Visualization to meet Visual Quality Effectiveness Obligations in British Columbia

for

Visualization Tools Forum

Portland Oregon, April 19, 2017

Ken B. Fairhurst, PhD, RPF

Co-Founder and Head, RDI Resource Design Inc, Vancouver Canada

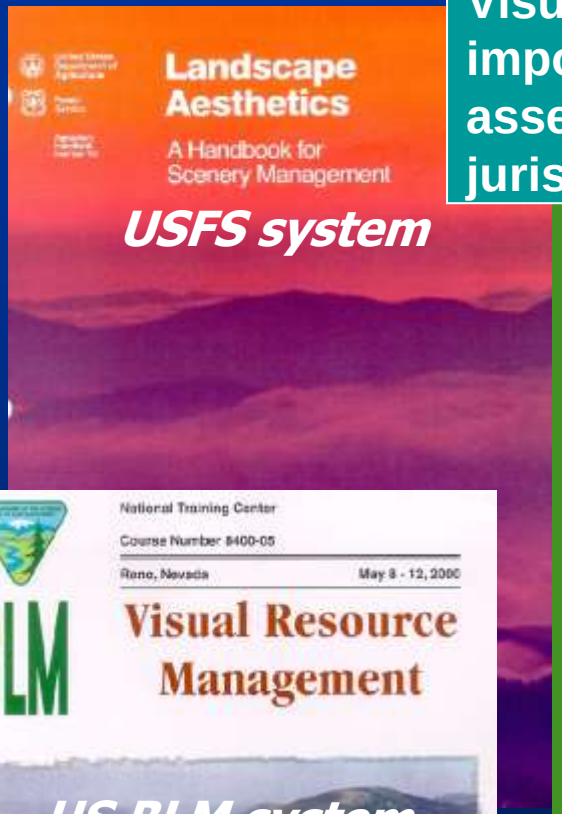
and

Adjunct Professor, Forest Resources Management

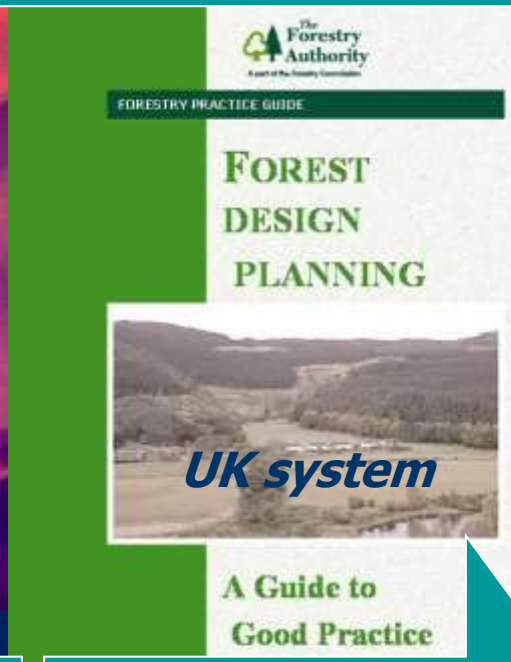
Faculty of Forestry, the University of British Columbia, Vancouver

Linkages between VRM Systems

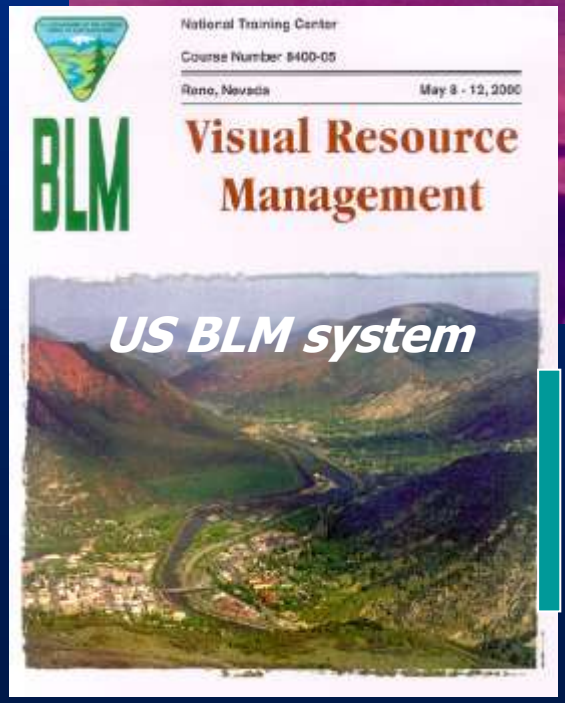
Visual risk assessment and planning procedures are important components of major expert visual assessment processes in British Columbia and other jurisdictions:



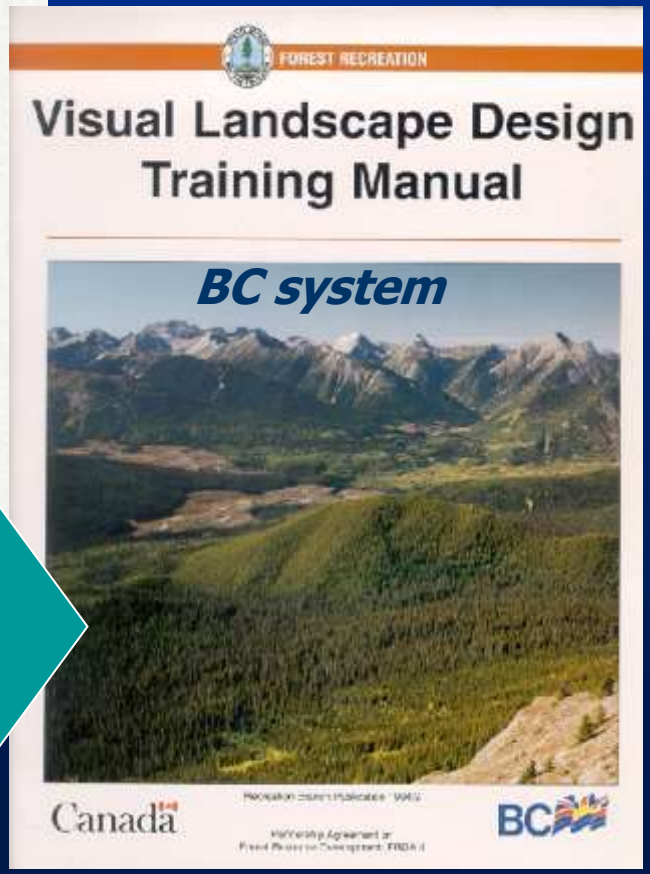
USFS system



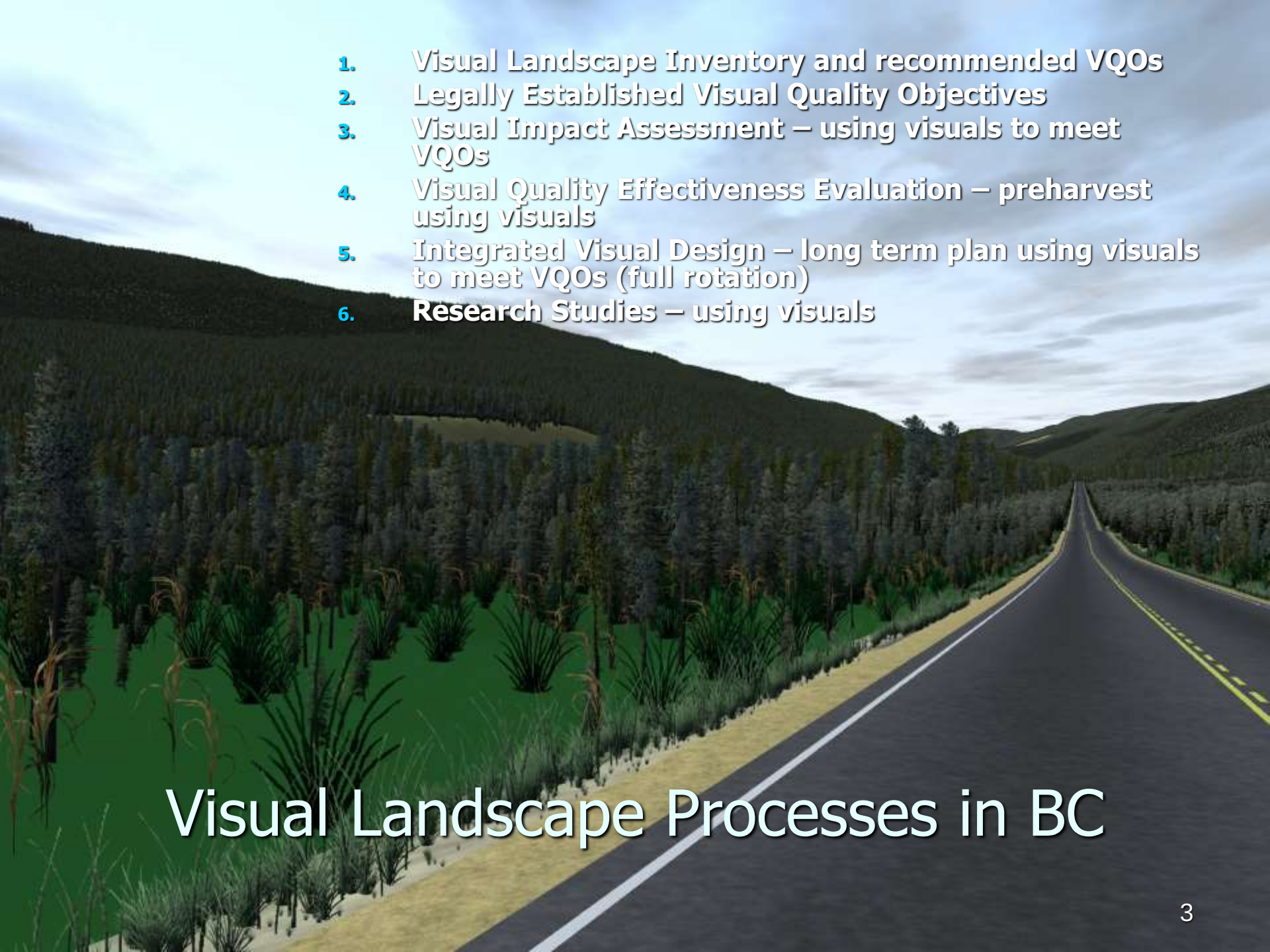
UK system



US BLM system



BC system



1. Visual Landscape Inventory and recommended VQOs
2. Legally Established Visual Quality Objectives
3. Visual Impact Assessment – using visuals to meet VQOs
4. Visual Quality Effectiveness Evaluation – preharvest using visuals
5. Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)
6. Research Studies – using visuals

Visual Landscape Processes in BC

1. Visual Landscape Inventory and recommended VQOs
2. Legally Established Visual Quality Objectives
3. Visual Impact Assessment – using visuals to meet VQOs
4. Visual Quality Effectiveness Evaluation – preharvest using visuals
5. Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)
6. Research Studies – using visuals

1. Visual Landscape Inventory

(1) Visual Landscape Inventory
and
(2) Established Visual Quality Objectives

British Columbia Land Mass:
950,000 sq. km / 360, 000 sq. mi.
(Alaska only US state larger)

Provincial Forest: 94%

Arable Land: 5%

Parks and other Protected Areas: 12%

Area with VQO's: 12,800 sq. km. (14% of land mass) from highways, waterways

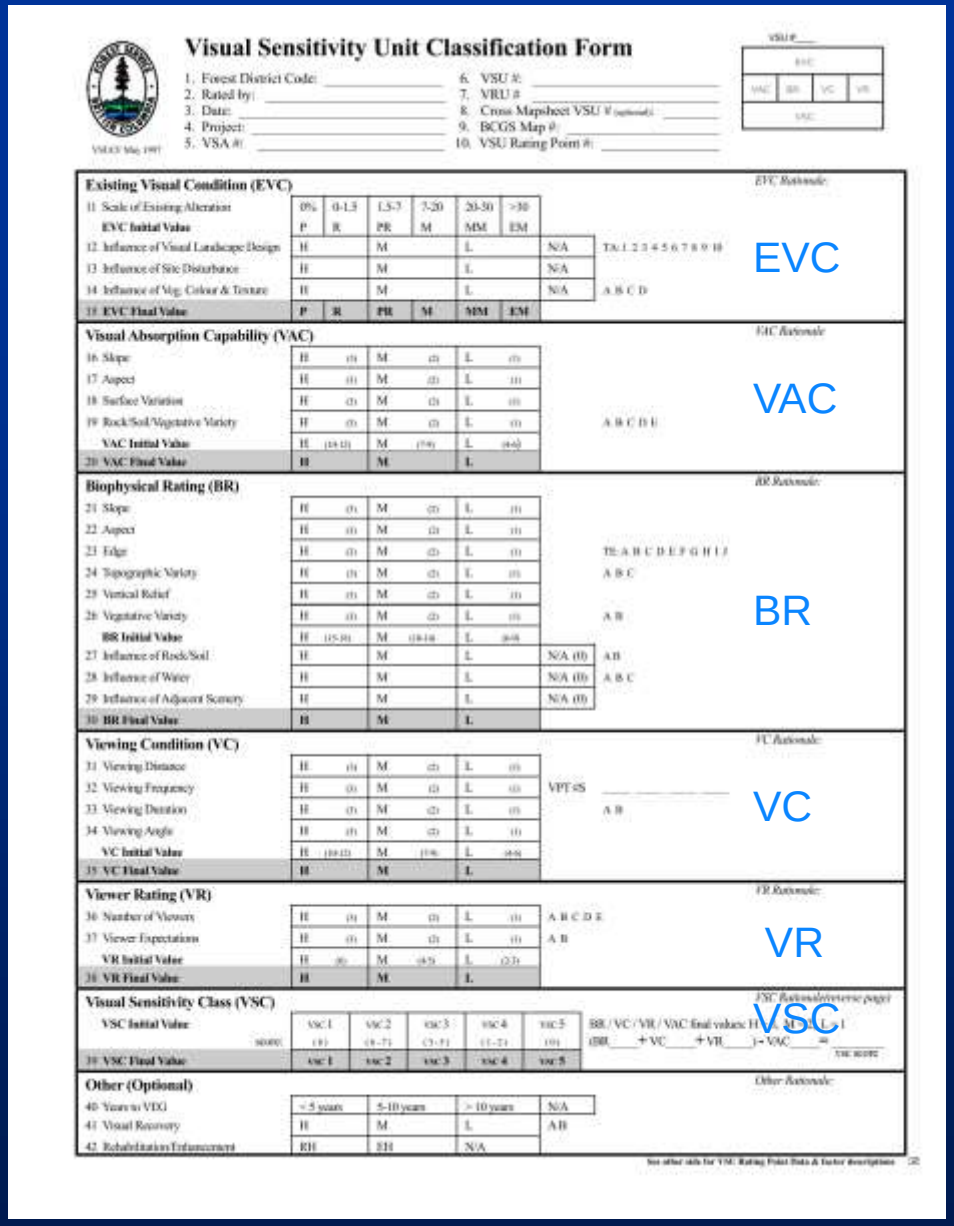
Allowable Annual Cut:
71.6 million cubic metres (30 mfbm)

Conversions:
1 sq. km. = 0.4 sq. mi.
1 sq. km. – 100 hectares
1 ha = 2.5 ac.
1 ac = 0.4 ha

1 mfbm = 2.36 cubic metres

(Values rounded)

Green and orange areas have VLI with VQOs



Visual Sensitivity Unit Classification Form

1. Forest District Code:
2. Rated by:
3. Date:
4. Project:
5. VSA #:
6. VSU #:
7. VRU #
8. Cross Mapsheet VSU #
9. BCGS Map #:
10. VSU Rating Point #:

VSU #
EVC
VAC | BR | VC | VR
VSC

Existing Visual Condition (EVC)

EVC Rationale:

11 Scale of Existing Alteration	0%	0-1.5	1.5-7	7-20	20-30	>30	
EVC Initial Value	P	R	PR	M	MM	EM	
12 Influence of Visual Landscape Design	H		M		L		N/A
13 Influence of Site Disturbance	H		M		L		N/A
14 Influence of Veg. Colour & Texture	H		M		L		N/A
15 EVC Final Value	P	R	PR	M	MM	EM	

TA: 1 2 3 4 5 6 7 8 9 10

A B C D

EVC

Visual Absorption Capability (VAC)

VAC Rationale:

16 Slope	H	(3)	M	(2)	L	(1)	
17 Aspect	H	(1)	M	(2)	L	(3)	
18 Surface Variation	H	(3)	M	(2)	L	(1)	
19 Rock/Soil/Vegetative Variety	H	(3)	M	(2)	L	(1)	
VAC Initial Value	H	(10-12)	M	(7-9)	L	(4-6)	
20 VAC Final Value	H		M		L		

A B C D E

VAC

Biophysical Rating (BR)

BR Rationale:

21 Slope	H	(3)	M	(2)	L	(1)	
22 Aspect	H	(1)	M	(2)	L	(3)	
23 Edge	H	(3)	M	(2)	L	(1)	
24 Topographic Variety	H	(3)	M	(2)	L	(1)	
25 Vertical Relief	H	(3)	M	(2)	L	(1)	
26 Vegetative Variety	H	(3)	M	(2)	L	(1)	
BR Initial Value	H	(15-18)	M	(10-14)	L	(6-9)	
27 Influence of Rock/Soil	H		M		L		N/A (0)
28 Influence of Water	H		M		L		N/A (0)
29 Influence of Adjacent Scenery	H		M		L		N/A (0)
30 BR Final Value	H		M		L		

TE: A B C D E F G H I J

A B C

A B

A B

A B C

BR

Viewing Condition (VC)

VC Rationale:

31 Viewing Distance	H	(3)	M	(2)	L	(1)	
32 Viewing Frequency	H	(3)	M	(2)	L	(1)	
33 Viewing Duration	H	(3)	M	(2)	L	(1)	
34 Viewing Angle	H	(3)	M	(2)	L	(1)	
VC Initial Value	H	(10-12)	M	(7-9)	L	(4-6)	
35 VC Final Value	H		M		L		

VPT #S

A B

VC

Viewer Rating (VR)

VR Rationale:

36 Number of Viewers	H	(3)	M	(2)	L	(1)	
37 Viewer Expectations	H	(3)	M	(2)	L	(1)	
VR Initial Value	H	(6)	M	(4-5)	L	(2-3)	
38 VR Final Value	H		M		L		

A B C D E

A B

VR

Visual Sensitivity Class (VSC)

VSC Rationale/reverse page

VSC Initial Value	VSC 1 (5)	VSC 2 (4-3.5)	VSC 3 (3-2.5)	VSC 4 (2-1.5)	VSC 5 (1)
39 VSC Final Value	VSC 1	VSC 2	VSC 3	VSC 4	VSC 5

BR / VC / VR / VAC final values: H (BR____ + VC____ + VR____) - VAC____ = ____ VSC SCORE

VSC

Other (Optional)

Other Rationale:

40 Years to VEG	< 5 years	5-10 years	> 10 years	N/A
41 Visual Recovery	H	M	L	A B
42 Rehabilitation/Enhancement	RH	EH	N/A	

See other side for VSU Rating Point Data & factor descriptions

10. VSU Rating Point Data:	Print:	Slide:	Digital Image	Videocassette
VSU Rating Point Number				
10.1 Viewpoint Type: rating point (V0), major (V1); minor (V2); potential (V3)				
10.2 Elevation of the VSU Rating Point (meters)				
10.3 Latitude and Longitude (UTM) Coordinates (optional)				
10.4 BCGS Map Number of VSU Rating Point				
10.5 Compass Bearing (0-360 degrees)				
10.6 Vertical Viewing Angle (0-90 degrees ±)				
10.7 Roll Number (start-end frame number)	/ /	/ /	/ /	/ /
10.8 Focal Length of Lens (mm)				

EVC

11 Scale of Existing Alteration			
12 Influence of Vis. Landscape Design	H (greatest)	M (moderate)	L (least)
13 Influence of Site Disturbance	H (dominant)	M (moderate)	L (subordinate)
14 Influence of Veg. Colour & Texture	H (strong)	M (moderate)	L (weak)
15 Existing Visual Condition	P - R - PR - M - MM		

VAC

16 Slope	H (0 - 30%)	M (30 - 60%)	L (>60%)
17 Aspect	H (S/SW/SE)	M (E/W)	L (NW/N/NE)
18 Surface Variation	H (high)	M (moderate)	L (low)
19 Rock/Soil/Vegetative Variety	H (high)	M (moderate)	L (low)
20 Visual Absorption Capability	H (high)	M (moderate)	L (low)

BR

21 Slope	H (>60%)	M (30-60%m)	L (0 - 30%)
22 Aspect	H (SW/S/SE)	M (E/W)	L (NW/N/NE)
23 Edge	H (high)	M (moderate)	L (low)
24 Topographic Variety	H (high)	M (moderate)	L (low)
25 Vertical Relief	H (>300m)	M (200-300m)	L (<200m)
26 Vegetative Variety	H (high)	M (moderate)	L (low)
27 Influence of Rock/Soil	H (high)	M (moderate)	L (low)
28 Influence of Water	H (high)	M (moderate)	L (low)
29 Influence of Adjacent Scenery	H (high)	M (moderate)	L (low)
30 Biophysical Rating	H (high)	M (moderate)	L (low)

VC

31 Viewing Distance	H (0-1km)	M (1-3km)	L (3km +)
32 Viewing Frequency	H (< 3 veh)	M (3-4 veh)	L (>2 veh)
33 Viewing Duration	H (long)	M (moderate)	L (short)
34 Viewing Angle	H (focal)	M (tangent)	L (peripheral)
35 Viewing Condition	H (high)	M (moderate)	L (low)

VR

36 Number of Viewers	H (high)	M (moderate)	L (low)
37 Viewer Expectations	H (high)	M (moderate)	L (low)
38 Viewer Rating	H (high)	M (moderate)	L (low)

VSC

VSC Initial Rating	VAC, BR, VC, VR: H=3 M=2 L=1
39 Visual Sensitivity	1 2 3 4 5

Other (Optional)

40 Years to VEG	< 5 yrs	5-10 yrs	> 10yrs
41 Visual Recovery	H (mod. rdm)	M (mod. rdm)	L (Low rdm)
42 RH/EH/NA	Rehabilitation	Enhancement	N/A

Further Notes

1. Visual Landscape Inventory

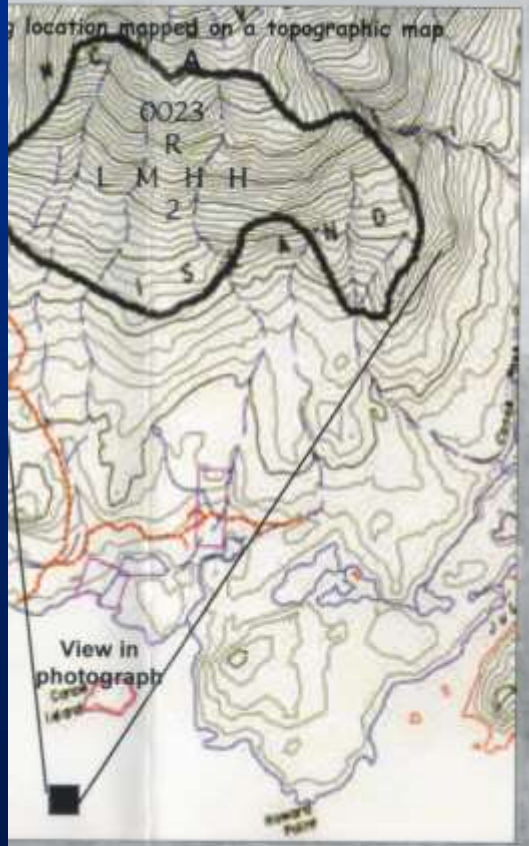
Landform in Perspective View

Interpreting Inventory Symbols

The notation or code on the map contains abbreviated information describing each unit. Units are delineated based on landforms and what is visible from different viewpoints. Each letter describes a characteristic of the unit and the final number ranks the sensitivity of the unit to alteration.

Extremely important to viewers
Very sensitive to alterations

Somewhat important to viewers
Low sensitivity to alterations



Existing visual condition (EVC):
identifies the existing level of human-made alteration on the landscapes at the time the inventory is conducted. The scale is preservation, retention, partial retention, modification, maximum modification and excessive modification. Unaltered landscapes are rated as preserved.

Visual absorption capaiblity (VAC):
rates the relative capacity of a landscape to absorb human-made alterations and still maintain its visual integrity. The scale is high, medium and low. The higher the rating the greater the ability to absorb alteration.

Biophysical rating (BR):
identifies the degree of visual interest in the landscape and rates the level that it would attract viewer attention. The scale is high, medium and low. The higher the attraction, the more sensitive the landscape.

Viewing condition (VC):
records the conditions under which the landscape is viewed such as viewing duration and number of viewpoints. The scale is high, medium and low. The higher the rating the more you see the landscape and the more sensitive it is.

Viewer rating (VR):
measures the number of people and their expectations for visual quality. Ratings are high, medium and low. The higher the rating, the more people view the landscape and/or are more concerned.

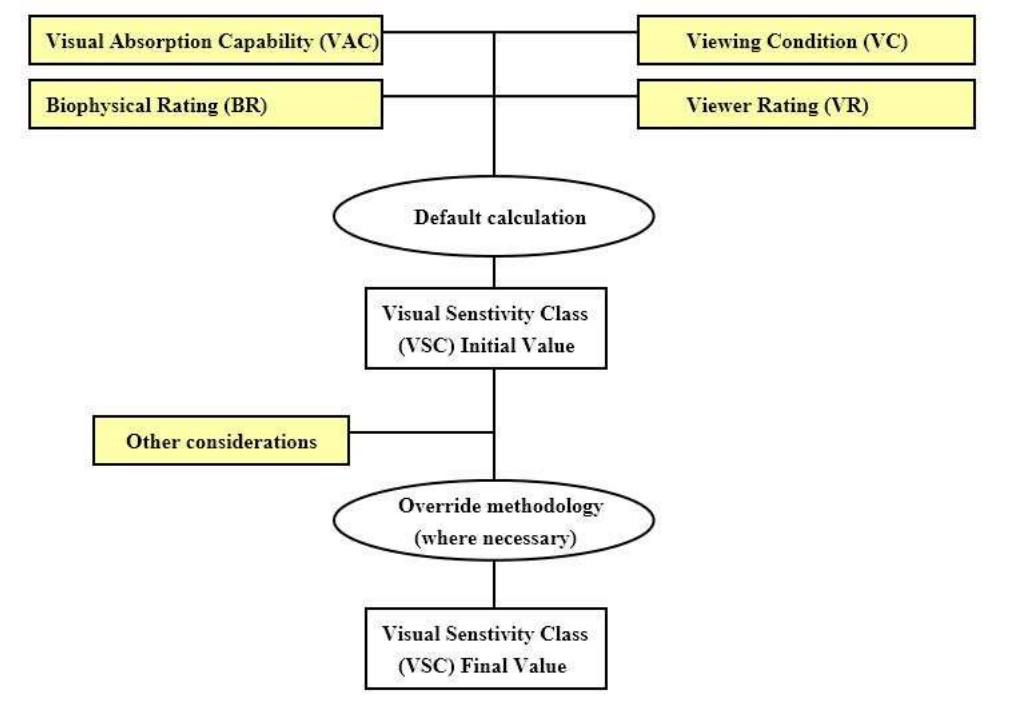
Visual sensitivity class (VSC):
rates the sensitivity of the landscape to visual alteration based on biophysical and viewing characteristics listed above. The rating scale is 1 to 5. Class 1 is extremely sensitive to alteration and class 5 has low sensitivity to alteration.

The photographs to the right show representative landscapes and their corresponding VSC.

Visual Landscape Inventory Brochure
Source: Ministry of Forests, Lands, and Natural Resource Operations (FLNRO)

Visual Landscape Inventory Terminology Review

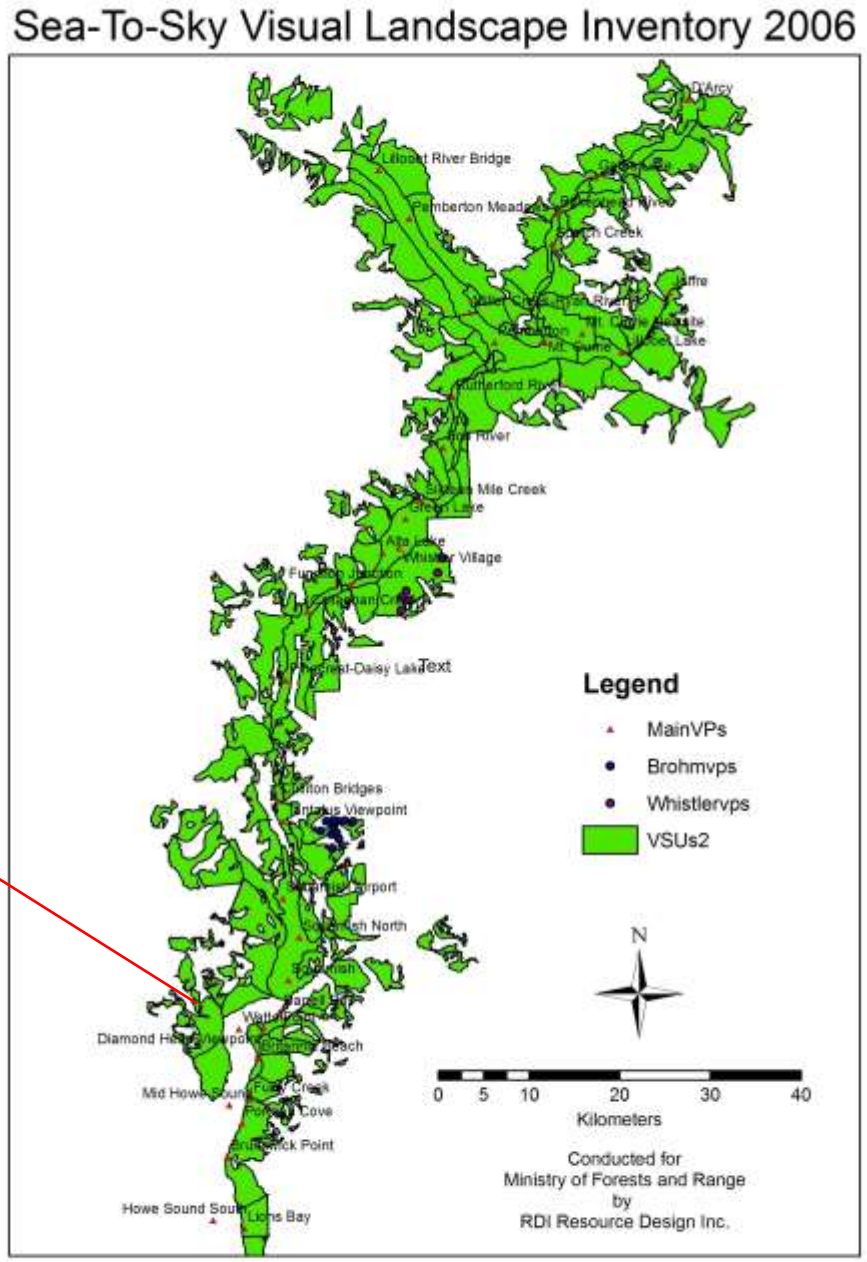
BR = Biophysical Rating
EVC = Existing Visual Condition
VAC = Visual Absorption Capability
VC = Viewing Condition
VQO = Visual Quality Objective
VR = Viewing Rating
VSC = Visual Sensitivity Class
VSR = Visual Sensitivity Rating



Visual Absorption Capability (VAC)

VAC is the ability of a particular landscape unit to accept visual alteration or resist visual impacts, the opposite of visual vulnerability

VAC is determined during BCMOFR's visual landscape inventory process, applied to large Visual Sensitivity Units as a 3-class rating: (High-Moderate-Low).



1. Visual Landscape Inventory and recommended VQOs
2. **Legally Established Visual Quality Objectives**
3. Visual Impact Assessment – using visuals to meet VQOs
4. Visual Quality Effectiveness Evaluation – preharvest using visuals
5. Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)
6. Research Studies – using visuals

2.Visual Landscape Analysis - eVQOs

Visual Quality - Categories of Alteration

Visual Quality Objectives are defined in Section 1.1 of the Forest Planning and Practices Regulation. Visual Quality research shows that percent alteration for clear cuts and volume/stems per hectare for partial cuts are also good predictors of visual quality if applied correctly.

Preservation: very small in scale, and not easily distinguishable from the pre-harvest landscape.

0% ground may be visible.

Retention: is difficult to see, small in scale, and natural in appearance

0 -1.5% ground may be visible.

Partial Retention: easy to see, small to medium in scale, and natural and not rectilinear or geometric in shape.

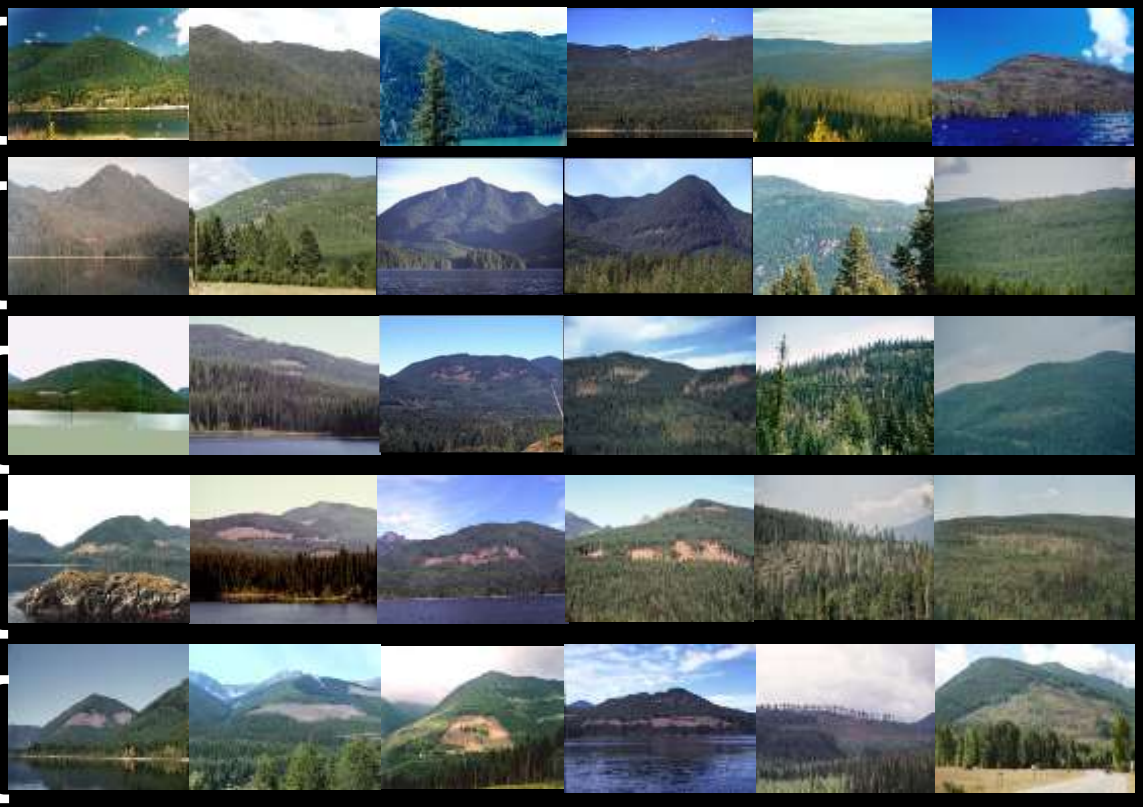
1.6 – 7% ground may be visible.

Modification: is very easy to see, and is A) large in scale and natural in its appearance, or B) small to medium in scale but with some angular characteristics.

7.1-18% ground may be visible.

Maximum Modification: is very easy to see, and is (A) very large in scale, (B) rectilinear and geometric in shape, or (C) both

18.1-30% ground may be visible.



Percent Alteration Per VQO

Preservation	0
Retention	0 - 1.5
Partial Retention	1.6 - 7.0
Modification	7.1 - 18.0
Max Modification	18.1 - 30.0

Note: % Alteration numbers must be applied to a readily distinguishable landform. They were not derived for application against entire landscapes.

Note: The Partial Cutting table may be applied across the landscape as this measure is landform Independent.

Categories of Alteration Review

	Percent Alteration of Landform (not in Act or Regulations)
Preservation: very small in scale, and not easily distinguishable from the pre-harvest landscape.	0% ground may be visible.
Retention: is difficult to see, small in scale, and natural in appearance	0 -1.5% ground may be visible.
Partial Retention: easy to see, small to medium in scale, and natural and not rectilinear or geometric in shape.	1.6 – 7% ground may be visible.
Modification: is very easy to see, and is A) large in scale and natural in its appearance, or B) small to medium in scale but with some angular characteristics.	7.1-18% ground may be visible.
Maximum Modification: is very easy to see, and is (A) very large in scale, (B) rectilinear and geometric in shape, or (C) both	18.1-30% ground may be visible.

Quite similar to BLM VRM Classes 1-5 and USDA Forest Service VMS VQOs
Except the BC method provides the numerical measure of percent alteration of the landform)

Some Legalise requiring the setting and meeting of Visual Quality Objectives (Categories of Altered Forest):

A. Forest and Range Practices Act (FRPA) - Scenic Areas and VQOs
B. Government Action Regulation (GAR) - Scenic Areas, and VQOs consistent with:
C. Categories of Altered Forest prescribed in the Forest Planning and Practices Regulation (FPPR).

(See next 2 slides)

Legal Establishment and Obligations

Scenic Areas and Visual Quality Objectives are Authorized under Sec. 150.3 (1) of the Forest and Range Practices Act (FRPA) and Sec. 7 (1) and (2) of the Government Actions Regulation (GAR)

FRPA

Scenic areas and visual quality objectives

150.3 (1) The Lieutenant Governor in Council may make regulations

(a) authorizing the minister responsible for the *Land Act* to designate an area of land as a scenic area,

(b) authorizing the minister to establish visual quality objectives in relation to a scenic area,

(c) prescribing the circumstances in which the discretion conferred in the authorization may be exercised, and

(d) respecting scenic areas.

(2) The minister may not specify an objective referred to in subsection (1) (b) for an area unless the objective is consistent with the objectives set by government that pertain to the area.

GAR

Scenic areas and visual quality objectives

7 (1) The minister responsible for the *Land Act* by order may establish an area as a scenic area if satisfied that the area

(a) is visually important based on its physical characteristics and public use, and

(b) requires special management that has not otherwise been provided for by this regulation or another enactment.

(2) The minister responsible for the *Forest Act* by order may establish for a scenic area visual quality objectives that are consistent with subsection (1) and are within the categories of altered forest landscape prescribed under section 1.1 of the Forest Planning and Practices Regulation.

http://www.bclaws.ca/civix/document/id/complete/statreg/582_2004#section7

Forest Planning and Practices Regulation (FPPR)

Objectives set by government for visual quality

9.2 (1) In this section:

"scenic area" means an area of land established as a scenic area under the *Forest Practices Code of British Columbia Act* on or before October 24, 2002 and continued as a scenic area under section 180 (c) of the Act;

"visual sensitivity class" means a visual sensitivity class established on or before October 24, 2002, particulars of which are publicly available in the Land and Resource Data Warehouse maintained by the minister responsible for the *Land Act*.

(2) The objective set by government in relation to visual quality for a scenic area, that

(a) was established on or before October 24, 2002, and

(b) for which there is no visual quality objective

is to ensure that the altered forest landscape for the scenic area

(c) in visual sensitivity class 1 is in either the preservation or retention category,

(d) in visual sensitivity class 2 is in either the retention or partial retention category,

(e) in visual sensitivity class 3 is in either the partial retention or modification category,

(f) in visual sensitivity class 4 is in either the partial retention or modification category, and

(g) in visual sensitivity class 5 is in either the modification or maximum modification category.

[en. B.C. Reg. 580/2004, s. 9.]

http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/14_2004#section9.2

2. Visual Landscape Analysis

Following the inventory, Visual Sensitivity Class is used to derive a recommended Visual Quality Class (rVQC)

VSC1: preservation or retention
VSC2: retention or partial retention
VSC3: partial retention or modification
VSC4: partial retention or modification
VSC5: modification or maximum modification.

Note:

The final Established VQO (eVQO) is derived in a higher level planning process or by the FLNRO District Manager

1. Visual Landscape Inventory and recommended VQOs
2. Legally Established Visual Quality Objectives
3. **Visual Impact Assessment – using visuals to meet VQOs**
4. Visual Quality Effectiveness Evaluation – preharvest using visuals
5. Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)
6. Research Studies – using visuals

3. Visual Impact Assessment

3. Visual Impact Assessment (VIA) Considerations:

Landform Determination
Existing Visual Condition
Visually Effective Green-up
Visual Design
- Visual Force Lines
- Natural Character
- Edge Treatment
- Avoid Straight Lines
- In-block Tree Retention
- Visible Roads

Existing Alteration with Poor Design
Design Techniques / Simulation
Percent Alteration Calculation
Usually Requires 3-d Visualization

Existing Alteration that exhibits Visually Effective Green-up (VEG) is exempt.

VEG is the condition of reforestation and regrowth when bare ground and stumps are no longer visible and the average viewer can see a regenerating forest.

1. ASSESSING BASIC VQO DEFINITION

Describe the level of impact that the proposed alteration, in combination with any existing non-VEG alterations, will have on the landscape from each viewpoint, using one of the following terms: ***Not visible, Not visually evident, Subordinate, Dominant, Out of scale***	**VPT #___**	**VPT #___**	**VPT #___**	**VPT #___**
Which basic VQO definition would the proposed alteration, in combination with any existing non-VEG alterations, meet from all the selected viewpoints and taking into account viewpoint importance, viewing distance and viewing duration? P ___ R ___ PR ___ M ___ MM ___				
If applicable, state reasons why the proposed alteration(s) does not achieve the basic definition of the established VQO from any of the selected viewpoints. _____ _____				

2. ASSESSING VISUAL DESIGN

Have major lines of force been identified and used to develop the size and shape of the proposed operation? (If Yes, attach visual force analysis to this form.)	Yes ___ No ___
Has the proposed operation borrowed from the natural character of the landscape?	Yes ___ No ___
Have edge treatments been incorporated into the design of the proposed operation (feathered edges, irregular cutblock design, etc.)?	Yes ___ No ___
Have "islands," or patches of trees, been maintained to mitigate visual impacts and other resource management objectives?	Yes ___ No ___
Are there any existing human-made alterations visible in the unit that exhibit poor design? If **Yes**, describe design deficiencies below: _____ _____	Yes ___ No ___
If applicable, list any additional design techniques used and/or state reasons why certain design techniques could not be employed. _____ _____	

3. ASSESSING NUMERICAL DATA

Complete either the clearcut or partial-cutting section below depending on the silviculture system used.

Percent Alteration Worksheet for Clearcutting

Use photograph or computer simulation output from each viewpoint for calculations. See Appendix 8 for example of calculation.	VPT #____	VPT #____	VPT #____	VPT #____
1. Total area of landform/VSU in perspective view as seen from each viewpoint (measured in cm^2)				
2. Visible ground area of *proposed* alteration(s) in perspective view as seen from each viewpoint (measured in cm^2)				
3. Visible ground area of all *existing* alterations in non-VEG state in perspective view as seen from each viewpoint (measured in cm^2)				
4. Total % alteration of the viewshed in perspective view as seen from each viewpoint [(#2+#3),#1]*100=#4				
Identify for each viewpoint which VQO will be achieved based on % alteration. See Table 3 in VIA Guidebook for % alteration guidelines.				
Which VQO would the proposed alteration, in combination with any existing non-VEG alterations, meet from all the selected viewpoints based on percent alteration only? P ___ R ___ PR ___ M ___ MM ___ or Other _____				

Partial-cutting Evaluation

What percent volume or stems retention is proposed?	%Volume Remaining	% Stems Remaining
Which VQO would the proposed alteration, in combination with any existing non-VEG alterations, meet from all the selected viewpoints based on volume or stems remaining? See Table 4 in VIA Guidebook for partial-cutting guidelines. P ___ R ___ PR ___ M ___ MM ___		

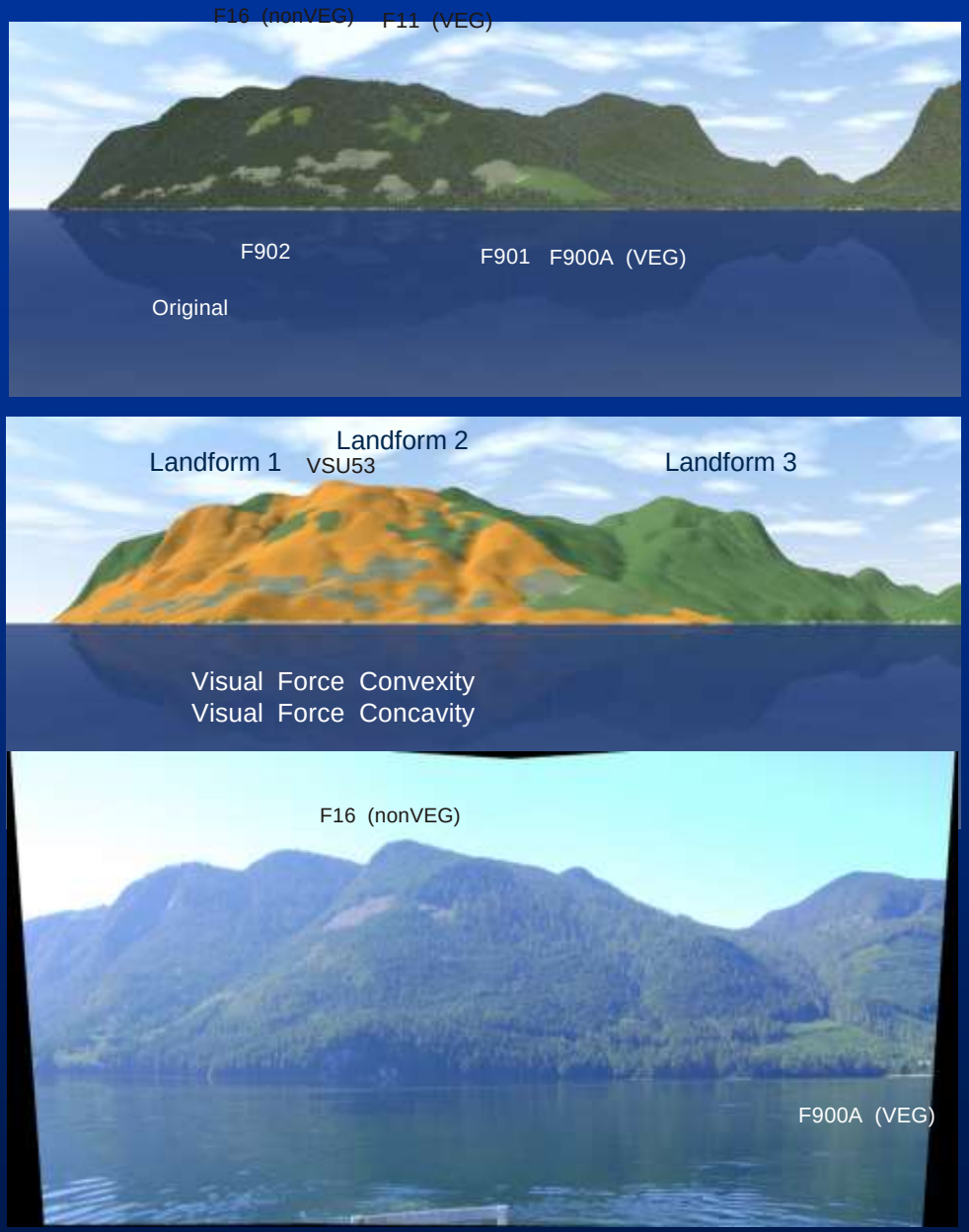
VIA SUMMARY

Does the proposal, in combination with any existing non-VEG alterations, achieve the basic definition for the established VQO?	Yes ___ No ___

Visual Impact Assessment Summary Form
(not a legal requirement but common practice for “due diligence”)

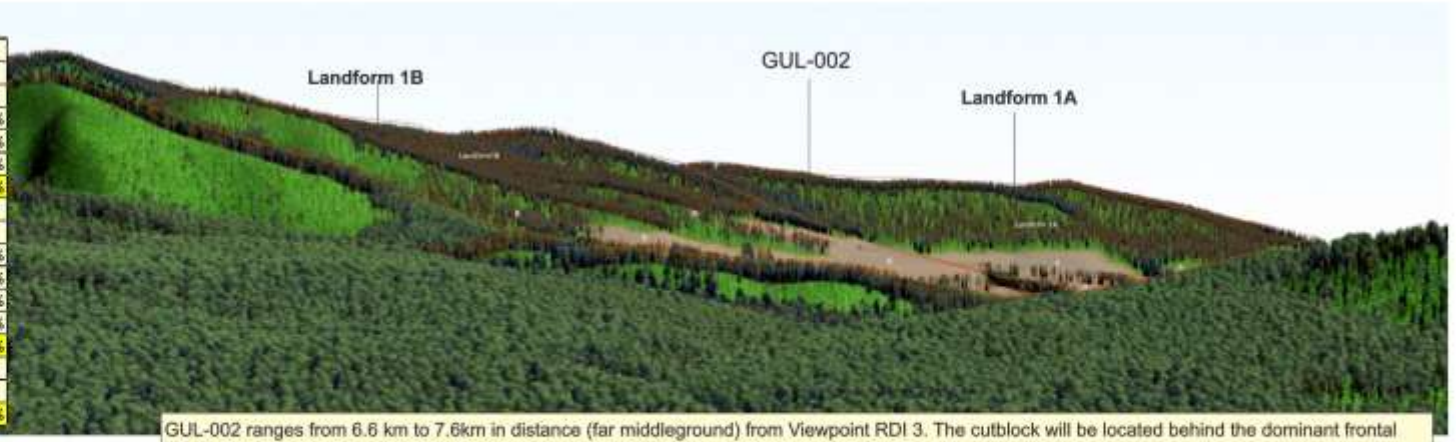
FLNRO Working Definition of Landform: a distinct topographic feature that is 3-dimensional in form and is generally defined by ridges, drainage channels, valleys, shorelines and skylines.

RDI interpretation: a piece of 3-dimensional terrain distinguished from its neighbours by major draws, major skyline breaks and intervening non-visible land (if any).



Sample VIA prepared for Interfor Corp. 2017

Percent Alteration Viewpoint RDI 3		
Name_1	AREA	% Alt
Landform 1A	75959.85	
A	6286.19	8.28%
A	465.40	0.61%
A	113.45	0.15%
Sum Alt 1A	6865.03	9.04%
Landform1B	146429.92	
B	3717.16	2.54%
B	9099.19	6.21%
B	81.84	0.06%
B	22.74	0.02%
Sum Alt 1B	12920.92	8.82%
Total Combined	222389.77	
	19785.95	8.90%



Original Percent Alteration

GUL-002 ranges from 6.6 km to 7.6km in distance (far middleground) from Viewpoint RDI 3. The cutblock will be located behind the dominant frontal landforms along the lakeshore which are designated as Sutherland River Provincial Park.

This view offers a glimpse of both Landform 1A and Landform 1B. Together, their viewing width is 20 degrees, with GUL-002 a width of 6 1/2 degrees.

The original Percent alteration was 9.04% for Landform 1A and 8.82% for Landform 1B. The combined effect was 8.9%. The layout has a good location away from the skyline, and has good compatibility with the visual forces in the landforms.

This viewpoint offers a view of Landform 1B and a portion of Landform 1A together and the combined coverage is broader (20 degrees) than from 4-Mile Shore Viewpoint (11 degrees).

RDI designed extra leave patches - Leave #2 in 1A and #3 in 1B are visible, as shown below. Leave #2 is an upper corner of the block, reducing Landform 1A 2.80%. Leave 3 in Landform 1B follows below the mid road, reducing Landform 1B to 7.06%. The patch in Landform 1B may require a road extension below the patch. The combined effect is to reduce Percent Alteration to 5.6%, easdily within Partial Retention VQC, particularly with stengthened visual force and natural shape and pattern.

Percent Alteration Viewpoint RDI3		
Name_1	AREA	% Alt
Landform1B	146429.92	
B4	3717.16	2.54%
B1	6510.52	4.45%
B2	81.84	0.06%
B3	22.74	0.02%
Sum Alt 1B	10332.26	7.06%
Landform 1A	75959.85	
A2	465.40	0.61%
A3	113.45	0.15%
A1	1475.86	1.94%
A4	75.01	0.10%
Sum Alt 1A	2129.72	2.80%
Landform 1A+1B	222389.77	
Sum Alt 1A+1B	12461.98	5.60%

RDI3 Final Percent Alteration with RDI Leave

Viewpoint RDI 3 Percent Alteration Original Layout and with Final RDI Leave

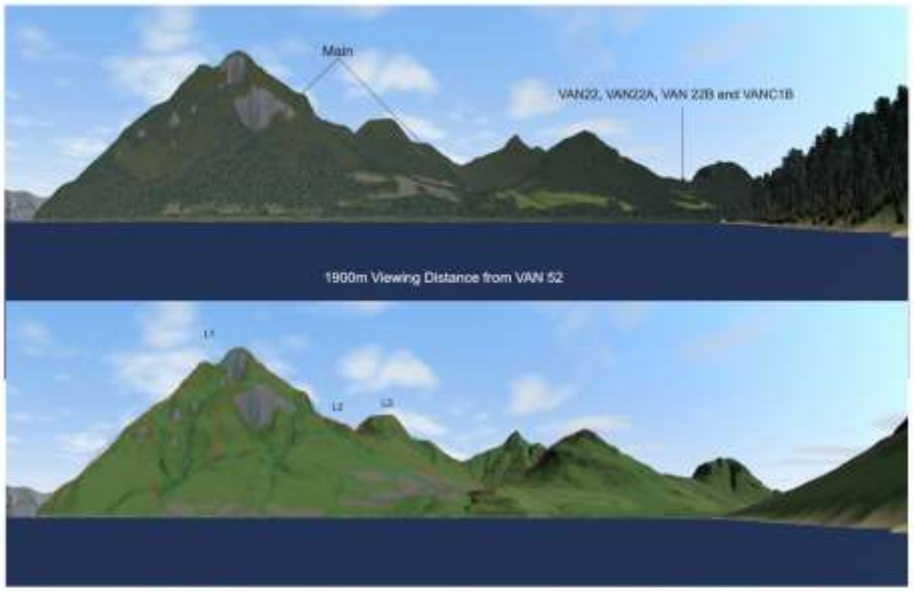
10

Analysis by Landform

3.82% alteration in Landform 1 (meets Partial Retention)

A landform is defined as

Sample VIA prepared by RDI for Interfor Corp. 2017



This "worst-case / best-opportunity" viewpoint is located on the southeast side of Van Bay near the log-dump operation (not a travel route). The locations of VAN53 and VAN52A are seen together, medium in size, and are low and to one side of the central bold landform. The small pockets of VAN86 are strung along the bottom of the dominant, highly complex and scenic landform. VAN87, VAN 63 and VAN63A are located on the side-slopes behind Landform 1 on Landform 2 which extends back to the knoll of Landform 3. The key focal point is beyond Landform 3 towards Mount Churchill. The percent alteration in both landforms 1 and 2 is within the VQC of Partial Retention.

The array of irregular-shaped openings are small to medium in themselves and overall in each landform, responding well to lines of force and to the strongly angular peaks. As well, the larger (medium-sized) openings respond to the large rock faces in shape and scale (obscured in the photo). Roads are very subordinate where seen at all. The general visual condition in the bay is that of "active" forest management. No design intervention was considered necessary by RDI in order to meet the VQO, but look for opportunities for retention of residuals in VAN52 if any. Additional cutblocks VAN22, VAN22A, VAN 22B and VANC1B are seen in the distance as very small, well-shaped openings.

VanBay VB1 North Percent Alteration

Percent Alteration Van Bay Viewpoint VB1		
NAME	AREA2	%Alt
L1	1214845.44	
VAN86-1	6948.74	0.32%
VAN86-2	848.11	0.07%
VAN86-3	3350.63	0.28%
VAN86-4	956.66	0.08%
VAN86-5	2601.03	0.21%
VAN86-6	1747.34	0.14%
VAN86-7	1199.99	0.10%
VAN86-8	56.95	0.00%
VAN86-9	59.63	0.00%
VAN86-10	321.67	0.03%
VAN52	22059.23	1.81%
VAN52A	7024.57	0.58%
Sum Alt L1	46468.52	3.82%
L2	69566.32	
VAN63A	394.91	0.65%
VAN63	1867.73	3.07%
VAN67	1954.23	3.23%
Sum Alt L2	4296.87	6.95%

Full forest simulation identifies shapes, roads, old harvesting and existing forest with heights and other data derived from ArcMap shape files

Bare-ground simulation exposes landform structure

New alteration simulation outlined using ArcMap for Percent Alteration calculation

Photo verifies simulation and existing conditions

Examples of Simulations

Interfor Corp. Data and Simulation revealing age classes,
roads, nonVEG, VEG, proposed alteration.

Powerhouse – 3-D model imported into VNS by RDI for Run-of-River Power Project

LiDAR in ArcScene:

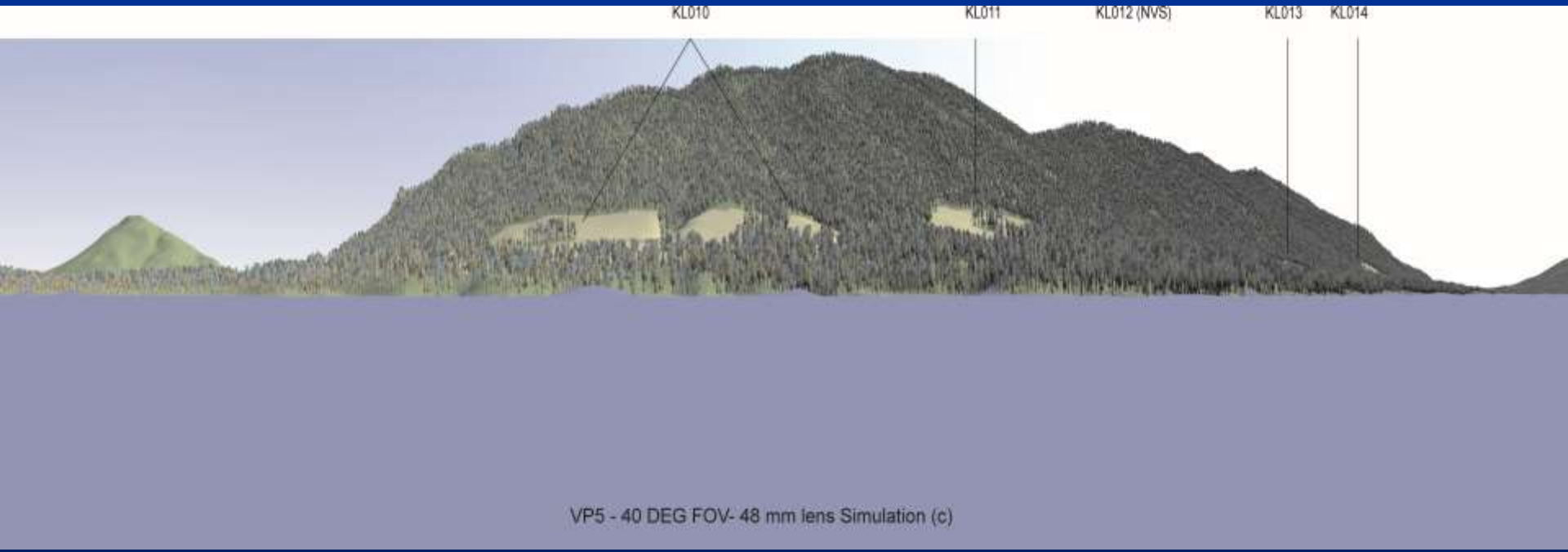
Light Detection And Ranging (sometimes *Light Imaging, Detection, And Ranging*)

For comparison with VNS (next slide)

INTERFOR

Lidar Tree Heights Precise but no “see-through”

Visual Nature Studio Rendering – RDI
with some “see-through” – to compare with LiDAR (previous slide)

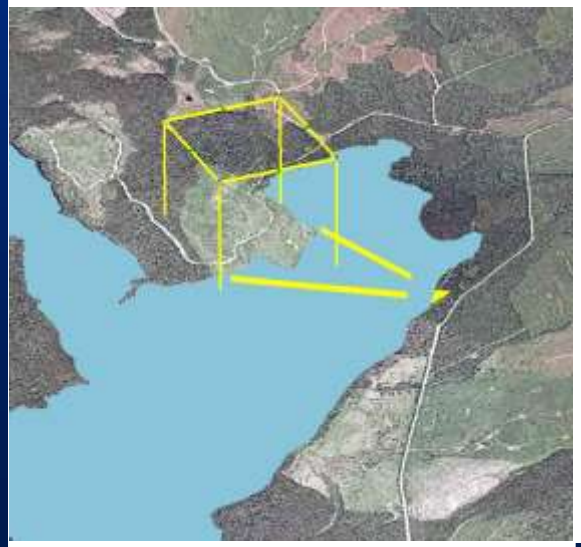


Almanac Consulting

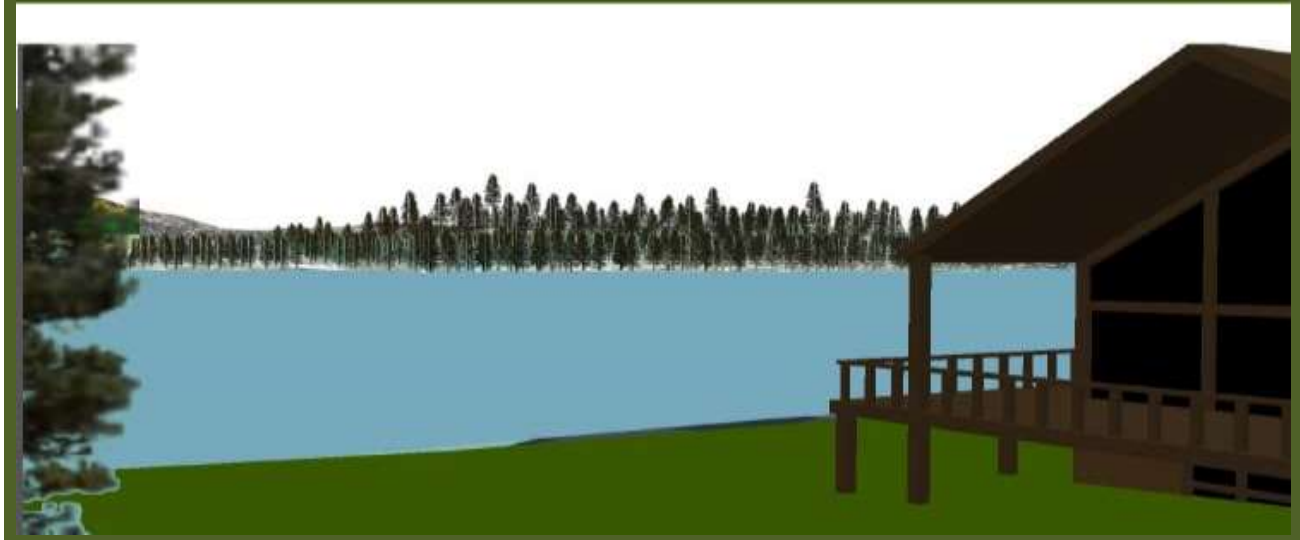
A student initiative

Visual Quality Assessment of Kloch

Lake Recreation Site and Cabin



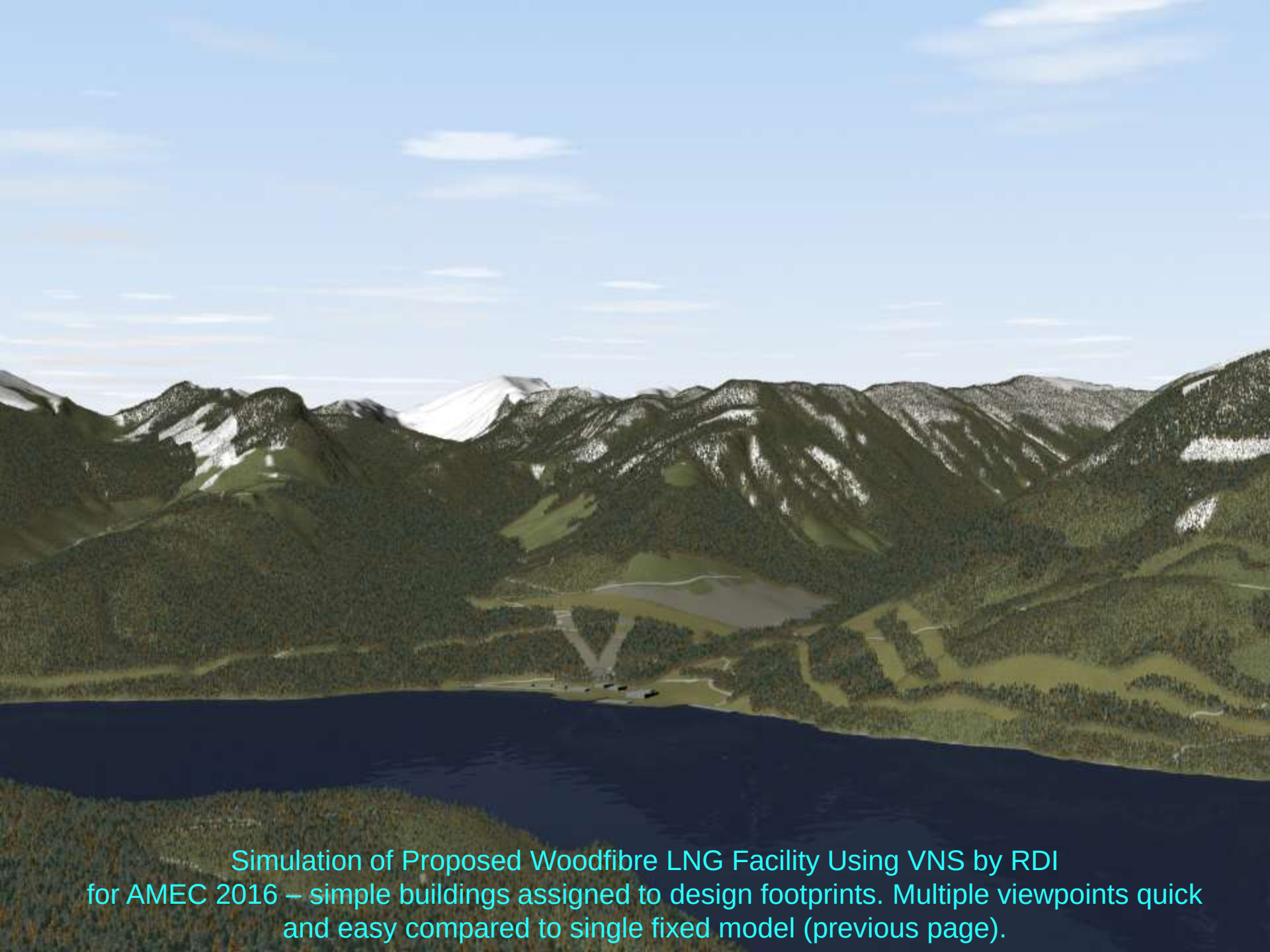
Current cabin view facing cut block



Potential future view in a no harvest/retention scenario

Example of Application of ArcScene with Tree Cover over Draped Ortho-photo
(FRST 424 Student Project)

Simulation of Proposed Woodfibre LNG Facility single full 3-D Model in Photo to compare with VNS next slide – alternate viewpoint assessment difficult and expensive
Source: AMEC 2016

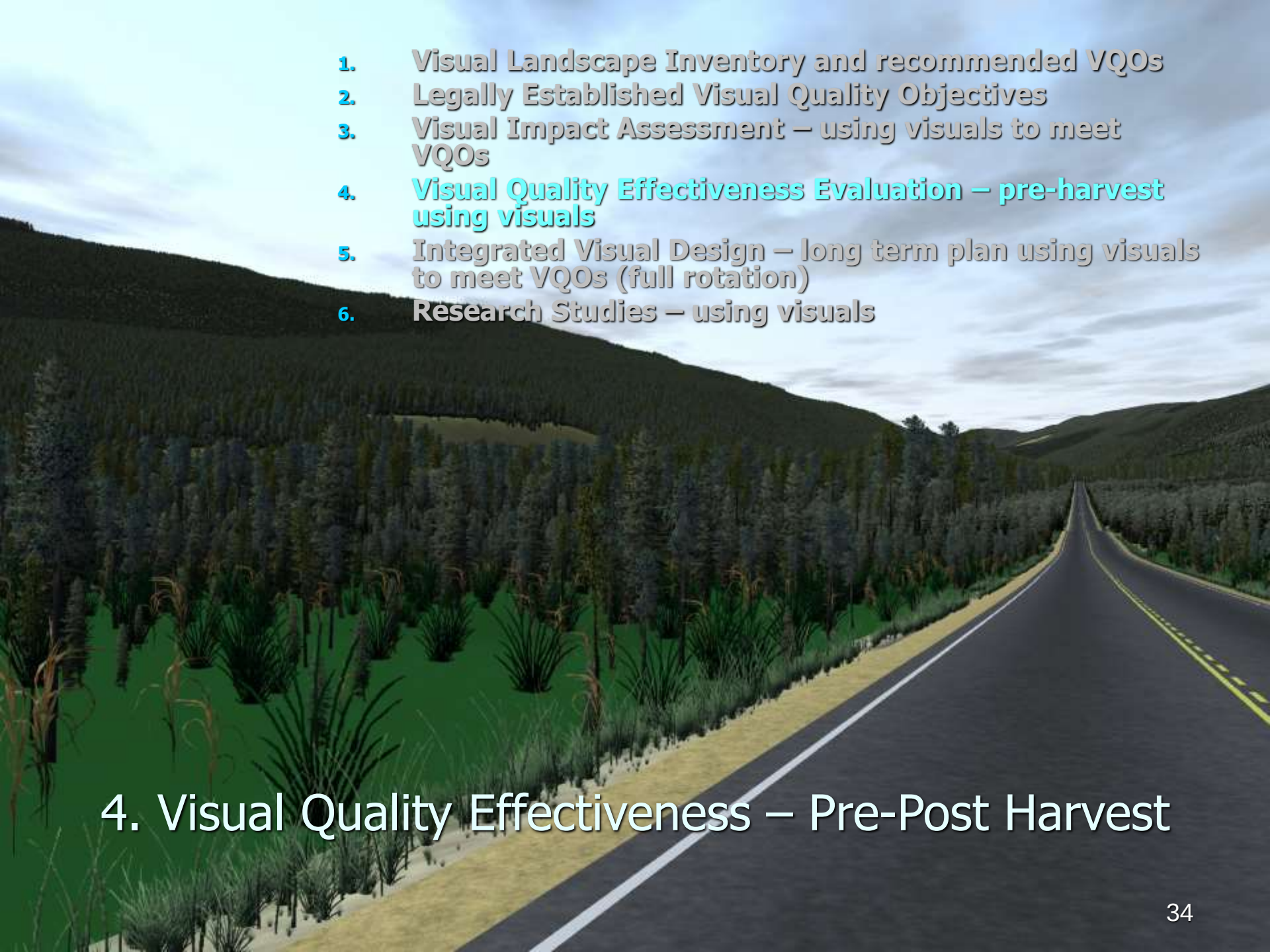


Simulation of Proposed Woodfibre LNG Facility Using VNS by RDI
for AMEC 2016 – simple buildings assigned to design footprints. Multiple viewpoints quick and easy compared to single fixed model (previous page).

Transmission line model .dxf in ortho imagery. Produced for Northwest Cascade Power by RDI

West A

Transmission line model .dxf in VNS.
Produced for Northwest Cascade Power by RDI



1. Visual Landscape Inventory and recommended VQOs
2. Legally Established Visual Quality Objectives
3. Visual Impact Assessment – using visuals to meet VQOs
4. **Visual Quality Effectiveness Evaluation – pre-harvest using visuals**
5. Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)
6. Research Studies – using visuals

4. Visual Quality Effectiveness – Pre-Post Harvest

4. Forest and Range Evaluation Program – Visual Quality Monitoring

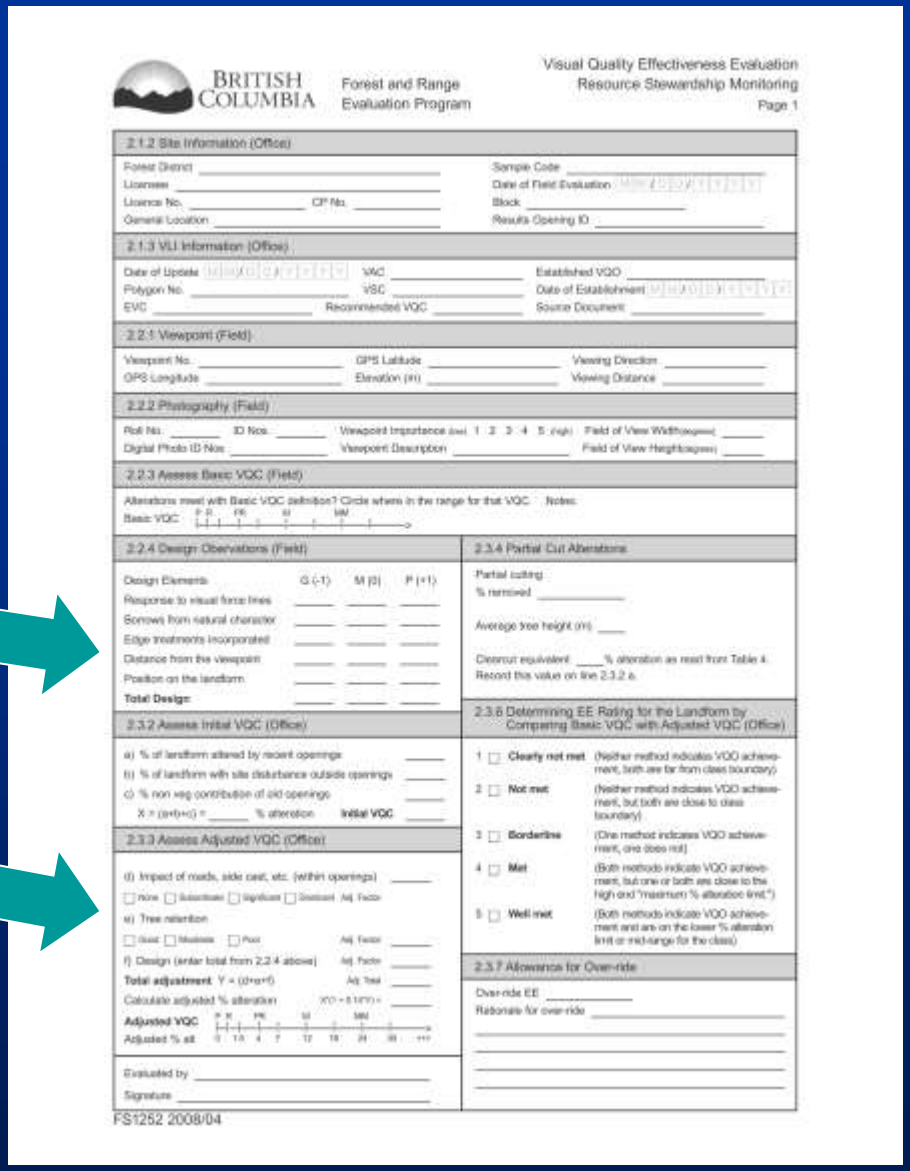
Have objectives been met?
How are views in scenic areas being effectively managed?
How are visual quality objectives being effectively managed?

Can raise or lower adjusted percent alteration to determine if Effectiveness is met, partly met, or not met (see form on next slide).

A similar form is used by Natural Resource Officers of the Compliance and Enforcement Branch to investigate possible failures to meet the prescribed Visual Quality Objectives. The Officers have the authority to enforce a broad range of environmental and natural resource laws and administer administrative remedies.

Used also to inform pre-harvest assessment by RDI (a level playing field).

http://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/integrated-resource-monitoring/forest-range-evaluation-program/frep-monitoring-protocols/visual-quality



BRITISH COLUMBIA Forest and Range Evaluation Program

Visual Quality Effectiveness Evaluation
Resource Stewardship Monitoring
Page 1

2.1.2 Site Information (Office)

Forest District
Licensee
Licence No. CP No.
General Location
Sample Code
Date of Field Evaluation
Block
Results Opening ID

2.1.3 VLI Information (Office)

Date of Update
Polygon No.
EVC
VAC
VSC
Recommended VQO
Established VQO
Date of Establishment
Source Document

2.2.1 Viewpoint (Field)

Viewpoint No.
GPS Latitude
Viewing Direction
GPS Longitude
Elevation (m)
Viewing Distance

2.2.2 Photography (Field)

Roll No. ID Nos.
Viewpoint Importance (low) 1 2 3 4 5 (high)
Field of View Width(degrees)
Digital Photo ID Nos
Viewpoint Description
Field of View Height(degrees)

2.2.3 Assess Basic VQC (Field)

Alterations meet with Basic VQC definition? Circle where in the range for that VQC. Notes:

Basic VQC: P R PR M MM

2.2.4 Design Observations (Field)

Design Elements	G (-1)	M (0)	P (+1)
Response to visual force lines			
Borrows from natural character			
Edge treatments incorporated			
Distance from the viewpoint			
Position on the landform			
Total Design			

2.3.2 Assess Initial VQC (Office)

a) % of landform altered by recent openings
b) % of landform with site disturbance outside openings
c) % non veg contribution of old openings
X = (a+b+c) = % alteration **Initial VQC**

2.3.3 Assess Adjusted VQC (Office)

d) Impact of roads, side cast, etc. (within openings)
None Subordinate Significant Dominant Adj. Factor
e) Tree retention
Good Moderate Poor Adj. Factor
f) Design (enter total from 2.2.4 above) Adj. Factor
Total adjustment Y = ((d+e+f) Adj. Total
Calculate adjusted % alteration Y(C) = 0.1(Y)) =
Adjusted VQC P R PR M MM
Adjusted % alt 0 1.0 4 7 12 18 24 30 >30

Evaluated by
Signature

2.3.4 Partial Cut Alterations

Partial cutting
% removed
Average tree height (m)
Clearcut equivalent ____% alteration as read from Table 4.
Record this value on line 2.3.2 a.

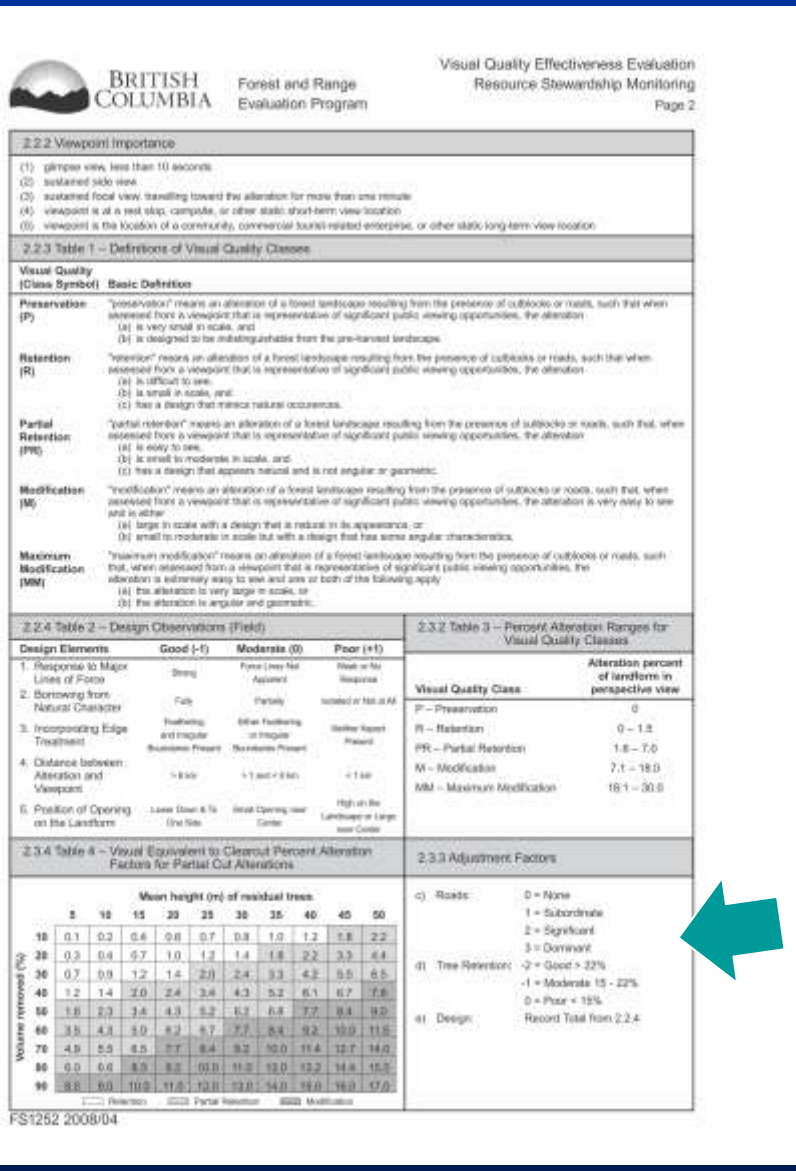
2.3.6 Determining EE Rating for the Landform by Comparing Basic VQC with Adjusted VQC (Office)

1 ☐ **Clearly not met** (Neither method indicates VQO achievement, both are far from class boundary)
2 ☐ **Not met** (Neither method indicates VQO achievement, but both are close to class boundary)
3 ☐ **Borderline** (One method indicates VQO achievement, one does not)
4 ☐ **Met** (Both methods indicate VQO achievement, but one or both are close to the high end "maximum % alteration limit.")
5 ☐ **Well met** (Both methods indicate VQO achievement and are on the lower % alteration limit or mid-range for the class)

2.3.7 Allowance for Over-ride

Over-ride EE
Rationale for over-ride

FS1252 2008/04



BRITISH COLUMBIA Forest and Range Evaluation Program

Visual Quality Effectiveness Evaluation
Resource Stewardship Monitoring
Page 2

2.2.2 Viewpoint Importance

(1) glimpse view, less than 10 seconds
(2) sustained side view
(3) sustained focal view, travelling toward the alteration for more than one minute
(4) viewpoint is at a rest stop, campsite, or other static short-term view location
(5) viewpoint is the location of a community, commercial tourist-related enterprise, or other static long-term view location

2.2.3 Table 1 – Definitions of Visual Quality Classes

Visual Quality (Class Symbol)	Basic Definition
Preservation (P)	"preservation" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration (a) is very small in scale, and (b) is designed to be indistinguishable from the pre-harvest landscape.
Retention (R)	"retention" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration (a) is difficult to see, (b) is small in scale, and (c) has a design that mimics natural occurrences.
Partial Retention (PR)	"partial retention" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration (a) is easy to see, (b) is small to moderate in scale, and (c) has a design that appears natural and is not angular or geometric.
Modification (M)	"modification" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration is very easy to see and is either (a) large in scale with a design that is natural in its appearance, or (b) small to moderate in scale but with a design that has some angular characteristics.
Maximum Modification (MM)	"maximum modification" means an alteration of a forest landscape resulting from the presence of cutblocks or roads, such that, when assessed from a viewpoint that is representative of significant public viewing opportunities, the alteration is extremely easy to see and are or both of the following apply (a) the alteration is very large in scale, or (b) the alteration is angular and geometric.

2.2.4 Table 2 – Design Observations (Field)

Design Elements	Good (-1)	Moderate (0)	Poor (+1)
1. Response to Major Lines of Force	Strong	Force Lines Not Apparent	Weak or No Response
2. Borrowing from Natural Character	Fully	Partially	Isolated or Not at All
3. Incorporating Edge Treatment	Feathering and Irregular Boundaries Present	Either Feathering or Irregular Boundaries Present	Neither Aspect Present
4. Distance between Alteration and Viewpoint	> 8 km	> 1 and < 8 km	< 1 km
5. Position of Opening on the Landform	Lower Down & To One Side	Near Opening near Center	High on the Landscape or Large near Center

2.3.2 Table 3 – Percent Alteration Ranges for Visual Quality Classes

Visual Quality Class	Alteration percent of landform in perspective view
P – Preservation	0
R – Retention	0 – 1.8
PR – Partial Retention	1.8 – 7.0
M – Modification	7.1 – 18.0
MM – Maximum Modification	18.1 – 30.0

2.3.4 Table 4 – Visual Equivalent to Clearcut Percent Alteration Factors for Partial Cut Alterations

Mean height (m) of residual trees

Volume removed (%)	5	10	15	20	25	30	35	40	45	50
10	0.1	0.2	0.4	0.6	0.7	0.8	1.0	1.2	1.8	2.2
20	0.3	0.4	0.7	1.0	1.2	1.4	1.8	2.2	3.3	4.4
30	0.7	0.9	1.2	1.4	2.0	2.4	3.3	4.2	5.5	6.5
40	1.2	1.4	2.0	2.4	3.4	4.3	5.2	6.1	6.7	7.6
50	1.6	2.3	3.4	4.3	5.2	6.1	6.8	7.7	8.4	9.0
60	3.5	4.3	5.0	6.2	6.7	7.7	8.4	9.2	10.0	11.0
70	4.9	5.5	6.5	7.7	8.4	9.2	10.0	11.4	12.7	14.0
80	6.0	6.6	8.5	8.2	10.0	11.2	12.0	13.2	14.4	15.5
90	6.8	8.0	10.0	11.6	12.8	13.8	14.0	16.0	16.0	17.0

Retention Partial Retention Modification

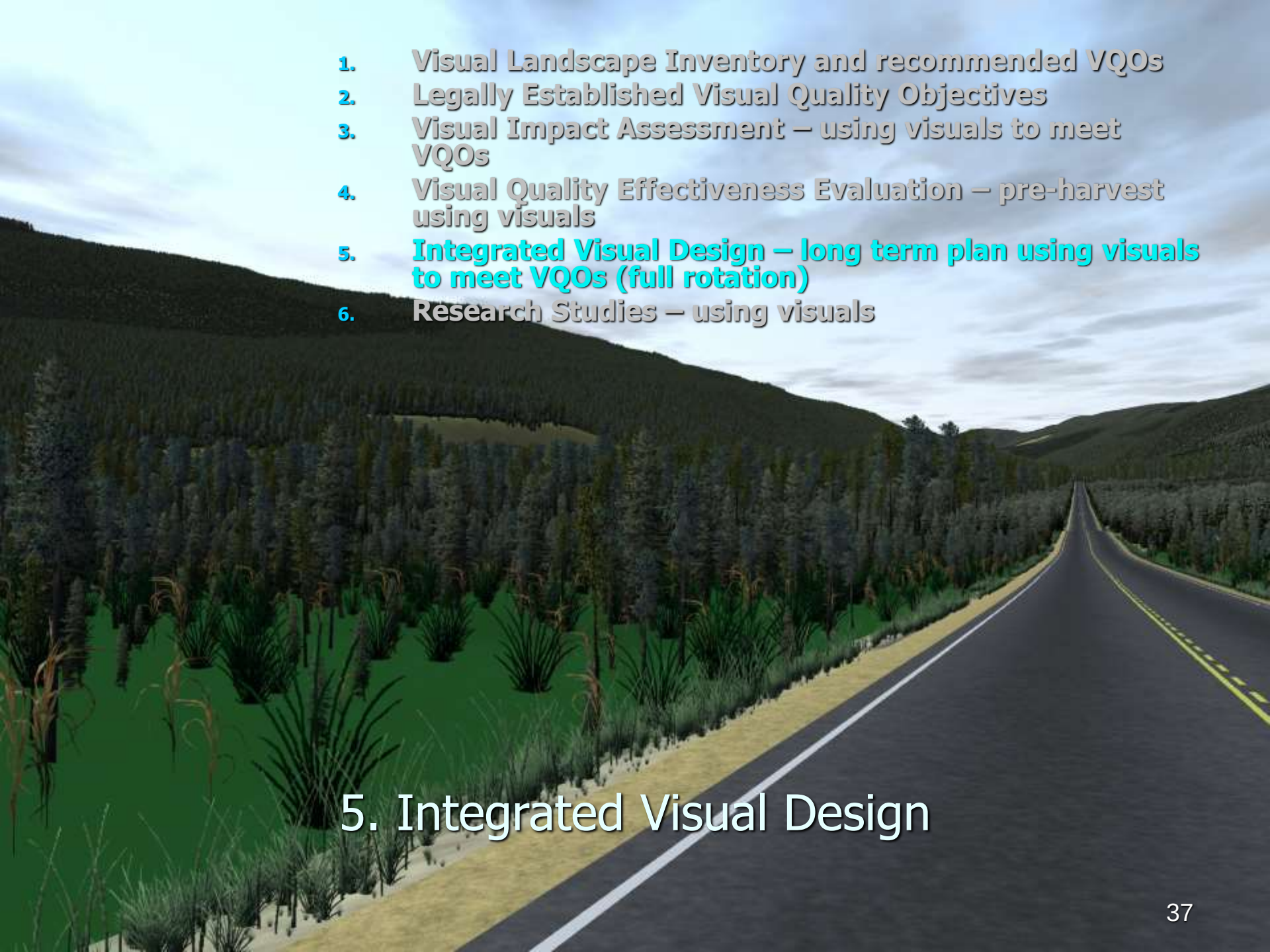
2.3.3 Adjustment Factors

c) Roads: 0 = None; 1 = Subordinate; 2 = Significant; 3 = Dominant
d) Tree Retention: -2 = Good > 22%; -1 = Moderate 15 - 22%; 0 = Poor < 15%
e) Design: Record Total from 2.2.4

FS1252 2008/04

Visual Quality Effectiveness Evaluation Protocol

1. Visual Landscape Inventory and recommended VQOs
2. Legally Established Visual Quality Objectives
3. Visual Impact Assessment – using visuals to meet VQOs
4. Visual Quality Effectiveness Evaluation – pre-harvest using visuals
5. **Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)**
6. Research Studies – using visuals



5. Integrated Visual Design

4. Integrated Visual Design – Full Rotation Planning

Foghorn East VDU (Foghorn 2 Operating Area)

Foghorn West VDU (Foghorn 1 Operating Area)

Foghorn Creek

Recent Harvest Patterns emphasized with snow cover

VP 12

Highway 5 viewing opportunities

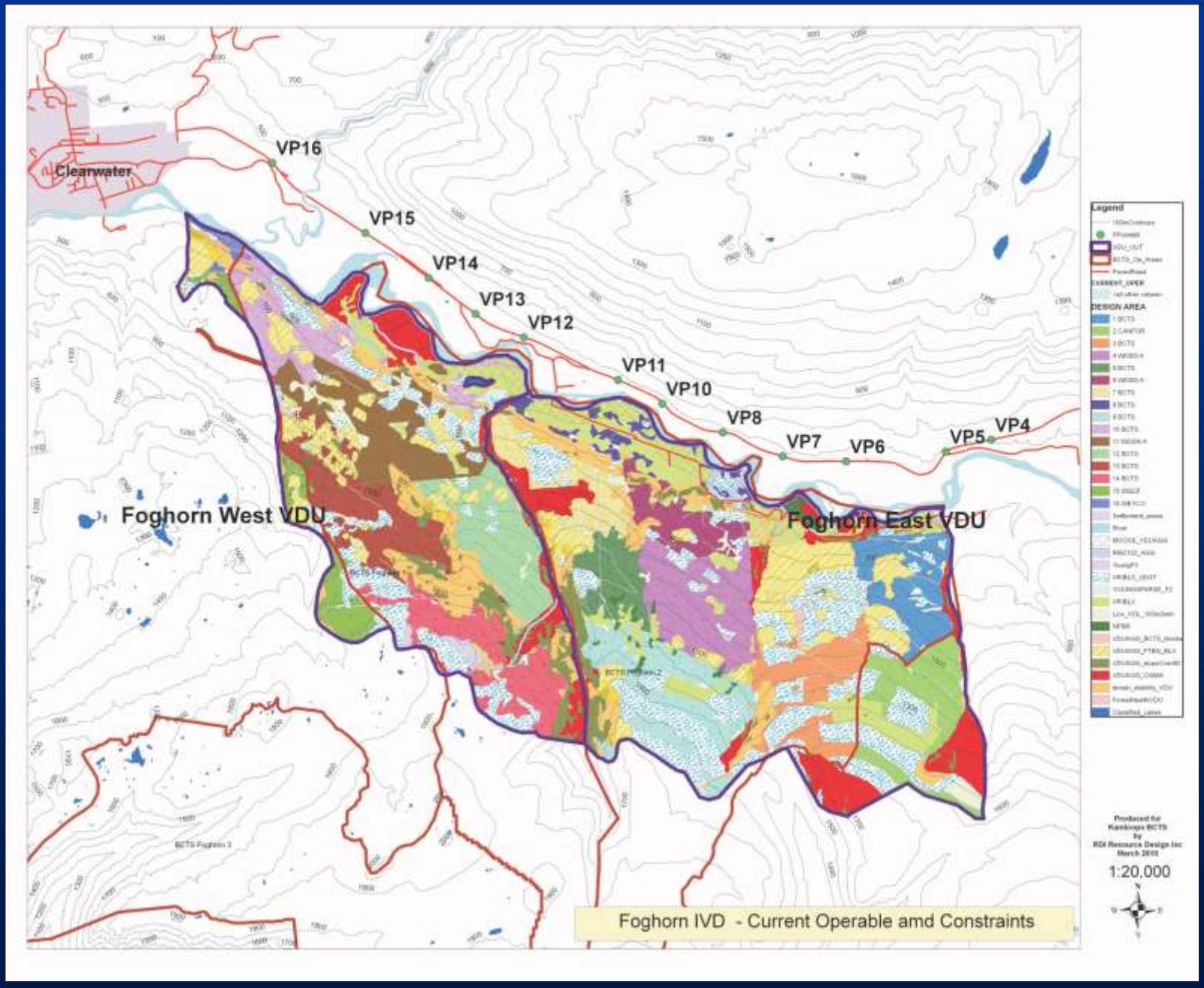
North Thompson River
River recreation viewing opportunities

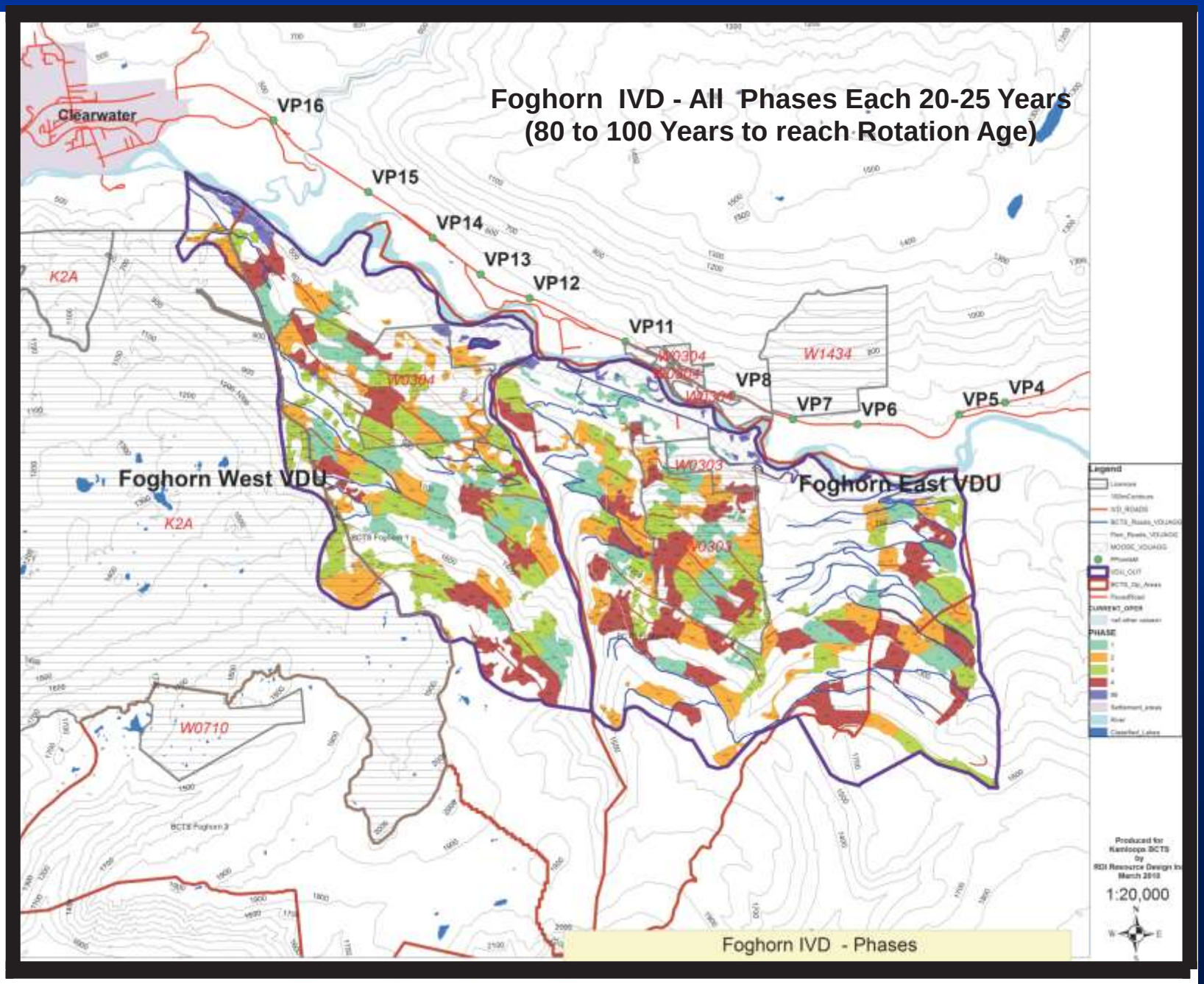
North Flanks of Granite Mountain
broadly rounded with main peak out of view

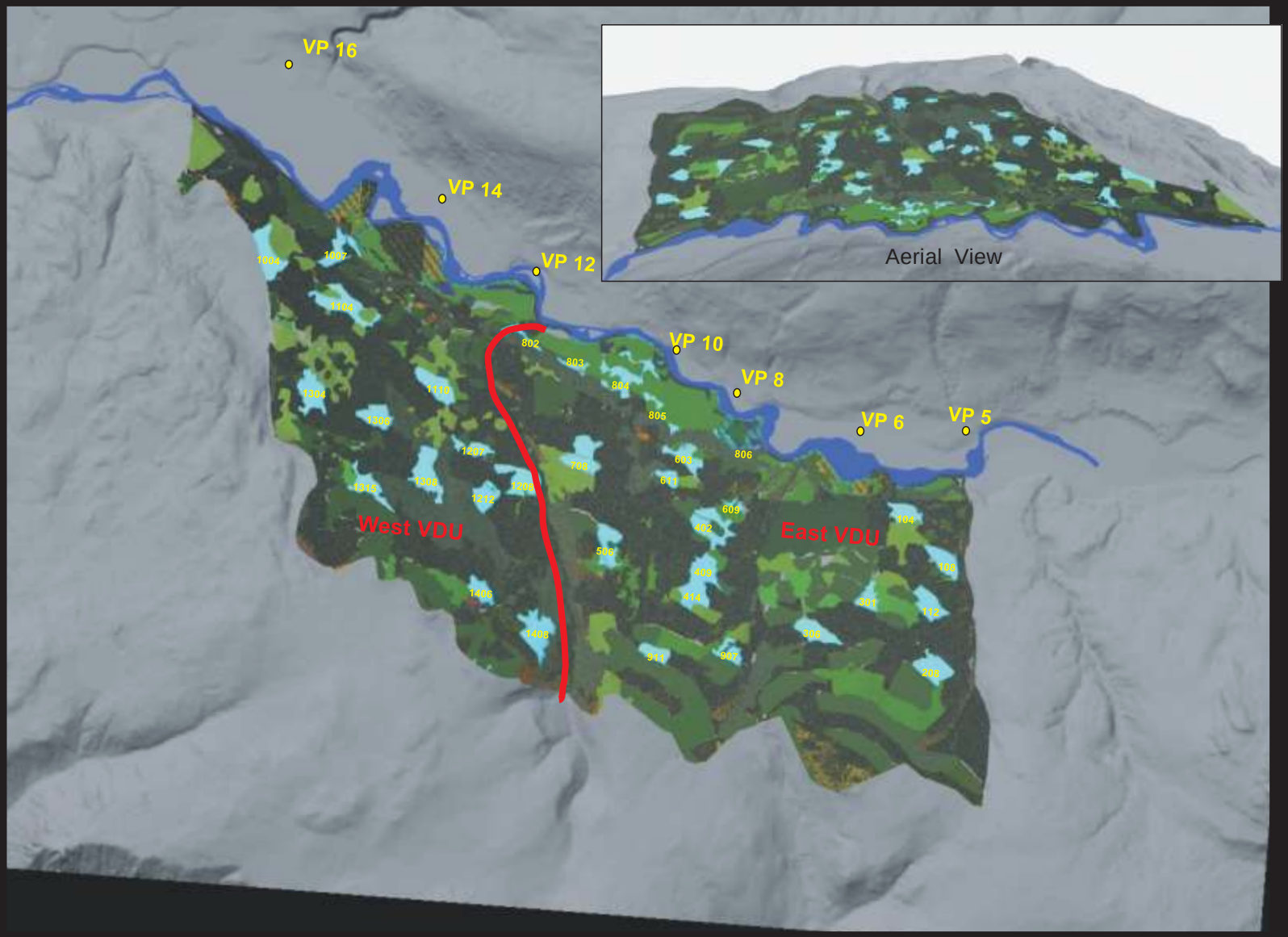
North-facing slopes often in shade,
particularly in winter.
Backlighting provides higher VAC
though contrasts emphasized with snow cover.

Intermittent roadside screening

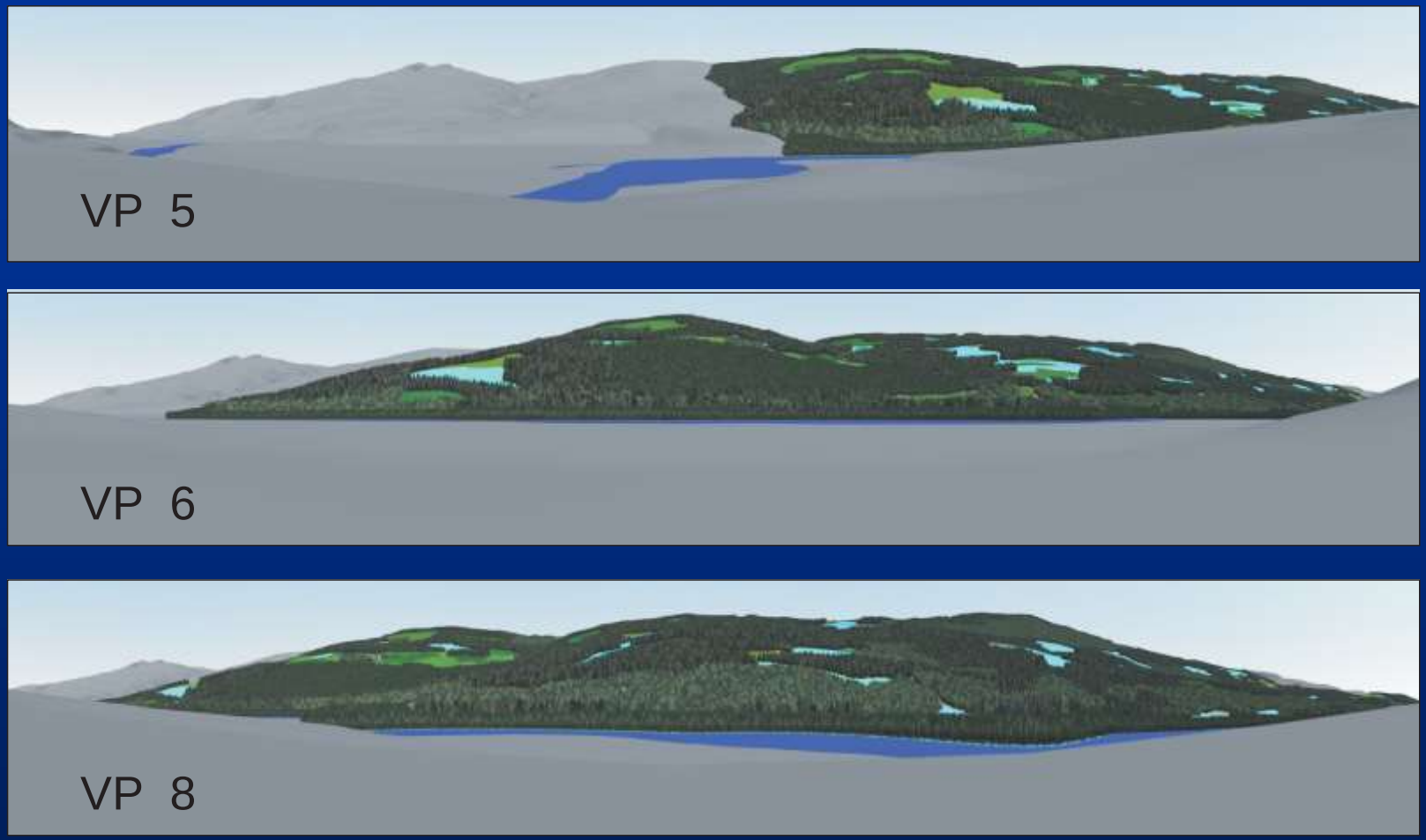
Highway 5 bends southward
west of the landform at Clearwater with only minor glimpse views of the VDU.


Clearwater
VP16
VP15
VP14
VP13
VP12
VP11
VP10
VP8
VP7
VP6
VP5
VP4
Foghorn West VDU
Foghorn East VDU
Legend
1:20,000
Foghorn IVD - Current Operable amd Constraints

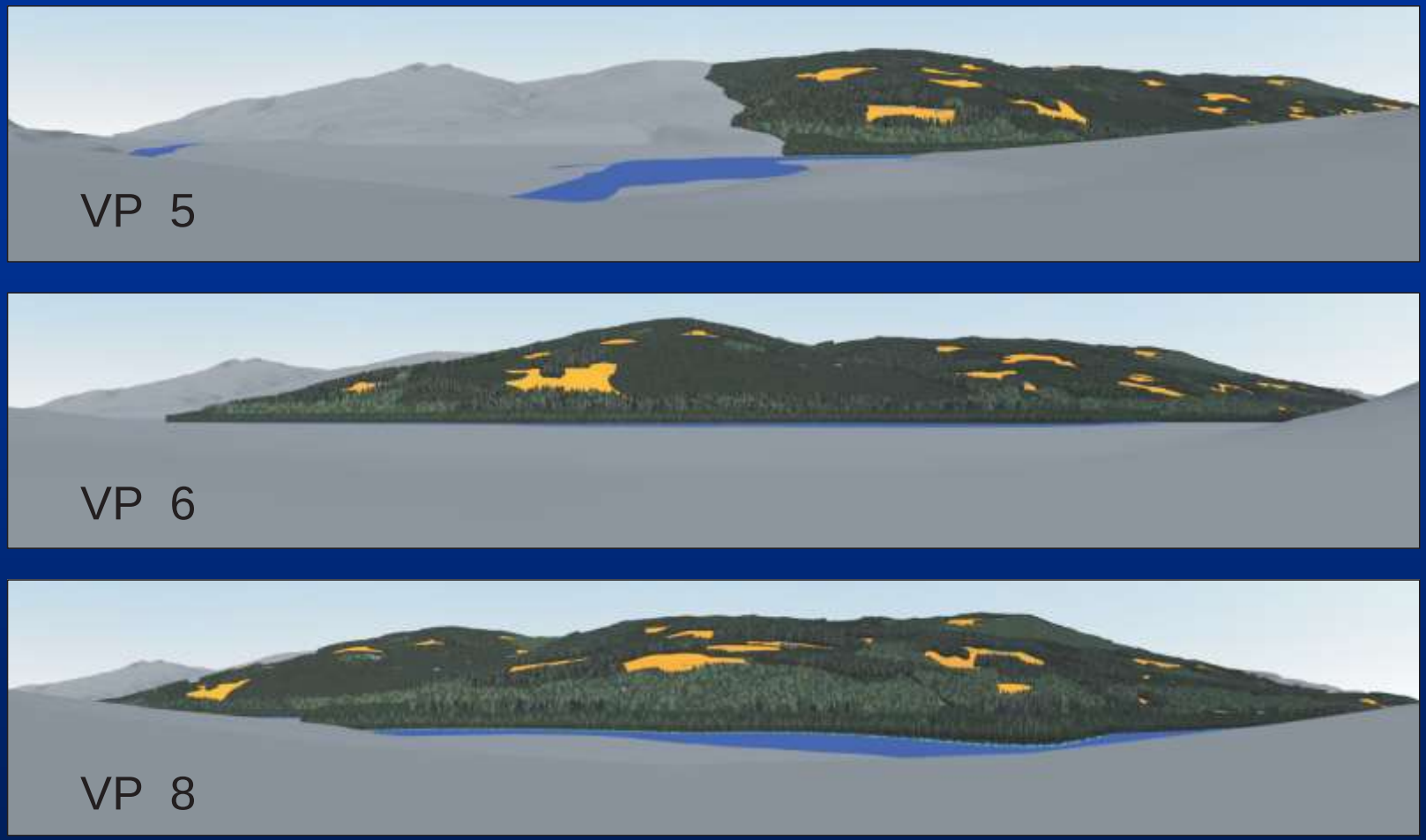

Foghorn IVD - All Phases Each 20-25 Years
(80 to 100 Years to reach Rotation Age)
Clearwater
VP16
VP15
VP14
VP13
VP12
VP11
VP8
VP7
VP6
VP5
VP4
K2A
K2A
W0304
W0304
W0304
W1434
W0303
W0303
W0710
Foghorn West VDU
Foghorn East VDU
Legend
PHASE
1:20,000
Foghorn IVD - Phases



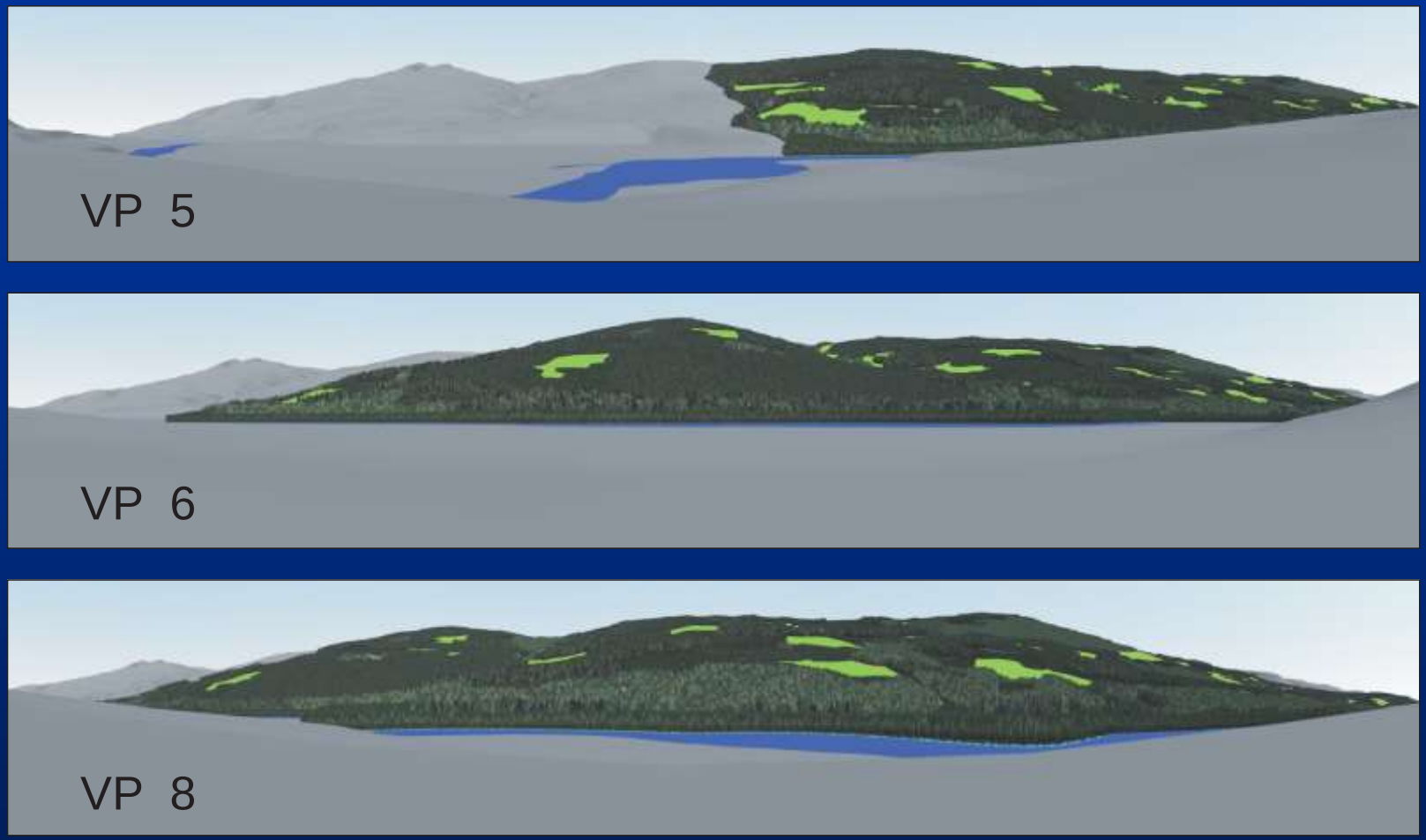
Foghorn IVD Phase 1



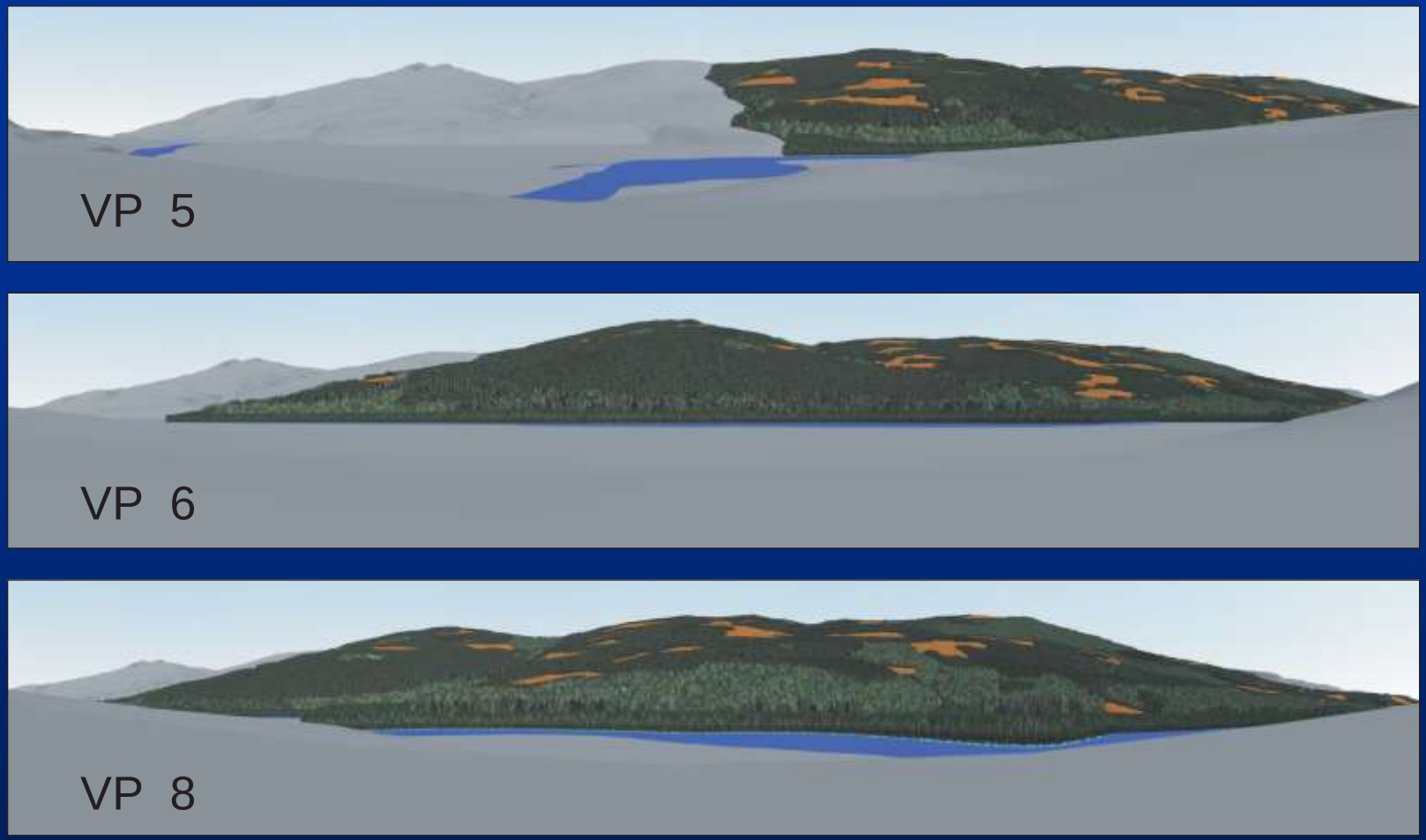
Foghorn IVD Phase 1 – 222,561 m3



Foghorn IVD Phase 2 – 298,011 m3



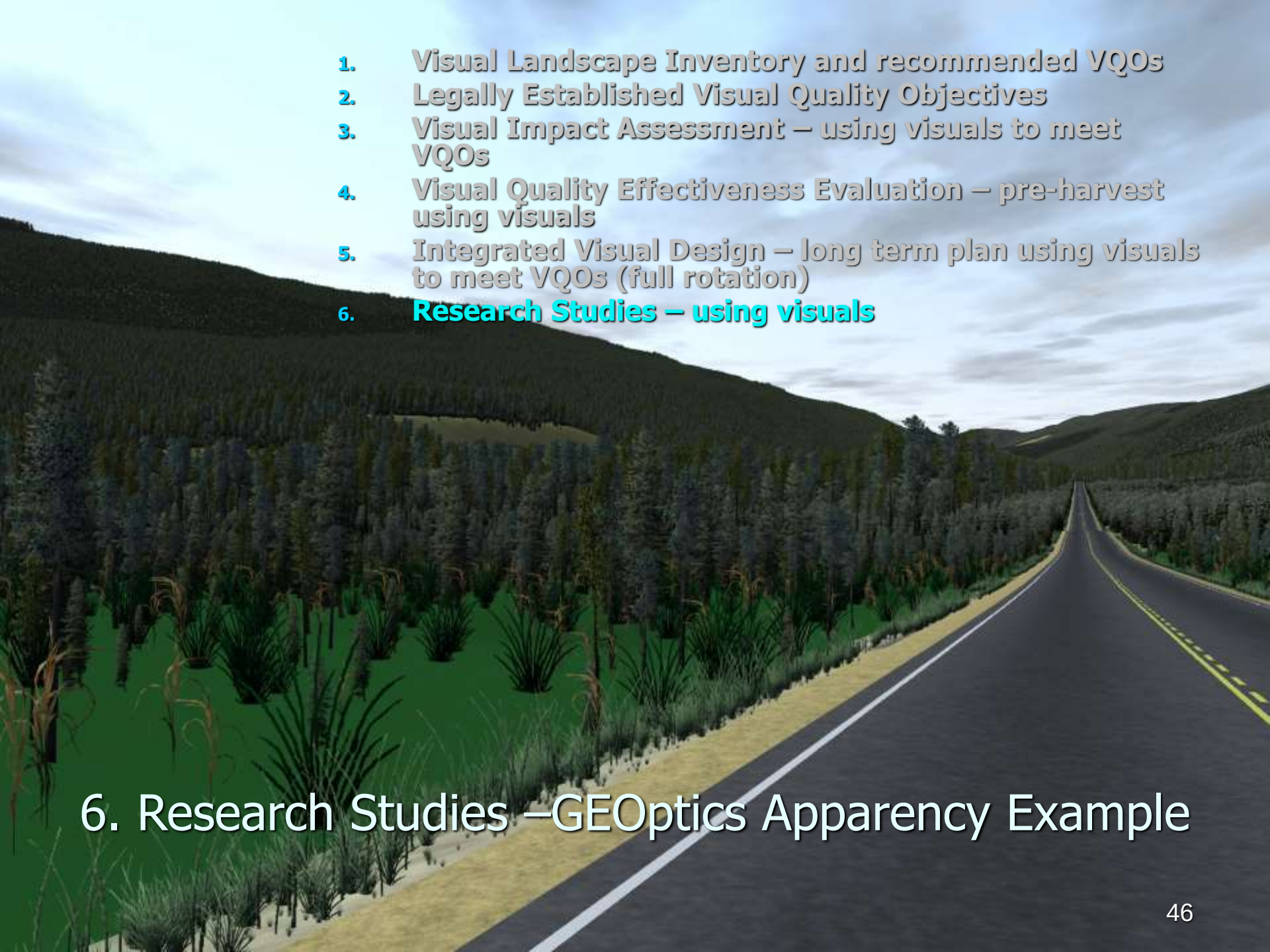
Foghorn IVD Phase 3 – 316,514 m3



Cumulative Total over 80 Years – 1,135,353 m3

Foghorn IVD Phase 4 – 298, 267 m3

1. Visual Landscape Inventory and recommended VQOs
2. Legally Established Visual Quality Objectives
3. Visual Impact Assessment – using visuals to meet VQOs
4. Visual Quality Effectiveness Evaluation – pre-harvest using visuals
5. Integrated Visual Design – long term plan using visuals to meet VQOs (full rotation)
6. **Research Studies – using visuals**



6. Research Studies –GEOptics Apparency Example

Fairhurst, K.B, 2010. PhD Dissertation. Geoptics Landscape Apparency: a dynamic visual resource indicator and tool for multi-functional landscape planning. https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0071267

Issues

- The visual landscape is a public good
- Visual impacts affect public opinion of forestry
- Poor design has enduring effect on next passes

Problems

- Coarse inventory delineation and categorization
- VQO's may be overly or inadequately constraining
- Forest operations "can't find the wood"
- Visual design in only 42% of harvested openings
- Design skills lacking or not being utilized

2. Overall Research Question

Could a new approach improve the worth* of one or more key components of an expert visual assessment system, i.e., the FLNRO Visual Landscape Management System:

- **Visual Resource Allocation and Protection**
- **Integrated Resource Planning**
- **Visual Landscape Design**

***** *"Expert visual assessment systems must be assessed for their worth in a variety of measures – sensitivity, reliability, validity and utility....unless an assessment method is sensitive and reliable, it can not achieve an acceptable level of validity"* **(Daniel and Vining '83).**

3. Possible Solution

GEOptics Landscape Apparency:

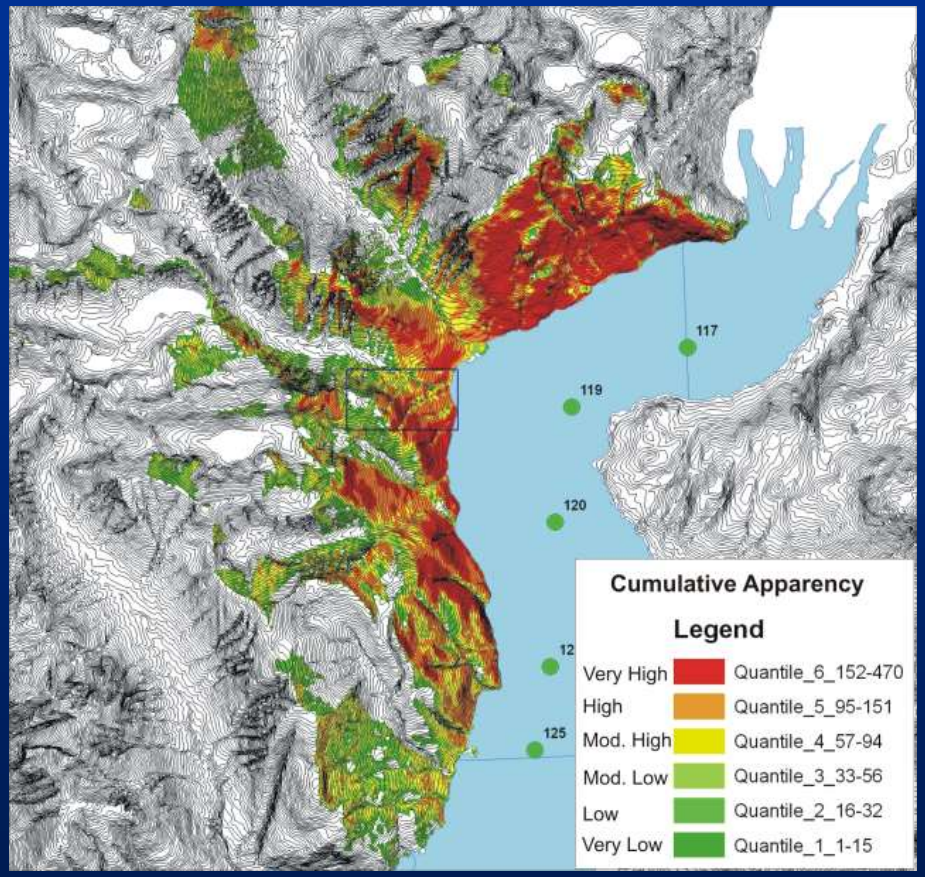
A quantified visual risk indicator and tool…

capturing the dynamic interaction…

between the viewer and the landscape…

as determined from an array of viewpoints…

***within a digital 3-D terrain environment*.**



Cumulative Apparency Map Example

4. Research Tasks

1. Examine expert visual assessment (EVA)
2. Develop a refined vulnerability/risk assessment tool and evaluation criteria
3. Conduct internal pre-testing
4. Evaluate by internal tests
5. Evaluate by external tests (focus groups)
6. Findings, conclusions, further research and applications

5. Evaluation Criteria

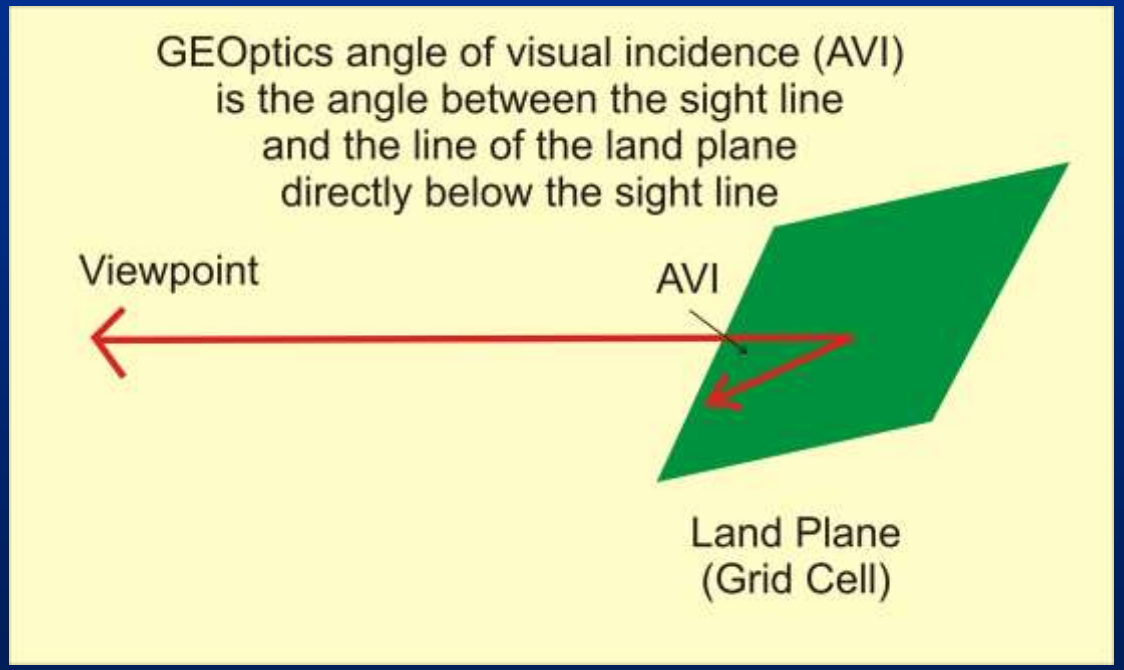
"Improving the worth of one or more key components of an EVA"

- Internally:
  - Reliability – agreement or consistency (precision/accuracy)
  - Sensitivity – method is sensitive to changes
  - Validity – measures what the system purports to measure
  - Utility – efficiency and generality

- Externally:
  - Advancement – inventory, planning and design
  - Utility – familiar programs, quick, easy, interest to do so
  - Adaptability – programs, systems
  - Compatibility – existing systems - ArcGIS
  - Generality – jurisdictions, applications

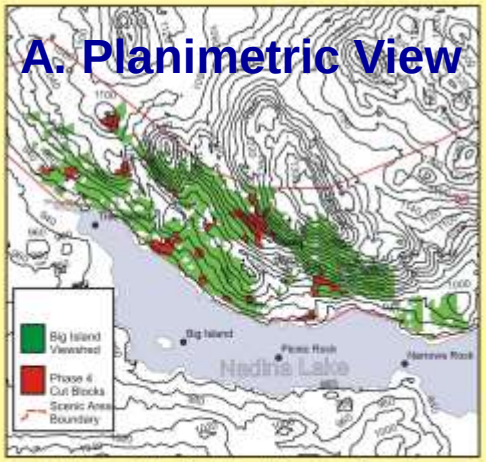
7. Concepts Related to Apparency

- Visual Contrast
- Visual Vulnerability
- Visual Absorption
- Visual Magnitude
- Visual Threshold
- Viewed Land Plane
- Visual Incidence
- Plan-to-Perspective Ratio



Plan-to-Perspective (P2P) Ratio

B) Nadina Lake - Big Island Perspective Viewshed
Phase 4 Cut Blocks outlined in yellow - 3% alteration



A) Nadina Lake Big Island Viewshed Plan View
Phase 4 Cut Blocks in Red
15% Planimetric Percent Alteration

Percent Alteration Calculation

A) Plan View: 15%

Big Island viewshed plan area = 495.6 ha.
Big Island viewshed Phase 4 alteration = 73.8 ha
Planimetric percent alteration: 73.8/495.6 = 15%.

B) Perspective View: 3%

Big Island viewshed perspective area = 3,621,481 units^2
Phase 4 perspective alteration in viewshed = 118,195 units^2
Perspective percent alteration: 118195/3621481 = 3.3%.

C) Plan-to-Perspective Ratio: 5:1

Big Island Viewshed plan to perspective area = 495.6 ha.
Big Island Viewshed Phase 4 alteration
Plan-to-Perspective Ratio = 15%/3% = 5:1

(Numbers rounded for demonstration purposes)

P2P ratio = A/B (in percent)

Predicted P2P ratios for slopes 0% - 70% for all visual designs (BCMoF 2003).

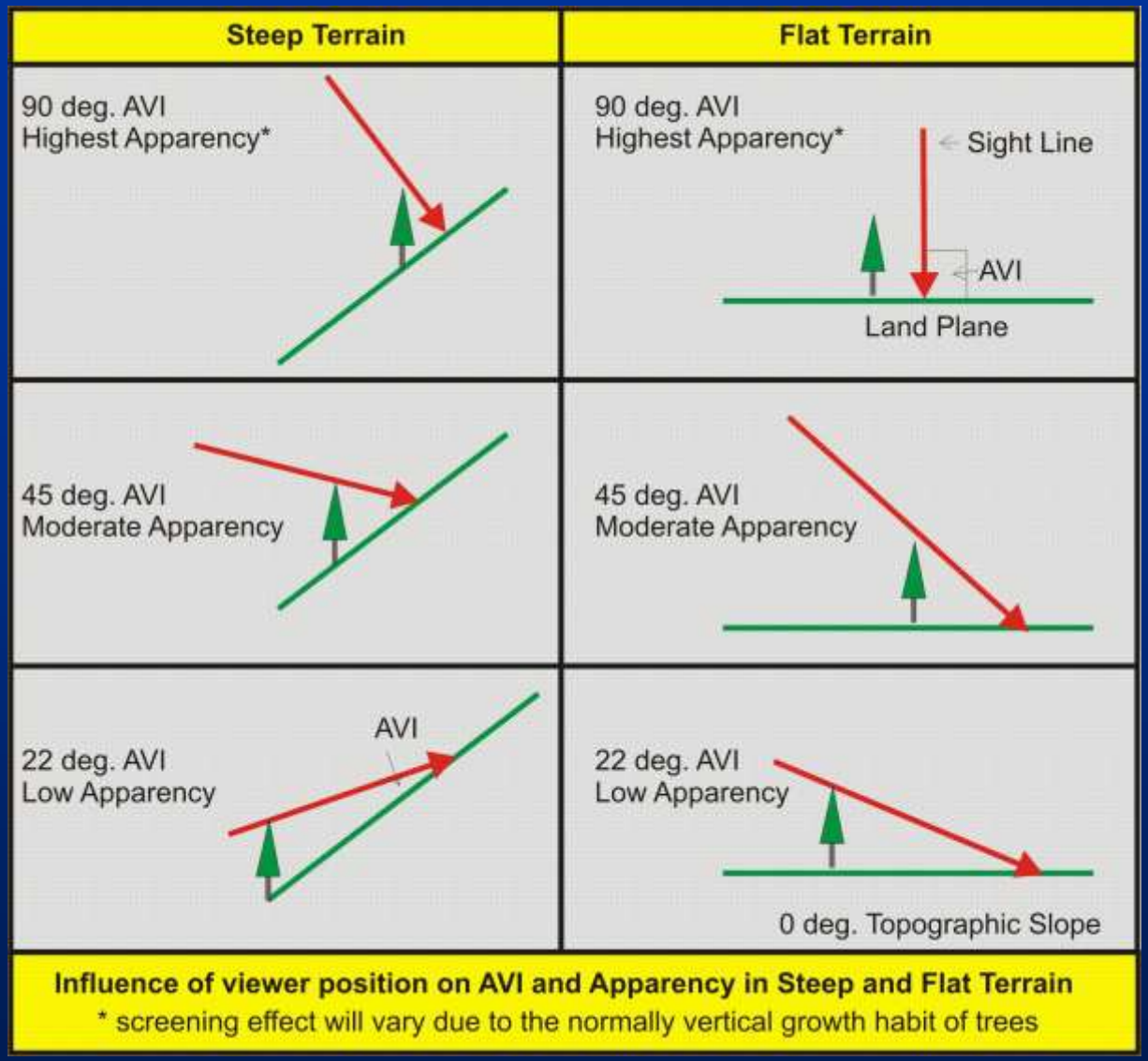
Slope	0%	10%	20%	30%	40%	50%	60%	70%+
P2P	4.68	3.77	3.04	2.45	1.98	1.60	1.29	1.04

The results subsequently were used to adjust the P2Ps used in timber supply review (BCMoF 2003). The standard is 2:1.

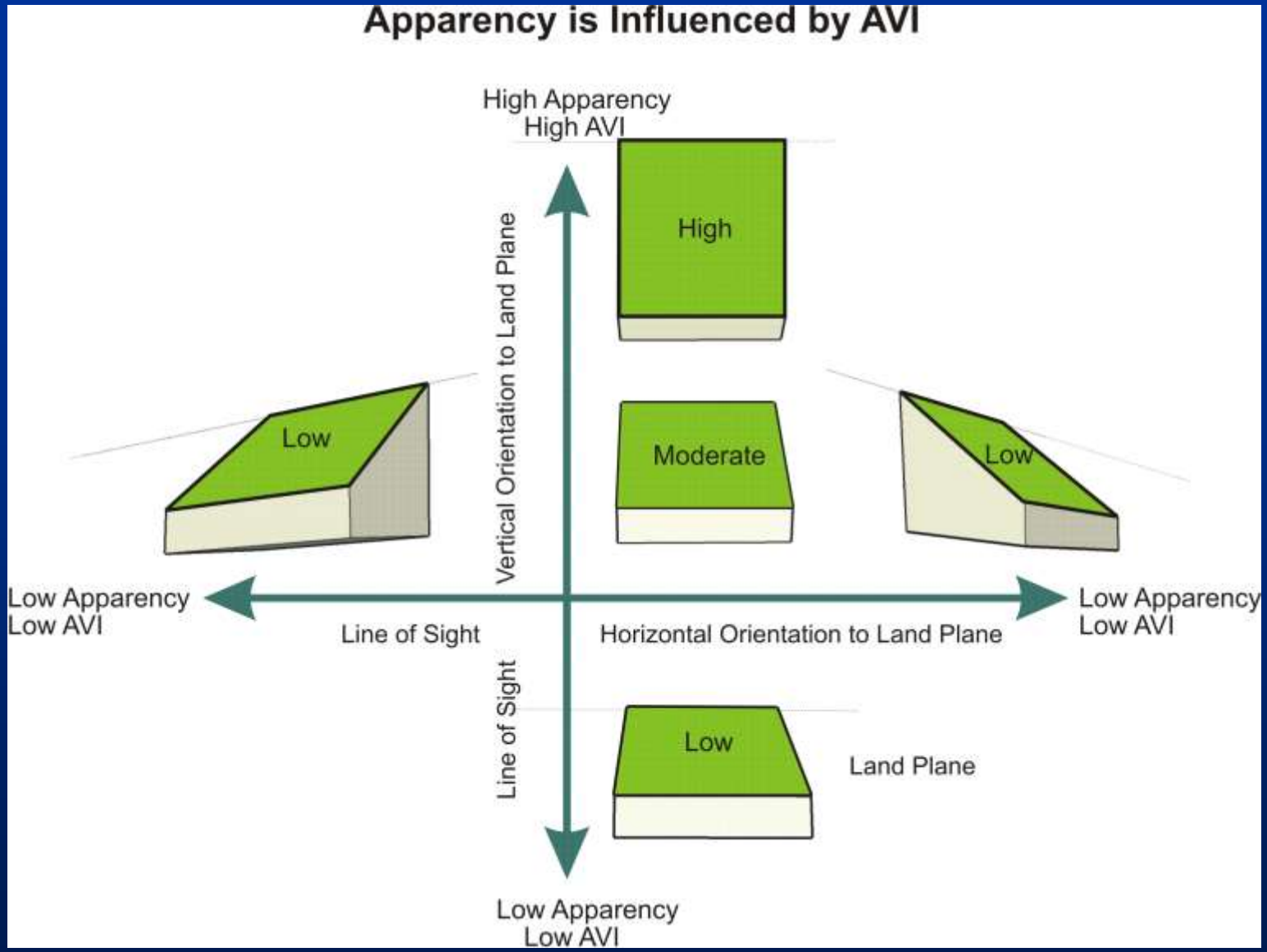
The findings indicated P2P could rise to as high as 14:1 for good design at 0% slope.

Multiple/Moving Viewpoints – Changing Perspectives

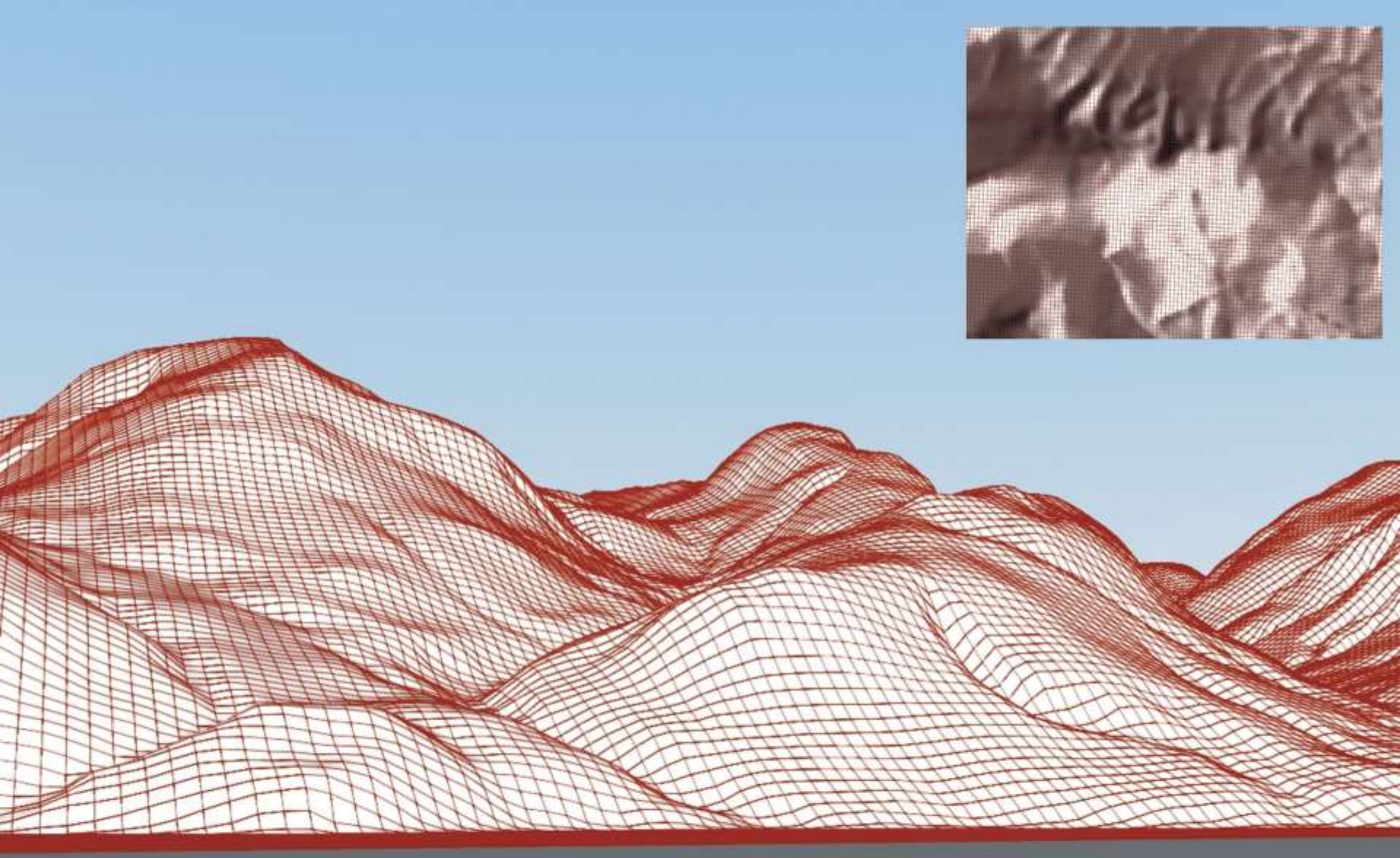
Pryce Channel - Left to Right Views



Viewer Position Affects AVI and Apparency in Steep and Flat Terrain.



Angle of Visual Incidence (AVI) is *the angle between the sight line and the land plane at the point of incidence*.

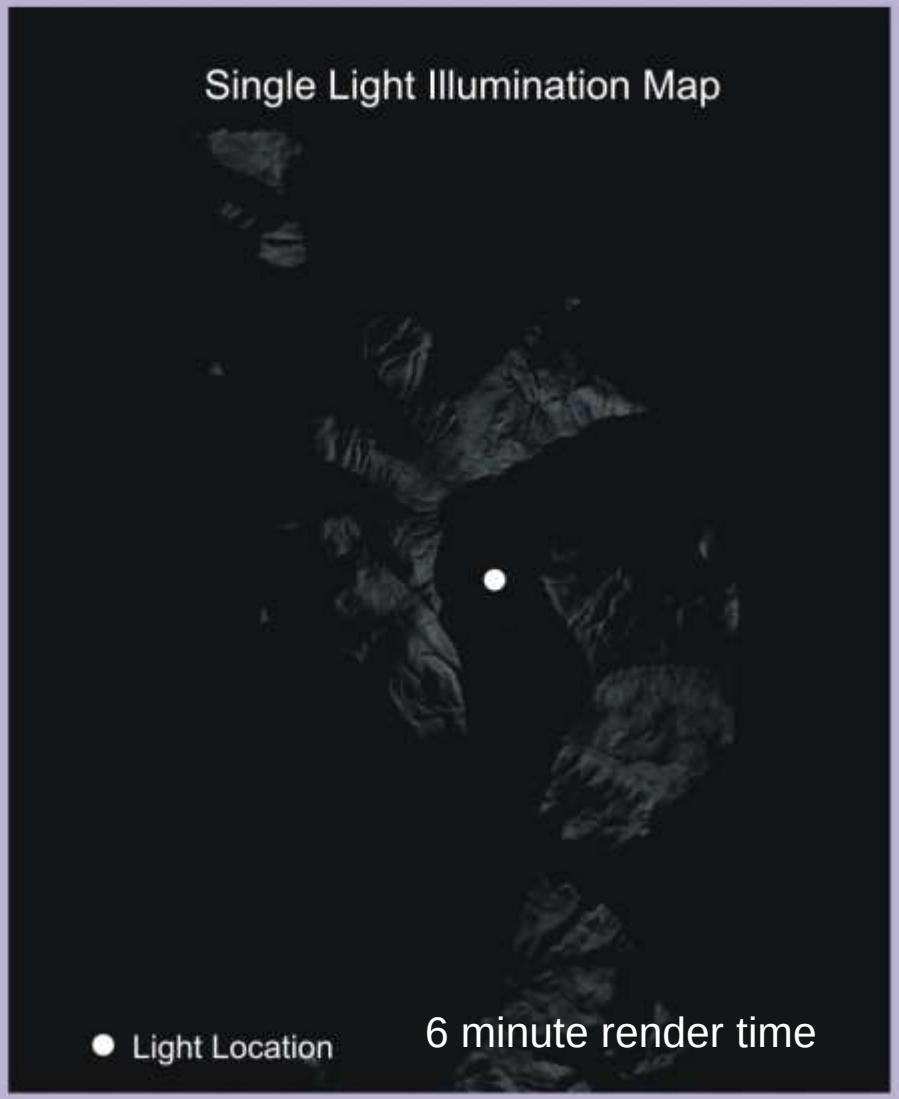


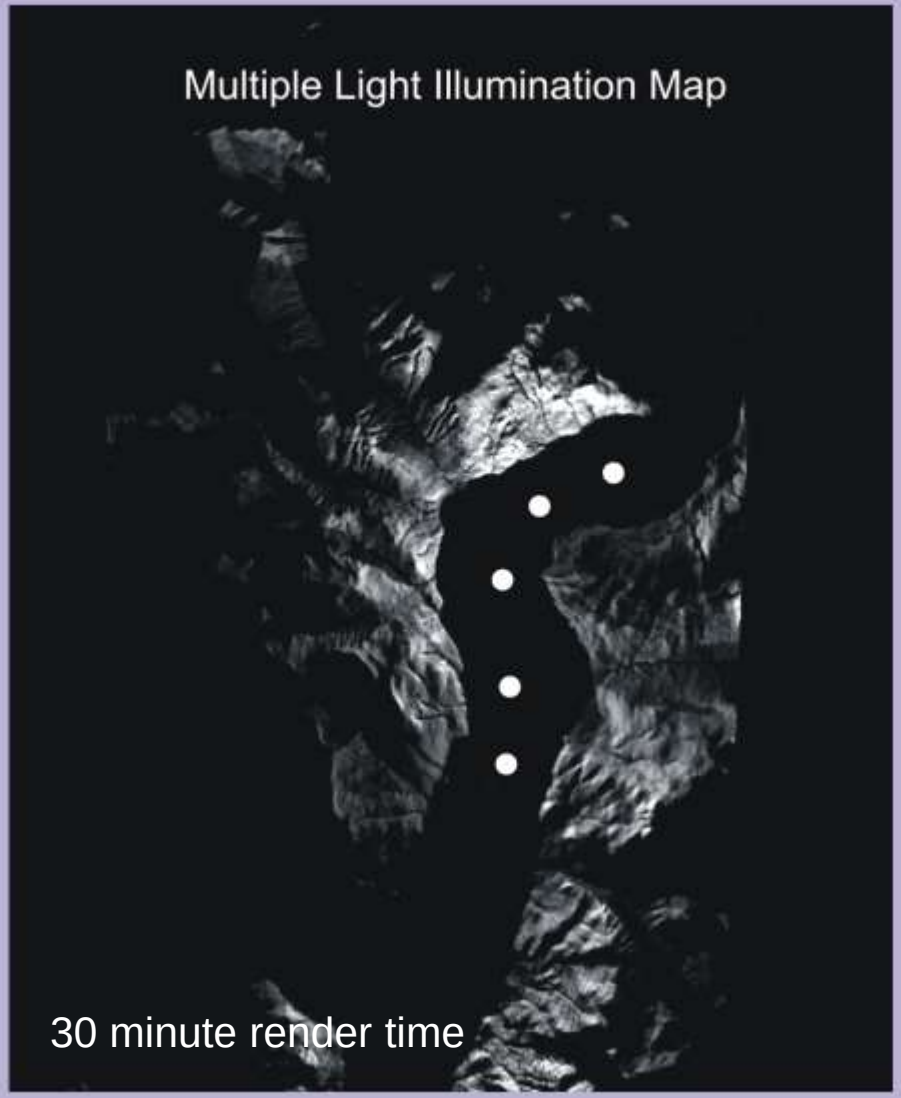
Angle of visual incidence and apparency affect the scale and shape of individual land planes relative to the viewpoint. Inset shows the planimetric pattern of 25 metre grid cells.

8. Building an Apparency Model:

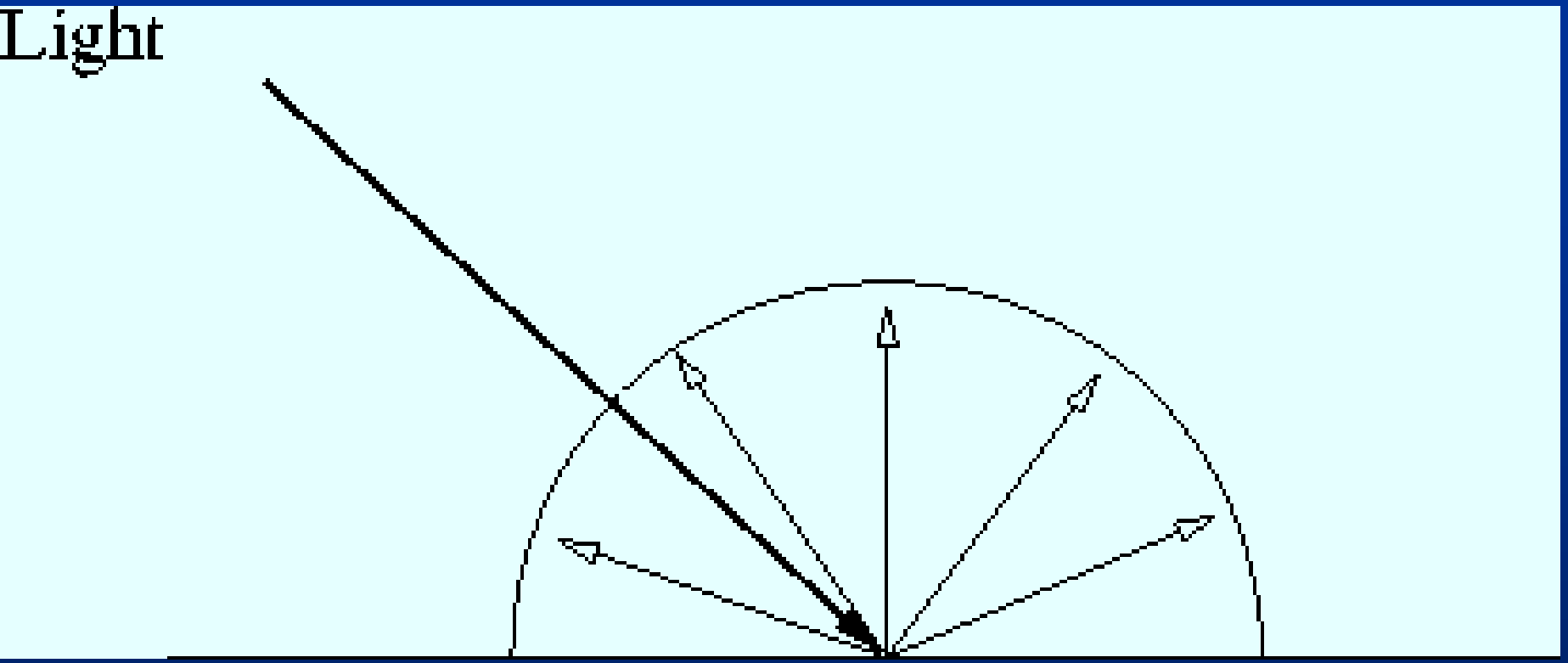
- ArcGIS and Visual Nature Studio (VNS)
- Illumination analog of cumulative "viewing" intensity
- Visual representation of angle of incidence
- Models what is seen and how it is seen (light intensity)
- Model ready for 3-D perspective visualization; design
- Map Classification; Multiple Attribute Analyses in ArcGIS
- Integrated Planning
- Automation (FPS-Atlas)

Howe Sound VNS Model



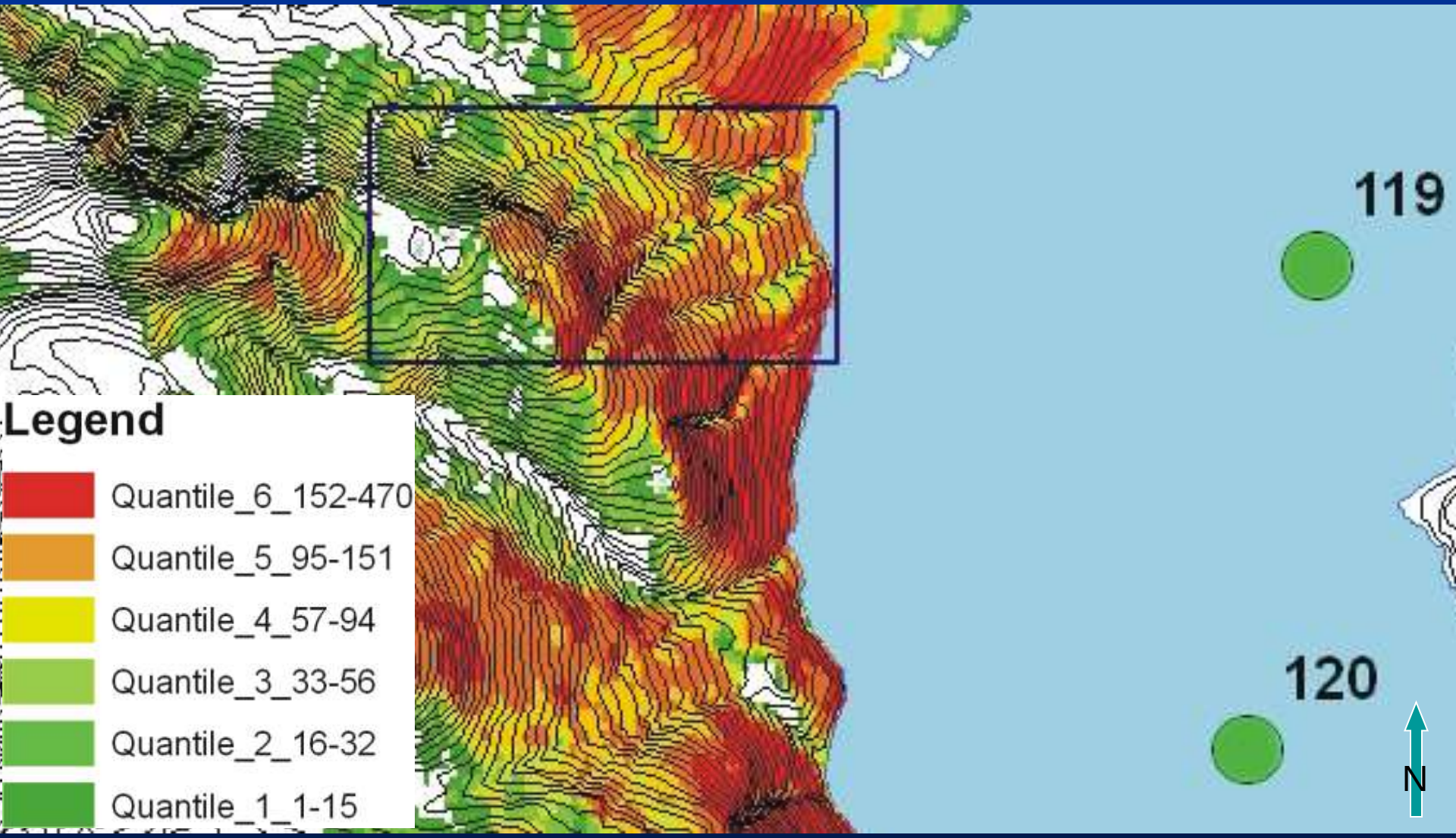


Apparency is determined from the intensity of illumination (reflected light) from each land plane in a digital terrain model. Render time varies with model size, lights, and number of shadow maps.



Light is reflected with equal intensity in all directions allowing measurement in planimetric (map) view

Five Viewpoint Cumulative Apparency Map Close-up



Scale Box 1km x 2km

9. Apparency Model
Internal Tests and Results

Landscape Apparency Internal Tests and Applications

Test Environment	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
	Terrain	Illumination	Classification	Integration	Applications A Strategic Planning	Applications B Tactical and Operational
Internal Trials, Tests, and Applications Results	Terrain model construction Other GIS	Light Placement Intensity, Reflectance Illumination / Shadow Maps Single and Cumulative Illumination maps	Classify into “equal area” quantiles Single light, cumulative lights Comparison with viewshed, times-seen, and slope mapping	GEOTIFFs to vector polygons Integration with other attributes	Percent alteration P2P tests	Integrated visual design Automated design (Atlas) Cutblock location Multiple attribute application
Projects	Howe Sound project; Nadina IVDP.	Pre-tests: Stella Lake; Dishtin.	Howe Sound project; Nadina IVDP.	Howe Sound; Nadina IVDP.	Howe Sound; Nadina.	Nadina IVDP; Atlas-Nadina; Howe Sound.

Apparency Results
Comparisons with Conventional Methods
(Highlights from Dissertation)

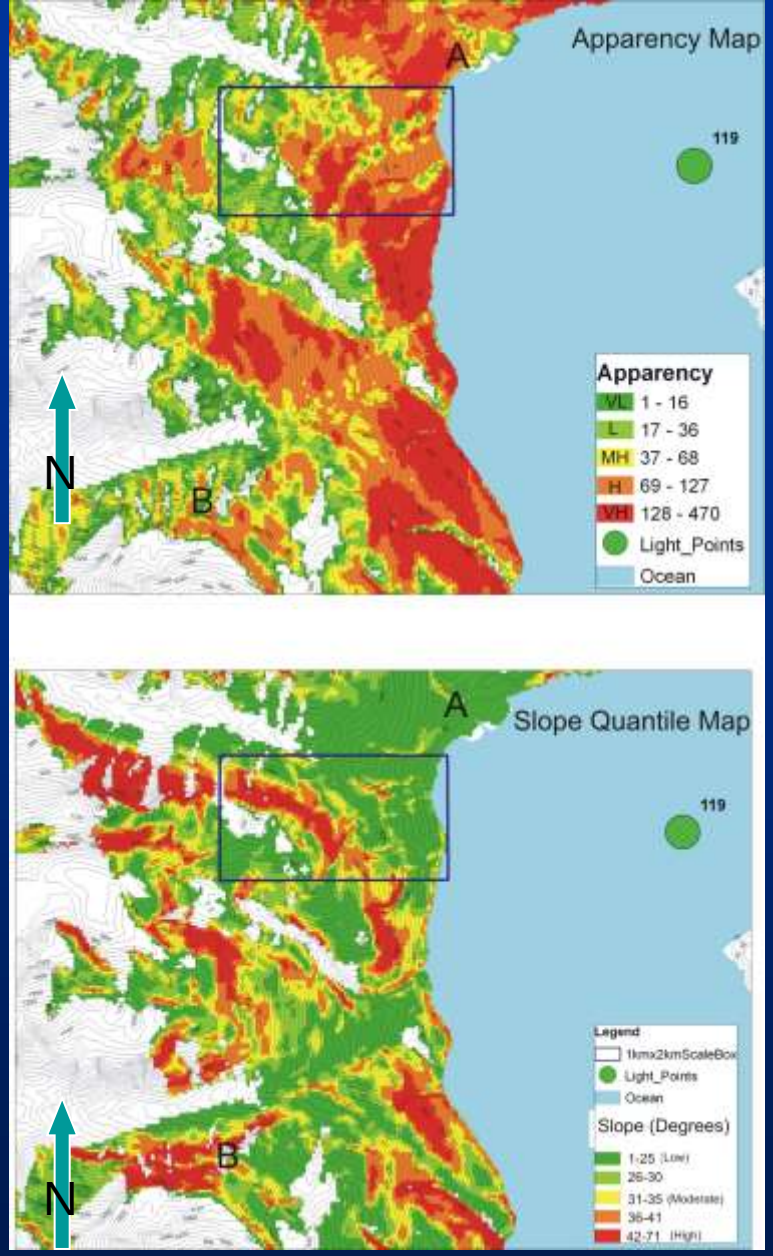
Test Area 1 – Howe Sound

Slope is a coarsely-rated (3-class) BCMOFR VAC factor and a moderator of VQO percent alteration in Timber Supply

"a crude axiom may be suggested:

the steeper the slope, the greater the potential for visual vulnerability."

Litton '73



Comparison of cumulative apparency and topographic slope analysis

Apparency Map

5 equal area quantiles

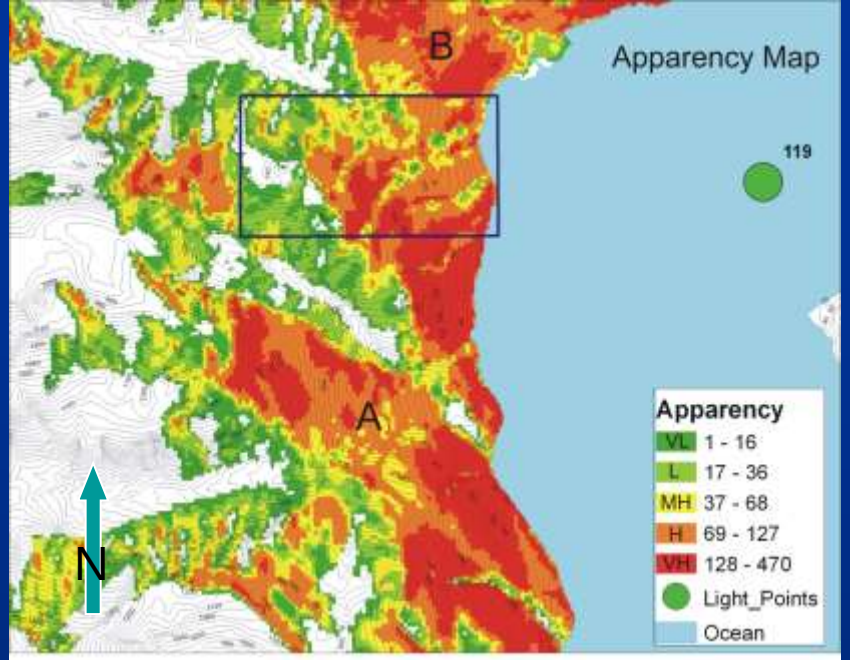
Compare areas marked "A" in each and "B" in each

Slope Map

5 equal area quantiles

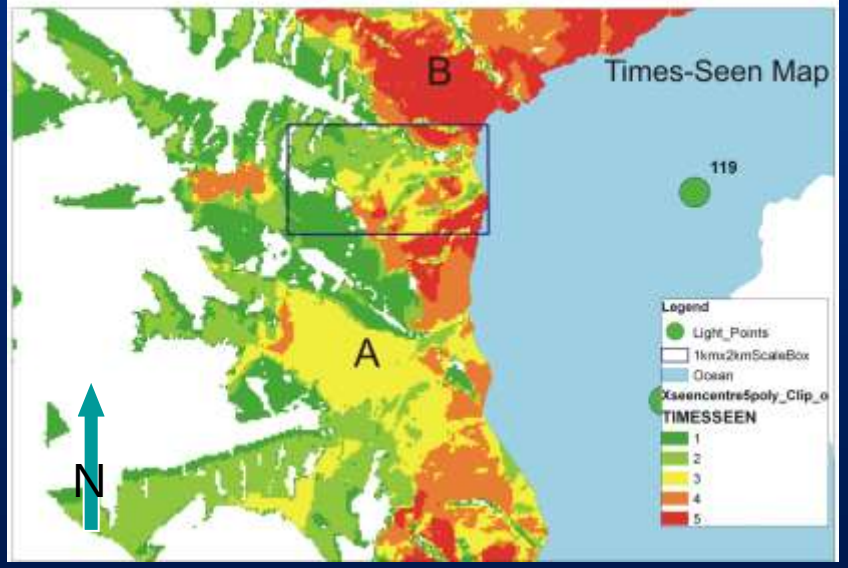
Times-seen is a conventional GIS measure emphasising areas of greater or lesser visibility by number of viewpoints observing a piece of land (visible or not visible only).

Not used in VLI.



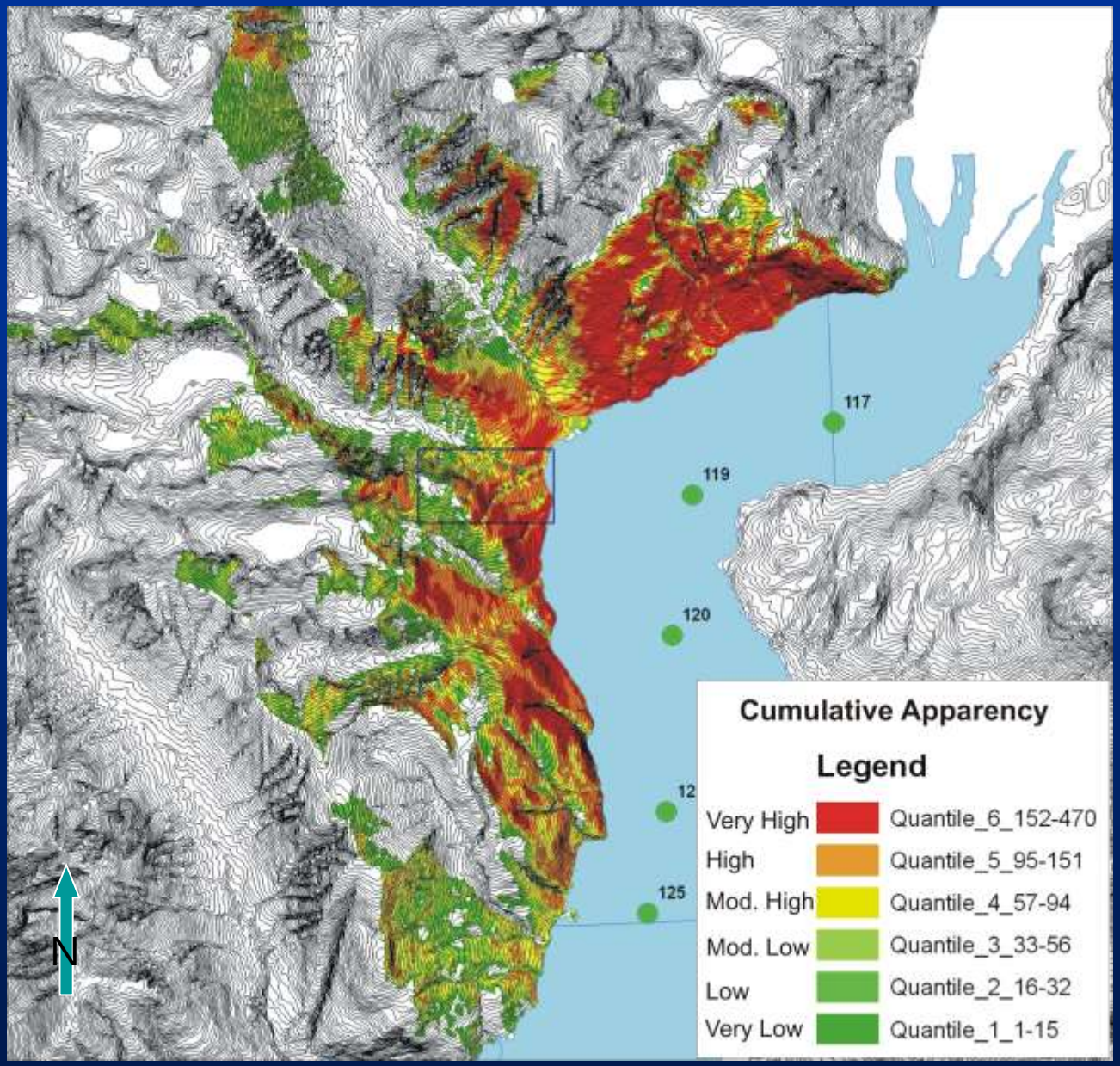
Apparency Map

Compare areas marked "A" in each and "B" in each



Times-seen Map (produced from 5 viewpoints)

Comparison of Howe Sound project cumulative apparency and times-seen



Cumulative apparency raster map with six classes of apparency Howe Sound west side model.

Howe Sound Apparency Quantile (equal area) Projections LCP117

(identifying visual risk and appearance if logged)

Quantile 1 – Very Low Risk (VL)

Quantile 2 – Low Risk (L)

Quantile 3 – Moderately Low Risk (ML)

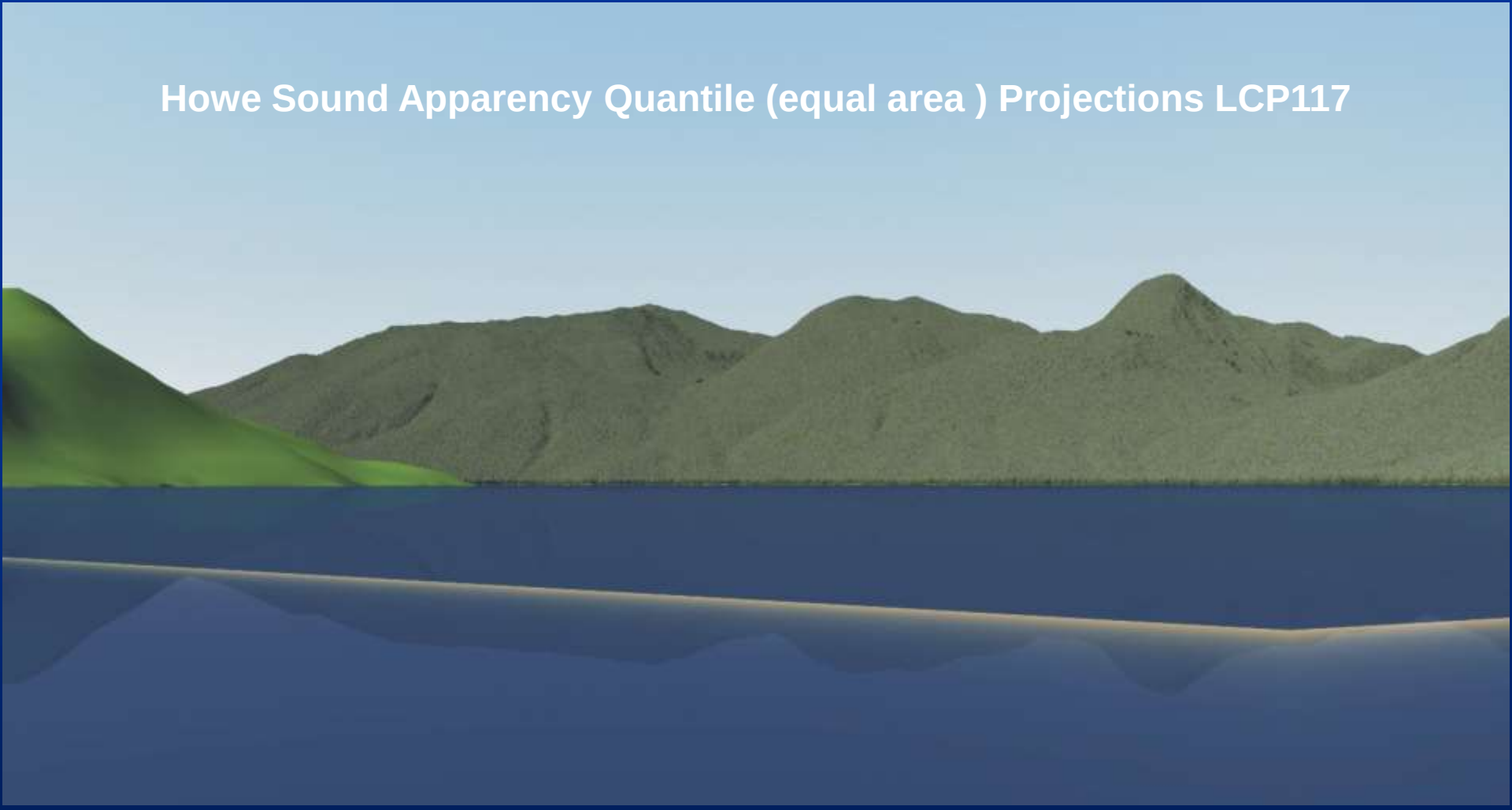
Quantile 4 – Moderately High Risk (MH)

Quantile 5 –High Risk (H)

Quantile 6 – Very High Risk (VH)

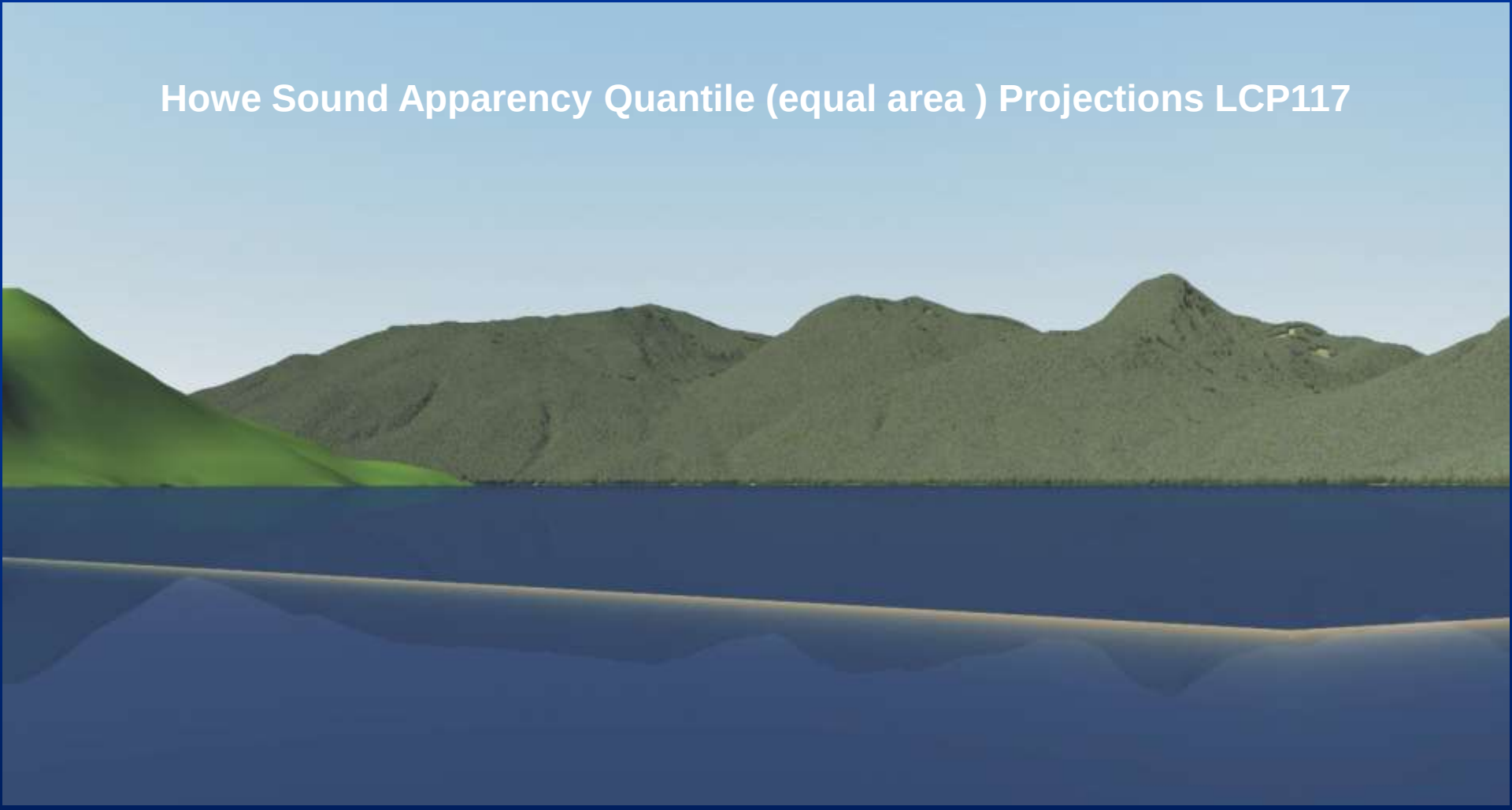
Default Forest Cover 25-30m Height

Howe Sound Apparency Quantile (equal area) Projections LCP117



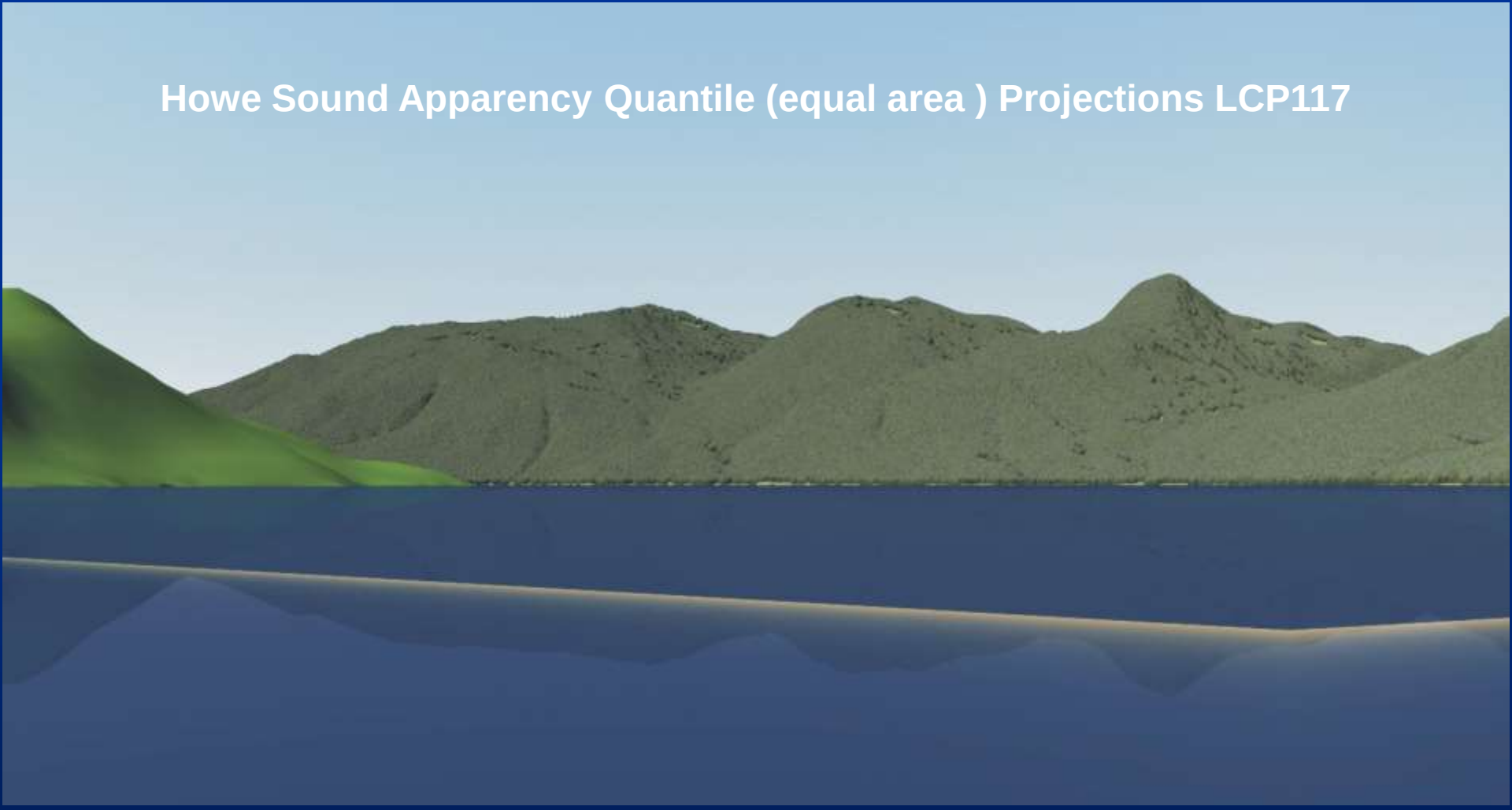
Quantile / Risk	Plan (%)	Pers. (%)	P2P
1 / VL	11	0.05	218:1

Howe Sound Apparency Quantile (equal area) Projections LCP117



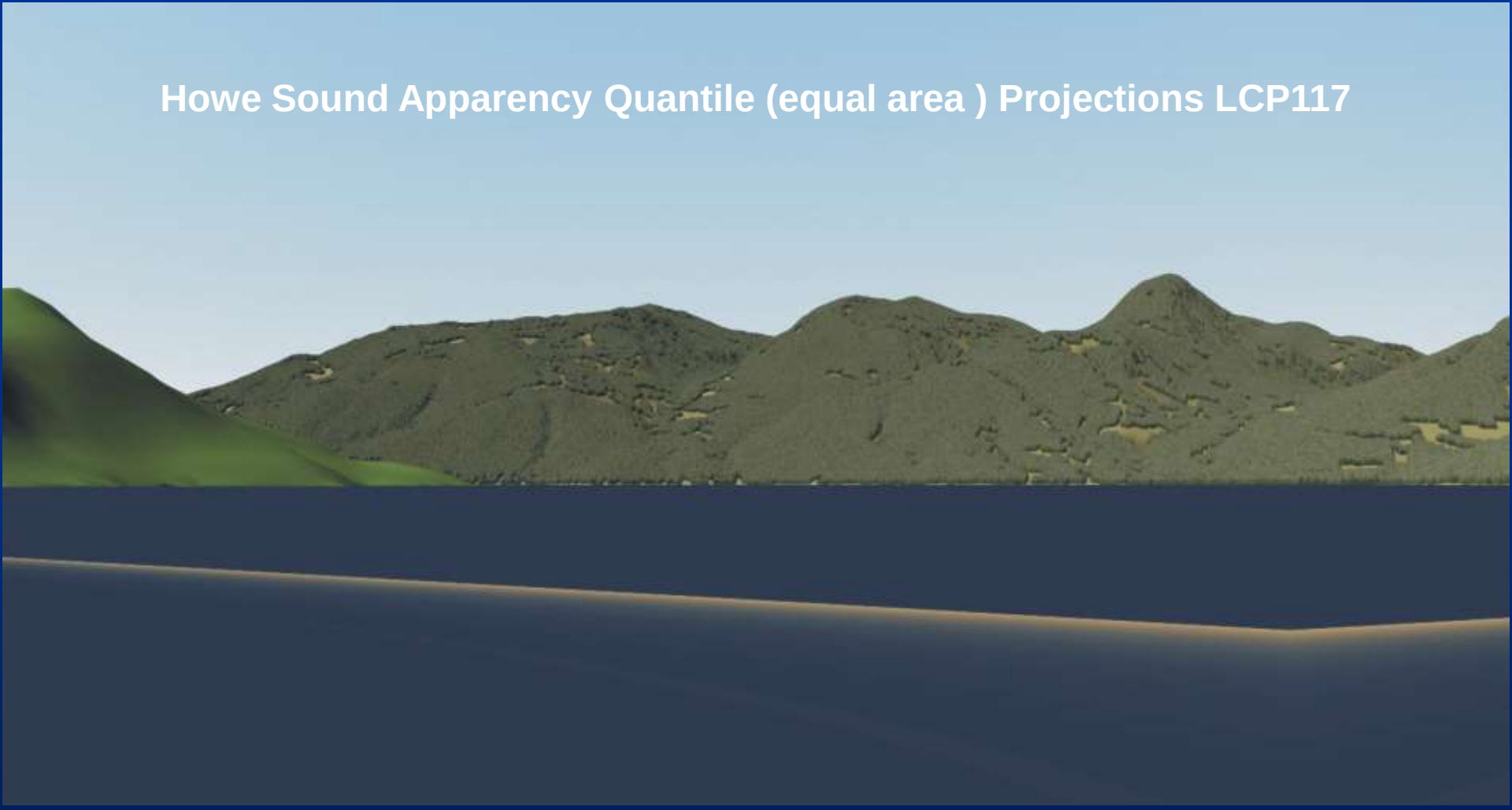
Quantile / Risk	Plan (%)	Pers. (%)	P2P
2 / L	12	0.2	89:1

Howe Sound Apparency Quantile (equal area) Projections LCP117



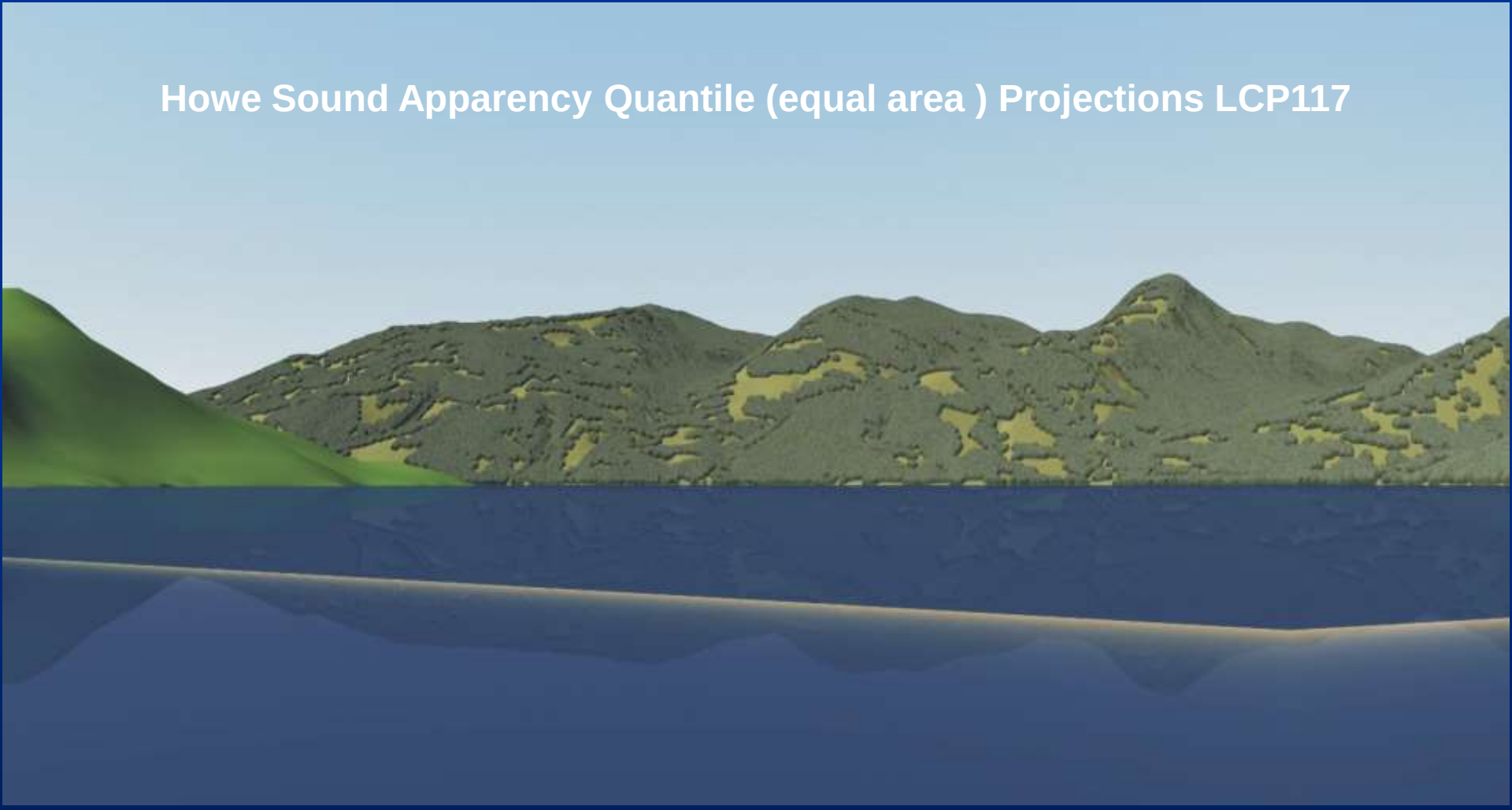
Quantile / Risk	Plan (%)	Pers. (%)	P2P
3 / ML	13	1	13:1

Howe Sound Apparency Quantile (equal area) Projections LCP117



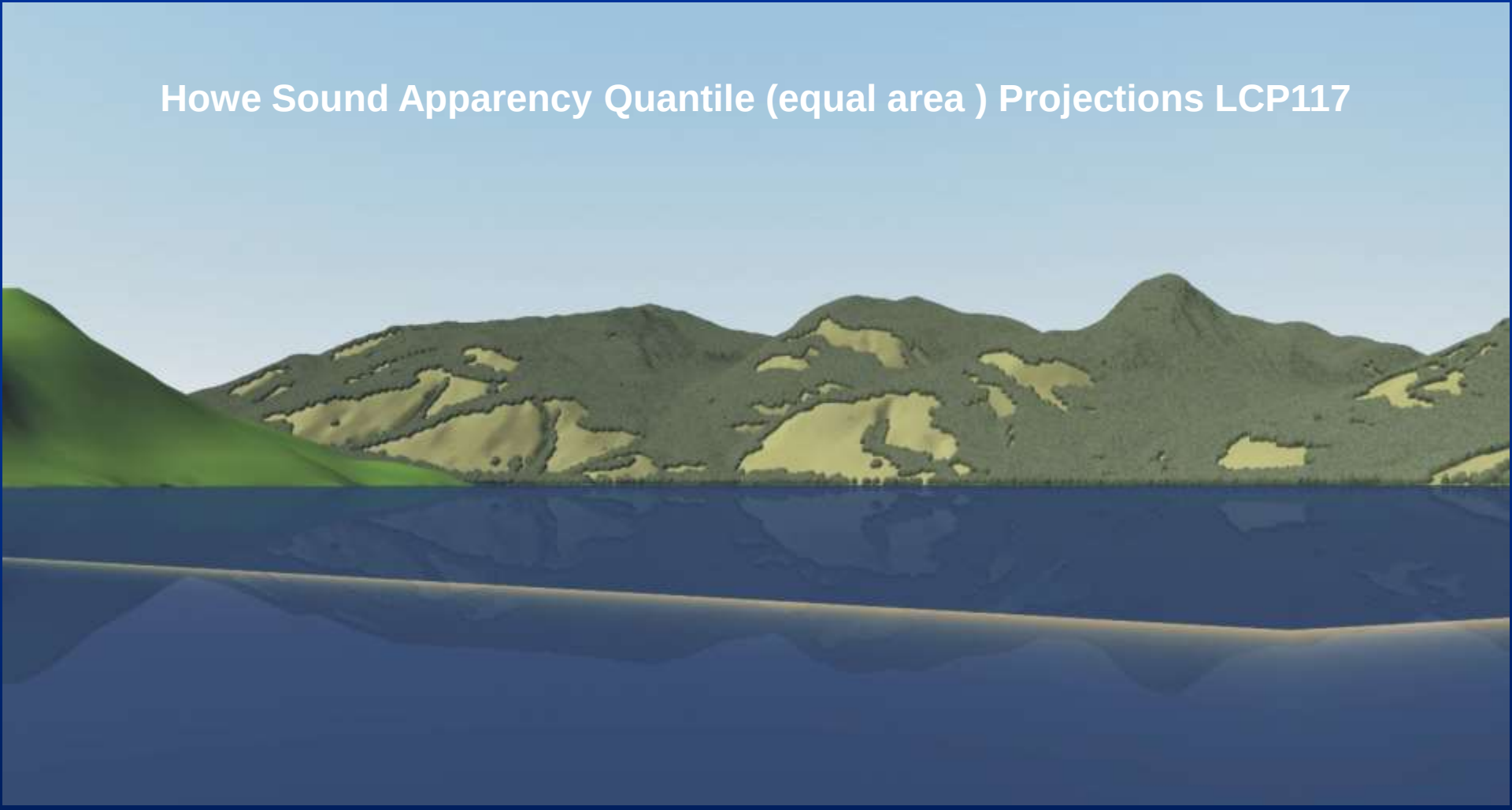
Quantile / Risk	Plan (%)	Pers. (%)	P2P
4 / MH	17	2.2	8:1

Howe Sound Apparency Quantile (equal area) Projections LCP117



Quantile / Risk	Plan (%)	Pers. (%)	P2P
5 / H	21	6.1	3.4:1

Howe Sound Apparency Quantile (equal area) Projections LCP117



Quantile / Risk	Plan (%)	Pers. (%)	P2P
6 / VH	26	50	0.5:1

Howe Sound Aggregated Apparency Quantile Projections LCP117

Aggregating Quantiles

1

1+2

1+2+3

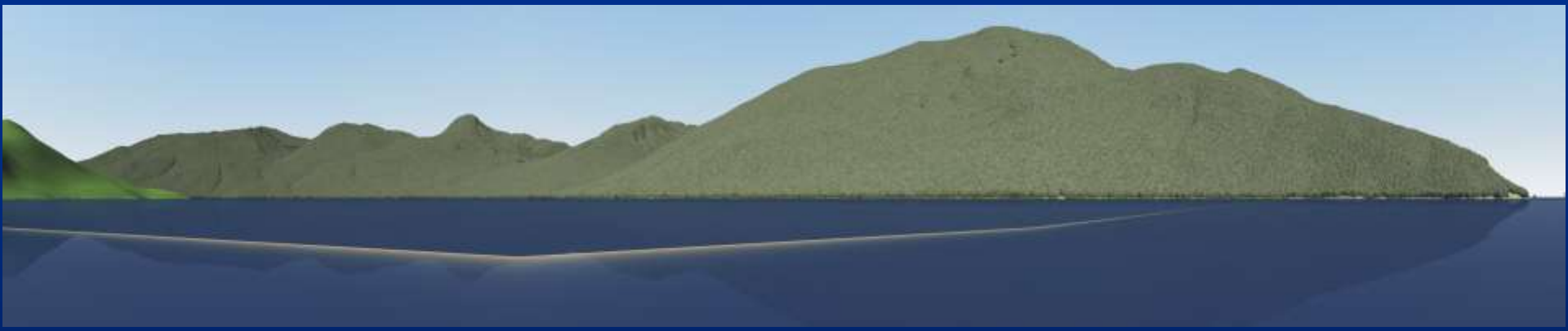
1+2+3+4

1+2+3+4+5

ALL

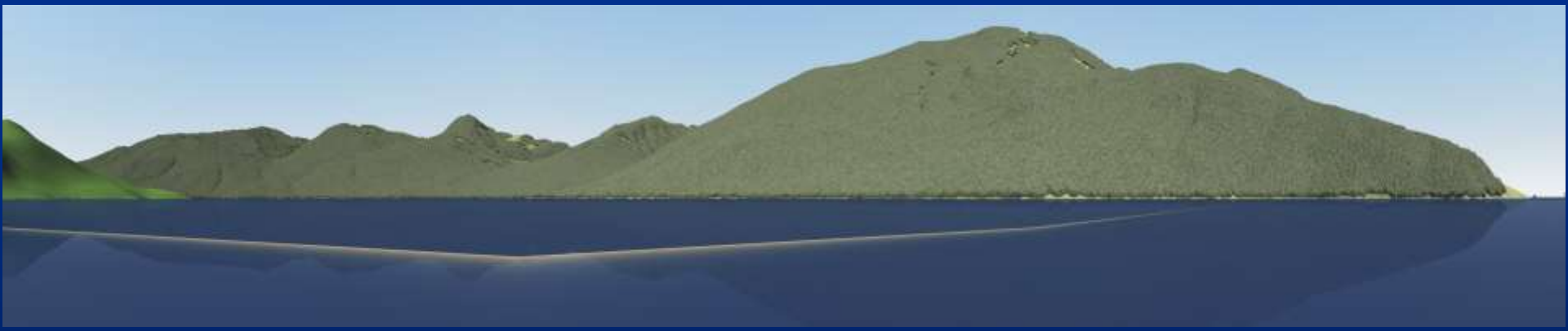
Default Forest Cover

Howe Sound Aggregated Apparency Quantile Projections LCP117



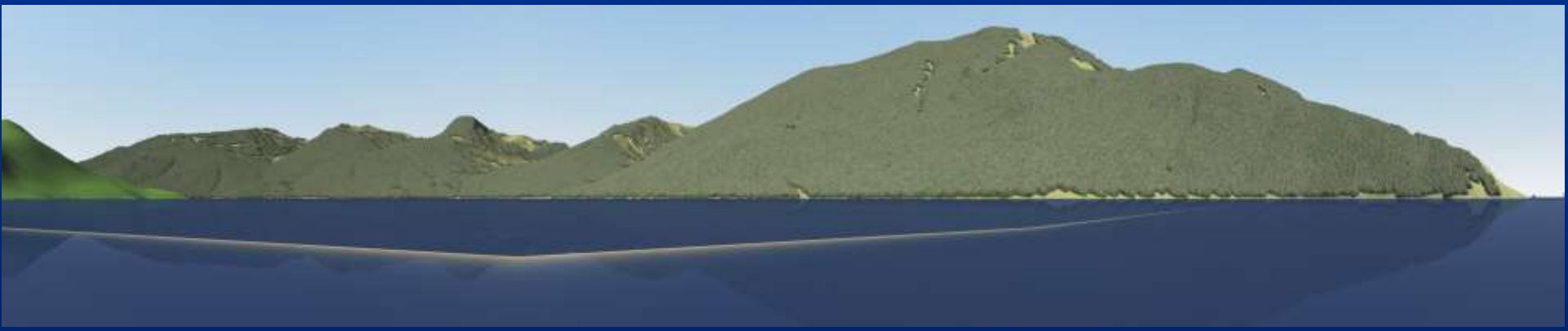
Quantile / Risk	Plan (%)	Pers. (%)	P2P
1 / VL	11	0.05	218:1

Howe Sound Aggregated Apparency Quantile Projections LCP117



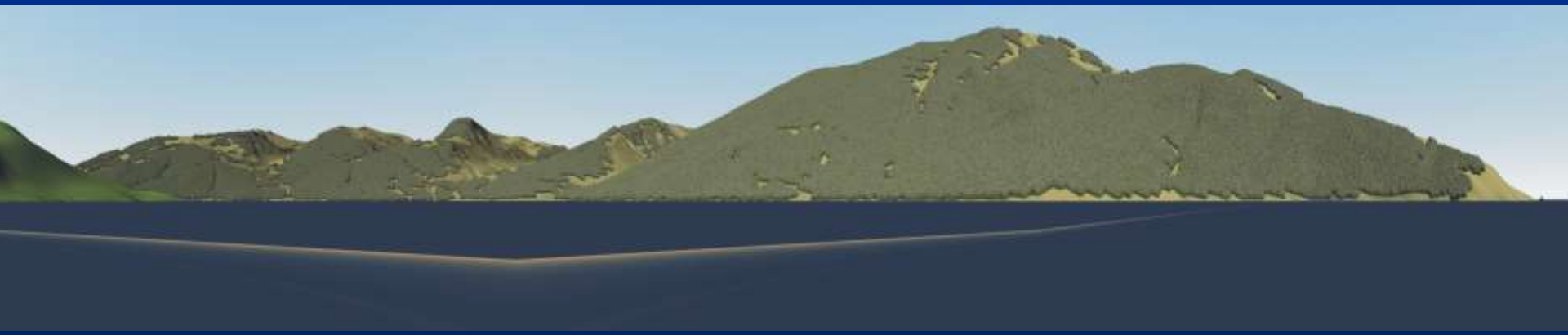
Quantiles / Risk	Plan (%)	Pers. (%)	P2P
1-2 / VL-L	23	1	23:1

Howe Sound Aggregated Apparency Quantile Projections LCP117



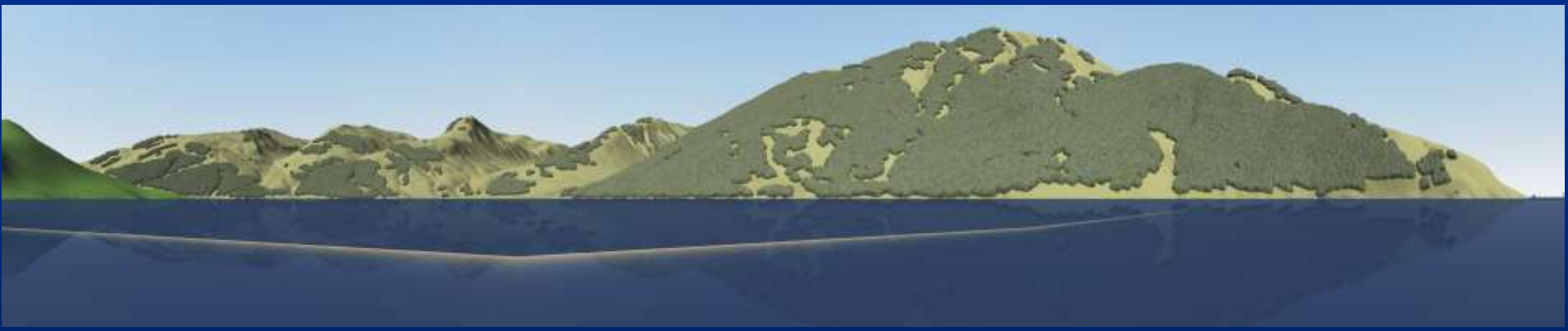
Quantiles / Risk	Plan (%)	Pers. (%)	P2P
1-3 / VL-L-ML	36	4.3	8:1

Howe Sound Aggregated Apparency Quantile Projections LCP117



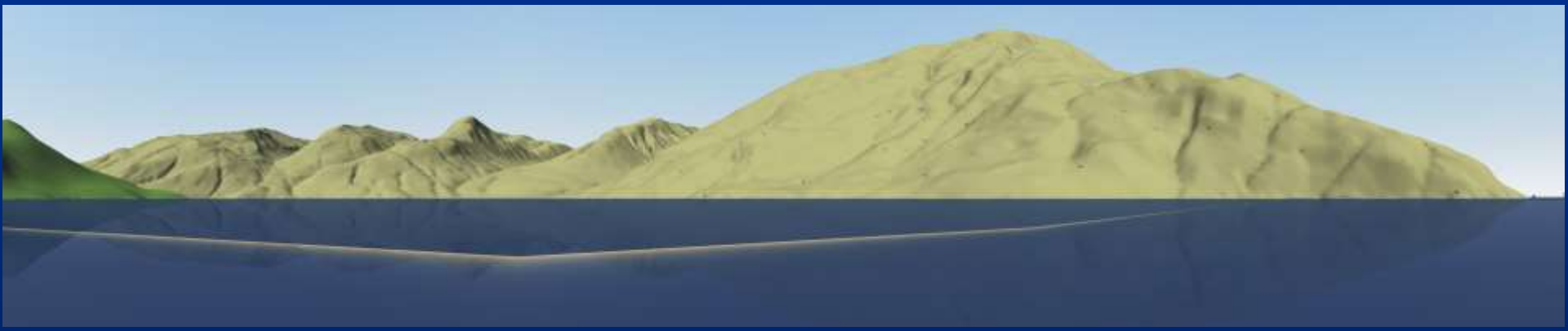
Quantiles / Risk	Plan (%)	Pers. (%)	P2P
1-4/ VL-L-ML-MH	53	12	4:1

Howe Sound Aggregated Apparency Quantile Projections LCP117



Quantiles / Risk	Plan (%)	Pers. (%)	P2P
1-5 / VL-L-ML-MH-H	74	28	2.6:1

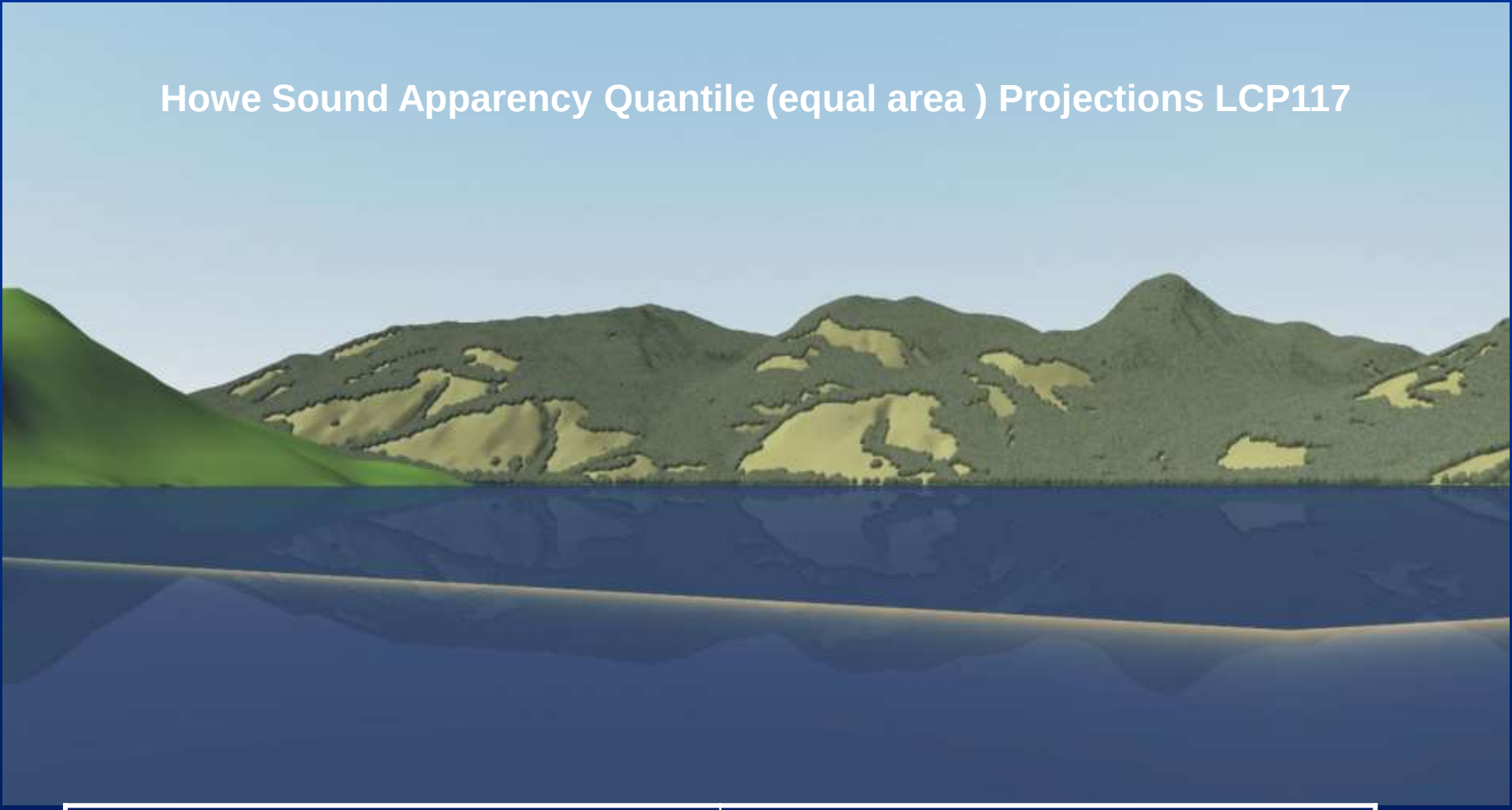
Howe Sound Aggregated Apparency Quantile Projections LCP117



Model Validated – all trees taken

Quantiles / Risk	Plan (%)	Pers. (%)	P2P
1-6 / All	100	100	1:1

Howe Sound Apparency Quantile (equal area) Projections LCP117

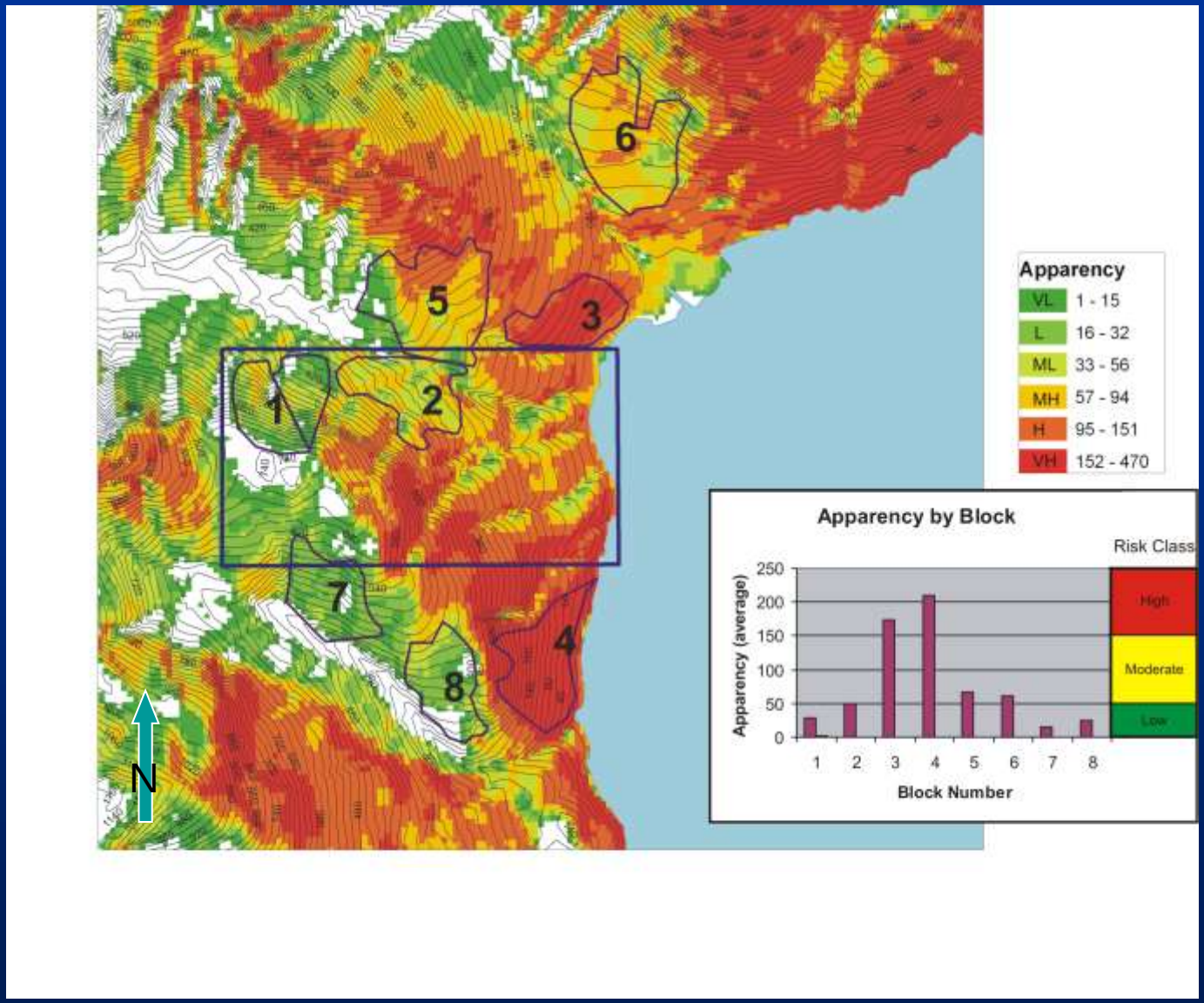


Conclusions of Howe Sound Test	Limitations
Consequences of apparency	Not a plan; no design
Learning opportunity with landbase	No other constraints at this point
Detailed P2P with tree screening	Generic forest
inherent design; lines of force, etc.	DEM limitation – accuracy/resolution

Test Area 1 – Howe Sound

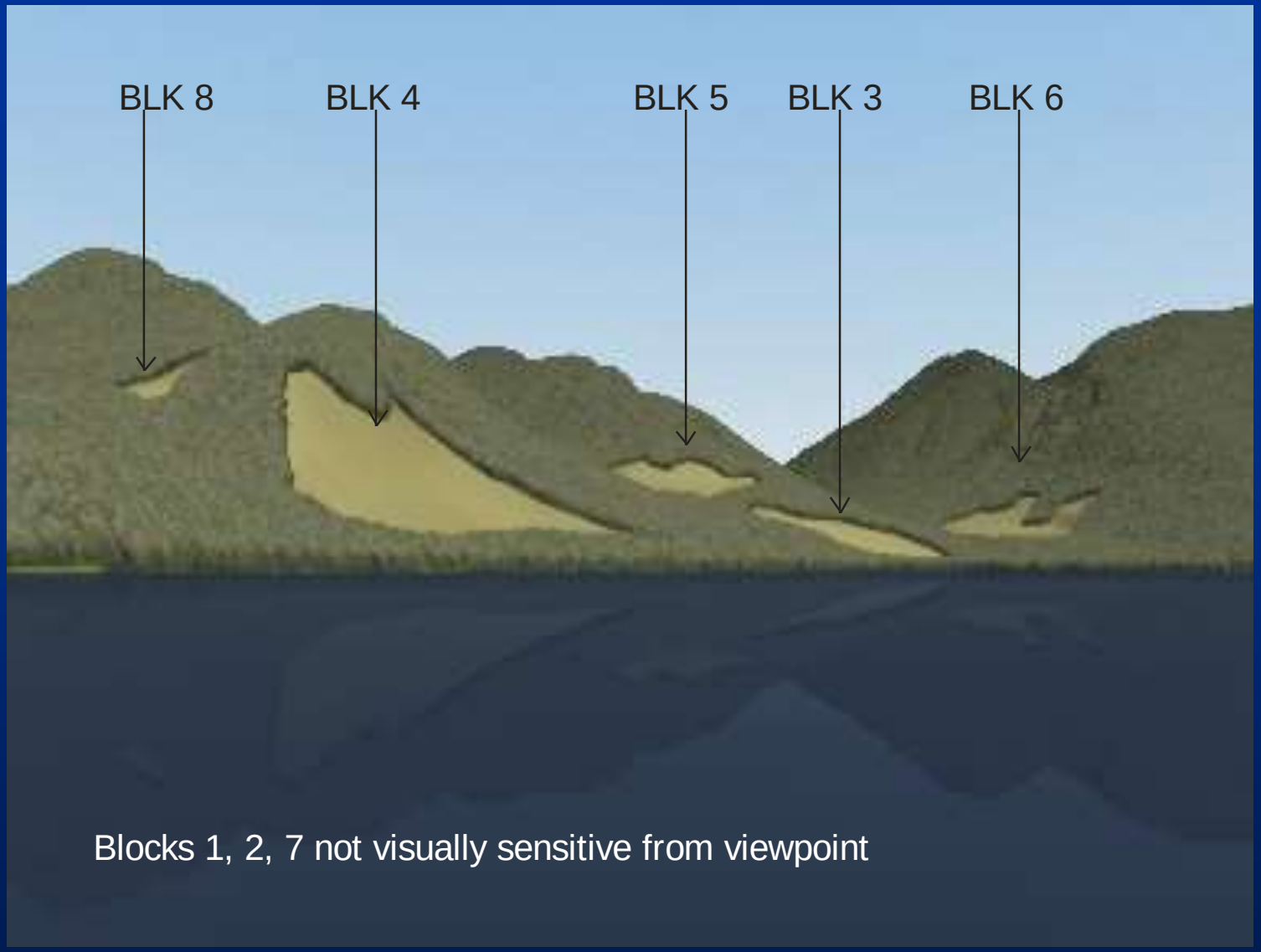
B. Harvest Layout Trial –

Using Apparency as a Test, Assisting Manual Design



Howe Sound Harvest Cutblock Location Test

Figure 101 Howe Sound harvest cutblock location test in higher and lower cumulative apparency areas, with average apparency calculated per cutblock, and coded by risk class (high, medium, low).



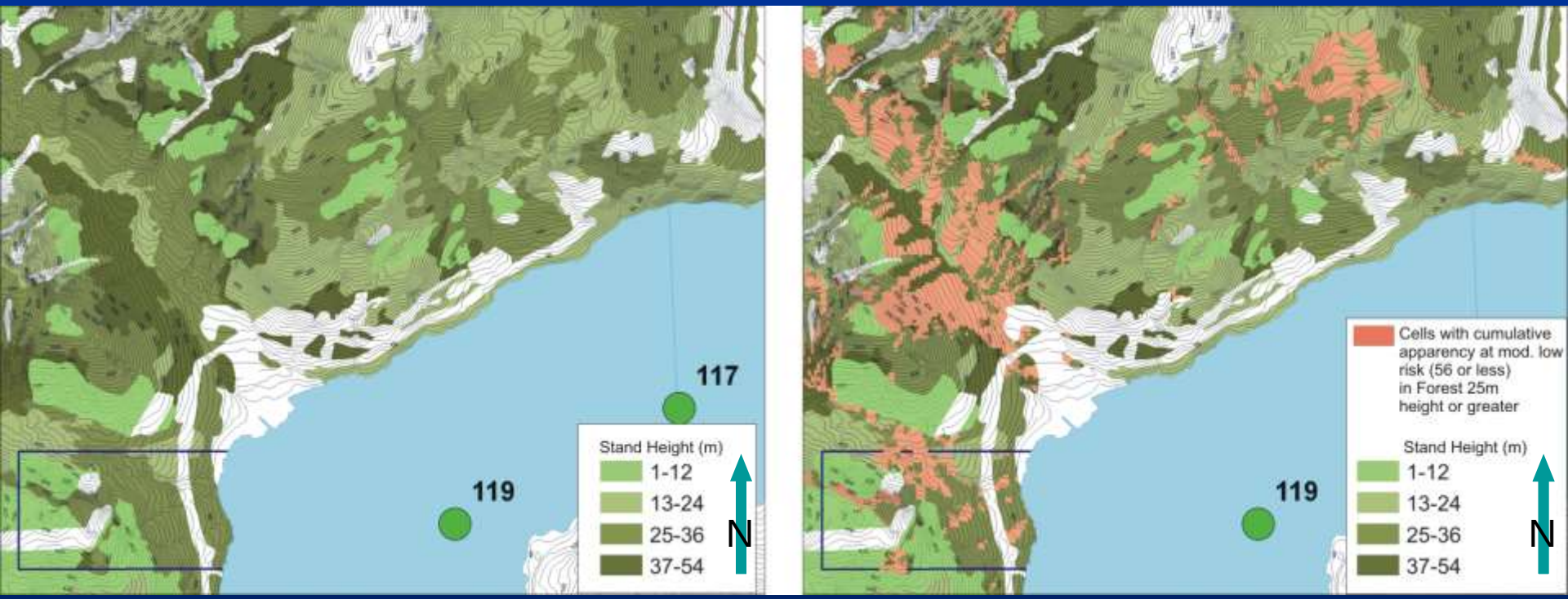
Howe Sound Harvest Cutblock Location Test

Figure 104 Trial cutblock locations selected by levels of apparency; appearance from LCP 119.

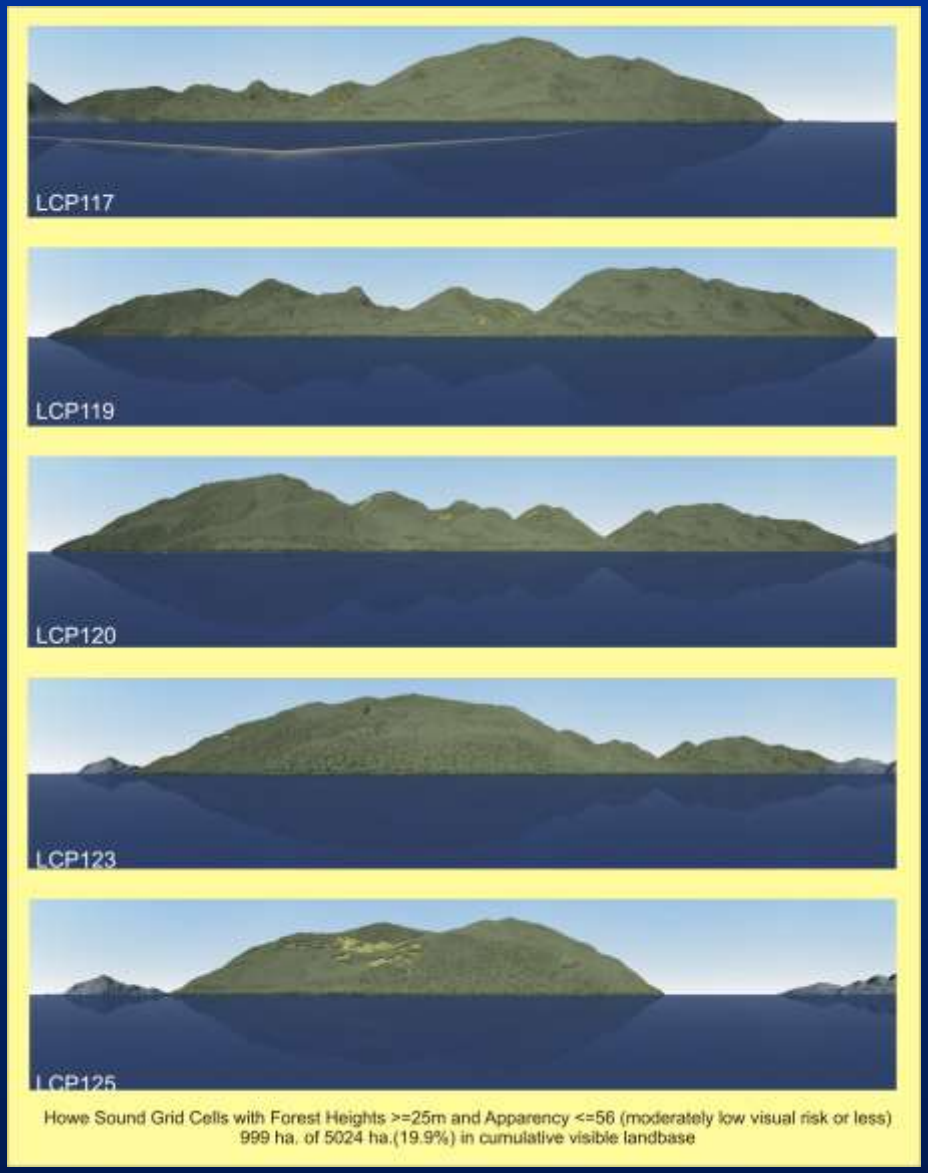
Test Area 1 – Howe Sound

C. Apparency-Forest Cover Selection Trial to Test Integration with Other Resources

– Finding Low Visual Risk Mature Timber as Provided from Vegetation Resources Inventory



Cell selection by tree height attribute (25m or greater) and moderately low or low apparency (visual risk) in ArcMap (right image: selected cells in pink).



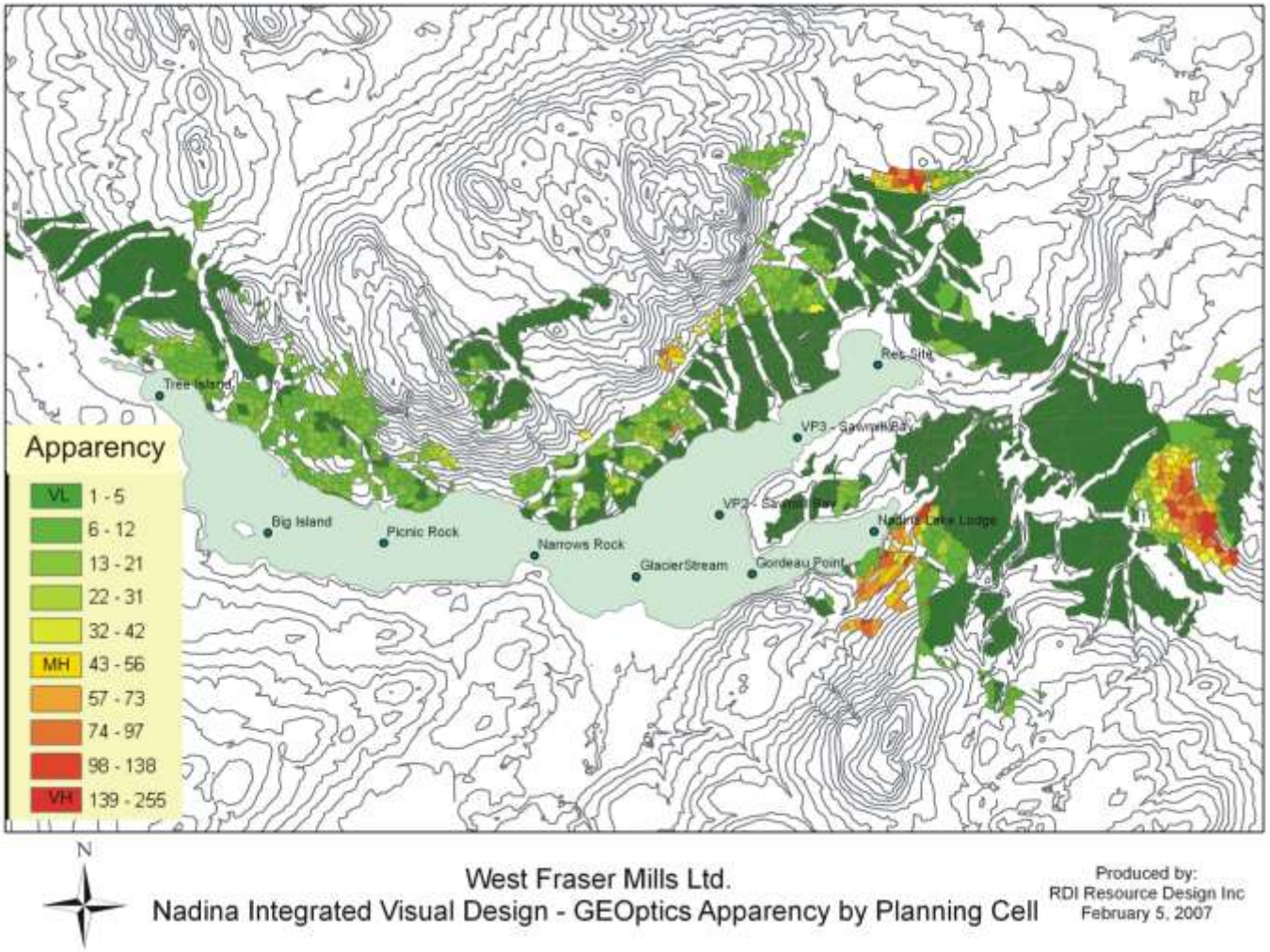
Cell selection by tree height attribute, Howe Sound model, all viewpoints
Visual results, if selected cells were harvested,
grid cells selected by forest height from VRI, 25m height or greater,
and cumulative apparency, moderately low to very low visual risk).

Conclusions of Howe Sound Tests	Limitations
Selecting by apparency and forest height Consequences of apparency Learning opportunity with landbase Correct P2P with tree screening using actual forest cover inherent design; lines of force, etc.	Not a plan; no design No other constraints at this point

Test Area 2 – Nadina Lake

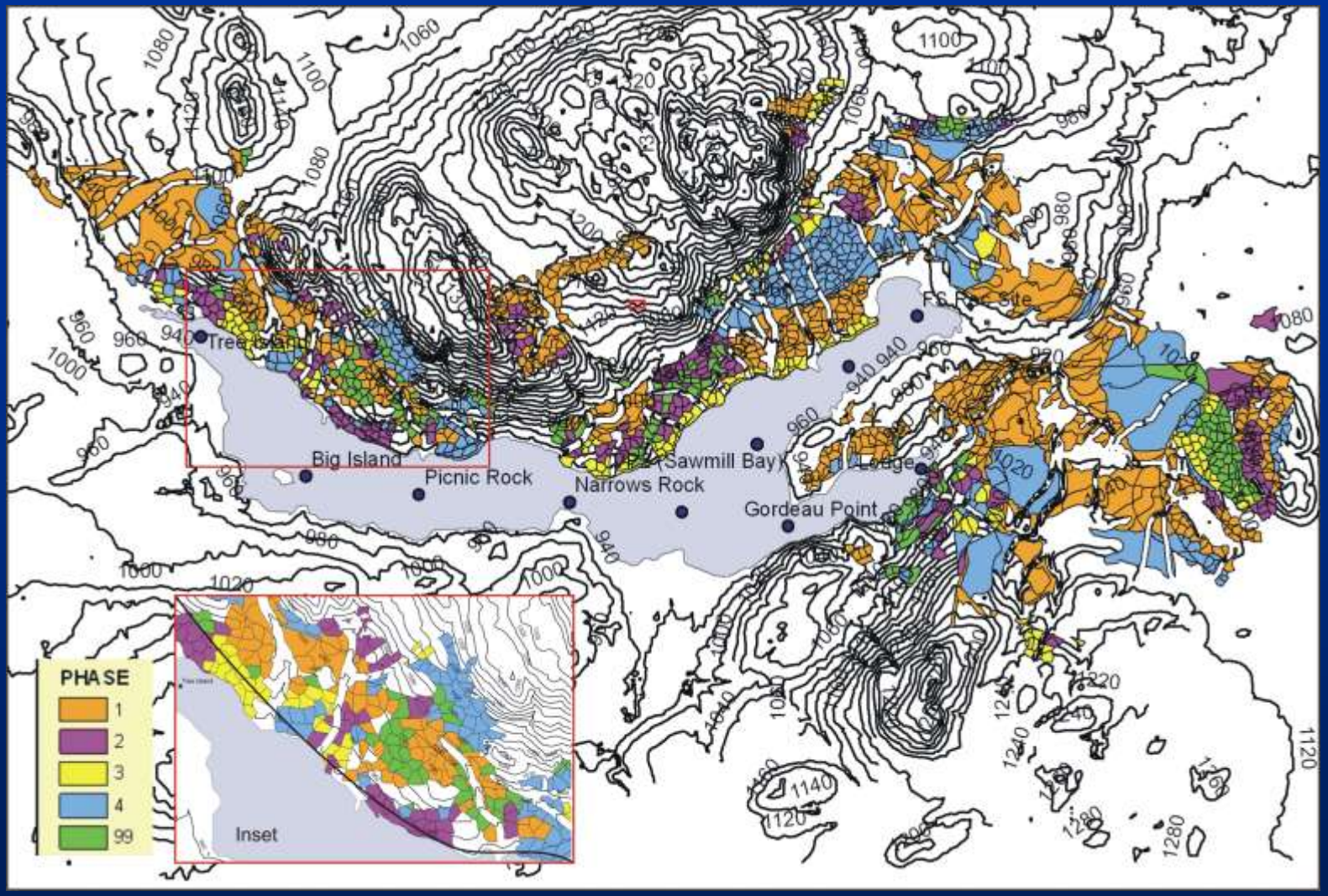
A. Integrated Visual Design Plan to provide full rotation harvest plan of beetle infested timber, using apparency to guide scheduling and design
Four 20-year passes

(RDI Commercial Application)



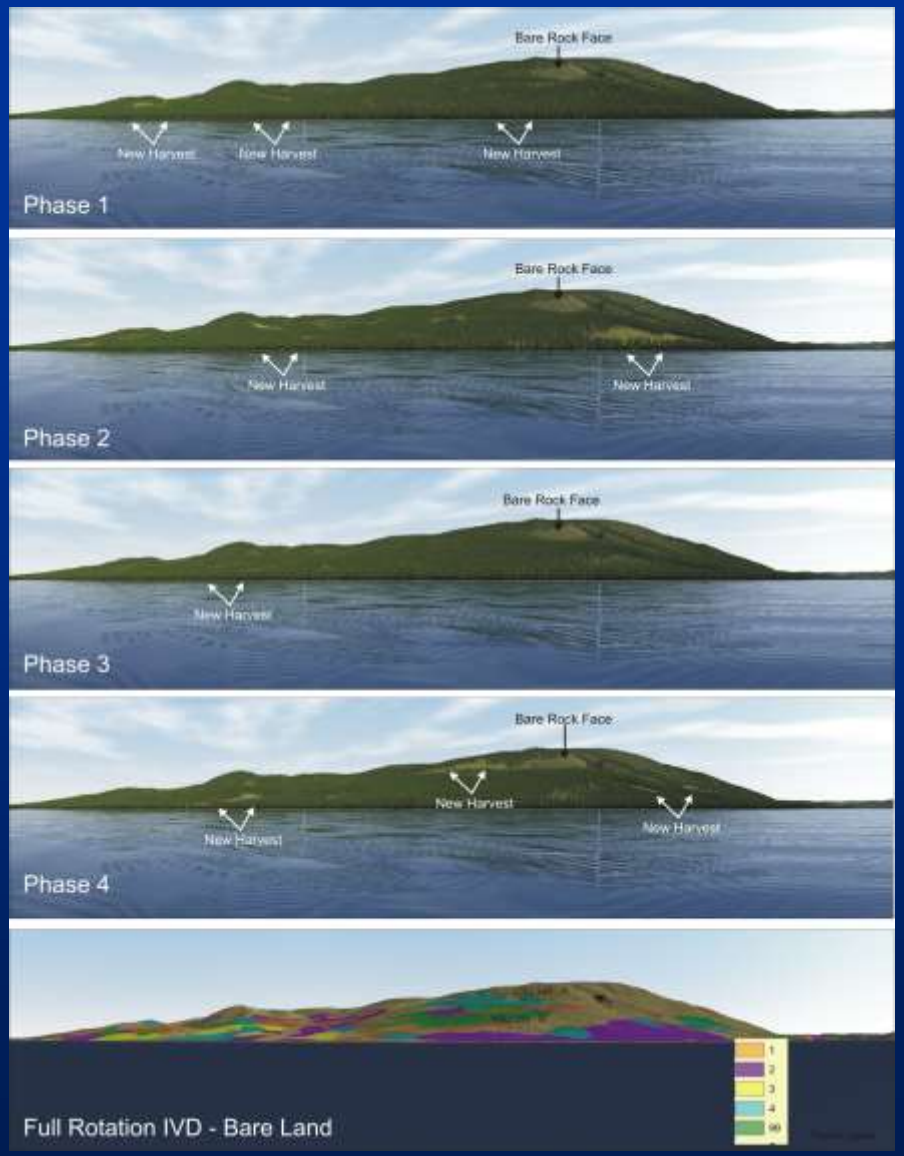
Nadina Lake Integrated Visual Design Plan

Figure **83 Apparency value is assigned to each potential harvest unit to provide guidance when scheduling the units for harvest phase.**



Nadina Lake Integrated Visual Design Plan

Figure 84 Four pass scheduling to meet VQOs applied to treatment units based on cumulative apparency and iterative testing with perspective visualizations, with inset showing closer view of treatment units; Class 99 units were not set to a schedule.



Nadina Lake Integrated Visual Design Plan

Figure 85 Four-pass schedule projected from the Big Island viewpoint, with all phases shown in bare land image at bottom, with legend. Phase 99 (not scheduled for harvest) is evident in the bottom image, classified by phase.

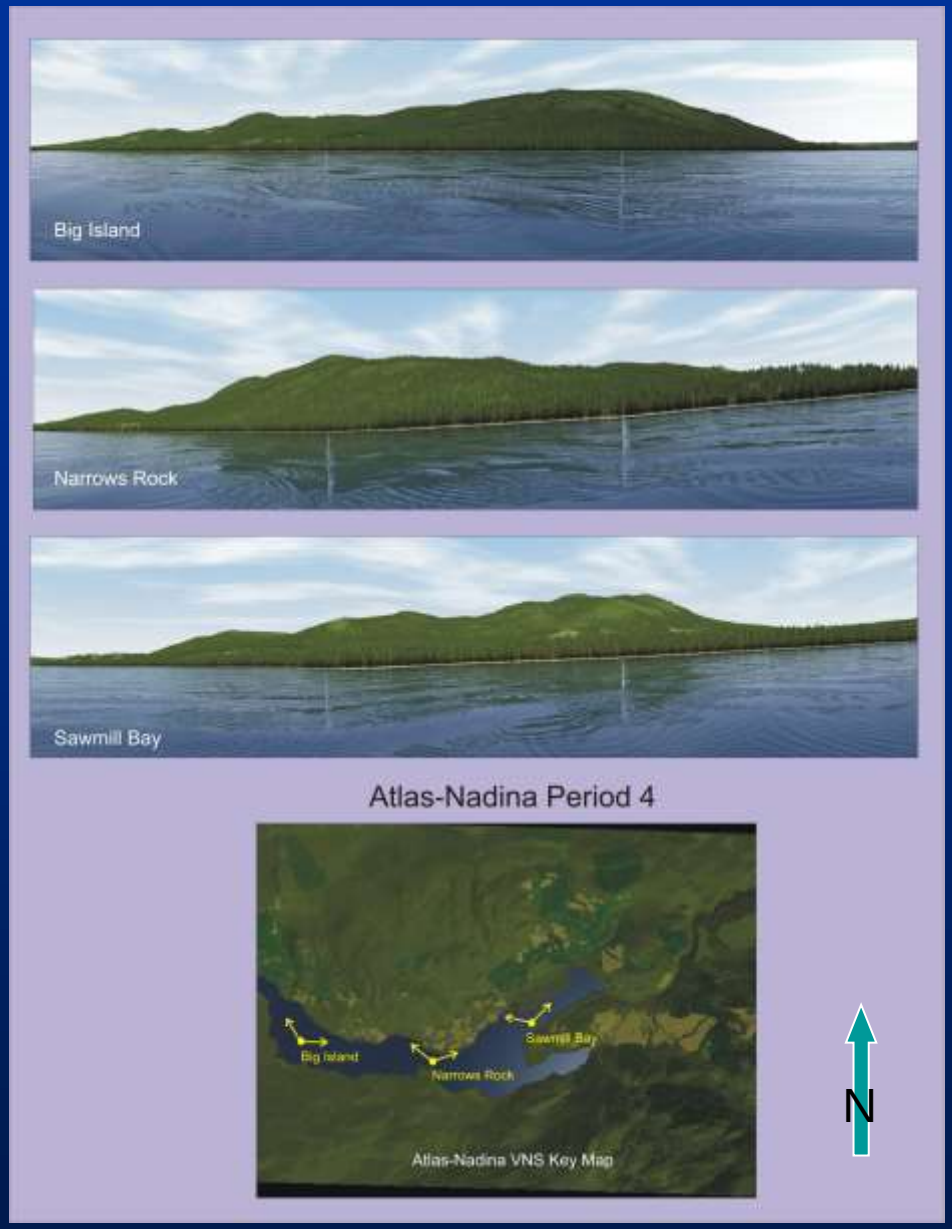
Conclusions of Nadina Tests	Limitations
Actual plan with all constraints Apparency informed scheduling and design Learning opportunity with landbase Detailed P2P with tree screening	Requires expert design intervention DEM resolution Viewpoint selection

Test Area 2 – Nadina Lake

B. Atlas-GEOptics Automated Landscape Design Plan

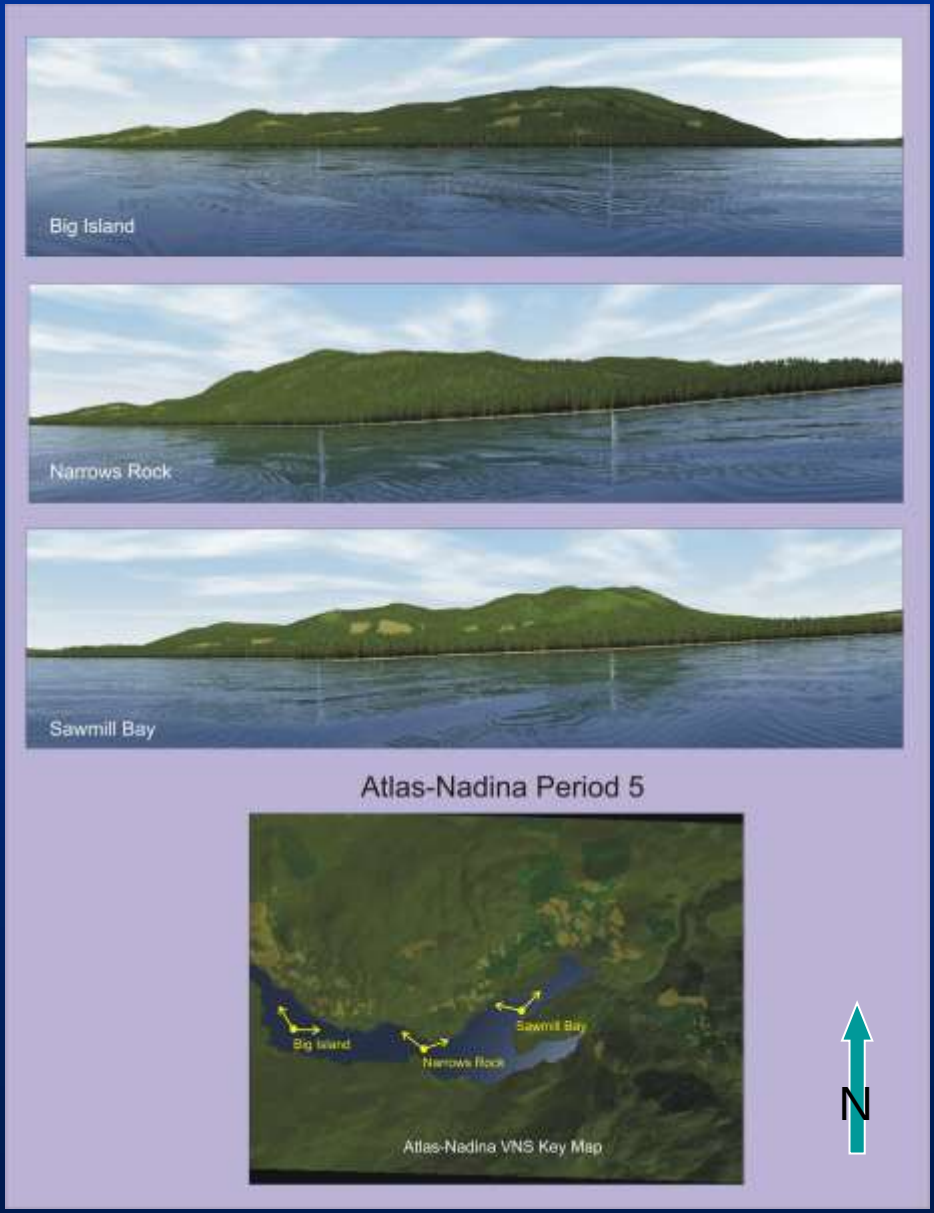
to determine efficacy of a harvest scheduler program (Atlas) using apparency

12 – 20 year Periods – 150,000 m3 each
Forest Cover Attributes from
Vegetation Resource Inventory



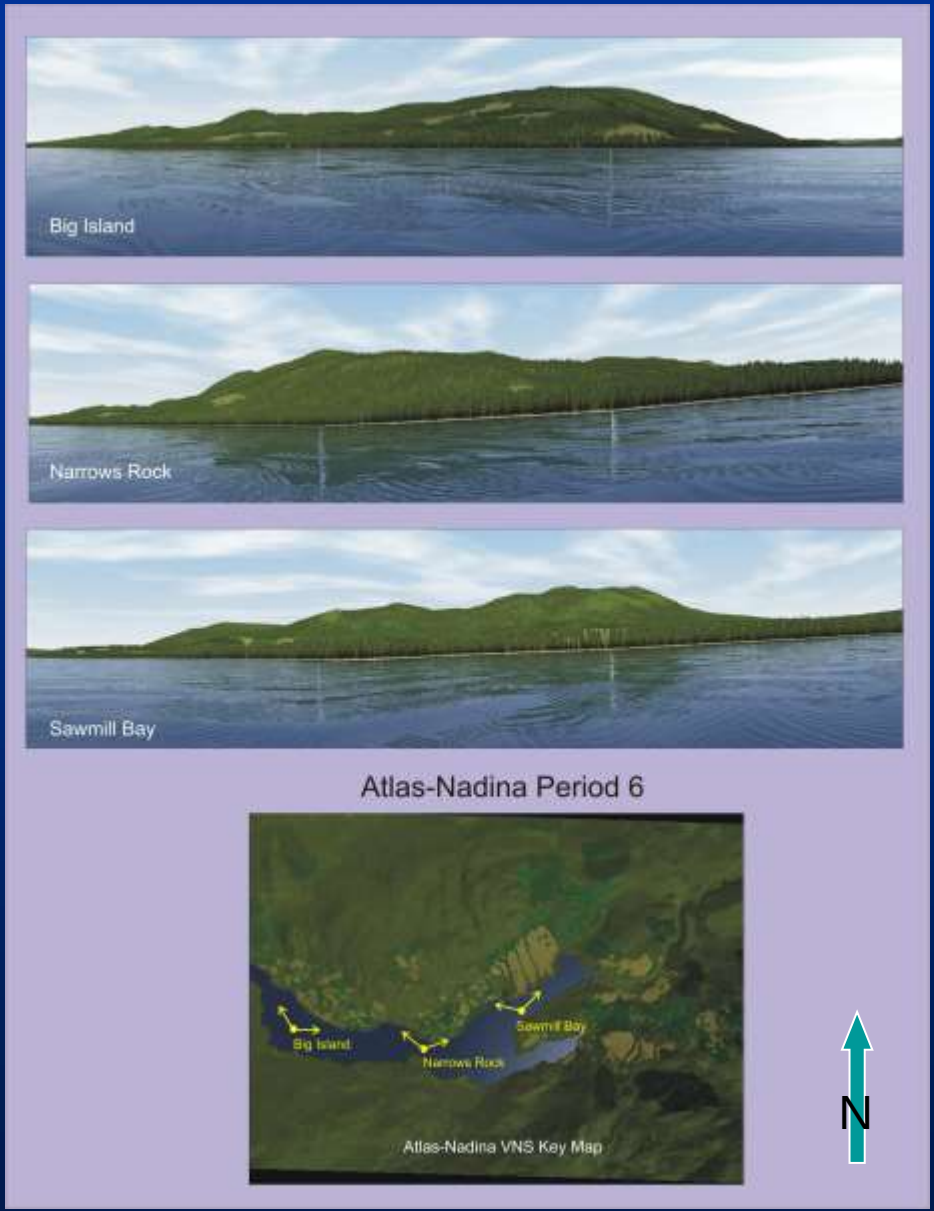
Automated Design using Forest Planning Studio (ATLAS)

Figure 92 Atlas-Nadina automated harvest schedule - Period 4.



Automated Design using Forest Planning Studio (ATLAS)

Figure 92 Atlas-Nadina automated harvest schedule - Period 5.



Automated Design using Forest Planning Studio (ATLAS)

Figure 92 Atlas-Nadina automated harvest schedule - Period 6.

Conclusions of Nadina Automation Tests	Limitations
Actual plan with all constraints Apparency informed scheduling and design Learning opportunity with landbase Detailed P2P with tree screening Replaced trial and error Supplemented expert design	DEM resolution Constraint data

9.2 External Testing - Focus Groups

9.2 External Testing - Focus Groups Questionnaire and Discussions

Three Sessions

- Richmond (7): All 5 BCMOFR VRM Practitioners
- UBC (5): Academics, Students, Managers
- Nanaimo (4): MOFR and Industry Managers

Three Part Questionnaire

- Opinion survey (19 Questions)
- Written Discussion (6 topics provided)
- Verbal Discussion (recorded)

Questionnaire Components

1. Opinion Survey Question Groups:

Part A. Presentation Effectiveness (6)- how presented
Part B. Mapping Effectiveness (4) – product perception
Part C. Applications; Advantages; Disadvantages (9)

Questionnaire rating scale

-2	-1	0	+1	+2
Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree

Questionnaire

A. Effectiveness of the Presentation (examples)	AVG
5. The possible **benefits** of the GEOptics landscape apparency method were clearly outlined.	
6. The possible **limitations** of the GEOptics landscape apparency method were clearly outlined.	

Questionnaire

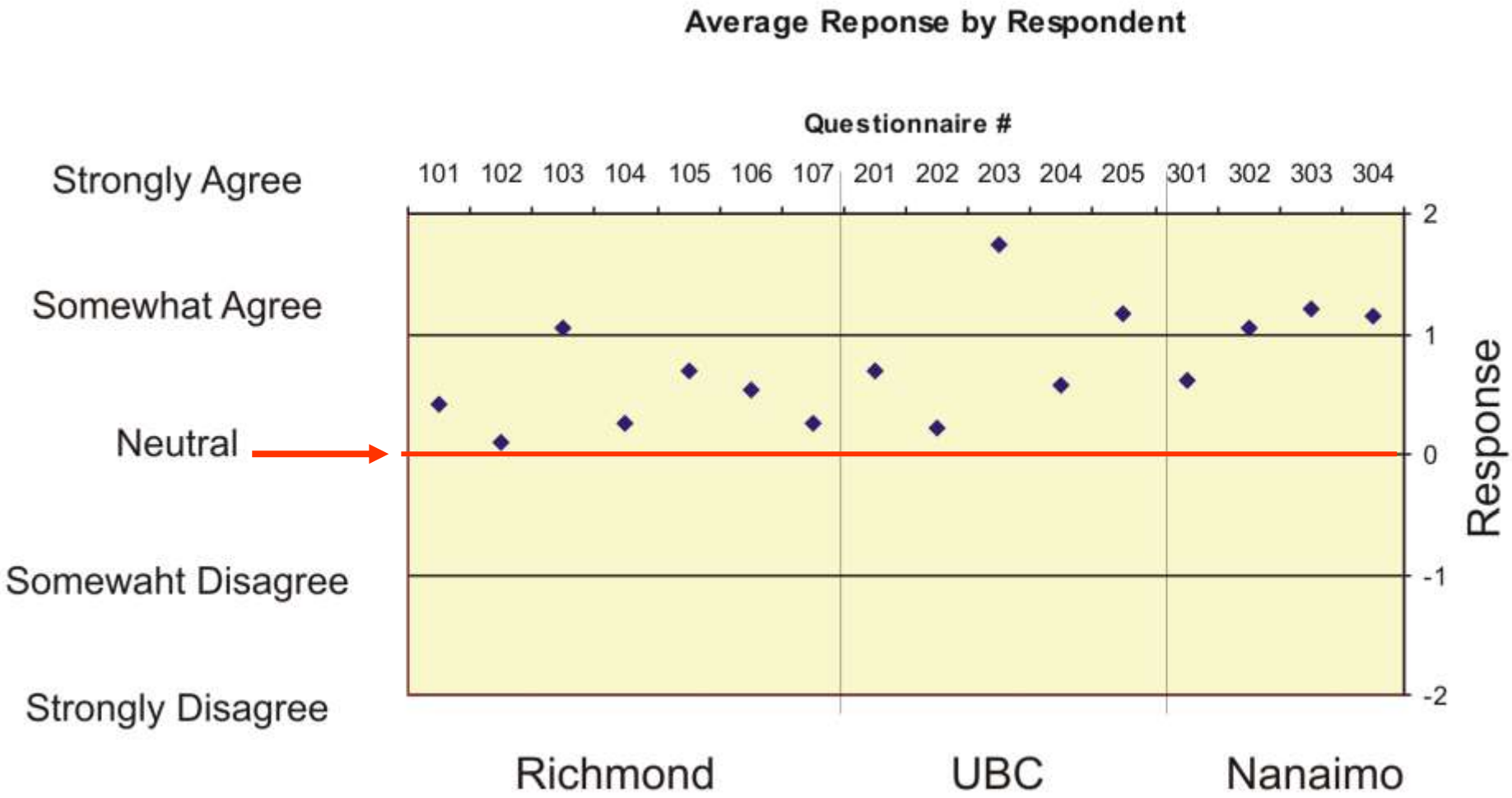
B. Effectiveness of the Landscape Apparency Mapping (examples)

9. The GEOptics output appeared to be **compatible** with conventional GIS resource analysis.	
10. The GEOptics output appeared capable of providing the degree of **detail and accuracy** necessary for consideration in resource planning and decision-making.	

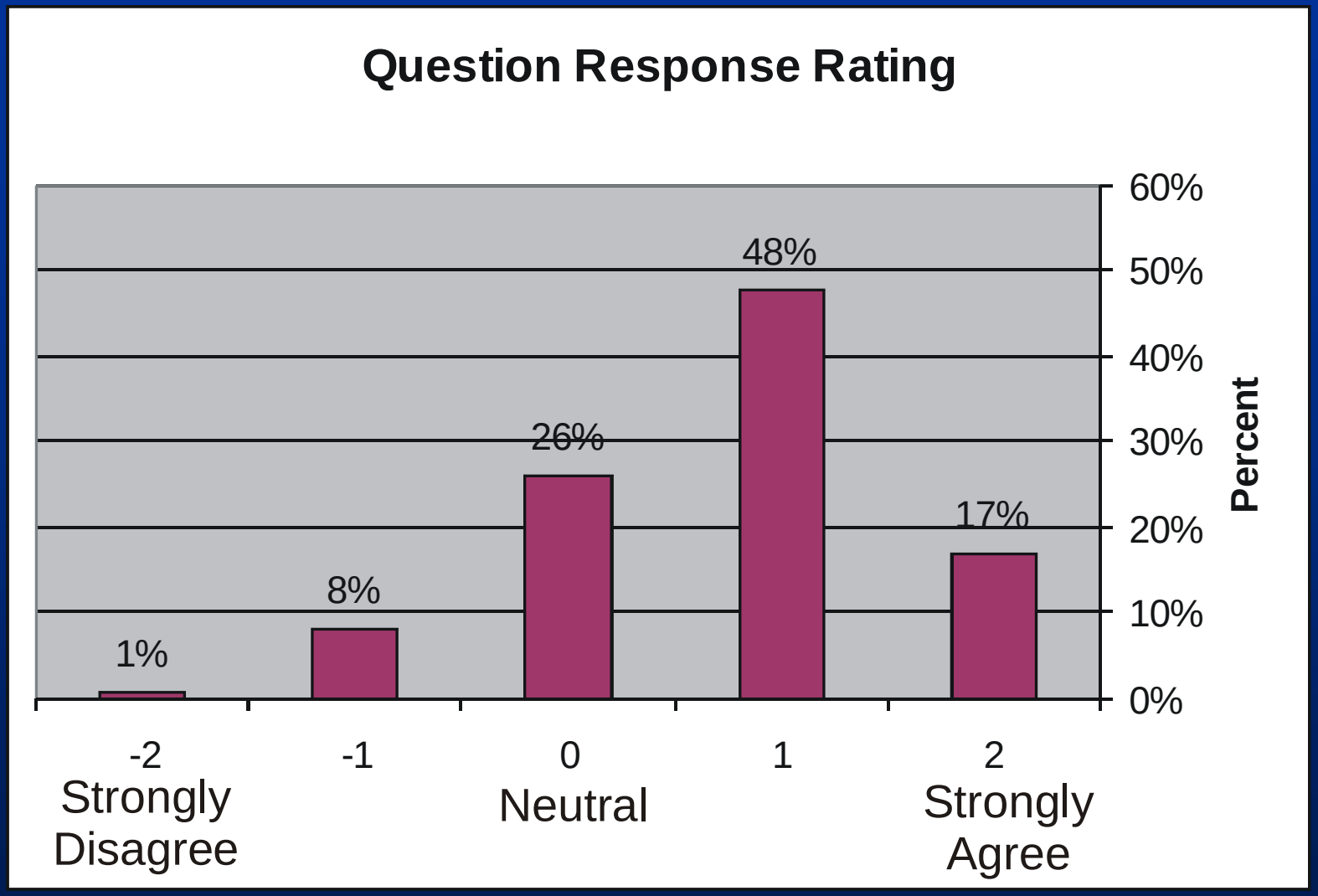
Questionnaire

C. Potential Applications, Benefits or Disadvantages of Methods (examples)

17. GEOptics output could be well suited for total chance integrated visual design over the long-term.	
19. The GEOptics method could provide greater flexibility for managing visually constrained areas relative to conventional VLM.	



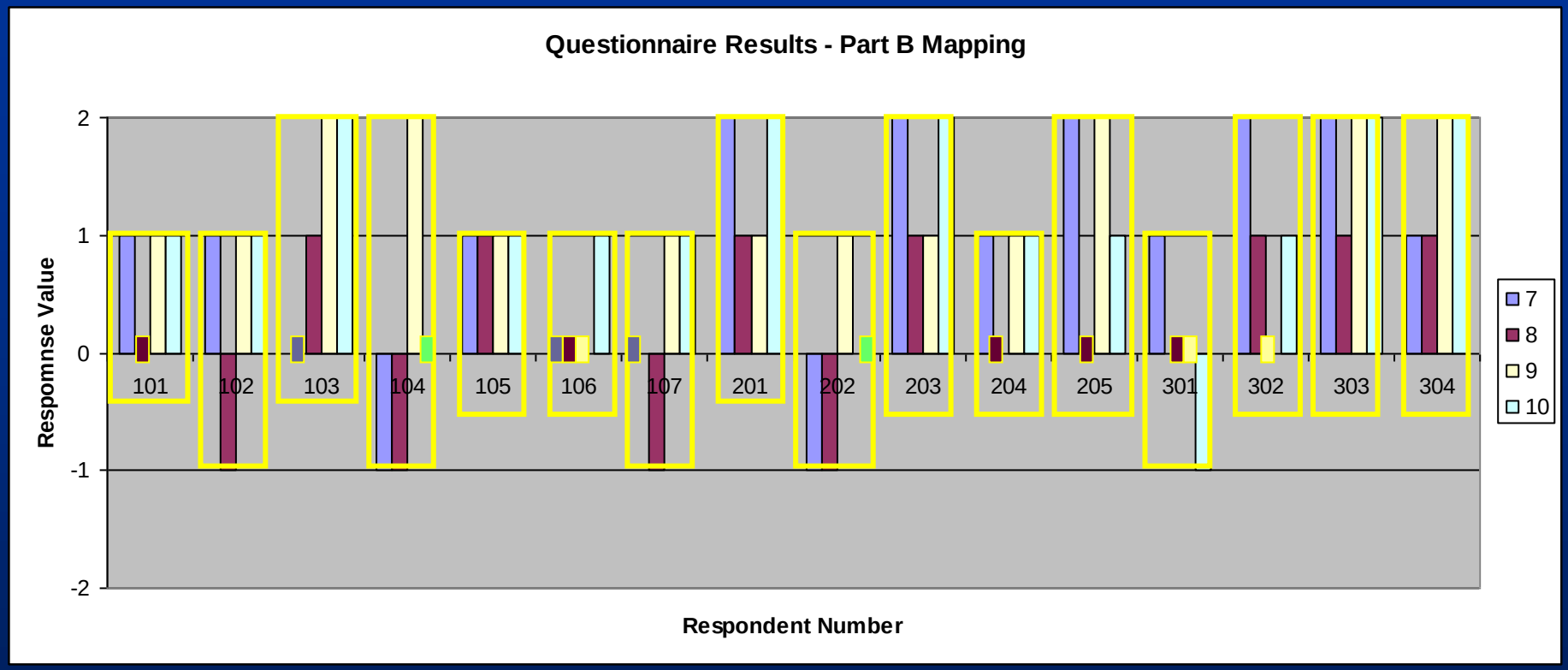
Overall Average Response to All Questions by each Respondent was Positive



65% of Responses to all Questions Agreed (1,2)
26% were Neutral*; 9% Disagreed (-1, -2)

***Includes four "no answers" taken as Neutral)**

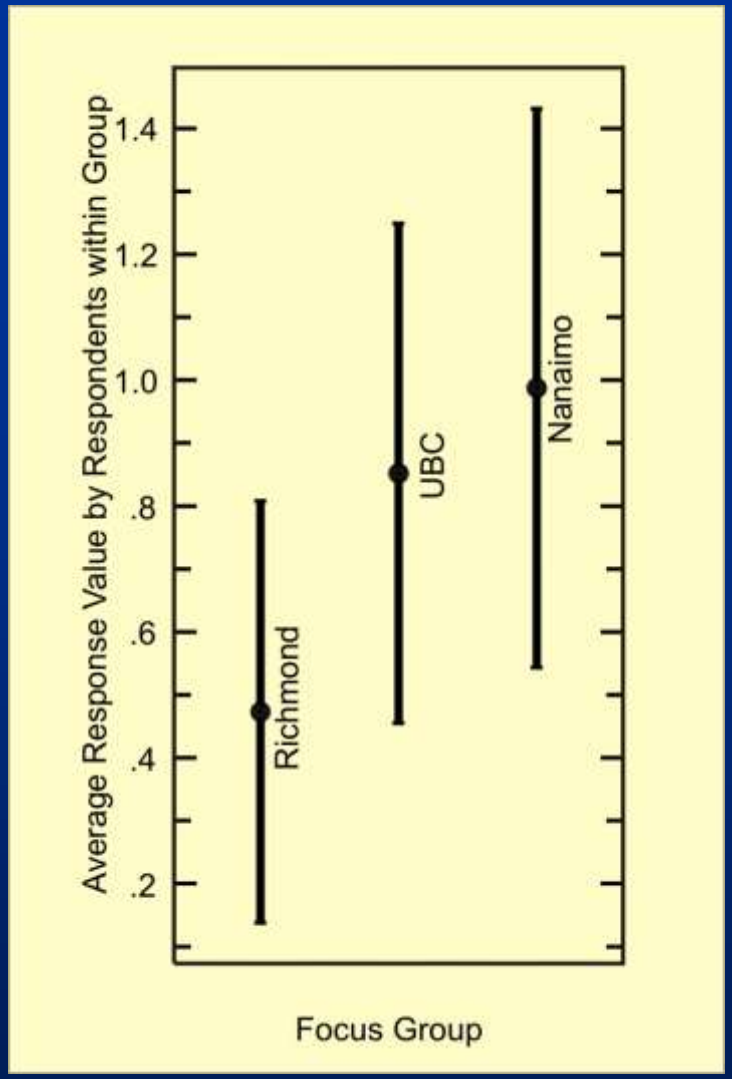
Response rating results: Questionnaire Part B Mapping



Question 7: Easy to Understand (pale blue)
Question 8: Easy to Apply (pale purple)
Question 9: Compatible with GIS (pale yellow)
Question 10: Detail for decision-making (pale green)
Full set by individual outlines in yellow
Zero ratings indicated with small boxes (on "0" line)

Questionnaire Results

Averages by Question Group	
Part A. Presentation	0.71
Part B. Mapping	0.85
Part C. Applications	0.69
Averages by Focus Group	
Group 1. Richmond (n=7)	0.47
Group 2. UBC (n=5)	0.88
Group 3. Nanaimo (n=4)	1.01
Overall (n=16)	0.73



Plot of focus group means with 95% confidence intervals, respondent's averages for all questions, and with centre dot the average per group, non-significant differences (null hypothesis = 0.13).

Focus Group Discussion

The 6 discussion topics were:

1. **Possible advantages relative to conventional VLM methods?**
2. **Possible disadvantages relative to conventional VLM methods?**
3. **How could apparency mapping be used by resource managers to enhance conventional visual landscape planning and design?**
4. **How could apparency be used by resource managers as a component of Timber Supply Planning?**
5. **How might the apparency method be improved or made more useful?**
6. **Any other issues or concerns raised in the session?**

Focus Group Discussion Results (sample)

103 (+) ***"Tells licencees where they can clearcut without affecting VQO, e.g. quantile 1-3 (lowest out of 6 apparency classes)."***

205 (+) ***"Greater precision, refinement, resolution. Move away from binary outputs***

305 (-) ***"Complexity; planning time; increased operational costs."***

102 (-) ***"Need some special tools to do this work, i.e., VNS."***

203 (+) **"Seems very useful in planning sequence of passes."**

304 (+) ***"Seems to easily dovetail into other strategic land management resource layers used at a landscape level planning process."***

105 (-) ***"Needs to be proven that results generated from GEOptics outperforms conventional existing methods. We have a VIA (visual impact assessment) process in place used by many consultants."***

107 (+/-) ***"GEOptics is a good model for showing what might be possible. TSR (timber supply review) must model what is current practice. The two might not be the same."***

Improving the Worth of EVA

- ✓Utility:
  - ✓Quick to prepare the illumination map
  - ✓Industry commonly has access to VNS/ArcGIS
  - ✓Single/Cumulative apparency options – build as you go
  - ✓Generalizable and compatible with other systems
- ✓Sensitivity
  - ✓Very sensitive to viewing angle changes
  - ✓Very sensitive to number of viewpoints (light)
- ✓Accuracy
  - ✓TRIM common digital terrain map base
  - ✓Can use refined topography as available
- ✓Precision
  - ✓All users will obtain same results if correctly set up
  - ✓Validated by ArcGIS viewshed

Potential improvement to the BCMoFR VLM system using GEOptics apparency

.

VLM Phase 1 VLI	VLM Phases 2-3 Analysis	VLM Phase 4 Design
VAC rating and map factor	VQO Apparency Class P2P weighting factor within VSU Entered in TSR for each VSU (bottom-up)	Apparency map values separates challenging from easy areas within VSUs and guide design and operations Guide to visual impact assessment in advance Hierarchical integrated planning element

Achievements of the Apparency Model

- ✓More precise understanding of visual risk within VSU
- ✓Integrated tool linking viewer and landscape
- ✓Inherent understanding of landscape
- ✓Informs users' understanding of visual impact potential
- ✓Visual Design "guide"
- ✓Efficient "automation"
- ✓Precise P2P factors may improve available wood supply
- ✓Adaptable to other GIS tools
- ✓Adaptable to other jurisdictions
- ✓Helpful, compatible with conventional mapping
- ✓Well-suited to integrated planning

Limitations of GEOptics apparency

- ✓New tool – requires learning
- ✓Shadow map/viewshed validation
- ✓Possibly new computer program(s)
- ✓DEM resolution; accuracy
- ✓Not replacement for design expertise
- ✓More trials required in more landscape types
- ✓Perceived as too complex - streamline
- ✓Caution with timber supply analysis – coarse by intent
- ✓Resistance to change; new concepts

Helpful Links to References relating to this presentation:

MFLNRO Forest Practices Branch Visual Resource Management Publications:

- Inventory
- Monitoring
- Research into public responses to
  - clearcutting,
  - partial cutting,
  - retention cutting,
  - visually effective green-up,
  - roadside management,
  - wind energy,
  - tourism,
  - mountain pine beetle
- All available at:

http://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/visual-resource-management

VQO Guide Poster https://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Rec/Rec044.pdf

Fairhurst, K.B, 2010. PhD Dissertation. Geoptics Landscape Apparency: a dynamic visual resource indicator and tool for multi-functional landscape planning.
https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0071267

Collaborative for Advanced Landscape Planning – UBC: **www.calp.forestry.ubc.ca**

General Information about RDI Resource Design Inc can be found at: www.rdi3d.com
Ken Fairhurst can be reached by e-mail at ken.fairhurst@rdi3d.com

This presentation can be down-loaded from:
http://rdi3d.com/Powerhouse.pptx

Quick Background of KBF:

- 15 years Ministry of Forests – Regional Visual Management Specialist
- 2 years Alberta Forest Service Preliminary Visual Landscape Program Set-up
- 21 years co-founder/head of RDI Resource Design Inc
- GIS and 3D Visualization Planning and Design
- University of British Columbia Doctoral Degree 2010
- UBC Forestry 491 – Co-teach Visualization and Design
- UBC Forestry 424 – Visualization Component
- Adjunct Professor – UBC Forest Resources Management
- Member - Collaborative for Advance Landscape Planning - UBC

Discussion and Conclusions

My Appreciation!

to

Rob Ribe - for recommending that I share the BC perspective

and to

Cheryl Friesen - for arranging this Forum

End