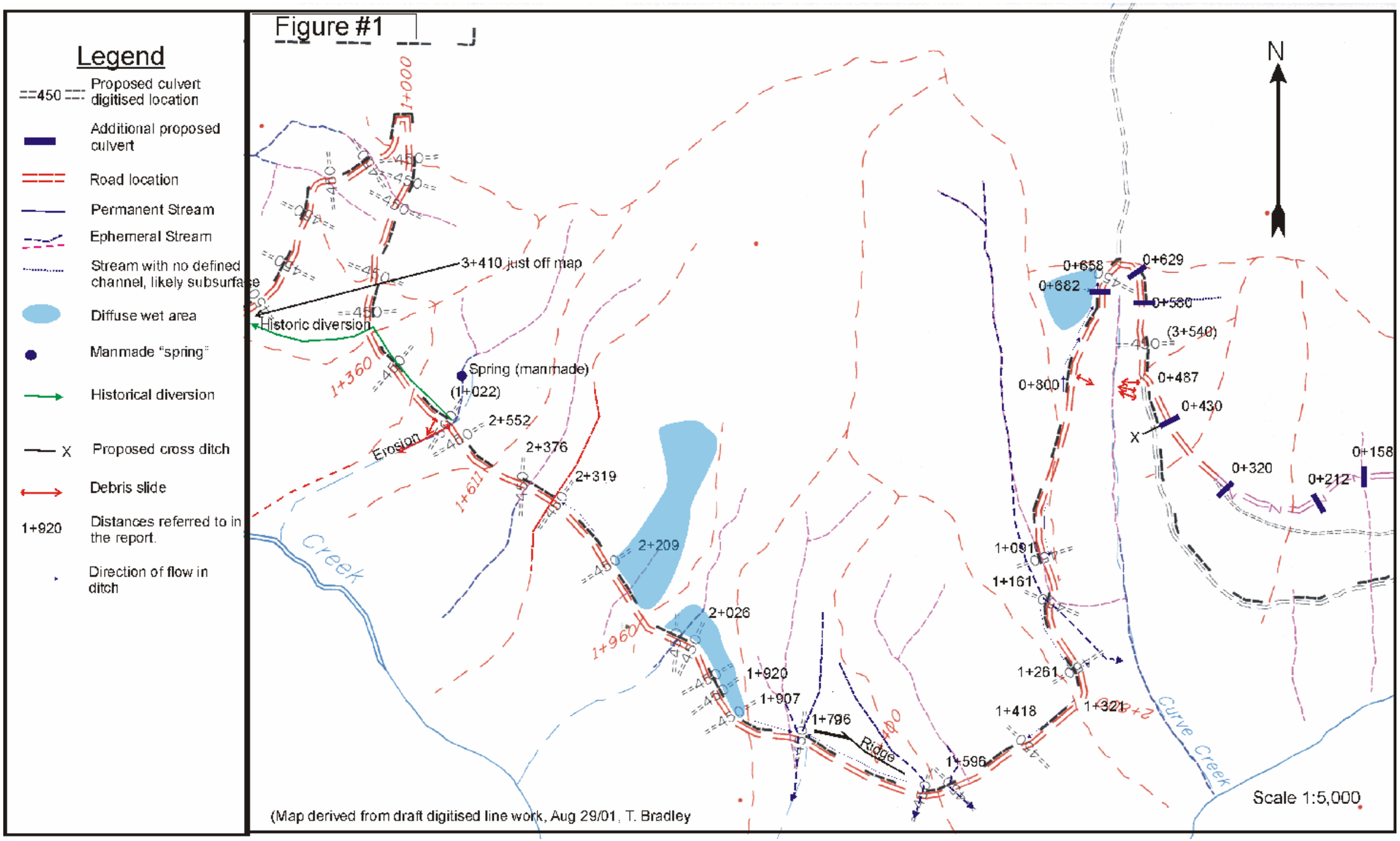


Figure #1
Legend
==450== Proposed culvert digitised location
Additional proposed culvert
Road location
Permanent Stream
Ephemeral Stream
Stream with no defined channel, likely subsurface
Diffuse wet area
Manmade "spring"
Historical diversion
X Proposed cross ditch
Debris slide
1+920 Distances referred to in the report.
Direction of flow in ditch
N
3+410 just off map
Historic diversion
Spring (manmade)
(1+022)
Erosion
1+000
1+360
1+611
2+552
2+376
2+319
2+209
2+026
1+960
1+920
1+907
1+796
Ridge
1+596
1+418
1+321
1+261
1+161
1+091
0+800
0+682
0+658
0+629
0+580
(3+540)
0+487
0+430
0+320
0+212
0+158
Creek
Curve Creek
(Map derived from draft digitised line work, Aug 29/01, T. Bradley
Scale 1:5,000