GEOB 270 Lab 5

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Question 1

What percentage of the proposed project area is "on the lower 600m of vertical" (i.e. potentially not enough snow)? To do this, you will need to isolate the parts of the DEM that are below 600 m. Show your calculations.

Total shape area (from Park boundary): 54 717 275m

Area less than 600m elevation: 17 394 028m

$$\frac{17\ 394\ 028}{54\ 717\ 275} = \frac{x}{100}$$

X = 31.79%

So approximately 31.79% of the proposed project area is on the lower 600m of vertical, and will potentially not have enough snow.

Question 2

What percentage of the proposed project area has old growth forest? (you have the area of all the old growth polygons, you need to sum the area and then determine the percent of the total project area.) Show your calculations.

In ArcMap, under the attributes table of the OGMA_Clip1, I selected all the values under the Shape Area column. Then right clicked > statistics… and found the sum to be 3 713 338m.

Using the total area from the Park Boundary (54 717 275m), the percentage of old growth can be calculated as follows:

$$\frac{3\ 713\ 338}{54\ 717\ 275} = \frac{x}{100}$$

X = 6.79%

So approximately 6.79% of the proposed project area contains old growth forest.

Question 3

What percentage of the project area has Mule Deer winter habitat? What about Mountain Goat winter habitat? The two types of ungulates in the project area are Mule Deer and Mountain Goat (SPECIES_1 codes M-ODHE and M-ORAM). Sum the area for each species and calculate the percentage

of the total project area for each species. Then report the total ungulate winter range as a percentage of the project area. Show your calculations.

Mule Deer Habitat (M-ODHE):

Sum of area (from selecting M-ODHE values in the attribute table, right clicking on Shape Area > summarize… and finding the sum) is 2 319 710m

Total project area (from the Park Boundary): 54 717 275m

So the area that Mule Deer are in within the total project area:

$$\frac{2\ 319\ 710}{54\ 717\ 275} = \frac{x}{100}$$

X = 4.24%

Therefore approximately 4.25% of the proposed project area is Mule Deer habitat.

Mountain Goat (M-ORAM):

Sum of area (from selecting M-ORAM values in the attribute table, right clicking on Shape Area > summarize… and finding the sum) is 1 998 898m

Total project area from the Park Boundary: 54 717 275m

So the area that Mountain Goat's are in within the total project area:

$$\frac{1\ 998\ 898}{54\ 717\ 275} = \frac{x}{100}$$

X = 3.65%

Therefore approximately 3.65% of the proposed project area is Mountain Goat habitat.

Total ungulate winter range

Total area for UWR (either from the sum of the total Shape Area in the attributes table, or by adding Mule Deer and Mountain Goat sums together manually): 4 318 607m

$$\frac{4\ 318\ 607}{54\ 717\ 275} = \frac{x}{100}$$

X = 7.89%

Therefore approximately 7.89% of the proposed project area is undulate winter habitat.

<u>Question 4</u>

a) What, if any, red-listed (i.e. endangered or threatened) ecosystems are located within the project boundary? (list the species name).

b) What percentage of the total area do all the red-listed species represent? Show your calculations.

(a) The Flat Moss, Falsebox, Salal, Kinnikinnick, Cat's-tail Moss, and Cladina are all red-listed species within the project boundary. Deer Fern is not within the project boundaries.

(b) To find how much of the project area includes red-listed species:
The sum of the total area containing red-listed species is 13 584 529m (found from the attributes table of the Red-listed layer > click Shape Area > right click > summarize… and find the sum)
Total project area from the Park Boundary: 54 717 275m

$$\frac{13\ 584\ 529}{54\ 717\ 275} = \frac{x}{100}$$

X = 24.83%

Therefore approximately 24.83% of the project area contains red-listed species.

Question 5

What percentage of the proposed project area will fall within fish bearing streams, or within fish habitat/riparian areas around streams?

Calculate the area of the buffer as a percentage of the total project area.

Total area of buffer around streams (both above and below 600m): 15 562 599m

Total project area from the Park Boundary: 54 717 275m

$$\frac{15\ 562\ 599}{54\ 717\ 275} = \frac{x}{100}$$

X = 28.44%

Therefore approximately 28.44% of the project area is within fish bearing streams or within fish habitat areas around streams.

Question 6:

What is the percent of the project area the falls in the sum of the protected areas? How does this value compare with the sum of answers 2-5?

Sum of the protected areas (from union and dissolve steps): 30 563 770m

Total project area from the Park Boundary: 54 717 275m

$$\frac{30\ 563\ 770}{54\ 717\ 275} = \frac{x}{100}$$

X = 55.86%

Therefore approximately 55.86% of the project area is in the sum of the projected area.

From the answers of questions 2-5, 6.8% of the proposed project area has old growth forest, 7.89% of the proposed project area is undulate winter habitat, 24.83% of the project area contains red-listed species, and 28.44% of the project area is within fish bearing streams or within fish habitat areas around streams.

6.8 + 7.89 + 24.83 + 28.44 = 67.96%

The difference in these two values is likely due to the overlap in layers, such as the habitat of the undulate species and the river buffers, which would essentially count that space twice. When the protected areas are in the union layer, it does not "double-count" spaces, so this value (55.86%) is lower, but it is the accurate value.

Question 9

Write a 1- to 2-page memo to your client summarizing what you have done, the results and what recommendations you have for the direction your client should take in relation to the project. This memo can be in full paragraph form, or be partly in bullet point format with brief introductory and concluding statements.

(memo begins on next page)

GARIBALDI AT SQUAMISH PROPOSED RESORT PROJECT

Review of potential effects on vegetation, fish, and wildlife habitats

The proposed Garibaldi at Squamish Ski Resort would provide all-season outdoor entertainment, just outside of Squamish, BC. This project has faced some aversion, mainly surrounding the potential environmental impacts, the pressure it would place on local transportation and medical resources, as well as negotiations with the Squamish First Nation's community. In terms of the environmental effects, the BC Environmental Assessment Office reported in 2010 that the proposal did not include sufficient information about impacted vegetation, fish, and wildlife within the project boundaries. The Resort Municipality of Whistler also voiced concerns, in the form of a 14-page letter critiquing economic feasibility, environmental impacts, and elevation for adequate snow accumulation. Despite these criticisms, the proposal received tentative environmental approval from the Provincial Government of BC in January of 2016.

The following memo, prepared for Northland Properties and Aquilini Investment Group of Vancouver, will summarize the effects that the proposed Garibaldi at Squamish Ski Resort project may have on vegetation, fish, and wildlife habitats. After summarizing and analyzing the results, recommendations will be given for primary issues to be addressed before the proposal proceeds further.

The data used for this report was acquired from DataBC, and included information for ungulate winter range, old growth management areas, project and park boundaries, terrestrial ecosystems, elevation, roads, and rivers. Data was combined in layers in the digital mapping program ArcMap. The final resulting maps are shown in **Figure 1** and **Figure 2**.

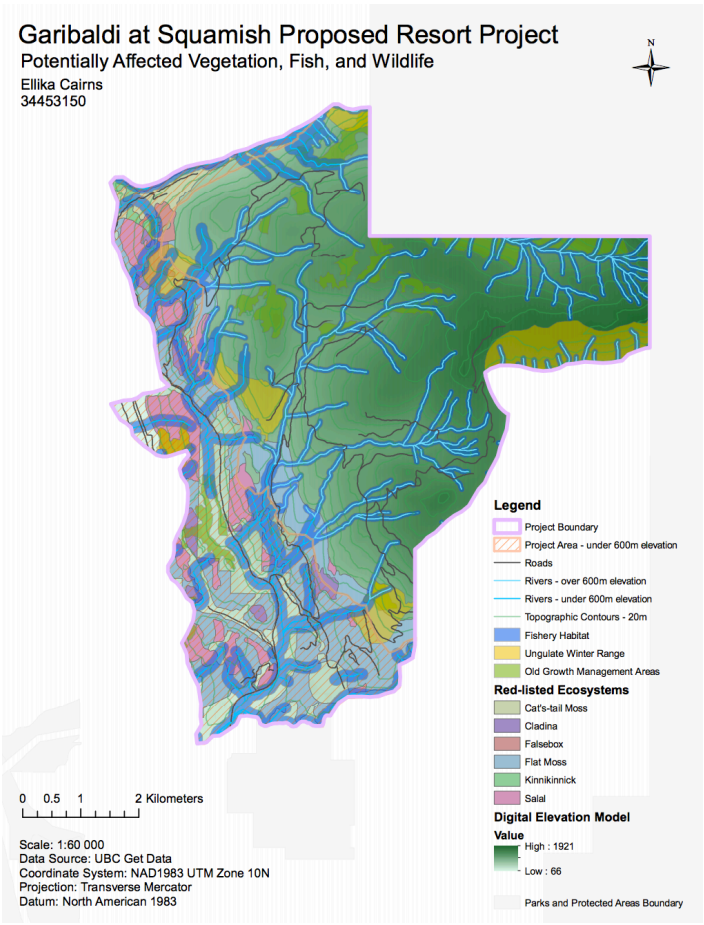

Figure 1 – Potentially Affected Vegetation, Fish, and Wildlife

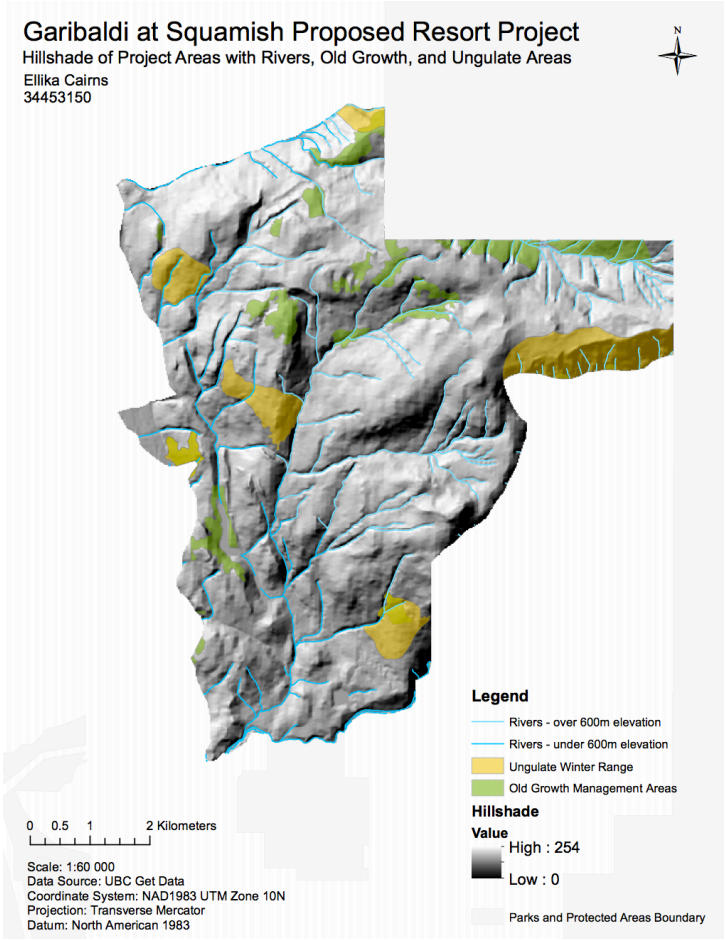

Figure 2 – Hillshade of Project Area with Rivers, Old Growth, and Ungulate Areas

During analysis of the data, percentages of the total project area that will impact ungulate habitat, old growth forest, red-listed ecosystems (Flat Moss, Falsebox, Salal, Kinnikinnick, Cat's-tail Moss, and Cladina), fish habitats, and areas below 600m elevation were calculated. The results are as follows:

Impact Areas	Percentage of Total Proposed Project Area
Ungulate Winter Range	7.89%
Old Growth Management Areas	6.79%
Red-listed Ecosystems	24.83%
Fish Habitats	28.44%
Areas Below 600m elevation	31.79%

Using a tool in ArcGis, the total percentage of the project area that falls within the protected areas was calculated, to avoid double-counting any overlap in areas at risk. This value was calculated to be 55.86%.

From the calculations, clearly the red-listed vegetation and fish are the species that will be most severely affected, while the areas of old growth and ungulates will be impacted to a lesser extent. Additionally, nearly a third of the proposed area would be located below 600m in elevation, which, according to the letter from The Resort Municipality of Whistler, is not reliable for skiing.

Therefore should the project be fully approved, the areas that include fish habitats and red-listed vegetation require the most attention in terms of mitigating environmental impact. In terms of project development, the amount of project area that will not be suitable for skiing is fairly large (31.79%), and therefore it will be important to utilize the area above 600m elevations wisely. Fortunately, most of the red-listed vegetation and much of the fish habitats are in the below 600m elevation range, so as long as development below 600m elevation is minimized, the project will have significantly decreased environmental impact.

As for the fish habitats, the streams and their surrounding banks are often steep and not ideal to ski over top of, and therefore can be beneficially avoided when building ski runs. If they must be crossed, during the winter the snow will help to protect the underlying habitat, while in the summer it can be protected through providing guests with clearly marked trails a distance away from streams, as well as bridges for when crossing is necessary.

In conclusion, though there is a significant area of the proposed project that contains protected species or unfavorable conditions, there are many solutions to avoid and minimize impact. Proceeding development should be mainly concerned with re-listed ecosystems, fish habitats, as well as take note of the area that is not suitable for reliable skiing.