



Cumulative Effects Framework
Assessing and Managing Cumulative Effects in British Columbia

Howe Sound Cumulative Effects Project

Grizzly Bear – Current Condition Report



South Coast Natural Resource Region

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

November 22, 2018

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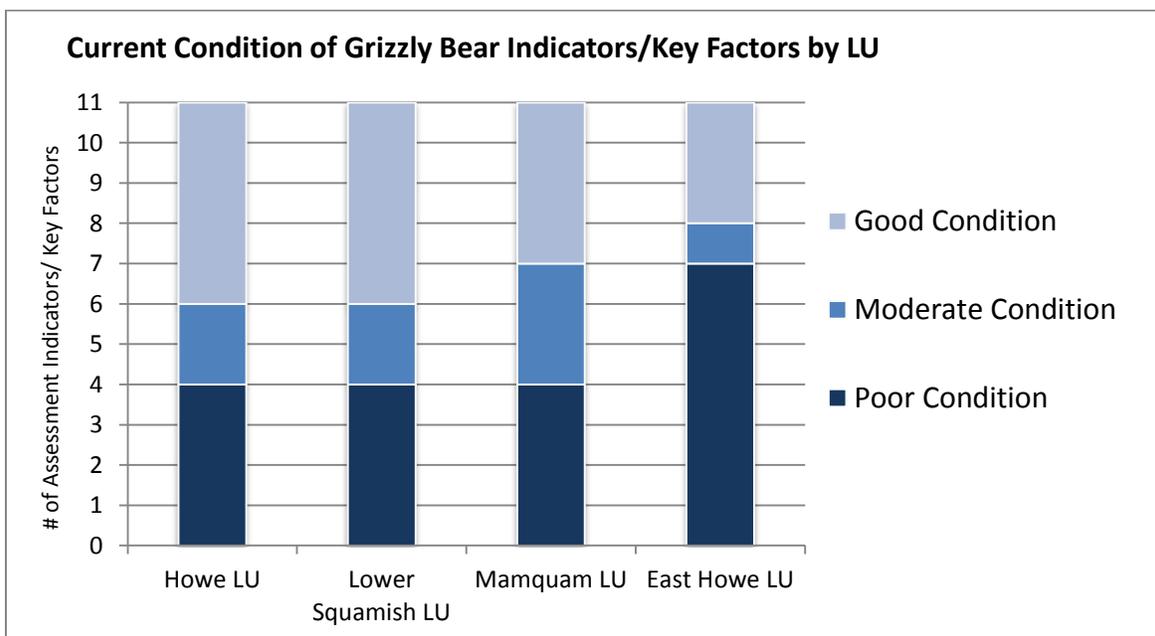
Executive Summary

The Howe Sound Cumulative Effects Project represents the Province’s initial application of the Cumulative Effects Framework in the South Coast Natural Resource Region of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). This report presents a current condition assessment of Grizzly Bear in the general Howe Sound area.

Six key population and habitat indicators from the Grizzly Bear CE assessment protocol have been used to explore the current condition and sustainability risk to Grizzly Bears populations in BC. The indicators include: population status; human-caused mortality; hunter day density (all wildlife hunting); front-country in habitat; capable secure core area; and mid-seral dense conifer stands in habitat. These assessment indicators have been supplemented with five other key habitat and population assessment factors to provide a more fulsome assessment: bear density; road density; quality food; capable habitat protected and front/back-country encounter classification.

The current condition assessment focuses on four Landscape Units (LUs) that partially, or fully, overlap the Howe Sound CE Project area and the Squamish-Lillooet and Garibaldi-Pitt Grizzly Bear Population Units (GBPUs). The general results from this initial current condition assessment should not be used to confirm the specific impacts from individual developments.

Overall, the general current condition assessment results (indicator assessments and supplemental information) show that there are mixed conditions to support Grizzly Bear populations in the Howe Sound CE Project area.



In general, Grizzly Bear density is quite low in the Howe Sound CE Project area (0-10 bears/1000 km²) but is higher in the northern portions in watersheds associated with the Cheakamus and Squamish rivers. Grizzly Bear density is higher in the Squamish River watershed (10-20 bears/1000 km²) due to quality seasonal food sources, limited high frequency human disturbance, habitat protection, sustainable forage areas (related to forestry and natural disturbances) and connectivity to other productive watersheds in the Squamish-Lillooet Grizzly Bear Population Unit.

The persistence of Grizzly Bears in the two GBPUs overlapping the Howe Sound CE Project area is identified as ‘threatened’ as the bear populations are less than 50% of the habitat capability in the area. This is largely due to the high levels of human activity and disturbance in the Sea-to-Sky corridor and adjacent watersheds. This urban-wildland interface area has high levels of road density and human use near the Sea-to-Sky corridor which can displace some bears from using quality habitats in the area (i.e. some areas on eastern side of Sea-to-Sky highway). Based upon the assessment results, the LUs with the most likelihood of Grizzly Bear persistence are the Lower Squamish LU (near Squamish River and Tantalus Range) and the Mamquam LU (in areas between Squamish and Cheakamus Rivers).

Overall, the results from this assessment indicate the potential need for increasing human access management to prevent the disturbance of important seasonal Grizzly Bear habitats and travel corridors. Long-term forest management may need to consider managing road density and the spatial interspersion of forage, cover and travel corridor attributes over time in areas prioritized for Grizzly Bear management and recovery. With the continued growth of human developments and activities in the Sea-to-Sky corridor, the long-term viability of Grizzly Bear populations in the area will require integrated management and planning for the two GBPUs overlapping the Howe Sound CE project area, which includes population connectivity with adjacent GBPUs.

FLNRORD is currently exploring a number of actions in response to these results such as: assessing the recent trends in these indicators; comparing these predictions to available site-specific habitat and population survey information; and applying these risk assessments to land and resource planning and management decisions where possible. Comparing the assessment results to available on-the-ground habitat and population surveys will more accurately confirm or reject the accuracy of the results and predictions. However, on their own, these initial assessment results do offer some general insights that can be considered immediately in certain statutory authorization decisions (i.e. major projects, urban land development, forest management, park management, and recreation/access management) and more proactive legal designations (e.g. Wildlife Habitat Areas, Wildlife Management Areas, Old Growth Management Areas etc.).

In the future, it is anticipated that the province will lead the development of more specific population and habitat objectives for provincial GBPU's in the broader context of integrated resource management and First Nations' socio-cultural values. This would include the exploration of possible management tool synergies (e.g. cultural heritage protection, legal designations, wildfire management, recreational access management, and land and forest authorizations).

The results of this assessment will also be incorporated into some new decision-support tools and processes that FLNRORD-South Coast is currently developing. These tools and processes will: integrate and communicate resource value objectives, assess how well these objectives are being achieved, and provide the basis for the development of future integrated resource management responses.

The indicators and data used in this assessment only provide a coarse filter estimate of current condition by Landscape Unit and may not reflect the actual current condition at a more refined scale. The assessment results are dependent upon the quality of inputs and it is expected that Regions may have more detailed regional and project-specific data that could complement this assessment. Therefore, this assessment does not tell the whole story and more investigation is required to better inform land and resource management.

1. Introduction

The Howe Sound Cumulative Effects Project represents the province's initial application of the Cumulative Effects Framework in FLNRD's South Coast Natural Resource Region. This report presents an initial current condition assessment of the Grizzly Bear value in the Howe Sound CE Project area (Appendix I). Other values being assessed for current condition in the Howe Sound area include: Aquatic Ecosystems, Old Growth Forests, Forest Biodiversity, Visual Quality, Roosevelt Elk and Marbled Murrelet.

The Province of British Columbia views the assessment and management of cumulative effects as a vital part of sustainable and integrated resource management, and an important foundational piece for addressing First Nations rights and interests. As population and resource demands grow, we must be able to measure the effect of all natural resource activities, large and small, on values that are important to the people of British Columbia. In January 2014, cabinet provided direction for the development and phased-implementation of the BC *Cumulative Effects Framework* (CEF). The intent of the CEF is to incorporate the combined effects of all activities and natural processes into decision-making to help avoid unintended impacts to key economic, social and environmental values. For more, see the CEF website:

<http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework> .

The Howe Sound Cumulative Effects Project will help with the implementation of a coordinated, multi-sector approach to assessing and managing cumulative effects. This will be achieved by providing transparent decision-support information to the province, First Nations, other levels of government, and non-government stakeholders.

The Province of British Columbia has identified Grizzly Bear as one of its initial core values for CE assessment. Grizzly Bears are an iconic 'umbrella species' that have environmental, economic, and social importance to people in British Columbia. They are a wide-ranging and opportunistic omnivore species with low re-productive and dispersal rates. They play an important ecological role by: distributing seeds in their habitats through the consumption and excretion of plant fruits; cycling of nitrogen when digging for food and carrying salmon into surrounding forests; providing carcasses for other animals to feed on; and by regulating prey populations to maintain ecosystem balance. For the purpose of this assessment, Grizzly Bear habitat and population are key components. More information on Grizzly Bears and Grizzly Bear management objectives can be found in Appendices II and III.

The intent of this report is to provide an initial indication of the current condition of Grizzly Bear habitat and population in the Howe Sound area by assessing the status of some initial Grizzly Bear indicators and also considering some supplemental environmental and regional context

information. This assessment acts as a coarse filter to help direct further current condition assessment and monitoring work.

This report is largely made up of a series of current condition indicator and supplemental maps derived from the interim Provincial CE assessment protocol for Grizzly Bear. The results from this assessment will be considered by FLNRORD to inform future assessments, planning projects, management decisions and resource objectives. The current condition results provide some important information on the risk to Grizzly Bear habitat and population related to the two Grizzly Bear Population Units (GBPUs) and 4 Landscape Units (LUs) that overlap the Howe Sound CE Project area. Further validation, analysis and contextual examination is required before assessing the actual condition of these assessment units. Therefore, the results in this assessment do not necessarily tell the whole story and more investigation is required to determine if special management actions are warranted. Where current condition assessments indicate there may be a concern (“flagged”), further internal examination, validation, analysis and management evaluation is to occur to better assess the current condition and risk to the value.

2. Assessment Approach for Grizzly Bear

The conceptual assessment model used in this report is intended to provide an initial foundation for a consistent approach to assessing the status of Grizzly Bear populations and habitat in BC. The conceptual assessment model is derived from assessment procedures detailed in the *Interim Assessment Protocol for Grizzly Bear in British Columbia, 2017*:

<https://www.nrs.gov.bc.ca/flnr/node/6794> . The assessment model focuses on a set of *core indicators* to provide an overview of the current condition of Grizzly Bears. The assessment also uses supplemental information to provide additional context and a more fulsome assessment. The model is based on the scientific understanding of Grizzly Bear ecology and is intended to provide a clear link to management action (practices, regulations, project mitigation, etc.).

The conceptual assessment model, shown in Figure 1, identifies the six core indicators used to assess the current condition of Grizzly Bears based upon the population and habitat components: Population Status; Average Hunter Day Density; Human-Caused Mortality; Front Country Area in Habitat; Capable Secure Core Area and Mid-Seral Conifer Stands. Some important supplemental information/factors include: Grizzly Bear Density, Road Density, Quality Food; Quality Habitat Protected/ Restricted Use; and Front-Country/Back-Country Encounter Classification.

The model uses *flags* to highlight areas where the condition of an indicator has exceeded a benchmark. Benchmarks are reference points that support interpretation of the condition of an indicator or component and are based on our scientific understanding of a system. These *flags* are provided for information only and do not necessarily indicate that there is an issue for Grizzly Bears in the area. They highlight areas needing further investigation and assessment to determine the current condition for Grizzly Bear, and what management responses may be needed. The indicators are not equal in their potential hazard to Grizzly Bears, so the flagging of more than one indicator in an area does not necessarily indicate a greater conservation risk than the flagging of a single indicator. Although there may be correlation between indicators, they address different issues and provide different information to aid further investigation into the potential cumulative effects to Grizzly Bears and appropriate management responses.

This assessment approach is primarily a strategic, broad scale analysis. It relies on the availability of Geographic Information System (GIS) data covering the full extent of the province. More detailed information may be available at the regional or sub-regional level that can inform finer scale grizzly bear assessments for operational land and resource decision making.

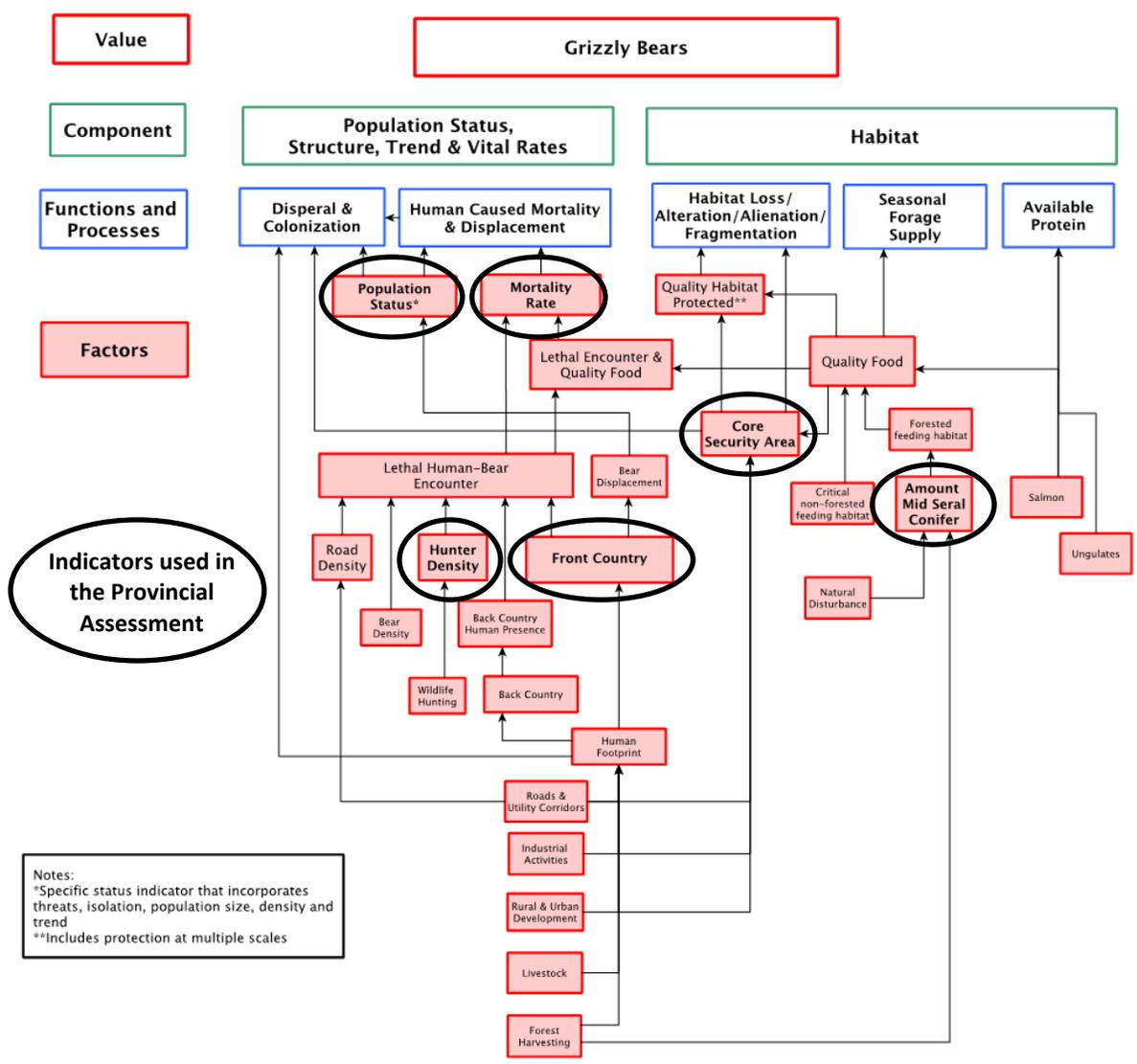


Figure 3: Cumulative Effects Framework Conceptual Model for Grizzly Bear

Conceptual Models for values describe how components and indicators influence or interact to affect the condition of a value.

Components (green) are features and attributes of a value that should be measured and managed to meet objectives associated with values.

Factors (red) are influential processes or states that act on a component and include both positive and negative effects. They may be used as indicators.

Indicators (black circles) are the metrics used to directly or indirectly measure and report on the condition of a component (state indicators) or the processes that act upon or influence the condition of a component (pressure indicators).

Limitations of the CEF Assessment Protocol for Grizzly Bear

The key limitations of this initial Grizzly Bear CE assessment protocol are:

- The data and maps used in this assessment can only provide an estimate of current condition at the broad scale used and may not reflect the actual current condition at an operational/site-specific scale;
- Areas shown as “flagged” on indicator maps are for information only and do not necessarily indicate that there is an issue for Grizzly Bears. They are areas where impacts may be occurring. The intention is for regional experts to further investigate flagged assessment units and advise decision-makers accordingly;
- The selection of indicators was influenced by the availability of provincial datasets. Other factors/metrics may be good potential indicators but available provincial datasets currently do not exist (e.g. don't have recreational user days and other human back country presence information);
- The results are dependent upon the quality of inputs. The expectation is that Regions may have more detailed regional and project specific data sets that could complement this assessment;
- Road density: It was presented in this assessment using line over polygon which is not as powerful an indicator as the raster/roving window road density product to define the zone of influence of mortality risk; line over polygon aligns best with current literature that sets $.75 \text{ km/km}^2$ as a key threshold above which demographic impacts can be expected;
- Core security: The Grizzly Bear CE Working Group recognises that some capable patches less than 10km^2 may provide some security to adult females; however, a universal provincial threshold was needed so the 10km^2 threshold was used as it reflects the average daily adult female movement (with cubs); and
- Hunter day density: It is captured only at Wildlife Management Unit (WMU) level.

Other Considerations

Additional monitoring information, existing at various spatial scales, can be used to help validate or complement the results of this assessment. For example, complementary monitoring information can come from:

- Research and monitoring projects conducted by provincial subject matter experts and/or academic institutions;
- Forest and Range Evaluation Program (FREP) assessments from the Ministry of Forest, Lands and Natural Resource Operations; and
- Monitoring projects carried out by major project proponents in order to meet Environmental Assessment Certificate Conditions.

3. Current Condition Assessment Results

The current condition assessment results for Grizzly Bear provide general coarse filter population and habitat information for LUs in the Howe Sound area. The results vary by LU reflecting more localized conditions but do not capture all of the habitat and population variation within an LU at this level of assessment. Some general observations can still be derived from the current condition assessment results. Table 1 provides an overview by LU of the general condition of the indicators/key factors considered in this assessment.

Table 1. General Condition of Grizzly Bear Assessment Indicators/Key Factors by LU

Indicators /Factors	Current Condition Assessment by Landscape Unit						
	Howe LU		Lower Squamish LU		Mamquam LU		East Howe LU
Core Indicators							
Population Status (Indicator)	Threatened		Threatened		Threatened		Threatened
% Front-Country in Habitat (Indicator)	0%		98%		99%		99%
% of Capable Secure Core Area (Indicator)	25%		61%		38%		30%
Mid-Seral Dense Conifer Forest (Indicator)	<30%		<30%		<30%		<30%
Mortality from Regulated Hunting (Indicator)	No Hunt		No Hunt		No Hunt		No Hunt
Aver. Annual Hunter Day Density (Indicator)	Low		Low		Low		Low
Supplemental Factors							
Grizzly Bear Density (GB/1000km ²) (Factor)	0-10		10-20		0-10		0-10
Significant Quality Food in LU (Factor)	No		No		Yes		No
Front/Back-Country Encounter Class. (Factor)	Low		High & Very High		High & Very High		Very High
% Capable Habitat Protected /Restricted (Factor)	30-60%		30-60%		30-60%		30-60%
Road Density (km/km ²) (Factor)	1.76- 2.5		0.61- 0.75		1.76- 2.5		>2.5

 - Good Condition

 - Moderate Condition

 - Poor Condition

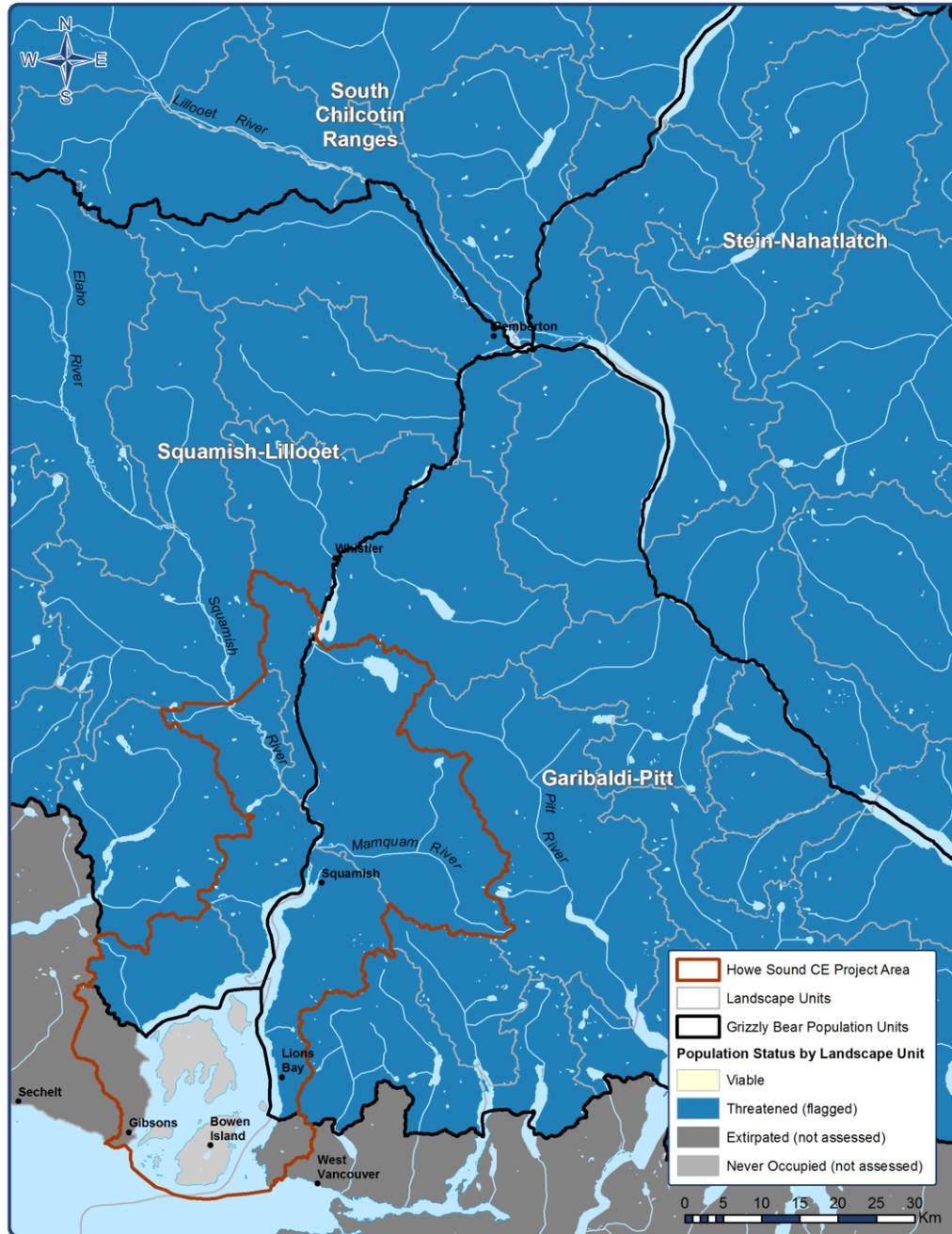
Initial Interpretation of the Current Condition Results

Some initial observations and possible key drivers affecting the CE results include:

- Grizzly Bear Population Units overlapping the Howe Sound CE Project area are listed as “Threatened” (bear population is less than 50% of capable habitat) for the most part due to the high level of human activity and disturbance in the Sea-to-Sky area (especially in the Sea-to-Sky corridor on eastern side of highway) and limited quality food;
- The portion of the Howe Sound CE Project area with the most effective Grizzly Bear habitat appears to occur west of the Sea-to-Sky highway from Squamish northwards due to the quality seasonal food sources, reduced human disturbance, habitat protection, highway deterrence and sustainable forage related to forestry and natural disturbances;
- The supplemental map showing the Sea-to-Sky LRMP Grizzly Bear recovery area indicates that the main focus of Grizzly Bear recovery efforts is from Squamish northwards in areas on both sides of the highway;
- The high levels of road density and human use near the Sea-to-Sky highway can have a significant impact on displacing Grizzly Bears from using certain habitats. They may also act as a partial barrier to some bears using quality habitats on the eastern side of the highway;
- The front-country/back-country classification used in this current condition assessment rates almost all the Grizzly Bear habitat in the Howe Sound CE Project area as front-country except the southwestern side of Howe Sound because of its marine-only access;
- In general, Grizzly Bear density is quite low in the Howe Sound CE Project area (about 0-10 bears/1000 km²). However, Grizzly Bear density is a little higher (10-20 bears/1000 km²) in the Lower Squamish LU which is located in the northwestern portion of the project area near the lower Squamish River;
- The Squamish River drainage and associated watersheds provide a more remote and contiguous environment with: quality forage, food protein (salmon), unobstructed access to seasonal terrain, protected Grizzly Bear habitats, lower road densities and less high frequency human disturbance;
- The Lower Squamish LU (from the Squamish Estuary to the Ashlu River confluence), has some valuable Capable Secure Core Area for Grizzly Bears because of capable habitat and restricted road and land development in the area (i.e. park, conservancy, wildland, First Nation Reserve and cultural sites in area);
- The Lower Squamish LU is also experiencing growing levels of recreational activity;
- The Howe and East Howe LUs, located in the southwest and southeast portions of the project area, have a low proportion of Capable Secure Core Areas for Grizzly Bears due to less protection and higher road densities associated with forestry and community developments;

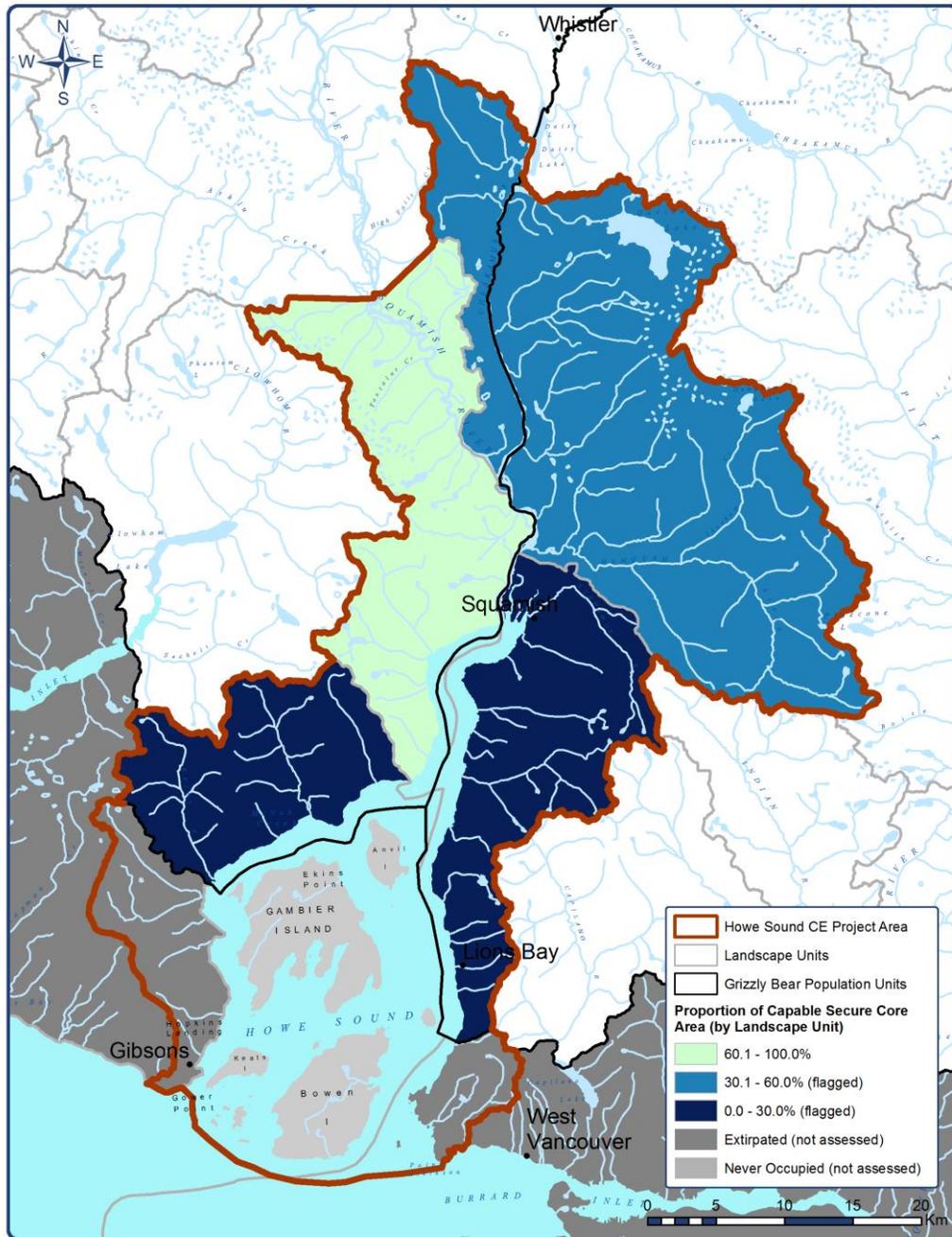
- The Mamquam LU, located in the northeastern portion of the project area, has a moderate but still unsatisfactory level of Capable Secure Core Areas for Grizzly Bears due to the extensive road networks from forestry and community developments. Some large roadless areas exist in Garibaldi Provincial Park but the trailed portions of the park experience high levels of front-country and back-country recreational use;
- The LUs in the Howe Sound CE Project area appear to have ongoing available forage as there is not too much mid-seral dense conifer forest stands (more than 30%) in any of the LUs due primarily to ongoing forest harvesting;
- Historical forest harvesting in the Howe Sound area has shaped current seral stage distribution which has likely helped to some degree provide a mix of Grizzly Bear forage and cover needs;
- The Squamish, Mamquam and Cheakamus drainages provide some high habitat capability and quality food for Grizzly Bears but the Squamish and Cheakamus River drainages appear to have more of these areas under protection and restricted use; and
- The hunter day density (all wildlife Hunters) is low in the Howe Sound CE Project area due to the fact that there is limited regulated hunting in the area due to the low population numbers of game animals and the issue of public safety in this popular tourism and recreation corridor.

Core Indicator - Population Status for Grizzly Bear



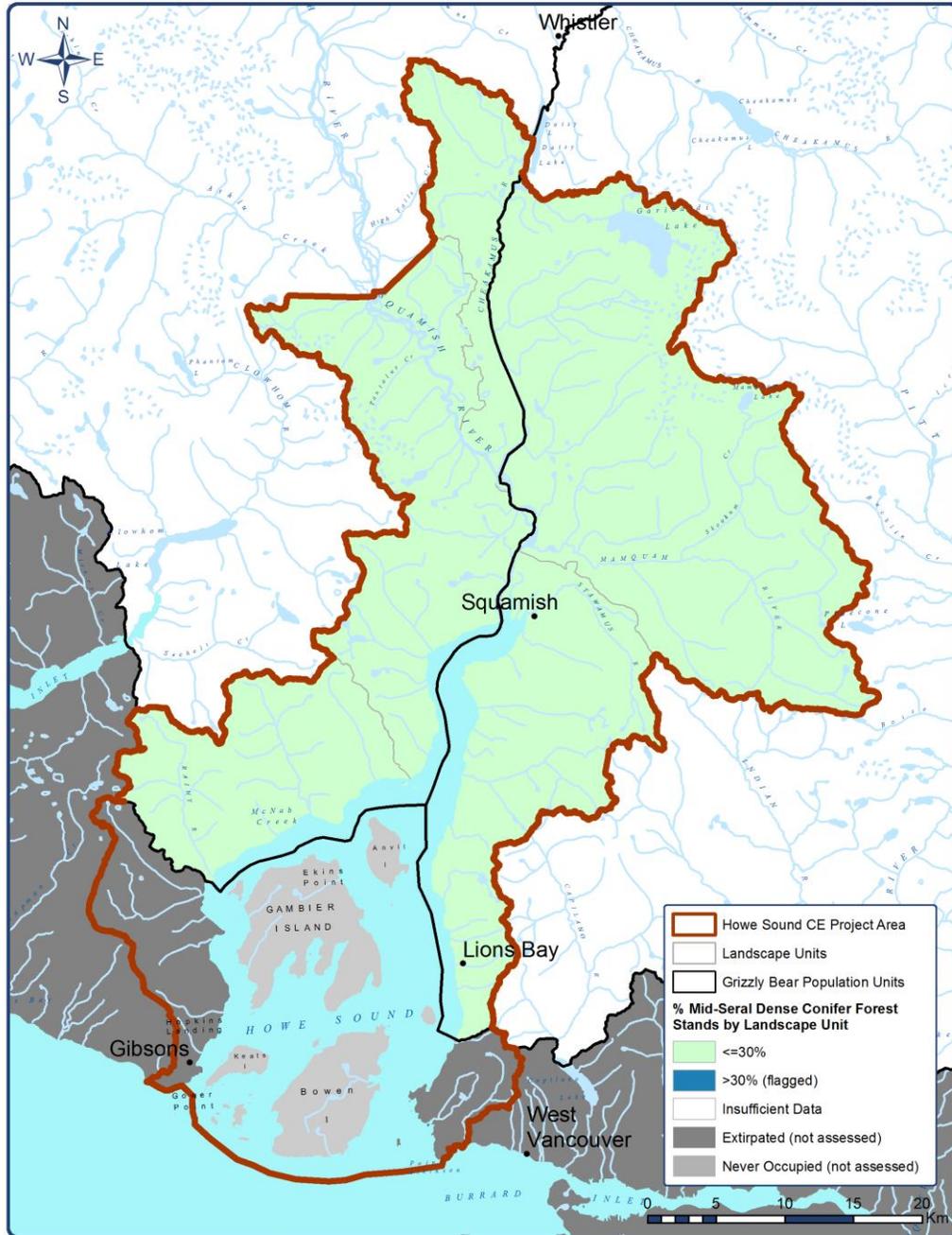
This map provides an estimate of the Grizzly Bear Population Status in 2012 by GBPU. This indicator is based on Grizzly Bear status as reported by Environmental Reporting BC. Viable GBPU are defined by an estimated population at, or greater than, 50% of the habitat capability of the unit. Those GBPU with less than 50% are flagged and identified as Threatened. They will require further examination and consideration in integrated management. In 2012, it was estimated that the Squamish-Lillooet GBPU had 59 Grizzly Bears and the Garibaldi-Pitt GBPU had 2 Grizzly Bears.

Core Indicator - Capable Secure Core Area for Grizzly Bear



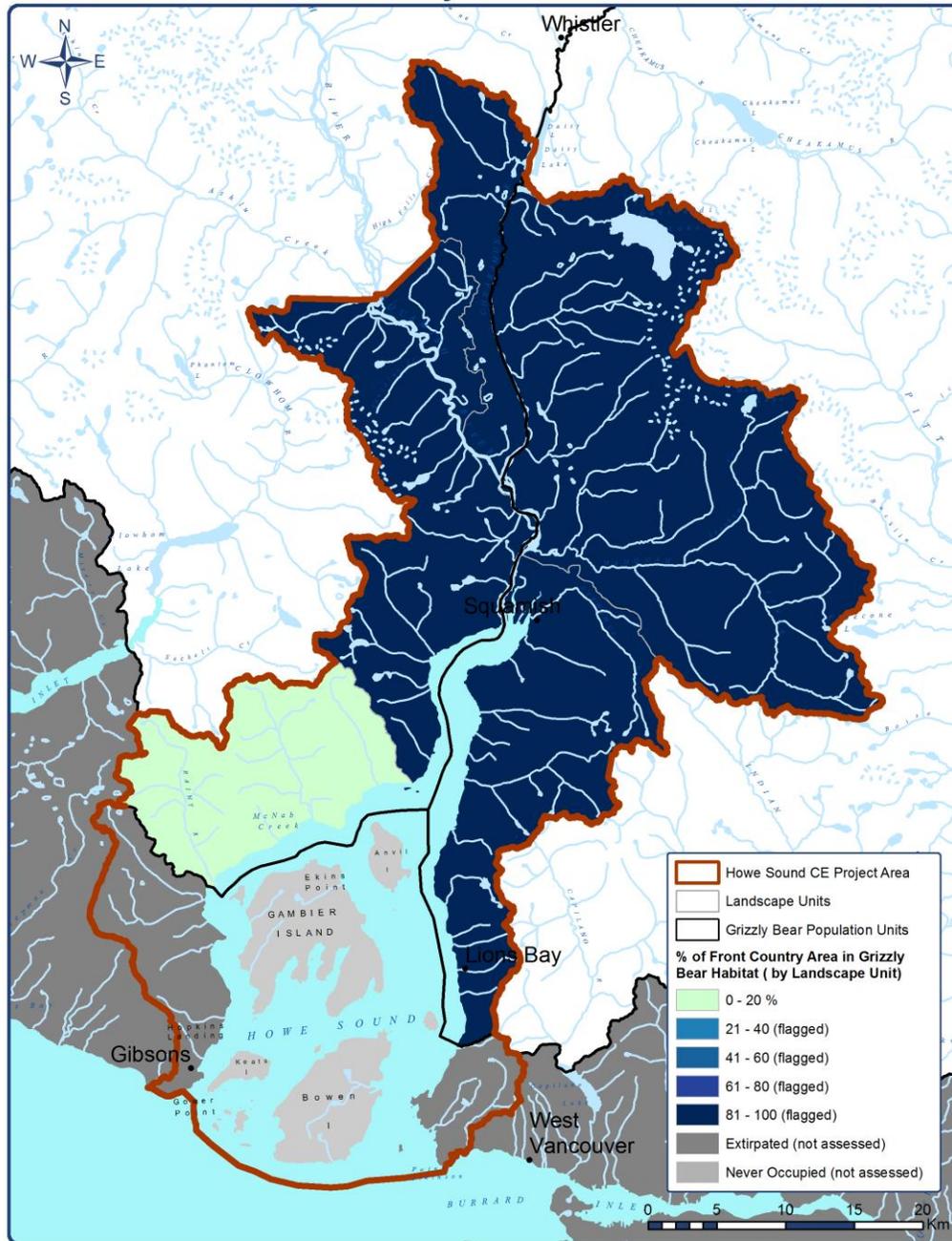
This map shows the proportion of capable secure core areas by landscape unit (LU). These areas are defined as roadless areas of capable habitat equal to, or greater than, 10km² (average daily movement of a female grizzly). Grizzly Bear habitats that have little human access and use can be an important factor in sustaining Grizzly Bear populations. LUs with less than 60% capable secure core areas are flagged for further examination and consideration in integrated management.

Core Indicator - Mid-Seral Dense Conifer Forest Stands in Grizzly Bear Habitat



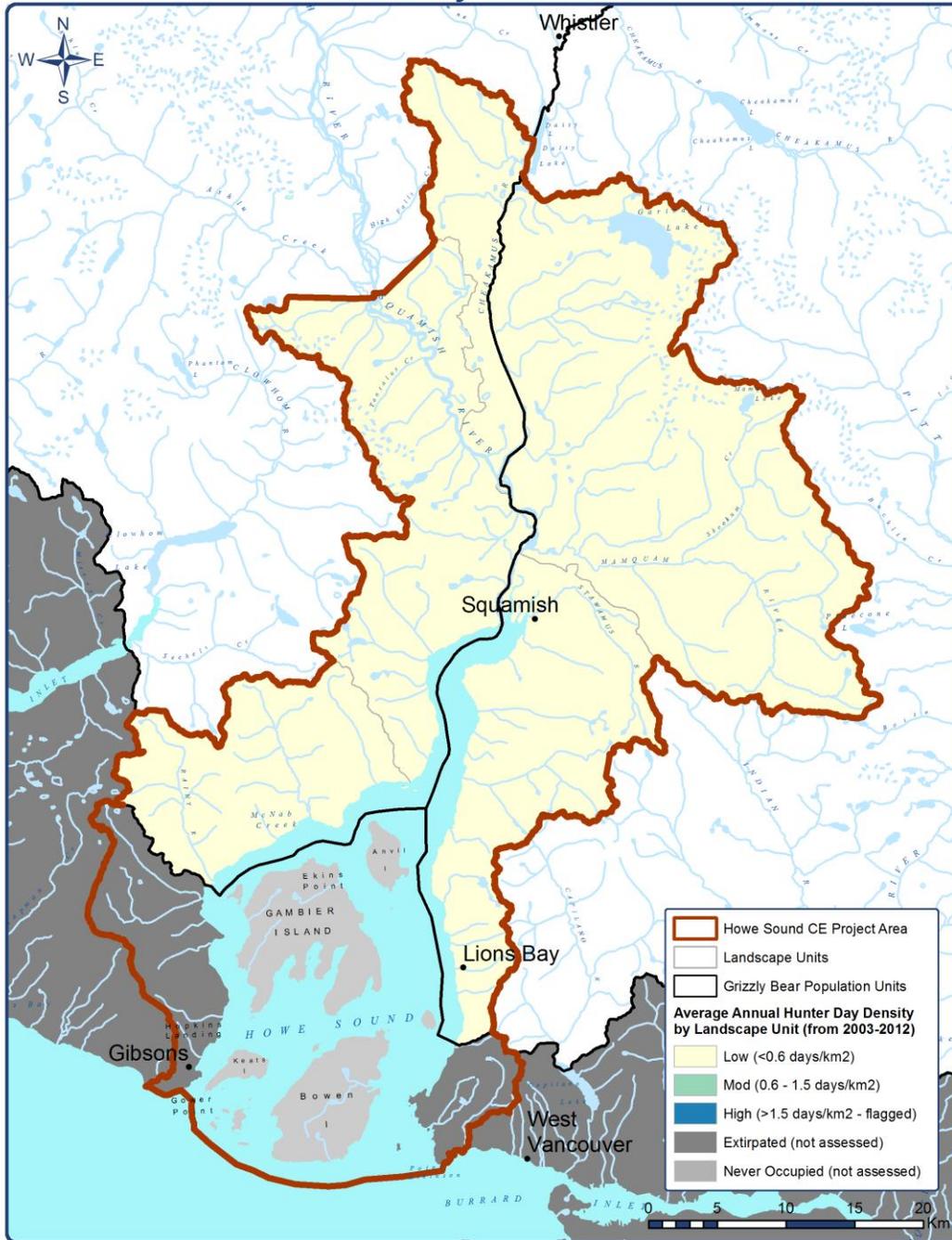
This map shows the proportion of the landscape unit (LU) containing mid-seral dense conifer forest stands for select Biogeoclimatic Ecosystem Classification (BEC) zones. These areas are likely closed canopy coniferous stands with poor potential for Grizzly Bear forage production. LUs greater than 30% mid-seral conifer dominant forest are flagged for further examination of sub-optimal forage production and consideration in integrated management. Note: some LUs may have insufficient seral stage data.

Core Indicator - Proportion of Front Country Area in Grizzly Bear Habitat



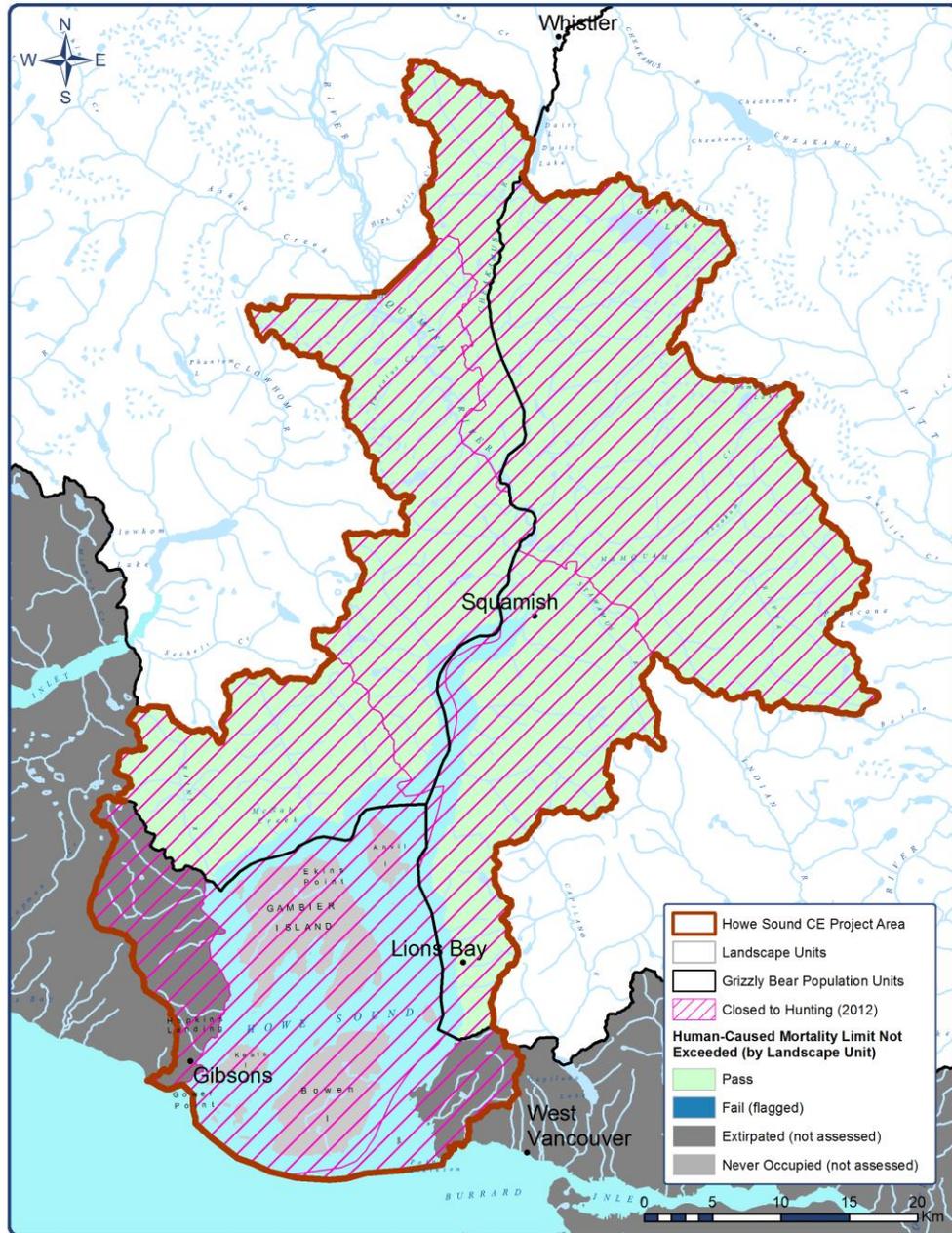
This map shows the percentage of front country area in Grizzly Bear Habitat by landscape unit (LU). LUs having greater than 20% of its area in the front country are flagged for further examination and consideration in integrated management. An LU with a darker colour does not mean that Grizzly Bears cannot persist in the area but does indicate where they are likely to be at greater risk from human activities. Front country areas in Grizzly Bear habitat have a higher likelihood of human-bear encounters and can lead to increased bear displacement and mortality.

Core Indicator - Average Annual Hunter Day Density in Grizzly Bear Habitat



This map shows average hunter day density by landscape unit (LU) from 2003-2012. Hunter day density can increase Grizzly Bear mortality due to the increased probability of lethal encounters with humans (mistaken identity, poaching, self defense, property defense and vehicle collisions). LUs in the top 25% of the province based upon the number of hunter density days (>1.5 days/km²) are flagged for further examination and consideration in management.

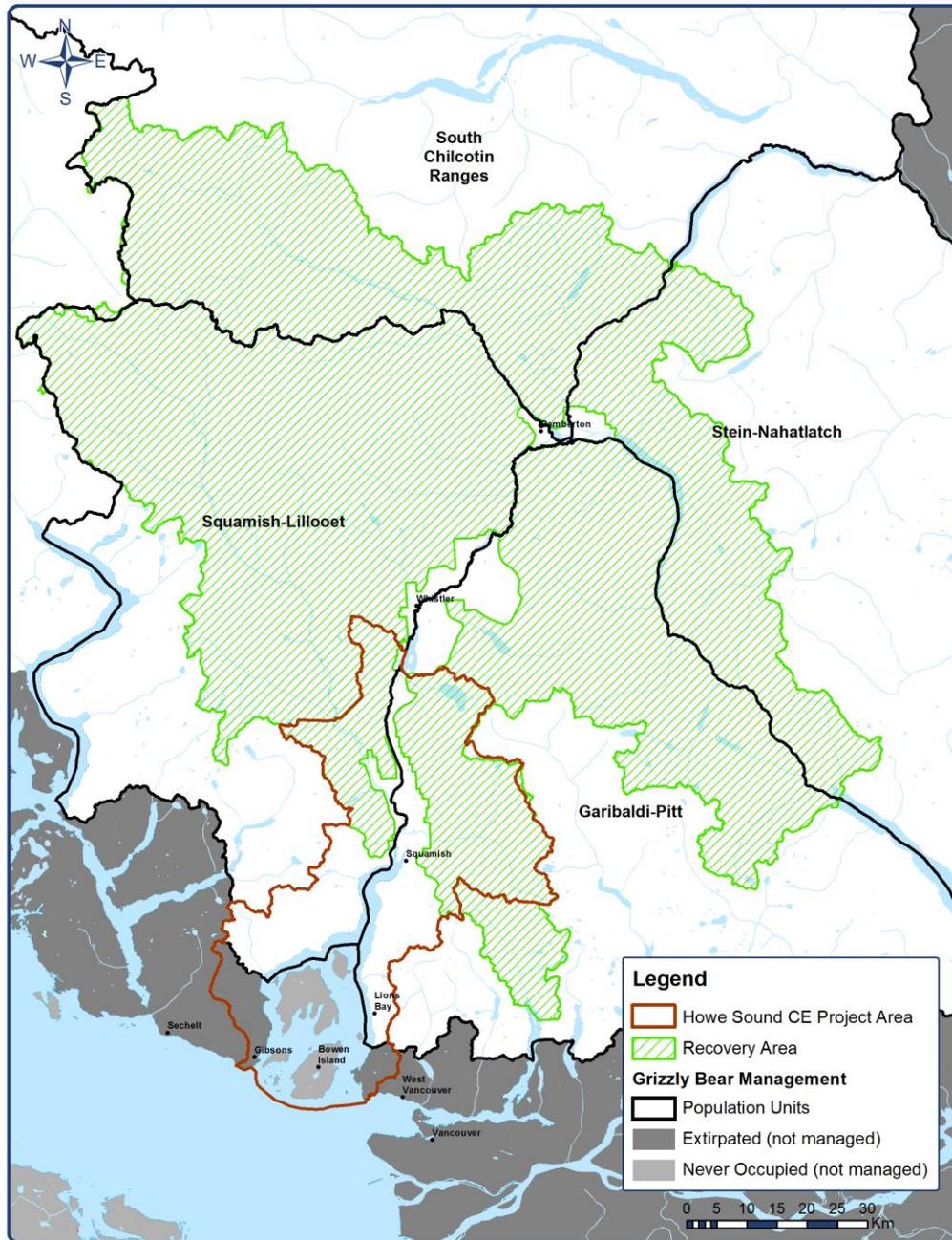
Core Indicator - Human Caused Mortality for Grizzly Bear



This map shows if overall human-caused Grizzly Bear mortality by landscape unit (LU) has been over the total allowable limit for any one of the three most recent allocation periods from 2004 to 2014 where hunting is allowed. Where human-caused mortality is above an allocation limit, the area would be flagged for further examination to determine which allocation periods were exceeded and if there is an ongoing mortality concern. No LUs on this map have exceeded human-caused mortality limits over the past three allocation periods. The area is currently closed to hunting.

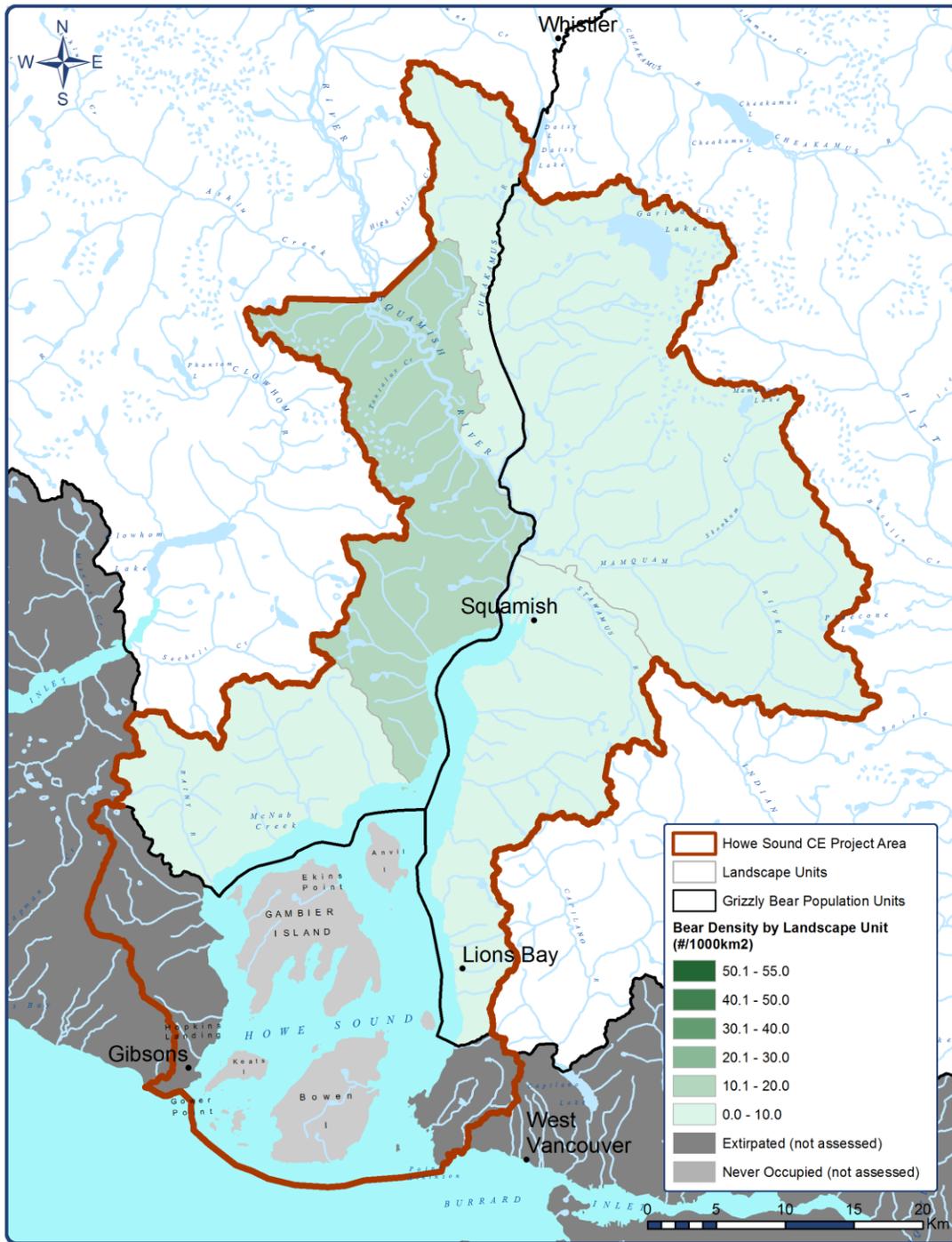
4. Supplemental Information

Sea-to-Sky LRMP Grizzly Bear Recovery Area



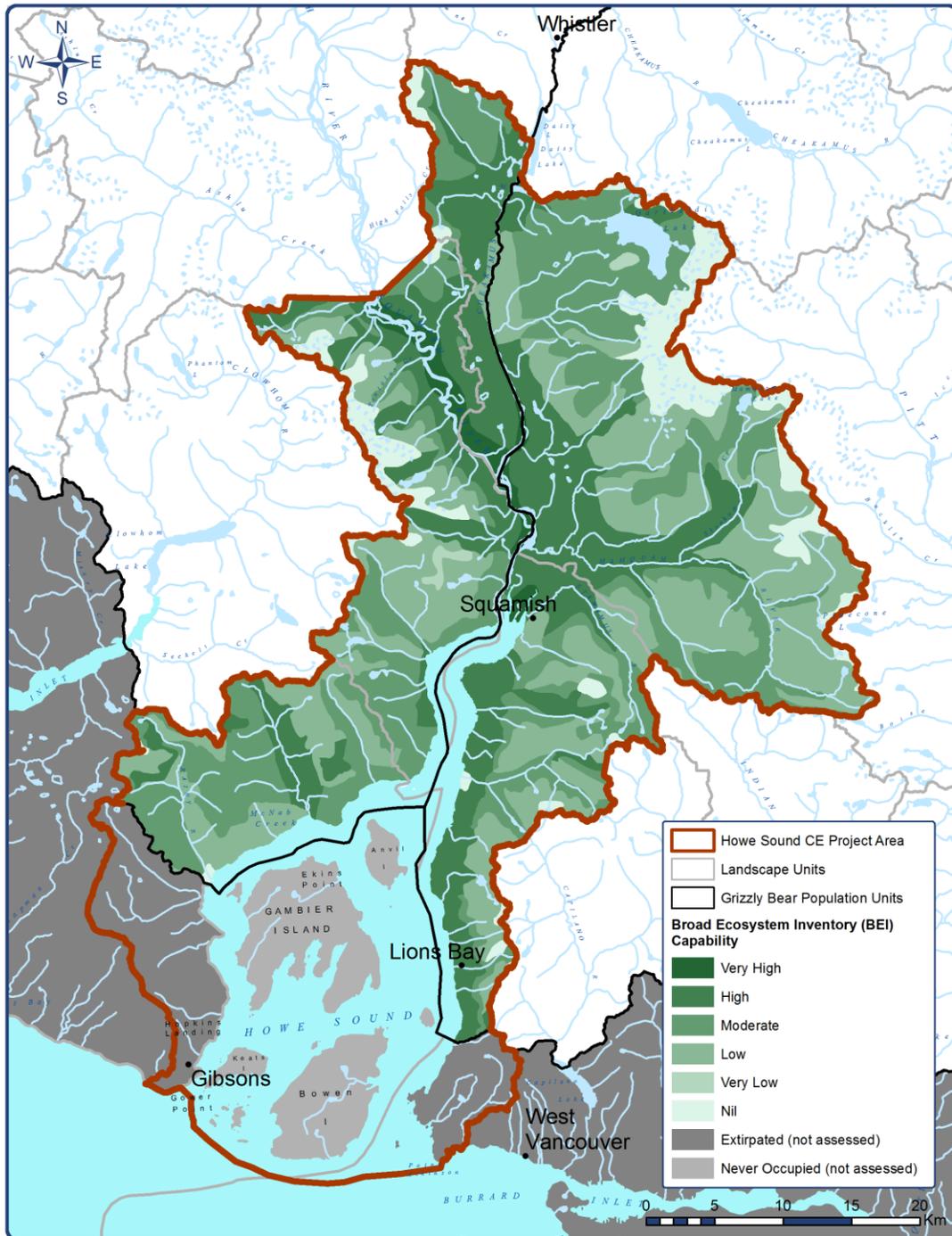
This map shows the Sea-to-Sky LRMP Grizzly Bear Recovery Area which indicates the general area managed for Grizzly Bear recovery in the overlapping Howe Sound CE Project area. Note: the portion of the Sea-to-Sky LRMP Grizzly Bear recovery area that is outside of the Howe Sound CE Project area does not reflect the full extent of provincial Grizzly Bear recovery interests outside of the Sea-to-Sky LRMP.

Grizzly Bear Density



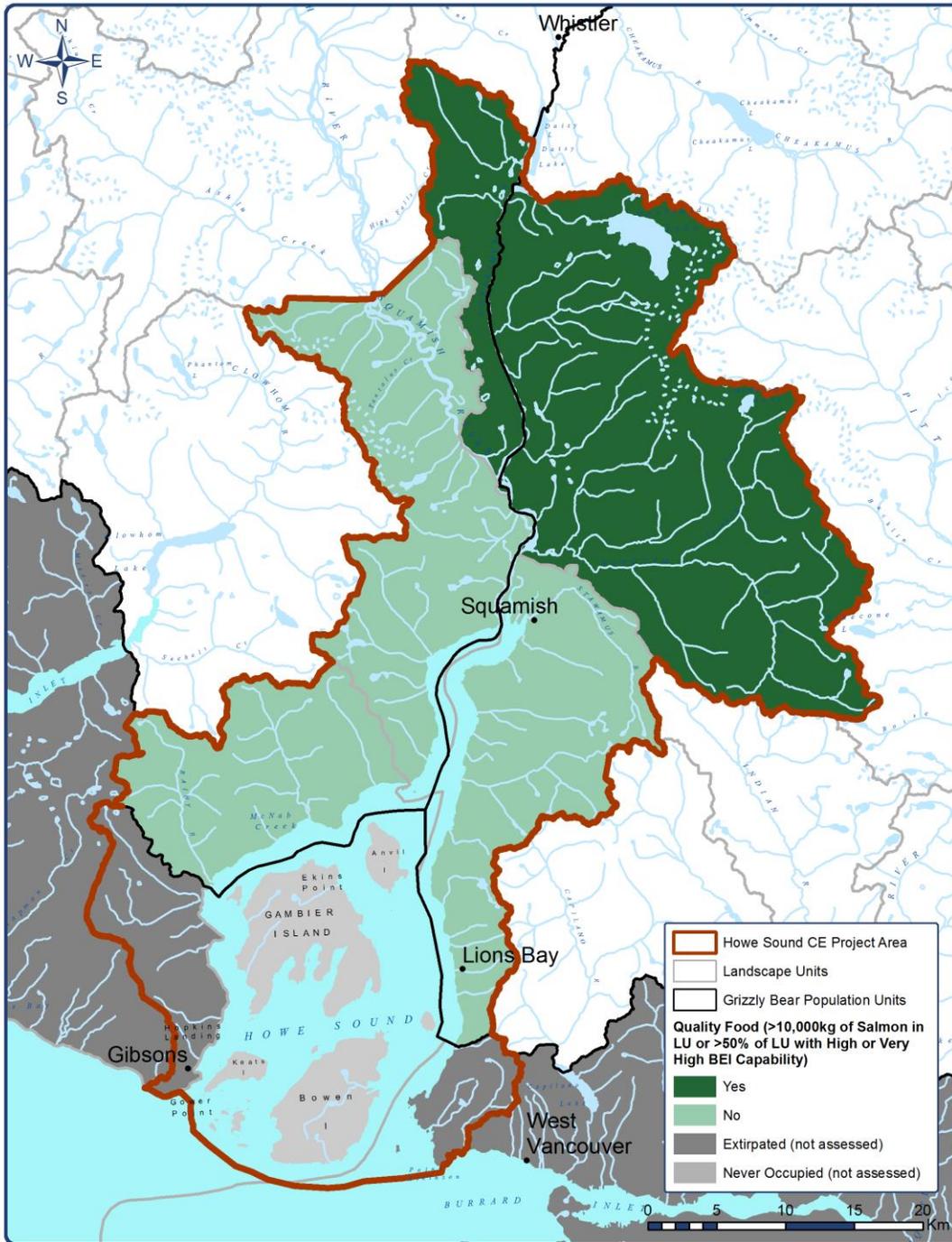
This map shows Grizzly Bear density by landscape unit (LU). Lower bear densities are a population conservation concern. Bear densities equal to, or greater than, 10 bears per 1,000 km² are at lower population risk and bear densities less than 10 bears per 1,000 km² are at higher population risk.

Grizzly Bear Habitat Capability



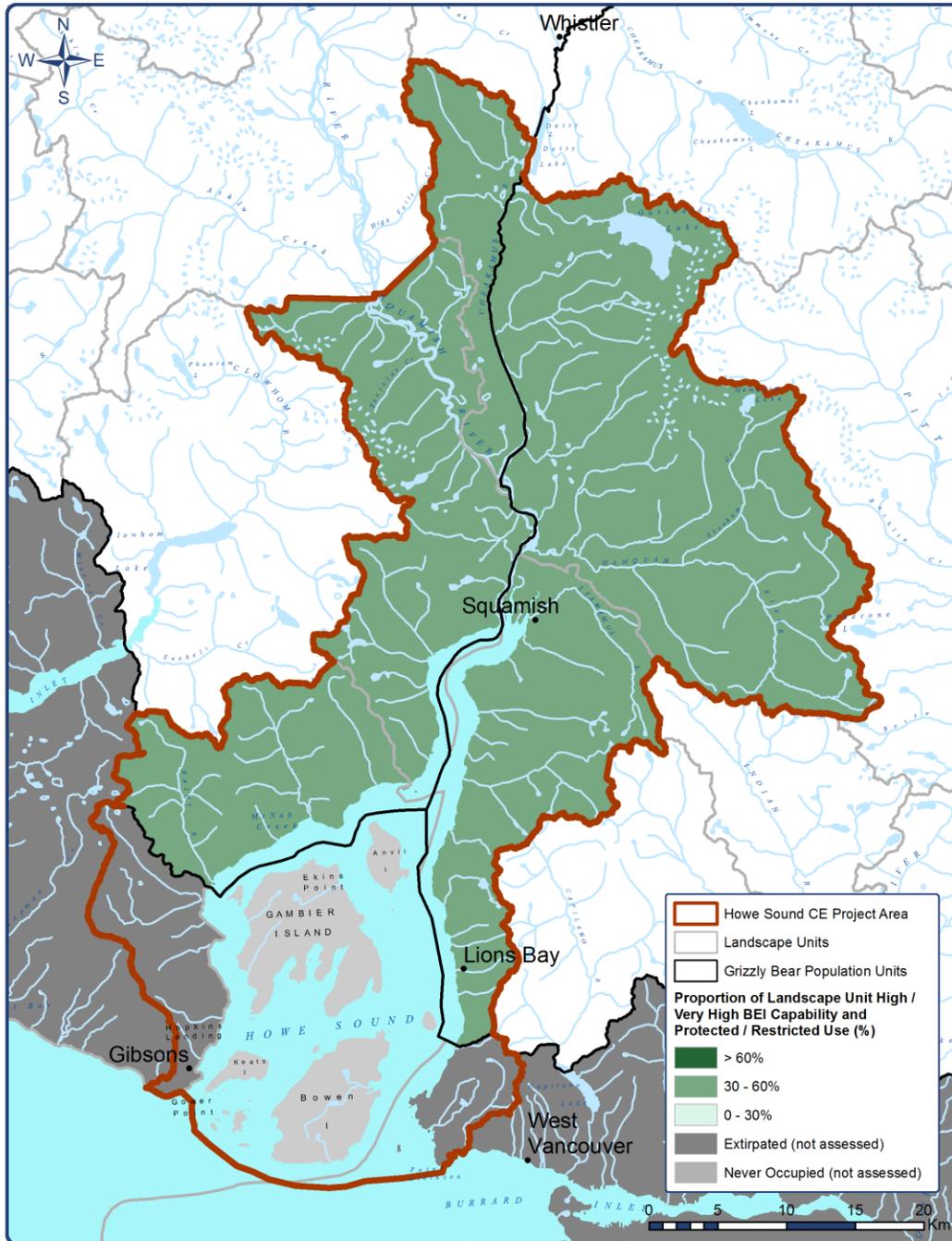
This map shows a spectrum of Grizzly Bear habitat capability classes based upon the use of Broad Ecosystem Inventory (BEI). At a coarse scale, this map provides an estimate of habitat capability for the abundance of seasonal Grizzly Bear food. As a result, the darker green areas are estimated to have more of an abundance of seasonal Grizzly Bear food.

Quality Food for Grizzly Bear



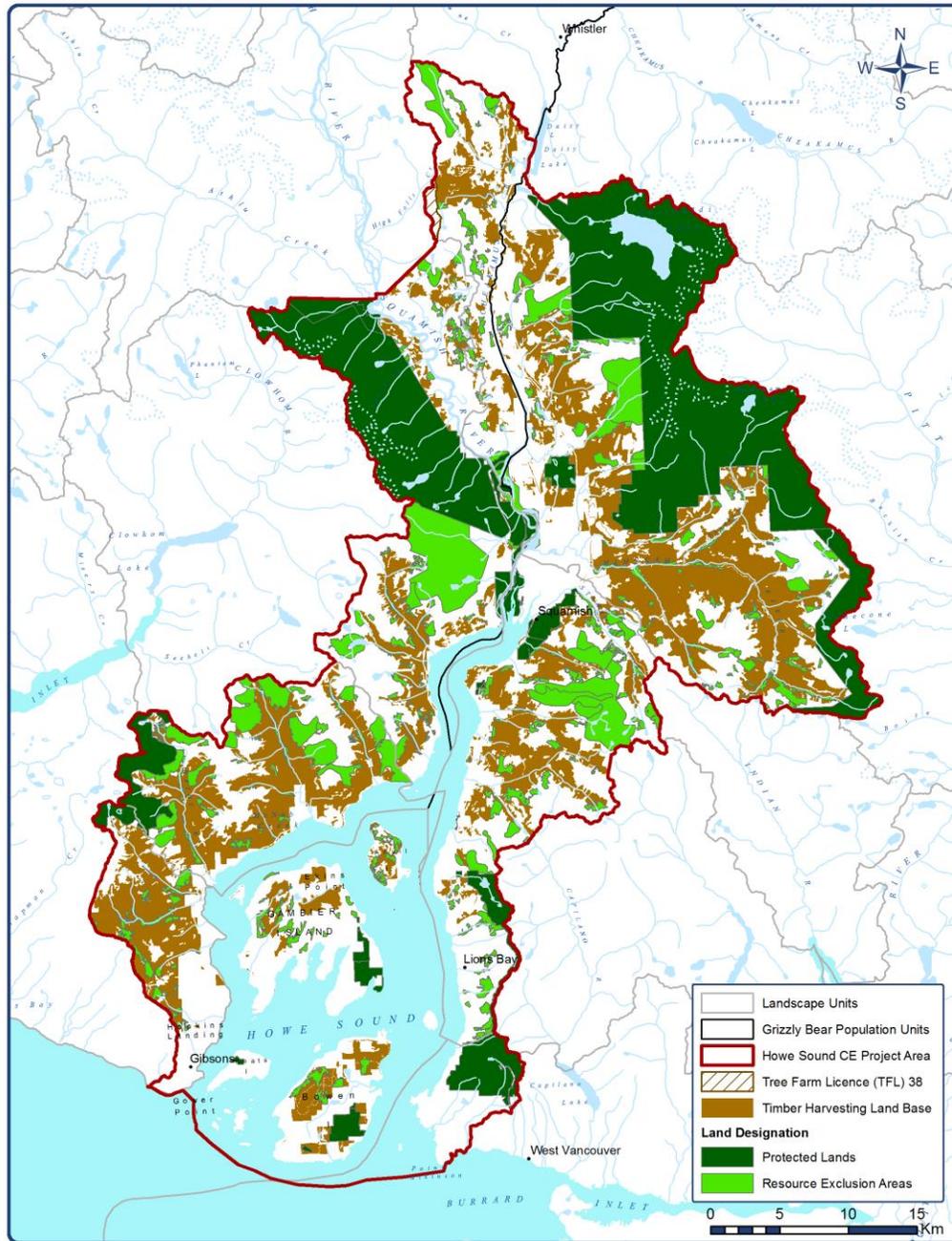
This map shows quality Grizzly Bear food by Landscape Unit (LU). Quality food areas are shown in dark green and are defined as having a high or very high habitat quality rating that is greater than 50% of an LU and/or having an LU with greater than 10,000kg of Salmon biomass per year. Quality food areas can have a significant effect on Grizzly Bear population productivity.

Grizzly Bear Habitat Protected / Restricted Use



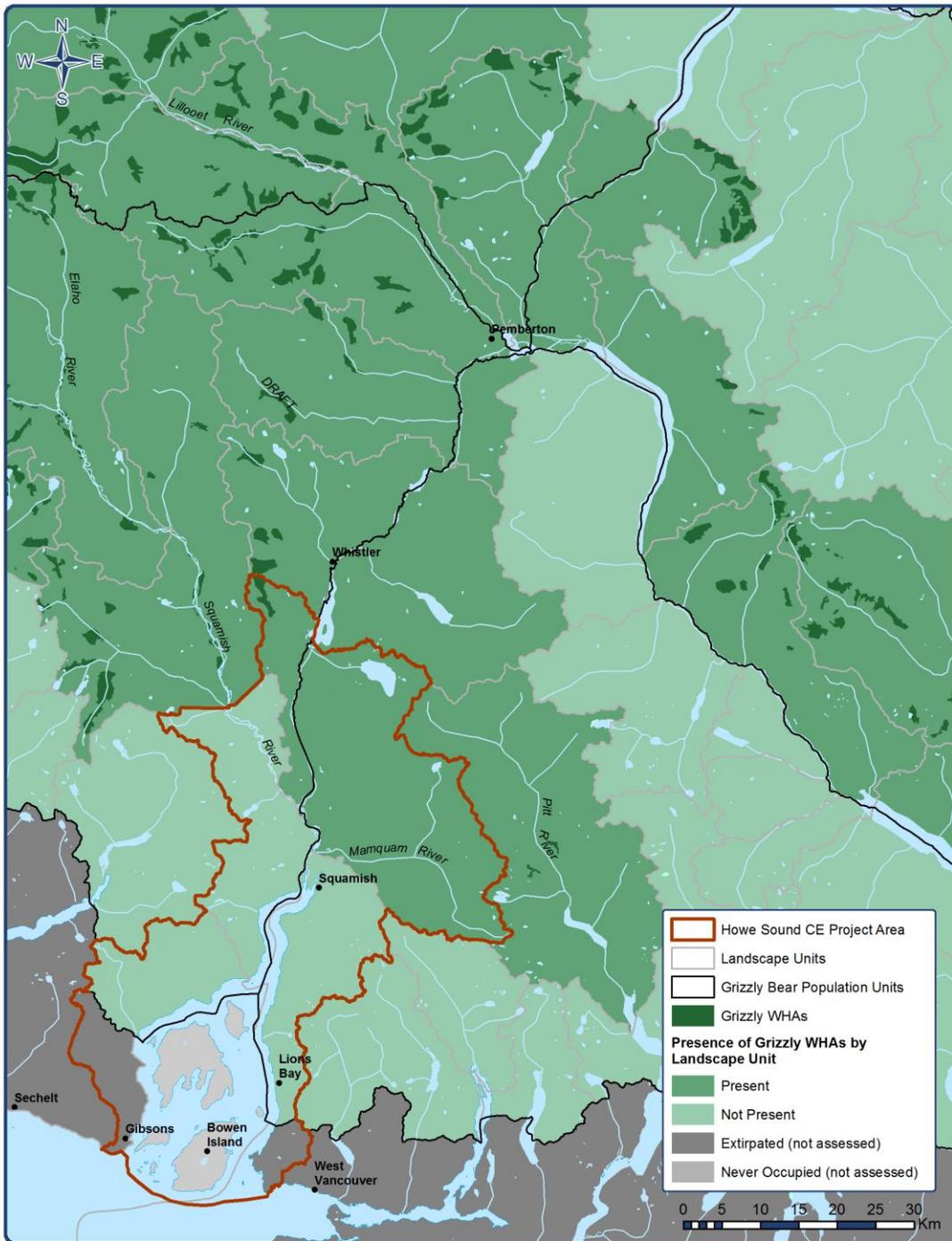
This map shows the proportion of a Landscape Unit (LU) that has both high, or very high, habitat capability and is also protected or restricted in use. LUs with greater than 60% protection/restricted use of capable habitat are of Low risk to Grizzly Bear populations; LUs with 30-60% protection/restricted use of capable habitat are of Moderate risk to Grizzly Bear populations; and LUs with 0-30% protection/restricted use of capable habitat are of High risk to Grizzly Bear populations.

Protected Lands, Resource Exclusion Areas and Timber Harvesting Land Base



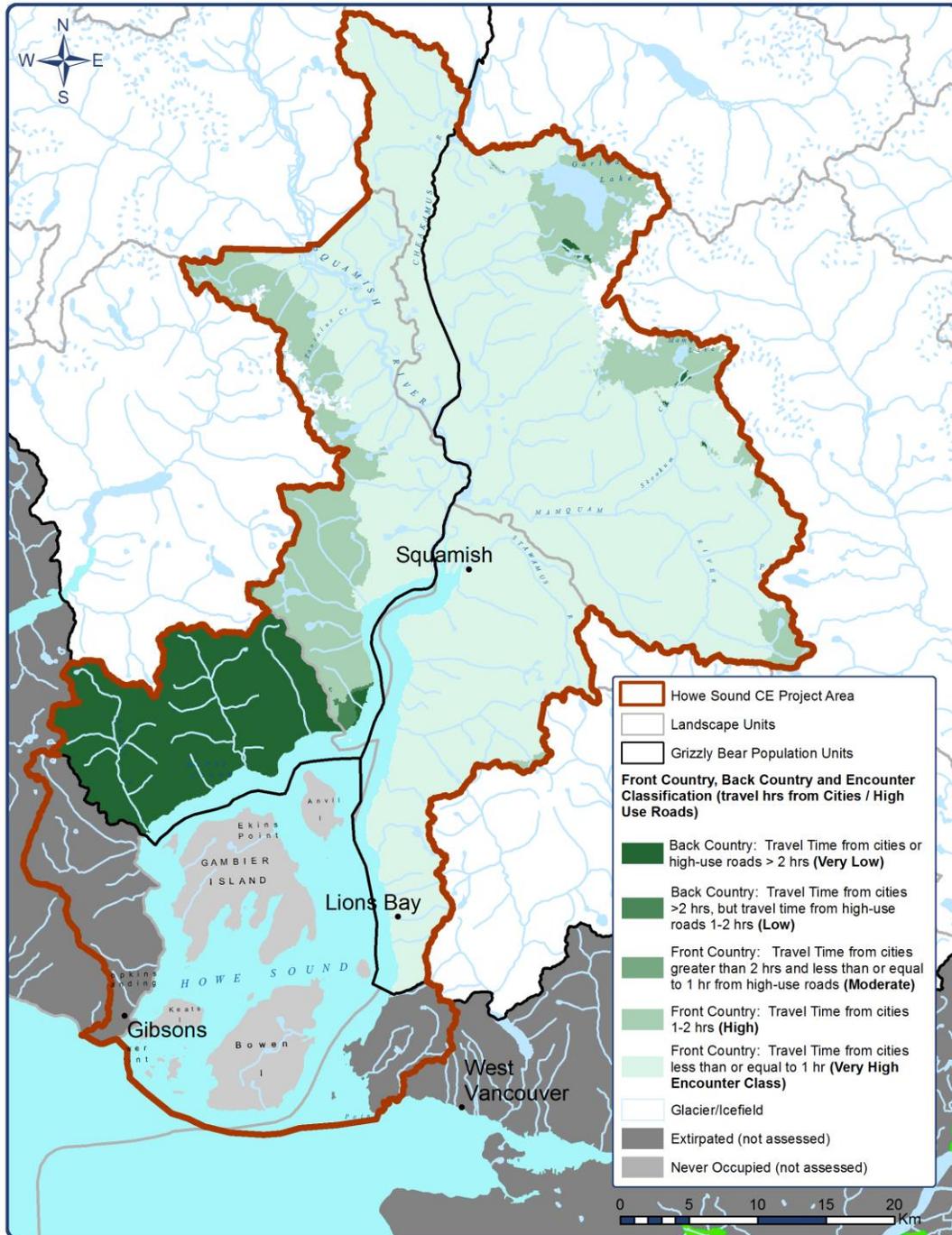
This map shows the main areas where timber harvesting is excluded (Protected Lands and Resource Exclusion Areas) and where it can be considered (Timber Harvesting Land Base and Tree Farm Licence 38). The Provincial Resource Exclusion Areas in the Howe Sound area are primarily made up of Wildland Areas, Old Growth Management Areas, Ungulate Winter Range areas (no harvest) and Wildlife Habitat Areas (no harvest). For more information on *Protected Lands* and *Resource Exclusion Areas*, please go to: <http://www.d.env.gov.bc.ca/soe/indicators/land/land-designations.html>

Grizzly Wildlife Habitat Areas



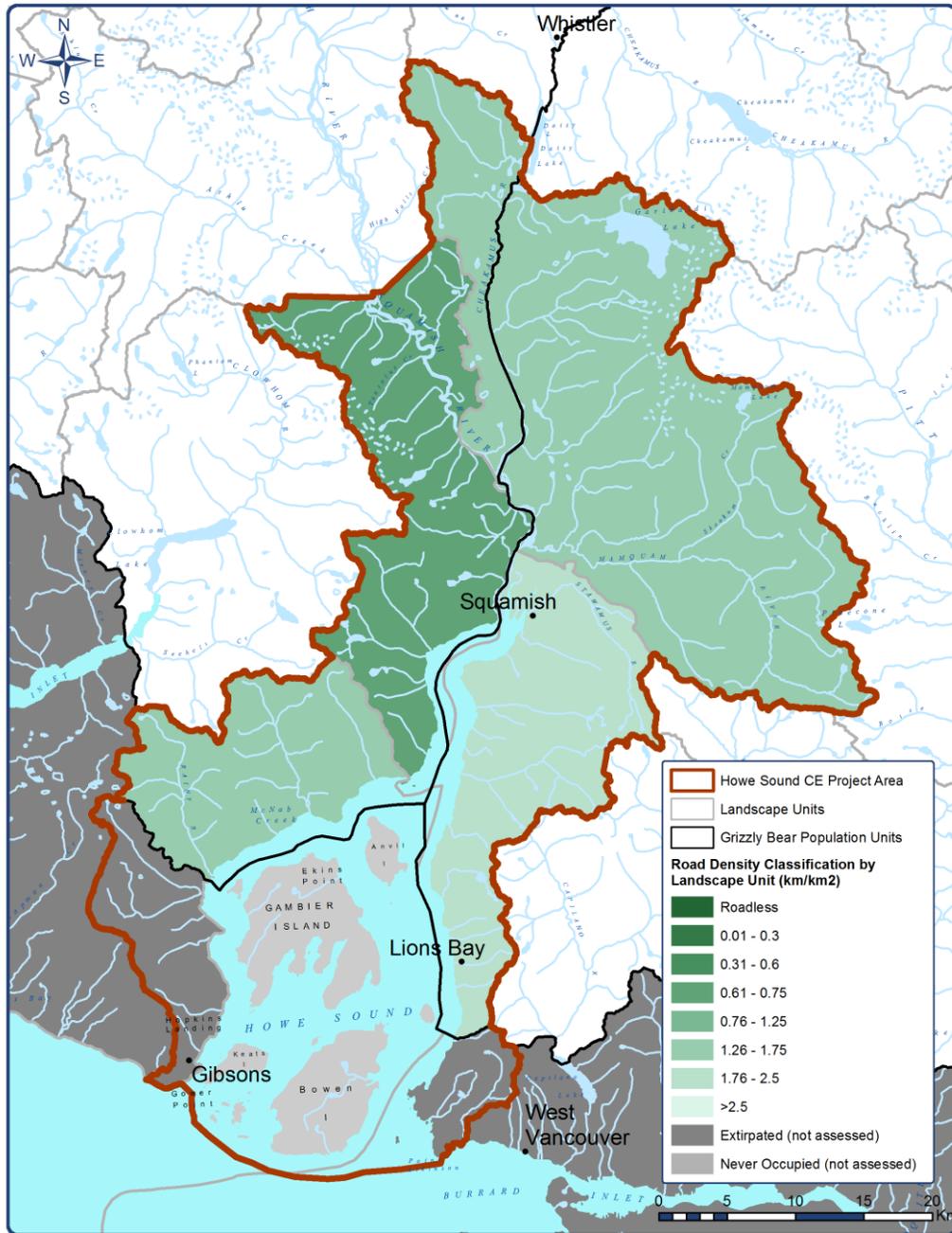
This map just shows where Grizzly Bear Wildlife Habitat Areas (WHAs) are located. The presence of WHAs can help to protect critical Grizzly Bear habitats by conserving key habitat elements. Activities are managed to limit their impacts on the key habitat elements.

Front Country / Back Country Classification - Likelihood of Human Encounter



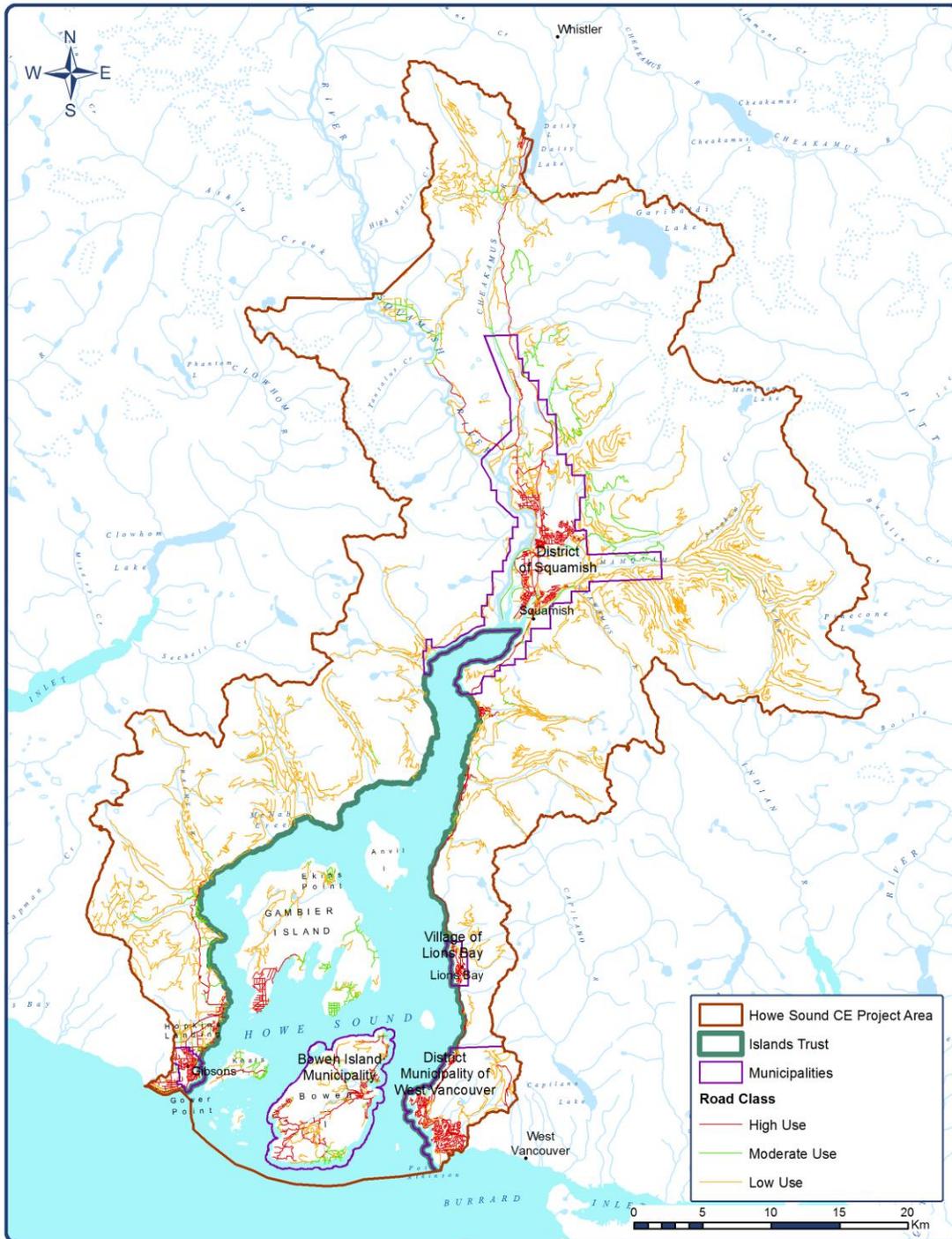
This map shows a backcountry and front country classification and human-Grizzly Bear encounter classification scheme. The lighter green colours basically show where Grizzly Bears are more likely to encounter humans. Increased human encounters with Grizzly Bears can increase bear mortality or cause habitat alienation.

Road Density Classification



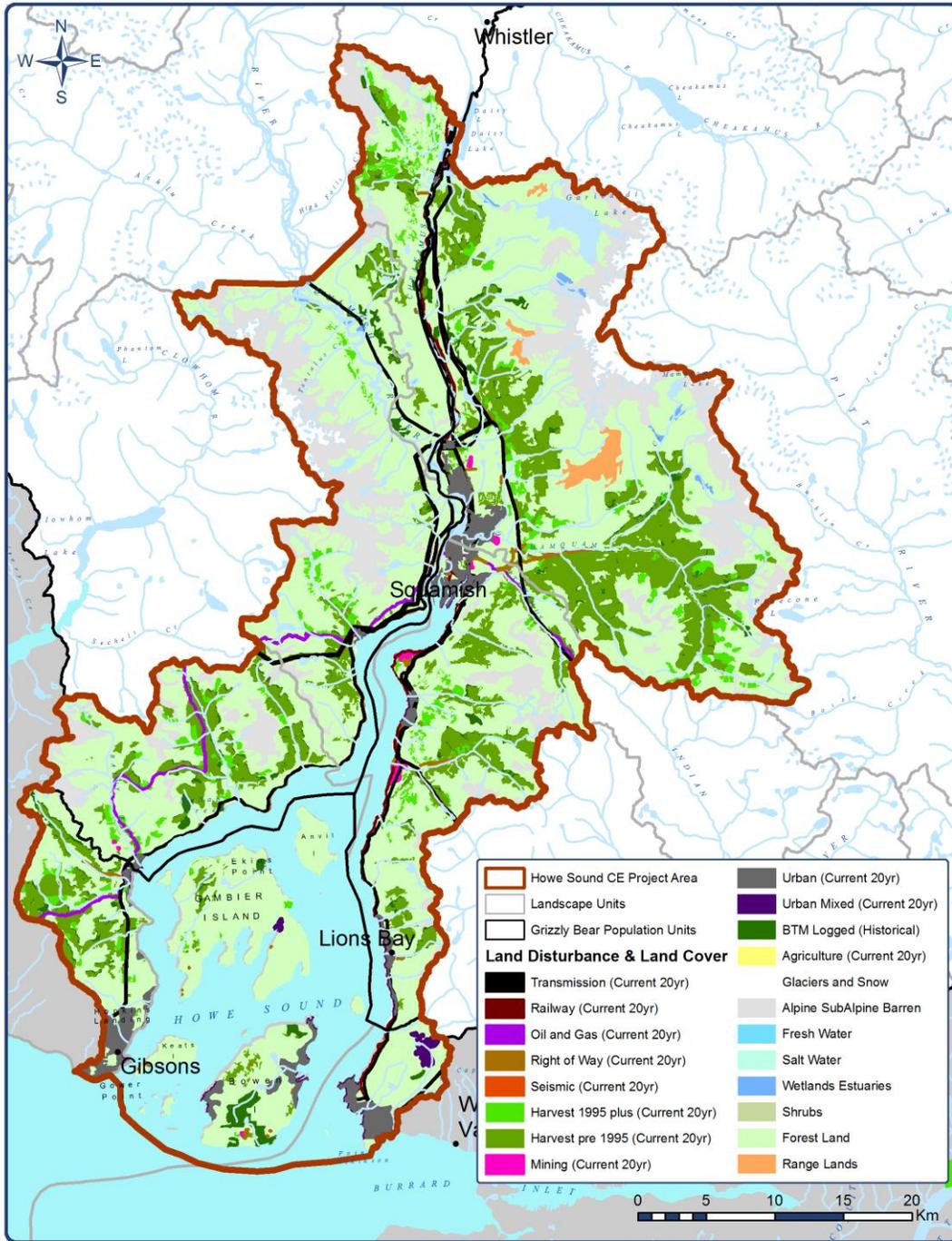
This map shows road densities by km of road per km² per landscape unit (LU). The LUs with lighter green colours have higher average road density and might benefit from access management to reduce human impacts on Grizzly Bears and their habitats. Roads and the human impacts associated with them can have a range of direct and indirect impacts to Grizzly bears such as: increase mortality; habitat loss; habitat alteration; habitat displacement; habitat fragmentation; population fragmentation; bear behaviour alteration; and exposure to anthropogenic foods.

Roads and Land Jurisdiction



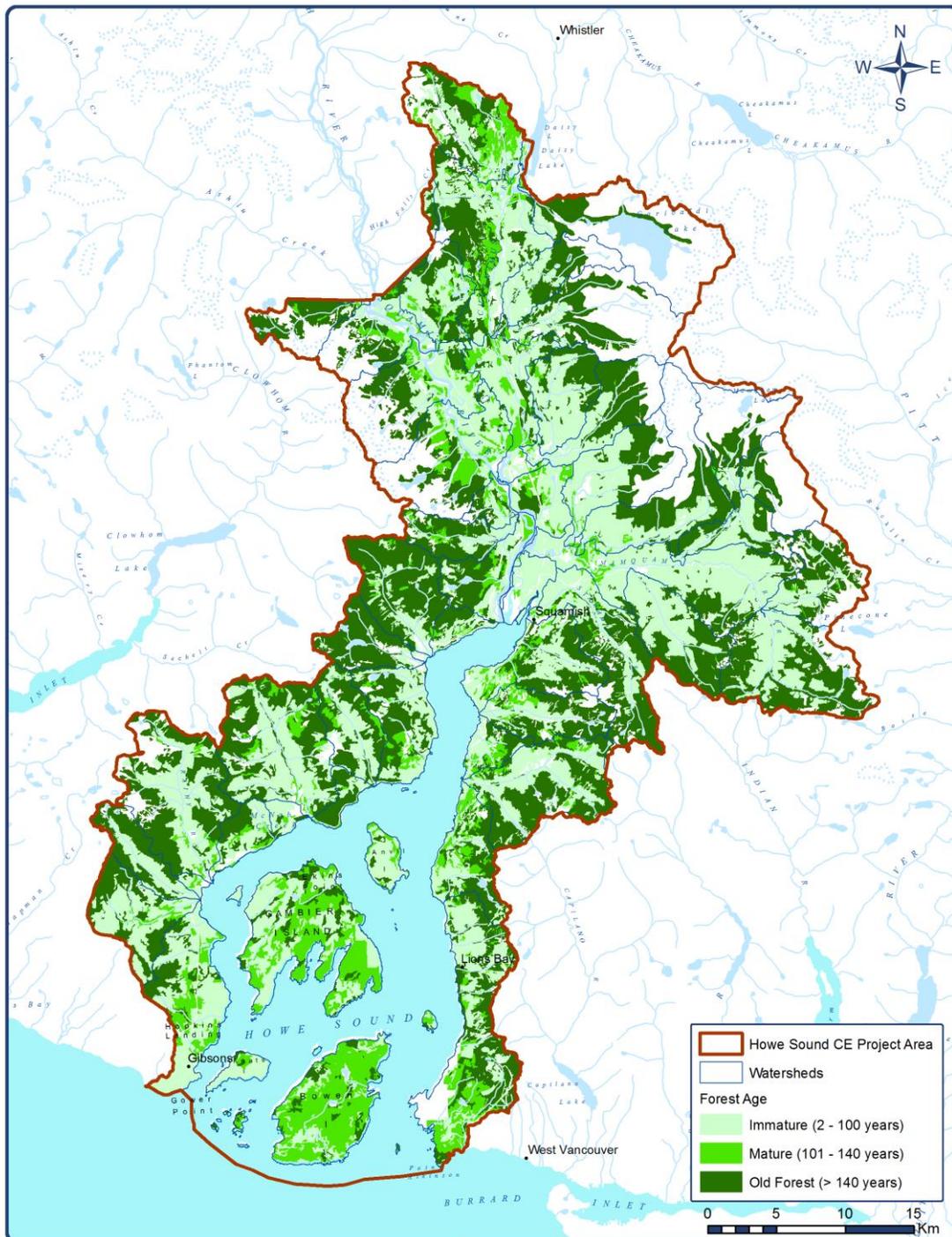
This map shows current road location and classification along with land jurisdiction. Roads and associated human access can have a range of direct and indirect negative impacts on Grizzly Bears and their habitats.

Human Land Disturbance and Land Cover



This map shows the current environments and various land disturbances that have occurred over the past 20 years. These disturbances can have negative and sometimes positive impacts on Grizzly Bear habitats. These historical land disturbances often bring a legacy of roads and new access routes into important Grizzly Bear habitats.

Forest Age and Watersheds



This map shows watershed boundaries and gives an estimate of forest age at the stand level. Old forest stands area defined as being greater than 140 years old. The areas in white do not show data for forest age or do not have forests.

5. Discussion of Assessment Results

The current condition assessment results in this report should be viewed as initial coarse filter information for consideration in strategic, tactical and operational decision-making at all levels of governance. It is an initial current condition assessment that would benefit from further validation and assessment work. These assessment results should also be considered in the context of: First Nations' interests, unique LU characteristics, competing resource values, climate change and other important contextual information before determining if, and what kind of, a management response is warranted.

The assessment results in this report provide some general insight into where Grizzly Bear persistence and recovery is potentially at higher or lower risk and what some of those risk factors likely are. From this assessment, it appears the main risk factors to Grizzly Bear population sustainability are disturbance from human activities (related to road access) and the limited amount of sustainable and accessible quality food in some LUs. These risk factors could receive some further attention in terms of exploring precisely what amount of risk they pose and what management actions can be taken over time to reduce those risks. Validation work could also be conducted on some individual sample LUs to ground truth the results and develop appropriate draft management responses.

At the individual LU scale, the ministry is exploring a number of actions in response to these results such as assessing the recent trends for these indicators, comparing these predictions to available habitat and population survey information (15 years of Grizzly Bear research in the Sea-to-Sky Resource District) and applying these current condition assessments, where possible, to land and resource management decisions. Some possible management responses could be improving forage and cover habitat attributes through forest seral stage distribution and better managing unregulated hunting and disturbance through access management. Some examples of these potential responses are offered in Table 2. The table provides some sample management responses for two LUs that were selected for their different levels of assessed risk, to demonstrate how this information could be applied in varying circumstances. The table also provides some potential interpretations of the assessment results, some types of further assessment that could be undertaken and some potential management responses to the observed risks.

Table 2. Examples of Potential Interpretation, Further Assessment & Management Responses

Landscape Unit & Interpretation	Condition of Indicators for Grizzly Bear Value (Good, Moderate or Poor)					
	Population Status	Front-country in GB Habitat	Capable Secure Core Area	Mid-Seral Dense Confer Forest	Average Annual Hunter Day Density	Mortality Unregulated Hunting
<p>Lower Squamish LU 34,923 ha</p> <p>(moderate bear density & lower road density & human activity)</p> <p>Squamish Lillooet GBPU: 50-75 bears</p>	Poor	Poor	Good	Good	Good	Good
Initial Interpretation	<ul style="list-style-type: none"> ➤ The Squamish River and the steep slopes and lack of roads in Tantalus Range Provincial Park limit access and human activity on the western side of the Squamish River, which makes up much of the LU. ➤ This LU does not have an abundance of quality food but does have some seasonal forage and feeding areas in the LU (i.e. lower slopes on both sides of Squamish River and drainage and avalanche chutes in Tantalus Range). ➤ Habitat capability exists nearby in adjacent LUs (primarily to the east and northeast on the eastern side of the Squamish river from Paradise Valley to Cheakamus River area). ➤ The limited amount of human access and the high level of capable secure core area along with the amount good habitat and population conditions within and adjacent to this LU makes this an area where Grizzly Bear persistence and recovery is more likely. ➤ The increase in recreational demand in the lower mainland is increasing recreational activity in the Squamish River Valley. This could lead to more disturbance and possible unregulated hunting further up the valley. 					
Recommended Further Assessment	<ul style="list-style-type: none"> ➤ 20 year past and anticipated future trend analyses of key indicators will indicate the direction and changing risks within the landscape. ➤ Analyze any available Grizzly Bear monitoring data (eg. GPS collaring data, camera traps, DNA sampling, observational data, etc.) to validate risk assessments and confirm population assumptions. ➤ Collect human-use data (eg. road & trail counters, helicopter activity, commercial recreational tenure information) in areas of anticipated conflict, correlated with biological data, in order to inform recreational management actions. 					

<p>Potential Management Responses</p>	<ul style="list-style-type: none"> ➤ Management for Tantalus Provincial Park should consider key seasonal Grizzly Bear habitats in and adjacent to the park and not encourage high levels of access development and human visitation to these areas. ➤ Fire management for Tantalus Provincial Park should consider a ‘Let Burn’ policy in the wilderness areas of the park without facilities. This type of natural disturbance could complement the existing natural forage areas for Grizzly Bears. ➤ Long-term forest management on the lower slopes of the Tantalus Range should consider a forest seral stage distribution as it relates to the interspersion of forage, cover and travel habitats. ➤ Forest management should also explore forest harvesting and silvicultural practices that can provide the best regime for the production of high quality, forage, berry crops and cover for Grizzly Bears and other wildlife. ➤ Future GBPU management plans through integrated management will need to consider the management of motorized access and recreational activity to important seasonal habitats in the Squamish River Valley. ➤ Future GBPU management plans through integrated management will also need to consider population connectivity through effective travel corridors within relevant LUs to ensure the long-term viability of Grizzly Bear persistence in the area and health of the broader population.
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Condition of Indicators for Grizzly Bear Value
(Good, Moderate or Poor)

Landscape Unit & Interpretation	Population Status	Front-country in GB Habitat	Capable Secure Core Area	Mid-Seral Dense Confer Forest	Average Annual Hunter Day Density	Mortality Unregulated Hunting
<p>East Howe LU (30,232 ha)</p> <p>(low bear density, high road density, high human activity & poor food quality)</p> <p>Garibaldi-Pitt GBPU: 2-8 bears</p>	Poor	Poor	Poor	Good	Good	Good

<p>Initial Interpretation</p>	<ul style="list-style-type: none"> ➤ Most of this LU is not identified for Grizzly Bear recovery because of its high levels of development, transportation and recreational use that continues to grow (e.g. S2S highway, S2S Gondola, the Stawamus Chief Prov. Park, Squamish and Britannia Beach Housing Developments etc.) ➤ Only the Stawamus River portion of the LU is included as part of the Sea-to-Sky LRMP Grizzly Bear recovery area due to some feed opportunities and connectivity to the Indian River watershed. ➤ The LU has high road density and access due to historical intensive logging dating back to 1970’s and recent land development in the corridor. ➤ Most of the East Howe LU does not have high quality food and has too much human activity to provide quality habitat.
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Recommended Further Assessment	<ul style="list-style-type: none"> ➤ 20 year past and anticipated future trend analyses of key indicators will indicate the direction and changing risks within the landscape. ➤ Analyze any available Grizzly Bear monitoring data (e.g. GPS collaring data, camera traps, DNA sampling, observational data, etc.) to validate risk assessments and confirm population assumptions. ➤
Potential Management Responses	<ul style="list-style-type: none"> ➤ This LU is not a priority for enhanced Grizzly Bear recovery due to the high recreational use, limited quality habitat and proximity to the highway. ➤ The development of a future Garibaldi-Pitt GBPU management plan should explore the long-term value and probability of success for Grizzly Bear recovery to the Indian River watershed and the subsequent value/risk of managing the Stawamus River watershed as a Grizzly Bear forage and travel corridor.

FLNRORD staff are developing tools and processes designed to integrate and communicate resource value objectives, assess how well these objectives are being achieved (including results from this report) and respond with integrated resource management approaches to help achieve these objectives. In the spirit of the United Nations Declaration on the Rights of Indigenous Peoples, FLNRORD will share these assessments with key local First Nations in the Howe Sound CE Project area and collaborate on the development of any warranted management responses.

Possible Management Considerations

The following information is to be considered in future Grizzly Bear management and related authorization decisions:

- Long-term forest management in Grizzly Bear recovery areas may need to consider the spatial interspersion of forage, cover and travel corridor attributes over time to provide effective long-term habitat areas for Grizzly Bears;
- The balancing of forest seral stage distribution should be considered in the broader context of any NRS integrated management direction for other values in the Howe Sound area to explore possible management tool synergies (UWRs, WHAs, WMAs OGMA's etc);
- Further research should focus on various forms of harvesting and silvicultural practices to see which forest practices provide the best regime for the production of high quality forage, berry crops and cover for Grizzly bears and other wildlife. We need to ensure that forest harvesting practices in the Coastal Western Hemlock zone do not regenerate extensive areas of weedy invaders and low quality forage species;
- To ensure the long-term viability of Grizzly Bear populations in the area, integrated planning and management needs to consider population connectivity through effective natural travel corridors to adjacent GBPUs (South Chilcotin Ranges, Stein-Nahatlatch and Garibaldi-Pitt GBPUs). This could involve prioritizing GBPUs for recovery/ sustainability

and undertaking more habitat securement and mitigation of travel barriers to population connectivity;

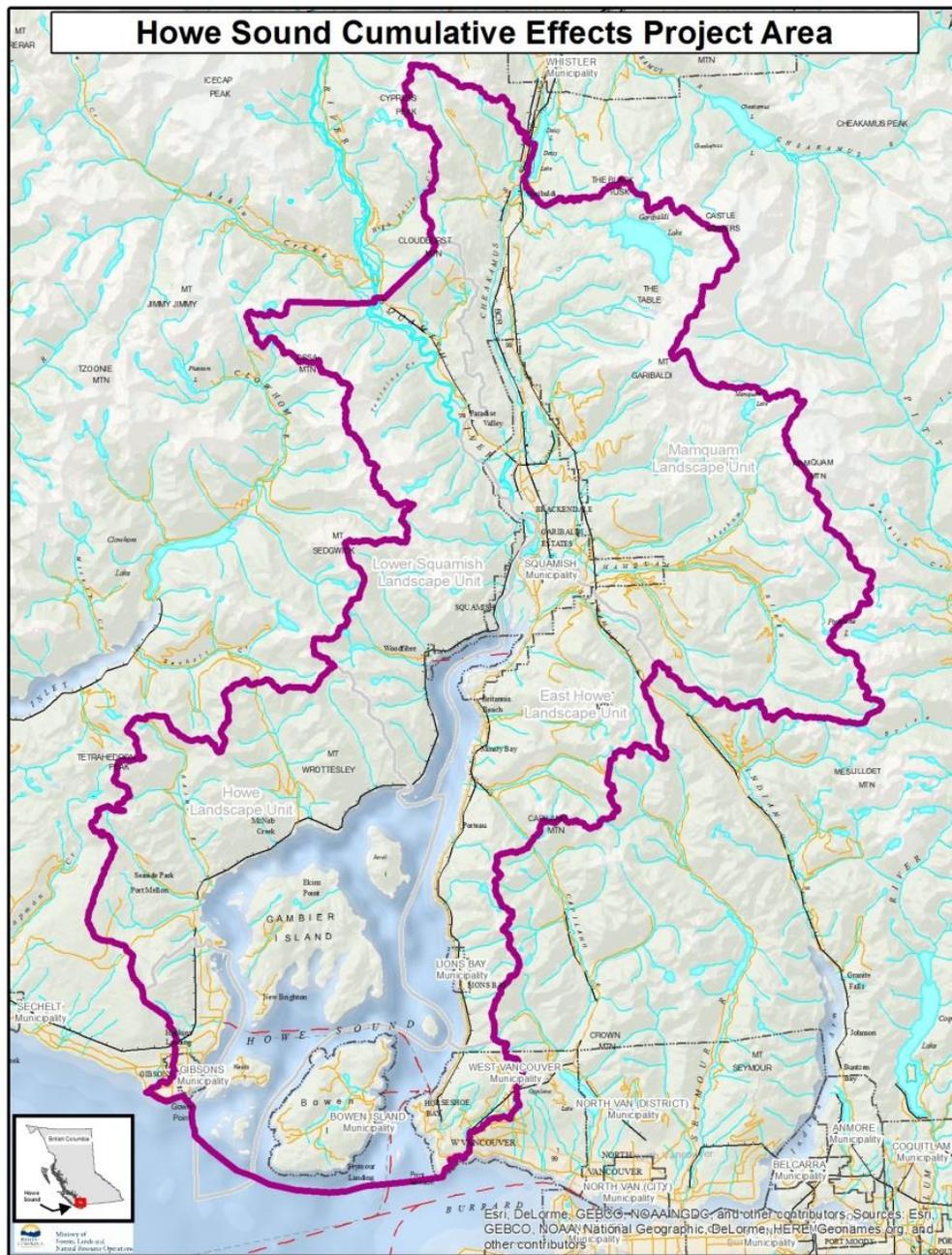
- Limiting human access into key seasonal Grizzly Bear habitats is expected to become more important as tourism, recreation and housing development continues to increase up the Sea-to-Sky corridor. In particular, integrated management will need to consider the management of roads and human access to important seasonal Grizzly Bear habitats west of the Sea-to-Sky highway to reduce risk of bear mortality and displacement in this area of higher bear density;
- Further research can identify key seasonal Grizzly Bear travel corridors and possible seasonal access management restrictions;
- EAO processes and any Land and water authorizations in the Howe Sound area should consider this Grizzly Bear CE current condition assessments and any subsequent management recommendations;
- Grizzly Bear CE assessment and long-term management should consider the latest estimation of climate change impacts to the South Coast (i.e. seasonal fire, drought, rain and possible reductions in salmon);
- The assessment results support dialogue on more region-specific Grizzly Bear management objectives and inform NRS strategic area based planning discussions;
- The assessment results can be used to improve the identification of priority GBPUs for more detailed monitoring, assessment and research;
- The assessment results can provide support information for consideration in the identification of general areas for project mitigation;
- Without more detailed validation/interpretation of the current condition results, the results are to be used only as an initial coarse filter for further validation, interpretation and area prioritization for further CE assessment and management focus;
- Fifteen years of Grizzly Bear research in the Sea-to-Sky area can be used to help validate some of the results of this assessment; and
- Further interpretation, assessment and consultation are required before appropriate management direction can be determined. (For example, a “flagged” mapping result does not always indicate that a strong management response is required as the assessment result could be trending in a positive direction without the need for additional management; or it may not be desirable to improve Grizzly Bear population sustainability factor in a particular LU if it conflicts with other management objectives like public safety.

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Appendix I

Map of Howe Sound Cumulative Effects Project Area



The Project area was tailored to the Howe Sound area to meet the expressed interests of local stakeholders. Local communities expressed a shared interest in CE value assessments that were focused on a more natural boundary like the Howe Sound watershed instead of the three separate provincial administrative districts that straddle the Howe Sound area. The project area essentially follows the height of land around Howe Sound and aligns with Provincial Landscape Unit boundaries except at the entrance to Howe Sound where the boundary was extended to capture the area from West Vancouver around Bowen Island to Gibsons considering bathymetry lines.

Appendix II

Grizzly Bear Value Description

Grizzly Bear Value Description

Description

Grizzly Bear (*Ursus arctos horribilis*) is a North American sub-species of the Brown Bear (*Ursus arctos*) and is an icon of wilderness in British Columbia. It is the second largest member of the bear family next to only the Polar Bear (*Ursus maritimus*). Grizzly Bears are wide-ranging and opportunistic omnivores with low re-productive and dispersal rates. They play an important ecological role by: distributing seeds in their habitats through the consumption and excretion of plant fruits; cycling of nitrogen when digging for food and carrying salmon into surrounding forests; providing carcasses for other animals to feed on; and by regulating prey populations to maintain ecosystem balance.

Grizzly Bears are powerful animals that can run up to 55 km/hr over short distances and can swim across lakes and narrow marine channels. Adult Grizzly Bears average about 1m at the shoulder and about 2m in length. Their weight can vary depending on gender, season, ecological region and availability of food. Grizzly Bears are generally heavier in the fall than the spring and heavier in coastal regions rather than interior regions. Adult spring weights average about 220 kg for males and 130kg for females. Average fall weights are about 30%-40% heavier. Maximum weights can exceed over 500 kg for coastal male bears.

Grizzly Bears have a low reproductive rate due to delayed sexual maturity (5 or more years old) and three or more year litter intervals. They live to about 20-30 years in the wild and are generally solitary animals during most of the year except during the mating season, rich feeding events (i.e. salmon runs) and cub rearing. The mating season generally occurs from May to early July and fertilized eggs do not implant until hibernation (delayed implementation) to ensure the sow is healthy enough. Sows have one to four cubs every three to four years and the cubs are born in the winter den and are nursed in the den until the spring. The cubs are raised for about 2.5 years before the sow encourages them to leave so she can breed again.

Habitat

Grizzly bears are wide-ranging animals that use a variety of seasonal habitats for feeding, breeding, denning, thermal cover and security. However, home range sizes are generally proportionate to food quality, quantity and distribution. Average female home ranges in BC are generally between 50 and 400 km² with the smaller home ranges occurring in the more productive habitats. Male home ranges are significantly larger, ranging from 500-2,000 km² with high variation likely due to food availability conditions and breeding interests.

Grizzly Bears are omnivores that have a diet that varies with location and season. They use early seral forest as well as non-forested ecosystems for foraging, and mature forest types for bedding, travelling and denning. Forested areas adjacent to non-forested feeding habitat can be important security and thermal habitat. Clearcutting forested areas adjacent high quality feeding sites can adversely affect their suitability as preferred high value feeding sites. Closed canopy forests can provide little in the way of Grizzly Bear forage, berry areas or preferred cover conditions (security and denning) and hence are not suitable Grizzly Bear habitat.

In BC coastal areas, Grizzly Bears spend spring foraging on early green vegetation at low elevations and then follow green-up with the receding snow up avalanche chutes. They then return to the lower slopes to forage on summer berries and then salmon runs into the fall. The consistent availability of protein food sources (i.e. salmon) in a home range greatly increases habitat quality for Grizzly Bears and can increase bear density and improve population productivity. Other more opportunistic protein food sources include insects, small mammals, ungulates and carrion. Grizzly Bears are habitual creatures and generally exhibit a significant degree of home range and site fidelity if seasonal food sources are reliable and consistent. They will return to the same seasonal feeding areas year after year.

Grizzly Bears depend on multiple, well-connected ecosystems, and at a broad-scale, ecosystem processes and functions. This makes them susceptible to cumulative effects from multiple impacts. Some of the main habitat impacts to Grizzly Bears include: industrial development, competing resource use, expanding human settlement, transportation and utility corridors, and increasing public and commercial recreational demand on wilderness and back-country areas. The increase in wilderness recreation alone can threaten the long-term persistence of Grizzly Bears in some areas.

One of the main reasons for declining Grizzly Bear populations in North America is human access to Grizzly Bear habitats. In particular, Grizzly Bears will start to avoid suitable habitats near roads in areas with moderately high levels of traffic (>10-20 vehicles/day) or high road density. This can result in quality habitats near active roads and other human developments not being effective habitats for Grizzly Bears due to displacement. However, in some areas where alternative high quality habitats are limited, Grizzly Bears may still be drawn to road side areas. This can put people and Grizzly Bears in close proximity and increase the risk of Grizzly Bear mortality due to: unregulated hunting, misidentification in hunting, management control kills from anthropogenic food habituation, property or self-defence kills, and road kills from vehicle collisions. The impacts of roads on Grizzly Bears can be influenced by: road density; proximity of habitat to roads; road characteristics; level of traffic; human activities; and Grizzly Bear age, gender, experience and behaviour.

Human Values and Uses for Grizzly Bear

First Nations have historically used Grizzly Bear for clothing, decoration, food and cultural inspiration. First Nations have great respect for this powerful animal and have expressed a strong interest in the conservation and sustainability of existing Grizzly Bear populations. They see this work as part of the Crown's responsibility to respect their aboriginal rights. The Province recognises that many First Nations have asserted or proven aboriginal rights or treaty rights to harvest wildlife for food, social and ceremonial purposes in their traditional territories.

Grizzly Bears have traditionally been an important sport hunting game species in parts of British Columbia. However, in 2017, BC placed a province-wide ban on Grizzly Bear hunting with the exception of First Nations being able to exercise their aboriginal rights or treaty rights. Grizzly Bears will continue to provide highly sought after wildlife viewing opportunities which will provide some indirect economic benefits to the province as well as economic benefits to regions and local communities.

Population Distribution and Trends

It is estimated that 25,000 Grizzly Bears once existed in British Columbia during the time of European settlement. The province currently supports an estimated 15,000 Grizzly Bears. Despite this decline, Grizzly Bears still persist in more than 80% of their historic home range in the province. Figure 1 shows Grizzly Bear densities in the province by GBPU in 2012. The total number of Grizzly Bears in British Columbia is currently stable even though some localized areas have experienced a decline in their numbers while others have had an increase. Despite the current overall stability of Grizzly Bear numbers in the province, the long-term sustainability of Grizzly Bear populations continues to be at risk from the cumulative impacts of numerous human activities that affect Grizzly Bear mortality and habitat effectiveness. Some of the historical mortality factors known to limit Grizzly Bear populations include: regulated hunting; unregulated hunting (poaching); mistaken identity hunting; control kills for human protection; and kills to protect livestock/property. Some of the habitat factors known to limit Grizzly Bear populations include: habitat loss (e.g. housing development); alienation (e.g. resource roads, intensive recreation); fragmentation (e.g. highways as barriers to movement); and degradation (e.g. some silviculture practices, road density, garbage and reduced prey). These limiting habitat factors primarily come from human development and natural resource use activities.

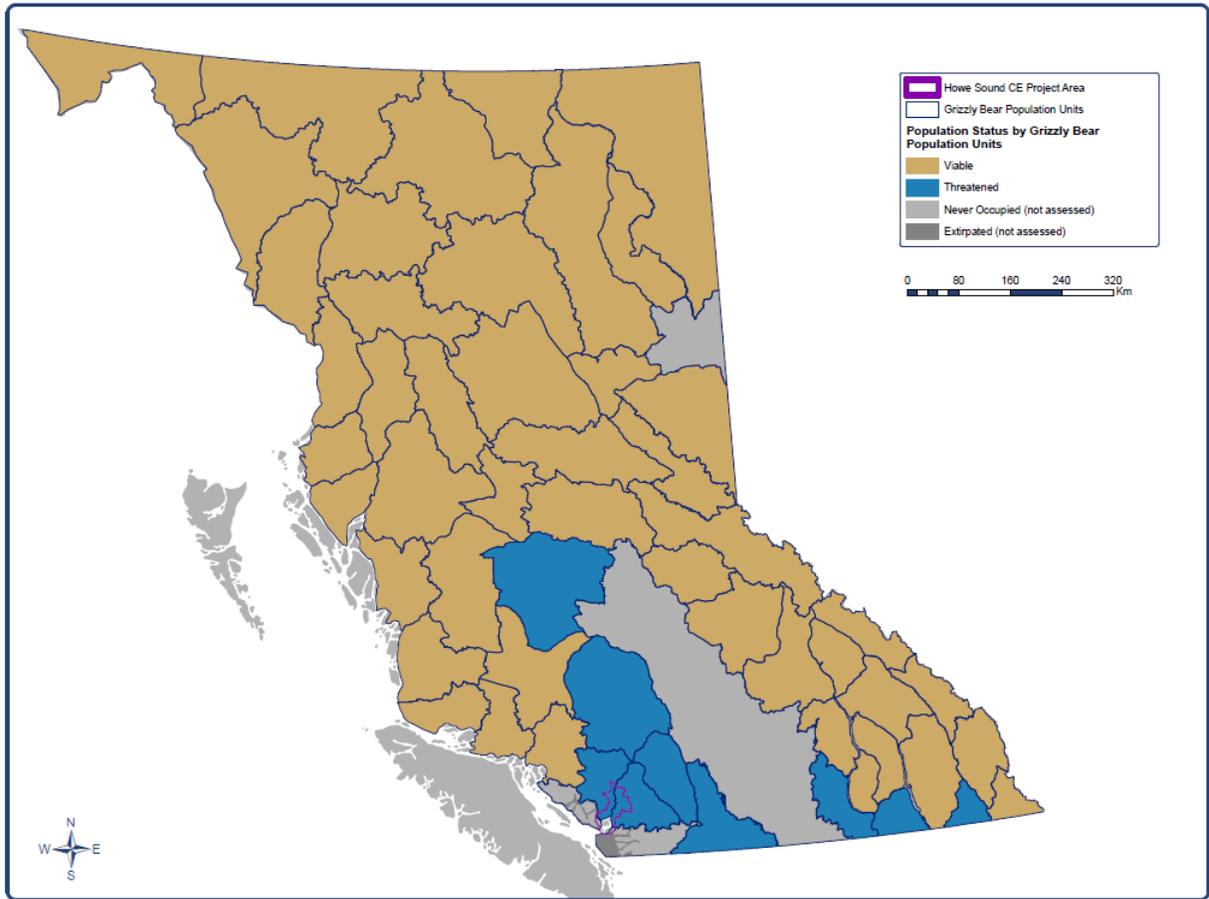


Figure 2: Conservation Status of Grizzly Bear Population Units in BC, 2015.

Grizzly Bear Population Sustainability

In an era of human population growth, increasing land development and natural resource extraction, the province will need to give strong management attention to Grizzly Bear habitat and mortality factors to ensure the viability and sustainability of Grizzly Bear populations in BC. Management will need to focus on such challenges as: limited secure suitable habitat; degradation of suitable habitat; reduced habitat connectivity; and human-caused disturbance and mortality to Grizzly Bears. Management will need to occur at different spatial scales and inform land use decision-makers of the trend and cumulative effects of land use and climate change on Grizzly Bear habitats and populations to inform operational decisions (Statutory authorizations on development projects), tactical decisions (inventory and work prioritization) and strategic decisions (land use planning). Ultimately, the management focus for sustaining Grizzly Bear populations is really about managing human land use activities and competing values in Grizzly Bear territory.

Appendix III

Management Objectives for Grizzly Bear

Management Objectives for Grizzly Bear

Management Objectives

Management objectives for Grizzly Bears in BC are derived from a variety of explicit and implicit objectives found in various pieces of legislation, regulation, policy and guidance documents:

Federal *Species at Risk Act* contains the implied broad objective of maintaining viable populations of Grizzly Bears.

Objectives from Provincial policy direction related to Grizzly Bears include:

- To maintain in perpetuity the diversity and abundance of Grizzly Bears and the ecosystems on which they depend throughout British Columbia;
- To improve the management of Grizzly Bears and their interactions with humans;
- To provide and manage sustainable uses of wildlife; and
- To prevent or reduce negative effects of wildlife-human encounters

Objectives from Provincial management direction related to Grizzly Bears include:

- At the population scale, ensure grizzly bear populations are sustainable, including management for genetic and demographic linkage;
- Continue to manage lands and resources for the provision of sustainable Grizzly Bear hunting and viewing opportunities as informed by research, inventory and monitoring;
- At the landscape scale, sustain and restore (where appropriate) the productivity, connectivity, abundance and distribution of grizzly bears and their habitats.

The Sea-to-Sky Land and Resource Management Plan, which covers the Grizzly Bear habitat in the Howe Sound CE Project area, provides the following objectives:

- To manage for the recovery of Grizzly Bear populations....with the goal of achieving long-term viability of bear populations in the plan area;
- To maintain the functional integrity of critical Grizzly Bear habitats....including visual (security) and resting (bedding) cover;
- To minimize displacement and mortality of Grizzly Bears resulting from human-bear interactions;
- To minimize displacement and habituation of Grizzly Bears due to public and commercial recreation activities;
- To minimize Grizzly Bear displacement due to roaded access; and
- To minimize disruption of Grizzly Bears feeding along streams.

In the future, a new provincial Grizzly Bear Management Plan will be developed that will contain more specific management objectives for each Grizzly Bear Population Unit.

Appendix IV

Howe Sound Context for Grizzly Bear

Howe Sound Context for Grizzly Bear

Location and Topography

Howe Sound contains one of the most southern fiords on British Columbia's coast. The entrance to Howe Sound is located about 10 km northwest of the city of Vancouver and stretches from the Strait of Georgia heading north for about 43 km up to the Squamish River Estuary. The sound itself is a triangular shaped inlet bounded by steep coastal mountains ranging from 1,200 m in the south up to about 2,700 m in the north. The southern portion of the sound contains four major islands (Bowen, Keats, Gambier and Anvil) and numerous smaller islands while the northern portion of the sound narrows to a 3 km wide channel becoming a fiord for 15 km before reaching the Squamish estuary. The estuary is fed by the Squamish River and the associated Cheakamus and Mamquam river drainages. The taller mountains, higher snowpacks and larger watersheds associated with the northern portion of the Howe Sound CE Project area provide the diversity of elevational habitats that are well suited for Grizzly Bears.

Precipitation and Climate Change

In general, the Howe Sound area is warm and dry during the summer months and cool and very wet (snow at higher elevations) during the winter months. Annual mean precipitation in the area is influenced by orographic precipitation along the coastal mountains and ranges from 1250 mm/yr in West Vancouver to 2250 mm/yr in Squamish. In the coming years, warming from climate change is expected to affect weather conditions and seasonal precipitation in the Howe Sound area. Climate change in the South Coast will likely shift the current rain/snow-driven hydrological regime to a more rain-driven regime over the next 35 years. More winter precipitation will likely fall as rain rather than snow and result in: lower snowpacks, earlier/more rapid snowmelt and longer fire seasons. Snowfall in the South Coast is projected to decrease by 10 to 40% in the winter and 14 to 73% in the spring by the year 2050. Forest fire seasons and risk are expected to increase as periods of relative summer drought become more common. In addition, more severe winter rainstorms are projected which can lead to an increased risk of flooding, landslides and windthrow.

Ecology and Climate Change

The ecosystems found in the Northern portions of the Howe Sound area provide large watersheds with year round freshwater supply from high elevation snowpack/icefield areas to provide the physical and chemical processes and seasonal food-webs that sustain a diversity of flora and fauna, including Grizzly Bears. The seasonal and elevational variation associated with these ecosystems supports Grizzly Bear habitat requirements for forage, prey, denning, bedding and thermal/security cover. In particular, these coastal mountain ecosystems provide avalanche chutes, subalpine meadows, wet meadows, marshes, swamps and early seral forest types that

are prime forage areas for Grizzly Bears. They also provide lower elevation rivers that can support salmon and mature forest types for traveling, bedding and cover.

Historically, fire has played a natural disturbance role in the ecology of the area and can provide important forest openings/forage areas for about 35-70 years (i.e. berries) for large mammals. Over the past century, forest harvesting in the area has become more of a driver of forest succession due to the suppression of fires. However, conventional forest management and silvicultural practices often don't provide the same forest succession conditions that small burned areas do which results in lower quality and shorter duration forage areas.

The ecosystems in the Howe Sound watersheds are currently experiencing the cumulative impacts of natural disturbances (i.e. fire, landslides, floods), anthropogenic disturbances (i.e. energy development, resource extraction, recreation, housing development) and climate change. Climate change alone is projected to change ecosystems over the next 30 years by altering temperature, hydrological, fire and natural disturbance regimes in the South Coast. Current climate change projections suggest Biogeoclimatic Zones in BC will shift upslope and northward. The main Biogeoclimatic zones found in the Howe Sound area include: Coastal Western Hemlock (CWH) -found at lower forest elevations; Mountain Hemlock (MH) - found at higher forest elevations; and Coastal Mountain Heather Alpine (CMA) -found just above the treeline. By the 2050s, the CWH and MH zones are predicted to shift about 200 – 300 m upward in elevation. However, high elevation ecosystems that contain MH and CMA zones will likely experience the highest degree of stress. They are projected to lose significant area (70% and 44% respectively) by the 2050s. Conversely, the CWH zone is projected to expand inland and upslope (MFLNRO, 2016).

The impacts of climate change on Grizzly Bear populations in the South Coast are still uncertain at this point but it is likely that there will be both positive and negative impacts. Grizzly Bears may be more able to adapt to ecosystem shifts associated with climate change than some species due to their more opportunistic feeding behaviour, breadth in diet and large range area. Some potential threats posed by climate change include increased habitat fragmentation due to new disturbance regimes and decreased reliability of seasonal food sources.

Human Settlement

The Howe Sound area falls within the traditional homelands of the Coast Salish people like the Tsleil-Waututh, Musqueam, and Squamish First Nations. The Squamish Nation has numerous reserves and cultural sites within the Howe Sound area and Squamish river watershed.

Overall, about 40-50,000 people live in the Howe Sound area with the majority of people residing in the communities of Squamish, Britannia Beach, Lions Bay, Horseshoe Bay, Gibsons,

and Bowen Island. To date, the topography in the area has restricted most of the settlement to the coastline, valley bottoms and lower lying islands. It is estimated that the population in the Sea-to-Sky corridor could increase by almost 30% over the next 25 years. It is anticipated that associated commercial services, tourism and recreational use will also continue to grow in the area during this period. Approximately 13,000 new dwelling units are currently being planned in the broader Howe Sound area through resort and housing development proposals located primarily on the East, North and South sides of Howe Sound. Consequently, the human ecological footprint in the Howe Sound area is expected to increase and place the “Threatened” Grizzly Bear populations in the area at further risk from cumulative impacts.

Land Use

The Howe Sound area, with its close proximity to Vancouver, has long been an interface area between wilderness and increasing human settlement, development and recreational activity. The area has multiple competing economic, social, cultural and environmental values and is now being exposed to a new era of development interests and potential cumulative impacts on terrestrial and marine ecosystems. The area’s economy is diversifying and becoming less reliant on natural resource extraction as improved highway access and tourism infrastructure spur new resort, housing, recreation, commercial and industrial development interests. Approximately, 32% of the total watershed area in the Howe Sound Project area has had its key watershed functions disturbed by human activity or natural disturbance processes. This number is expected to increase in the coming years due to the development interests and proposals in Howe Sound.

While the forestry sector has historically had the largest impact on watersheds in the Howe Sound area through road development, timber harvesting and other industrial practices, sensitive forest harvesting and silvi-cultural practices can also help with the sustainability of Grizzly Bear populations by providing the appropriate interspersion of forage and cover areas and being more sensitive to critical forage needs. Timber Harvesting is allowed in roughly 62% of the Howe Sound CE Project area and about 79% of the area is currently forested. By contrast, 24% of the land in the project area falls within parks and protected areas and about 37% of the land area has some form of forest protection. Much of the lower elevation forest in the CWH biogeoclimatic zone is second growth forest.

Several watersheds in the Howe Sound area have high road densities from a history of natural resource extraction, hydro development, industrial development and recreational access. The forestry sector has the greatest number of roads in the Howe Sound area. There are an estimated 2,300 km of total roads within the Howe Sound CE Project area and approximately 65% of these roads are active or inactive forestry roads. Roads and the human activities associated with them can have a range of direct and indirect impacts on Grizzly Bears and their habitats: increased risk of mortality; habitat loss; habitat alteration; habitat displacement;

habitat fragmentation; population fragmentation; bear behaviour alteration; and exposure to anthropogenic foods. Overall, forest management can play a significant role in determining the suitability and effectiveness of Grizzly Bear habitats in the Howe Sound area.

Recreation and Tourism

The Sea-to-Sky area, which includes most of the Howe Sound CE Project area, is seeing an increase in backcountry recreation from visitors that primarily come from outside the Sea-to-Sky corridor. The number of existing roads in the Howe Sound area can also create access opportunities for motorized and non-motorized recreationalists into watersheds with Threatened Grizzly Bear populations. The increasing public and commercial recreational demand on wilderness and back-country areas can have a significant impact on Grizzly Bears and their habitat. Some of the recreational activities can include: heli-hiking, unregulated hunting, motor biking, ATV use, snowmobiling, mountain biking, and front-country and backcountry camping on non-designated sites. The majority of recreational traffic occurs within front-country watersheds associated the Cheakamus River and the Sea-to-Sky corridor. However, increasing levels of recreation are occurring in the Squamish River Valley and adjacent watersheds.

Grizzly Bears

Nowhere in North America are Grizzly Bear home ranges so close (less than 35km) to such a large urban population (more than 2.5 million people). The southern portions of two Grizzly Bear Population Units (GBPUs) overlaps with the Howe Sound CE Project area; the Squamish-Lillooet GBPU to the west and the Garibaldi-Pitt GBPU to the east. The Grizzly Bear density is generally low in both of these two GBPUs ranging from 0.1 to 10 bears per 1000 km². However, Grizzly Bear use and presence is much greater in the Squamish-Lillooet GBPU. In 2012, the province estimated that there were 50-75 Grizzly Bears using the Squamish-Lillooet GBPU and only 2-8 Grizzly Bears using the Garibaldi-Pitt GBPU. Fifteen years of Grizzly Bear research in the Sea-to-Sky Natural Resource District indicates that Grizzly Bear presence and use in the Howe Sound CE Project area is more common in the northwest corner of the project area (in the Squamish River and Cheakamus River watersheds on the west side of the Sea-to-Sky Highway). In particular, Grizzly Bears seasonally use the floodplain portion of the Squamish River watershed for spring and fall foraging, and the high elevation (mountain slopes) for summer and fall foraging. The busy Sea-to-Sky highway along with housing development, road density, and high recreational activity in the Sea-to-Sky corridor likely limits Grizzly Bear use more towards the habitats west of the Sea-to-Sky highway. As a result, Grizzly Bear population recovery efforts are currently more focussed on areas west of the Sea-to-Sky highway. Integrated management for the conservation of important habitat areas along with the minimization of human/bear encounters will be very important to sustaining local Grizzly Bears using the northern portion of the Howe Sound CE Project area.