Model Refinement and Overview Mapping of the Kispiox Forest District

Report Prepared for:

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MANAGEMENT SUMMARY

In the autumn of 1997, Millennia Research Limited was retained to update and refine the existing Archaeological Overview Assessment model of the Kispiox LRMP. The original Overview was conducted by Millennia Research in 1995 at 1:250 000 scale[1]. The entire Kispiox Forest District, in the traditional territories of the Nisga'a, Gitxsan, Gitanyow and Wet'suwet'en Nations, is encompassed in the revised Overview.

This report is a refinement of the 1995 archaeological potential model for the Forest District, and is meant to be a tool that accompanies and explains the archaeological potential mapping (1:20,000 scale) of the District. As a refinement of earlier work, this report should not be considered exclusive of the original. The current report reviews archaeological work conducted in the study area since 1995. A database of reported pre-1846 trails in the Forest District has also been included. The majority of Aboriginal land use information has been collected from written and photographic materials. Further to this, the refinement of the model was conducted independent of meaningful consultation with and participation of First Nations communities. The integration of the archaeological component with on-going traditional-use studies and interviews is requisite for a complete and meaningful picture of traditional lifeways and land-use history of the area.

The current model has developed from the original one used in the Kispiox Forest District, where simple potential or potential ratings were assigned based on judgemental interpretations of criteria, through simple buffering and Boolean definition of one or two classes. The revised model uses a larger number of cultural, ecological, geographical and geological variables and output maps that show a larger range of possible limitations to potential. Datasets of known archaeological sites and random locations were created . Archaeological correlations are presented here and were used in predicting site distribution and density. Ethnographic variables are of paramount importance in constructing correlations.

The data inputs, digitising, near-to functions, GIS model implementation, and mapping output were the responsibility of Range and Bearing Environmental Resource Mapping Corporation. Colin Moyer with Morley Eldridge conducted relationship analysis, model construction, and refinement. A salmon model originally developed by Range and Bearing was customized by Millennia.

A number of limitations and datagaps have been highlighted in this process. The lack of probabilistic and intensive archaeological surveys in the Forest District in general, and in most of the biogeoclimatic zones in the study area reduces the confidence in model accuracy. Another limitation has been the amount and general quality of ethnographic information used for modelling. Recommendations address ways in which the model can be improved and provides guidelines for its re-evaluation. Our recommendations address the datagaps and limitations of modelling in the District by suggesting further research and data accumulation. Archaeological Inventory Studies (AIS) provide an opportunity to ground truth potential ratings and to identify anomalies in the ratings.

These maps should be used in consultation with concerned First Nations. We recommend that the Strategic Watershed Analysis Team (SWAT) of the Gitxsan Treaty Office review the model, as they have accumulated a great deal of information on archaeological sites and traditional use in Gitxsan territories.

Users should be familiar with *the Forest Practices Code* section 51 and the *Heritage Conservation Act.*

[1] Millennia Research 1995 Overview Mapping of Archaeological Resource Potential in the Bulkley Kispiox LRMP areas.

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We thank the original inhabitants of what is now the Kispiox Forest District and their descendants. What we study began with them.

The choicest of all that ancient country was the city of [T'emlaxamit]. It lay on the north shore of the big river- The Skeena - and had its western outpost where Carnaby now stands. Along the river's front ran the Street of Chiefs, reaching to where Hazelton has been built at the joining of two rivers, the Skeena and the Bulkley. Thence northward ran that street until it came close to the bounds of the Kispiox. [in W. Robinson's Men of Medeek, p.4 as told by W. Wright]

This was long before the flood, when many thousands of our people lived in [T'emlaxamit]. No other villages were known at the time and very little was known about the rest of the country... [J.Johnson 'Mugulsxw in Barbeau files]

ACKNOWLEDGEMENTS

Millennia Research Limited would like to thank the Ministry of Forests, Kispiox Forest District and the Ministry of Small Business, Tourism and Culture, Archaeology Branch for retaining our firm to conduct this study.

The final report is the culmination of the efforts of many people. We thank Doug Campbell of Range and Bearing for sharing his expertise and enthusiasm for the project. Doug Glaum at the Archaeology Branch provided guidance throughout the project. A number of other archaeological consultants contributed to this report. Clinton Coates (Clinton Coates Archaeological Consulting) and I.R. Wilson Consultants shared information for work-in-progress in the Forest District. Equinox Consultants outlined recommendations on Datagaps in Kispiox in their 1997 report. Tanja Hoffmann kindly shared some of her resources for much longer than we originally expected.

We extend our gratitude to Romi Casper in the Culture Library at the Ministry of Small Business, Tourism and Culture, the staff at the Surveyor General archives, and the Provincial Archives for their help in locating and lending sources.

The authors would like to extend our thanks to those that contributed to the 1995 Overview, particularly Dana Lepofsky and the other authors, Morley Eldridge, D'Ann Owens, Tina Christensen, Pam Smith, Bert Wilson. There are a number of people in the office of Millennia Research Ltd. who deserve acknowledgement, notably Donna Eckert who administered the project.

We extend our gratitude and appreciation to those we met in Gitanmaax, Gitanyow, Kispiox, and Hazelton. In particular we would like to thank Darlene Vegh and Russell Collier of the Strategic Watershed Analysis Team (SWAT) at the Gitxsan Treaty Office for their time. Janice Himech (Operations Manager), Ian Anderson (Aboriginal Liaison Officer), Linda Robertson (Regional Aboriginal Affairs Manager), Andrew Reviakin (GIS Operator), and Ron Cotton (Tenure Administration Officer) met with me at the KFD office to discuss the preliminary model this fall. We thank them all for their frank and honest discussions.

This project was conducted without prejudice to Aboriginal rights, title, or treaty negotiations. Any omissions or errors are the responsibility of the authors alone.

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INTRODUCTION

This overview is a refinement of the existing archaeological potential model for the Kispiox Forest District (see Figure 1)(Eldridge, et al. 1995b). The revised model uses a greater number of variables and results in an output map that shows a finer resolution of archaeological potential than the original. The end result is a layered representation of the relationships of various types of archaeological sites with sets of cultural, ecological, geographical and geological variables.

This report presents a summary of archaeological research including trail information in the Forest District; a description and rationale of the model utilised; the techniques and data for deriving the model; the application of the model to paper maps; model provisions and data limitations, and recommendations for resource management and subsequent research.

The Original Study

The product of the 1995 study was a 1:250,000 scale map of archaeological potential which were created by assigning simple potential ratings based on judgemental interpretations of criteria, and through simple hand drawn polygons defined by simple buffering or major waterways and Boolean definition of one or two additional variables. The mapping was compatible with the existing Land and Resource Management Planning (LRMP) formats. The 1995 study produced two categories of heritage resource information (datasets): known archaeological site locations, and archaeological resource potential.

Recommendations following the 1995 study were twofold. The preliminary concern resulting form the project was the lack of First Nations' representation and consultation in the LRMP process in general and in the project specifically. It was recommended that First Nations with an interest in the study area be contacted at the inception of the project, at appropriate levels of contact, with continued participation and involvement. The other concerns were for future map revision and further work. These are summarized as follows:

- Potential maps should be updated on a regular basis to take into account subsequent survey results. Particularly, systematic surveys of underrepresented areas should be tracked and potential ratings reviewed in light of professional developments.
- Potential mapping should be undertaken at a 1:20 000 or 1:50 000 scale in order to provide data for operational planning and archaeological resource impact assessment.
- Priority areas for impact assessment should consider where previous survey has taken place, so as to represent areas where little research has been conducted.
- The locations of all subsequent surveys in the LRMP should be mapped by the Ministry's Archaeology Branch, Inventory Section in order to track the distribution of known site and *nonsite* locations or survey locations.
- Future LRMP studies should involve a provision to map existing site survey coverage as a third dataset.

Figure 1. Forest District Boundaries (Kispiox Forest District is shaded) .

Current Objectives

As a refinement of the original potential model, the current project mapping was carried out at 1:20,000 scale to facilitate operational planning by forestry and heritage resource managers. This Overview will guide the Forest District in managing areas of archaeological sensitivity that may be impacted by forest development and areas that may require further archaeological consideration. Mapping was confined to identifying lands in which archaeological sites are expected to be located. For the purposes of this project, archaeological remains are the physical remains, the material remnants of past human behaviour.

Millennia Research and Range and Bearing have developed three datasets: the location of known archaeological sites; surveyed areas that contain no sites (known non-sites); and, random locations on a 1km grid across the entire District. All known site locations and survey areas were plotted from original site inventory information housed at the Archaeology Branch and with other consultants. Survey that has been conducted in the District since 1995 has been incorporated into all current datasets. Potential was derived by evaluating mapped environmental features with areas with archaeological resources and known non-sites.

The project and recommendations are focussed on forestry related management decisions as they relate to archaeological resources. According to *The Protocol Agreement on the Management of Cultural Heritage Resources* (1994), developed by the Ministry of Small Business, Tourism and Culture and the Ministry of Forests "cultural heritage resources will be managed so that their inherent values are protected, maintained, or enhanced according to the principles of integrated resource management" (British Columbia, 1994: Section 3.3).

First Nations Correspondence

To date, liaison with First Nation governments who represent those that live in or have traditionally used these lands has been generally limited to an introduction of the project. Upon being awarded the contract in the summer of 1997, introductory letters were sent to community Band Offices and Treaty Offices to request community review and participation in the Overview. First Nations' government offices were again contacted before the research portion of this project started. A trip to the study area was made in late October 1997. The purpose of the trip was to expand on introductory correspondences and to solicit information on land use and unrecorded archaeological sites.

At informal meetings held in Hazelton, Kispiox, and Kitwancool, concerns regarding the process of research and the project were voiced. The author made a second trip in September 1998. Information obtained and exchanged at those meetings has been incorporated into this report, the model, and is addressed in our recommendations. Copies of the draft report and final have been distributed to Band Offices.

Report Outline

The report is organised under the following headings. Following this **Introduction**, the **Predictive Model Development** section discusses predictive modelling applications in general as context for archaeological potential modelling in provincial planning of resource management. This is a relatively technical section, "Objectives of Modelling" provides a useful summary of the tenets a good model.

The Physical Setting presents a biophysical and palaeoenvironmental summary of the Forest District. This provides the mapped geographic landscape variables for predictive model building.

Ethnographic Variables summarizes aboriginal cultural and land/resource use information presented in the 1995 Overview. Sources of ethnographic information are presented and evaluated. Ethnographic, archaeological, and geographical information is combined to develop expectations concerning the types of sites produced and the environments (physical as well as social) in which they are expected to occur. Archaeologists planning fieldwork in the region should pay special attention to sections to be familiar with feature types often overlooked or not considered during field inventory.

Previous Archaeological Research is presented in the next section. Archaeological cultural sequences have been developed over many decades of research; they are briefly described here. The types of research are also reviewed and evaluated in terms model development.

The previous sections provide context and substance for the discussion of the **Model**. Mapped and cultural variables used in the model are discussed. A section on **Survey Bias and Data Gaps** points to insufficiencies in archaeological and environmental knowledge.

Recommendations are formed from **Application and Assessment of the Model** and draw together and evaluate the results of the refinement.

Confluence of the Bulkley and Skeena Rivers (1910). (Source British Columbia Provincial Archives)

PREDICTIVE MODEL DEVELOPMENT

Predictive Modelling in Cultural Resource Management

Over the last several years archaeological predictive or potential modelling has been a heavily relied upon tool for resource planners. The modelling process has evolved from judgementally identified areas of potential that are hand-drawn on paper maps. Models today incorporate very sophisticated Geographic Information Systems (GIS) to represent complex interactions of a number of identifiable features or variables. With increasingly accessible technology and electronic information, modelling is very attractive alternative to risk management. It is important to continually evaluate modelling applications in order to maximise the accuracy and efficiency in its intended use.

Predictive models can accurately predict the likelihood that regions contain archaeological material. In other words, predictive models are useful in focusing limited CRM resources so that the majority of sites are discovered and protected. No model will however, predict the location of all sites. Models are simplifications of complex patterns of human behaviour so some deviation from modelled patterns is expected. An understanding of the theoretical assumptions of models and their limitations provides necessary information for building a successful model and for its successful application in CRM planning.

Assumptions of predictive modelling

The basic assumption underlying predictive modelling in archaeology is that human behaviour in the past shows regularities, therefore archaeological remains will be distributed across the landscape in a predictable, non-random pattern (Brandt, et al. 1992, Kohler 1986). Our ability to predict the distribution of archaeological remains depends upon our knowledge of past cultural behaviour. It must be stated at the outset that predictive models are inherently limited. Our understandings of past cultures are reconstructions based on archaeological evidence, ethnographic reconstruction and assumptions concerning human behaviour. This section will discuss the underlying assumptions of predictive modelling in archaeology and its provisions.

Predictive or locational modelling involves the spatial analysis of archaeological site location. Almost all recent models use GIS software to store spatial information and analyse patterns in the distribution of sites. This method essentially limits predictive models to data that can be mapped. Most predictive models have focused upon the comparison of site locations with environmental data, although some attempts to map and analyse other classes of "social" data have been made (Gaffney, et al. 1996). Nonetheless, all predictive models compare social to environmental data. Social data, at the very least, consists of the location of known archaeological sites but may also include classes of data such as culturally significant locations (e.g., sacred sites, traditional territories), trail networks, and modern settlements. Certain classes of "social" or cultural data related to site location preference are more difficult to map. These may include cultural notions of aesthetics, spiritual significance of certain locations, or habitual preference for a location by a specific group or social unit.

Environmental data includes mapped geographic features in addition to data that is the product of GIS analysis. The latter is often based on Digital Elevation Models (DEMs) which form a topographic model to which other information is attached. Environmental features traditionally used in predictive modelling include features such as terrain, surficial geology, location of water features and resources such as fisheries and tree species. Environmental data may also include "geographic models" such as "viewsheds" and terrain features interpolated from the DEM.

Despite the use of some classes of social data, most predictive models give preference to environmental data. According to Kohler and Parker (1986: 400):

> Whether right or wrong, most modellers have achieved some simplification in prediction by concentrating on the economic component of site location. Beyond that, it is further argued, or assumed, that in the prehistoric societies on which predictive models have focused, the most important economic transactions for most people were with the environment.

This focus is based upon the assumption that humans minimise effort in protracting resources, thus sites will tend to be located nearer to economic resources (Kohler 1986). An emphasis on efficiency is based on the assumption that human behaviour must be adaptive in order to have survived (Maschner 1996). Such assumptions are closely linked to materialist theories in archaeology, i.e., "those that infer cultural meanings from the relationships between people and their environment" (Hodder 1991: 19). Materialist perspectives are closely associated with systems theory (Hodder 1991: 20): "systems analysis has been the vehicle for the application of models emphasising ecology and economy, based on predictable law-like relationships."

Although the assumptions underlying systems theory approaches and, by extension, predictive modelling, can explain important patterns in the archaeological record, it is important to recognise that there is much that it cannot explain. Materialist approaches are best at explaining general patterns, rather than specific ones and often "do not give sufficient weight to non-material forces and to particular cultural meanings" (Hodder 1991: 26). Predictive modelling, which can fairly be viewed as an extension of such systems approaches is, in short, better at certain tasks than it is at others. While it may accurately predict probable site locations, it is much harder to determine the importance of those sites, in either a scientific or cultural sense.

Predictive modelling tends to focus on behaviours that are most closely related to resource use and settlement. Sites that are used either continuously for long periods or are used repeatedly for shorter periods are the most likely to leave abundant archaeological remains. They are thus easier to find and predict. These continuous or repeated use sites must have sustainable resources to support the people occupying or using them. Ecologically speaking, they must contain sufficient economic resources to sustain a population during their occupation or use. It is these types of sites that predictive models are best at locating. It is probable that these types of sites represent only a small fraction of the land used by past human populations. Sites that are used infrequently or for shorter periods are both less likely to leave recoverable archaeological remains and are more likely to be dispersed across the landscape. These sites do not require the same economic resources as do sites with sustained occupation or use and will not be as closely correlated to environmental features. These harder to predict sites may however have great cultural significance. Sites that are not related to settlement or resource use may be more closely related to "non-adaptive" elements of a culture such as ritual or aesthetics. A good example is the idea of a secluded site. Many cultures value secluded sites for ritual purposes. Almost by definition, secluded sites will be away from areas where people normally reside or base their activities, thus they may be further from areas with sustainable resources than settlement areas.

The use of geographical or environmental data poses other limitations to predictive modelling. One of the limitations is a temporal one. Almost all of the digital map products available to archaeologists are descriptions of current land patterns. "Geographical information is primarily cross-sectional - that is, it represents a "snapshot" at a point in time" (Goodchild 1996: 243). Environmental features change significantly over time. This has two important implications for predictive modelling: a) older sites may be correlated with environmental features which are no longer visible in the available GIS data and b) cultural land use patterns may have developed under one set of environmental conditions, but remained in operation after those conditions changed. The first point is simple and obvious. Several mappable features such as biogeoclimatic zones and the course of streams and rivers change significantly over time. In the modern era features such as hydroelectric dams and highways have significantly altered the environment. These alterations are reflected in the GIS maps available. The second implication is more complex. Cultural systems have a certain degree of conservatism/traditionalism and cultural patterns do not necessarily change with changes in the environment. Habitual land use patterns or preference for specific site locations developed under one set of environmental conditions may be applied to another. So long as they are not mal-adaptive, such dispositions are likely to continue. This may occur when a population moves from one region to another as well. An example of cultural conservatism may be a burial site or a petroglyph with great cultural significance. Originally it may have been located near an important resource, however, after the resource is no longer present, it may remain an important, perhaps sacred, part of the "cultural landscape." As such, despite its cultural importance, its location may be harder to predict. Models tend to be more successful at predicting recent sites than predicting ones of considerable age.

In general, predictive models, although an important planning tool, have important limitations. "The indiscriminate use of GIS solely in conjunction with mapped physical data may result in the slick but repetitive confirmation of otherwise obvious relationships"(Gaffney, et al. 1996: 133). In this regard it is important to note that while a predictive model may highlight those sites that one "expects" to find in an area, it does not help determining the scientific or cultural significance of those sites, and it may miss important sites for the previously mentioned reasons. But, it has been argued by Altschul and van Leusen that since predictive models highlight obvious relationships, it is the areas where the models are unsuccessful that are the most interesting. Sites which are the 'exception to the rule' are often those with the greatest scientific significance (Altschul 1990). Van Leusen suggests "by applying an ED [environmental determinism] model to a dataset, one can eliminate environmental patterning in the data, leaving a clearer view of whatever cultural factors may have influenced the data" (Gaffney and van Leusen 1995: 370). Maschner further suggests that "the deviation from the predicted model will inform on areas in which the prehistoric peoples were sacrificing economic efficiency for political and social ends" (Maschner 1996: 176). On a perhaps more practical level, predictive models may miss culturally significant sites and/or sites of considerable antiquity.

Many of the reasons for adopting a materialist approach are related to the inherent limitations to predictive modelling. Predictive modelling primarily remains an adjunct of cultural resource management (CRM) and thus has an operational or applied focus. It is usually limited by financial and time constraints, the availability of data (such as GIS mapsets), political constraints (one may work for clients who does not have a vested interest in the protection of cultural resources) and cultural constraints (access to sensitive cultural information). Despite the limitations, predictive models are useful in focusing limited CRM resources so that the *majority* of sites are discovered and protected. It is for this reason that models fulfil an important, if not necessary, role. No model will however 'catch' all sites and important sites will be missed. Predictive models should not be used to abdicate responsibility for sites that are not predicted. Neither should a model replace careful consideration of the significance of archaeological sites to the living cultures that *do* have a vested interest in their proper management and protection. Understanding the limitations of predictive modelling allows regional planners to make informed decisions about the application of the model, therefore improving the modelling process itself.

Nature of the data used for modelling

The success of a predictive model depends upon the availability and quality of data. As mentioned above, the data must be able to be mapped. This poses limitations on the data available. One of the most important classes of data is archaeological site locational data. Sites should be plotted on maps at an appropriate scale for analysis.

The scale of analysis depends on the area to be modelled for, whether the model predicts broad regional patterns or smaller scale prediction. Regional models "do *not* predict the probable location of individual sites but rather calculate the probability that a geographic area will contain a site" (Ruggles and Church 1996). Smaller scale models may try to predict actual site location. Although generally both fall under the category of predictive models, it is important to distinguish these types. The data used for modelling depends upon the type of model to be employed and the resolution of the model. Smaller scale models often require in depth field survey, including probing and/or shovel tests, however regional models usually include already recorded sites stored in a national or regional database and/or sites located through systematic survey linked to the modelling process. In models covering large areas, it is often prohibitively expensive to conduct new systematic surveys and previously recorded sites are used. The locations of previously recorded sites are often imprecise as recorded in conventional databases, and sites often need to be re-plotted at an appropriate scale using original documents (site reports or site inventory forms). Sites should be re-plotted at a scale equal to the scale of the final mapping products at the very least.

In addition to site locational data, a comparative data set should be used. In order to develop a model that is accurate and whose accuracy can be demonstrated comparative data is a necessity, not a luxury. Kohler and Parker (1986) state:

> To prove the importance of a particular variable in determining location, it is not enough to merely characterize the distribution of sites with respect to that variable to claim that a pattern has been found.... it is still common to find reports that conclude, for example, that because 55% of all located sites occur on a particular soil type, then that soil type was "selected...." this contention is supported only if that soil type occupies significantly *less* than 55% of the study area.... A null model of random location is absolutely essential to determining the role of environmental factors in location.

Two classes of data can be used to calculate a null model. Data that is the product of systematic survey is preferred, in fact it has been argued that models require systematic survey to be effectively used for planning purposes (Kohler 1986). Systematic survey provides both the locations of where sites are found, but also where sites are not found. The location of non-sites provides the best comparative data, provided that the systematic survey is representative of the environmental types in the study area as a whole.

Non-systematic survey is problematic, because such surveys usually employ judgmental sampling. The use of judgementally sampled data will ultimately result in the replication of the original assumptions used in judgmental sampling. The model will thus become a model describing the state of contemporary (or antiquated) archaeological theory rather than a model describing site location. Negative data (non-sites) in judgementally sampled regions will tend to be correlated with judgementally selected features that are also correlated with site locations.

The third alternative is the use of randomly generated data. This is perhaps the only dataset remaining if sites were discovered through a combination of survey methods. Often regional or national databases include sites that were discovered through a variety of methods including accidental discovery, judgmental or systematic survey. Although it cannot be assumed that these are representative of all possible site locations, they may comprise the only available site data. In this case it is preferable to use comparative data which represents the distribution of environmental features over the land. Perhaps the easiest method is to place randomly spaced points across the entire region being modelled for. The location of these points in relation to environmental features provides a random sample of the landscape. If the location of sites differs from the locations of these random points, it can be said that the *known* sites are non-randomly distributed in relationship to environmental variables. It should be pointed out that some biases will be retained because of the non-systematic locating of sites. Environmental data for such points is easily calculated using GIS.

Once the locations of sites and locations of the comparative data set have been mapped using GIS, the environmental (or social) variables need to be generated. Existing GIS maps form the bulk of the data used. Digital products describing basic geographic features such as stream and lake location, elevations, slope, forest cover and ecological regions are commonly employed. In addition to existing

GIS data other classes of data can be incorporated including trail locations and ethnographically important sites. It is important to include data which is presumed or known to be significant for site location, however, it is preferable to include classes of data which do not have obvious relationships to site locations. Using such classes of data has the potential to discover previously unknown relationships. Limiting the analysis to variables of known importance has the potential to reaffirm conventional understanding. Certain variables will not be available and will either have to be plotted or generated using GIS. These may include plotting specific resources or mapping ridges and terraces.

An important class of data that can be used for predictive modelling is ethnographic information or ethnoarchaeological reconstructions. Particularly in the case of relatively recent archaeological sites, ethnographic and historical documents as well as ethnographic interviews should be used in conjunction with known site locations to generate significant variables. Ethnographic information is useful in suggesting important data types as well as probable site locations. Information such as the seasonal migrations of people and the types of resources utilised in different environments provides a valuable starting point in determining variables that may influence site location. If there are important gaps in the archaeological record, such as certain ecological zones in which surveys have not been conducted, ethnographic information provides the best possible means to fill in missing information. Ethnographic information also provides a means to test the model at a basic level. The basic classes of data chosen as significant should correspond, in a general sense at least, with the ethnographic information. As mentioned above, certain ethnographic features (such as trails and traditional territories) can be directly mapped and used in the GIS analysis.

Objectives for Modelling

In the development of a predictive model, a number of factors were taken into consideration. The characteristics/objectives set for the predictive model include:

- **Factors (variables) that affect where sites are located must be clearly identified.** Known sites should be used to identify the environmental characteristics of known site locations. These characteristics should be assessed in terms of their relative importance in affecting site locations. Ethnographic information is used to select and assess factors influencing site location. Ethnographic information is also used to "fill in gaps" in areas where there is inadequate archaeological information;

- **Factors that are thought to affect the location of sites should be more strongly associated with sites than areas without sites.** In other words, sites (or areas with sites) must be associated with a factor to a greater extent than areas without sites to be of predictive value. In addition to site location information, information about the location of areas where sites are known not to occur, or a random sample of the study area is needed. The model can then involve a comparison of these two datasets (site and non-site/random data) to determine if the factors identified as important for site location are in fact good predictors of site locations;

- **An estimation of how close a location must be to an environmental feature is required in order for that factor to be considered important in affecting site location.** If a site is on a lakeshore, then it is reasonable to suggest that the lake influenced the selection of that site. But, if that lake is 1500 m away, is it still legitimate to say the lake is affecting the location of that site? It may be, but decisions about cut-off distances need to be carefully thought out and tested for the model to work at its best. These decisions should be made by considering the distances of all sites, non-sites and random points from an environmental feature;

- **A satisfying and consistent way to measure site potential needs to be part of the predictive model.** Since areas of the study region will differ in the proportion of sites expected, the relative levels of site potential must emphasise the relative importance of factors determining site location.

This could involve a simple scale that is additive – that is, if a location has a number of features that are likely to attract human habitation, more sites will be expected than areas which do not. There is no area in the study region without some potential for sites to be present. Some locations are, of course, better suited to human use than others;

- **The management and protection of archaeological resources is the ultimate objective of the predictive model.** Areas with a high potential for sites should contain the highest proportion of archaeological sites, and areas of lower site potential should contain a lower proportion of archaeological sites. Although all sites are protected to some extent by law, focusing limited CRM resources on areas where a greater proportion of sites are expected will protect the greatest number of sites which may be affected by alteration or development.

- **The model should be evaluated with actual 'in-field' investigations.** The correspondence between the model and reality should be tested. This will provide an overall sense of the model's ability to predict where, and with what relative frequency, sites will occur in different environmental zones. Evaluation of the model through fieldwork can also serve as a means to refine the model; and

- **The model needs to be replicable.** Others should be able to use the same or similar data to determine if the same results can be obtained. The model commands or steps should be clearly presented. This can be achieved by presenting actual commands used in the database running of the model. The model should be easy to update when further information becomes available.

These points spell out the underlying considerations in developing a predictive model for archaeological sites in the study region. These guiding concepts are incorporated into the model presented later in this report.

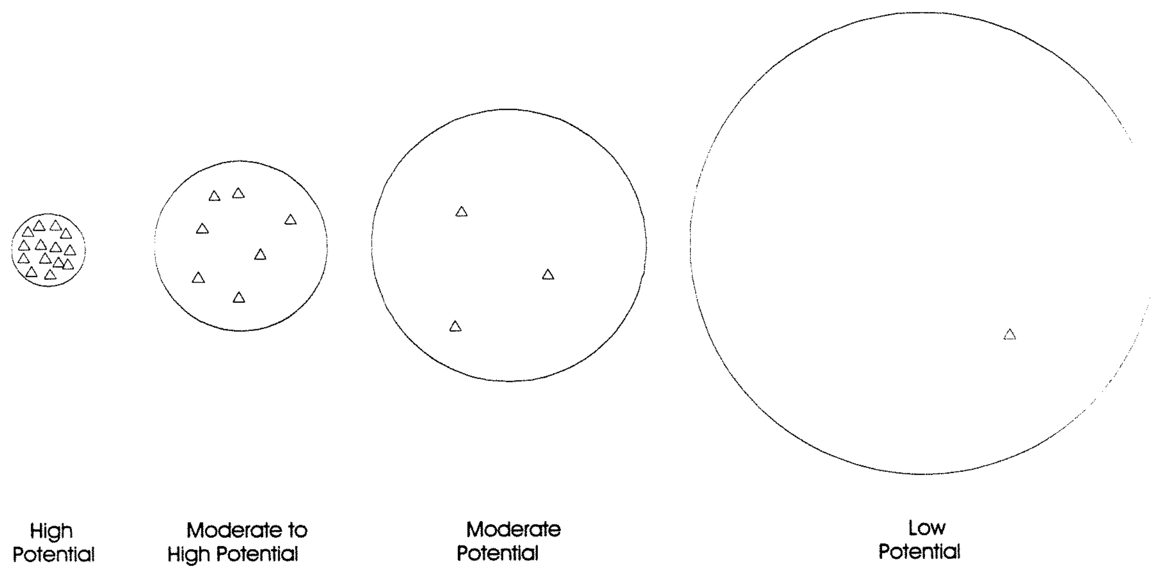
Model Development

Models can be developed in a number of ways once the data has been generated. Statistical methods for model development are preferred, however they are not necessary. Statistics provide efficient and accurate means to assess the significance of the variables used. Several statistical methods have been used in the past including complex multivariate methods such as discriminant analysis or logistic regression. There has, however been little discussion on measurements of significance for individual variables. It is important both to know whether a variable is more significantly related to an environmental feature, but also, in the case of continuous variables how close sites tend to be to that variable. The area surrounding a feature that is conducive to site formation is considered to increase the potential for sites to be located there. Determining the catchment value, or size of the area around the feature (i.e., a "buffer") has received little attention in the literature on predictive modelling.

Predictive models highlight areas where one expects sites to be found. There are several different types of predictive models. One type of model, a probability landscape is produced when multivariate statistics, such as logistic regression, are employed. For this any given point in the landscape (e.g., a $20m^2$ cell) is given a probability score that a site is present. Although often showing considerable accuracy (Kohler 1986, Maschner 1996), such models can be costly to implement and difficult to interpret. Other models are more ad hoc. An example of an ad hoc model is a contingency model, where each logical possibility is given a weighting, for example if a site is within 100 meters of a stream and within 100 meters of a lake it will be given a high potential value. This model often incorporates subjective weighting of each possibility in the landscape. This method relies on previous assumptions about site distribution and does not necessarily rely on comparative analyses. A third common method is to use a "weighted map-layer approach" (Brandt, et al. 1992). In this method, each variable is assessed as to whether it affects site location. Those areas that are either near to or within a significant environmental feature are given a weight. The potential value for an area to have sites is simply the sum of these weights for any given point. This is a simple method which can incorporate straightforward statistical tests and result in an accurate product (Brandt, et al. 1992, McLaren 1998).

The goal of any predictive model should be to maximise the number of sites in areas of high potential and to minimise the number of sites found in areas of low potential. At the same time the ideal model would maximise the total area in the category of low potential and minimise the total area in high potential zones. There should thus be an inverse relationship between the score for the location of a known site and the random comparative data in terms of their potential value.

Figure 2 below represents an idealised potential model. The circle represents the physical area covered by each category of potential. The smallest area (High Potential) should contain the greatest number of sites (triangles), while the largest area (Low Potential) should contain the fewest number of sites. The model is considered ideal because it is most efficient in terms of allocating time and funding to CRM interests. The size of the actual areas of potential may differ from the ideal model, however in all cases the majority of sites should be found in areas of higher potential. The possibility (although unlikely) exists that in the best possible model for a region, the area with the highest potential is the largest.



The circle indicates the proportional area of each level of potential and the number of triangles indicates the number of sites.

Figure 2. Diagram of an Ideal Model for Four Levels of Potential

Once a model is generated, levels of potential are often applied to the model results. Depending on the method employed, several criteria are determined to construct levels. For probability models, cut-offs (at different p-values) are created and placed into categories such as High, Moderate and Low Potential. In contingency models, the levels of potential are pre-determined and applied to each logical possibility. In additive models, cut-off values in the number of contributing features are chosen. For each of these models, the cut-off values should be created so that the levels of potential best approximate the ideal model.

Application of Model

Once a model is generated, specific recommendations are normally made for CRM planning. It should be remembered that predictive models are models of archaeological potential and not descriptions about where sites are actually located. Archaeological survey and field identification of sites are still required to record and manage sites.

Once the model is created it should be tested. Kohler and Parker (1986) emphasise that new, independent data be used to test the model. This independent testing should not only be done in areas where sites are expected, but also where they are not expected. Testing should be systematic and identical methodologies should be employed regardless of the level of site potential in an area. In field-testing the model, the variables used in the modelling should be evaluated, both to test the accuracy of the environmental (or social) data itself and to test whether they appear to be significant "in reality". Particular emphasis should be placed on recording and describing sites discovered in areas of Low Potential. This should be done both to determine their significance (as Altschul (1990) and van Leusen (1995) suggest) and to search for variables that were not used in model development which could better predict these anomalous sites. Ideally any model should be field-tested and refined before it is implemented as a planning tool.

Another means to test the model is to compare the distribution of areas of potential with known ethnographic patterns and ethnoarchaeological reconstructions. The significant variables should correspond at some level to known patterns. The implementation of the model should also be done in consultation with any group whose traditional territory is affected by the model. Including First Nations people throughout model development and testing can confirm newly identified relationships and highlight strengths and weaknesses in the model.

Variables used in the model are described in detail below in the next sections. These variables includes ecological geographical, and geological data that come from mapped sources or in the case of cultural variables have mappable correlates.

THE PHYSICAL SETTING

The Kispiox Forest District encompasses over one and one quarter million hectares in west central British Columbia[2]. Though the Forest District generally follows watershed boundaries, the district is not an ecologically, nor culturally distinct entity. The administrative bounds, the study area are often arbitrary lines overlaying land use areas, house territories, and archaeologically meaningful variables. The study area is a diverse collection of resources, landscapes and peoples.

The District includes three major watersheds, the Skeena River drainage from Doreen to just north of the confluence of the Sicintine at Poison Mountain; the entire Kispiox River drainage; and a large section of the Bulkley drainage from Hazelton to just north of Moricetown. The Forest District boundary blankets nine general Gitx̲san and Wet'suwet'en territories, and over 30 inter-Gitx̲san House territories, in addition to portions of Gitanyow and Nisga'a territories (Monet and Skanu'u 1992 and SWAT personal communication October 1997). An environmental description of the study area is the backdrop for identifying physical variables that are archaeologically significant. Additional factors influencing site location are found in the ethnographic overview and are listed in the modelling sections of the report.

The biogeoclimatic descriptions produced by the Ministry of Forests provide information regarding generalized and integrated ecosystems. These descriptions are a backdrop for identifying variables or values in the study area and are known to be significant in influencing land-use patterns. The biogeoclimatic information of modern ecosystems shape analogues for past ecosystems, where variable resources were aboriginally significant and/or used in precontact periods. Past modelling projects have identified environmental characteristics such as elevation, drainage, aspect, and availability of animal, plant, water resources as factors that influence archaeological site location (Eldridge 1974, Eldridge, et al. 1995a, Eldridge, et al. 1996, Eldridge, et al. 1995b, Eldridge, et al. 1995c, Eldridge and Mackie 1993, Eldridge, et al. 1994, Millennia Research Ltd. 1997a, Millennia Research Ltd. 1997b, Millennia Research Ltd. 1997c). The significance and/or use of variable resources might translate to archaeological sites if physical remains are preserved.

Modern Physical Setting

The Skeena River bisects the study area. The Skeena's numerous tributaries carve through the Kispiox and Babine Ranges. The lower Skeena is dominated by coastal biota, while north of Hazelton the study area is increasingly influenced by drier and cooler interior climate. The Coastal Western Hemlock Biogeoclimatic zone (CWH) typifies the lower Skeena area at low elevations and the Mountain Hemlock zone (MH) at higher elevations. At low elevations, particularly along river and stream valleys, the middle and upper Skeena River are characterized by the Interior Cedar - Hemlock zone (ICH), while higher elevation areas are distinguished by the Engelmann Spruce - Subalpine Fir zone (ESSF) with Alpine Tundra (AT) in the highest areas. At the extreme south-western extent of the study area, the lower to moderate elevation areas give way to the Sub-Boreal Spruce zone (SBS); (Banner, et al. 1993, Meidinger and Pojar 1991).

Environmental change is not dealt with in these descriptions. A brief section describing palaeoenvironmental variables follows and is another line of evidence for reconstructing environmental conditions that may affect land-use and, in turn, archaeological site location.

[2] Based on 1997 figure presented in Equinox Research and Consulting Ltd., (1997)

Coastal Western Hemlock (CWH)

A wide variety of tree species are found in the various forests of the CWH subzone in the southern part of the study area. Among them are western hemlock, mountain hemlock, lodgepole pine, Sitka spruce, cottonwood, and amabalis fir, with lesser amount of western redcedar. The economically important understory forest plants include Alaskan and oval-leafed blueberries, salmonberry, bunchberry, edible wood fern, and lady fern. Red huckleberry, stink currant, Nootka rose, prickly rose, and soapberry can also be found in this subzone. Economically important animals found in this zone are marten (in forested areas), mule deer, black bear, grouse (in forested areas, riparian zones, floodplains), mountain goat (in old growth forests and rocky slopes), and various species of waterfowl (in wetlands, lakes, and streams; (Pojar in Meidinger and Pojar 1991).

Mountain Hemlock (MH)

The Mountain Hemlock biogeoclimatic zone is present in the montane and subalpine elevations in the south-west part of the study area. Mountain hemlock, western hemlock, and amabilis fir dominate the forests in the Nass Range of the Hazelton Mountains, with lesser amounts of yellow cedar and subalpine fir also occurring. Shrubs found in this zone include Alaskan blueberry, oval-leafed blueberry, black huckleberry, salmonberry, bunchberry, and lady fern (Banner, et al. 1993). Species diversity of animals in this MH subzone tends to be low due to deep and long-lasting snowpack (Banner et al. 1993:6.8). Economically important animals in the zone include snow-shoe hare (in conifer forests), black bear, mule deer (in conifer forests, wetlands and streams, subalpine meadows), Roosevelt elk (subalpine meadows and forest openings), and mountain goat (rock outcrops, and talus) (Pojar in Meidinger and Pojar 1991).

Interior Cedar Hemlock (ICH)

The ICH zone covers much of the study area. Different biogeoclimatic subzones characterize the northern and southern parts of the study area, with the southern part of the study area being a slightly drier variant. Although there is considerable overlap in species, there are some differences between the two areas. In general, lodgepole pine, subalpine fir, western hemlock, white spruce, and cottonwoods can be found in the forests throughout the ICH zone. Western redcedar, black spruce, and trembling aspen are limited to the southern half of the study area. Understory plants in the ICH subzone include soapberry, black huckleberry, oval-leafed blueberry, thimbleberry, swamp currant, highbush cranberry, bunchberry, edible wood fern, and lady fern. Hazelnuts are also found in the southern half of the study area (Banner et al. 1993).

Forests in ICH also support many economically important animals. These include moose, elk, mule deer, white-tailed deer, black bear, and marten. Elk, black bear, mountain goat, and marmot can be found on avalanche tracks in the mountains, and rocky cliffs and talus slopes. The relatively lower snowpack in the southern portion of the study area makes it an important wintering range for large numbers of ungulates (Banner et al. 1993).

Lakes and waterways are common throughout the ICH zone in the study area, and are associated with abundant riparian zones and lakeshore marshes. Many of the waterways in the study area support five species of salmon and several non-anadromous fish species, such as lake whitefish, rainbow trout, lake trout, Dolly Varden, and white sturgeon, inhabit the lakes. Important terrestrial resources associated with these habitats include moose, mule deer, black bear, beaver, caribou (in the summer), and waterfowl (spring through fall). Bog cranberry, an economically important food resource to northern Native groups, grows in small bogs found throughout the zone (Ketcheson et al. in Meidinger and Pojar 1991)

Engelmann Spruce – Subalpine Fir

ESSF and alpine tundra (AT), are the mountainous zones in the District. The ESSF zone is distinguished by forest at its lower and middle elevations, and by subalpine parklands at the higher elevations. As indicated by its name, subalpine fir and Engelmann spruce, as well as mountain hemlock, western hemlock, and lodgepole pine dominate the forested areas of ESSF. Economically important understory plants include crowberry, dwarf blueberry, bunchberry, edible wood fern, lady fern, and cow parsnip (Banner et al. 1993). Both mountain goat and caribou frequently winter in these forested areas, as do many fur-bearing animals (e.g. fisher, marten, and wolverine). The forested areas also provide habitat for moose and mule deer. Avalanche tracks are important summer range for ungulates and mountain goats, and spring and summer habitat for bears. Ungulates and snowshoe hares can also be found in early successional forests during the summer, while bear frequent them in the fall. Economically important shrubs in the ESSF forested areas include black huckleberry and oval-leafed huckleberry.

The subalpine areas within ESSF are characterized by clumps of trees separated by meadows and grasslands. There are few economically important plants in the subalpine of the ESSF zone, but may include root crops (Banner pers. comm. 1995). The subalpine area does provides habitat for a variety of traditionally important animals including caribou in the late winter, mule deer, elk, mountain goat, moose, bighorn sheep, bear, and marmot in the summer, mountain sheep in the summer and fall, and blue grouse during the winter (Coupé et al. in Meidinger 1991).

Alpine Tundra (AT)

Much of the alpine lacks vegetation, and is covered by rock, ice, and snow. The vegetation, dwarfed shrubs and herb meadows, was not heavily exploited for traditional resources. However, despite the harsh conditions of the Alpine Tundra, the zone provides habitat to several traditionally important animal resources. During the summer months the AT above the MH zone provided habitat for mountain goats and marmots. Ungulates occur in the alpine above the ESSF zone in both the winter and summer (Pojar and Stewart in Meidinger 1991), but it is unlikely that people attempted to hunt in this harsh environment during the winter.

Sub-Boreal Spruce (SBS)

A Sub-Boreal Spruce zone is present in the eastern extent of the study area. Forests here are dominated by subalpine fir, lodgepole pine, and hybrid white spruce. Economically important understory plants include black huckleberry, bunchberry, and highbush cranberry. Moose and caribou are common in the SBS zone forests, as are several fur-bearing animals (e.g. fisher, marten, and ermine) and other small mammals such as show-shoe hare and porcupine. Alluvial forests are composed of black cottonwoods, with a minor spruce component. Such floodplains, as well as riparian areas and other wet zones, provide habitats for a variety of animals including bear, grouse, and moose. Wetlands also provide breeding grounds for abundant waterfowl (Meidinger et al. 1991).

Table 1. Translation to model variables

Variable	Description
ecosection	Physiogeographic feature (eg. range, valley, plateau) in which the point is located
zone	biogeoclimatic zone in which the point is located
subzone	biogeoclimatic subzone in which the point is located
ecotone	nearness to biogeoclimatic zone boundary
timberline	nearness to Alpine Tundra

Palaeoenvironment

The post-glacial vegetation and climate history of Northern British Columbia in general is not well known, and the Kispiox region is no exception. Palaeoenvironmental information is regionally specific, and scholars caution against extrapolating local environmental data over broad areas (Moss and Erlandson 1995).

Lakebed silt cores from Seeley Lake, about 4 km south of Hazelton, is the only sequence available for ecological reconstruction of the study area (Gottesfeld, et al. 1991). The results of this core, combined with more general vegetation and climatic reconstructions for Northern British Columbia (Hebda, in press), provide an overview of palaeoenvironmental conditions (early Holocene period, 11,000 years ago) in the Hazelton area. This information tests the quality of analogue that modern biogeoclimatic information provides. The reconstructions from palaeoenvironmental evidence may or may not be congruent with current biogeoclimatic descriptions.

The study area was covered by ice during the glacial maximum of ca. 14.5 thousand years ago (kya). Glaciers retreated rapidly from the lower Skeena region ca.10 kya (Clague 1984). More specific information from the Hazelton area indicates that the valley may not have been ice-free until a few thousand years later (Gottesfeld, et al. 1991:1584). Ice retreat in the Bulkley Valley occurred some time before 9300 B.P. (Clague 1984). Whether these lands were hospitable at the time of deglaciation is debated (see D. Huntly in Stafford and Eldridge 1997). Archaeological sites dated to the early Holocene period elsewhere in the province indicate that the moraine environments at the foot of glaciers (proglacial areas) were hospitable for gathering resources etc. if not for habitation. Indicator flora and fauna imply that the area was inhabitable during the early Holocene. Certainly "by 5 kya, the Skeena River valley 20 km north east of Terrace was occupied on a seasonal basis. The promontory and surrounding valley sides would have provided a productive and defendable site for short-term seasonal occupation by nomadic maritime-oriented communities" (Huntly in Stafford, 1997).

Glacial retreat results in rises in water levels. At ca. 10,500 BP shorelines in the lower Skeena Valley and the Kitsumkalum-Kitimat trough west of the study area (running roughly north-south from the head of the Kitsumkalum River to the Kitimat River) were 200 m higher than present. Marine waters extended up the Skeena Valley to Terrace and Lakelse Lake at this time, and then fell to the present level by 8000 B.P. (Clague 1984).

Hebda (1995) presents a summary picture of climate based on the Seeley and other northern cores in Northern British Columbia. Pollens present in the Seeley Lake core (zone A, 10-6 kya) indicate mixed forests composed of spruce and fir, and early successional stands of cottonwood, paper birch, alder, and lodgepole pine. Fires may have been common during this period, reflecting a warmer, drier climate. From ca. 6 – 4.7 kya an increasingly wetter climate is inferred from an increase in western hemlock, and the decrease in pine, among other species. A further increase in western hemlock from ca. 4.7 – 2.2 kya suggests continued cool and moist conditions. The period after ca. 2.2 kya marks the arrival and steady increase in abundance of western redcedar in the region. It has been suggested that a decline in lodgepole pine during this period may be the result of aboriginal burning of the landscape (Gottesfeld, et al. 1991). Conditions after 3.5 kya were increasingly similar to modern conditions (Hebda 1995).

Effects of the Palaeoenvironment on the Archaeological Record, Modelling

Palaeoenvironmental features are included as variables if the mapped information is available (like river terracing, lake palaeoshorelines) and is figured into constraints on potential. Changes in palaeoenvironment and palaeolandscape have important implications for the ways archaeological records are interpreted. For instance, due to post-glacial sea level rise, early Holocene fishing or storage sites located near the lower Skeena are expected to be encountered on old river terraces well above the current water level. Gottesfeld et al. (1991:1584) surmise that the highest river terrace in the middle Skeena area dates to the early Holocene, while the lower terraces may be from the middle Holocene. We should not expect to find sites older than 8000 yBP (years before present) to be associated with the current landscape. A 4000-year-old fishing camp at Hagwilget associated with the modern river level suggests that sites dating to the latter part of the Holocene are closely associated with current landscapes (Ames 1970). This supports Hebda's (1995) reconstruction that after 3500 years BP modern climatic conditions were present.

Models for aboriginal seasonal rounds and land-use based on modern, well established ecosystems are not easily applied to the early period ecosystems (4000 years ago). The warmer than modern conditions characteristic of the first two thirds of the Holocene likely influenced the availability and abundance of both terrestrial and aquatic resources. This in turn would have influenced timing and nature of seasonal food and technological pursuits (compare against Fladmark 1975). The commonly used resources of redcedar and salmon illustrate this point.

The late arrival of redcedar to the middle Skeena has particular importance with respect to precontact technological developments. As Hebda and Mathewes (1984) point out, the reliance on cedar for various technological purposes could not have developed until relatively late, coincident with late migration of cedar to the Province (Hebda and Matthewes 1984). The presence of redcedar in the Seeley pollen core suggests the species was established by 2000 years ago. Given the ethnographically documented reliance on redcedar for construction, tools for hunting, fishing, and gathering, and rituals, it can be assumed that heavy cedar reliance does not appear earlier than 2000 years ago. This does not preclude trade of these resources. Redcedar is nonetheless an extremely significant variable for modelling.

The quaternary distribution of salmon is not well recorded. There are a number of factors relating to salmon habitat and distribution that would have undoubtedly effected their procurement in precontact periods. It has been presented that salmon species have been procured in British Columbia's southern interior as early as 9000 years ago. Various species, ocean and land locked varieties have been identified and dated to the last glaciation. So, the potential exists for salmon to be taken as early as people were exploiting other resources. The desire and distribution (both spatially and seasonally) would be the only limitations to procuring these resources. The specific habitat requirements of each species determine their distribution. As with the modern species, coho, chum (dog), pink, sockeye and Chinook (spring), we would expect earlier species to respond to subtle environmental change. Water temperature fluctuations; stream and river size; and distance to saltwater are examples of environmental conditions that would have fluctuated yearly or over greater amounts of time. The location and type of sites associated with salmon procurement are expected to fluctuate with the resource.

Evidence for archaeological excavations at Moricetown and Hagwilget Canyons indicates that salmon production was an important economy in these territories as early as 5000 years ago. Fish bones in association with birch bark wrappers and food storage pits at the lowest levels of Tse Kya at Hagwilget. It is expected that procurement predates this archaeological evidence.

Localised landscape changes

Very localised landscape changes would have effected precontact human land-use and the archaeological record just as the general fluctuations in climate and resource availability. These too have to be taken into account in the model. For instance, Gottesfeld et al (1991) document a large avalanche dating to ca. 3500 BP which originated in the headwaters of Chicago Creek and dumped significant amounts of debris into Seeley Lake. The resultant debris flow raised the water level of Seeley Lake 2-4m. A Gitxsan account of an avalanche (arguably this one) documents the force and speed of the avalanche and the loss of lives of several berry pickers along the rapidly rising lakeshore. Such a catastrophic event obviously had an effect on the land-use patterns of the inhabitants in the immediate vicinity. Archaeologically, sites earlier than ca. 3500 BP may have either been obliterated by the flow or made inaccessible by the rise in lake level.

A more recent event further exemplifies the impact of local landscape changes on land-use patterns and site potential. Jenness (1943:485) recorded a landslide, which occurred 20 miles below Moricetown on the Bulkley River (Roche de Boule). The slide partially blocked the river's flow and as a result transformed what was reported to be the best fishing on the river. In response, the majority of the Wet'suwet'en village was forced to move and re-establish a village beside Tse Kya at Hagwilget Canyon (see also Monet and Skanu'u 1992).

Table 2. Features and Model reconstruction of features

Palaeolandscape Feature	Reflected in the Model by setting a buffer or catchment area to:
Higher sea level	High river terraces
Lower sea level	Foreshore/river equivalent
Higher/lower lake levels	Higher lake shores
Changing timberline altitude	Timberline

The inclusion of a hillshade layer in the final test areas maps highlighted a number of palaeolandscape features that were not readily identifiable with TRIM data alone. These features include two sets of palaeoshorelines around Kitwancool Lake, and several oxbow features of the upper Kispiox River. Palaeolandscape features are not necessarily included in the model, but can be interpreted from the maps.

Land Use Zones, Archaeological Variables, Biogeoclimatic Zones

Valley bottoms of the CWH, ICH, and SBS zones were extensively and intensively used producing a myriad of site types. Riverine environments were an abundant source of food, transport, raw materials, and trade. The concentration of resources in this area correlates with human settlement and activity.

The Montane Zones of MH, ESSF, ICH CWH and is characterized by dense tree growth that could have provided past populations with the bark, wood, pitch and cambium needed for manufacture and food or medicine. Animal species and berries are also abundant in this zone and it is easy to envision small hunting or gathering expeditions to this zone. Resources were often processed at these locations leaving archaeological remains.

Meadows, which are abundant in the subalpine zone of ESSF, are hosts to various root crops, berry patches and animal species such as goats, deer, and sheep. As in the Montane Zone, resources would have been processed at resource locations such evidence as roasting pits, butchering sites, and hunting blinds.

Alpine areas, AT were a source of lithic raw material, and ungulates. Due to the distance of these areas from settlements, resources were processed at these locations as noted above. On-site resource processing facilitated their transport to villages or camp areas. A level of expedient resource use areas is also expected.

ETHNOGRAPHIC VARIABLES

The following section is an ethnographic summary of land-use patterns by First Nations whose traditional territories have been overlapped by the Kispiox Forest District. This section presents the results of a review of published historical documents, and minor contributions from primary, unpublished sources. This is not an exhaustive review nor is it a traditional-use study. The information compiled here is used in formulating the predictive model for precontact land-use in the study area. The selection of sources and behaviour is biased toward those that describe and produce physical remains, or archaeological evidence.

The ethnographic sources used in this summary of land-use can be generally divided into two types: ethnographic and ethnohistoric documents collected in the late 19th and early 20th centuries, including transcriptions of oral histories, and information (ethnographies, ethnobotanies, and evidence for court challenges) collected in the past 20 years. Much of the information is reprinted from the 1995 ethnographic summary. Additional information was gathered during a visit to the study area in October 1997. It is hoped that by using varied sources, the bias inherent in ethnographic sources is mediated.

A number of First Nations--the Gitanyow, the Nisga'a, the Gitxsan, the Wet'suwet'en, and Sekani--have traditional territories within the Kispiox Forest District (Indian and Northern Affairs 1994)[3]. Generalisations can be made about 'archaeology-producing behaviour' within and between Nations; however, it is more meaningful archaeologically to look at land-use 'patterns' at House levels, where economic activities are traditionally manifest. This perspective allows a consideration of regional variability within Nations, and similarities between Houses of different Nations. A tenet of this perspective is that House groups who shared similar ecosystems and were in frequent contact with one another also shared general and similar economic adaptations (Drucker 1950, Jenness 1943, Steward 1960:738). House land and resource use is a well-founded analogy for past group dynamics as communicated through oral historic information (adaawk and kungax for example). Ethnographic variables are presented in the most general form and are not specific to any ethnolinguistic group unless otherwise noted.

Sources

Most early observations of the Tsimshian focus on Coastal and Southern Tsimshian subgroups [e.g. Garfield, 1979 #2844] at the expense of descriptions of the 'river groups' Nisga'a and Gitxsan. William Benyon and Marius Barbeau are notable exceptions for their work with Gitxsan. However, the bulk of published material by Barbeau and Benyon focuses on art and myth, which is beyond the scope of this review. Barbeau's unpublished notes, on the other hand, contain a wealth of information on Gitxsan traditional land-use (Cove 1985). These and Wilson Duff's (1951) material are the main sources for early ethnographic information.

Allaire et al. (1979), Ames (1979), and G. MacDonald (1984) present archaeological summaries of the study area. The information compiled for the Delgamuukw court challenges is an invaluable source on traditional Gitxsan and Wet'suwet'en land-use. Recent ethnobiological work by the People of 'Ksan (1988) and Gottesfeld et al. (1980) are valuable reconstructions of traditional Gitxsan resource use. Duff (1959) provides some useful observations specific to the Kitwancool of the mid-20th century. McDonald (1985), Seguin (1984) and Garfield are written sources for Tsimshian lifeways.

[3] Where appropriate the authors have used contemporary First Nation names. The ethnographic section will reference names that are no longer in use (e.g. Wet'suwet'en – Northern Carrier).

Jenness' (1943) ethnography of the Northern Carrier (Wet'suwet'en), conducted in 1924-1925 is a principal source for Wet'suwet'en land-use. Morice's (1890, 1892-1893, 1906-1910, [1980] 1978) observations in the late 1800's and early 1900's provide information on Northern Carrier -Wet'suwet'en peoples. Tobey (1981) reviews general Carrier land-use, and Denniston (1981) reviews Sekani economic patterns.

Nisga'a sources include Edward Sapir (1915) and Steven McNeary (1976). Other sources include recent court documents and press releases or commentary from the modern communities.

Evaluating the Ethnographic Sources

As the ethnographic information presented in this review is used to formulate a model of precontact land-use, it is useful to consider the limitations of the ethnographic data for describing the past. Post-contact changes in aboriginal life that effected traditional land-use are outlined below. This summary is not intended to negate the value of ethnographic sources for archaeology, but merely to place this information in an appropriate context for modelling the archaeological record.

The evaluation of the ethnographic literature brings up another important issue. The literature records the wide range of activities, including plant gathering and hunting, which may leave little in the way of archaeological evidence due to preservation factors.

European Contact

Although direct contact with Europeans by interior groups occurred relatively late, European influence through indirect trade preceded contact by many years. For instance, direct contact with early fur traders was brief and intermittent. However, independent trading activities with coastal aboriginal groups, who had greater contact with Europeans, had significant impacts on interior socio-economy (Goldman 1941:373). Settlement, trade and transportation patterns were directly effected by the exponential increase of nonsubsitence based economies.

In addition to European goods, the spread of European diseases preceded European contact among Interior groups. Diseases, which likely accompanied these early goods, travelling via well-established aboriginal trade/contact routes, would have caused significant declines in population early in the postcontact period. For instance, it has been calculated that by 1806 the Carrier population was already half of its estimated precontact numbers (Tobey 1981:416). We can assume that aboriginal populations had already been significantly reduced over a century prior to the first written ethnographic observations of these people.

The establishment of trading forts in the region resulted in direct and continued contact with non-Natives. The Hudson's Bay Company in 1820s established forts at head of Babine Lake just outside the eastern boundary of the study area (Old Fort and Babine Fort), and at the head of Bear Lake, outside the north-eastern side of the study area (at Fort Connelly). The forts developed into the administrative centres for all trade in the region, as well as a locus of religious and other social activity (Harris and Ingram 1972).

Effects on Resource and Land-use

The fur trade and the establishment of forts in the region effected socio-economic systems in many ways. The trade in furs led to a greater emphasis on the hunting by aboriginal groups of fur bearing, rather than subsistence animals (e.g. Morice 1889-1890:130). Among the Carrier, the presence of forts combined with dramatic declines in populations, resulted in a considerably more nucleated settlement pattern than prior to European contact (Goldman 1940:373; 1941:417). The expanding fur trade, also combined with decreasing populations, prompted considerable intermarriage and contact between neighbouring Nations. Houses amalgamated to survive. As a result of this contact, Interior social organization took on aspects of that of Coastal peoples, such as the establishment of chiefs and the recognition of individually-owned resource areas (Duff 1951, Goldman 1941, Morice 1892).

The introduction of European technology, combined with lower populations, led to an expansion of the food supply beyond traditional use and traditional trade (Goldman 1940:346; J. MacDonald 1985). Guns, steel traps, steel axes, and horses (which were introduced into the region in the 1800's) facilitated access to resource sites as well as reduced extraction and processing time. Further, because of declining populations, many resource extraction/processing sites that were traditionally private property were now available to a wider portion of the population.

The considerable food needed to support the forts had significant impacts on the traditional harvesting systems. It has been estimated that the men and dogs at one fort required 30 - 40,000 dried fish in annual rations (Harris and Ingram 1972:182, 186). These fish were caught by the local Indians and then traded to the post for European goods. This meant that sufficient stocks were no longer stored for native subsistence, and in times of winter shortage the posts traded back the salmon for Indian-trapped furs (Harris and Ingram 1972:182, 186). Monet (1992) noted that the fort extended credit, advancing supplies against a season's trapping, effectively binding trappers to the forts.

Finally, the introduction of European foods and medicines rapidly changed traditional resource use among all the groups. Aboriginal and Europeans foods introduced by Europeans, such as potatoes, were quickly adopted by both groups (People of 'Ksan 1980:98 - 100; Goldman 1940:373). The addition of new foods represents a shift in focus away from traditional foods and the traditional seasonal round. Likewise, the introduction of European medicines, and the consequent subordination of traditional healing systems, led to a significant decline in the gathering of medicinal resources (Gottesfeld and Anderson 1988).

Socio-economic Units and Resource Control

Gitxsan

Each village was an independent territorial, economic, and political unit. Within ancestral Gitxsan, clans were divided into Houses, each with its own Hereditary Chief. Each House had control over fishing, hunting, and gathering sites, which were managed and controlled by the chief on behalf of his or her people. The highest ranked lineage in a village controlled the largest territory (Adams 1973:21-37; Seguin 1984:x-xii). Descent was recognised bilaterally so individuals could use both the husband/father's and the wife/mother's territories (Gottesfeld and Anderson 1988:13-14).

According to Cove (1982:4-5) the traditional Gitxsan territorial units were based on salmon spawning streams, or watersheds. Each unit contained a river at its mouth, a valley behind it, and a mountain source. The Gitxsan seasonal round was contained within this House territory which encompassed resource zones - riverine, mid-slope, and alpine. Cove estimates that each territory was approximately 200 square miles. Barbeau and Benyon fieldnotes (n.d.) list some of the named Gitxsan territories and place names.

There were very specific and strict laws governing the use of house territories.

> All these people knew which territory is theirs. They turned off at the proper trail, they didn't trespass on each others territory. They don't camp on someone's territory just because it is a good place, they go on...Our people in the old days had a law, if a thoughtless person went to another territory and trapped/hunted it is considered stealing. He didn't get permission from the owner. [(Olive Mulwain, A Gitxsan elder in Blackstock 1996:107)]

Carrier

The extended family was the smallest social and economic unit among the Carrier. The first born male of the family was the headman, whose responsibilities included regulating hunting and fishing within the family (Goldman 1940:334-335). Traditionally, each group was associated with loosely defined hunting and fishing grounds, but monopolized use of these areas only during seasonal use (Goldman 1940:334-335; Tobey 1981:418). As a result of the influence of coast cultures, more exclusive land-use rights, controlled by a hereditary chief, developed among the interior groups (Goldman 1940:334-335; Morice [1978] 1906:5; Tobey 1981:419). According to Morice (1906-1910:421), saskatoon berry gathering locations were the only plant harvesting spots that were privately owned among the Carrier.

There are few recorded details on traditional Carrier land-use patterns, particularly for those Houses on the Bulkley River. According to Harmon (1957:250) hunting and fishing grounds were bounded by natural landforms. Jenness (1943:489) notes that hunting territories were quite extensive, often composed of several discrete pieces of land.

Settlements

Ames (1979) provides a useful analysis of the village site locations of central groups in the study area. Villages are located along the major rivers (Bulkley and Skeena), likely to facilitate access to mountain territories and access to tributaries as well as access to the network of grease trails in that area (see Jenness (1943:fig. 61); but also see Tobey (1981:414)). As Ames notes (after Adams 1973), in the land tenure system, Houses owned resource territories which correspond to whole stream basins; the villages have been located to facilitate the tenure of river resources.

Permanent villages were at prime summer fishing locations, such as Hagwilget Canyon, at the confluence of rivers, and on the northern banks of lakes (also to maximise exposure to the sun; Morice 1892-1893:184; Jenness 1943:531). Villages were situated to provide maximum protection from raiders. Ideal places offered good vantage points from the front of the village, but were protected from the back. Interior Tsimshian Houses had fortresses or refuges associated with them. An average village had less than 100 people, but a few numbered as many as 500 people (Garfield 1979:10). Adams (1973:25) states that the number of houses per village depended upon the size and proximity of the hunting grounds, but unfortunately does not elaborate further.

According to Morice, the Wet'suwet'en ancestors did not have fortified villages (Morice 1892-1893:195-196). Conflict among the Wet'suwet'en, Morice reports, was usually between families rather than between whole villages. Families needing refuge retreated to log structures built in secluded parts of the forest (Morice 1892-3).

There isn't enough archaeological data to assume ancestral settlement patterns are consistent with Gitxsan and Wet'suwet'en patterns recorded in the ethnographic literature for recent times (Albright 1987).

Resource Use

Fishing

Fishing was a major component of ancestral native subsistence. Fresh and dried fish including the five species of salmon, trout (steelhead, char, rainbow and Dolly Varden), anadromous smelt, carp and occasionally rocky mountain whitefish were all procured where available (People of 'Ksan 1980:30; Gottesfeld et al. 1988:13). Eulachon were also taken, but it is argued by Coupland and others that Gitxsan fishing of the lower Nass was a post-contact phenomenon, and the grease was previously obtained through trade (1988). According to Morice (1906-1910:133) a "small sardine-like fish called *thelmoek* [was harvested] by the Carrier, who secure thousands of it in a single day...".

The relationship of salmon, its abundance and ownership is very closely linked to fishing site distribution and location. Permanent fishing sites were distributed along migratory paths of salmon, especially at the junctions of rivers and spawning streams (Cove 1982:4). In the late 20th century non-anadromous fishing spots were family-owned (Morice 1889-1890:130; 1906-1910:135), but this may be a post-contact phenomenon. Ames (1979:227-228) notes the dependence on salmon taken from the upper reaches of the Skeena, and its small tributaries was considerably more risky and less productive than the dependable and abundant salmon resource in the southern territories. Following this, we expect limited settlement and archaeological site concentration on the upper Skeena than compared to the middle Skeena and tributaries. The availability of salmon in the upper reaches of the Skeena and its tributaries is accounted for in the model.

Salmon were harvested from fish weirs built across the large rivers and from fishing stations located on rocky promontories (e.g. Bulkley, Skeena and Stuart Rivers; Morice 1906:136-141,187-188; Morice 1889-1890:139; for detailed descriptions of fishing methods, and photos below). If these promontories were not pronounced enough, scaffolding was constructed on the rocks (Morice 1892-1893:91). The narrows at Moricetown and Hagwilget in the Bulkley Basin were a particularly important salmon harvesting location. In postcontact times, such platforms or stations were the exclusive, hereditary property of family members (Barbeau 1930:139).

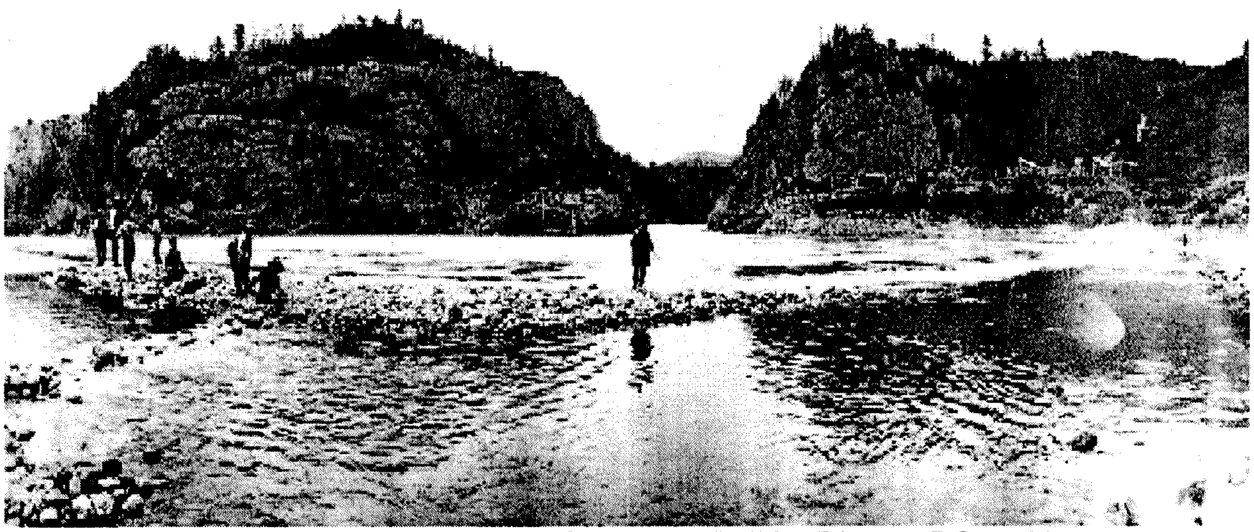


Plate 1. Stone fish trap at the confluence at Skeena and Bulkley Rivers. (BC Archives)

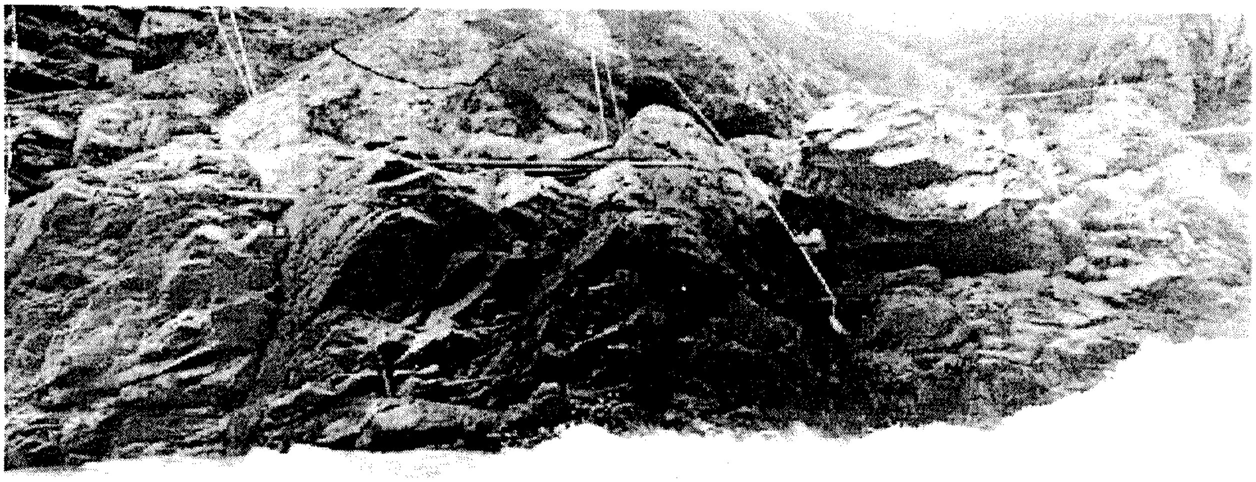


Plate 2. Fishing station near Hazelton (BC Archives)

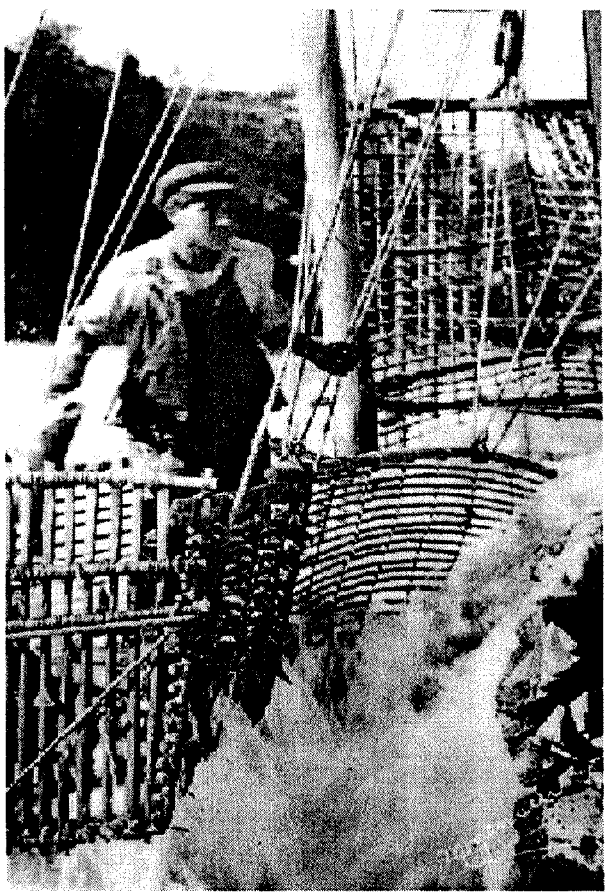


Plate 3. Fishtraps at Hazelton, early 20th Century (BC Archives)

Salmon and other larger fishes were caught in basket traps and weirs or with harpoons or long poles with detachable hooks (Barbeau 1930:139, 144; Drucker 1950:166-167). All the smaller fish were caught by net (Morice 1889-1890:129).

Fish were eaten fresh, partially dried, or fully dried. Drying methods included using sun, wind, smoke, and fire (Morice 1889-1990:139; 1892-1893:92). Filleted fish was splayed out on a willow rack and roasted over an open fire. Such fires were sometimes built along streams and rivers where there was an abundance of suitable rocks (People of 'Ksan 1980:18-19). The most common method of preserving salmon was by smoking (Drucker 1950:167; People of 'Ksan 1980:20). Smokehouses for processing salmon were located close to fishing spots (see photo below. People of 'Ksan 1980:20; Shotridge 1919:118); storage pits were located close to villages (People of 'Ksan 1980:22).

Salmon roe was preserved separately and stored in pits or cellars (Drucker 1950:167; People of 'Ksan 1980:27). The pits are circular depressions ranging in size but averaging between 1.5 and 2.5 m. Cache pits were lined in cedar and fish wrapped in birch bark were placed in the pits for storage.

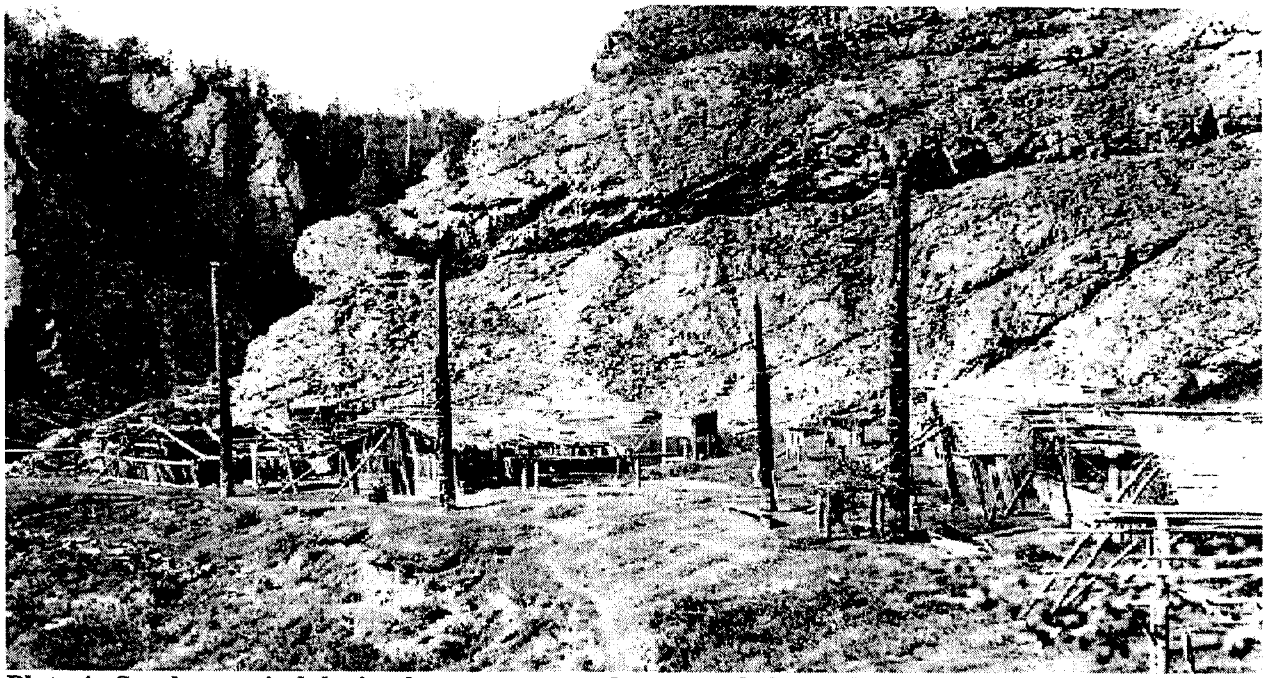


Plate 4. Smoke or wind drying houses amongst houses and elevated caches at Hagwilget (BC Archives)

Gathering/Plant Use

A wide variety of plants were utilized for food and for traditional medicines throughout the district. Subsistence pursuits often determined the location and timing of the gathering of medicines, although the changes in the medicinal properties throughout the growing cycle were also taken into account when plants were gathered (Gottesfeld and Anderson 1988: 28-29). Medicinal plants were available from a variety of ecosystems throughout the year (e.g. Gottesfeld and Anderson 1988; (Morice 1892, Morice 1893:130-132, Smith nd). In most cases, gathering activities left little or no traces that would be visible in the archaeological record. The resources, berry patches, root-gathering areas or controlled burning areas for example may not be visible on the landscape due to the lack of preserved physical evidence (although new research is being conducted elsewhere in the province to identify regularly burned areas from charcoal in bogs). But features associated with plant gathering are expected. For instance, depending on location of the berry harvest patch, groups "camp for weeks with their families and friends on their berry grounds" (Morice 1906-1910:421). Sitetypes associated with plant harvesting include drying racks (posts moulds, scaffolding); storage, roasting or steaming pits; fire altered rock dumps; camping sites; and, trails.

As one of the more visible, widespread, and distinctive signs of resource utilization, culturally modified trees are integral to the archaeological and historical record. A culturally modified tree or CMT is defined as a "tree that has been intentionally altered by Native people participating in the traditional utilization of the forest" (Arcas Associates 1984:1). CMTs may be stripped for subsistence (e.g. cambium) or cut for resource extraction (e.g. pitch, bark, planks, or logs).

Berries provided an important source of food both in-season and preserved for later consumption. Morice (1892-1893:127-130; 1898-1890:134-135; 1906-1910:598) presents an abbreviated list of berries consumed at the Stuart Lake that includes saskatoons, various blueberries, raspberries, strawberries, crowberry, and soapberry. Blueberries and huckleberries collected in the mountains were an especially important source of stored food. The collected berries were crushed and then stone boiled in boxes. The cooked berries were dried on racks with a fire underneath, and after several days the dried berries were rolled or cut into cakes. Occasionally meat was smoked at the same time as the berries. Depending on the location of the collection site, shelters were sometimes built over the drying racks (People of 'Ksan 1980:20, 51-58). Morice (1892-1893:125-127) provides a detailed description of drying and preserving of berries among the Stuart Lake peoples (see Harmon [1957:207-208] for similar description).

Various greens and "roots" were eaten throughout the year and taken for medicine. Greens, which were eaten in the spring, include fireweed, cow parsnip, wild celery devil's club, water lily roots, and the lower stem of cattails. Black tree lichen, which grows on conifer trees, was also processed into cakes by the Wet'suwet'en (Morice 1906-1910:598). Hazelnuts were the only nut mentioned in the literature as being eaten. Despite the presence of white bark pine (Pa) in the District, pine nuts were not included in food lists (People of 'Ksan 1980).

The "roots" of edible wood fern and water parsnip were eaten (MacKinnon et al. 1992; Morice 1889-1890:135). Greens were consumed immediately with little or no processing, and as a result are relatively invisible in the archaeological record. Chocolate lily bulbs, which were harvested in June, were boiled before being eaten (People of 'Ksan 1980:77). The root of the edible wood fern was harvested in the spring or fall. It was baked in earth ovens, often at the harvesting site and then stored for later use (People of 'Ksan 1980:77-79; Turner et al. 1992).

The inner bark (cambium) of hemlock and lodgepole pine were also collected for food (People of 'Ksan 1980:83-85). The outer bark was first removed, and then the inner bark was scraped off, producing long noodle-like strips or "thin ribbon like shavings" (Morice 1989-1890:134). The cambium was preserved by baking in an earth oven at the collection site, and then further dried at the village with the aid of a fire. Cambium processing occurred during the early spring while the Wet'suwet'en was camped along lakes and rivers.

> [The cambium was] wrapped in spruce bark and roasted for several hours on hot stones. Then they crushed the fibres with hot stone hammers and dried the pulpy mass in large cakes that could be softened in water and eaten with fat. (Jenness 1943:532 on Stuart Lake Carrier).

Bark of western redcedar, maple, paper birch, and alder were taken. Roots and withes of redcedar and spruce and cherry were procured for weaving (Drucker 1950; Lafforet 1984:218; Morice 1892-93:120-124, 132-135, People of 'Ksan 1980:51). Certain woods, such as cottonwood, aspen, and rotted alder were preferred for smoking (People of 'Ksan 1980:21). According to Harmon (1957:246) canoes were made out of the "aspen tree" [cottonwood] as well as "spruce fir" [spruce] bark. Morice (1898-1890:131) notes that dugout canoes made of cottonwood were only a recent introduction to the area, and birch bark canoes were traditionally made. However, Jenness (1943:532) states that canoes of spruce or birch bark were the recent introductions to the area. The inner bark of willows, along with nettle fibres, were used to make nets to catch small fish (Morice 1898-1890:129). Harlan I. Smith collected one of the most comprehensive and early ethnobotany lists between 1925- 27. For more complete lists, scientific names and ethnobotanical information see the edited annotated version, Smith (1997).

Hunting/Animal Use

A variety of land mammals were hunted including caribou, black and grizzly bear, goats, mule deer, and moose, lynx, beaver, marmots, hare, cats, martin, fisher, fox, mink, porcupine, groundhogs, ptarmigan, and grouse. Spring traps, snares, and bow and arrows were used to procure these animals (Harmon 1957:249; Jenness 1943:531; Morice 1898-1890:132; Drucker 1950:173-176; People of 'Ksan 1980:45-50; see Morice 1892-1893:95-104 for details on hunting methods). Waterfowl were caught for meat, feathers, and eggs including ducks, especially grebes, geese and occasionally gulls. Grebes were taken in the spring by driving them into nets that were held by several canoes. "Grebes were rendered for their fat which was preserved as cakes and added to dried berries" (Morice 1898-1890:133). Hunting territories were very specific and were governed over by House Chiefs.

Animals were processed either for immediate and later consumption, or for furs. Small mammals, such as porcupine and marmot, and fowl, were often roasted over an open fire (People of 'Ksan 1980:18-19; Drucker 1950:42). Small mammals and fowl were usually eaten immediately (People of 'Ksan 1980: 48), but those to be smoked and dried for later consumption were first boned and "opened out like a blanket" and then hung in the smokehouse (People of 'Ksan 1980:46). Whole mountain goats and other large mammals were also baked in large earth ovens (People of 'Ksan 1980:17).

Where carcasses were processed was likely dependent upon the size of the animal, the distance from the procurement site to the village, and whether the meat was for immediate consumption or to be stored. For instance, the following account of the Kitwancool suggests that mountain goats were sometimes processed in the mountains.

> Up on the mountain when they kill a goat, they make a trench, line it with stones, cover it with leaves, and light a fire on the top. In about two hours the meat is cooked (Duff 1959:42).

Shotridge (1909:140), on the other hand, noted at Kitwancool "some hunters [who] came down from the neighbouring mountains with fresh goat meat which was prepared in one of the houses". Unfortunately, we do not know if the goat was partially butchered at the kill site, or if perhaps these hunters where travelling by horseback, which would have greatly facilitated the transportation of unprocessed meat in postcontact times. Smokehouses were built at those hunting grounds that were a distance from the main village (People of 'Ksan 1980:20).

Seasonal Rounds

Gitxsan and the Wet'suwet'en ancestors moved seasonally to take advantage of various resources spatial and temporal availability of the resources within the study area.

The following summary of annual round is based on Halpin and Seguin (1990:271), the People of 'Ksan (1980:41, 51-76), Harmon (1957:141-142, 247-249), Morice (1898-1890:117-135; 1906:21; 1906-1910) and Jenness (1943:531-532). According to Halpin and Seguin and supported by Jenness (1943:531), the primary spring (February - April) activity was fishing for eulachon on the Nass. Some eulachon were eaten fresh, but the majority were dried or processed into grease for transportation back to Gitksan territories (see Trails below). Some ice fishing for steelhead, trout and kokanee occurred in March and April; these fish were preserved by drying at the near-by fishing camp (Jenness 1943:532). In mid-April (or sooner in some years) people moved to small lakes and rivers where they netted and dried non-anadromous fish, and caught waterfowl (Morice 1892-1893:127; 1889-1890:134; 1906-1910:598).

Households dispersed to establish fishing camps in the early summer when salmon began running in the rivers and after the ice broke up. Collecting occurred throughout the fishing season. Hemlock, spruce, and lodgepole pine cambium were collected and processed in the spring and early summer, as was cedar inner bark for weaving (Halpin and Seguin 1990:271). Other spring plant foods included cow parsnip and fireweed stalks, and soapberries. Based on Halpin and Seguin together with the People of Ksan, hemlock cambium was collected for an extensive season. The People of Ksan (1980: 83-85) record that lodgepole pine cambium was collected in May and June, and hemlock cambium were collected in May through July. The harvest time was variable from year to year, depending on when the sap began to flow. By mid-June, Harmon (1816) notes, that people were subsisting largely on dried fish, "herbs", inner "cypress bark" [probably hemlock], and some berries. Berries, especially saskatoons, riceroot, huckleberries, blueberries were harvested throughout the summer months and into the early fall.

The primary fall activities continued to be fishing and processing salmon and steelhead, and hunting in the owned hunting territories. Moose, mountain goat, caribou, deer, and marmot were hunted at this time. Excursions were also made to the mountains to collect and process huckleberries.

Winter months were spent at the permanent villages. Subsistence pursuits during the cold winter months were limited to some hunting, primarily for bear and caribou. After the lakes froze and the snow fell, subsistence pursuits were minimal, and people were largely dependent on stored foods and trade goods until spring.

The degree to which any group moved was dependent on how clustered the resources were within their territories (see discussion in Ames 1979). Systems of land trails linked water routes and resource areas, forming complex network webs.

Transportation, Trails Research and Database

It was important to create a database of traditional trail corridors within the Forest District given the significance of trails in patterning archaeological resources. Trail plots were mapped by hand, then digitised to be used as variables in the model. A brief review of the plotting methodology is followed by some written accounts of trails in the District.

Methods

In the Kispiox region, the lack of extensive Euro-Canadian settlement and road building until well into the 20th Century means that traditional aboriginal trails were in regular use into the time when high-quality maps were being produced. For instance, a branch of the Cranberry Grease Trail appeared on NTS sheets until the most recent edition in the Kispiox-Nangeese locality (Eldridge 1989). "Pre-emptor's Maps" and 'Edition 1' NTS maps, and other maps published in the late 19th and early 20th centuries, were the primary sources of trail information. More precise information on trails was found in the surveyor's notes of the original District Lots other sources are noted below. Sources for mapped trail segments are presented in Table 17.

Each "trail" for the purposes of recording and the GIS, consists of several segments, each with a discrete number, and differing source numbers and designations. The segments of a trail do not necessarily correspond to discrete known trails.

Trail segments were given one of three designations, and colour coded on paper maps for digitising:

1) Trails or portions of trails that could be identified with the **greatest certainty** were hand drawn in red. Map sources depict them as 'Trails', and ethnographic sources indicate that they are aboriginal in origin. When the map sources were not drawn to scale or lacked geographic features, the best-projected route was drawn after consulting current mapped contours and geographic features. Where sources gave conflicting routes for known trail segments, they were mapped separately. It is also reasoned that trail routes may well have changed over time, reflecting geographic changes (e.g. landslides, burns, water level or stream-bed changes) or cultural changes, and that contemporary sources mapped these evolving routes. The multiple mapped routes may also reflect coexisting trails, and/or seasonal alternatives. Trails may be braided in order to accommodate older or younger travellers. There would be multiple routes to the same area, one steeper - faster, and another that circumvents obstacles. This is particularly true of mountain trails (pers. comm 1997, Darlene Vegh and Russel Collier of SWAT).

2) **Presumed aboriginal trails** or portions of trails. Trails hand drawn in green include postcontact trails (such as telegraph trails), wagon roads, or modern roads that are reported to be built upon aboriginal trails or parts of aboriginal trails.

3) Assumed trail routes connect segments of the two previous types, along logical routes where a source for that section is lacking.

In addition to colour coding, each trail segment was given a discrete database number, and tagged with its source number. Where more than one source existed for a trail segment, each source number was appended, except in the case of segments with many sources, where for the sake of simplicity only a sample was included.

- "Edition 1" or "Provisional" 1:50,000 NTS maps
- A number of siteform maps on file at Archaeology Branch, Ministry of Small business, Tourism, and Culture show trail locations though in none of these instances
- Provincial Archives maps
- Surveyor General - Indian Reserve survey maps; pre-emptor's maps;
- Strategic Watershed Analysis Team, (SWAT) info and map
- Bureau of Mines, BC
- Department of Lands BC
- Department of Lands BC, Ministry of Forests.
- Map Library at UBC.

Results

It became apparent during research that two principal trail systems exist in the District. There were major systems, the famous Grease Trails for instance, and smaller systems of House trails. Both sets of trails are equally significant variables and the presence of any trail is expected to increase the potential of locating archaeological remains in the vicinity. The different systems however may indicate distinctive social phenomenon, and may be reflected in the archaeological record in different site types, or site density or site content. How trail use is reflected in the archaeological record needs to be explored further.

Dozens of trails connected the interior and coastal villages. The trails that linked the streams and rivers of the Coast were collectively called grease trails. The spring eulachon run brought people to the Nass from the interior along overland trails named for the fish oil. "The lure of grease was like to lure of gold and every year most of our people trekked off loaded with surplus meat or fur to exchange for the prestigious grease, and to enjoy the reunions and trade opportunities"(People of 'Ksan 1980:89).

> The most famous grease trail led inland from the Nass River. The trail went up the Nass from the village of Gitlakdamiks (now Aiyansh), thence up the Cranberry River and **over the low divide** to Kitwancool and Kitwanga. This most important of all **grease trails had branches to Kuldo and Kispiox**. Oil from fisheries farther south connected Kitimat with the Skeena and then forked. One fork proceeded up the Skeena to the Bulkley, the other went up the Zymoetz across to the Bulkley. (Duff in Harrington 1953:43-44)

> Travel conditions were cruel because the oolichans run in March or April, sometime the end of February. So, with great wooden boxes strapped to their backs, the old people fought their way along the trails which were often buried in snow and ice. They trudged at least a hundred and thirty miles on foot to Grease Harbour on the Nass River. From there if the river was open, they could take a canoe through the treacherous waters to Fishery Bay, another forty miles away. There they got the oolichan and oolichan grease. The return trip was even tougher...(People of 'Ksan 1980:89)

> They would have a hard time packing the grease home. It might take them about a month to get there [Nass]. It takes longer coming back...they bring their packs in relay. They bring one ahead, then leave it and walk back and get the other pack and on it goes until they reach home. Sometimes they have three packs. They usually left early in the morning, then camped at nightfall. (People of 'Ksan 1980:89)

The modes of travel in the Interior may have split between waterways and land routes. River, creek, or lake crossings were made by raft, canoe, or bridge (see Plates 5-7 below). An article in the *Beaver* in 1953 stressed the importance of water routes for moving Grease, but it appears to be a Coastal phenomenon. "Coastal Indians would not travel on land, if they could avoid it. And the river valleys were so densely forested that the trails were high in the mountains, just under the snow line" (Harrington 1953:43). Under good conditions, the Nass was navigable by canoe roughly up to the junction of the Cranberry River (just west of the study area). None of the tributaries of the Nass are navigable (Richards 1981). It is presented by People of 'Ksan (1980) that the use of canoes is a recent phenomenon and that most travel was on foot or if a water route, then by raft. "Our wise people...do not believe that we [Gitxsan] used canoes in ancient times...we did not travel far by water...when we did get canoes- cottonwood dugouts and a few Haida canoes- we began to travel farther afield..." (1980:93).

> Some Gitksan hunters, whose trapping grounds lay in the Meziadin or Stewart areas...took their winter catch directly to the Nass as they were closer to the oolichan than their home village. Their journey, if they followed the shortest trail would have been every bit as hard as the trip from Kispiox or Hazelton because there is a steep mountain range to cross (People of 'Ksan 1980:89).

MacDonald and Cove (1987) cite eight major trail systems in the Kispiox district. In addition to these there are no doubt House trails that link villages or camps to the larger systems. The Kitwankul Trail between the Skeena and Nass Rivers was reported to be the widest in the region, and about 60km long (MacDonald, 1983). The trail was worn as much as a meter deep where it cut over hills and ridges (MacDonald, 1983:x).

The Gitxsan Treaty Office (the Strategic Watershed Analysis Team) has accumulated extensive mapped trail information, but their database was not available to us for this study. Inland routes and trails to resources within and between House territories are examined below.

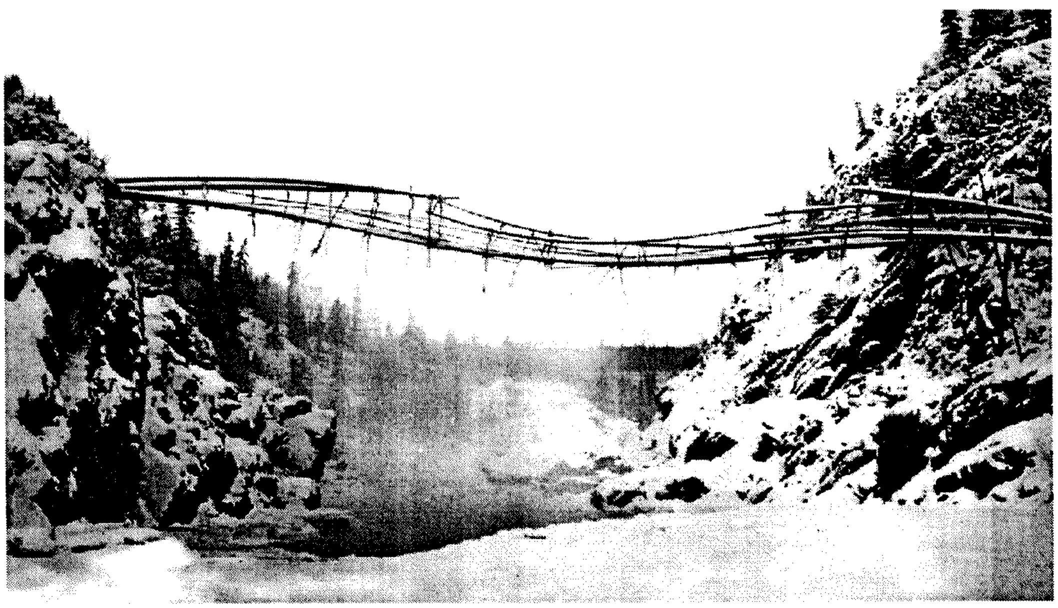


Plate 5. First Bridge at Hagwilget (1872). (BC Archives)

Table 3. Major trail routes and goods carried (sources in text)

Trail Route	Direction	Item
Telegraph Trail	Southward	Obsidian
		Copper
		Wooden crest items
	Northward	Eulachon grease
Cranberry River	Nass to Skeena	Eulachon grease
		Marine shells
		Copper
		Dried sea weed
		Obsidian
		Sea-lion teeth and skin
	Skeena to Nass	Furs
		Moose skins
		Goat wool and horn
		Sheep horn
Kitwancool (data incomplete)	Skeena to Nass	Furs
		Moose hides
	Nass to Skeena	Eulachon grease
		Copper
		Obsidian

Trail Route	Direction	Item
Kitwanga/ Bulkley River Gitanmaax/ Bulkley River	Eastward	Sea shells
		Dried shellfish and fish
		Dried seaweed
		Eulachon grease
		Sea-lion teeth and whiskers
	Westward	Furs
		Deer and moose skins
		Obsidian and amber
Gitanmaax/ Babine	Eastward	Eulachon grease
		Dried shellfish
		Dried seaweed
		Sea-lion teeth
		Copper
	Westward	Furs
		Moose skins
Kitsegas/ Driftwood (connecting trail)	North-eastward	Eulachon grease
		Dried salmon and shellfish
		Sea-lion teeth
	South-westward	Furs, moose hide

Table 4. Skeena River Trade Goods. Source: ***Historical Atlas of Canada, Vol. I*** **by George McDonald, Gary Coupland and David Archer.**

Trail Route	Direction	Trade Category	Item	Item	Trade Category	Direction
Skeena	Downriver	Food	Dried berries (soap, Saskatoon, blue)	Dried seaweed	Food	Upriver
			Dried caribou and goat meat	Dried and smoked shellfish		
			Mountain goat fat	Dried seal and sea-lion meat		
		Raw Materials	Sheep and goat horn for spoons	Dried salmon-berries		
			Goat wool	Dried halibut, cod		
			Moose hide	Native tobacco		
			Caribou hoofs	Dentalium abalone shell	Raw materials	
			Grizzly claws and teeth	Purple hinged scallop shell (bracelets)		
			Furs	Killer whale jaw		
			Obsidian	Copper		
			Jet	Sea-lion whiskers, teeth		
			Amber	Large cedar canoes	Manu-factured Goods	
		Manu-factured Goods	Goat wool blankets	Crest carvings		
			Ground hog skin blankets	Armour		
			Horn spoons	Shell wood working tools		
			Arrow shafts	Clam shell beads		
			Jade adze blade	Whale bone clubs		
			Stone clubs			

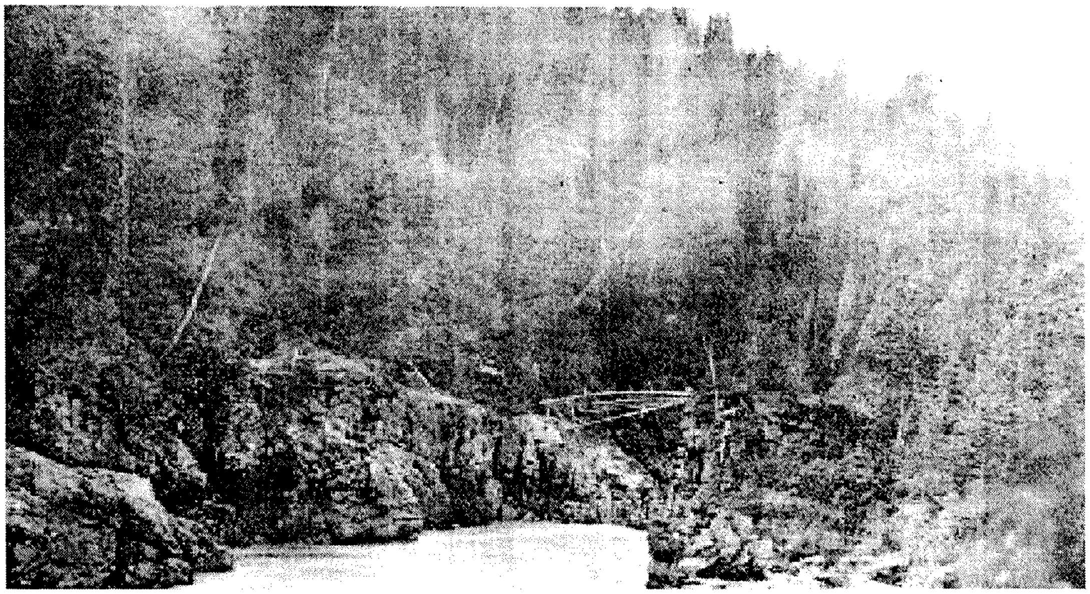


Plate 6. Bridge at Kuldo (BC Archives)

House Trails and Territories

Interterritory trails are almost invisible in ethnographic literature. Within House territories, there are a number of trails that are generally known and were part of day to day living, but somehow they escaped being recorded. Gitxsan Treaty Office personnel have recorded trails on both sides of the rivers in Gitxsan territory, are braided, are variable in size, steepness etc (Vegh, 1997, personal communication).

Trails were marked with blazes, carvings, and other markings that were recognised by people using the route (Blackstock 1996).

> The tree carvings that I have seen were along trails. Mainly a trail from Hazelton to Blackwater, and generally what is called the telegraph trail today, and also the Kispiox Trail, the trail from Kispiox to Hazelton. I seen others on trails farther in the bush. They are called Gyetim Gan (Neil Sterritt in Blackstock 1996:109).

> All along the trail were tree trunks whereupon some loitering Siwash has delineated a human face by a few deft and powerful strokes of the axe, the sculptural planes of the cheek, brow, and chin being indicated broadly but with truth and decision. Often by some old camp, a tree would bear on a planed surface the rude pictographs so that those coming after could read the number, size, sex, and success at hunting of those who had gone before. (Garland 1899:82)

> All these people knew which territory is theirs. They turned off at the appropriate trail, they didn't trespass on each other territories. (Olive Mulwain in Blackstock 1996:107)

Resource use too is specifically correlated to trails. Cache pits and culturally modified trees associated with subsistence often follow trail corridors.

> All the old style storage holes were situated close to a village, just off a trail. (People of 'Ksan 1980:22)

> ...[T]hese people have discovered the virtues of the inner bark of the black [lodgepole] pine. All along the trail were trees from which wayfarers had lunched, leaving a great strip of the white inner wood exposed (Garland 1899:82).

The Gitxsan Treaty Office (GTO) and House members have specific geographical information of a number of House Territory trails. Personnel at the GTO have mapped trails from recorded information, interviews and in many cases on the ground. Specific locations from the GTO were not available for this Overview, but where enough descriptive information existed to map trail locations with relative accuracy, they were included (see below). Trails that have been recorded as archaeological sites or that were mapped by archaeologists were available for this study, and are included in this database.

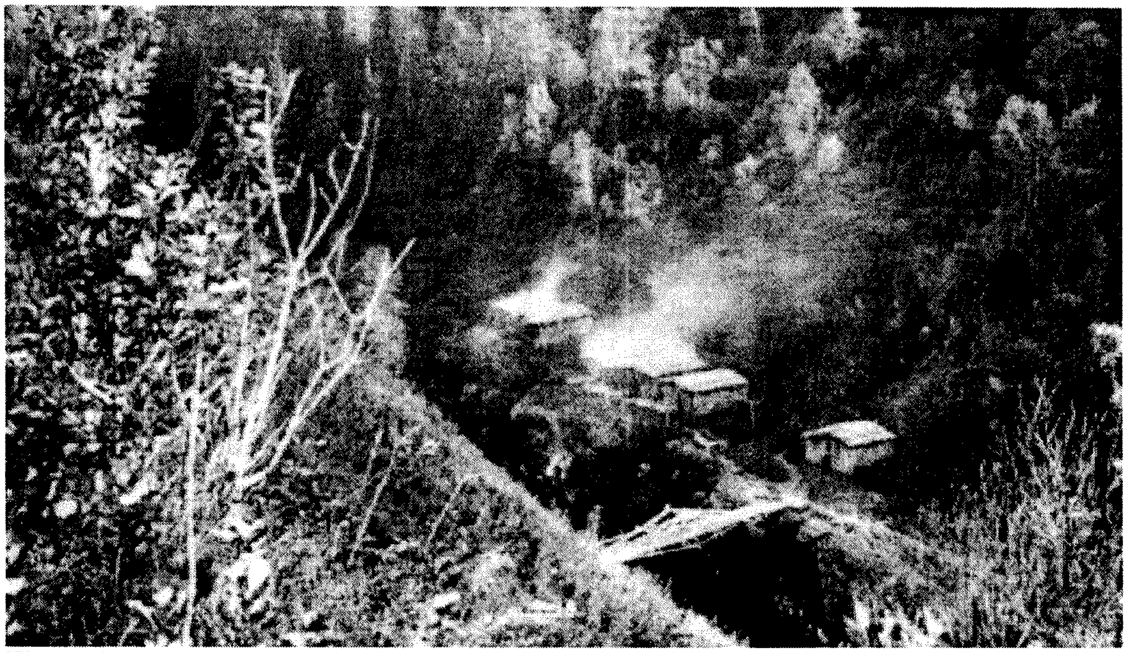


Figure 3. Fishing Village with Bridge, Kisgegas (1945, used now infrequently) (BC Archives)

The Telegraph Trail

The Collins Overland line was proposed in the early 1800s as an alternative telegraph to a Trans Atlantic gradual connection from America to Europe over-land through Russia. Construction began in America and continued through the BC interior when it appeared a Trans-Atlantic route was unfeasible. The Collins Overland was halted at Fort Stager, near Kispiox Village when it became apparent that a Trans-Atlantic connection was successful. The Dominion government purchased the line shortly thereafter and was hence known as the 'Dominion Telegraph' and the Yukon Telegraph Trail (L'Heureux 1990:26-30). The progress of its construction is well documented. Ed Conway reported in a letter to Col. S. Bulkley, of U.S. Army Telegraph Trail Expedition that he had sent a journal including map of the route and a description of the country in detail (L'Heureux 1990:27-28).

There are a number of instances that prospectors lament the rough route of the Telegraph Trail in comparison to the 'Indian Trail' (L'Heureux 1990:94).

> [The Telegraph Trail] cut uselessly over hills and plunged senselessly into ravines. It was an irritation to all of us who knew the easy swing, the circumspection, and the labour saving devices of an Indian Trail. The telegraph line was laid by compass, not by the stars and the peaks; it evaded nothing; it saved distance not labour. (Hamlin Garland 1898 in L'Heureux 1990:93).

With this in mind we are also aware that the Telegraph Trail, as it is mapped by a number of sources, follows portions of established aboriginal trails. Aboriginal use of the Telegraph Trail is worth further investigation. A postcard is captioned with: "Old Indian Bridge"

The remarkable Indian Suspension Bridge near the junction of the Bulkley and Skeena rivers at Hazelton, B.C. was lashed together with copper wire from the famous San Francisco to London overland Collins Telegraph System (c.1865)

The reinforcement of the bridge at Hazelton with telegraph supplies reportedly occurred after the Overland was stalled at Fort Stager (near Kispiox Village today).

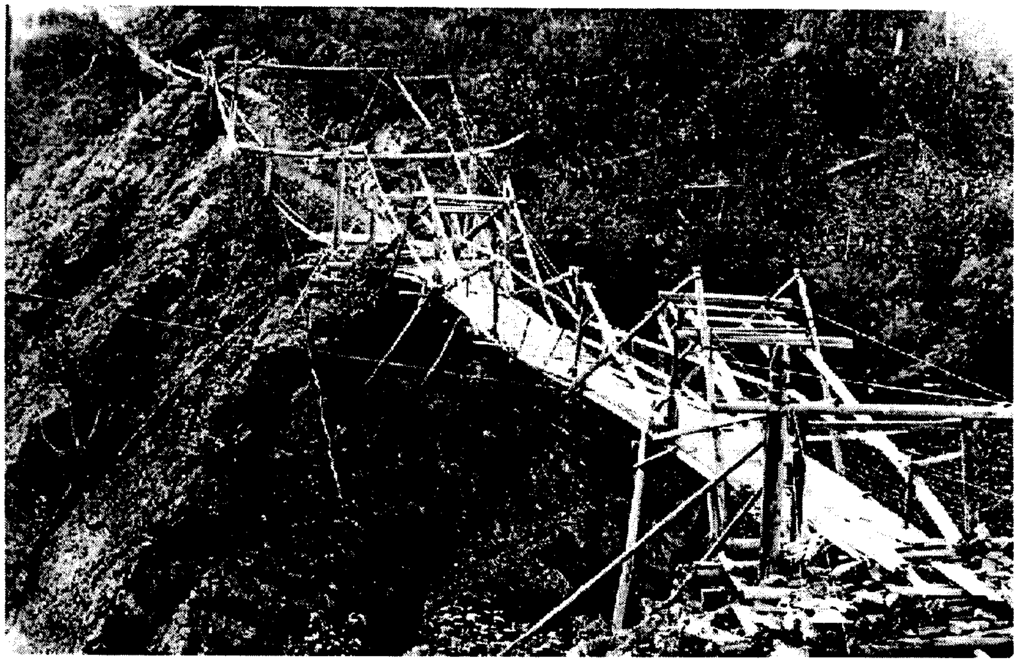


Plate 7. Second Bridge at Hagwilget, (189-) (BC Archives)
Compare this with Plate 5.

PREVIOUS ARCHAEOLOGICAL RESEARCH

Initial background research for the revision included a review of the original overview of archaeological potential mapping of the Kispiox LRMP conducted in 1995. A major goal has been to input the results (both positive—new site locations—and negative—defined locations with no sites) of archaeological work conducted since the Overview. Relative to other districts, very little archaeological work has been conducted in Kispiox since 1995. The work that has taken place is limited to the Skeena Valley and Interior Cedar Hemlock regions of the District. No other ecological zones are well represented in projects. Very significant data gaps remain (Equinox 1997).

For this refinement, a number of databases of recorded sites were created. An original list of all sites in the Forest District was obtained from Canadian Heritage Information Network (hereafter CHIN). This list was then cross-checked with the paper map and from the database of sites plotted and registered at Inventory and Mapping, Archaeology Branch, the Provincial Heritage Registry Database (hereafter PHRD). The resulting list represented the total number of sites recorded in the study area to date. The GIS consultants created an independent database of sites when the site locations were digitized. The plot-generated list was then compared to the known inventory and we were able to cross-check and correct the plotted information.

The Archaeology Branch library catalogue was searched for projects that have been conducted in the Kispiox Forest District. Another search was made for sources cross-referenced in the electronic version of the BC Archaeological Site Inventory. The Archaeology Branch's Permit List was examined (to October of 1997). Site investigation permits (Section 12) and site alteration permits (Section 14) were included in the review. The resulting combined list of archaeological sources was used to find documents in the Cultural Library of the Ministry of Small Business, Tourism, and Culture. The bibliographies of the reports were also searched for additional sources. The permit list allowed us to review work in progress for recent permits that were not yet available from the Culture Library. In cases where fieldwork was just completed or in progress we asked the consultants to provide a map of the area investigated and a summary of their methodology and results.

For the purposes of modelling, intensive survey was defined as any methodologically rigorous project that includes systematic subsurface testing. This allows for an analysis and prediction of site density and known site size as well as for the confident identification of non-sites. Only a small portion of the work conducted in the District could be described as intensive, systematic survey. We have added to the original list compiled in 1995, and the list compiled by Equinox in 1997 (see Table 5, Table 6, Table 7). Building on the same data summarized by Equinox Research and Consulting Ltd. in their analysis of datagaps, we have calculated that as of December 1997, 794 ha of the region has been surveyed to the degree that can be useful to the model (Equinox Research and Consulting Ltd. 1997).

After a brief review and critique of the types of surveys used in archaeological research, we summarize the sources we located.

Survey Types

Previous research in the District includes several types of surveying techniques, which can be classified as probabilistic surveys, systematic intensive surveys, or small, localized, non-probabilistic, non-intensive surveys.

Probabilistic Surveys

Although probabilistic surveys are the most useful for the development of predictive models and mapping, few surveys of this type exist within the province, and none have been conducted within the

Kispiox Forest District. Probabilistic surveys involve the random selection of units for survey. These surveys include areas of High, Moderate, and Low Potential and the same inventory techniques are applied to all. In a probabilistic survey, the chance that a site is located is independent of judgmental factors such as preconceived notions of site distribution and location. Archaeological investigations of apparently Low Potential areas may confirm the non-existence of sites in certain types of locales. Negative data is essential to the development of an effective model of site location. The absence of probabilistic surveys in the Kispiox area poses challenges to the development of archaeological potential maps for the District.

Systematic Intensive Surveys

Systematic intensive surveys are often associated with government inventory projects of the mid-1970s to mid- 1980s, and more recent development projects. These projects follow a standardized methodology using foot surveys of High and Moderate Potential areas and subsurface testing. This work is usually linear, confined to shorelines and river valleys, highways, roads, rail, gas, and Hydroelectric lines. These studies often note associations between specific physical environments and site types that can be effectively extrapolated to other similar locations within the Kispiox Forest District. Assumptions of "low potential" often remain untested in these reports, but they can provide 'negative data'.

Other Surveys

These site surveys do not conveniently fall into the probabilistic or systematic, intensive categories. They are characterized by the lack of systematic methodology or the absence of a description of methods and/or of the specific area surveyed. Techniques vary widely from unspecified survey methods to exclusive use of informant testimony. Although these projects may be conducted over large areas, the surveyed area tends to be small and localized.

Summary of Work presented in 1995 Overview

Table 5. Summary Of Intensive Systematic Surveys In The Kispiox LRMP To 1995

Authors	Date	Area	Sub-surface	Length (km)	Width (km)	# of Sites	Total km^2	Sites/ km	Sites/ km^2
Carlson/ Bussey	1989	Bulkley R./ Hagwilget	Probe	not given	not given	26			
Zacharias/ Eldridge	1990	Hazelton	Probe/ Shovel	1.25	0.100	2	0.125	0.625	16
Zacharias/ Eldridge	1990	Skeena/ Carnaby Crossing	Probe/ Shovel	9	0.100	2	0.9	0.22	2.22
Eldridge	1989	Nangeese R.	Probe/ Shovel	3.50	1.5	1	5.25	0.28	0.19

The intensive survey in the District is directly correlated to proposed developments including bridge crossings, highway construction, and logging cutblocks. In 1989, Carlson and Bussey attempted to apply Gary Coupland's culture history sequence from Kitselas[4] to the Hagwilget Canyon in their systematic, intensive survey of the Bulkley River near Hazelton. The authors recorded 24 new sites that they suggest could represent the "entire span of prehistoric human occupation" in the area (Carlson and Bussey 1990:iv). Although they were unable to associate assemblages with specific phases, the variety

[4] See excavation summary in Millennia Research Overview report 1995.

of sites indicated a wide range of activities and site density implying that the Hagwilget Canyon had been intensively used. Their study found three times as many sites on the north side of the river as on the south and the authors suggest that this distribution is valid for the entire Bulkley Canyon.

In their systematic, intensive survey of nine kilometres of highway west of Hazelton, Zacharias and Eldridge (1989), found two sites containing 23 and 50 cultural depressions respectively, culturally modified trees, and large areas of possible cultural burning. The large number of food storage features provided evidence for long term gathering, possibly extending back 4500 years.

Eldridge (1989) conducted a detailed heritage resource inventory and evaluation of several proposed cutblocks at the headwaters of the Kispiox River. This is one of the only intensive surveys off the Skeena and Bulkley Rivers. Eldridge recorded a dendrograph, and reported recent blazes and a trail. The area surveyed is relatively small, generally following planned roads and block boundary. Given the restricted area of survey the author is reluctant about using the results to draw conclusions of site density off the Skeena and Bulkley.

Non-intensive surveys of the District warrant review as they provide information regarding: the assessment of previous overview work; the diversity and richness of archaeological site types both reported and recorded; the quantity and quality of survey in the District; as well as recommendations for future research. The most salient work is summarized below.

Table 6 Descriptive Non-Intensive Survey in the Kispiox prior to 1995

Authors	Date	Area	Sub-surface	Length (km)	Width (km)	# of Sites	Total km^2	Sites /km	Sites /km^2
Ames	1972	Usk to Bulkley	not specified	90		7			
Inglis	1977	West bank Skeena, W. of Hazelton	not specified						
Mackie/ Montgomery	1977	Skeena Crossing	not specified			1	1		
Irvine	1980	Skeena R.	Shovel	16	0.03	18	0.48	0.5	16.6
Montgomery	1981	Doreen to Cedarvale	Shovel	7.0	0.6	2	4.2	3.5	0.47
Richards	1981	Upper Skeena	Exposure / Bank			20			
Blackstock	1985	Throughout District	none						
Simonsen	1989	Bulkley R.	Probe/ Shovel	5	0.8	2	4	0.4	0.5

Summary Of Survey in the District Since 1995

Table 7. Surveys in the Kispiox Forest District Since 1995 that were used in the model									
Authors	**Date**	**Area**	**Sub-surface**	**Length km**	**Width km**	**# of Sites**	**Total km²**	**Sites /km**	**Sites/ km²**
Prince	1995	Kitwanga Valley	Probe	17	.05	10	0.85	0.59	11.7
Wilson/ Coates	1995	Babine R.	Judgement/ Shovel	5.0	.05	3	0.25	0.6	12
Wilson/ Mitchell	1994	Babine R. / Sam Green Ck.	Judgement/ Shovel			3	1.0		3

The confidence of mapping these survey areas as non-site areas varied with the description of methodology and results. Mapping of the surveyed areas as non-site was conservative, with only nine permits in total were mappable (Coates 1997-179, Eldridge 1989-32, 1989-37, Millennia Research 1989-55, Millennia Research 1996-137, 1996-138, IR Wilson 1994-39, 1995-120, Prince 1995-147).

Kuldo, Babine River and Sam Greene Creek

In 1994, I.R. Wilson Ltd. was contracted to conduct an archaeological overview assessment of proposed forestry developments including cut blocks and several kilometres of haulroads along the Skeena River, north of Kuldo Creek (approximately 80 km north of Hazelton). IR Wilson's Overview (permit 1994-39) was primarily at a reconnaissance (or RECCE) level of survey with helicopter overflight, as access to the proposed blocks was difficult. The reported results were brief. Depending on the specific archaeological potential of the area examined, transect intervals differed between 10 and 50 meters apart. It is estimated that a total of 245 ha were to be part of the overview and several kilometres of haulroad. It is undetermined from the report how many hectares were covered by on ground survey. Low Potential areas described as very steep or very poorly drained terrain were generally excluded from survey. The blocks north of Kuldo were allotted Low Potential due to fairly steep terrain, distance from water, or swampy terrain. Blocks closer to the Skeena were given a moderate rating. The flat terrain of east side of the Skeena River where a proposed bridge crossing was given a High Potential rating. Shovel tests were judgementally placed in areas of archaeological potential with fair to poor surface exposure. It is impossible to calculate survey coverage or intensity, site density or analyse the methodology for arriving at potential.

In 1995, I.R. Wilson Consultants Ltd. undertook an AIA of proposed crossing options of the Babine River in light of their 1994 recommendations. Fieldwork was conducted under permit 1995-120 and included research methodologies and sources outlined in the overview (permit #1994-39). The development areas were walked by the field crew, with transects varying between 5 m and 10 m apart. The remainder of the study area (approximately 20 ha) was judgementally surveyed, focussing on the road right-of-way and High Potential areas. Surface inspection of the 20 ha was augmented with systematically placed subsurface tests (on a 20-m grid). Steep areas (>70% slope), active slide areas and areas within recorded boundary of GkSw-2 were excluded from the subsurface testing program.

Nineteen distinct clusters of cultural depressions were identified, and divided into six archaeological sites based on their geographic association and presumed contemporaneity. A blazed trail was identified and followed 1.13 km along the edge of a series of terraces, above the east bank of the Skeena River. The positive and negative results of permits 1994-39 and 1995-120 were included in the model despite the very restricted area of systematic survey.

Kitwanga Valley

Paul Prince of McMaster University conducted archaeological survey in the Kitwanga Valley under permit 1995-147 (Prince 1995). The survey was designed to address questions related to precontact and early postcontact period use of resources in the Valley. A judgmental sampling strategy was employed, aimed at a relatively narrow research focus that was primarily to determine the location of precontact village sites. Prince's work is included here as he is relatively specific in his descriptions and rationale of surveyed areas, site descriptions and associations, and he was not limited to specific developmental areas.

Prince's (1995) study gave priority to postcontact village locations (reported and recorded), confluences of tributaries and streams, ancient river terraces, and reported fishing locations and those that geographically resemble informant reported sites. In addition, parts of the Skeena River bank that were within reasonable access of Highway 37, and side roads were inspected. Within the study areas, archaeological sites were located by surface inspection only. The riverbank was inspected for erosional faces or buried cultural strata. Transects were walked on the terrace or floodplain above the River, with spacing varying between 5 and 10 m apart. Informal interviews were conducted with those who have knowledge of site locations. No specific site information from the interviews was given in the report.

Prince covered an approximate total of 17 linear km of the Kitwanga Valley. Ten archaeological sites were recorded, and three previously recorded sites were revisited. Prince presents the results by surveyed area. He provided maps with his survey traverses. The potential ratings he presents are for habitation site types only.

Lower Kitwanga River

Prince inspected approximately 9.5 km of the riverbank, from the confluence of the Kitwanga River and the south branch of Kitwancool Creek, to the mouth of the Kitwanga River. Long sections of the river were inspected.

Upper Kitwanga River

Six km of the upper Kitwanga River was inspected from Kitwanga Creek to Kitwanga Lake. Three new sites were recorded, a cache pit site and two modified tree sites were located. Three and a half kilometres of the riverfront at Kitwancool were inspected.

Kitwanga Lake

The lakeshore was not surveyed in its entirety. The peninsula that divides the lake in half was targeted for survey, as the rapids at the point would be a potential fishing location. The south side of the peninsula was inspected; two sites were recorded

Skeena River

Informants reported a number of possible village locales in the vicinity of Kitwanga. These include the mouths of Boulder Creek, Sedan Creek, and Coyote Creek along the Skeena. The mouth of Mill Creek was also inspected.

Prince's results are framed around his original thesis on settlement patterns. Current settlement pattern data in the valley suggests there was a shift towards greater sedentism in the early contact period with an increase in the number of large archaeological sites, and a tendency for them to be situated at important locations along trade routes. The judgemental survey methodology used by Prince is consistent with generally accepted survey practices. Proximity to water, specific landforms such as terraces, level ground, and ethnographic information are all variables that contribute to potential ratings. Prince's work also highlights the variability of sitetypes that are present in the area and that sitetypes such as villages are not necessarily predicated on specific variables.

Other

Michael Blackstock's (MA) research on tree carvings in the mid 1990s explored ethnographic and archaeological significance of culturally modified trees. Blackstock augmented interviews and archival research with fieldtrips to document the location of tree carvings and associated trails in the

District. The locational information as reported in Blackstock (1996) is unfortunately too vague for specific modelling purposes. Nonetheless, his research is very valuable in providing context for this type of culturally modified tree and the relationship of heritage features to the physical and cultural landscape.

Survey Problems

There are several common limitations to older reports. In particular, older reports often lack detailed descriptions of the study area boundaries, methodology, and findings. Few surveyors included subsurface testing as part of their methodology, a practice that is now standard. Sites that were not overtly evident on the ground surface or in existing exposures must have been missed. In addition, the early reports seldom acknowledged the archaeological potential of wet lands and mistakenly rank these areas as having low heritage potential. Maps are frequently absent from reports or of such a general nature that it is not possible to relocate the area actually surveyed. Commenting on these limitations in their review of existing surveys, Eldridge and Moon (1992:10) state that:

> Few give detailed accounts [of survey methodologies] and, in many cases, it was very difficult to determine exactly how survey was accomplished, let alone any overall research design. This tends to be particularly true of older reports. Another endemic problem is the lack of information on areas which were surveyed but lacked sites altogether.

We have addressed these difficulties by carefully using data collected during intensive surveys, put together with information extrapolated from well-surveyed areas of similar terrain and vegetation.

The amount and intensity of surveyed areas within the forest District remain the most significant datagap for modelling purposes, as we will explore in the next section. The remainder of the report is dedicated to the presentation and discussion of the Potential Model for the Forest District.

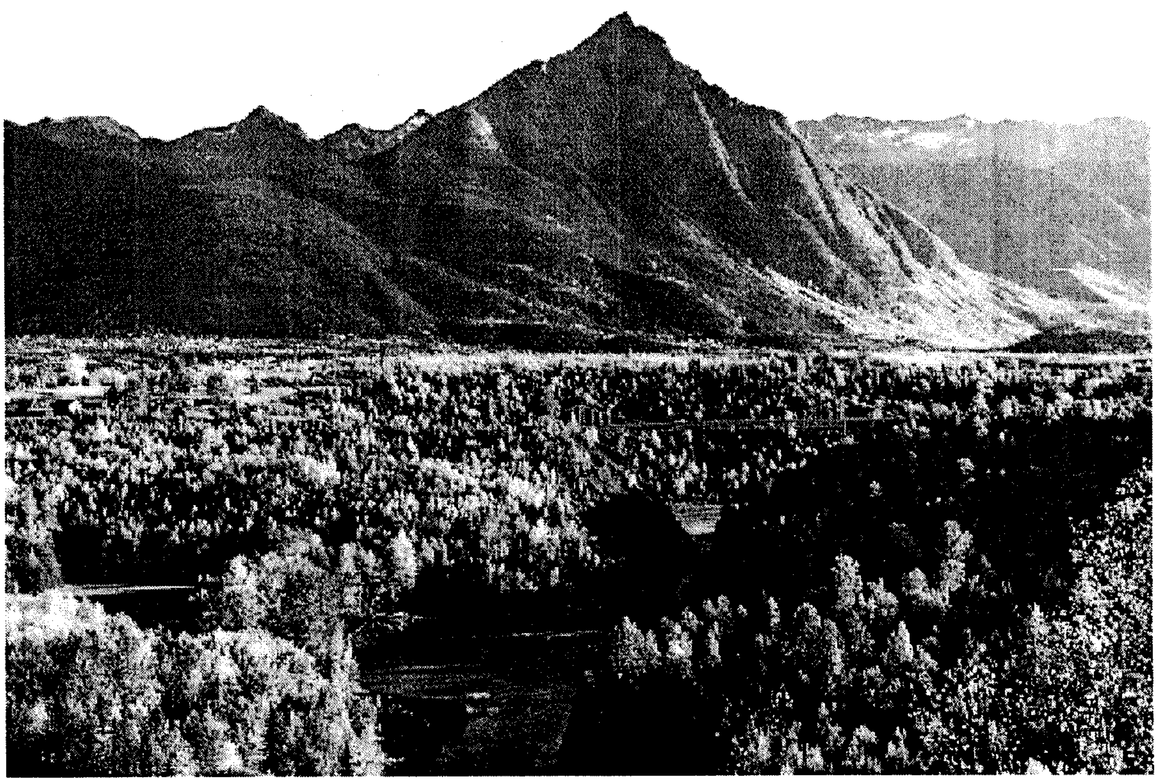


Plate 8. Stekeyoden and Skeena Valley

MODEL

Data Used In Analysis

The geographical information was gathered by plotting the following "points" in GIS format:

1. Archaeological site locations as points and as "polygons" (for sites greater than 100m in any dimension);
2. A grid of points spaced 100 meters apart covering all surveyed areas which were further than 200 m from any site; and
3. A grid of points spaced 1 km apart covering a representative sample of the study area.

The gathering of this data provided, respectively:

1. A set of known locations of sites, $N_{preliminary}$=143 N_{final}=138;
2. Known locations where sites where absent, N=794 Ha; and,
3. A random sample of points describing the study area, N=12,717.

Most variables used were available for each point listed above; however, several variables were not available for either grid point and survey points. In addition, the salmon model and hillshade values were not available for model development in the database.

The data used for analysis was based on the following mapped sources:

- TRIM (Terrain and Resources Information Mapping), at 1:20,000 scale, provided the base mapping layer. Included were water bodies, wetlands, slope, and aspect derived from a DEM, the road system and features such as glaciers, rapids, and waterfalls.
- Fisheries data was estimated for modelling development and a model for salmon location was developed by Range and Bearing and was customized for the implementation of the final model. The salmon model was compared to FISS maps to determine its accuracy.
- Aboriginal trails researched from a number of sources (see Trails research section of this report) were digitised from 1:50,000 hardcopy topographic maps.
- Forest-cover data from Ministry of Forests 1:20,000 digital base maps.
- Known archaeological sites, obtained from the Provincial Heritage Register Database (PHRD) and checked for accuracy using original site inventory forms on file at the Archaeology Branch, Victoria.
- Ethnographic data.

Survey Bias and Data Gaps

Three years after the original model was presented, the amount of archaeological data relevant for understanding cultural development in these territories remains meagre. The lack of probabilistic and intensive archaeological surveys in the Forest District in general, and any survey in most of the biogeoclimatic zones in the study area, is particularly impeding (see Table 8). Only ICH and MH have been adequately surveyed in terms of proportions, however the overall amount of survey (794 hectares) is extremely low.

Table 8. Surveyed Areas by Biogeoclimatic Zone

Zone	Grid	%	Sites (preliminary)	Sites (final)	%	Survey	%
AT	1894	14.89%	0		0.0%	24	3.02%
ESSF	4207	33.08%	0		0.0%	0	0.00%
MH	531	4.18%	0		0.0%	106	13.35%
CWH	718	5.65%	3	3	2.0%	4	0.50%
SBS	484	3.81%	0		0.0%	0	0.00%
ICH	4883	38.40%	140	134	98.%	660	83.12%
Overall	12717	100.00%	143	137	100.0%	794	100.00%

Systematic survey provides both the locations of where sites are found, but also where sites are not found. Survey identifies variables that effect archaeological potential either positively or negatively. The location of non-sites provides the best comparative data, provided that the systematic survey is representative of the environmental types in the study area as a whole.

Another limitation has been the deficiency of ethnographic information used for modelling. Ethnographic interviews were not conducted to learn locations of ethnographic sites (including unrecorded archaeological sites or traditional use sites) or ethnographically known trails. Placenamed and ethnographically known site information have demonstrated significant correspondence with archaeological resources and past land use.

Variables Used for Analysis

The variables used in the present analysis are presented in Appendix 1 with brief explanation. Although many of the variables reflect known archaeological correlates, many simply reflect available GIS data. In order to discover previously unknown relations, the greatest number of variables as possible, given financial and time constraints, was used. Distance measurements were limited to 2000 meters from the given point. This was done to limit processing time in the GIS. For each variable, a field was created in the database. Data types included distance measurements (continuous variables), identity fields (nominal variables) and ranked data (ordinal variables).

The first group of variables used for analysis describes the general ecological context in which the point was located. Features such as biogeoclimatic zone and sub-zone describe the climate and plant species located in a particular region. Ecotone describes the proximity to a biogeoclimatic boundary. Timberline measures the distance to the boundary of the Alpine Tundra biogeoclimatic zone.

The second group of data describes surficial geology and includes variables such as eskers and glaciers.

The third group of variables describes water features. Streams and rivers were classified according to whether or not they contained fish. For the final model, a salmon location model was developed by Range and Bearing for the mapped GIS product. This model began by being 'seeded' with salmon at known fish rivers and then worked 'upstream' on all tributaries until calculated slopes indicated a significant barrier, at which point areas were dropped as salmon bearing. If the tributaries had upstream approximate volume and gradient, they were classed as fish streams. Near analysis values to this feature were run on preliminary salmon stream classifications. As a check, a combination of stream order and magnitude in conjunction with TRIM data simulated the streams with salmon in the database. Double-line streams with order greater than 3 or order 3 and a magnitude of greater than 25 were treated as salmon bearing streams. The salmon model was compared to FISS maps in order to assess its accuracy. The model was then further refined by manually identifying features or barriers that were not recognised as bearing or limiting salmon. For example, high altitude streams that were captured were downgraded from salmon to fish streams and known important canyon fishing locations that were single line streams were treated as salmon bearing. The FISS comparison appeared to better approximate the location of salmon than the combination of order and magnitude.

The fourth group of variables describe the forest cover in which a point falls. For each tree species, the percentage of that species in the forest stand in which the point was located was listed, the average age class of the stand, the average height, and the crown closure of that stand was listed.

The fifth group of variables describe topography. The slope was measured using slope classes. Exact slope and aspect measurements were not obtained for each point (except sites) because the slope and aspect maps required too much processing time to calculate. The slope categories used are presented in Table 9. Aspect was recorded using directions (N, NW, W, SW, etc.) and the categories used in the database are presented in Table 10. Slope, aspect, and hillshade were not calculated for the survey grid points and the kilometre grid points. Summary tables for the entire district listing the proportion of the entire study area by slope class, aspect and hillshade were used instead. These were compared with the distribution of sites.

Table 9. Slope Classes Used in Model Development

Slope Class	Percent Slope
0	0
1	1-15%
2	15-30%
3	23-45%
4	45-75%
5	75% or greater

Table 10. Aspect Classes Used in Model Development

Aspect	Compass Bearing	Direction
0	Flat (no bearing)	
1	339-23	N
2	24-68	NE
3	69-113	E
4	114-158	SE
5	159-203	S
6	204-248	SW
7	249-293	W
8	294-338	NW

The final types of data that were recorded for each point were social features such as proximity to known trails and proximity to other archaeological sites. Trails are known to be associated with other site types such as camps, culturally modified trees, resource extraction areas including quarries, fishing locations, berry patches, trapping areas etc. (see Blackstock 1996, Vegh and Collier 1997, SWAT personal communication).

In addition to these classes of data, other classes of data specific to sites, survey points and random grid points were collected. These included, for sites: the Borden number (unique identifier), and the site type (see Appendix 2 for site typology); for survey points, the surveyor, and type of survey was recorded. The archaeological surveys used are discussed in the previous archaeology section of this report. Each survey and grid point received a unique identifier.

All of the data was stored in a database in dB format using FoxPro. Sitelist stored the information for sites, kmgdlist stored the information for the one-kilometre grid points (study area) and, survlist stored the information for the surveyed points.

Preliminary Model Results

The preliminary model was developed using descriptive statistics and the comparison of site locations to survey locations and the random grid points. Tests of significance were not employed for two reasons: a) sites were restricted to only two of six possible biogeoclimatic zones and thus were not a representative sample and b) standard tests of significance (e.g., comparisons of means) were not appropriate because of the skewed nature of the data.

Descriptive statistics highlighted whether sites tended to be closer to a particular feature in the case of continuous (near-to) variables. Histograms, comparing frequencies of points (sites, survey points or grid points) by distance to the feature were also used. The ideal pattern when comparing sites with either grid points or survey points is reflected in Figure 4.

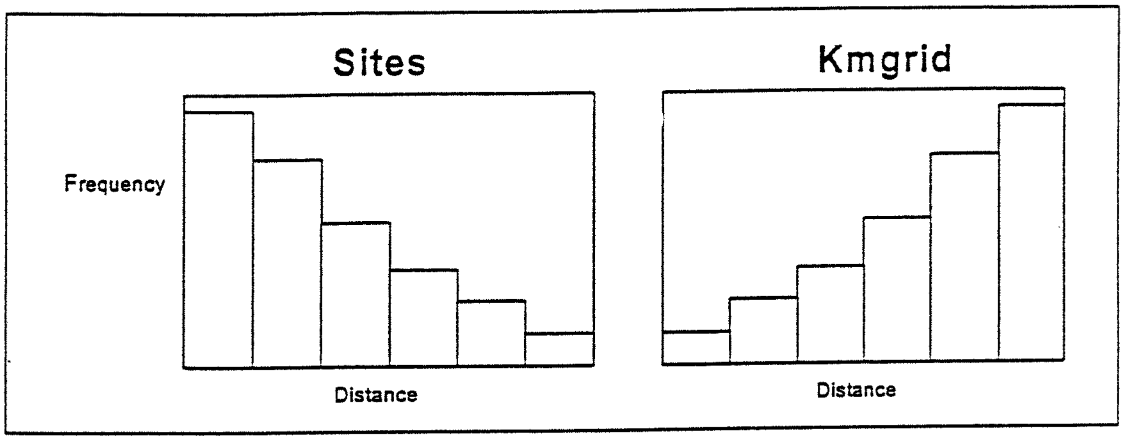


Figure 4. Ideal Distribution of a Significant Variable.

For non-continuous variables, the number of sites sharing a feature (for example, within a stand of trees with a specific characteristic) was compared with the number of survey points and the number of random grid points sharing that feature.

Where data was available for analysis, buffer sizes were selected so that the proportion of sites within that buffer would be greater than the proportion of either random grid points or surveyed areas without sites (or, preferably, both). Buffer sizes were chosen using an iterative approach. The buffer sizes were increased incrementally until an optimal size was reached (the largest number of sites in the smallest total area). Several versions of the model were created changing buffer sizes each time until a model was developed which best approximated the ideal model (Figure 2).

Buffers were created so significant variables would have transitional zones of archaeological potential around them. By initially placing a large buffer around these features then placing a smaller additive buffer around them, transitional buffers were created. Such buffering is represented in Figure 5.

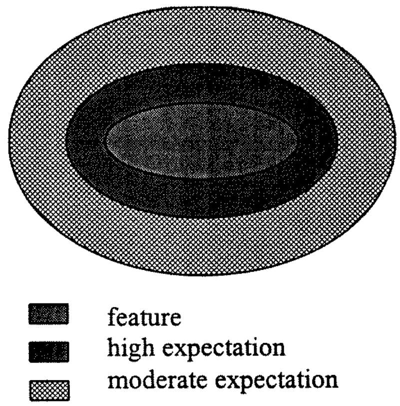


Figure 5. Transitional Buffers Around Significant Variables.

Because of the restricted distribution of recorded sites in the Kispiox Region, ethnographic information and assumptions based on previous models were used to model for areas where there were no sites recorded. Certain variables were selected because of their known ethnographic importance (discussed below).

Discussion of Significant Variables

Timberline, Ecotone

Timberline was selected for the potential of its association with trails, hunting areas and camps. Studies in neighbouring Districts have confirmed that the zones at the boundary of biogeoclimatic zones (called ecotones) have significantly higher site densities compared to the central areas of the zones. This is probably due to the desirability of locating camps near a variety of resources, available in multiple biogeoclimatic zones.

No recorded sites were located near these features.

Streamsalm

As indicated in the discussion of fishing in the ethnographic section, salmon provided one of the most important food resources. Salmon streams are associated with procurement site types, including drying racks or houses, storage pits, traps, or habitation sites.

Ninety two percent of the known archaeological sites in this district are within a kilometre of the large double line streams (indicating likely to contain salmon). Only 17 percent of the entire study area; and only 52 percent of the surveyed (non-site) areas are within one kilometre of such streams. These figures suggest that sites are in general, strongly associated with this feature.

Lakesalm

Several lakes have salmon runs. These lakes are considered ethnographically important because of the importance of salmon. In addition, at the outflow of these lakes into salmon bearing streams, good fishing spots may be located. Other fishes were procured as well at these locations. No known sites were located near this feature.

Streamfish

Large streams that did not contain salmon were likely to have contained other species of fish. Large, single line streams (above the order and magnitude levels specified) were considered to have contained fish. Species of fish other than anadromous fish ethnographically used in the Kispiox District include trout (char, rainbow and Dolly Varden), carp, and occasionally rocky mountain whitefish. Twenty- four percent of known sites were located within 300 m of such streams, whereas only 5 percent of the study area and 16 percent of the surveyed non-site areas were. These figures suggest that sites are non-randomly associated with this feature.

Lakelarge, Lakemed

Like large streams, the larger lake classes were considered to have contained fish that was utilized by First Nations. Waterfowl and large mammals are also expected to be present at these areas. Habitation and hunting sites are expected in addition to fishing sitetypes. Few sites have been recorded near these features to date. Little survey as occurred at large and medium sized lakes.

Lakesmall, Lakevs, Streamother

Small lakes and small streams were considered to be important as fresh water sources, and potentially for fish. Water is an important resource and camps or other activity areas may have been associated. In upper elevation areas especially, small lakes and streams may have provided important locations for base camps because of the relative lack of water at these altitudes. Very limited survey (totalling 40 ha) has been conducted in higher elevations, and while evidence of recent use was identified, no archaeological sites were located. In other models, in other regions (McLaren 1998), sites were associated with such water features in higher elevations.

> The Halayt find their own medicine song by fasting and praying by a waterfall. (Gyolugyet in Monet, 1992:33)

Site types associated with water but not with fishing would be captured with buffers on these small water features. These sitetypes include pictograph sites, refuges, seclusion sites where water is the resource sought. These water sources too are gathering areas for game (goats, deer) and provided landscape markers for hunting parties or travellers.

Trails

Ethnographically documented trails provide direct evidence of past human use of an area. Trails connect habitation and resource areas. Seventy percent (70%) of the known archaeological sites within this district were located within 200m of a trail, whereas only 4 percent of the study area and 16 percent of the surveyed non-site areas were. The statistical significance of trail data provides empirical support for the use of ethnographic material in predictive modelling.

Open Range

Open range areas were included in the model because these open areas both likely provided range for ungulates and may be associated with habitation sites, storage (caches) and gathering sites. Ecological burning may also be associated. Near analysis values were not available for this feature, however in other regions sites are associated with open range (Eldridge, et al. 1998, McLaren 1998).

Cedar, Hemlock, Lodgepole Pine, Spruce

Of numerous tree species used traditionally in the interior, western redcedar, western hemlock, and lodgepole pine were highlighted in ethnographic record. Bark, wood, cambium, and pitch were collected for fuel, shelter, clothing, food, and medicine.

Any class (in any tscode 1-6, not necessarily leading) of redcedar, hemlock, lodgepole pine, spruce and in a stand with age class greater than 6 (age greater than 120yrs) was included. Nearness to water (200 m) was the only other characteristic placed on the forest cover variables.

Redcedar was the most important tree species in the data analysis. The bulk of the recorded sites within cedar forest cover were also near sources of water. Thirteen percent of all recorded sites, 3 percent of the study area, and 3 percent of the surveyed areas were both within cedar forest cover and within 200m of any water source. Fifteen percent of all recorded sites, 8% of the study area, and 11% of the surveyed areas were both within lodgepole pine forest cover and within 200m of any water source. Twenty-two percent of all recorded sites, 19% of the study area, and 18% of the surveyed areas were both within hemlock forest cover and within 200m of any water source. 20 percent of all recorded sites, 11% of the study area, and 16% of the surveyed areas were both within spruce forest cover and within 200m of any water source. Sites in cedar forest cover, although less numerous than sites in other forest types showed the greatest difference between the number of sites and the total study area and/or surveyed non-site areas and were thus considered to be the most significant tree species in this area.

Variables not Evaluated in Preliminary Model

Slope, aspect, and hillshade (a measure of the amount of sunlight on an area) were not incorporated into the preliminary model. They were included in the final model. We used southern exposure class and favourable hillshade classes to support the archaeological and ethnographic evidence that give weight to aspect. Carlson and Bussey (1990) observed a pattern of greater number of sites on the northern side of the Skeena. It is noted that village and camp locations maximised exposure to the sun (Morice 1892-1893:184)

Application and Assessment of the Model

The model was implemented as follows.

1. All areas are given one point of potential at the outset. This reflects the expectation for archaeological sites to be found anywhere, and acknowledges the statements of many Native people that their ancestors used all the land.

2. The first step was to create a base buffer layer. In this layer, each area in the district which met any of the following conditions had its potential increased by one point:

Table 11. Variables Used in Baseline Buffer

Variable	Buffer Size
Timberline	100m
Near any waterbody*	100m
Near any waterbody with fish*	300m
Near any waterbody with salmon*	1000m
Trail	200m
Near any waterbody and within cedar, hemlock, lodgepole pine or spruce forest (age class >6;120 yrs)	200m (waterbody)

In this case, any area that met more than one of the above criteria only was given one point (thus not additive).

3. Following the first base buffer several layers were added which were additive. For each of the following variables a point of potential was added:

Table 12. Variables Used in Additive Buffers

Variable	Buffer Size
Near any waterbody* and within cedar forest	200m (waterbody)
Trail	200m
Near any waterbody with fish	100m
Near any waterbody with salmon	300m
Near any waterbody within AT, ESSF, or MH biogeoclimatic zone (upper elevations)	50m
Near to or within open range	100m/within

* Near any waterbody (nearwater) is equivalent to near streamsalm, lakesalm, streamfish, lakelarge, lakemed, lakesmall, lakevs or streamother. Near any waterbody with fish (nearfish) is equivalent to near streamsalm, lakesalm, streamfish, lakelarge or lakemed. Near any waterbody with salmon (nearsalm) is equivalent to near streamsalm or lakesalm.

4. Once the potential values were calculated, the values were coded into four classes of potential:

Table 13. Calculation of Potential Classes

Potential points	Potential class
Less than 2	Low
2	Moderate
3	Moderate to High
Greater than 3	High

Implementation of the Kispiox Model in FoxPro

The preliminary model was tested in FoxPro using the following commands:

```
*** setup
set filter to
repl all potential with 1

*** baseline buffer
repl all potential with potential + 1 for (timberline < 101 and timberline <>
0) or (nearwater < 101 and nearwater <>0) or (nearfish < 301 and nearfish <>0)
or (nearsalm < 1001 and nearsalm <> 0) or (trails < 201 and trails <>0) or
((ageclass > 6 and (cedar_id = 'CEDAR' or heml_id = 'HEML' or spruc_id =
'SPRUCE' or lpine_id = 'LPINE')) and (nearwater < 201 and nearwater <>0))

*** additive buffers
repl all potential with potential + 1  for ((ageclass > 6 and (cedar_id =
'CEDAR')) and ((nearwater < 201 and nearwater <>0)))
repl all potential with potential + 1  for (trails < 201 and trails <> 0)
repl all potential with potential + 1  for (nearsalm < 301 and nearsalm <> 0)
repl all potential with potential + 1  for (nearfish < 101 and nearfish <> 0)
      repl all potential with potential + 1  for (nearwater < 51 and nearwater
      <> 0) and (zone = 'AT' or zone = 'MH' or zone = 'ESSF')
```

At this preliminary stage, nearness to salmon in the FoxPro database is not equivalent to nearness to actual salmon rivers as defined by the salmon model developed by Range and Bearing and "open range" values were not recorded in the database.

Based on the implementation of the preliminary model in FoxPro, the model's accuracy was assessed. Table 14 shows the proportion of sites, the proportion of surveyed areas and the proportion of the study area that fall in each category of potential. The salmon model was simulated and open range was not included in the calculation of Table 15, thus it should be considered an estimation of the areas in each potential class in the preliminary model as it appears in the GIS model.

Table 14. Distribution of Sites, Survey Areas and Total Study Area by Potential Zones, Preliminary Model

Potential	Study Area	%	Sites	%	Survey	%
Low	5340	42%	3	2%	83	10%
Moderate	4519	36%	3	2%	344	43%
Mod/High	2424	19%	20	14%	220	28%
High	434	3%	117	82%	147	19%
Total	12717	100%	143	100%	794	100%

In the preliminary model, 82% of the sites were found in areas of High Potential whereas only 3% of the total study area were in areas of high potential. The high proportion of sites in High Potential is related to the fact that the majority of sites known in this region are limited to a single biogeoclimatic zone, Interior Cedar Hemlock. This biogeoclimatic zone is found in the main river valleys. The majority of the survey in this region has been done in this zone (over 80% of the survey). This explains why the surveyed areas tend to be found in areas of higher potential than the entire study area. Ninety six percent of the known sites, 47% of the surveyed areas, and 22% of the entire study area are found in areas of either Moderate high or High Potential.

The model went through a number of revisions. The final data information including salmon, hillshade, and trails values were also added at this stage. The revisions are as follows:

```
/*****************************************************************************
/*** Logical Statements for the KISPIOX Archaeological Potential Model
/*** - Version 4.0: SEPT 22, 1998 - FURTHER REFINEMENTS
/*** - Version 5.0: OCT 19, 1998 - ADDED SITES,TRAILS,STREAMSAL1,STREAMSAL2
/***                              - INTEGRATED POT_NOSITE ITEM
/*** - Version 6.0: OCT 20, 1998 - INTEGRATED REFINED LAKESAL1 AND LAKESAL2
/***                              - LAKESAL1 = LAKESALM LAKESAL2 = STREAMSAL2
/*** - Version 7.0: OCT 22, 1998 - INTEGRATED CURVATURE TO REDUCE POTENTIAL
/***                                FROM 2 TO 1 FOR NON - RIDGELINES SECT 9
/***                              - ADDED POT_NOCULT
/*** - Version 8.0: OCT 23, 1998 - CURVATURE AFFECT ALL NOT JUST POT 2
/***                              - SITES NOT EXCLUSIVE HIGH POT (POTADD +2)
/*** - Version 9.0: OCT 27, 1998 - SITE POLYS (NON BUFFER KPOLYIN) ALWAYSHIGH.
/***                NOV 14, 1998 - TRAILS WERE REMOVED FROM BEFORE POTNOCULT
/***                              - POST NO TRAIL EFFECTS MODIFIED.
/***                NOV 16, 1998 - INTEGRATED FULL REFRESH AFTER NOC CALCS
/***                NOV 18, 1998 - ADDED POT_NOSITE, SIMPLIFIED STATEMENTS
/*****************************************************************************
```

Many of the changes made to the model as it approached the final version were not tested with the database. This meant that effects of the changes on the entire area could not be evaluated. Rather, the need for and effects of these changes relied on visual assessment of sample maps produced by the GIS. For instance, hillshade values were found to be very useful in finding sunny locations that would be suitable for camps and identifying ridges suitable for trails and camps. However, what worked well on one or a few test map sheets was found to capture far too much area where gently rolling terrain predominated, and adjustments were required. One way this was accomplished was by analysing the local topography to see if there was significant curvature (typical of ridges) or whether a large area shared the same characteristics (typical of gently rolling topography). The unanticipated benefit of hillshading allowing visual identification of palaeolandform features is discussed elsewhere in the report.

The way in which known sites were incorporated into the model also needed experimentation. Actual site locations were to be kept confidential, yet it was desirable to ensure that both the site itself and the surrounding area was High Potential, in order to ensure known sites were well protected by the map. By combining a number of factors in determining polygon shapes, the sites were generally classed as High and Moderate-high Potential, but the locations are not obvious.

Table 15 presents the results of the final model in terms of the distribution of sites and land in the various potential classes. The statistics are based on the model without the effect of known sites, which were added to the final maps as discussed above. The effect of these additions will be to increase the known sites that are in High Potential land to almost 100%, but this is not useful in terms of evaluating the model.

The results are as follows.

Table 15. Distribution of Sites, Survey Areas and Total Study Area by Potential Zones FINAL

Potential	Study Area km^2	%	Sites	%
Low	5570	43%	3	2%
Moderate	3532	27%	6	4%
Mod/High	2342	18%	19	14%
High	1390	11%	109	80%
River/Lakes	166	1%	0	0
Total	13000	100%	137	100%

Despite the changes in the model and the addition of variables, the results resemble those of the preliminary foundations. The number and percentage of sites in Low Potential remains the same, at 2%. Although the number of sites in Low Potential stays the same, the total area in Low Potential increases from 42% to 44% (including 1.3% in lakes and rivers, not separated in the preliminary model).

What is normally somewhat of a 'grey' area where management decisions are difficult, the Moderate Potential areas are refined from 36 % to 27%.

The amount of land in High Potential and Moderate High rises from 22% to 29%, and this change comes from an upgrade of Moderate Potential lands. The percentage of sites 'captured' in High Potential fell compared to the preliminary data, from 82% to 80%, whereas it is expected to rise with the increase in land area. The paradox is accounted for in a number of factors including clipping of data to the District; the addition of trail data, final identification of salmon variables, and visual queuing resulting from hillshade overlay.

The reduction in the number of 'captured' sites in High Potential lands comes from the restriction of the sites to the District area proper. Six sites previously included in the preliminary model database were eliminated in the final model sample because they are located outside the District Boundary.

Several factors account for the decrease in Moderate and increase in High Potential Lands: corrections of salmon model errors, addition of hillshade variable and addition of trail variables. All are typified by being underrepresented in the existing inventory so few new sites were added to the capture in the High Potential classes.

Tributaries of the Nass River were omitted in error in the preliminary configuration of the salmon model. The inclusion of these tributaries in the final model resulted in a substantial increase in Moderate High and High land area. The area of High Potential increased around these waterways because they were not longer 'simple water sources', but much more important salmon sources with subsequently wider buffers. Little archaeological work has been conducted along these rivers, resulting in a disproportionate site inventory.

Another contributor to the increase in land area in High Potential in the final model is the trail data. A large number of trails were mapped and, even with a relatively narrow buffer (200 m compared to 300 m in other Districts), this adds area that rises in potential rating. The trail data adds little to the known site capture rate, because so many of the trails go overland in areas where no archaeological survey has taken place. A database of sources used to determine the existence and location of trails is included as an appendix to allow for future interpretation of trail mapping (see Recommendations section).

The hillshade values highlighted areas of potential on the sample maps that were previously not apparent and unaccounted for in the original model. Inland ridges and prominent escarpment edges are added.

Final Version Logical Statements

```
/*==============================
/*** NO TRAILS OR SITES SECTION
/*==============================
/*******************************
/*** RESET POTENTIAL CLASSES
/*******************************
SELECT POTGRD_V9.VAT
CALCULATE Pot_add = 1
CALCULATE POT = 0
CALCULATE POT_AN = 0
CALCULATE POT_NOCULT = 0

&TYPE 'NOC1'
SELECT POTGRD_V9.VAT
RESELECT ( TIMBERLINE < 3 or STREAMSAL1 < 6 or LAKESAL1 < 6 or STREAMFISH < 5
OR LAKESAL2 < 5 or STREAMSAL2 < 5 or LAKELARGE < 5 or LAKEMED < 5 or LAKESMALL
< 3 or LAKEVS < 3 or STREAMOTHR < 3 )
/* REMOVED OR TRAIL < 4 )
ASELECT ( LAKESMALL < 4 or LAKEVS < 4 or STREAMOTHR < 4 ) and ( CEDAR = 1 or
HEMLOCK = 1 or SPRUCE = 1 or Lpine = 1 )
CALCULATE Pot_add = Pot_add + 1


&TYPE 'NOC2'
SELECT POTGRD_V9.VAT
RESELECT ( STREAMSAL1 < 4 or LAKESAL1 < 4 or STREAMFISH < 4 OR LAKESAL2 < 4 or
STREAMSAL2 < 4 or LAKELARGE < 4 or LAKEMED < 4 or LAKESMALL < 4 or LAKEVS < 4
or STREAMOTHR < 4 ) and ( CEDAR = 1 )
CALCULATE Pot_add = Pot_add + 1

/*&TYPE 'NOC3'
/*SELECT POTGRD_V9.VAT
/*RESELECT ( TRAIL < 4 )
/*CALCULATE Pot_add = Pot_add + 1

&TYPE 'NOC4'
SELECT POTGRD_V9.VAT
RESELECT ( STREAMSAL1 < 5 or LAKESAL1 < 5 )
CALCULATE Pot_add = Pot_add + 1

&TYPE 'NOC5'
SELECT POTGRD_V9.VAT
RESELECT ( STREAMSAL1 < 3 or LAKESAL1 < 3 or STREAMFISH < 3 OR LAKESAL2 < 3 or
STREAMSAL2 < 3 or LAKELARGE < 3 or LAKEMED < 3 )
CALCULATE Pot_add = Pot_add + 1

&TYPE 'NOC6'
SELECT POTGRD_V9.VAT
RESELECT ( ( STREAMSAL1 < 2 or LAKESAL1 < 2 or STREAMFISH < 2 OR LAKESAL2 < 2
or STREAMSAL2 < 2  or LAKELARGE < 2 or LAKEMED < 2 or LAKESMALL < 2 or LAKEVS
< 2 or STREAMOTHR < 2 ) and ( BIOGEO = 1 or BIOGEO = 3 or BIOGEO = 5 ) )
CALCULATE Pot_add = Pot_add + 1
```

```
/*zone = 'AT'/1 or zone = 'MH'/5 or zone = 'ESSF'/3

&TYPE 'NOC7'
SELECT POTGRD_V9.VAT
RESELECT ( OPENRANGE = 1 )
CALCULATE Pot_add = Pot_add + 1


/*==================================================================
/* ADDITIONAL CRITERIA CONSIDERING SLOPE AND HILLCLASS
/*==================================================================

&TYPE 'NOC8'
SELECT POTGRD_V9.VAT
RESELECT HILLCLASS = 5 AND SLOPE < 4 AND ( CURVATURE = 1 OR CEDAR = 1 OR
HEMLOCK = 1 OR SPRUCE = 1 OR LPINE = 1 ) AND ( BIOGEO = 1 OR BIOGEO = 3 OR
BIOGEO = 5 )
/** ADDED ( CURVATURE = 1 OR CEDAR = 1 OR HEMLOCK = 1 OR SPRUCE = 1 OR LPINE =
1 OR TRAIL < 4 )
/*** REMOVED TRAIL < 4 AS NO CULTURAL FEATURES ARE SUPPOSED TO INFLUENCE YET
CALCULATE POT_ADD = POT_ADD + 1

&TYPE 'NOC9'
SELECT POTGRD_V9.VAT
RESELECT HILLCLASS = 5 AND SLOPE < 3 AND ( CURVATURE = 1 OR CEDAR = 1 OR
HEMLOCK = 1 OR SPRUCE = 1 OR LPINE = 1 ) AND ( BIOGEO = 2 OR BIOGEO = 4 OR
BIOGEO = 6 )
/** ADDED ( CURVATURE = 1 OR CEDAR = 1 OR HEMLOCK = 1 OR SPRUCE = 1 OR LPINE =
1 OR TRAIL < 4 )
/*** REMOVED TRAIL < 4 AS NO CULTURAL FEATURES ARE SUPPOSED TO INFLUENCE YET
CALCULATE POT_ADD = POT_ADD + 1

&TYPE 'NOC10'
SELECT POTGRD_V9.VAT
RESELECT SLOPE > 3
CALCULATE POT_ADD = POT_ADD - 1

&TYPE 'NOC11'
SELECT POTGRD_V9.VAT
RESELECT SLOPE > 4
CALCULATE POT_ADD = POT_ADD - 1

&TYPE 'NOC12'
SELECT POTGRD_V9.VAT
RESELECT HILLCLASS < 4
CALCULATE POT_ADD = POT_ADD - 1
```

```
/*******************************
/*** CALCULATE THE NOCULT ITEM
/*******************************

&TYPE 'NOC13'
SELECT POTGRD_V9.VAT
RESELECT Pot_add < 2
CALCULATE POT_NOCULT = 1

&TYPE 'NOC14'
SELECT POTGRD_V9.VAT
RESELECT Pot_add = 2
CALCULATE POT_NOCULT = 2

&TYPE 'NOC15'
SELECT POTGRD_V9.VAT
RESELECT Pot_add = 3
CALCULATE POT_NOCULT = 3

&TYPE 'NOC16'
SELECT POTGRD_V9.VAT
RESELECT Pot_add > 3
CALCULATE POT_NOCULT = 4


/*====================================================
/*** TRAIL POTENTIAL SECTION (INCLUDING TRAILS / SITES)
/*====================================================

/*==================================================================
/* TRAIL POTENTIAL
/*==================================================================

/*** ADD ONE FOR TRAIL ONLY
&TYPE 'NOS1'
SELECT POTGRD_V9.VAT
RESELECT TRAIL < 4
/*RESELECT TRAIL < 4 AND POT_NOCULT < 2 AND KSITE = 0 AND KPOLY = 0
CALCULATE POT_ADD = POT_ADD + 1
/**** ASSUMES YOU NEED TRAILS AND A CULT

/*&TYPE 'NOS2'
/*SELECT POTGRD_V9.VAT
/*RESELECT TRAIL < 4 AND POT_NOCULT = 2 AND KSITE = 0 AND KPOLY = 0
/*CALCULATE POT_ADD = POT_ADD + 1

/**********************************
/*** CALCULATE THE POT_NOSITE ITEM
/**********************************
&TYPE 'NOS3'
SELECT POTGRD_V9.VAT
RESELECT Pot_add < 2
CALCULATE POT_NOSITE = 1

&TYPE 'NOS4'
SELECT POTGRD_V9.VAT
RESELECT Pot_add = 2
```

```
CALCULATE POT_NOSITE = 2

&TYPE 'NOS5'
SELECT POTGRD_V9.VAT
RESELECT Pot_add = 3
CALCULATE POT_NOSITE = 3

&TYPE 'NOS6'
SELECT POTGRD_V9.VAT
RESELECT Pot_add > 3
CALCULATE POT_NOSITE = 4


/*===================================================================
/* SITES EUC DISTANCES BUFFER ADD 2
/*===================================================================

&TYPE 'POT1'
SELECT POTGRD_V9.VAT
RESELECT KSITE = 1 OR KPOLY = 1
CALCULATE POT_ADD = POT_ADD + 2


/*******************************
/*** CALCULATE THE POT ITEM
/*******************************

&TYPE 'POT=1'
SELECT POTGRD_V9.VAT
RESELECT Pot_add < 2
CALCULATE POT = 1

&TYPE 'POT=2'
SELECT POTGRD_V9.VAT
RESELECT Pot_add = 2
CALCULATE POT = 2

&TYPE 'POT=3'
SELECT POTGRD_V9.VAT
RESELECT Pot_add = 3
CALCULATE POT = 3

&TYPE 'POT=4'
SELECT POTGRD_V9.VAT
RESELECT Pot_add > 3
CALCULATE POT = 4

/* SITE POLYS WITH NO EUC DISTANCE BUFFERS ARE ALWAYS HIGH
&TYPE 'POT2'
SELECT POTGRD_V9.VAT
RESELECT KPOLYIN = 1
CALCULATE POT = 4
```

```
/*======================================
/* CONSIDER THE POLY WATER FOR ANALYSIS
/*======================================

&TYPE 'POLY WATER...'

SELECT POTGRD_V9.VAT
CALCULATE POT_AN = POT

SELECT POTGRD_V9.VAT
RESELECT LAKE_ <> 0 AND LAKE_ <> 9
CALCULATE POT_AN = 9
CALCULATE POT_NOCULT = 9
CALCULATE POT_NOSITE = 9


SELECT POTGRD_V9.VAT
RESELECT RIVER_ <> 0 AND RIVER_ <> 9
CALCULATE POT_AN = 8
CALCULATE POT_NOCULT = 8
CALCULATE POT_NOSITE = 8


/*======================================
/* POTENTIAL CLASS LIST
/*======================================

/* 1 - LOW POTENTIAL
/* 2 - MODERATE POTENTIAL
/* 3 - MODERATE TO HIGH POTENTIAL
/* 4 - HIGH POTENTIAL
/* 8 - RIVER
/* 9 - LAKE
```

RECOMMENDATIONS

The recommendations generated by the Kispiox AOA are organized in two categories. The first is specific to the use of the potential maps in operational planning and to the level of archaeological effort required for potential zones. The second category addresses ways in which the model can be improved and provides guidelines for its re-evaluation.

Potential Zones and Operational Planning

As a first step for forestry users, the five-year development plan or other mapping should be checked for meeting Ministry topological standards (especially closed polygons) and overlain with the archaeological potential maps. A GIS can then determine the number of hectares of each potential class within each block or development.

The Level of Effort appropriate for archaeological study should be negotiated between First Nations, the Archaeology Branch, and the MoF. The District Manager has the final authority to determine the appropriate level of effort. However, as a guideline, the following recommendations are offered for the various potential areas. The guidelines assume that a cutblock or other development encompasses a variety of potential areas.

Levels of Effort

The following are definitions of level of effort.

Archaeological Impact Assessment (AIA). AIAs follow the provincial guidelines for archaeological impact assessment (Archaeology Branch 1995). High Potential areas are surveyed using relatively closely spaced traverses in order to observe all, or almost all, the land in the High Potential area subject to possible impacts. Shovel tests are excavated at regular spaced intervals, supplemented by judgemental shovel tests where surface exposures are limited and where field observations confirm the High Potential assessment. This work requires a Section 12 permit under the *Heritage Conservation Act*.

Detailed Reconnaissance (Detailed Recce). Detailed reconnaissance is similar to an AIA, but the traverses will be wider spaced and shovel testing will be less intensive. Shovel testing may be restricted to small local areas judged in the field to have relatively high potential during fieldwork. This work requires a Section 12 permit under the *Heritage Conservation Act* whenever shovel testing or increment coring of CMTs is conducted.

Cursory Reconnaissance (Cursory Recce). Cursory reconnaissance is a quick field inspection by an archaeologist, involving a walk through areas of potential. A block will be crossed sufficient times (sampling within major environmental types present for microtopographical features with archaeological potential) to judge whether further fieldwork is necessary. This work does not require a Section 12 permit under the *Heritage Conservation Act.* However, it is advisable to conduct the work under permit. Often, small areas of relatively high potential can be quickly checked to an AIA level if a permit is in place.

No Further Work (NFW). No further work means that the potential for impacting archaeological sites is so low that further archaeological study is thought to be unwarranted. However, if CMTs or other suspected archaeological remains are found in the block, an archaeologist should conduct a cursory reconnaissance to ensure that the remains are indeed archaeological, and an appropriate level of work should be defined at that point. Note that the *Forest Practices Code* Section 51 requires that operations cease that could endanger archaeological remains that have been unexpectedly encountered.

Traditional Use information available for the area should be assessed to determine if physical remains of the use may be present, and, if so, a minimum of a Cursory Recce may be necessary.

Developments Overlapping Several Potential Zones

In most cases, especially when cutblocks are designed without archaeological consideration, developments will span several different potential zones. It will often not be necessary to complete a full impact assessment of the entire development.

Table 16. Recommended Levels of Work.

Highest Potential Level in Development ↓	Adjacent Potential Level (in or out of development) ↓			
	High	Moderate-High	Moderate	Low
High	AIA Recommended	AIA Recommended	AIA Recommended	AIA Recommended
Moderate-High	AIA or Detailed Recce Recommended	AIA or Detailed Recce Recommended	Detailed Recce Recommended	Detailed Recce Recommended
Moderate	Cursory Recce	Cursory Recce	Cursory Recce	Cursory Recce
Low	Cursory Recce	NFW	NFW	NFW

Developments within High Potential areas and Moderate-High areas both run a serious risk of damaging archaeological sites. Some 94% of the known sites occur in the 29% of the land in these two classes. High Potential areas will usually have greater site density, and therefore can be expected to require more intensive work to deal with inventory and assessment compared to Moderate-High Potential areas. For developments that have even a very small amount of **High Potential**, an AIA should be completed. However, in many cases, this High Potential will be distributed in a very thin sliver along the edge of a cutblock. In this situation, the cutblock will usually also contain areas of Moderate-High and Moderate Potential. In effect, the "AIA" that is conducted in this situation would be a Detailed Reconnaissance survey, with the area of High Potential walked through (shovel testing as required), with a return traverse through the Moderate-High or Moderate Potential working at Detailed Recce level. The study would expand to full AIA of these lower potential zones if archaeological concerns are identified in the initial passes.

Where no High Potential exists, but **Moderate-High** occurs, some flexibility is necessary. If the area of Moderate-High exceeds about 2ha, then an AIA or Detailed Recce of that part of the block, with inspection of Moderate Potential lands adjacent to the Moderate-High, should be conducted under permit. If the area of Moderate-High is less than 2ha, the block should be assessed by an archaeologist with a minimum of a Cursory Recce that includes the area of Moderate High Potential. The archaeologists should review the values of variables contributing to the potential (access to the database connected to the potential map will be necessary for this step. See below for further discussion.)

Where no High or Moderate-High exists, but **Moderate** Potential occurs with low, the block should be subject to a Cursory Recce. The archaeologist should examine the variables contributing to the Moderate Potential (access to the database connected to the potential map will be necessary for this step). Moderate Potential presents the greatest challenge to archaeological management. This is because although only 4% of the known sites lie in Moderate Potential we suspect, from recent fieldwork conducted by Millennia Research Ltd. and IR Wilson Consulting Ltd, that previous site inventories underestimate the number of sites in these areas. CMTs are badly underrepresented in the existing inventory, and we anticipate many more of these will be found in Moderate Potential. Sites in Moderate Potential can have individually high significance. Moderate Potential **all** has something about it that leads to a potential that sites could be present. Significant ridges and prominences are often in this class, and are often completely surrounded by Low Potential. Such areas should receive special attention (a minimum of a Cursory Recce) until data gaps in the present inventory narrow to insignificant levels.

Low Potential: Sites occur infrequently in these areas, with 2% of known sites in Low Potential areas, which form 43% of the land area. Archaeological sites in these areas are often associated with trails, wagon roads, or Traditional Use Sites. Trails were the only features included in the present model, since no database of Traditional Use sites is available. Undoubtedly additional aboriginal trails exist that are not included in the present mapping. First Nations and the MoF should determine the appropriate level of effort for further archaeological work in Low Potential areas. In cases where Low Potential borders High or Moderate High Potential land, it should be subject to Cursory Reconnaissance. Often, this can be done during access to the higher potential parts of the blocks. Otherwise, visual inspection from within the higher potential areas should be adequate to determine if additional survey is needed within the Low Potential.

Also, see the cautionary notes above regarding No Further Work.

CMTs

The model did not try and discriminate between potential for CMTs and potential for other site types. There are several reasons for doing this. Primarily, this is because CMTs appear to generally co-occur with other site types, and so a single model represents all site types reasonably well. This corroborated observations Millennia staff have made in the Southern Interior, where it seems CMTs often co-occur with other site types. If two or more models had been used, it also would have created unnecessary complexity in the presentation and interpretation of the map.

CMTs, even those post-dating 1846 and therefore not automatically protected under the *Heritage Conservation Act*, should be recorded in the Provincial Heritage Registry Database, and their presence should indicate the potential for other archaeological sites, and therefore the need for archaeological field inspection. CMTs post-dating 1846 may be regarded as scientifically or historically significant, and therefore must be inventoried and managed according to the *Forest Practices Code*. The Ministry of Forests also assumes that CMTs indicate the presence of Aboriginal Rights protected under the Canadian Constitution. More information regarding significance assessment and management of CMTs is available through the Ministry of Forests Vancouver Region (Eldridge 1997).

Trails

Review of the trail data as it is presented here may clarify the nature of some trails. As discussed previously, trail information was gathered from variable sources (see Appendix 3). While most trail origins are clear and have multiple corroborative sources, there may be those with sources that are in conflict. Use of the database to identify trail specifics (source and plot accuracy) combined with local knowledge is recommended to identify factors that contribute to potential areas with plotted trails. Local information may indicate non-aboriginal use of a trail, or in other instances, fieldwork may indicate trails are not plotted correctly. In such cases, the local ratings could be downgraded *by the values of the trail variables*. This would in turn affect the resulting score and might affect the potential rating.

Note that if other particular variables are present, the score would continue to be high, and a downgrading of potential rating should not be automatic. Also note that any historic remains may be significant and require managing impacts, although these sites are not automatically protected under the *Heritage Conservation Act*.

Notes regarding Using the Database Variables.

When reviewing areas of potential (particularly Moderate Potential), reviewers should consider the variable or variables that led to the score. Some locations may have scored only Moderate Potential because of single variables, but may be just outside the buffer limit of other variables, such as nearness to a fish-bearing lake. Such locations can reasonably be expected to actually have High Potential (i.e., had they been situated just a few metres closer to the lake, the location would have scored Moderate-High or High Potential). Some features, such as local high points (ridgetop variable) should receive special attention until sufficient surveys have taken place in such areas to determine site density in these places.

Using Maps in Combination with Hillshading to Fine-tune Potential Assessment

The potential maps include an inset of the hillshade model for that mapsheet. The hillshade model provides a 3-dimensional appearance for the map and allows a rapid assessment of slope and, more importantly, geographical features. The full-resolution 10-m hillshade DEM is available on disk for large-scale assessment of specific areas. The hillshade model allows for some very exciting interpretation of palaeolandforms. It should be used in tandem with the potential map. Paradoxically, patches of **lower** potential that occur **within High Potential** are indications of special geographic features that indicate nearby **particularly high potential.** For instance, map 93M/042 shows a crescent of lower potential in a High Potential zone. The model reduces the potential along this curve due to local steep slopes. Examining the hillshade values for the same area shows that the crescent is, in fact, the steep banks of an old river channel, forming a feature known as an oxbow (see Figure 6). The top of this bank is probably an area of particularly high archaeological potential, as it was once directly on the riverbank, perhaps hundreds or thousands of years ago, even though it is now hundreds of metres from the water. It should receive special attention during an AIA.

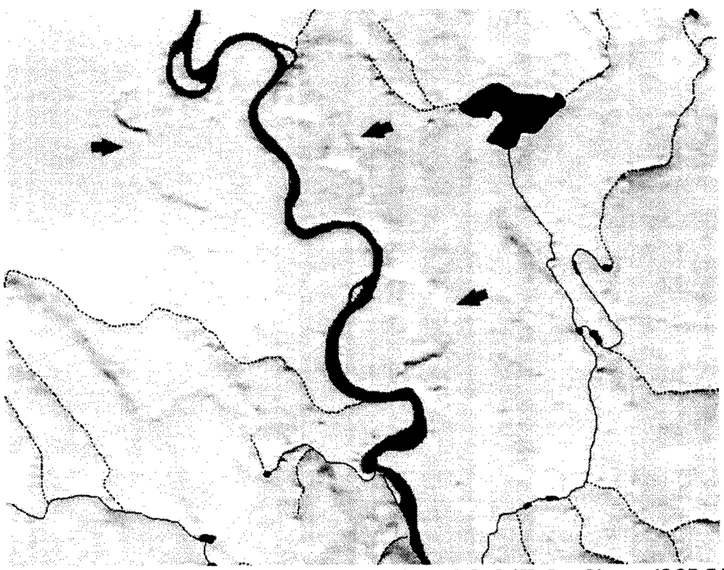


Figure 6. Oxbow features visible with hillshading, (93M/042).

In a different case, a line of lower potential indicates a steep bluff above a lake. The top of this bluff may have especially high potential for lithic scatters associated with lookout sites, while the base of the bluff would be a place to expect pictographs.

In a third example, small patches of Moderate-high Potential exist above Kitwancool Lake lakeshore that is otherwise High Potential. No pattern is obvious, however, until the hillshade inset of the same area is examined. This shows a series of palaeo-lakeshores parallel to the lakeshore (Figure 7). These are nearly continuous, but only in places are the scarps between the terraces steep enough to affect potential. These ancient lakeshores would be prime candidates for having sites dating to initial post-glacial occupation.

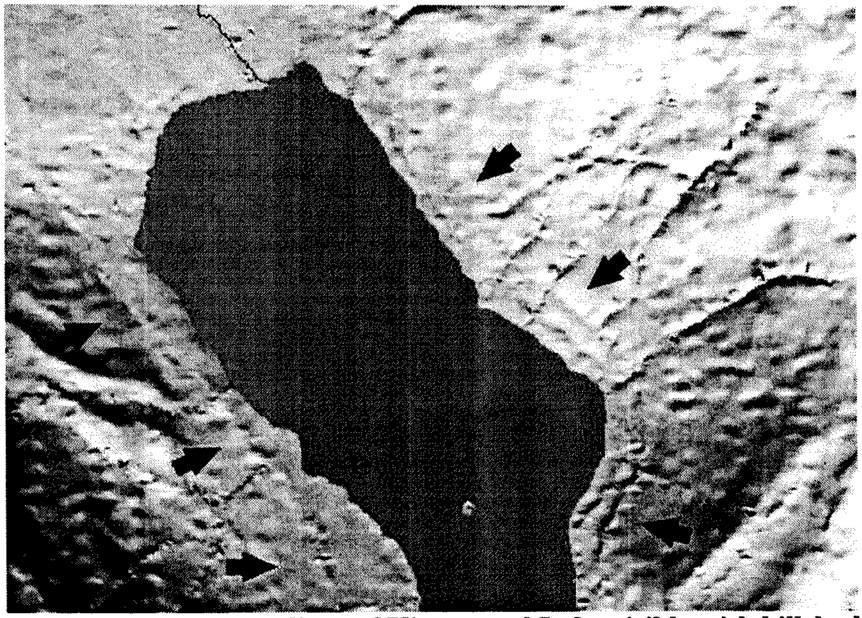


Figure 7. Palaeoshorelines of Kitwancool Lake visible with hillshade layer

Future Revisions

The model should be re-examined after one or two years to assess its accuracy and usefulness. At the same time, the database upon which it is evaluated should be updated with information from subsequent AIA and AIS survey, and TUS information, as it becomes available. Thereafter, every 5 to 10 years should be an adequate interval for determining whether an update is needed. One year of use should determine if it is appropriate to make immediate adjustments to the model itself, or to the table of recommended levels of work, or if certain map situations should be interpreted differently. It is likely that variable combinations can be identified that can dramatically decrease or increase the amount of land in various potential classes. Any revisions to the model should include the expert opinion of an archaeologist. As part of any revision, the database should be queried with revised parameters to determine the effect of buffer changes on the model's accuracy.

Major data gaps remain in the Kispiox Forest District. The sample of archaeological sites on which the model was built is very small and is heavily biased towards the major valleys. Archaeological Inventory Surveys (AIS), funded under FRBC, can be used to gather data to improve and refine the predictive model developed for the KFD. AISs provide data useful for refining the model, especially in terms of examining what are currently thought to be "Low Potential" areas, which are not normally subject to AIA.

AISs should focus initially on poorly known areas, as identified in the 'Data Gaps' section of this report and should include a sample of Low Potential areas. This can serve as a check on the accuracy of the predictive model, ensuring that the model is not missing large numbers of sites in Low Potential areas. If large numbers of sites are found in Low Potential areas, then it will be necessary to return to the modelling stage and (1) conduct an analysis of potential problem variables and analytical methods, and (2) identify ways to improve the model.

Forestry AIAs are only now becoming commonplace and little of this data could be incorporated into the present model. Future AIAs and AIS survey will quickly produce a much larger sample of sites, especially CMTs. Similar to other interior forest districts (e.g., Eldridge, et al. 1998), CMTs appear to be seriously underreported in previous archaeological investigations conducted in the study area. Recent fieldwork, conducted too late to be included in the modelling, is showing very high densities of CMTs in various parts of the study area, with CMT sites extending past present buffer distances from main rivers into Low Potential zones. Particular attention should be paid to the 'Evaluation of Research' components of AIA and AIS studies to ensure that CMT locations are accurately predicted by the model.

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LIST OF APPENDICES

Appendix 1. Variables

Variables used for analysis

variable	description	unit of measure
ecosection	ecosection in which the point is located	
zone	biogeoclimatic zone in which the point is located	
subzone	biogeoclimatic subzone in which the point is located	
ecotone	nearness to biogeoclimatic zone boundary	meters
timberline	nearness to alpine tundra	meters
esker	nearness to eskers	meters
icefield	nearness to icefield-glacier (won't want if all alpine)	metres
lakevs	nearness to size class 1 lakes (< 5ha)	meters
lakesmall	nearness to size class 2 lakes (5ha < 100ha)	meters
lakemed	nearness to size class 3 lakes (100ha < 1000ha)	meters
lakelarge	nearness to size class 4 lakes (1000+ ha)	metres
lakesalm	nearness to a lake on a salmon run	meters
meltlarge	nearness to meltwater areas (polys)	meters
meltsmall	nearness to meltwater lines	meters
rapids	nearness to rapids	meters
wetsmall	nearness to size class 1 wetlands (< 5ha) (include intermittent indefinate lakes)	meters
wetlarge	nearness to size class 2 wetlands (> 5ha) (include intermittent indefinate lakes)	meters
in_wet	identifies whether a point falls within a wetland	
streamsalm	nearness to double line streams of greater than order 3 or order 3 with a magnitude of 25 or greater	meters
streamfish	nearness to single line streams of greater than order 3 or order 3 with a magnitude of 25 or greater	meters
streamothe	nearness to any stream not in above cutoffs	meters
nearwater	nearness to any water feature (excluding wetlands)	meters
nearfish	nearness to streamsalm, lakesalm, streamfish, lakelarge or lakemed	meters
nearsalm	nearness to streamsalm or lakesalm	meters
trails	nearness to identified trails	meters
sites	nearness to identified sites	meters
lpine_id	identifies whether point is within lodgepole pine forest coverage	
lpine_perc	proportion of lodgepole pine in forest coverage	percent
Cedar_id	identifies whether point is within cedar forest coverage	
Cedar_perc	proportion of cedar in forest coverage	percent
Heml_id	identifies whether point is within hemlock forest coverage	
Heml_perc	proportion of hemlock in forest coverage	percent
Spruc_id	identifies whether point is within spruce forest coverage	
Spruc_perc	proportion of spruce in forest coverage	percent
ageclass	ageclass of forest coverage	

htclass	height class of forest coverage	
slope*	slope	% from TIN
aspect*	aspect	degrees
elevation*	elevation	meters

* these values were only collected for sites.

Open range was used in the predictive model although no near analysis was performed. Lakes and streams with salmon in them were based on the salmon model developed by Range and Bearing in the GIS model.

Site Typology

Site types as defined for modeling purposes. Feature components of sites were extracted from CHIN/ ZTYI field supplemented by data from original paper B.C. Site Inventory Forms. Each field is a logical present/absent database field. Original ZTYI and Archaeology Branch typology were maintained in a text field.

Field names are relatively short and mnemonic, but may incorporate several different feature types names. The advantage of an easily remembered short field name comes in working with the database later, when it becomes very easy to select sites through a command such as 'set filter to lithic or housepit' to select all cultural material, surface, lithic and/or habitation, depression sites. The following table provides field names, and the corresponding Archaeology Branch typology.

Field Name	Corresponding Archaeology Branch typology
lithic	cultural material, surface [or subsurface], lithics [or bone or FCR if other site type not identified]. Include cultural material, surface, isolated, lithic
quarry	cultural material, surface [or subsurface], lithics, quarry
housepit	habitation, depression, circular [rectangular], or cultural depression [over 4m diameter unless a different site feature type is specified or inferred, such as large root roasting pits]
cave	habitation, rockshelter [cave]
habitat	habitation, other [not to include historic features such as cabins]
subsist	subsistence depressions where function not specified [such as all cultural depressions less than 4m diameter only recorded as 'cultural depression']
cache	subsistence feature, depression, cache; or historic, subsistence feature, cache
roast	subsistence feature, depression, roasting pit [cooking pit, etc.]
hunt	subsistence feature, land mammal [or depression] [pitfall or deadfall or blind or drive lane or deer/Caribou fence or corral, etc.]. Also check for Petroform, rock alignment [or cairn] related to hunting; and Historic, subsistence feature [aboriginal hunting related]
fish	subsistence feature, fish, [trap or weir or drying rack or smokehouse or fishing station, etc. Also check Historic, subsistence, etc.]
subsothr	other subsistence features, including trapping [not including large animal hunting pitfall or deadfall traps, which should go under hunting]
trail	Trail [or Earthwork, trail].
burial	Human Remains [burial, or cairn, talus, etc.]. Also check for aboriginal burial places in 'Historic, Human Remains'.
rockart	Pictograph; Petroglyph
cmt	Cultural Material, surface, culturally modified tree [also just modified tree, without the 'culturally']; also try Subsistence Feature, culturally modified tree; and zfe features field from CHIN
historic	anything with 'historic' as string header, without any other prehistoric site types or other exceptions noted above. Do not include for sites with both prehistoric and historic components, or it will be very difficult to exclude historic only sites from analysis of all prehistoric sites
other	anything not covered by any of the above categories. Might include such things as Traditional Use Sites without associated archaeological remains but already assigned Borden Numbers and in the Archaeological Inventory.

Appendix 3. Source codes for Trails database

Table 17. Source maps for Trails

Source Code	Map description
1	Hazelton Sheet. Department of National Defence 1942. From the Provincial Archives.
2	Department of Mines and Resources Geological Survey, Mines and topography Branch (1944) Showing Hazelton and north of Hazelton.
3	New Kitsegukla Reserve Plan (n.d.) From Provincial Archives
4	The Strategic Watershed Analysis Team, SWAT, in Hazelton provided information on trail locations in general. Permission to the use of a map of a foot trail from Gisgea'as up Shedin Creek. Ground truthed 1996-7
5	Map titled *Map of Telegraph Trail Hazelton to Naas*. Scale reduced from original, (n.d.)
6	Nation, H. T. (1911) Map titled *Sketch Map showing portions of Skeena, Stikine, and Omineca Mining Divisions*.
7	Bureau of Mines, B.C. (early ed.) NTS Mapsheet 103 P/9 West Half with Cranberry and Kispiox Trails
8	NTS mapsheet (1st ed.) (1955) 103P/9 East Half Kispiox River
9	Department of Lands BC (1922) Map titled *Pre-emptor Map Bulkley Sheet*. Scale 1 Inch: 3 Miles (reduced) Province of B.C.
10	Hudson Bay Co. (1868) "Sketch Showing Position of Trails from Hazelton to Omineca"
11	MacDonald and Cove (1987) trail map of North Coast Tsimshian
12	MacDonald and Cove (1987) Trading trails in the Northern Interior
13	British Columbia Forest Service Map titled *Kispiox Forest District Recreation Map*. Scale 1:250 000. Ministry of Forests.
14	Provincial Bureau of Information (1912) Map titled *Map of Northern Interior of British Columbia*. Scale 1inch: 20 miles. .
15	Maps and description from Maureen Cassidy's (1984) From Mountain to Mountain: A history of Gitksan Village of Ans'payaxw, page 6, page 30
16	NTS mapsheet (early edition) 103P /16 photocopy from the Archaeology Branch
17	B.C. Department of Mines (1915). Pre-emptors Map, Bulkley Sheet
18	B.C. Department of Mines. (1924) 2nd ed. Blue Print of Nass, Kispiox Rivers and Kuldo Creek. Province of B.C., Victoria. Surveyor-General Map titled *Pre-emptor's Map Bulkley Sheet 103P/NE*. Scale 1 inch: 3 miles (reduced) .
19	Province of B.C., Victoria, B.C. (1928) Blue Print of 93M/NW.
20	Province of B.C., Victoria, B.C. (Obsolete 1923) Blue Print of 93M/NW Skeena, Suskwa River.
21	Province of B.C., Victoria, B.C. (1923) Blue Print of 93M/SW. Kispiox River.
22	Province of B.C. (Obsolete 1923) Blue print of the Bulkley: Moricetown to Suskwa River. 93M/SW
23	Surveyor General (n.d.) Telegraph Trail TP1A to Hazelton, Victoria, B.C.
24	Skinner, E. M. (1899). Plan No. 2 of the Hazelton Indian Reserves Hagwilget and Ksoo Gun Ya. For Province of B.C.
25	Skinner, E. M. (1899). Plan No. 1 of the Hazelton Indian Reserves Gitanmaax. For Province of B.C.
26	Skinner, E. M. (1901) Map titled *Kispaiax IR*. Province of B.C.
	continued

27	Skinner, E. M. (1899) Map titled *Hagwilget IRs*. Province of B.C.
28	Skinner, E. M. (1900) Map titled *Kitseguecla IR #1 IR #2*. Province of B.C.
29	Skinner, E. M. (1898) Map titled *Kuldoe IR*. Province of B.C.
30	Skinner, Kit Sum Kay Lum Reserve, outside of study area
31	Skinner, E. M. (1901) Map titled *Kitselas IR*. Province of B.C.
32	Skinner, E. M. (1898). Kisgegas IRs. Province of B.C.
33	Skinner, E. M. (1900) Map titled *Kitwangar No. 1*. Province of B.C.
34	Surveyor General (n.d.) Detail of 104A/ SE Brown River Trail and YTT
35	Surveyor General (n.d.) Detail of 104A/East half F.B. 630/30 Survey triangulation

Table 18. Accuracy plots for trails to be used in conjunction with Database

Trail	Accuracy	Source Code	Comments
1	T	9	Map 103 I/088, I/089
2	T	9	Map 103 I/088, I/089
3	T	9	Map 103 I/089
4	T	11,12, 2	Map 103 I/088, I/089, /098, 103 P/010, 93 M/001, M/011, M/012
5	T	17	103 I/099
6	T	9	103 I/099
7	T	103 P /009	
8	*	13	trail location accurate, but is FS Trail
9	T	103 P /009	network
10	T	103 P /009	network
11	T	103 P /009	network
12	T	20	fork
13	T	20	fork
14	T	20	fork
15	T	17	103 P/010
16	T	9	103 P/010
17	T	33	
18	T	33	103 P/010
19	T	33	103 P/010
20	T	20	103 P/010, possibly connects with 5, All south of Skeena
21	T	9	103 P/010 93M /001
22	T	33	
23	T	20	103 P/010, P/020 P/011
24	T	33	103 P/020
25	T	33	103 P/020
26	T	14, 7, 9, 20, 17	103 P/020, P/030, P/040. SF GiTc-H2, GjTb-1, -2,
27	T	20	
28	T	9, 20	Note approx. Location Loop
29	*	13	103 P/020, FS TRAIL
30	T	20	103 P/030
31	T	20	103 P/040
32	T	103 P/040	103 P/040

Trail	Accuracy	Source Code	Comments
33	T	Siteform, GhTa-4	
34	T	103 P/040	103 P/040
35		20	103 P/040
36	T	103 P/040	103 P/040
37	T	103 P/040	103 P/040
38	A		TO JOIN CABINS?
39	T	20	93 M/001
40	T	28	93 M/001
41	T	9, 20	93 M/001, M/004, M/012
42	A		93 M/001
43	T	28	93 M/001, M/002
44	T	20	93 M/002
45	T	20	93 M/002
46	A		93 M/002
47	*	13	93 M/002
48	T	20	93 M/001, M/011
49	T	28	93 M/011
50	T	20	93 M/011
51	A		93 M/011
52	T	20	93 M/012
53	T	28	93 M/012, M/011
54	T	20	
55	T	6	93 M/012
56	A		93 M/012
57	T	28	93 M/012
58	A		93 M/012
59	T	3, 28, 20	93 M/012
60	A		93 M/012
61	T	1	93 M/012
62	T	1	93 M/012
63	T	1	93 M/012
64	T	1	93 M/012
65	T	1	93 M/012
66	T	1	93 M/012
67	T	1	93 M/012
68	T	1	93 M/012
69	T	1	93 M/012
70	T	20	93 M/012
71	T	20	93 M/012, M/022
72	T	20	93 M/012
73	T	20	93 M/022
74	T	20	93 M/022
75	T	23	93 M/022
76	T	23	93 M/022
77	A	27, 1, 20	93 M/022
78	T	23, 20	93 M/022
79	T	24	TELEGRAPH TRAIL'

Trail	Accuracy	Source Code	Comments
80	T	24, 23	93 M/022
81	T	23	93 M/022
82	T	20	93 M/022
83	T	23, 24	93 M/022
84	T	24	93 M/022
85	T	9, 2	93 M/022
86	T	24	93 M/022
87	T	23	93 M/022
88	T	1	93 M/022
89	T	23	93 M/022
90	T	2, 15	93 M/022, M/032
91	T	2	93 M/022
92	T	2	93 M/022
93	T	24	93 M/022
94	T	1	93 M/022
95	T	20	93 M/022
96	T	23, 25	93 M/022
97	T	1	93 M/022
98	T	1	93 M/022
99	T	23	93 M/022
100	T	25	93 M/022
101	T	23	93 M/022
102	T	23, 20	93 M/022
103	T	2	ADDITIONAL SOURCES
104	T	23	
105	T	1	93 M/022, M/033
106	T	1, 11, 12, 2	TELEGRAPH? CONNECTS WITH 4 ON UPPER KISPIOX R.
107	T	26, 23	
108	T	23	93 M/033
109	T	17, 9	93 M/033
110	T	21	93 M/033
111	T	6	93 M/033
112	T	9	93 M/033
113	T	11, 12, 4, 14, 21, 2, 9, 23, 19, 17	93 M/033, /042, /043, /062, /072, /073
114	T	20	93 M/033, /043, /042
115	T	21	93 M/033
116	T	9, GiSw-12, -13, GiSv-1-4, -10	93 M/033
117	T	23	93 M/033
118	T	2, 8, 7, 18, 19, 20, 23, 103 P/15 1st ed.	93 M/033, /042, /051, /052, 103 P/060, P/069, P/087, P/088
119	T	26	93 M/033
120	T	26	93 M/033

Trail	Accuracy	Source Code	Comments
121	T	20 Siteform maps	GiSw-12, -13; GiSv-1-4, -10
122	T	20 Siteform maps	GiSw-12, -13; GiSv-1-4, -10
123	T	Siteform maps	GiSw-12, -13; GiSv-1-4, -10
124	T	Siteform maps	93 M/032, M/052 GiSv-5-8,
125	T	9, 11,12	93 M/032
126	T	20	93 M/032
127	T	2, 20	93 M/042
128	T	9	93 M/042
129	T	20	93 M/042
130	T	20	93 M/042
131	T	20	93 M/042
132	T	2	93 M/042
133	T	11, 12	93 M/041, /042, 103 P/050, P/049, P/059
134	T	13, 23	93 M/022, M/023
135	T	9, 1	93 M/023, M/033
136	T	1	93 M/022
137	T	14, GhSu-2 Siteform	
138	T	1, 14, 27	93 M/013, M/023
139	T	11, 12, 27	
140	T	23	93 M/023
141	T	22, 23	93 M/023
142	T	1	93 M/023
143	T	1	93 M/023
144	T	1	93 M/023
145	T	1	93 M/023
146	T	1	93 M/023
147	T	1	93 M/023
148	T	1, 9, 13	93 M/023, M/013
149	P	93M/022	93 M/022
150	T	13	93 M/033, M/043
151	T	13	93 M/033
152	T	1	93 M/033
153	T	21,9, 22, 1, 2, 6, 10, 14	93 M/023, M/036
154	T	9	93 M/024, M/034, M/035
155	*	13	93 M/035
156	T	2	93 M/035, M/036
157	T	2	93 M/035
158	T	3	93 M/035, /036
159	T	23	93 M/014
160	T	27, 14, 1	93 M/023
161	T	9	93 M/052
162	T	11, 12	93 M/062
163	T	11,12, 2	93 M/051,/061, /071

Trail	Accuracy	Source Code	Comments
164	T	20	93 M/051
165	T	19, 20	93 M/051
166	T	19, 20	103 P/060
167	T	18, 19, 20	103 P/060
168	A	19	103 P/060,P/070
169	T	19	103 P/070, P/080
170	T	19, 20	103 P/070
171	P	8	103 P/070, /080
172	P	18, 16	103 P/070, /080
173	T	19, 20	103 P/069
174	T	7	103 P/069
175	T	7	103 P/069
176	T	7, 6, Siteform GiTe-3	103 P/068, P/056, P/057
177	A		Trail from GreasEtrail Lake
178	A		Permit Report, GiSx-3, aborgraph, Kispiox to Sweetin
179	T	18, 103 P/15 2nd ed.	103 P/078
180	T	13, Siteform GiSx-3	93 M/041, Moolit Trail
181	P	93 M/13 1st ed	93 M/071, M/081, Permit IRW 1994-39
182	P	Site Maps	IRW permit 1994-39
183	T	29, 19, 32	Kuldo-Kisgegas, M/082, M/072, M/081
184	P	93 M13	93 M/081
185	P	35	104 A/2, A/10, 94 D1,
186	T	6, 7, Siteforms	GkSw-1
187	T	Permit 1995-120	93 M/072
188	T	12	93 M/072
189	T	32	93 M/072
190	T	4	93 M/072
191	T	32	93 M/072
192	T	4	93 M/072
193	T	32	93 M/072
194	T	4	93 M/072
195	T	32	93 M/072
196	T	32	93 M/072
197	T	2, 14, 13	93 M/072, M/075, M/085
198	T	93 M/11 2nd ed	93 M/063
199	T	93 M/11 2nd ed	93 M/063
200	T	93 M/11 2nd ed	93 M/063
201	T	93 M/11 2nd ed	93 M/063
202	T	103 P/046	
203	T	103 P/046	
204	T	Siteforms GiTe-4, -5, -6, GiTf-1	On Nass, 103 P/046, P/056, P/057, P/067, Siteform GiTf-3
205	T	GiTf-4	
206	T	11, 12	103 P/057, P/067

Trail	Accuracy	Source Code	Comments
207	T	6	103 P/057, P/067
208	T	GiTe-2	103 P/057
209	T	6, GiTe-2	
210	T	6, GiTe-1, -2	North, Northeast
211	A	6	103 P/057, P/067