Road Assessment
Harrison Mills – Mt. Currie
Addendum

prepared for:

Land and Water British Columbia Inc. and
South Coast Region Ministry of Transportation

November 2003

submitted by:

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Infrastructure Systems Ltd.

in association with:

TRILLIUM ***Business Strategies Inc.***

ARLINGTON GROUP Planning + Architecture Inc.

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Executive Summary

A number of studies have been undertaken which have examined the feasibility of developing a public road to connect Pemberton / Mt. Currie to the Lower Fraser Valley along what has become known as the Sasquatch Corridor. Some of these studies focused on either progressive upgrading of the existing In-SHUCK-ch and Harrison West Forest Service Roads to a two-lane paved roadway, or making localized improvements to these Forest Service Roads (FSRs).

In 1999, Infrastructure Systems Ltd. (ISL) completed a study of the Sasquatch corridor for the Ministry of Transportation. The study proposed improvements that would provide a more consistent operating speed and would increase reliability and safety while utilizing as much as possible of the existing roadbed and structures along the corridor. The results of that study are contained in the report titled "Road Assessment – Harrison Mills to Mount Currie".

In 2003, the Ministry of Transportation initiated a study to examine the costs and impacts of constructing a two-lane, 60 km/h low traffic volume road along the corridor. This evaluation was confined to the design aspects of the road and did not assess the impact on regional traffic patterns.

Key Plan 1

In the 1999 study, ISL estimated the cost of upgrading the road along the Sasquatch Corridor between Mt. Currie and Harrison Mills to be $200 million. This current study has estimated the total project cost at $275 million. The updated cost includes the following components that ISL was not asked to include in the 1999 cost estimate:

- Replacement of eight single-lane bridges with new two-lane structures
- Engineering during design and construction
- Property acquisition
- Environmental mitigation
- Archaeological mitigation
- Project management.

The 2003 cost estimate is based on the alliance model of project delivery.

The roadway would:

- Provide access to First Nations communities and other residents and businesses in the corridor.
- Provide access for new commercial, tourist and recreation land uses.
- Offer an alternate access to Pemberton, Whistler, and Lillooet from the lower Fraser Valley.
- Provide an emergency route to Vancouver in the event of long term closures of Highway 99 between Horseshoe Bay and Squamish.

Development of a road in this corridor needs to be undertaken in a way which recognizes the following important considerations:

- First Nations interests.
- The rugged mountainous terrain.
- Archaeological and environmental impacts.
- The location of the hydro transmission line.
- The impact of natural hazards on road maintenance.

1.0 Introduction

A number of studies have been undertaken previously to evaluate potential highway routes that would connect Pemberton / Mt. Currie to the Lower Fraser Valley. The 1999 study “Road Assessment - Harrison Mills to Mt. Currie” recommended either an upgrade of the existing forest service roads to two-lane paved roadways (In-SHUCK-ch Road and Harrison West FSR) or a series of progressive localized improvements.

The study focused on carrying out improvements that would provide a more consistent operating speed and would increase reliability and safety while utilizing as much as possible the existing roadbed and structures along the corridor.

The 1999 study recommended that an alignment that utilizes the In-SHUCK-ch FSR from Hwy. 99 along the east side of the Lillooet Lake and Lillooet River crossing to the west side at the Lillooet Bridge and continuing on the west side until the south end of Harrison Lake. It recommended completion of the connection between Hwy. 99 (Mt. Currie) to Harrison Mills (Hwy. 7) by utilizing the existing paved road which extends from Harrison Mills northward for approximately 11 km and then utilizing the Harrison West FSR. The Harrison West FSR starts approximately 1 km north of the end of the paved section.

This study examined the cost and impact of constructing a two-lane paved low traffic volume road along this alignment. For purposes of orientation, the kilometre station used on the plans follows the kilometre markings posted along the In-SHUCK-ch and Harrison West FSRs.

2.0 Scope of Study

The purpose of this study, which is presented as an addendum to the 1999 study, was to update costs for a conceptual alignment of a paved two-lane roadway with a 60 km/h design speed. The roadway would be located along the east side of Lillooet Lake and River and the west side of Harrison Lake. The route extends from Highway 99 (near Mr. Currie) to Highway 7 (near Harrison Mills), a total distance of approximately 160 kilometres.

It is intended that the upgraded roadway would provide a safer, more reliable and shorter connection between the existing communities and resources in the Lillooet Valley and the Lower Mainland. It could also function as an alternative network route between the Pemberton Valley and the Lower Mainland. The proposed road upgrade would also make the Lillooet Lake, Lillooet River and Harrison Lake watersheds accessible for recreational use.

The objectives of this study were to:

- Develop a new cost estimate based on design criteria prescribed by the Ministry of Transportation.
- Disaggregate the cost estimate into discreet road sections.

3.0 Existing Conditions

The overall route is 160 km in length. The corridor was divided into eight logical sections. The four sections of the In-SHUCK-ch FSR, starting at the Duffy Lake Road, are:

- East side of Lillooet Lake to Tenas Bridge – Km. I-0 to I-29.5.
- Tenas Bridge to Skookumchuck settlement – Km. I -29.5 to I-51.
- Skookumchuck settlement to Lillooet River Bridge – Km. I-51 to I-76.5.
- Lillooet Bridge to north end of Harrison Lake– Km. I-76.5 to I-87.

The four sections of the Harrison West FSR four sections, starting at the south end of the Harrison West FSR, are:

- End of pavement 11 km north of Harrison Mills to a location where a number of different forestry roads meet – Km H-0 to H-23.
- Forestry roads intersection to Twenty Mile Bay access – Km H-23 to H-35.
- Twenty Mile Bay to Five Mile Bay access – Km H-35 to H-59.
- Five Mile Bay to north end of Harrison Lake – Km H-59 to H-73.

The alignment crosses 43 identifiable water courses. Ten of these are either box culverts or rock fords. The remainder are bridge structures of various types ranging from a 6 metre structure to a 45 metre structure across the Lillooet River. All existing structures are single lane and the current roadway width is between 3.5 and 5.0 metres.

The existing roadway was originally constructed to build the power line, service the logging industry, and connect communities along the length of the route. In certain locations, the roadway is within the hydro corridor.

The terrain along the route can be classified as one of five types:

1. Rough mountainous.
2. Mountainous.
3. Rough glacial.
4. Smooth glacial.
5. Level valley bottom.

These different terrains are described and shown on plans in Appendix 1. Each section of the route has been broken into parts by terrain type. The breakdown is listed by distance in a spreadsheet in Appendix 1. Appendix 2 contains plans and profiles of the corridor showing the different sections.

3.1 In-SHUCK-ch FSR (Lillooet Lake & Lillooet River)

Section 1 – East Side of Lillooet Lake – Km. I-0 to I-29.5

The first segment extends southward from Highway 99 along the east side of Lillooet Lake and then along a short section of the Lillooet River to the Tenas Bridge. The road was originally constructed to serve the logging industry and to provide access to the hydro line and access in and out of the Lillooet Valley for First Nations residents.

This segment has primarily mountainous terrain interspaced with glacial terrain ending with level terrain adjacent to the Lillooet River. The Tenas Bridge provides the first opportunity to access the west side of the Lillooet River and Lillooet Lake as well as the First Nations community of Skateen.

The existing roadway in Section 1, with a width of approximately 6 metres in most locations, has a poor surface structure with many potholes as well as boulders projecting through the surface. ***Exhibit 3.1*** is a good representation of the road surface condition along the complete corridor.

Exhibit 3.1

Sections 2 & 3 – East Side of Lillooet River Km I-29.5 to I-51 and Km I-51 to I-76.5

Section 2 extends along the east side of the Lillooet River from the Tenas Bridge to the Skookumchuck settlement (21.5 km) and Section 3 extends from Skookumchuck settlement to the Lillooet Bridge (24.6 km).

These two segments parallel the east bank of the Lillooet River on generally level terrain with pockets of glacial till. At a number of locations the adjacent mountainous terrain creates a bench adjacent to the Lillooet River. A number of First Nations communities as well as St. Agnes Well hotsprings and Skookumchuck hotsprings are located along these sections.

Section 4 – West side of Lillooet River – Km. I-76.5 to I-86.7

Section 4 extends from the Lillooet River bridge along the west side of the Lillooet River to the north end of Harrison Lake. This 10 km section crosses a smooth glacial till area that is relatively flat, with one mountainous bench adjacent to the Lillooet Bridge.

3.2 Harrison West FSR

Sections 5, 6, 7, and 8 - West side of Harrison Lake

The four roadway sections along the west side of Harrison Lake are:

- End of pavement 11 km north of Harrison Mills to a location where a number of different forestry roads meet – Km H-0 to H-23.
- Forestry roads intersection to Twenty Mile Bay access – Km H-23 to H-35.
- Twenty Mile Bay to Five Mile Bay access – Km H-35 to H-59.
- Five Mile Bay to north end of Harrison Lake – Km H-59 to H-73.

These sections are approximately 74 km in length. These segments of the road have a mix of rugged mountainous and rugged glacial terrain.

Exhibit 3.2

The Harrison West FSR connects a number of subsidiary forestry roads. The roadway surface width is between 3 and 6 metres. There are pullouts located along the route for passing oncoming vehicles. Communications between regular users of the road is maintained by radio. Vehicles not equipped with radios have limited opportunity to find a pullout prior to meeting an oncoming vehicle.

Exhibit 3.3

Trees, rocks and other material is often very close to the edge of the road as shown on ***Exhibits 3.2 & 3.3***. Tree branches regularly hang over the edge of the road. These intrusions reduce the comfort level of the driver and reduce the effective drivable width.

The terrain adjacent to the route varies from high overhanging rock to relatively flat sloping terrain. Vertical rock diminishes the clear distance from the edge of the road, and as a result, reduces the comfort level and drivable width of the road. Steep unstable terrain has resulted in landslides that block part or all of the road as shown on ***Exhibit 3.4***.

Exhibit 3.4 - Landslide

The terrain is generally consistent along all four sections of this corridor.

Both the In-SHUCK-ch / Harrison West Forest Service Roads pass through rock slides as well as active and historic debris torrents. Rocks and other debris can be encountered on the road at these locations (see ***Exhibit 3.5***). Most of the larger structures have been located at an elevation so that debris torrent conditions within the channel do not threaten the structure. Small streams utilize culverts to handle the flow. Shifting or movement of the debris torrent channel has blocked culverts causing the road to wash out.

Exhibit 3.5 – Debris Torrent

4.0 Proposed Roadway

4.1 Design Criteria

The proposed roadway would be a recreational roadway designed to a low traffic volume standard not specifically matching any Provincial roadway classification. The following design criteria were specified by the Ministry of Transportation.

- Roadway Classification – No formal classification.
- Design Speed – 60 km/h (30 km/h with speed advisory where necessary in extreme terrain or to avoid structure costs).
- Basic Lanes – two lanes paved.
- Maximum Grade – 12%.
- Lane Width – 3.5 metres.
- Modified Paved Shoulder Width – 0.5 metres.
- Gravel Shoulder Width – 0.5 metres.
- Clear Zone and Recovery Slope – none.
- Rock Catchment Width – 1.25 metres.
- Bridges – primarily single lane.

Lane widths of 3.5 metres are consistent with TAC standards for a two-lane rural collector roadway classification.

The modified paved shoulder width of 0.5 metres is below the TAC standard of 1.56 metres for a rural collector roadway and below the 1.0 metre standard for rural local roadways. The 1.0 metre composite shoulder width was used for this basic access road.

5.0 Social Considerations

5.1 First Nations

There are seven First Nation communities within the Lillooet Valley. Residents are sometimes stranded by washouts and poor road conditions. Currently, all supplies and emergency services come from Pemberton to these remote communities. These people have the highest need for an improved road facility. A paved low volume road would:

- Provide improved safety under all weather conditions.
- Reduce travel time and vehicle operating costs.
- Improve reliability.
- Promote business development and employment opportunities.

There are many anthropological and archeological sites along the corridor. A search of existing databases should be completed to determine which sites have been catalogued in the corridor. Impact assessments should be done prior to embarking on any short or long term improvements. It should be noted that local communities prefer not to publicize the locations of archaeological and heritage sites, only to identify and protect them.

5.2 Parks

There are no provincial parks located along this corridor. There are, however, a number of forestry campsites. These sites support amenities such as St. Agnes and Skookumchuck hotsprings and recreation activities such as fishing, hiking, and sightseeing.

5.3 Archaeological Sites

A number of archaeological sites have been identified along the route including remnants of the gold rush trail. There are at least seven areas with a combined length of approximately 9 km. where the existing road uses the historic trail.

There are a number of cemeteries located along the route (see ***Exhibit 5.1***).

Exhibit 5.1

Other archaeological values include culturally modified trees and painted rock faces. The locations of known archaeological sites are indicated in the maps in ***Appendix 2.*** A complete inventory of culturally modified trees and pictographs is not available at this time. Further study will be required to determine the impacts to any trees and rocks with heritage value and to establish appropriate mitigation plans.

6.0 Environmental Considerations

The proposed alignment is generally located on the mountain slopes adjacent to the Lillooet Lake, Lillooet River and Harrison Lake. Roads in such topography typically are exposed to such natural hazards as:

- Snow avalanches.
- Land slides.
- Rock falls.
- Debris torrents and washouts.
- Floods.

Waterway Impact

A recent concern in road construction is the leaching of acid from freshly excavated rock faces. Leachate entering waterways may affect fish. A comprehensive geotechnical survey would be required prior to preliminary design to identify zones where acid-leaching rock is likely to pose a problem. A strategy should be developed to either use the material in embankments or to dispose of the material in stockpiles with appropriate neutralization blankets.

Fish Impact

The existing gravel access road crosses many tributary streams. Many of these streams are fish-bearing and offer ideal fish-rearing habitat. A fish inventory and assessment should be completed as part of the field work leading up to the preliminary design. Culverts at fish-bearing streams should be designed to allow for the passage of fish.

7.0 Cost Estimate

Costs have been calculated using five terrain types described in Appendix 1. The designation of sections of the corridor by the terrain types was based on field reconnaissance and topographical mapping.

This cost estimate was prepared using the Ministry of Transportation's elemental parametric highway cost estimating method. This method includes all major items of construction such as site preparation, earthworks, rock slope stabilization, gravelling, paving, drainage, bridge and retaining wall structures, and utility relocations. The sizes of bridge structures and retaining walls were estimated using bridge inspection information and cross-section details from earlier studies.

This cost estimate also includes amounts for environmental mitigation, archaeological investigation and mitigation, and property acquisition as well as preliminary and detailed design, project management and construction supervision.

The 1999 study of this corridor was based on the assumption that any of the existing single-lane bridges in good condition would not be replaced. This study assumed that eight bridges would be replaced, one in each section. Utilization of the existing bridges will compromise horizontal and vertical geometry at some of the bridge approaches.

The following approach will provide a cost-effective roadway:

Road Structure

- 150mm granular sub base layer in areas of rock excavation, 300mm in glacial terrain and 450mm in valley bottoms (reflects an effective allocation of granular materials for a low volume road with a low volume of heavy vehicles).
- 150mm of crushed base gravel.
- 75mm asphalt pavement.

Road Rehabilitation

- Replace only the most deficient bridges (one per section).
- No smooth wall blasting or rock slope stabilization as rock is strong and massive (lower capital cost will result in higher maintenance costs).

Other Considerations

- Alliance delivery model recommended with lower engineering, project management and construction supervision costs. Basic quality control.
- Relocate only one high voltage tower at a cost of $300,000 (Section 1).

This approach will provide a cost-effective facility for a low volume of traffic. Higher maintenance costs will be incurred. However, some future maintenance funds can be applied to areas where further improvements are most needed.

7.1 Right-of-Way Costs

The majority of the corridor is Crown Land. There are a number of private land holdings at the northern end of the project just south of Duffy Lake Road. Some acquisition of private property may be required.

The alignment passes through seven First Nations reserves in Sections 2 and 3. Some acquisition of right-of-way may be required.

7.2 Utility Costs

A BC Hydro high-voltage transmission line shares the corridor with the proposed roadway.

Based on discussions with BC Hydro officials, relocation of each hydro transmission tower is estimated to cost approximately $300,000. While the proposed 60 km/h design speed affords some flexibility in alignment, there are areas where towers will compromise the alignment.

It is anticipated that one tower may require relocation at the north end of the project where the road and the towers would share a narrow bench area through difficult terrain adjacent to Lillooet Lake.

7.3 Environmental/Archaeological Mitigation

Formal environmental and archaeological assessments of the corridor have not been carried out. However, there are known archaeological sites. There is at least one site in Section 1, six sites in Sections 2 and 3, and two sites along Section 4. The gold rush trail is encountered seven times for a total length of about 9.9 km along Section 2 & 3.

Costs for studies and mitigation have been based on known environmental and archaeological evidence along the corridor.

7.4 Detailed Cost Estimate

The following table provides a summary of the cost estimate prepared using the “Elemental Parametric Method”. More detailed itemized section-by-section cost breakdowns are included in Appendix 3.

In-SHUCK-ch FSR				
Section	**Road Construction**	**Structures**	**Engineering Project Mgmt.**	**Construction Cost**
1	$27.1 M	$4.7 M	$5.2 M	$37.0 M
2	$20.7 M	$1.7 M	$3.8 M	$26.2 M
3	$29.6 M	$5.1 M	$5.0 M	$39.7 M
4	$12.1 M	$1.2 M	$2.0 M	$15.3 M
Subtotals	$89.5 M	$12.7 M	$16.0 M	$118.2 M
Harrison West FSR				
5	$30.8 M	$12.7 M	$5.6 M	$49.1 M
6	$17.7 M	$6.5 M	$3.0 M	$27.2 M
7	$35.2 M	$8.8 M	$5.7 M	$49.7 M
8	$21.4 M	$6.0 M	$3.4 M	$30.8 M
Subtotals	$105.1 M	$34.0 M	$17.7 M	$156.8 M
Land				$0.4 M
TOTAL	**$194.6 M**	**$46.7 M**	**$33.7 M**	**$275.4 M**

The additional cost of replacing all existing single-lane structures with two-lane structures is estimated to be $15.0 M. No additional retaining wall are included in this estimate.

The unit prices used for this cost estimate are based on similar types of highway construction projects in the southwestern part of the province. A general contingency allowance of 20% has been included.

The cost estimate is in 2003 dollars. This cost estimate should be adjusted to include escalation between 2003 and the anticipated construction year. The actual construction cost may be affected by the volume of concurrent road construction activity underway at the time of contract tendering.

The 2003 cost estimate exceeds the 1999 estimate by $75.4 M. The 1999 cost estimate was based on a lesser design standard and only reflected construction costs. It did not include the costs associated with the replacement of eight bridges, property acquisition, engineering and project management.

The two cost estimates are reconciled as follows:

1999 Cost Estimate	**$200.0 M**
Land	$0.4 M
Environmental	$3.5 M
Archaeological	$4.5 M
Structures (including retaining walls)	$22.6 M
Construction Supervision	$10.7 M
Engineering / Project Management	$33.7 M
2003 Cost Estimate	**$275.4 M**

7.5 Maintenance Costs

Annual maintenance costs for this type of roadway will vary along the length of the route due to the changing conditions. The annual maintenance cost of a two-lane roadway would vary between $11,000/km for flatter areas to $16,000/km for more mountainous areas.

Based on a blended cost of approximately $15,000/km/year for the 160 km road, the annual maintenance cost is expected to be about $2.4 million.

7.6 Traffic Disruption/Traffic Management Cost

Non-forestry traffic is minimal. Since there are no detour routes, good communications with local residents will be required during construction in order to avoid excessive delays. As the majority of local residents drive 4x4 pickups and SUVs, they will be able to drive through rough construction sites with traffic control.

APPENDIX 1

TERRAIN TYPES

The terrain along the Harrison Mills to Mount Currie corridor can be characterized into five types:

- rough mountainous,
- mountainous,
- rough glacial,
- smooth glacial, and
- level valley bottom.

These terrain types are described below and illustrated graphically in a series of diagrams following the text. The corridor has been divided into short pieces by terrain type. The pieces are listed in a spreadsheet at the end of this Appendix. The pieces are shown as coloured line segments on the conceptual alignment plans in Appendix 2.

Rough Mountainous Terrain

- side slopes on one or both sides with rock cuts or future rock cuts between 5 and 10m
- can contain grades in excess of 10% necessitating switchbacks
- poor horizontal and vertical alignment associated with a design speed of 20 – 40 km/h

Mountainous Terrain

- rock side slopes on one or both sides of approximately 5 m or less
- grades usually less than 10%
- fewer switchbacks
- horizontal and vertical alignment associated with a design speed of approximately 30 – 50 km/h

Rough Glacial Terrain

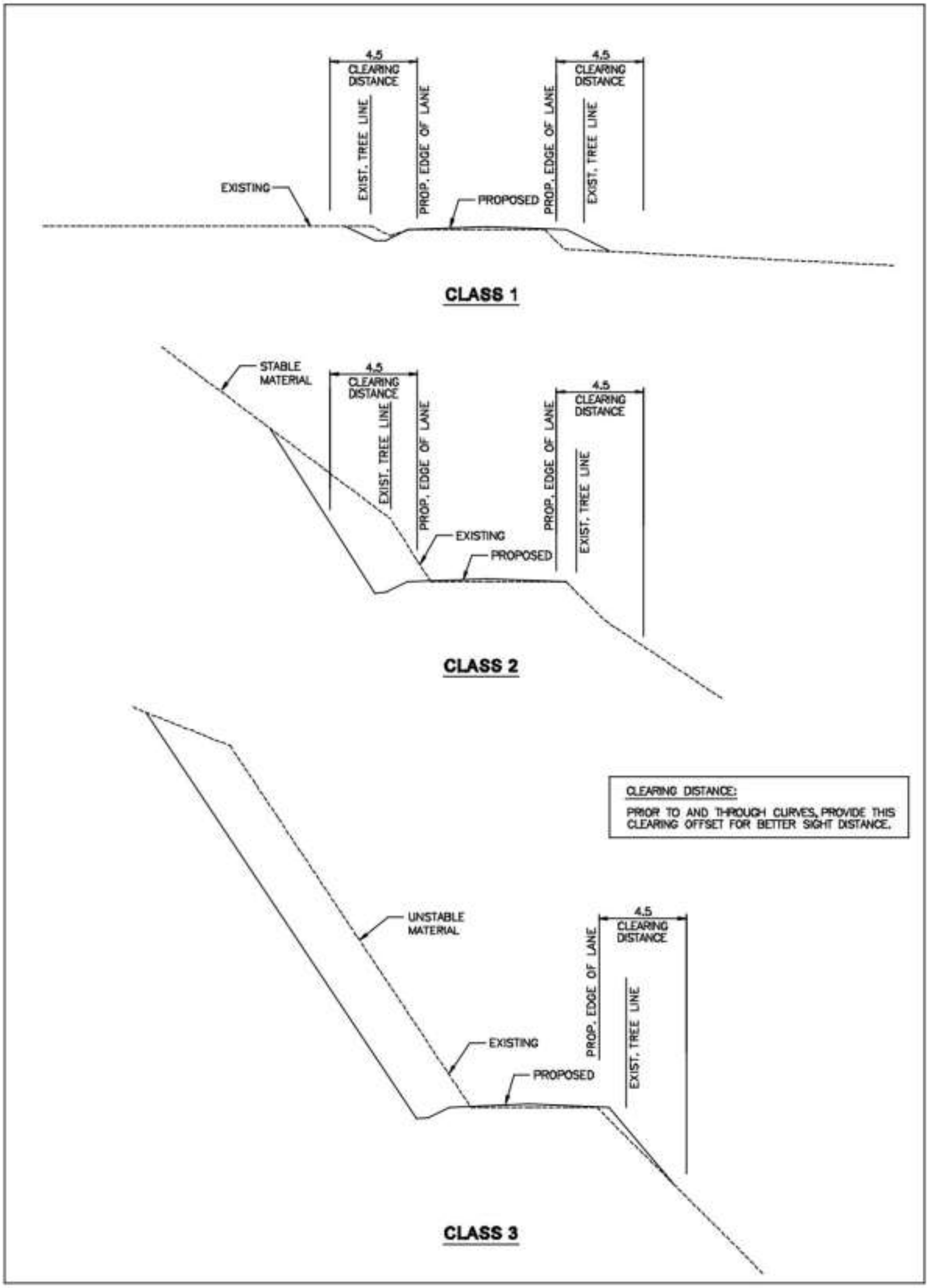
- high side slopes with slopes of approximately 1.5:1
- granular material with cobble rock mixed in
- steep drop-off; on one side
- switchback in certain locations
- some grades in excess of 10%
- horizontal and vertical alignment associated with a design speed of between 20 – 50 km/h

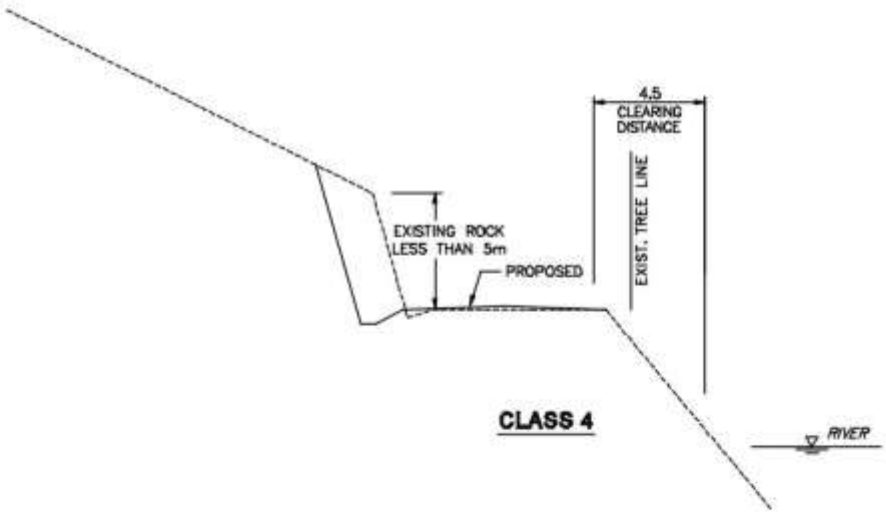
Smooth Glacial Terrain

- back slopes less than 2 m high
- material in back slope is glacial granular till with cobble
- no switchbacks
- horizontal and vertical alignment associated with a design speed of 40 – 70 km/h

Level Terrain

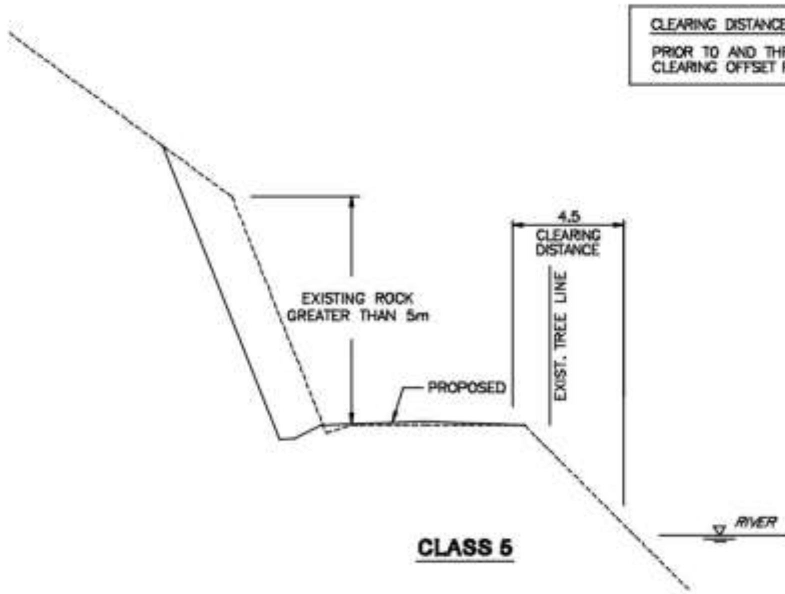
- terrain is flat usually with trees on each side
- roadway subgrade is soft due to poor drainage
- subgrade material contains more fines (silt)
- horizontal and vertical alignment will not pose any constraint for improvements


4.5
CLEARING DISTANCE
EXIST. TREE LINE
PROP. EDGE OF LANE
EXISTING
PROPOSED
CLASS 1
STABLE MATERIAL
CLASS 2
CLEARING DISTANCE:
PRIOR TO AND THROUGH CURVES, PROVIDE THIS CLEARING OFFSET FOR BETTER SIGHT DISTANCE.
UNSTABLE MATERIAL
CLASS 3



CLASS 4

CLEARING DISTANCE:
PRIOR TO AND THROUGH CURVES, PROVIDE THIS CLEARING OFFSET FOR BETTER SIGHT DISTANCE.



CLASS 5

Table of Sections & Terrain Types

IN-SHUCK-CH FSR							
		ROADWAY TYPE					
SECTION	**STA TO STA**	**Rock 5-10**	**Rock 0-5**	**G.T. Rough**	**G.T. Smooth**	**Flat Valley Bottom**	**HV Towers**
	Class	**5**	**4**	**3**	**2**	**1**	
1	0-0.5			0.5			1.0
	0.5-1.5		1.0				
	1.5-4.5				3.0		
	4.5-8.0		3.5				
	8.0-10.5			2.5			
	10.5-12.0		1.5				
	12.0-13.0			1.0			
	13.0-14.5		1.5				
	14.5-16.5				2.0		
	16.5-18.5		2.0				
	18.5-21.5				3.0		
	21.5-22.0		0.5				
	22.0-23.5			1.5			
	23.5-24.0		0.5				
	24.0-29.5					5.5	
2	29.5-37.0					7.0	
	37.0-38.0	1.0					
	38.0-39.5			1.5			
	39.5-40.5	1.0					
	40.5-44.0					3.5	
	44.0-50.0						
	50.0-51.0		0.5		1.0	5.5	
3	50.0-57.0				7.0		
	57.0-62.0					5.0	
	62.0-68.0			6.0			
	68.0-69.0	1.0					
	69.0-74.0				5.0		
	74.0-74.5		0.5				
	74.5-76.5				2.0		
4	76.5-77.0	0.5					
	77.0-87				10.0		
Harrison West FSR							
5	0-4			4.0			
	4-7	3.0					
	7-9	2.0					
	9-16			7.0			
	16-18	2.0					
	18-23			5.0			
6	23-26			3.0			
	26-31	5.0					
	31-35			4.0			
7	35-42			7.0			
	42-46	4.0					
	46-50			4.0			
	50-59	9.0					
8	59-62	3.0					
	62-66			4.0			
	66-73	6.0					
		37.5	11.5	40.0	33.0	27.0	1