# Evaluation Of A Public Participatory GIS Tool Within A Public Planning Case Study

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## Abstract

The purpose of Public Participatory Geographic Information Systems (PPGIS) is to use the practices of GIS and mapping to promote knowledge production and efficient decision-making. PPGIS has the ability to empower potentially marginalized populations, who have limited ability to express themselves in the public arena, using geographic technology education and participation. PPGIS is being increasingly recognized as a valuable method for gathering public knowledge and opinions.

This study evaluates the usefulness of a PPGIS tool compared with a traditional participatory method in an environmental planning case study within north-western British Columbia (BC), Canada. Attitudes of lay public and expert planners were surveyed on the usefulness of the PPGIS tool and paper PP (Public Participation) method. The results of this study suggest that the PPGIS tool has the ability to be used, in certain situations, as a means of providing and collecting public information. However, its use is limited for certain public groups as it requires a certain level of computer literacy and technological infrastructure. As a result, the simplicity and familiarity of traditional participatory methods need to be integrated with GIS-based participatory methods.

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## List of Acronyms

| | |
|---|---|
| BVCRB | Bulkley Valley Community Resources Board |
| CBO | Community-based Organization |
| EAST2 | Enhanced Adaptive Structuration Theory 2 |
| GEOIDE | Geomatics for Informed Decisions |
| GIS | Geographic Information Systems |
| GIT | Geographic Information Technologies |
| HCI | Human-Computer Interaction |
| ILMB | Integrated Land Management Bureau |
| LRMP | Lands and Resources Management Plan |
| MCDM | Multicriteria Decision Model |
| PGIS | Participatory Geographic Information Systems |
| PLA | Participatory Learning and Action |
| PPGIS | Public Participatory Geographic Information Systems |
| OCP | Official Community Plan |
| RAMP | Recreational Access and Management Plan |
| RDBN | Regional District of Bulkley-Nechako |
| RRA | Rapid Rural Appraisal |
| SRMP | Sustainable Resource Management Plan |

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# Chapter 1: Introduction

## 1.1 Rationale

As computers become more commonplace, digital mapping tools are finding their way into many aspects of life. Nyerges *et al.* (2002) outline the use of GIS (Geographic Information Systems) to assist in data-gathering strategies in public planning processes. They suggest that GIS tools can be used to gather, store, and analyze previously unknown local knowledge. Wood (2005) suggests that hands-on use of GIS, with technical support, could benefit and empower community groups when responding to local geographic issues. A relatively recent participatory method, PPGIS, has been growing in interest and has the potential to enable computerized mapping to benefit and empower communities (Pickles, 1995; Sheppard., 1995; Talen, 2000; Sieber, 2000; Nyerges and Jankowski, 2001; Craig *et al.*, 2002; Elwood, 2002). Although PPGIS itself may promote cooperation (Kyem, 2004), it also has the potential to disempower communities (Harris *et al.*, 1995; Abbot *et al.*, 1998). Furthermore, Carver *et al.* (2001) states that access to GIS software by itself may not benefit facilitation as strengths and weaknesses may require identification first. The information and data must be presented to the public in a simple, straightforward manner so that informative decisions can be made. Obermeyer (1998) and Ghose (2003) outline the use of GIS in recent PPGIS mapping initiatives which seek to incorporate information held by local communities into a planning process, to address concerns articulated by community participants and groups, in order to reduce inequalities in public access to information and technology, and to develop and make spatial information more adaptable for community use.

GIS provides the opportunity to innovatively link additional media, such as video clips, sketches, and photographs, to the map interface (Wood, 2005). PPGIS can incorporate many technological devices, including web-based software, to assist the public in providing accurate knowledge and opinions. Web-based software offers the potential for Internet-based community mapping projects (Carver *et al.*, 2001). Kraak (1999) states that the Web is increasingly being used as a 'demand-driven' medium by community groups. Furthermore, there exists the potential for interactive Web-based maps to instigate a two-way dialogue between communities over the Internet (Al-Kodmany, 2001).

Whether using paper or computer-based maps, public planning processes should focus on enabling the public to highlight what is unique and distinct about an area (Clifford and King, 1993), and describe what is important to them about these areas (Greeves and Taylor, 1987; Clifford and King, 1996). Sheppard (2005) explains the need to integrate public participation, decision support, and computer technology to spatial modelling and visualization. In addition, he states that more well-documented studies are needed in order for planners to develop comprehensive, engaging, open and accountable processes. Harrison and Haklay (2002) draw three conclusions where they examined the ability of GIS to incorporate the public in the planning process: (1) The public evaluation of GIS planning services cannot be separated from the concerns of the planning process and local government; (2) there is a lack of studies which analyze the combination of GIS with cultural studies of participatory approaches; (3) more studies need to be conducted to explore the interactions of different publics with PPGIS as a means of better understanding.

While many public planning processes utilize GIS, few take a "hands-on" approach in which members of the public operate the GIS tools themselves. These planning processes primarily employ spatially related knowledge from members of the public. Talen (2000) argues specifically for resident-generated GIS, whereby maps are created by, rather than for, neighborhood residents, a procedure helping to facilitate local interaction and participation. However, one must consider the public's knowledge of technology as well as the existing technological infrastructure at the outset of the planning process. Nyerges and Jankowski (2001) highlight the need to examine the influence that place, time and communication channels have on information use in geographic problem solving and decision making. In this study, the rural setting, at least, is found to affect the access to certain kinds of technological infrastructure.

The use of a PPGIS tool could facilitate a simple method of gathering local knowledge and opinions. Researchers at UNBC are developing, testing and evaluating a PPGIS tool that is part of a GEOIDE funded research project which is intended to assist rural communities in planning for sustainable development. GEOIDE is a Canadian Centres of Excellence funding agency for research on geomatics. GEOIDE attempts to consolidate and strengthen the domestic geomatics industry. It supports the research and development of new geomatics technologies and methods via multidisciplinary collaboration of numerous GEOIDE nodes (e.g., UNBC). *Promoting Sustainable communities through Participatory Spatial Decision Support* is a GEOIDE funded project which focuses on bridging the gap between research and practice by developing specific decision support tools to enable planners and the public at large to collaborate on planning issues. These tools consist of open source software freely accessible on the internet. Particular effort is directed at engaging users in testing and evaluating the tools in a variety of settings in order to integrate them into routine planning. The study documented here is an evaluation of a case in which a PPGIS tool is employed in a rural planning process. The GEOIDE PPGIS tool will henceforth be referred to as the PPGIS tool throughout this study.

The PPGIS tool is a multi-user mapping interface that aims to collect public input concerning community planning processes. The PPGIS tool allows users to add features (e.g., points, arcs, polygons) and comments to a map layer that depicts their area of interest. Each feature and comment is visible and can be replied to by all users within that topic area. Computer icons link each comment to its corresponding feature. In addition, a number of multi-purpose tools (e.g., zoom in/out, identify) are embedded within the PPGIS tool which assist in displaying and organizing information.

There are a number of methods that could be applied to the evaluation of public participatory techniques, such as the PPGIS tool. Patton (1982) states that the definition of program evaluation is ambiguous and concludes it is not practical to adopt a single definition of evaluation. There are three primary forms of evaluation for social programs. These forms include summative evaluation, formative evaluation, and impact evaluation (Patton, 1982). These evaluation models clarify the purposes of the participatory method and provide a framework for public participation (Chess, 2000). Summative evaluation occurs subsequent to the completion of a process and can track the extent to which public participation has furthered towards its expected results. Formative evaluation is aimed at improving programs in progress and can provide researchers with feedback during program development. It can consider complex issues such as relationships among stakeholders, perceptions of agency communication, and, as in this study, the effectiveness of participatory methods. Impact evaluation focuses on long term results and has the potential to inform major policy decisions and track social learning (Patton, 1997).

The PPGIS tool needs to be continually modified with respect to the ability of its users and the planning process in which it is used. Ortolano and Wagner (1977) use formative evaluation to evaluate new GIS technologies and tools. They incorporated the use of questionnaires to acquire feedback throughout their study. In this study, formative evaluation will allow for the ongoing improvement of the PPGIS tool.

### 1.3 Research Goals and Objectives

One of the most contentious debates on evaluation, concerns which objectives to evaluate (Chess, 2000). Although this seems straightforward, in practice objectives are difficult to define in clear, specific and measurable terms (Patton, 1987). In this case, subjects of the evaluation are based upon the objectives of the PPGIS tool within the planning project. The purpose of this study is to evaluate the utility of a tool based on three subjects of evaluation:

- the usefulness of the tool in a planning process;
- the possibility that members of the public and community planners will use it in a planning process (willingness);
- the possibility that members of the public and community planners would actually prefer the tools over traditional planning tools

The research examines the use of a PPGIS tool that aims to enhance public participation within a public planning process in northern BC. Assumptions regarding the effect the PPGIS tool might have on certain aspects of the public planning case study were derived from premises within Nyerges and Jankowski's (2001) Enhanced Adaptive Structuration Theory 2 (EAST2) (see Section 2.2).

The above subjects of evaluation assisted in developing the following research questions:

1. ***With regard to public participation, how does the PPGIS tool compare with other traditional public participatory tools or methods?***
2. ***What are the strengths and weaknesses of the PPGIS tool?***
3. ***Can the PPGIS tool advance the participation and understanding of the public?***
4. ***Does the PPGIS tool contribute to shaping the opinions of members of the public?***

### 1.4 Organization of the Thesis

The thesis is organised into six chapters: 1. Introduction, which provides the rationale and outline of the research questions; 2. Conceptual Framework, which defines PPGIS, explores its potential, and examines suitable evaluation measures through literary comparison; 3. Methods, Data Collection, and Analysis, which provides an overview of the research techniques employed and outlines the specific procedures followed; 4. Public Results and Discussion, which describes the lay participant results and discusses these findings in the context of related studies and research findings; 5. Planner Results and Discussion, which describes the expert planner results and discusses these findings in the context of related studies and research findings 6. Recommendations and Conclusions, provides recommendations for further research and the overall conclusions of the research study.

# Chapter 2: Conceptual Framework

## 2.1 Defining Public Participation GIS (PPGIS)

This chapter reviews literature related to the use of the PPGIS tool in an environmental planning case study. It defines PPGIS, compares PPGIS with traditional methods, and describes applications, limitations, and potential evaluation methodologies of PPGIS. This chapter also provides reasons for selecting this case study.

PPGIS expands as Public Participatory GIS. The first step to defining PPGIS is to understand its relation to GIS (Geographic Information Systems). GIS generally uses computer hardware, software, and geographic data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS applications cover a broad spectrum such as education (Linn, 1997; Pedersen *et al.*, 2005), emergency management (Newsom and Mantrani, 1993) and archaeology (Holdaway, 2003). Sieber (2006) explains that GIS has generated interest in policy makers for three main reasons. First, most information used in policy making contains a spatial component. For example, a number of policy applications require information about the location of crime, land-use planning zones, environmental health problems, habitats, or where social services are provided (e.g., address, distribution of mailing codes, and latitude/longitude). Second, providing spatial information to all relevant stakeholders presumably leads to better policymaking. Third, policy-related information can be analyzed spatially and visually, and the resulting maps or information can convey ideas and convince people of the importance of those ideas. The development of GIS applications and software has increased the need for the lay citizen to understand the purpose and capabilities of GIS.

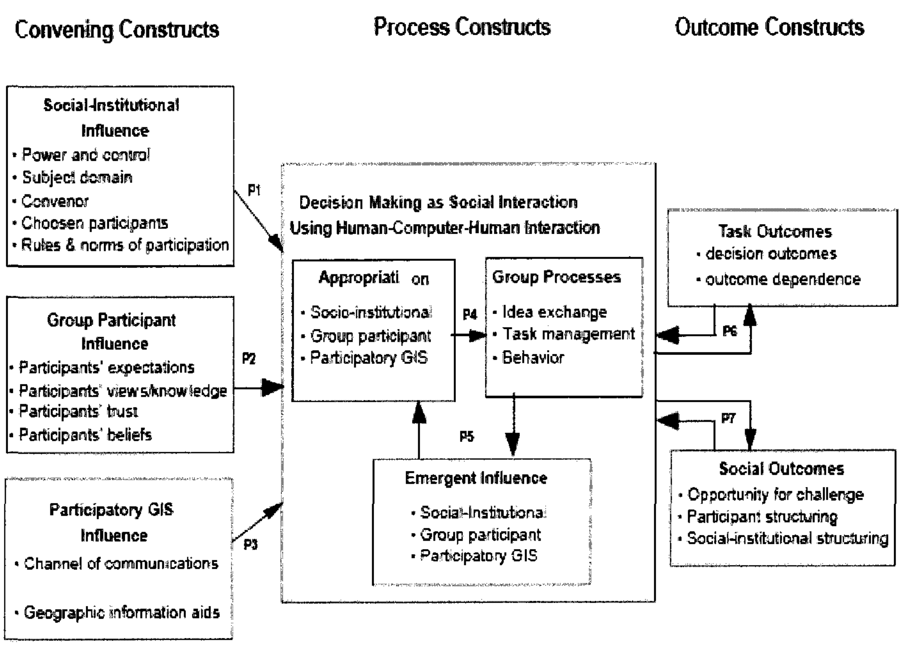
Initially, PPGIS was defined as "a variety of approaches to make GIS and other spatial decision making tools available and accessible to all those with a stake in official decisions" (Schroeder, 1996). PPGIS resides neither in a single sector nor exclusively in the domain of geography. Understanding of PPGIS therefore requires a deeper examination of the technology, the users, and their practices. According to Sieber (2006), PPGIS aims to broaden public involvement in policymaking. Furthermore, PPGIS applications usually occur within one or more of several organizational arrangements, including community-university partnerships with inner-city communities (Craig and Elwood, 1998; Ghose, 2001), grassroots social organisations (Sieber, 2001), and Internet-based PPGIS (Carver *et al.*, 2001; Craig *et al.*, 2002). These arrangements combine GIS with a host of modern communication technologies to facilitate dialogue and data usage among local groups.

Recently, there has been confusion between PPGIS and PGIS (Participatory GIS) and there are no clear definitions to separate the two terms. PGIS is also an emergent practice; it is a result of a merger between Participatory Learning and Action (PLA) methods with Geographic Information Technologies (GIT) (Sieber, 2006). PGIS employs customized, user-friendly applications of GIS technologies in an attempt to empower communities. A suitable practice of PGIS is flexible and adapts to different socio-cultural and biophysical environments while relying on a combination of 'expert' skills and local knowledge. Although these two methods are known by different terms, there appears to be no clear distinction between PPGIS and PGIS.

The use of PPGIS depends on data-gathering strategy of the group or planning process. Furthermore, Nyerges *et al.* (2002) acknowledge the need for PPGIS to incorporate appropriate data-gathering strategies. Although the technology of GIS is the key component to PPGIS, the issues that determine its future direction are not primarily technical (Taylor, 1994). Taylor (1994) explains that while maps have always asked the question "where", now they must also answer new questions such as "why", "when", "by whom" and "for what purpose" and they must convey to the user an understanding of a much wider variety of topics than was previously the case.

From a theoretical perspective, Nyerges and Jankowski (2001) outline a structured theory that investigates what to expect during human-computer-human interaction. The Enhanced Adaptive Structuration Theory 2 (EAST2) provides a way of "systematically" interpreting how people make use of GIS in a problem context. EAST2 is composed of eight constructs which outline the major issues for characterizing group decision making. Seven premises relate these constructs to each other (Figure 2.1).

**Figure 2.1:** Conceptual Map of the Enhanced Adaptive Structuration Theory (EAST2)




**Source: Nyerges and Jankowski (2001)(Geographic Information Systems for Group Decision Making)*

The "macro-micro" conceptual framework that embeds EAST2 is a powerful, yet flexible, organizing mechanism for framing research activity about "realistic" complex, inter-organizational decision situations. This theory attempts to both deconstruct and reconstruct PPGIS in society. Furthermore, EAST2 can assist in the construction of a GIS based participatory tool by identifying core aspects of a group or participatory process. The convening and process constructs are particularly applicable to the research undertaken in this study since they provide an analytical framework for evaluating the usefulness and suitability of the PPGIS tool in the planning process.

EAST2 includes three process constructs: *Appropriation, Group Processes*, and *Emergent Influence.* These constructs outline a structured approach to human-computer-human interaction as a means of supporting public participation within group processes (Nyerges and Jankowski, 2001). To achieve social interaction, powerful group-oriented decision support tools are needed (Armstrong, 1993; Nyerges *et al.*, 2002).

EAST2 includes three convening constructs: *Social-institutional influence, Group Participant Influence, and Participatory GIS influence.* The convening constructs deal with the influence of convening a decision process when information technology is involved (Nyerges and Jankowski, 2001). These constructs relate more towards planners or decision makers, rather than members of the public, since planners are the chief conveners and organizers of a planning process. However, an influence on one construct may influence another since both convening and process constructs are interconnected. As a result, those aspects that influence planners may also influence members of the public.

PPGIS research itself has undergone an evolution as participants have sought to formalize the nature or process of PPGIS. Many of the early PPGIS efforts were exploratory case studies, which provided the ''social narratives'' of PPGIS (Kyem, 2001). These included studies of GIS by marginalized communities, nongovernmental organizations and grassroots groups (Convis, 2001), native groups (Poole, 1995), social movements (Sieber, 1997), peoples in developing countries (Jarvis and Spearman, 1995; Sedogo and Groten, 2000; Kyem, 2001), and urban community-based organizations (CBOs) (Craig and Elwood, 1998). Whereas the earliest work showed the possibilities of GIS for grassroots environmental advocacy (Aberley, 1993), the latest forms vary in technology and theory: for instance, implementation of Web-based neighborhood information systems (Carver *et al.,* 2001; Wong and Chua, 2001; Kingston, 2002), community resident-developed monitoring of the environment with mobile GIS (O'Brien, 2003), and models of GIS availability in urban CBOs (Leitner *et al.*, 2000).

## 2.2 Traditional Participatory Methodologies

Public participation processes use diverse techniques and occur in many different contexts (Beierle and Cayford, 2002*)*. This study is primarily concerned with public participatory methods used in environmental planning. A number of methodologies can be used to gather public knowledge in a planning process. For example, researchers have used tools to assess public opinion, such as focus groups, community dinners, open houses, or surveys, which provide one-way communication mechanisms between agencies and the public (Raimond, 2001; Carr and Halvorsen, 2001). Traditional methods such as notices, hearings, and comment periods inform the public and gather a limited set of views in a non-deliberative framework (Checkoway, 1981; Kemp, 1985; Kemmis, 1990; Moote *et al.*, 1997; Adams, 2004). Collaborative mechanisms emphasize two-way communication and deliberation. They include mediation procedures, workshops, task forces, consensus arrangements (e.g., Innes, 1996), conflict resolution, and regulatory negotiations (e.g., Susskind and Cruikshank, 1987; Susskind and Field, 1996) as well as Citizen Advisory Boards (FFERDC, 1996; Raimond, 2001). These deliberative processes are widely considered in the planning literature to be the most effective participatory methods (e.g., Healey, 1993, 1997, 1998; Forester, 1999; Innes and Booher, 2000; Margerum, 2002). However, at times, traditional methods have failed to take into account the different perspectives of the public and the mutual trust needed between the various stakeholders (Alio and Gallego, 2002).

Workshops are a commonly used method that allows the public to be informed, as well as to provide spatial information in a planning process. For example, the Electoral Area A Community Trails Study provides an example of a practical planning framework used in the planning of a system of trails within the Regional District of Nanaimo, BC (RDN, 2005). The study adopts a traditional step-by-step process that incorporates a number of workshops to gather local knowledge and opinions concerning potential trail routes. In addition, public consultation in the process incorporates the use of maps and orthophotos to sketch features and provide comments concerning potential and existing trail routes. Similarly, King *et al.* (1989) used freehand sketches as the standard participatory tool in more than 190 participatory planning workshops. In both of these participatory planning workshops, a member of the public chooses an area and draws a new feature on the basis of his or her ideas or preferences. Pen-and-paper sketching within a workshop setting promotes dialogue and people enjoy seeing their ideas put into realistic drawings (Al-Kodmany, 2002). However, the pen-and-paper sketching process may not ultimately result in an accurate design, because sketches tend to leave out important information.

Many public participatory methodologies incorporate a number of traditional tools. For example, Zanetell and Knuth (2002) employed a participatory research methodology called Rapid Rural Appraisal (RRA) for gathering local knowledge by formulating partnerships between expert planners and lay citizens. RRA involves resource users through the use of hands-on group activities that lead to well-rounded information and triangulation (Frey and Fontana, 1993). RRA utilizes maps, drawings, and diagrams to enhance interaction and reduce participant exclusion based on literacy, age, gender, etc.

However, many authors have critiqued traditional methods, such as public hearings and comment periods, as being unsatisfying to participants (Sewell and Phillips, 1979; Cortner, 1996; Lauber and Knuth, 1999), unrepresentative of concerned or potentially affected publics (O'Riordan, 1976; Force and Williams, 1989; Cortner, 1996; Poisner, 1996; Moote *et al.*, 1997) and lacking in two-way dialogue, information sharing, and deliberation (Blahna and Yonts-Shepard 1989, Shannon, 1990; Cortner, 1996; Poisner, 1996; Moote *et al.*, 1997; Tuler and Webler, 1999). The lack of participants within participatory processes has been linked to barriers of access (Halvorsen, 2001). In addition, public involvement within a planning process is at times reactive in nature, too often occurring after a decision has been made. Many processes involve little actual "hearing" and lack sufficient participants and deliberation (Beierle and Konisky, 1999).

Many academic researchers and professionals have observed limitations in traditional participatory methods. They suggest that there is a distinct need for the development, implementation, and evaluation of techniques that participants find deliberative, convenient, and comfortable (Applegate, 1998; Bradbury and Branch, 1999; Coglianese, 1997; Lynn and Busenberg, 1995; Renn *et al.*, 1995).

### 2.3 Applications of PPGIS in Planning

PPGIS has attracted researchers and practitioners from multiple fields, including natural resources, community development, urban planning, and landscape ecology (Morain, 1999). PPGIS projects in these areas focus on expanding the number of stakeholders in planning, easing the understanding of analyses through visualization, circulating planning-related information online, and weighting preferences utilizing graphical user interface measures which, when combined, result in a more collaborative planning process (Shiffer, 1998; Talen, 2000; Al-Kodmany, 2001; Ball, 2002; Drew, 2003).

Pettit and Pullar (1999) recognize the difficulties in incorporating GIS into a public planning process to solve urban and environmental design problems. The accountability and capability of each participant needs to be considered prior to the implementation of GIS in a public planning process. Three categories of participants are incorporated within a GIS-based planning process: stakeholders, decision-makers, and technical specialists. These participant categories may exhibit a wide range of GIS expertise in practically any planning process (Nyerges and Jankowski, 2001). Participants need to understand the main aspects which affect the successful use of the PPGIS tool in a planning process. Harrison and Haklay (2002) identify the potential requirements of PPGIS as a planning tool, the expected type of social and institutional collaboration when using a GIS-based tool, the level and effect of human-computer interaction (HCI), key theoretical themes that should guide the analyses of the GIS tool, and the anticipated functionality of the GIS tool in order to serve participatory settings (Pickles, 1995; Nyerges and Jankowski, 2001; Craig *et al.*, 2002; Harrison and Haklay, 2002).

Kyem (2004) addresses the problem that GIS has been undermined by competing claims about human factors that sustain conflicts. He concludes that without active participation from stakeholders, the use of planning opportunities created by the local community, and the collaborative processing of the GIS data, the resulting participatory GIS methods cannot be used to successfully resolve land use conflicts. Many facilitators or planners acknowledge the problems created by omitting local input in the knowledge formation of planning and agree that it is imperative for planners to consider the perspectives of various groups and to ensure there is trust between these groups (Zanetell and Knuth, 2002; Petrzelka *et al.*, 2005; Corbett *et al.,* 2006). Rural residents in particular often remain isolated from planning processes (Corbett *et al.,* 2006). However, the seemingly contrary nature of rural resident attitudes can be partially attributed to the lack of data concerning the attitudes of certain subgroups (Petrzelka *et al.*, 2005).

A number of GIS-based methods collect stakeholder and local knowledge within a planning process. The most popular of these methods incorporates the use of a multicriteria decision model (MCDM) which allows users to create map output by weighting independent criteria. These criteria are based on judged values of importance (Smith, 1980). Applications of multi-criteria decision models include, but are not limited to, site control planning (Pettit and Pullar, 1999), transportation (Geneletti, 2005) and land suitability assessments (Bojórquez-Tapia *et al.*, 2001). MCDM's provide decision-makers with a valuable overview of all available information and increase stakeholder motivation to participate (Genelitti, 2005). In addition, these models can be used in cooperation with alternate participatory support models to enhance public participation (Laukkanen *et al.*, 2004). However, MCDMs are criticized for causing barriers of perception or information transmission which lead members of the public not to participate (Sheppard and Achiam, 2004; Hamersley Chambers and Beckley, 2003). Many researchers have expressed the concern that MCDMs are too technocratic when used in a public decision-making context (Cohen, 1997; Kangas *et al.*, 2001; McCool and Stankey, 2001; Mendoza and Prabhu, 2005).

MCDMs allow lay participants to provide their knowledge on previously identified sets of variables. However, they lack the functionality to allow lay participants to add their own variables and other information to the system. In addition, Halverson (2001) notes that MCDMs' lack participatory techniques to assist the stakeholder in expressing and listening to a variety of perspectives regarding a particular issue. Furthermore, the public may feel pressured to provide inaccurate information if not given opportunities for input and deliberation on alternative management actions (Sheppard, 2005). Consequently, Harrison and Halklay (2002) emphasize the usefulness of "once-only sessions" which allow users to provide information during the early phase of a planning process. In short, there is a need to develop and implement new participatory techniques that can be applied in collaboration with multi-criteria decision methods (Halvorsen, 2001; Nyerges and Jankowski, 2001; Laukkanen *et al.,* 2004). In comparison with traditional methods, these participatory techniques need to integrate public input, modeling techniques, and emerging communication tools to form hybrid decision-support methods which will better consider the public's needs and knowledge (Sheppard, 2005).

A number of existing participatory techniques could merge to develop new methods of participation. For example, Cassettari *et al.* (1992) suggest the ability to communicate via interactive maps (two-way virtual GIS database) will allow spatial data to be processed and interpreted differently by users. In addition, Haklay and Tobin (2003) state that tools using geographical visualization would allow a more interactive and dynamic approach to providing information, one which is not available through traditional techniques (Cartwright and Hunter, 1996). Similarly, Sheppard (2005) suggests that the emergence of integrated GIS to utilize visualization and modeling techniques would further assist the public's understanding of specific issues. Not only do GIS-based participatory tools need to be integrated within other GIS-based tools, but certain aspects of traditional methods need to be integrated within PPGIS tools (Al-Kodmany, 2001). Moreover, the production output from computer screens, especially in hardcopy form, still essentially mimics the paper maps that were used before the introduction of computers and could perhaps be upgraded (Cartwright, 1995; Cartwright and Hunter, 1996). Lastly, natural spatial queries, such as "query by sketch", in which the user draws a rough approximation of the image they are looking for and the software locates images whose layout matches the sketch, would help accommodate human understanding of spatial knowledge (Haklay and Tobon, 2003).

The successful application of a PPGIS tool largely depends on the specific objectives within that planning process, and no single approach is better in general than any other approach (Nyerges *et al.*, 2002). In any particular study, tradeoffs are to be made among various objectives of data gathering.

## 2.4 Limitations of PPGIS

According to the literature, two main limitations, a steep learning curve and disempowerment, may limit the full capability of PPGIS in a public planning process.

GIS has a steep learning curve, as well as a strong commitment to keeping software and operator skills current (Corbett *et al.*, 2006). In certain studies, the level of understanding and education of stakeholders has limited the full use of GIS within the planning process (Bojórquez-Tapia *et al.*, 2001). For example, more users have to concentrate on using the actual application rather than on providing the data itself (Cartwright and Hunter, 1996). In addition, the application must have the ability to collect passionately held positions and reduce complex beliefs to points, lines, areas, and attributes (Sieber, 2000). Similarly, other authors argue that the dialogue within menu choices and features will have to employ jargon suitable to the users (Cartwright and Hunter, 2001). In addition, Elmes (1991) states that to limit future computer avoidance and increase computer applications, more emphasis needs to be placed on ensuring computer literacy as a basic component in education.

Historically, certain groups have had restricted access to GIS technology due to its high price (Wood, 2005; Corbett *et al.*, 2006). Specifically, under-resourced users are considerably disadvantaged in their capacity to engage in the decision-making process without equitable access to GIS data and technology (Harris and Wiener, 1998). Also, GIS technology is more accommodating to certain conceptions, forms of knowledge, and kinds of language, and as a result causes unequal access to information (Mark *et al.*, .n.d.). Sieber (2000) states that it is highly doubtful that GIS alone can guarantee empowerment or understanding of a particular decision-making process. A widespread critique regards GIS as an instrument of governmental control and surveillance (Pickles, 1995; Curry, 1998; Aitken, 2002). Providing information through technology may provide members of the public with a sense of influence in the decision making process, while actual influence remains within the governing bodies (Sieber, 2000). Harris and Wiener (1998) conclude GIS potentially "empowers the powerful and disenfranchises the weak".

In certain cases, these limitations have decided planners to refrain from integrating GIS technology within urban planning processes (Petit & Pullar, 1999). Restraint is more evident in rural planning processes where the lack of GIS integration is due, in part, to a lack of technological infrastructure. As a result of these limitations, future GIS was seen in the last decade to need to be easier to use, inexpensive, and available to a greater variety of users (Crane, 1993; Pettit and Pullar, 1999). However, slightly increasing attributes within these applications and lowering the entry costs of computing cannot dispel what are considered to be inherent problems with GIS (Sieber, 2000).

## 2.5 Evaluation of PPGIS tools

In the evaluation of PPGIS tools, researchers must take into account the objectives meant to be achieved. PPGIS research has yet to establish a technique to demonstrate whether or not PPGIS is a suitable approach for a given problem (Sieber, 2006). Historically, researchers have spent most of their resources in software development without making any concerted attempt to evaluate product effectiveness rigorously (Cartwright and Hunter, 2001). Nyerges and Jankowski (2001) state that most of the research concerning collaborative spatial decision-making has been principally GIS development rather than GIS use, without a strong theoretical link between the two. In addition, according to Sieber (2000), little has been done until recently to study the use of GIS technology at a decision group level. Many evaluation studies have employed interviews or surveys of the public employees who implemented the public participation projects (Sewell and Phillips, 1979; Blahna and Yonts-Shepard, 1989; Shannon 1990; Selin *et al.,* 1997; Smith *et al.,* 1999). Others have been either qualitatively based or a mixture of qualitative and quantitative methods while focused upon or including as one component the surveying or interviewing of citizen participants (Lach and Hixson, 1996; Moore, 1996; Moote *et al.*, 1997, Schuet *et al.*; 1998, Tuler and Webler; 1999). The richness of the GIS environment can overwhelm the designer with evaluatory options, so that proper evaluation of multimedia GIS needs to be conducted in a manner which is sympathetic to both the user and the processes undertaken during system use (Cartwright and Hunter, 2001).

Evaluation procedures must be carefully designed and implemented to uncover the strengths and weaknesses of new techniques such as GIS and apply them more effectively and efficiently (Cartwright and Hunter, 2001). Many environmental planning processes require the progressive evaluation of public participatory methods for future improvement (Chess, 2000). For this purpose, many evaluators of public participation processes use "formative evaluation" (Ortolano and Wagner, 1977; US DOE, 1996, 1997; Bradbury and Branch, 1999). Krygier and Wood (2005) state that formative evaluation would be of equal use in the evaluation of GIS-based products. In this context, formative evaluation would involve increasing the researcher's knowledge about the capability of the participatory method by collecting and analyzing data based on educational value. It would require the researcher to consider the needs of the user when using a GIS product and it would collect data through a combination of methods. The focus of formative evaluation would be directed towards defining unique contributions and the further development of the GIS product (Krygier and Wood, 2005).

Many researchers believe that establishing whether new GIS-based methods are more effective than traditional communication approaches is a task too complex to be accomplished (Cartwright and Hunter, 2001). Alternative cross-comparative studies that involve GIS-based tools and traditional methods have focused on their effectiveness in geography education (Krygier *et al.*, 1991; Pedersen *et al.*, 2005), transportation (Reilly *et. al*, 2006) and visualization (McGuinness and Ross, 1995). With few exceptions (e.g., Martin and Davis, 1999; Al-Kodmany, 2001; Sawicki and Peterman, 2002), cross-comparative research has not yet been conducted in the public participatory setting.

Cartwright and Hunter (2001) state that proper evaluation of multimedia GIS needs to be conducted in a manner which is sympathetic to both the user and the processes undertaken during system use. Chess (2000) suggests that environmental agencies should practice methodological pluralism. Methodological pluralism proclaims that the use of multiple methodological approaches in the course of a practice is legitimate. Past methods of GIS evaluation have included map analysis (Fritze, 1994; MacEachren, 1995; Salter, 1995), questionnaires (Fonsesca and Raper, 1992; Cartwright and Hunter, 2001), participant observation and interviews (Cartwright and Hunter, 2001), and the analysis of computer log files during system use (Elmes, 1991).

The researcher must consider which aspects of the GIS application are important for interpreting its successful use. If public participation be the stated objective, as in the case of PPGIS, it likely will pose a challenge to evaluation (Sieber, 2000). In the case of public participation, objectives include empowerment, expanded participation, social capacity and inclusion, equity and redistribution, and heightened democracy (Sieber, 2000; Craig *et al.*, 2002; Kyem, 2004). However, evaluators of new GIS techniques need also to consider human-computer interaction, and its indicators, to gauge the success of a PPGIS tool. Previously used indicators include ease of use (Elmes, 1991), perceptual and cognitive processes associated with reading map and symbol elements (MacEachren, 1995), mobility of mapping methods (Reilly *et al.*, 2006), cost, interactivity, scale flexibility and ability to represent complex contextual data (Al-Kodmany, 2002), and task performance and computer-map literacy (Morita, 1991). The importance of gauging computer-map literacy is especially important when comparing the two mapping methods (Morita, 1991). A GIS-based tool with consistently poor usability will result in both the user and the technician rejecting further use of the system (Elmes, 1991). Therefore, the evaluator must establish the positive and negative features of the GIS-based tool to enable effective symbolization and design (MacEachren, 1995).

## 2.6 Case Study Selection and Description

The study reported in this thesis sought to examine public and planner attitudes and preferences towards use of a traditional method and PPGIS tool within a rural setting. For this purpose, the case study required a rural location that was close for planners, that affords a certain amount of technological infrastructure, and that had a history of a high degree of public participation. The Regional District of Bulkley-Nechako (RDBN) within northern British Columbia was selected for all of these reasons. It covers an immense area (approximately 77,000 sq km) but has a relatively small population (40,856), much of it rural (RDBN, 2006). This study focused on the town of Smithers within Electoral Area A of the RDBN. Smithers has the largest population (5217 people) in the Regional District (RDBN, 2006). In addition, Smithers is home to the regional office for the Integrated Land Management Bureau (ILMB), which is responsible for regional planning on crown land (ILMB, 2007), and the Bulkley Valley Community Resources Board (BVCRB), which represents the residents of the Bulkley Valley in crown land planning (BVCRB, 2007).

# Chapter 3: Methods, Data Collection, and Analysis

## 3.1 Methods

This chapter is divided into two main sections. The first on methods summarizes the structure and principles behind the research design and the effectiveness and limitations of these methods; the second is on data collection and analysis, outlining specific procedures followed in this study.

An experimental framework can be used to evaluate the effectiveness of GIS tools at influencing public participation within a planning process. Within experimental research, the investigator is striving to generalize a particular set of results to some broader theory. This study uses both quantitative and qualitative research techniques. Quantitative methods apply to phenomena that can be measured objectively while qualitative methods are subjective and vary according to the researchers (Yin, 1998).

The methods used in the study reported here were fitted to a qualitative and quantitative design, one involving a pretest, the testing of the traditional and the PPGIS based methods, a traditional method questionnaire, and a PPGIS method questionnaire (See Appendix A, B, C, and D). The methods were used to assess public and planner attitudes and aptitudes towards the use of a PPGIS tool in a case study of trail planning and management within the Bulkley Valley of northern British Columbia.

3.1.1 ***Paper PP method***

The paper PP method incorporated the use of three topographic maps and two orthophoto image maps. For comparison purposes, attempts were made to limit the amount of map feature differences (e.g., colors) between the PPGIS map interface and paper maps. In addition, both mapping methods used corresponding GIS-based features (e.g., existing trails) and orthophoto images. Descriptions of the topographic maps are outlined in Table 3.1.

**Table 3.1: Topographic maps used within the paper PP method**

| | **Map 1** | **Map2** | **Map3** |
|---|---|---|---|
| *Series* | A721 | A721 | A502 |
| *Map index* | 93L/11 | 93L/14 | 93L |
| *Edition* | 2MCE | 2MCE | 4MCE |
| *Scale* | 1/50,000 | 1/50,000 | 1/250,000 |
| *Year printed* | 1975 | 1975 | 1988 |
| *Contour interval* | 100ft | 100ft | 500ft |
| *Datum* | NAD27 | NAD27 | NAD27 |
| *UTM zone* | 9 | 9 | 9 |

Descriptions of the orthophoto maps are outlined in Table 3.2.

**Table 3.2: Orthophoto maps used within the paper PP method**

| | **Orthophoto #1** | **Orthophoto #2** |
|---|---|---|
| ***Area*** | Northeast slope of Hudson Bay Mountain | Smithers Community Forest |
| ***Scale*** | 1:2500 | 1:20,000 |
| ***UTM zone*** | 9N (WGS84) | 9N(WGS84) |
| ***Pixel size*** | 1m | 1m |

### *3.1.2 PPGIS tool*

Designers at UNBC used the Flexible Internet Spatial Template (FIST) as platform in which to develop the PPGIS tool. As with the PPGIS tool, FIST is an open-source GIS software that was developed at UNBC. The original name of the PPGIS tool is Collaborative Spatial Interface (CSI). Images of the PPGIS or CSI tool are displayed in Figure 3.1 and 3.2.

The initial display of the PPGIS tool presented an area of 60,000 sq km which consisted of the majority of the Bulkley Valley. There were three categories of layers used within the PPGIS tool: Topographic, which included, but not limited to, contours, rivers, roads, and trails; Boundary, which included, but not limited to, regional districts, parks, municipal boundaries, forest districts, and land ownership; and Imagery, which included orthophoto images and hillshade.

**Figure 3.1:** PPGIS tool interface with underlying orthophoto layer

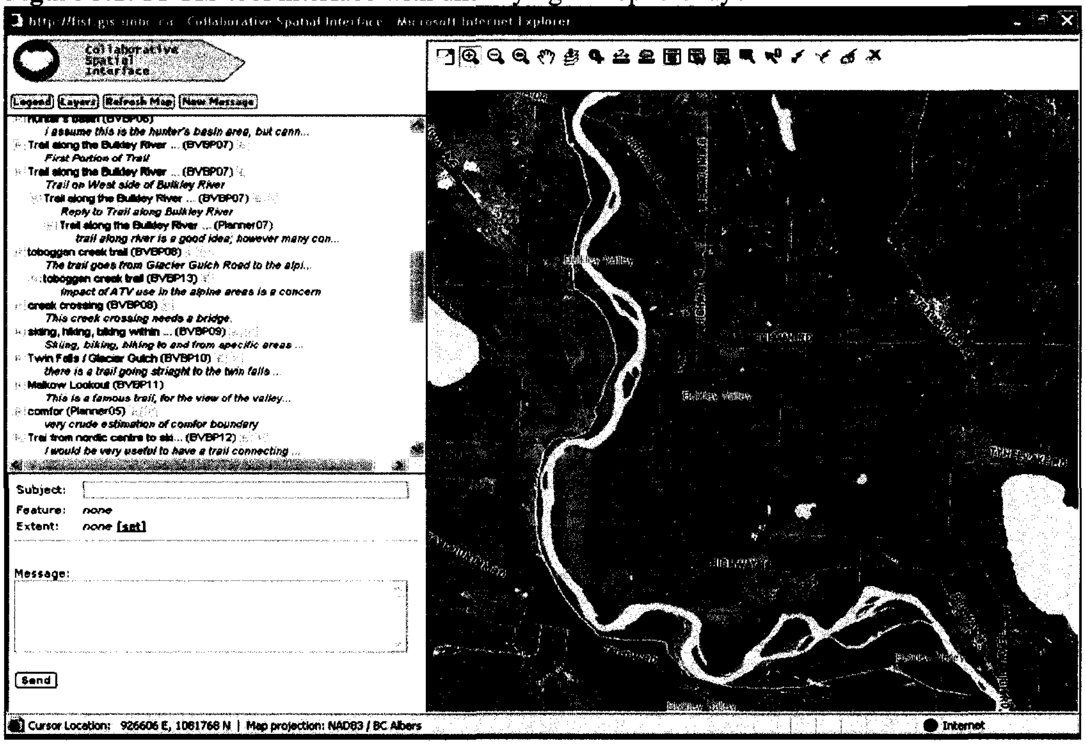
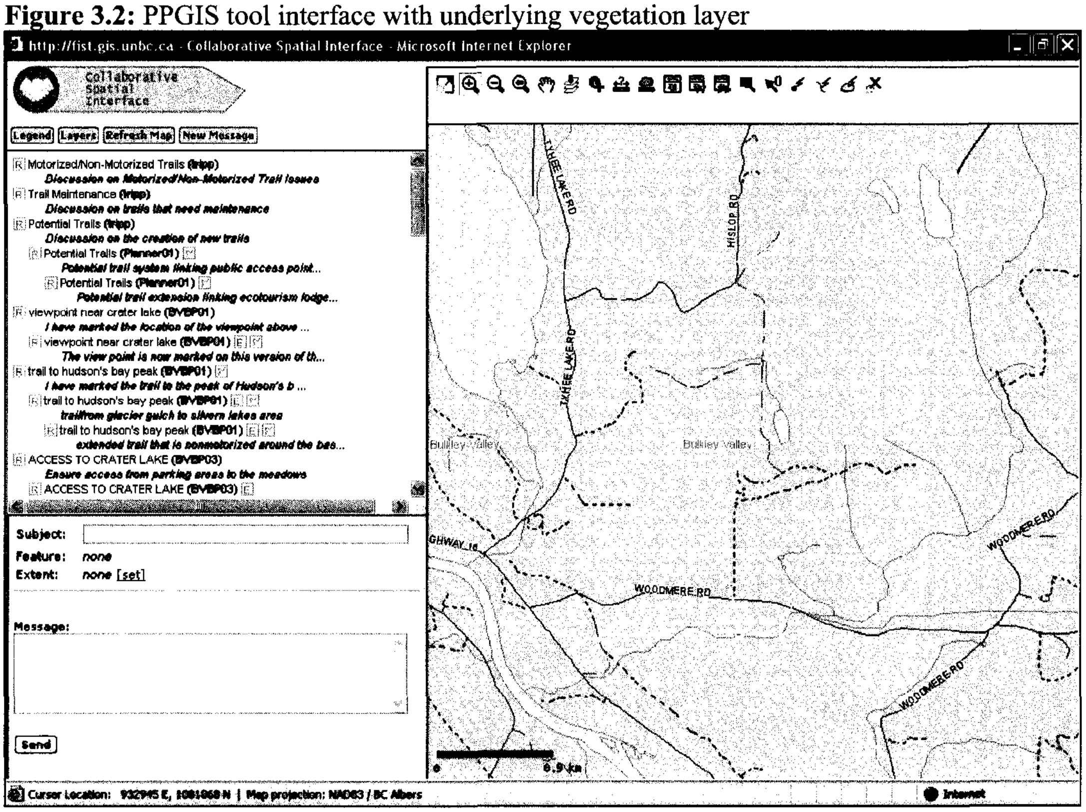



**Figure 3.2:** PPGIS tool interface with underlying vegetation layer



### 3.2 One-Group Pretest-Posttest Design

The one-group pretest-posttest design involves observing or measuring a group of subjects (here, the pretest), introducing a treatment (here, the PPGIS tool), and observing the subjects again (via the questionnaire) (Singleton and Straits, 2005). This design provides the foundation for comparison. However, a major threat to validity is the length of time between the pretest and posttest. In this study, the pretest was followed immediately by the treatment and posttest to reduce the loss of validity.

Comparative research focuses on the analysis of similarities and differences between units (Warwick and Osherson, 1973). In this case, comparative research was used to analyze differences between how lay participants viewed their use of the PPGIS tool and how they viewed use of the traditional method. Comparative research can evaluate the strengths and weaknesses for each of the mapping methods to form a more effective mapping tool or method.

Ragin (1992) explains that qualitative researchers examine a wide variety of aspects of one or a few cases. According to Rubin and Babin (2005), commonly used qualitative research methods include participant observation, direct observation, case studies, and unstructured or intensive interviewing. These qualitative research methods collect data through detailed descriptions of situations, events, people, interactions, and observed attitudes, beliefs, and thoughts. In addition, qualitative data provides depth and detail which can emerge from responses to open-ended questions in a questionnaire (Patton, 1982). Neumann (2003) states that qualitative research tends to use a "case-oriented approach that places case, not variables, center stage". In the present study, the case-oriented approach focuses on participants' views and opinions in relation to their ability to use the PPGIS tool within a public planning process.

### 3.3 Non-probability Sampling

In a qualitative research design, a variety of methods can be use to select participants, each dependent upon the purpose of the research. Rubin and Babbie (2005) state that non-probability sampling is often conducted in situations when it is impractical to select various kinds of probability samples. Non-probability sampling can be carried out using several techniques. In this study, purposive and snowball sampling techniques were employed to select participants.

Rubin and Babbie (2005) define purposive sampling as selecting a sample on a basis of knowledge of the population, knowledge of its social elements, and the nature of the researchers' aims. Here, lay participants were selected based on their desire to provide information concerning existing and potential recreational areas (e.g., trails, reserves). The sample of expert planners was composed of individuals whose occupation involved some form of planning (e.g., land-use planning, community planning). Initially, participants were contacted through local trail organizations and government agencies.

The other non-probability sampling technique used, snowball sampling, is a method for identifying and sampling cases in a network (Neumann, 2003). This sampling technique is implemented by collecting data on the few members of the target population that one is able to locate, and then asking those individuals to provide the information needed to locate other members of that population (Rubin and Babbie, 2005). Snowball sampling was employed to gather additional participants in the present study. Participants were asked to identify other key informants, characterized by their trail knowledge with respect to the development, management, and planning of potential and existing trails within the Bulkley Valley. Snowball sampling is used primarily for exploratory purposes, and the present study is exploratory in nature.

The appropriate number of participants in a study is determined by a number of factors, including the population investigated, the intent of the researcher, and potential participant familiarity with the study topic (Warren and Karner, 2005). The participants' familiarity of study topic is particularly important for non-probability sampling, in which participants are carefully chosen to suit the purpose of the study. Neumann (2003) states that the study population has likely been adequately sampled when no new names are given, indicating a closed network. As the study progresses, the researcher can consider how close he or she is to a suitable sample of participants by considering the factors outlined above (Warren and Karner, 2005).

### *3.3.1 Limitations of Non-Probability Sampling*

The potential for bias is one of the main limitations of non-probability sampling (Neumann, 2003). A number of kinds of biases can occur with the use of non-probability sampling techniques. For example, the failure to include all the relevant groups in the population of interest is called coverage error (Lidner *et al.*, 2001). In this study, coverage error would occur if a certain group of planners involved with public participatory planning, such as Integrated Land Management Bureau (ILMB) planners, were not included in the sample.

With the use of snowball sampling, the initially selected participants can recommend participants with views similar to their own and thus create bias (Stewart and Shamdasani, 1998). In addition, those participants who do participate may differ, to some degree, from those participants who refuse to participate (e.g., they may be less educated), which can create bias and weaken validity (Neumann, 2003). Within random sampling, this is a common form referred to as non-response bias (Rubin and Babbie, 2005).

In this study, stratified sampling was used in an attempt to reduce limitations of non-probability sampling and include a representative sample of participants. In this case, the sample was divided into two main strata, public and planners. However, the selection of participants through non-probability sampling does not control for researcher bias (Singleton and Straits, 2005). In addition, the use of this sampling method preempts the applicability of statistical testing techniques and hence makes calculating the probability of sampling error impossible (Miller, 1977). Finally, this method allows for only a suggestive interpretation of the results, which limits external validity, or the researcher's ability to generalize to a larger population (Miller, 1977; Blalock, 1979).

### 3.4 Questionnaires, Observations, and Map Analysis

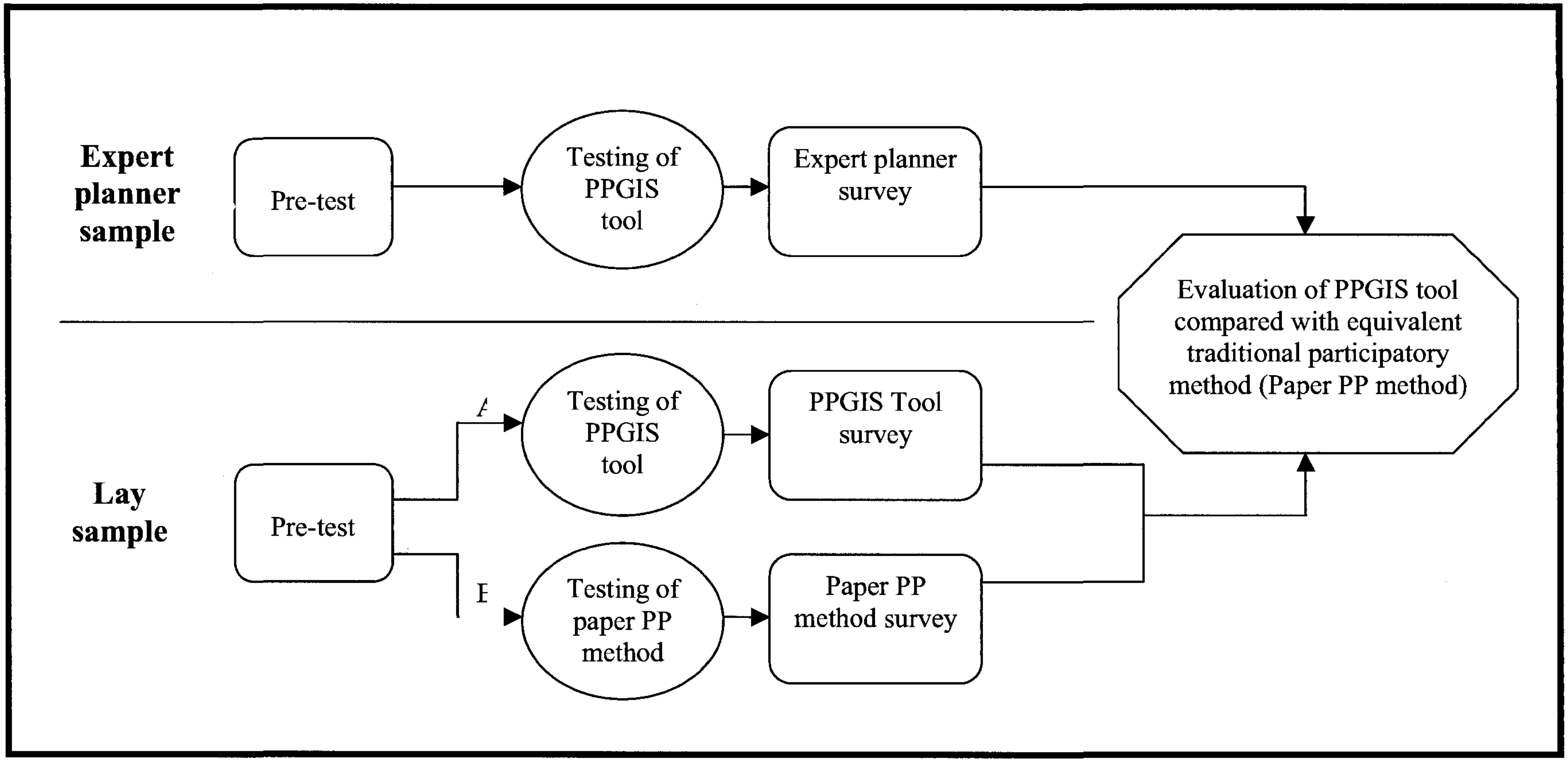
Three instruments of measurement aimed to evaluate the ability of the traditional participant method and the PPGIS tool from the viewpoint of public and expert planners. These three instruments, namely self-reported questionnaires, researcher observations, and map analysis, allowed for triangulation during data analysis.

A questionnaire can be a useful and powerful tool for both public and private organizations that need to know the characteristics and opinions of people they serve (Salant and Dillman, 1994). Questionnaires have the ability to gather both quantitative and qualitative data. Previous GIS-related studies have used some form of a pre-test in association with questionnaires to measure the level of a participant's computer-map literacy (McGuinness and Ross, 1995; Linn, 1997; Cartwright and Hunter, 2001; Pedersen *et al.*, 2005). A pre-test measures dependent variables prior to the introduction of the treatment (Neumann, 2003). The dependent variables can then be measured a second time using a post-test or questionnaire. Open-ended questions can be used to establish comfort and promote interactive dialogue, which is believed to assist in increasing the reliability and validity of research (Schoenberger, 1991). In this study, pre-tests and questionnaires, which contained both close and open-ended questions, were designed to answer the research questions outlined in Chapter One (see Appendices A, B, C, and D).

An appropriate schema is needed for the structured analysis of map readability. Human visual perception is powerfully driven by the global organization of form. For example, the grouping of points, lines, and basic features will determine which kinds of patterns are noticed and whether symbols are seen as intended (MacEachren, 1995). In this study, the transparency of basic features on paper maps and the PPGIS map interface were compared using indicators of map analysis. These indicators were based on factors of feature groupings: proximity, similarity, good continuation, closure, and simplicity (Ellis, 1955).

Many researchers consider participant observation as a data-gathering technique which produces an "accurate" portrayal of case study phenomena (Yin, 1998). In participant observation, the investigator may take on variety of roles within a case study situation. Many have argued that such a perspective is invaluable in producing an "accurate" portrayal of case study phenomena (Yin, 1998). Concerning geomatics, Turk (1990) explains that a large amount of useful information and informal evidence can be obtained by observing people who operate GIS equipment. Over the course of the testing in this study, the principal researcher observed reactions from the participants while using the PPGIS tool and the traditional methods. Detailed field notes of these meetings and post-meeting reflections were kept in a journal. They were later coded and integrated with the other data sources. The methodological research design employed in this study is displayed in Figure 3.1.

**Figure 3.3:** Methodological research design used to evaluate the PPGIS tool and paper PP method involving members of lay public and expert planners




*Note: The sequence of participatory method testing and questionnaire delivery was switched (A↔B) for every lay participant

### *3.4.1 Limitations of Questionnaires, Observations, and Map Analysis*

The truthfulness and validity of the information obtained from questionnaires can be compromised in several ways. Questions asking for a response on multiple issues, affective wording or words that stimulate certain emotions, and complex questions can lead to incoherent and unnatural responses (Berg, 1989). Response patterns can also be influenced by the phrasing and sequencing of patterns. As recommended by Salant and Dillman (1994), in the field studies reported here the sequencing of questions and the language chosen for questions were carefully considered. More specifically, questionnaire questions were reviewed by the principal researcher and investigators of the UNBC GEOIDE node for simplicity, precision, and effectiveness.

Participant observation has two approaches. The first approach involves observation alone, while the second involves both observing and participating, to some degree, in a study. However, in the case of the latter option, the participant role may simply require too much attention relative to the observer role. Consequently, recording detailed observations can quickly become overwhelming and lead to misconceptions (Yin, 1998). Similarly, observing and participating in a study limits external observation which, in certain instances, creates a position of advocacy contrary to good scientific practices (Mack *et al.*, 2005). The researcher must remain objective within participant observation. In particular, the researcher must distinguish between reporting or describing what is observed (more objective) and interpreting what is seen (less objective) (Mack *et al.*, 2005). To minimize these sources of bias, the researcher attempted to remain objective when testing and observing participants. Additionally, in those cases that required a greater participatory role, observations were recorded immediately from memory after testing was completed.

MacEachren (1995) states that a map with no feature organization can prove to be harder to interpret than others. Hence, an appropriate feature schema for structuring map analysis is needed to accurately identify and understand feature groupings. In this study, each indicator of map analysis (see Section 3.4) was interpreted independently to reduce the uncertainty of feature grouping errors between maps.

Researchers should practice and review their roles and routines prior to conducting a study (Berg, 1989). In this case, the testing was conducted on sample participants prior to the case study and certain aspects were modified to allow for a simple and straightforward testing process. Berg (1989) states that a researcher's age, gender, ethnicity, dress, and speech mannerisms have been known to influence the effectiveness of the researcher-participant rapport. Throughout the testing process of this study, the researcher was mindful of participant mannerisms and attempted to retain a natural demeanour. Most interviewees seemed comfortable with the testing process. Participants were assured of the anonymity and confidentiality of their responses (see Appendix E). During the initial explanation phase, efforts were made to describe the purpose of the study and to provide clarification when needed.

### 3.5 Data Collection

Various trails groups and governmental agencies were contacted by email and general information concerning the research study was disclosed. Tests were conducted by the principal researcher between August. 13$^{th}$ and Sept. 17$^{th}$, 2006 in Smithers, BC. Individual testing was selected over group testing in an attempt to improve validity and reliability since each of the participant's thoughts and opinions would be unbiased by others. The exact location of each testing process was determined through an agreement between the researcher and the participant. In many cases, these locations consisted of offices, houses, or local community centers, such as libraries. The testing was conducted in person, and observations on participant behavior were recorded.

A basic training period describing the functioning of the PPGIS tool was verbally provided to participants. Participant questions were answered by the principal researcher throughout their use of the tool.

The lay participant testing included the writing of a pre-test to determine participants' computer literacy followed by the use of either the paper public participation (PP) method or the PPGIS tool, and lastly, the writing of a questionnaire concerning their use of the participatory method. In order to minimize bias, the participatory method testing sequence was switched for every participant. For example, Participant 1 would use the paper PP method followed by the PPGIS tool, whereas Participant 2 would use the PPGIS tool followed by the paper PP method. Lay participants were asked to provide knowledge on at least one of three aspects concerning recreational areas within the Bulkley Valley: Potential Recreational Areas; Maintenance and Upkeep of Existing Recreational Areas; and Access Issues with Existing Recreational Areas. The duration of the tests for the lay participants was approximately 60 to 90 minutes.

Expert planner testing included the writing of a pre-test, the use of the PPGIS tool, and the completion of a questionnaire. Expert planners did not use the paper PP method since they were assumed to have had prior experience utilizing numerous traditional participatory methods. However, for comparison purposes, the procedure for collecting lay participant information using the paper PP method was explained to each expert planner. Expert planners were asked to consider the ability of the PPGIS tool to gather information from lay participants based on the three aspects of recreational areas listed above. The duration of the testing for the expert planners was approximately 45 to 70 minutes.

### 3.6 Data Analysis

The purpose of the research being undertaken, to a large extent, directs the analysis of qualitative results (Punch, 2005; Ulin *et al.*, 2005). Deriving qualitative results involves several steps (Neumann, 2003) including examining, coding, categorizing, reducing, and interpreting data. A clear and structured approach to following these steps is essential to the effective analysis of qualitative data. Rubin and Babbie (2005) describe a structured approach to data analysis which includes processing the data, followed by the interpretation of data through descriptive or inferential data analysis. An effective qualitative data processing technique, content analysis, allows the researcher to gather and analyze a content of text (Neumann, 2003). Once data have been analyzed, a statistical method is needed to present a quantitative description of the data in a manageable form. Descriptive statistics summarize a set of sample observations, whereas inferential statistics move beyond the description of specific observations to make inferences about a larger population (Rubin and Babbie, 2005). Due to the small sample size and exploratory nature of this study, descriptive statistics were used. The phases of the data analysis are specified below.

### *3.6.1 Content Analysis*

Content analysis is a means of transforming qualitative material into quantitative data and can be applied to virtually any form of communication (Rubin and Babbie, 2005), in this case questionnaires and observations. Qualitative and quantitative analysis are often integrated in content analysis. Appropriate units of analysis of verbal or written information (e.g., words, sentences, themes) are classified into categories. Categories must be mutually exclusive and exhaustive to allow for replication (Neumann, 2003). Measurement of content involves careful and systematic observation based on a coding system. Coding systems typically identify one or more of four characteristics of text content: frequency, direction, intensity, and space (Neumann, 2003). A researcher is expected to employ selection criteria in the categorization of the text content. In adapting selection criteria, researchers must consider the type of content to be analyzed. Manifest content refers to countable elements that are visible in surface content, whereas latent content refers to the underlying, implicit meaning in the content of the text (Neumann, 2003). Latent content may lead to a loss of reliability and specificity (Rubin and Babbie, 2005). However, Berg (1989) believes that since latent and manifest content need not be mutually exclusive, similar coding processes can be employed for both.

In the present study, a coding scheme based on units of analysis was developed to assist in the coding and categorization of text content. Categories were developed based on the units of analysis of the text content within the research. In this case, units of analysis were defined based on qualities of each participatory method since they were the fundamental components of each participatory method that would have either enhanced or restricted public participation. Remaining text content was judged against existing categories, and if no link was found, a new category was formed. Categories were grouped based on specified key points of the research. Each of these aspects of text were coded by the principal researcher.

Statistical Package for the Social Sciences (SPSS) Version 15.0 analyzed the data. Data analysis for the lay sample and expert planner sample was completed separately. Generally, responses were coded for each questionnaire during field research. Following field research, some open-ended responses were coded and transcription errors were checked. The questionnaire allowed manifest content to be easily detected due to the straightforward and clear nature of the questions, while latent content became more apparent during the cross-comparative analysis. During data entry phase, Likert scale questions were reassigned codes (using SPSS) from response categories to numerical codes so that a negative response would correspond with a low numerical code. For example, on a 5-point scale, "very hard" would receive a score of 1. Questions that incorporated greater detail were assigned a 7-point scale, rather than a 5-point scale, to further enhance the measurement of participant opinions.

Reliability of data analysis needs to be carefully considered during the classification of categories. The choice of category classification may differ from one coder to another for the same unit of analysis. Therefore, if a researcher uses a number of coders, then there must be a set of parameters within the coding system which allows checking for consistency across coders (Neumann, 2003). Similarly, when a coding process occurs over an extended period (e.g., three months), the researcher must check the stability reliability by recoding samples of text which were previously coded (Neumann, 2003). Cronbach's Alpha coefficient can be used to measure the overall reliability of the categorical classification, ranging between 0 and 1 (De Vaus, 2002). Cronbach's Alpha coefficients were calculated for lay sample and expert planner sample separately. Generally a value of 0.7 or higher indicates a reliable scale (DeVellis, 1991). In this study, Cronbach's coefficient was calculated to a value of 0.73.

#### *3.6.2 Interpretation*

Following the coding process, data reduction occurs, which further reduces data into more manageable portions. In this case, the themes and categories were further examined with respect to the Enhanced Adaptive Structuration Theory 2 (Nyerges and Jankowski, 2001). Furthermore, Punch (2005) states that theoretical comparisons of results can occur through both qualitative and quantitative data. A commonly used descriptive statistical technique, frequency distributions, was used to quantify the results of content analysis. Frequency distribution refers to the reviewing and adding of the number of cases that instantiate a specific themes or variables in question (Rubin and Babbie, 2005).

Data interpretation involves a comprehensive understanding of the data which involves knowledge of the previous phases of analyses and existing theories. However, there has yet to be any widespread accepted set of rules for the process of data interpretation. The main focus of data interpretation involves linking ideas and relationships to one another through coding, and drawing conclusions from these relationships. Ulin *et al.* (2005) suggest that this process explains how a system of concepts and themes is linked to relevant theories. Conceptual linkages can fill in theoretical gaps as well as answer existing questions.

### *3.7 Limitations of Data Analysis*

Potentially, several limitations can affect qualitative data analysis. For example, the use of content analysis restricts the researcher to examining recorded communications (Rubin and Babbie, 2005). To minimize the effect of this limitation, alternative evaluation methods (e.g., map analysis) were used in combination with content analysis. Rubin and Babbie (2005) state that the reliability and validity of the data analysis technique chosen can both influence the concreteness and generalizability of the research findings. In this case, non-random samples preclude generalization to populations outside the study.

Validity is threatened when a researcher extends relationships from frequency distributions of categories to complex theories and concepts (Punch, 2005). In this study, causal inferences, discussed within the discussion sections of Chapters 4, 5, and 6, are taken to be merely suggestive.

A common form of bias involves the development of unrelated categories and the analysis solely of data which supports the researcher's preferred outcome (Holsti, 1969; Babbie, 1995). The use of a fixed system of rules and parameters can allow a researcher to reduce the amount of subjective classifications (Holti, 1969). In this case, as described in section 3.6.1, the researcher carefully followed well-defined rules and parameters during the classification, verification, and exclusion of categories. Categorization of words and phrases required that they match written descriptors of the categories (See Appendix F for descriptors).

# Chapter 4: Results for Lay Sample

This chapter presents results from fieldwork with the samples drawn from lay members of the public. The "public" results are organized according to the research question they are meant to answer. Each section is sub-divided into results and discussion. Results sections focus on the direct outcomes of content analysis and discussion sections describe interesting findings, provide insight into relationships among the data, and discuss literature related to the findings.

## 4.1 Demographic Results

In total, 21 members of the public participated in tests involving both the PPGIS tool and the paper PP method. Educational backgrounds of participants ranged from high school to postgraduate education (Table 4.1). Lay participants' educational background were compared with these of members of the public within the Bulkley-Nechako Regional District (BC STATS, 2001). Educational background was categorized according to the highest level of education achieved, defined as follows: bachelor's degree or higher; some university; completed diploma; some diploma; completed high school; some high school; and less than high school.

| Table 4.1: Educational attainments of lay members of the public participating in study and the Bulkley-Nechako Regional District | | | |
|---|---|---|---|
| | **No. of lay participants** | **Percentage of lay participants** | **Percentage of members of the public from the Bulkley-Nechako Regional District*** |
| **Highest level of education achieved** | | | |
| *Bachelor's degree or higher* | 8 | 38.1% | 9.8% |
| *Some University* | 4 | 19.0% | 6.3% |
| *Completed Diploma* | 1 | 4.8% | 28.8% |
| *Some Diploma* | 3 | 14.3% | 7.5% |
| *Completed High School* | 5 | 23.8% | 15.3% |
| *Some High School* | 0 | 0% | 24.0% |
| *Less than Grade Nine* | 0 | 0% | 8.4% |

*Source: BC Stats (2001) (http:*//www.bcstats.gov.bc.ca/data/cen01/profiles/59051000.pdf)*

The majority of lay participants had at least some post secondary education. On average, lay participants exhibited higher educational attainments than the general public within the Bulkley-Nechako Regional District.

For the purposes of this study, age was categorised into eight intervals. The age distribution of the group ranged from 0-19 to 65-74, with 55-64 having the highest number of participants (Table 4.2).

| Table 4.2: Age categories of lay participants | |
|---|---|
| | **No. of participants** |
| **Age** | |
| *0-19* | 3 |
| *20-24* | 2 |
| *25-34* | 4 |
| *35-44* | 3 |
| *45-54* | 3 |
| *55-65* | 5 |
| *65-74* | 1 |
| **Total** | 21 |

In making comparisons between age (Table 4.2) and educational attainments (Table 4.1), the figures for the lay sample and Bulkley populations are incommensurable because, generally speaking, the 0-19 age group have not had time to complete the same levels of education. The lay public group was composed of 10 males and 11 females. Of these 21 participants, only 2 indicated that they were colour blind.

Lay participants were classified into five occupational categories (Table 4.8): Sales/Services, which includes participants that work in the sales or service industry; Clerical/Admin, which includes participants that are involved in clerical or administrative work; Trades, Primary and Manufacturing, which includes participants whose occupation involves trades, manufacturing, and work within primary industry; Professional Management, which includes participants who work in a management or professional occupation; and Unemployed, which includes participants who are retired or otherwise not in the work force (McGuckin and Nakamoto, 2004). There was roughly an even distribution of participants within the various occupational categories.

| Table 4.8: Distribution of lay participants within various occupational categories | |
|---|---|
| | **Number of participants** |
| **Occupational category** | |
| *Sales/Services* | 5 |
| *Clerical/Admin* | 3 |
| *Trades, Primary, Manufacturing* | 5 |
| *Professional and Management* | 3 |
| *Unemployed* | 4 |

Participants were asked in which kinds of planning processes they had previously participated, with examples including: Official Community Plan (OCP), which addresses the long term vision for the community; National Park Plan, which guides management of

National Parks and Historic Sites; Provincial Park Plan, which guides management of Provincial Parks and Historic Sites; Forest Plan, which guides management of urban and regional forests; Lands and Resources Management Plan (LRMP), which provides strategic level direction for managing Crown land resources and identifies ways to achieve community economic, environmental, and social objectives; and Sustainable Resource Management Plan (SRMP), which presents objectives and strategies for the sustainable management of resources within a particular region (Table 4.3). Of the 21 participants, 10 participants had previously participated in a planning process.

**Table 4.4: Previous participation in various planning processes by the lay participants**

| | **No. of individuals** |
|---|---|
| **Planning process** | |
| *OCP* | 4 |
| *LRMP* | 4 |
| *Provincial Park Plan* | 1 |
| *Forest Plan* | 1 |
| *SRMP* | 1 |
| *National Park Plan* | 1 |

For the purpose of comparing the participants' knowledge of and ability with computer and traditional participatory tools, the frequency of the lay participants' use of computers, paper maps, and computer-based maps over a year was measured (Table 4.4).

| Table 4.5: Lay participant use of computers, paper maps and computer-based maps | | | |
|---|---|---|---|
| | Number of participants | | |
| | Computers | Paper maps | Computer-based maps |
| **No. of times per year** | | | |
| *0 times a year* | 0 | 0 | 4 |
| *1-5 times a year* | 1 | 5 | 3 |
| *6-10 times a year* | 0 | 0 | 3 |
| *11-15 times a year* | 0 | 0 | 1 |
| *16-25 times a year* | 1 | 2 | 2 |
| *26-35 times a year* | 0 | 1 | 3 |
| *36-50 times a year* | 0 | 3 | 1 |
| *Over 50 times a year* | 19 | 10 | 4 |
| **Total** | 21 | 21 | 21 |

Lay participants' use of paper maps was over twice the amount of their use of computer-based maps in a year. Computer-based maps were used with no specific pattern ranging across all classes. Nearly all of the participants used a computer over fifty times a year.

Each of the lay participants completed a pre-test that examined their map literacy, computer icon knowledge and PPGIS knowledge (Table 4.5). The pre-test measured the participants' ability to read various components of a map, such as a legend. The computer icon section measured the participants' ability to understand the use of various computer icons relating to the use of computer-based maps. The PPGIS feature section measured participants' familiarity with various PPGIS features (e.g., polygons, arcs, points).

| Table 4.6: Distribution of scores in the lay participant map literacy pre-test | | | | | | |
|---|---|---|---|---|---|---|
| | **No. of participants** | **No. of questions** | **Minimum correct** | **Maximum correct** | **Mean** | **Std. deviation** |
| **Pre-test sections** | | | | | | |
| *Map literacy* | 21 | 7 | 6 | 7 | 6.95 | 0.22 |
| *Computer icons* | 21 | 8 | 3 | 8 | 6.81 | 1.83 |
| *GIS features* | 21 | 4 | 0 | 4 | 2.33 | 1.68 |
| **Total** | 21 | 19 | 9 | 19 | 16.10 | 2.88 |

The minimum correct score for the all sections combined was 9 and the maximum was 19, with a mean score of approximately 16.

Prior to the participatory method test, participants were asked to provide ratings on the qualities of computer-based and paper maps, from which scores were tabulated on the following variables: difficulty of use, quality of design, amount of relevant information and efficiency. The frequency of the lay participants' ratings on the four variables relating to performance of computer-based maps is outlined in Table 4.6.

| Table 4.7: Lay participant ratings of the difficulty of use, quality of design, amount of relevant information, and efficiency of computer-based maps | | | | |
|---|---|---|---|---|
| | **Difficulty of use** | **Quality of design** | **Amount of relevant information** | **Efficiency** |
| **Rating** | | | | |
| *Very low* | 4 | 1 | 1 | 1 |
| *Low* | 6 | 1 | 1 | 1 |
| *Fairly low* | 0 | 1 | 1 | 0 |
| *Neutral* | 3 | 1 | 2 | 2 |
| *Fairly high* | 3 | 7 | 2 | 8 |
| *High* | 0 | 6 | 9 | 5 |
| *Very high* | 2 | 1 | 2 | 1 |
| **Total** | 18 | 18 | 18 | 18 |

Three of the 21 lay participants believed they should not provide their opinion on the qualities of computer-based maps since they lacked PPGIS knowledge and experience. Of the 18 remaining lay participants, over half stated that they thought computer-based maps had a *Low* to *Very low* difficulty of use. In addition, the majority of lay participants indicated that PPGIS map quality of design, amount of relevant information and efficiency were at the higher end of the scale. Frequencies of the lay participants' ratings on the four variables relating to qualities of paper maps are outlined in Table 4.7.

**Table 4.8: Lay participant ratings on the difficulty of use, quality of design, amount of relevant information, and efficiency of paper maps**

| | **Difficulty of use** | **Quality of design** | **Amount of relevant information** | **Efficiency** |
|---|---|---|---|---|
| **Rating** | | | | |
| *Very low* | 10 | 1 | 1 | 0 |
| *Low* | 5 | 0 | 0 | 0 |
| *Fairly low* | 3 | 2 | 0 | 0 |
| *Neutral* | 1 | 3 | 4 | 7 |
| *Fairly high* | 2 | 3 | 5 | 2 |
| *High* | 0 | 9 | 9 | 7 |
| *Very high* | 0 | 3 | 2 | 5 |
| **Total** | 21 | 21 | 21 | 21 |

The majority of participants (18/21) rated paper maps as having a *Fairly low* to *Very low* difficulty of use. In addition, the majority of the participants indicated that the paper maps had a *Fairly high* to *Very high* quality of design, amount of relevant information, and efficiency.

## 4.2 Results from Tests of Paper Public Participation (PP) Method

### *4.2.1 Statement of Research Question(s) Addressed*

This section presents results from lay sample tests of the traditional public participatory method of providing information which primarily relate to research questions one and two (See section 1.2). Results bear on the overall performance, ability to provide information, orientation, and the pleasing/irritating aspects of the paper PP method. In addition, results are provided on participants' reasons for their failure to complete tasks and their opinions about changes needed to improve the traditional participatory methods.

### *4.2.2 Analysis of Data*

Lay participants rated the overall performance of the paper PP method of providing information. Ratings were classified into four main groups: difficulty of use, quality of design, amount of relevant information, and efficiency (Table 4.9).

**Table 4.9: Lay participant ratings on the difficulty of use, quality of design, amount of relevant information, and efficiency of the paper PP method**

| | Difficulty of use | Quality of design | Amount of relevant information | Efficiency |
|---|---|---|---|---|
| **Rating** | | | | |
| *Very low* | 8 | 2 | 2 | 1 |
| *Low* | 3 | 0 | 0 | 2 |
| *Fairly low* | 5 | 2 | 0 | 1 |
| *Neutral* | 4 | 1 | 3 | 3 |
| *Fairly high* | 1 | 6 | 6 | 3 |
| *High* | 0 | 4 | 5 | 6 |
| *Very high* | 0 | 5 | 5 | 5 |
| **Total** | 21 | 21 | 21 | 21 |

The majority of participants (16/21) indicated that the paper PP method had a *Fairly low* to *Very low* difficulty of use. The quality of design was rated as *Fairly high* to *Very high* by 15/21 participants. The amount of relevant information was indicated as *Fairly high* to *Very high* by 16/21 participants. Lastly, 14/21 lay participants rated the paper PP method as having a *Fairly high* to *Very high* efficiency.

Participants were invited to rate the paper PP method of presenting cartographic information according to a Likert-type scale with five intervals, on eight qualities (Table 4.10). A positive rating corresponds with a rating of *Strongly Agree* or *Agree*, while a negative rating corresponds with a rating of *Strongly Disagree* or *Disagree.*

**Table 4.10: Lay participant ratings on descriptors concerning the paper PP method**

| | *Strongly Disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| ***Qualities** | | | | | |
| *Simple* | 1 | 2 | 4 | 6 | 6 |
| *Useful* | 0 | 2 | 2 | 8 | 9 |
| *Quick* | 1 | 5 | 1 | 7 | 7 |
| *Informative* | 0 | 2 | 3 | 9 | 7 |
| *Friendly* | 0 | 1 | 6 | 7 | 7 |
| *Comfortable* | 1 | 0 | 6 | 8 | 6 |
| *Interesting* | 0 | 4 | 2 | 8 | 7 |
| *Easy* | 0 | 3 | 2 | 11 | 5 |
| *Trustable* | 0 | 2 | 4 | 14 | 1 |
| *Enjoyable* | 1 | 6 | 1 | 10 | 3 |
| **Total** | 4 | 27 | 31 | 88 | 58 |

*See Appendix F for descriptors

Overall, lay participants expressed positive ratings for each of the qualities regarding the paper PP method. Participants' ratings on the difficulty of sketching their spatial knowledge on a paper map are outlined in Table 4.11.

| Table 4.11: Lay participant ratings on difficulty of sketching a trail or area on the paper maps | | |
|---|---|---|
| | **No. of ratings** | **Percentage of all participants** |
| **Perceived level of difficulty** | | |
| *Very hard* | 1 | 4.8% |
| *Hard* | 0 | 0% |
| *Fairly hard* | 2 | 9.5% |
| *Neutral* | 3 | 14.3% |
| *Fairly easy* | 5 | 23.8% |
| *Easy* | 7 | 33.3% |
| *Very easy* | 3 | 14.3% |
| **Total** | 21 | 100% |

The majority of participants (15/21) believed that it was *Fairly easy* to *Very easy* to draw a trail or area on the paper maps. Lay participants were asked to rate their ability to shift between various maps while attempting to complete their tasks. Participants rated their level of speed when moving between various paper maps (Table 4.12).

| Table 4.12: Lay participant ratings of speed in moving between various paper maps | | |
|---|---|---|
| | **No. of ratings** | **Percentage of all ratings** |
| **Level of speed** | | |
| *Very slow* | 0 | 0 |
| *Slow* | 2 | 10.5% |
| *Fairly slow* | 2 | 10.5% |
| *Neutral* | 5 | 26.3% |
| *Fairly quick* | 2 | 10.5% |
| *Quick* | 3 | 15.8% |
| *Very quick* | 5 | 26.3% |
| **Total** | 19 | 100% |

Slightly over half of the participants (10/19) felt that they could quickly move between the paper maps. However, over one-fourth of the lay participants (5/19) indicated a *neutral* ease of movement between the various paper maps. The amount of information that the participants provided about recreational areas while using the paper PP method is outlined in Table 4.13.

**Table 4.13: Frequency of lay participants ratings of amount of information provided about trails within the Bulkley Valley by the paper PP method**

| | **Frequency of ratings** | **Percentage of all ratings** |
|---|---|---|
| **Descriptors of amount of information provided** | | |
| *Info provided - none* | 4 | 19% |
| *Info provided - very little* | 1 | 4.8% |
| *Info provided - little* | 2 | 9.5% |
| *Info provided - fair* | 5 | 23.8% |
| *Info provided - large* | 5 | 23.8% |
| *Info provided - very large* | 3 | 14.3% |
| *Info provided - a lot* | 1 | 4.8% |
| **Total** | 21 | 100% |

Lay participants were asked to rate their ability to orient themselves using paper maps. Various features were used to test the participants' ease of orientation. These features included: Lakes, Roads, Mountains, and Existing trails (Table 4.14).

| Table 4.14: Lay participant ratings on their ease of orientation towards features on paper maps | | | | | | |
|---|---|---|---|---|---|---|
| | **Lakes** | **Roads** | **Mountains** | **Existing trails** | **Total** | **Percentage of total participant ratings** |
| **Descriptor chosen for ease of orientation** | | | | | | |
| *Very slow* | 0 | 0 | 1 | 1 | 2 | 2.4% |
| *Slow* | 0 | 0 | 0 | 0 | 0 | 0% |
| *Fairly slow* | 0 | 0 | 1 | 1 | 2 | 2.4% |
| *Neutral* | 1 | 3 | 4 | 0 | 8 | 9.8% |
| *Fairly quick* | 2 | 4 | 3 | 3 | 12 | 14.6% |
| *Quick* | 5 | 6 | 4 | 7 | 22 | 26.8% |
| *Very quick* | 13 | 8 | 6 | 9 | 36 | 43.9% |

Nearly all of the lay participants indicated they oriented themselves *Fairly quick* to *Very quick* to the lakes (20/21), roads (18/21), mountains (13/19) and existing trails (19/21). Of the 82 ratings collected, seventy (70/82) ratings indicated that the lay participants orientated themselves *Fairly quick* to *Very quick*.

Participants identified numerous pleasing aspects of using the paper PP method. Each of the pleasing aspects was coded into categories listed in Table 4.15. The methodology of coding aspects into categories within Tables 4.16, 4.17, 4.19, and 4.20 was earlier explained in Chapter 3.

| Table 4.15: Aspects of the paper PP method that pleased lay participants | | |
|---|---|---|
| | **Frequency with which aspect was cited** | **No. of times aspect was cited, as a percentage of all times aspects were cited** |
| **Categories of pleasing aspects of the paper PP method** | | |
| *Overall perspective (e.g., no screen movement needed)* | 8 | 25% |
| *Quick orientation* | 5 | 15.6% |
| *Familiar* | 5 | 15.6% |
| *Portable* | 3 | 9.4% |
| *Quick sketching of trails or areas* | 2 | 6.3% |
| *Applied use (e.g., hands on)* | 2 | 6.3% |
| *Quick ability to provide knowledge* | 2 | 6.3% |
| *Simple quality of design* | 2 | 6.3% |
| *Easy to understand* | 1 | 3.1% |
| *No comment* | 2 | 6.3% |
| **Total** | 32 | 100% |

In total, there were 32 instances of lay participants citing some pleasing aspect of the paper PP method. Those instances were coded into 10 categories. Overall perspective (8/32) of the map area was the category of pleasing aspect most commonly invoked by the lay participants. For example, three participants mentioned that the paper maps provided a "bird's eye view" of the whole research area.

Lay participants identified numerous irritating aspects of the paper PP method. Irritating aspects were coded into categories. The frequency with which each of the categories of irritating aspects was mentioned is outlined Table 4.16.

| Table 4.16: Aspects of the paper PP method that irritated lay participants | | |
|---|---|---|
| | **Frequency of irritating aspects** | **Percentage of irritating aspects** |
| **Categories of irritating aspects of the paper PP method** | | |
| *Features cannot be found* | 5 | 17.8% |
| *Scale cannot be changed* | 5 | 17.8% |
| *Permanence of paper maps(e.g., cannot edit digitizations or comments)* | 4 | 14.3% |
| *Paper maps are outdated* | 3 | 10.7% |
| *Paper maps cannot be shared without meeting* | 2 | 7.1% |
| *Paper maps are cumbersome* | 2 | 7.1% |
| *Information from public is inaccurate* | 2 | 7.1% |
| *Paper map is cluttered* | 1 | 3.6% |
| *Scale system is hard to understand* | 1 | 3.6% |
| *Information can be lost easily* | 1 | 3.6% |
| *No comment* | 4 | 14.3% |
| **Total** | 30 | 100% |

The majority of lay participants cited irritating aspects (e.g., permanence, can't change scale) that related to the inflexibility of paper maps. Certain roads or trails may have been not shown on the paper maps because those maps were outdated. Several lay participants (4/30) indicated that the permanence of the paper maps was a cause of irritation. More specifically, information provided by the participant was difficult to change or edit once provided.

Participants identified up to five tasks that they tried to complete when using the paper PP method. Tasks were coded to form categories. The number of times each category of task was attempted is outlined in Table 4.17.

| Table 4.17: Categories of tasks lay participants attempted to complete while using the paper PP method | | |
|---|---|---|
| | **No. of occasions on which tasks in category were attempted by participants** | **Percentage of all tasks attempted** |
| **Categories of tasks attempted by participants** | | |
| *Sketch a trail* | 18 | 34.6% |
| *Write comments concerning a feature* | 17 | 25.4% |
| *Outline an area or boundary* | 15 | 28.8% |
| *Locate a landmark* | 5 | 9.6% |
| *Sketch a road* | 4 | 7.7% |
| *Locate a trail* | 4 | 7.7% |
| *Label a trail* | 1 | 1.9% |
| *Measure distance of a trail* | 1 | 1.9% |
| *Sketch a landmark* | 1 | 1.9% |
| *Determine a location* | 1 | 1.9% |
| **Total** | 67 | 100% |

Lay participants identified the number of tasks they did not complete while using the paper PP method (Table 4.18).

| Table 4.18: Tasks not completed by lay participants | | |
|---|---|---|
| | **No. of participants** | **Percentage of participants** |
| **No. of tasks completed** | | |
| *Completed all tasks* | 12 | 57.1% |
| *Failed to complete one task* | 5 | 23.8% |
| *Failed to complete two tasks* | 1 | 4.8% |
| *Failed to complete three tasks* | 1 | 4.8% |
| *No comment* | 2 | 9.5% |
| **Total** | 21 | 100% |

Lay participants identified the main causes that may have prevented them from completing their tasks. The frequencies of these causes are outlined in Table 4.19.

| Table 4.19: Reasons why lay participants did not accomplish tasks when using the paper PP method | | |
|---|---|---|
| | **No. of instances of this reason** | **Percentage of all reasons offered** |
| **Participants' reasons for not accomplishing tasks** | | |
| *Paper maps were unfamiliar* | 4 | 23.5% |
| *Task was out of map area* | 3 | 17.6% |
| *Paper maps were outdated (i.e. missing roads)* | 3 | 17.6% |
| *Trails not shown* | 1 | 5.9% |
| *Length could not be measured accurately* | 1 | 5.9% |
| *Cutblock and timber areas not classified* | 1 | 5.9% |
| *Elevation change difficult to recognize* | 1 | 5.9% |
| **Total** | 17 | 100% |

Participants identified aspects that should be changed within the paper PP method. The frequencies of kinds of aspects identified are outlined in Table 4.20.

| Table 4.20: Categories of change recommended by lay participants for the paper PP method | | |
|---|---|---|
| | **Instances of category of change** | **Percentage of all recommendations for change** |
| **Categories of lay participant recommendations for change** | | |
| *Map detail should be enhanced* | 6 | 46.2% |
| *Colors should be purer* | 2 | 15.4% |
| *Map should have more trails* | 1 | 7.7% |
| *Maps of more varying scales should be used* | 1 | 7.7% |
| *Questions about recreational ideas should be more detailed* | 1 | 7.7% |
| *Color pencils should be available for sketching of different features* | 1 | 7.7% |
| *Participant features should be better organized* | 1 | 7.7% |
| **Total** | 13 | 100% |

### *4.2.3 Discussion*

Initially, individuals who were members of trail groups (e.g., hiking, biking, etc.) were deemed relevant to this study. However, after difficulty was encountered in acquiring adequate numbers of participants from these groups, the study participants were expanded to include other members of the public who had knowledge or opinions concerning recreational areas within the Bulkley Valley

Lay participants exhibited a wide diversity of socio-economic characteristics. However, some of the lay participants involved in this study were found to have college or university level education, including postgraduate studies. Given that many studies have shown that high levels of education are related to high degrees of civic participation (Wolfinger and Rosenstone, 1980; Verba *et al.*, 1995; Nie *et al.*, 1996), this finding was expected.

Lay participants experienced a higher difficulty of use with computer-based maps than with paper maps. The quality of design, amount of relevant information, and efficiency of the paper and computer-based maps were rated similarly to one another with high performance attributed to each mapping method. Lay participants had more experience of paper maps than of computer-based maps. Since the development of computer-based maps is more recent than that of paper maps, this finding was to be expected. The higher difficulty of use with computer-based maps may be due to their lack of experience with those maps. Further implications of these findings are discussed within sections 5.2.3 and 6.1.

### 4.3 Results from the Tests of the PPGIS Method

#### *4.3.1 Statement of Research Question(s) Addressed*

This section describes the results from tests of lay participants' reactions to using the GEOIDE PPGIS tool which primarily relate to research questions one, two, three, and four. Results from this test are presented in parallel format to results from the test of the paper PP method.

#### *4.3.2 Analysis of Data*

Lay participants rated the overall performance of the PPGIS tool. Ratings were classified into four main groups which include: difficulty of use, quality of design, amount of relevant Information, and efficiency (Table 4.21).

**Table 4.21: Lay participant ratings on the difficulty of use, quality of design, amount of relevant information, and efficiency of the PPGIS tool**

| | Difficulty of use | Quality of design | Amount of relevant information | Efficiency |
|---|---|---|---|---|
| **Rating** | | | | |
| *Very low* | 3 | 0 | 1 | 0 |
| *Low* | 4 | 4 | 2 | 2 |
| *Fairly low* | 5 | 3 | 3 | 2 |
| *Neutral* | 4 | 3 | 2 | 5 |
| *Fairly high* | 2 | 4 | 9 | 3 |
| *High* | 2 | 4 | 1 | 2 |
| *Very high* | 1 | 3 | 3 | 7 |
| **Total** | 21 | 21 | 21 | 21 |

Over half of the lay participants (12/21) indicated that the PPGIS tool had a *Fairly low* to *Very low* difficulty of use. The quality of design was rated as *Fairly high* to *Very high* by eleven (11/21) lay participants. Thirteen (13/21) lay participants indicated that the PPGIS tool had a *Fairly high* to *Very high* amount of relevant information. Finally, twelve (12/21) lay participants rated the PPGIS tool as having a *Fairly high* to *Very high* efficiency.

Participants were invited to rate the PPGIS tool when presenting cartographic information according to a Likert-type scale with five intervals, on eight descriptors (Table 4.22). A positive rating corresponds with the descriptive factors on the right of the scale, while a negative rating corresponds with the descriptive factors on the left.

**Table 4.22: Lay participant ratings on descriptors concerning the PPGIS tool**

| | *Strongly disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly agree* |
|---|---|---|---|---|---|
| ***Qualities** | | | | | |
| *Simple* | 4 | 7 | 1 | 7 | 2 |
| *Useful* | 2 | 1 | 2 | 8 | 7 |
| *Quick* | 1 | 4 | 2 | 9 | 4 |
| *Informative* | 0 | 3 | 2 | 12 | 4 |
| *Friendly* | 1 | 3 | 3 | 9 | 5 |
| *Comfortable* | 2 | 3 | 4 | 8 | 3 |
| *Interesting* | 0 | 3 | 3 | 7 | 8 |
| *Easy* | 1 | 7 | 3 | 5 | 5 |
| *Trustable* | 0 | 7 | 2 | 9 | 3 |
| *Enjoyable* | 1 | 2 | 3 | 10 | 5 |
| **Total** | 12 | 40 | 25 | 84 | 46 |

*See Appendix F for descriptors

The lay participants expressed an overall positive rating for each of the descriptive factors regarding the PPGIS tool with exception of a negative rating for the *Simple* quality.

Lay participants' ratings on the ease or difficulty of digitizing a feature on the PPGIS tool map interface are outlined in Table 4.23.

| **Table 4.23: Lay participants ratings on difficulty of sketching a trail or area using the PPGIS tool** | | |
|---|---|---|
| | **Frequency of ratings** | **Percentage of all participants** |
| **Perceived level of difficulty** | | |
| *Very hard* | 0 | 0% |
| *Hard* | 1 | 4.8% |
| *Fairly hard* | 3 | 14.3% |
| *Neutral* | 4 | 19.0% |
| *Fairly easy* | 0 | 0% |
| *Easy* | 6 | 28.6% |
| *Very easy* | 7 | 33.3% |
| **Total** | 21 | 100.0% |

Thirteen lay participants (13/21) believed that it was *Fairly easy* to *Very easy* to digitize a trail or area using the PPGIS tool. Lay participants were asked to rate their ease of movement while using the PPGIS tool (Table 4.24).

| **Table 4.24: Lay participant ratings on ease of movement in use of the PPGIS tool** | | |
|---|---|---|
| | **No. of ratings** | **Percentage of all ratings** |
| **Level of speed** | | |
| *Very slow* | 0 | 0% |
| *Slow* | 3 | 14.3% |
| *Fairly slow* | 0 | 0% |
| *Neutral* | 5 | 23.8% |
| *Fairly quick* | 5 | 23.8% |
| *Quick* | 5 | 23.8% |
| *Very quick* | 3 | 14.3% |
| **Total** | 21 | 100% |

Over half of the participants (13/19) felt that they could quickly move through the PPGIS tool map interface. The amount of information each participant felt they provided while using the PPGIS tool is outlined in Table 4.25.

**Table 4.25: Frequency of lay participants ratings of amount of information provided about trails within the Bulkley Valley by the PPGIS tool**

| | **Frequency of ratings** | **Percentage of all ratings** |
|---|---|---|
| **Descriptors of amount of information provided** | | |
| *Info provided - none* | 0 | 0 |
| *Info provided - very little* | 2 | 9.5 |
| *Info provided - little* | 6 | 28.6 |
| *Info provided - fair* | 2 | 9.5 |
| *Info provided - large* | 7 | 33.3 |
| *Info provided - very large* | 2 | 9.5 |
| *Info provided - a lot* | 2 | 9.5 |
| **Total** | 21 | 100 |

The following section reports participants' ratings of their ability to orient themselves using the PPGIS tool. Various categories of features were used to test the participants' ease of orientation. These features included: Lakes, Roads, Mountains, and Existing trails (Table 4.26).

| Table 4.26: Lay participant ratings on their ease of orientation towards features on the PPGIS tool | | | | | | |
|---|---|---|---|---|---|---|
| | **Lakes** | **Roads** | **Mountains** | **Existing trails** | **Total** | **Percentage of total participant ratings** |
| **Descriptor chosen for ease of orientation** | | | | | | |
| *Very slow* | 1 | 1 | 5 | 4 | 11 | 13.1% |
| *Slow* | 2 | 2 | 1 | 3 | 8 | 9.5% |
| *Fairly slow* | 3 | 2 | 1 | 0 | 6 | 7.14% |
| *Neutral* | 5 | 1 | 6 | 0 | 12 | 14.3% |
| *Fairly quick* | 1 | 4 | 3 | 4 | 12 | 14.3% |
| *Quick* | 4 | 5 | 1 | 4 | 14 | 16.7% |
| *Very quick* | 5 | 6 | 4 | 6 | 21 | 25.0% |

The majority of lay participants indicated they orientated themselves *Fairly quicky* to *Very quick* to roads (15/21) and the existing trails (14/21). Their orientation towards lakes (9/21) was slightly directed towards *Fairly quickly* to *Very quickly*. However, the lay participants' ratings on their orientation towards *mountains* were roughly evenly distributed. A sum of 84 lay participant ratings was collected concerning the four factors indicated above. Overall, just over half of the lay participant (47/84) ratings indicated that they orientated themselves quickly.

Lay participants identified numerous pleasing aspects of using the PPGIS tool. Each of the pleasing aspects was coded into categories listed in Table 4.27. The methodology of coding aspects into categories within Tables 4.28, 4.29, 4.31, and 4.32 was earlier explained in Chapter 3.

| Table 4.27: Aspects of the PPGIS tool that pleased the lay participants | | |
|---|---|---|
| | **Frequency with which aspect was cited** | **No. of times aspect was cited, as a percentage of all times aspects were cited** |
| **Categories of pleasing aspects of the PPGIS tool** | | |
| *Digitization of trails* | 7 | 24.1% |
| *Ability to zoom in/out* | 5 | 17.2% |
| *User friendly* | 4 | 13.8% |
| *Knowledge can be shared easily* | 4 | 13.8% |
| *Ability to pan throughout screen* | 3 | 10.3% |
| *Comment board* | 2 | 6.9% |
| *Operation of tool was enjoyable* | 2 | 6.9% |
| *Comments can be added to the features* | 1 | 3.4% |
| *Layers of many features* | 1 | 3.4% |
| **Total** | 29 | 100.0% |

Lay participants identified numerous irritating aspects of the PPGIS tool. Each of the irritating aspects was coded into an appropriate category. The frequency with which each of the categories of irritating aspects was invoked is outlined in Table 4.28.

| Table 4.28: Aspects of the PPGIS tool that irritated the lay participants | | |
|---|---|---|
| | **Frequency of irritating aspects** | **Percentage of irritating aspects** |
| **Categories of irritating aspects of the PPGIS tool** | | |
| *Orientation is difficult* | 5 | 16.7% |
| *Visibility is poor* | 4 | 13.3% |
| *Detail of some features is poor* | 3 | 10.0% |
| *Contours were concealed at certain scales* | 2 | 6.7% |
| *Features were misnamed (e.g., mountains, creeks)* | 2 | 6.7% |
| *Digitization cannot be edited after submission* | 2 | 6.7% |
| *Message cannot be edited after submission* | 2 | 6.7% |
| *Comment board was disorganized* | 2 | 6.7% |
| *Information was difficult to access (e.g., participant comments and features)* | 2 | 6.7% |
| *Feature deletion would also result in message deletion* | 2 | 6.7% |
| *Legend is not present at all times* | 1 | 3.3% |
| *Training is required* | 1 | 3.3% |
| *Map feature has no link to comments on message board* | 1 | 3.3% |
| *Information tool malfunctioned* | 1 | 3.3% |
| *Map features are difficult to interpret* | 1 | 3.3% |
| **Total** | 30 | 100% |

Several lay participants cited it was difficult to orientate oneself while using the PPGIS tool (5/30). Of these five participants, two used paper maps to better orientate themselves when using the PPGIS tool. Four participants mentioned that the PPGIS tool had poor visibility (4/30). More specifically, the PPGIS tool displayed faint colors. These faint colors may be due to the operation of the PPGIS tool locally, rather than the university server. If the PPGIS tool is operated through the university server, then the colors are more pure and distinct whereas if operated locally, the colors become fainter.

It should be noted that the rural location of this case study was evident in the conduct of these tests. The majority of lay participants (14/21) lacked high-speed Internet access and transporting the appropriate materials to the household contributed to the inflexibility of the PPGIS tool.

Participants identified up to five tasks that they tried to complete when using the PPGIS tool. Tasks were coded to form categories. The number of times each category of task was attempted is outlined in Table 4.29.

**Table 4.29: Categories of tasks lay participants attempted to complete while using the PPGIS tool**

| | **No. of occasions on which tasks in category were attempted by Participants** | **Percentage of all tasks attempted** |
|---|---|---|
| **Categories of tasks attempted by participants** | | |
| *Digitize a trail* | 13 | 26.5% |
| *Add a comment* | 9 | 17.3% |
| *Locate an area (e.g., protected area)* | 8 | 16.3% |
| *Add a point* | 6 | 12.2% |
| *Zoom in/out* | 5 | 10.2% |
| *Outline an Area* | 4 | 8.2% |
| *Edit a message* | 4 | 8.2% |
| *Read peoples' comments* | 2 | 4.1% |
| *Identify certain areas (e.g., sighting of a bear)* | 1 | 2.0% |
| **Total** | 52 | 100.0% |

Participants identified the number of tasks they did and did not complete while using the PPGIS tool (Table 4.30).

| **Table 4.30: Tasks not completed by lay participants when using the PPGIS tool** | | |
|---|---|---|
| | **No. of participants** | **Percentage of participants** |
| **No. of tasks completed** | | |
| *Completed all tasks* | 10 | 47.6% |
| *Failed to complete one task* | 7 | 33.3% |
| *Failed to complete two tasks* | 0 | 0% |
| *Failed to complete three tasks* | 1 | 4.8% |
| *Failed to complete four tasks* | 1 | 4.8% |
| *Failed to complete five tasks* | 1 | 4.8% |
| *No comment* | 1 | 4.8% |
| **Total** | 21 | 100.0% |

Nearly half of the lay participants (10/21) completed all their tasks while 10 of the lay participants (7/21) indicated that they could not complete at least one of their tasks. Although the lay participants were provided with basic training on the PPGIS tool, many of the participants required the researcher's assistance to complete many of their tasks.

Lay participants identified the main causes that may have prevented them from completing their tasks. The frequencies of these causes indicated by the lay participants are outlined in Table 4.31.

| Table 4.31: Reasons why lay participants did not accomplish tasks when using the PPGIS tool | | |
|---|---|---|
| | **No. of instances of reasons** | **Percentage of all reasons offered** |
| **Participants' reasons for not accomplishing tasks** | | |
| *Unclear visuals* | 3 | 23.1% |
| *Computer mapping/GIS is unfamiliar* | 2 | 15.4% |
| *Trail is difficult to digitize* | 2 | 15.4% |
| *Roads and trails are difficult to decipher* | 2 | 15.4% |
| *Comment cannot be edited* | 1 | 7.7% |
| *Map lacks detail* | 1 | 7.7% |
| *Landmarks are lacking* | 1 | 7.7% |
| *Features are misnamed* | 1 | 7.7% |
| **Total** | 13 | 100% |

Participants identified aspects that should be changed within the PPGIS tool. Map detail refers to presence of basic features (e.g. streams) throughout the map display. The frequency counts for mentions of those aspects are outlined in Table 4.32.

| Table 4.32: Categories of change recommended by lay participants for the PPGIS tool | | |
|---|---|---|
| | **Instances of category of change** | **Percentage of all recommendations for change** |
| **Categories of lay participant recommendations for change** | | |
| *Participant features should be linked comments* | 6 | 16.2% |
| *Map detail should be enhanced* | 5 | 13.5% |
| *Comment should be able to be edited/deleted* | 4 | 10.8% |
| *Contours should be visible at all scales* | 3 | 8.1% |
| *Colors of participant features should be different* | 3 | 8.1% |
| *Overview map should be present* | 3 | 8.1% |
| *Colors should be clearer* | 3 | 8.1% |
| *Larger features should be represented over many small features* | 3 | 8.1% |
| *Comment board should be organized* | 2 | 5.4% |
| *Characters within comment board should be limited* | 1 | 2.7% |
| *Mouse wheel should zoom in/out* | 1 | 2.7% |
| *Roads should be represented with a thicker line* | 1 | 2.7% |
| *Feature "label" should pop-up when scrolling over* | 1 | 2.7% |
| *"Opinion" and "fact" should to be separated* | 1 | 2.7% |
| **Total** | 37 | 100% |

### *4.3.1 Discussion*

Lay participants benefited from the paper PP method's familiarity and ease of use. However, the lack of detail (e.g., zoom in/out) and permanence of paper maps as compared to the PPGIS tool restricted the participant's ability to understand and provide knowledge about a specific area.

The ease of using paper maps may be attributed, in part, to the lay participants' relatively abundant experience with paper maps. The relatively high level of experience with paper maps allowed the participants to adapt to the paper PP method quickly. Furthermore, paper maps offer a quick way to undertake map work (Wood, 2005). Ease of use can be related to the relative simplicity of paper maps. Simplicity decreases training time and it provides the participant with the ability to focus on the planning process rather than on the participatory method itself (Al-Kodmany, 2002). Although some participants were unfamiliar with topographic maps, many understood the basics of map reading, which allowed them to adjust quickly to the maps. However, paper maps are less sophisticated for performing analysis (Al-Kodmany, 2002). Generally, a great deal of effort is required by the map user to access information from a paper map (Peterson, 1995). In addition, paper maps cannot store data to the extent of a GIS database and, as a result, their information is more prone to loss or a more limited presentation.

A combination of reasons may explain why lay participants' find using the paper PP method of map work easy. First, the overall perspective that results from the relatively large map size of paper maps assists the participants when identifying features or areas. MacEachren (1995) explains that the size of "features" on a display will correspond with the geographic scale of features in the real world. This explanation suggests that the proximity of one feature to another over the large map surface provides the participants with an accurately scaled "bird's eye view" that assists in their orientation. Secondly, the portability of paper maps allows the user to handle the maps at almost any time or place. Reilly *et al.* (2006) found that computer science students preferred using paper maps over computer-based maps, in part, because of the paper maps ability to simply compact (fold up) and transport. Thirdly, the tangible or "hands-on" use of the paper maps was perceived as a benefit. Traditional methods such as pen and paper sketching, paper maps, photographs, and physical models draw forth high levels of participation and input from planning process participants (Al-Kodmany, 2002; Reilly *et al.*, 2006). High levels of participation can also be credited to real-time social interaction between participants (Arias, 1996).

The design of a map should focus not just on the reader's map-use needs but also on understanding the maps user's cognitive processes, skills, and abilities (Kolacny, 1969). In this case, the majority of participants who disliked using the PPGIS tool had very little or no prior experience using computer-based maps. In addition, many of those participants who had little or no prior experience with computer-based maps were within the 55-64 and 65-74 age categories. Wood (2005) discovered many older participants indicated they were too old to learn a new computer-based participatory method. Similarly, in this study several participants from the 64-75 age category stated their reluctance to learn to use the PPGIS tool. MacEachren (1995) argues the perceptual and cognitive processes of humans involved in map "reading" and spatial information processes need to be ascertained so that maps can be designed appropriately. In this study, many lay participants exhibited low GIS feature knowledge which, along with their lack of experience with computer-based maps, suggests that the PPGIS tool should be designed specifically for users who lack GIS knowledge.

# Chapter 5: Results for Expert Planner Sample

## 5.1 Demographic Results

The planner sample in this study was composed of ten individuals. Planners worked in occupations related to recreation, forestry, land use, and GIS analysis. Educational backgrounds categorized according to the level of education achieved are outlined in Section 4.1. Educational levels of the expert planners is outlined in Table 5.1, and compared with those of members of the public from within the Bulkley-Nechako Regional District (BC STATS, 2001).

**Table 5.1: Educational attainments of expert planners participating in study and members of the public of Bulkley-Nechako Regional District**

| | **No. of expert planners** | **Percentage of expert planner** | **Percentage of members of the public from the Bulkley-Nechako regional district*** |
|---|---|---|---|
| **Highest level of education achieved** | | | |
| *With bachelor's degree or higher* | 9 | 90% | 9.8% |
| *Some university* | 0 | 0% | 6.3% |
| *Completed diploma* | 1 | 10% | 28.8% |
| *Some diploma* | 0 | 0% | 7.5% |
| *Completed high school* | 0 | 0% | 15.3% |
| *Some high school* | 0 | 0% | 24.0% |
| *Less than grade nine* | 0 | 0% | 8.4% |

*Source: BC Stats (2001) (http:*//www.bcstats.gov.bc.ca/data/cen01/profiles/59051000.pdf)*

Of the ten expert planners, six (6/10) were male and four (4/10) were female. For the purposes of this study, the age groups were categorized in the same way as the lay participants (Table 5.2).

**Table 5.2: Age categories of expert planners**

| | No. of participants |
|---|---|
| **Age** | |
| *0-19* | 0 |
| *20-24* | 0 |
| *25-34* | 1 |
| *35-44* | 3 |
| *45-54* | 5 |
| *55-65* | 1 |
| *65-74* | 0 |
| **Total** | 10 |

Expert planners' ages ranged from 25-34 to 55-65, with the mode within the 45-54 age group. As with the lay participants (see Table 4.3), the expert planners were asked which kinds of planning processes they had previously participated in (Table 5.4).

**Table 5.3: Previous participation in various planning processes by the expert planners**

| | No. of individuals |
|---|---|
| **Planning process** | |
| *LRMP* | 9 |
| *SRMP* | 5 |
| *Forest Plan* | 5 |
| *Provincial Park Plan* | 2 |
| *Official Community Plan* | 1 |
| *National Park Plan* | 0 |

For purposes of comparing the expert planners' knowledge of and ability with computer and traditional tools, the frequency of the planners' use of computer, paper, and computer-based maps over a year was measured (Table 5.4).

| Table 5.4: Expert planner use of computers, paper maps and computer-based maps | | | |
|---|---|---|---|
| | **Number of participants** | | |
| | **Computer use** | **Paper maps** | **Computer-based maps** |
| **No. of times per year** | | | |
| *0 times a year* | 0 | 0 | 0 |
| *1-5 times a year* | 0 | 0 | 0 |
| *6-10 times a year* | 0 | 0 | 0 |
| *11-15 times a year* | 0 | 0 | 1 |
| *16-25 times a year* | 0 | 1 | 1 |
| *26-35 times a year* | 0 | 1 | 1 |
| *36-50 times a year* | 0 | 2 | 1 |
| *Over 50 times a year* | 10 | 6 | 7 |
| **Total** | 10 | 10 | 10 |

All of the ten expert planners indicated that they used computers over fifty times a year, while the majority of planners indicated that they used both paper (6/10) and computer-based maps (7/10) over fifty times a year.

Each of the expert planners completed the same pre-test administered to the lay participants (see section 4.1), measuring map literacy, computer icon knowledge and GIS knowledge (Table 5.5).

| Table 5.5: Distribution of scores in the expert planner map literacy pre-test | | | | | | |
|---|---|---|---|---|---|---|
| | **No. of participants** | **No. of questions** | **Minimum correct** | **Maximum correct** | **Mean** | **Std. deviation** |
| **Pre-test sections** | | | | | | |
| *Map literacy* | 10 | 7 | 6 | 7 | 6.90 | 0.316 |
| *Computer icons* | 10 | 8 | 5 | 8 | 7.30 | 1.160 |
| *GIS features* | 10 | 4 | 0 | 4 | 2.90 | 1.792 |
| **Total** | 10 | 19 | 12 | 19 | 17.10 | 2.885 |

The minimum individual score for the all sections combined was 12, the maximum was 19 and the mean was 17.1. Expert planner scores were lowest in the GIS features section, with a mean score of 72.5%.

Prior to the test, the participants were asked to provide ratings on the performance of paper and computer-based maps, as a measure of the following variables: difficulty of use, quality of design, amount of relevant information and efficiency (Table 5.6 and 5.7).

**Table 5.6: Expert planner ratings of the difficulty of use, quality of design, amount of relevant information, and efficiency of paper maps**

| | **Difficulty of use** | **Quality of design** | **Amount of relevant information** | **Efficiency** |
|---|---|---|---|---|
| **Rating** | | | | |
| *Very low* | 5 | 0 | 0 | 0 |
| *Low* | 3 | 0 | 0 | 0 |
| *Fairly low* | 2 | 0 | 1 | 2 |
| *Neutral* | 0 | 3 | 2 | 2 |
| *Fairly high* | 0 | 0 | 0 | 1 |
| *High* | 0 | 4 | 5 | 3 |
| *Very high* | 0 | 3 | 2 | 2 |
| **Total** | 10 | 10 | 10 | 10 |

Of the 10 expert planners, over half stated that they thought computer-based maps had a *Low* to *Very low* difficulty of use. In addition, the majority of participants rated the quality of design, amount of relevant information and efficiency at the higher end of the scale. Frequencies of the lay participants' ratings on the four variables relating to qualities of computer-based maps are outlined in Table 5.7.

| Table 5.7: Expert planner ratings on the difficulty of use, quality of design, amount of relevant information, and efficiency of computer-based maps | | | | |
|---|---|---|---|---|
| | **Difficulty of use** | **Quality of design** | **Amount of relevant information** | **Efficiency** |
| **Ratings** | | | | |
| *Very low* | 1 | 0 | 0 | 0 |
| *Low* | 3 | 0 | 0 | 0 |
| *Fairly low* | 1 | 0 | 0 | 0 |
| *Neutral* | 2 | 2 | 0 | 0 |
| *Fairly high* | 1 | 4 | 1 | 3 |
| *High* | 1 | 2 | 4 | 4 |
| *Very high* | 1 | 2 | 4 | 2 |
| **Total** | 10 | 10 | 9 | 9 |

Half of the participants' (5/10) indicated that the computer-based maps had a *Fairly low* to *Very low* difficulty of use. The quality of design was rated as *Fairly high* to *Very high* by eight (8/10) participants. All of the expert planners (9/9) indicated that computer-based maps had a *Fairly high* to *Very high* amount of relevant information and efficiency. Expert planner preferences as between paper and computer-based maps prior to the test are shown in Table 5.8. Of the six *Unsure* expert planners, three indicated their map preference depends on the situation.

| Table 5.8: Expert planners' initial preferences for using paper or computer-based maps when providing information | | |
|---|---|---|
| | **Frequency** | **Percentage** |
| *Paper Maps* | 1 | 10.0% |
| *Computer-based Maps* | 3 | 30.0% |
| *Don't know/Unsure* | 6 | 60.0% |
| **Total** | 10 | 100% |

## 5.2 Results from the Tests of the PPGIS Method

### *5.2.1 Statement of Research Question(s) Addressed*

This section describes the planner results from the field research. As with section 4.3, results are reflective of research questions 1, 2, 3, and 4 (See section 1.2). This section is sub-divided into results and discussion. Results sections present on the direct outcomes from content analysis and discussion sections describe relationships between the data and literature.

### *5.2.2 Analysis of data*

This section describes the results from the study of expert planners' opinions concerning their use of the GEOIDE PPGIS tool. The expert planners rated the overall performance of the PPGIS tool. Ratings were classified into four main groups which include: difficulty of use, quality of design, amount of relevant Information, and efficiency (Table 5.9).

**Table 5.9: Expert planner ratings on the difficulty of use, quality of design, amount of relevant information, and efficiency of the PPGIS tool.**

| | **Difficulty of use** | **Quality of design** | **Amount of relevant information** | **Efficiency** |
|---|---|---|---|---|
| **Rating** | | | | |
| *Very low* | 1 | 0 | 0 | 0 |
| *Low* | 1 | 0 | 0 | 0 |
| *Fairly low* | 4 | 0 | 0 | 0 |
| *Neutral* | 2 | 3 | 4 | 4 |
| *Fairly high* | 1 | 2 | 3 | 1 |
| *High* | 0 | 2 | 0 | 3 |
| *Very high* | 0 | 0 | 2 | 1 |
| **Total** | 9 | 7 | 9 | 9 |

As with the lay participants, expert planners were invited to rate eight qualities of the PPGIS tool using the same Likert-type scale (Table 5.10).

**Table 5.10: Expert planner ratings on descriptors concerning the PPGIS tool's performance**

| | *Strongly Disagree* | *Disagree* | *Neutral* | *Agree* | *Strongly Agree* |
|---|---|---|---|---|---|
| ***Qualities** | | | | | |
| *Simple* | 0 | 4 | 0 | 4 | 2 |
| *Useful* | 0 | 0 | 1 | 8 | 1 |
| *Quick* | 0 | 1 | 4 | 3 | 2 |
| *Informative* | 0 | 0 | 1 | 6 | 3 |
| *Friendly* | 0 | 0 | 3 | 3 | 3 |
| *Comfortable* | 0 | 2 | 1 | 5 | 1 |
| *Interesting* | 0 | 0 | 2 | 4 | 4 |
| *Easy* | 0 | 0 | 4 | 4 | 2 |
| *Trustable* | 0 | 2 | 2 | 2 | 3 |
| *Enjoyable* | 0 | 2 | 1 | 6 | 0 |
| **Total** | 0 | 11 | 19 | 45 | 21 |

*See Appendix F for descriptors

Expert planners expressed an overall positive rating for each descriptive factor regarding the GIS tool. Expert planners' ratings on the difficulty of understanding a digitized feature on the PPGIS map interface are outlined in Table 5.11.

| Table 5.11: Expert planner ratings on difficulty of understanding sketched features on the PPGIS tool interface | | |
|---|---|---|
| | **Frequency of ratings** | **Percentage of all ratings** |
| **Perceived level of difficulty** | | |
| *Very hard* | 0 | 0 |
| *Hard* | 0 | 0 |
| *Fairly hard* | 1 | 10% |
| *Neutral* | 0 | 0 |
| *Fairly easy* | 5 | 50% |
| *Somewhat easy* | 3 | 30% |
| *Very easy* | 1 | 10% |
| **Total** | 10 | 100% |

Of the ten expert planners, nine felt (9/10) that it was *Fairly easy* to *Very easy* to understand sketched features on the PPGIS tool interface. Expert planners were asked to rate their ease of movement while using the PPGIS tool (Table 5.12).

| Table 5.12: Expert planner ratings on ease of movement in use of the PPGIS tool | | |
|---|---|---|
| | **Frequency of ratings** | **Percentage of all ratings** |
| **Level of speed** | | |
| *Very slow* | 0 | 0 |
| *Slow* | 0 | 0 |
| *Fairly slow* | 0 | 0 |
| *Neutral* | 0 | 0 |
| *Fairly quick* | 3 | 33.3% |
| *Quick* | 4 | 44.4% |
| *Very quick* | 2 | 22.2% |
| **Total** | 9 | 100% |

All of the expert planners indicated that their ease of movement was *Fairly quick* to *Very quick*. Expert planners rated how quickly they could collect various comments and features when using the PPGIS tool as compared with traditional participatory tools

(Table 5.13). These comments and features include: public opinions, public trail sketches, and existing trails.

| Table 5.13: Expert planner ratings on speed of collecting of various GIS comments and features when using the PPGIS tool as compared with traditional participatory methods | | | | |
|---|---|---|---|---|
| | **Public opinions** | **Public trail sketches** | **Existing trails** | **Total** |
| **Level of speed** | | | | |
| *Very slow* | 0 | 0 | 0 | 0 |
| *Slow* | 1 | 1 | 1 | 3 |
| *Fairly slow* | 0 | 0 | 0 | 0 |
| *Neutral* | 0 | 0 | 0 | 0 |
| *Fairly quick* | 6 | 3 | 3 | 12 |
| *Quick* | 0 | 2 | 1 | 3 |
| *Very quick* | 1 | 2 | 3 | 6 |

Of the 24 ratings collected, 21 ratings indicated that the gathering of public opinions, public trails, and existing trails were *Fairly quick* to *Very quick.* Expert planners' ratings on the efficiency, amount of relevant information, and quality of design of the PPGIS tool compared with equivalent features of traditional participatory tools are outlined in Table 5.14.

| Table 5.14: Expert planner ratings on the efficiency, amount of relevant information and quality of design of the PPGIS tool compared to traditional participatory methods | | | |
|---|---|---|---|
| | **PPGIS tool** | **Trad. participatory tools** | **Unsure** |
| **Factors of performance** | | | |
| *Greater Efficiency* | 4 | 1 | 3 |
| *Greater Amount of Relevant Information* | 5 | 1 | 2 |
| *Greater Quality of Design* | 3 | 2 | 3 |
| **Total** | 12 | 4 | 8 |

Of the 24 ratings collected, half of the ratings (12/24) indicated that the efficiency, amount of relevant information, and quality of design were greater for the PPGIS tool.

The expert planners volunteered ten kinds of pleasing aspects to the PPGIS tool. The recording of personal ideas and comments from a distance, the potential to facilitate dialogue at the spatial level, and the ability to compile information as needed into specific forums were each offered by two participants as pleasing aspects of the GIS tool. Quickness and efficiency, clear layout, interactive ability, and easy display of the PPGIS tool were each offered once.

The expert planners volunteered eleven sources of irritation. Two planners indicated the comments and features cannot be edited as a source of irritation. The following aspects of irritation when using the PPGIS tool were each indicated once by a expert planner: PPGIS tool is biased towards GIS experienced users, technology may disorient the public rather than assist them, layers are missing (e.g., cadastral), Internet is required, rural users are disadvantaged, training is required, PPGIS tool is impersonal, link between comments and features is confusing, color selection is poor and flexibility is limited.

Expert planners identified aspects that should be changed within the PPGIS tool. The frequencies of those aspects are outlined in Table (5.15). The methodology of coding aspects into categories within Table 5.15 was explained earlier in Chapter 3.

| Table 5.15: Categories of change recommended by expert planners for the PPGIS tool | | |
|---|---|---|
| | **Instances of category of change** | **Percentage of all recommendations for change** |
| **Categories of expert planner recommendation for change** | | |
| *Map detail should be enhanced* | 5 | 13.5% |
| *Printer should be accessible with tool* | 4 | 10.8% |
| *Comment board and features should be better organized* | 3 | 8.1% |
| *Participant feature should not be deleted when multitasking* | 3 | 8.1% |
| *Participant features should be linked comments* | 2 | 5.4% |
| *Comment should be able to be linked to multiple features* | 2 | 5.4% |
| *Help tool should be created* | 2 | 5.4% |
| *Toolbars should be visible at all times* | 2 | 5.4% |
| *Overview map should be present* | 2 | 5.4% |
| *Electronic pencil should be available for digitizing* | 1 | 2.7% |
| *Features should flash when selected* | 1 | 2.7% |
| *Features should be able to be digitized more accurately* | 1 | 2.7% |
| *Colors should vary for up and down tracks of digitized lines* | 1 | 2.7% |
| **Total** | 37 | 100% |

Most categories of recommendations for change relate to modifications or additions to the PPGIS tool's interface, such as the enhancement of map detail (5/37) and the better organization of comment board and features (3/37). Some of these kinds of changes might be rectified by a GIS technician.

Expert planners gave their opinions on whether the PPGIS tool should be solely concerned with capturing the public's knowledge and opinions or also with providing the public with the opportunity to be involved in the decision-making process (Table 5.16).

| **Table 5.16: Planner views on the decision-making function of the PPGIS tool** | | |
|---|---|---|
| | **Instances** | **Percentage of all instances** |
| **Appropriate function** | | |
| *PPGIS tool should solely collect public information* | 1 | 10% |
| *PPGIS tool should collect public information and allow them to be involved in the decision-making process* | 8 | 90% |
| *Don't know/Unsure* | 1 | 10% |
| **Total** | 10 | 100% |

Most planners (8/10) indicated that the public should provide information and be involved in the decision-making process because of the time, ideas and resources invested by the public (e.g., planning and land management of their property). One participant indicated that the planning process should be solely concerned with gathering the public's knowledge and opinions since the information would have to be processed before use in a decision-making process. Lastly, one participant indicated that they were unable to choose because the function of the tool depends on the various priorities of the planning process.

Expert planners identified whether the PPGIS tool should be solely concerned with collecting the public's knowledge and opinions or also informing the public about the planning process (Table 5.17). This question deliberately parallels the preceding one (Table 5.16) for the reasons of assessing the functional needs of the PPGIS tool.

| Table 5.17: Planner views on informative function of the PPGIS tool | | |
|---|---|---|
| | **Instances** | **Percentage of instances** |
| **Appropriate function** | | |
| *PPGIS tool should solely collect public information* | 0 | 0 |
| *PPGIS tool should collect public information and inform the public about the planning process* | 8 | 80% |
| *Don't know/Unsure* | 2 | 10% |
| **Total** | 10 | 100% |

Of the ten participants, eight participants (8/10) indicated that the PPGIS tool should collect public information as well as also inform members of the public. As reasoning for their choice, three of these planners suggested that informing the public promotes trust between the public and planners. The two planners who indicated *Don't know/Unsure* suggested that informing the public about the planning process depends on the purpose of the study. Expert planners were asked to indicate if they believed they would use the PPGIS tool within a planning process (Table 5.18).

| Table 5.18: Expert planner readiness to adopt use of PPGIS within a planning process | | |
|---|---|---|
| | **Frequency** | **Percentage** |
| **Overall use of PPGIS tool** | | |
| *Planners that would use the PPGIS tool* | 8 | 80.0% |
| *Planners that might use the PPGIS tool* | 1 | 10.0% |
| *Planners that would not use the PPGIS tool* | 1 | 10.0% |
| **Total** | 10 | 100.0% |

Those planners who indicated they would use this tool within a planning process were asked to list the possible planning processes in which the PPGIS tool could be applied (Table 5.19). Expert planners listed six kinds of planning processes in which the PPGIS tool could be applied. Site series refers to ecosystems with similar soil conditions and mature plant species. See Table 4.3 for descriptions of the planning processes.

| **Table 5.19: Public processes in which the PPGIS tool could be applied as suggested by expert planners** | | |
|---|---|---|
| | **No. of instances of suggestion** | **Percentage of all suggestions offered** |
| **Public planning processes suggested** | | |
| *OCP (official community plan)* | 3 | 23.1% |
| *RAMP (recreational access management plan)* | 3 | 23.1% |
| *SRMP (sustainable resource management plans)* | 2 | 15.4% |
| *Land use planning* | 2 | 15.4% |
| *Site series* | 2 | 15.4% |
| *Public input processes* | 1 | 7.7% |
| **Total** | 13 | 100% |

The one participant who would not use the PPGIS tool in a planning process gave as his reason that paper maps have a greater potential for stimulating discussion and generating personal interaction. Expert planners were asked whether they preferred to use computer-based maps or traditional-based methods to gather public information (Table 5.20).

| Table 5.20: Expert planner preferences as between paper and computer-based maps for use in future planning processes | | |
|---|---|---|
| | **No. of participants** | **Percentage of all participants** |
| *Paper maps* | 2 | 22.2% |
| *Computer-based Maps* | 1 | 11.1% |
| *Don't Know/Unsure* | 6 | 66.7% |
| **Total** | 9 | 100% |

Of those planners who were *Unsure*, four stressed that it would inappropriate to rely on computer-based maps in planning situations that deal with First Nation or general public groups whom have little or no knowledge of computer applications. At the same time, three of these planners indicated that a computer-based participatory mapping tool could be used in association with a traditional method, such as paper maps. One planner recommended that the PPGIS tool be used solely for intergovernmental (planner) applications. The PPGIS tool could convey spatially oriented information from one planner to another regardless of their location.

### *5.2.3 Discussion*

Overall, expert planners exhibited a high amount of GIS knowledge, as would be expected. However, the mean GIS feature recognition score was comparatively lower than other pre-test section scores. Many planners exhibited a basic knowledge of interpretation of the GIS features, however, many did not know the exact GIS terms. The majority of lay participants showed a high literacy in map “reading”. However, the overall lay participant knowledge was less with computer icons and even less with GIS feature recognition. Along with the experience component of the pretest, the public exhibited low experience with and knowledge level of GIS, a finding which corresponds with Al-Kodmany’s (2002) statement that many stakeholders in urban planning problem situations are laypersons with varying amounts of experience with computers. This finding is also consistent with the suggestion that rural areas within Canada are lagging behind urban areas in computer use, which would further limit the ability of rural planning bodies to utilize current technology, such as computers or GIS (Thompson-James, 2000). The planner’s high education and experience of GIS may be the reason they scored higher than lay participants on the pre-test.

In comparison with previously used computer-based maps, planners in this study expressed a lower difficulty of use as well as a lower quality of design and amount of relevant information when using the tool. While most GIS software can manipulate and analyze relevant data to a greater degree than the PPGIS tool, they also come with a higher difficulty of use. Nonetheless, the lower complexity of design and amount of relevant information of the PPGIS tool, compared to other GIS software, are required for the operation of the tool by those members of the public with little or no GIS experience.

Members of the public need to believe that planners are providing an equitable planning process. Prior research suggests that the experience a planner has in solving a particular type of problem can have important impacts on the processes he or she uses and the outcomes he or she generate (Nyerges and Jankowski, 2001). The expertise of a planner is limited to his or her domain and diminishes when the planner moves outside of his or her area of expertise (Mennecke *et al.*, 2000). For example, a planner who has previous GIS knowledge within decision-making processes would better understand the limitations and benefits of PPGIS than a planner who lacks GIS knowledge. In this study, the planners indicated a higher ease of use of the PPGIS tool than other computer-based maps. As a result, planners might be tempted to use the PPGIS tool in planning processes, not realizing that lay citizens may be uncomfortable with its use.

One important aspect of the *social-institutional* construct of the EAST2 is the role and influence of the convener on various elements of the planning process. For instance, these elements include the setting of a topic, the participants, and direction of the planning process. In a general sense, planners and decision makers are the chief conveners. With the use of GIS technology, Innes (1996) suggests there is a need for planners to act as an "interactive professional" in many situations. An "interactive professional" works with an entirely non-expert concept of decision support, one which tries to embed knowledge in an organizational and policy process so that it will make a difference. For example, planners must gauge which tools would be most suitable and efficient for the public to get their opinions and knowledge across. In this study, half of the expert planners indicated that the PPGIS tool was believed to be more efficient than traditional tools. However, several planners indicated that it would inappropriate to rely on the tool when dealing with public or first nation groups located in remote locations.

# Chapter 6: Discussion

## 6.1 PPGIS tool vs. Paper PP Method

This section describes lay participants' reasons for preferring the paper PP method or the PPGIS tool when providing information. Lay participants' preferences between paper and computer-based maps prior to testing are shown in Table 6.1.

| Table 6.1: Lay participants' initial preferences for using paper or computer-based maps when providing information | | |
|---|---|---|
| | **Frequency** | **Percentage** |
| *Paper Maps* | 10 | 47.6% |
| *Computer-based Maps* | 4 | 19.0% |
| *Don't know/Unsure* | 7 | 33.3% |
| **Total** | 21 | 100.0% |

Lay participants offered four reasons for preferring the paper PP method when providing their own information (Table 6.2).

| Table 6.2: Lay participant reasons for paper maps when providing their knowledge | | |
|---|---|---|
| | **No. of mentions** | **Percentage of all mentions** |
| **Reasons for preferring paper maps** | | |
| *Familiar* | 9 | 52.9% |
| *Portable* | 4 | 23.5% |
| *Simple quality of design* | 3 | 11.8% |
| *Ease of sketching* | 1 | 5.9% |
| **Total** | 17 | 100% |

Lay participants cited four reasons for preferring computer-based maps when providing their own information (Table 6.3).

| Table 6.3: Lay participant reasons for computer-based maps when providing information | | |
|---|---|---|
| | **No. of mentions** | **Percentage of all mentions** |
| **Reasons for preferring computer-based maps** | | |
| *Multi-purpose tools* | 3 | 50% |
| *Ease of movement* | 1 | 16.7% |
| *Accuracy of information* | 1 | 16.7% |
| *Clarity of information* | 1 | 16.7% |
| **Total** | 6 | 100% |

Lay participants' preferences between the two participatory methods when providing their own information are shown in Table 6.4.

| Table 6.4: Lay participants' preferences for using the paper PP method or the PPGIS tool when providing information | | |
|---|---|---|
| | **No. of participants** | **Percentage of participants** |
| *Paper PP method* | 9 | 42.9% |
| *PPGIS tool* | 8 | 38.1% |
| *Don't Know/Unsure* | 4 | 19.0% |
| **Total** | 21 | 100.0% |

Lay participants rated the two participatory methods for efficiency (Table 6.5).

| Table 6.5: Lay participant ratings of mapping tools' efficiency in gathering local knowledge | | |
|---|---|---|
| | **No. of participants** | **Percentage of participants** |
| *Paper maps* | 8 | 38.1% |
| *Computer-based maps* | 9 | 42.9% |
| *Don't Know/Unsure* | 4 | 19% |
| **Total** | 21 | 100.0 |

Participants cited several reasons for believing that paper maps are more efficient at gathering local knowledge and opinions than computer-based maps (Table 6.6).

**Table 6.6: Lay participants' reasons for believing believed paper maps are more efficient than PPGIS maps at gathering local knowledge within a planning process.**

| | **No. of mentions** | **Percentage of all mentions** |
|---|---|---|
| **Reasons for believing that paper maps are more efficient** | | |
| *Paper maps do not require training* | 2 | 33.3% |
| *Paper maps are easy to use* | 2 | 33.3% |
| *PPGIS tool has flaws* | 1 | 16.7% |
| *PPGIS tool was frustrating to use* | 1 | 16.7% |
| **Total** | 6 | 100% |

Participants also offered several identified numerous reasons for believing that computer-based maps are more efficient at gathering local knowledge and opinions than paper maps (Table 6.7).

| Table 6.7: Lay participants' reasons for believing that computer-based maps are more efficient than paper maps at gathering local knowledge within a planning process. | | |
|---|---|---|
| | **No. of mention** | **Percentage of all mentions** |
| **Reasons for believing that computer-based maps are more efficient** | | |
| *Greater organization of information than paper maps* | 6 | 42.9% |
| *Multi-purpose tools* | 4 | 28.6% |
| *Ease of movement* | 2 | 14.3% |
| *Convenient* | 1 | 7.14% |
| *Greater networking capability than paper maps* | 1 | 7.14% |
| **Total** | 14 | 100% |

Of the four participants who were unsure as to whether the paper or computer-based maps were more efficient, two stated that the efficiency of the participatory method depends on the user's comfort level and experience. One participant indicated that it depends on the technical background of the participant. Another indicated that computer-based maps are better for gathering knowledge while the traditional tool is better for gathering opinions.

This section compares results on the paper PP method and PPGIS tool from the perspective of the planning literature on public participation.

Many researchers agree one of the main objectives of public participation is the empowerment of the local community (Aberley, 1993; Harris and Weiner, 1998; Sieber, 2000; Kyem, 2001; Wood, 2005). However, increasing the amount of citizen involvement does not necessarily empower communities. Researchers have argued that mass involvement in decision-making processes is undesirable because of logistical problems. Specifically, widespread public involvement in planning processes will almost inevitable result in fragmentation and polarization of interests without a means to achieve consensus (Fagence, 1977). In this study, as more participants were tested on the PPGIS tool and the paper PP method, more features and comments were added, causing the map and comment display to become cluttered. When multiple features or themes are added to a map, the process of grouping these elements into meaningful concepts and relationships becomes more difficult (Head, 1984; Wood, 2005). Unlike traditional participatory methods, the PPGIS tool has the ability to layer comments and features into simple, understandable concepts, thereby increasing the tools ability to manage mass public involvement. Nonetheless, high degrees of citizen involvement may heighten participant conflict rather consensus, thereby destroying the social stability upon which freedom ultimately depends (Barber, 1981; Grant, 1994).

The ability of GIS-based tools to manage large amounts of public information does not necessarily mean that the public is more likely to use these tools in planning processes. For example, potential participants who lack education or are of low socioeconomic status may fear contributing in a public discussion which employs participatory techniques that are inconvenient or intimidating (Burch, 1976; Lach and Hixson, 1996; Schuett and *et al.*, 1998). In this study, participants who had higher educational attainments and were from younger age groups were more likely to prefer using the PPGIS tool. Similarly, the participants' level of computer and map literacy may influence their preference for a participatory method. The highly technical jargon presented in certain participatory methods may confuse participants where their interests lie (Kweit and Kweit, 1990). In this study, lay participants that lacked GIS knowledge and experience were more likely to prefer using the paper PP method. As Henig (1982) explains, complex issues that may require professional expertise to be understood might deter citizen mobilization by encouraging feelings of helplessness and resignation.

Ideas brought into planning discussions and the way these ideas influence the direction of decision making is fundamental to the transition of one planning phase to another. The third process construct of EAST2, *group process,* deals with the effect of participant relationships on idea exchange and the management of this process (Nyerges and Jankowski, 2001). In this study, the PPGIS tool uses a computer interface for the exchange of ideas and comments while the paper PP method uses a face-to-face approach. The face-to-face approach allows an engaging and straightforward method for providing information. Arias (1996) asserts that the added value of real-time social interaction between neighbors surpasses the values of computer simulations even when the simulations have user-friendly computer interfaces. In this study, lay participants rated the PPGIS tool as having a lower difficulty of use than previously used computer-based maps (See table 4.7 and 4.21). The PPGIS tool's relatively low difficulty of use may enhance its ability to gather knowledge from a wider range of individuals. Similar studies have shown that GIS-based tools, much like the PPGIS tool, can assist in translating complex spatial information into a visual, non-technical language that everyone can understand (Myers and Ghose, 1995; Sheppard, 1995; Bosworth and Donovan, 1998; Elwood and Leitner, 1998; Krygier, 1999). It is interesting that many participants revealed a keen interest in using the PPGIS tool. Participants were intrigued with the ability to digitize as well as link those digitizations to comments. The digital contribution of participant knowledge was also seen as the case within Wood's study (2005); participants were interested in the storage of map data in an electronic format.

The use of various methods or situations can affect the proceedings of the planning process. The last convening construct of EAST2, *Public Participatory GIS*, addresses the effects meetings structured in terms of place, time, and communication channels have on who says what and when during participation in a decision situation (Nyerges and Jankowski, 2001). In this study, this construct applies to the understanding of what effects these variables may have on the operation of the PPGIS tool. Planners were pleased with a number of aspects of the tool, such as its ability to collect public knowledge from a distance and the potential to facilitate dialogue at the spatial level. As Innes and Simpson (1993) suggest, the ability to remotely collect spatial information from the public would permit planners to spend less time on the collection phase and more on the development of regulatory policy and management options. Likewise, it can be speculated that members of the public could spend less time and resources on providing information if they had access to a tool, such as the PPGIS tool, that can collect information from any computer with an internet connection.

The ability of the PPGIS tool to collect public information was limited by the location of the participants. A fundamental aspect of the first process construct of EAST2, *appropriation of participatory GIS influence*, addresses the affect that place, time, and communication channels have on the information use in various decision making processes (Nyerges and Jankowski, 2001). In this case, the rural location of many of the lay participants limited the channels of communication. The limited technological infrastructure (i.e. high speed Internet) within the Bulkley Valley of northern BC restricted the full use of the PPGIS tool by the participants. On the other hand, the portability and convenience of paper maps were effective for lay participants living in rural areas. This finding is discussed further in the next section (Section 6.2).

### 6.2 Strengths and Weaknesses of the PPGIS Tool

The study of relationships between various participatory methods is fundamental to the continued development of innovative participatory methods. This section compares the strengths and weaknesses of the paper PP method and PPGIS tool in relation to literature on public participation. This section deliberately follows the preceding one (Section 6.1) for the purpose of linking similar themes of comparison between the PPGIS tool and paper PP method.

Lay participants were clearly interested in the process of providing information through the PPGIS tool; however, participants required a lengthy training period to fully operate the tool. In addition, many operational errors within the PPGIS tool were discovered which contributed to the participants' disorientation.

Poor visibility of colors was an aspect that might have contributed to the lay participants' disorientation. As mentioned before, using the PPGIS tool through the on-site computer itself, rather than the university server via the Internet, caused the colors to become fainter. As a result, participants living in more rural areas were more likely than urban residents to observe fainter colors. Also, the number of hues of colors may have affected the participants' orientation. For example, Luria *et al.* (1986) mention that while the numbers of color hues are "truly astronomical", the readable numbers of possible hues of colors drops rapidly as their number goes up. In this study, the large number of hues of colors used within the PPGIS map interface may have contributed to the participants' ability to distinguish various features. There are also a number of other aspects of visualization that contributed to their disorientation or poor visibility. For example, screen size and glare are often cited as weaknesses (Reilly *et al.*, 2006).

The PPGIS tool provided participants with access to a number of multi-purpose tools to better manipulate the large amount of GIS data within the tool. For example, the PPGIS tool, along with many other computer-based mapping systems has the ability to provide coverage and control over level of detail (via overlays, zoom, and pan) or to present various scale shifts (Langendorf, 1995; Arias, 1996). In addition, the tool allowed participants to identify various locations by name and descriptive features (Reilly et al., 2006). Once trained on the tool, many lay participants showed a liking for the multi-purposed tools. The ability to electronically manipulate maps and data enables the user to process information and displays that would be impossible or impractical using traditional approaches (Ives, 1982). There is an inherent trade-off between sophistication and ease of use when members of the lay public are the ones using decision support tools (Al-Kodmany, 2002).

The emergence of social-technical structures, such as new map or database designs, can assist a group with information structuring. The second process construct of EAST2, *Emergent influence,* deals with emergence of social technical information and its influence on information a group treats from one planning phase to another (Nyerges and Jankowski, 2001). As mentioned, both the paper maps and PPGIS map interface became increasingly cluttered as more participants provided comments and features. However, the small screen size and high amount of features/layers may have caused the PPGIS map interface to appear more cluttered than the paper maps. Meanwhile, many participants cited the fixed scale and permanence of paper maps as irritations of the paper PP method. Both irritations act as a limitation that contributes to the inflexibility of paper maps. Geomatics researchers contend that considerable effort is required to retrieve information from paper maps due to their inflexibility because they are limited to one scale and do not provide a great deal of data about the community context (Muehrcke, 1990; Al-Kodmany, 2002).

As mentioned in Section 4.3.1, the simplicity of the paper PP method allowed lay participants to provide their knowledge and opinions without difficulty. Many participants expressed a sense of accomplishment from completing their tasks because they were involved in a hands-on-way. The advantages of paper map techniques in a community planning process are simplicity, engagement, and affordability (Al-Kodmany, 2002). However, the simplicity of the paper PP method becomes a liability when providing comprehensive contextual data, especially in comparison with the sizeable amount of data that can be stored within the PPGIS tool. Traditional participatory methods are far less sophisticated in performing analysis and require additional tools to facilitate decision making (Al-Komandy, 2002).

A strength of the paper PP method was the ease of orientation which may have resulted from the participants' ability to manipulate the paper maps to conform to their preferred reference point. It should be noted that many of the participants rotated the paper maps to better orient themselves. In the Reilly *et al.* (2006) study, paper maps were seen as providing a clearer, more accessible view, displaying a wider region which was easier to study and manipulate (by rotating, folding). Studies have shown that map readers perform map reading tasks more accurately and faster when the map is physically rotated so the direction of travel is oriented toward the top of the map (Levine *et al.*, 1984; Lloyd and Steinke, 1984; Aretz and Wicken, 1992).

## 6.3 Advancement of Public Participation and Understanding through the Use of the PPGIS Tool

This section discusses findings that relate to the advancement of public participation and understanding through the participants' use of the PPGIS tool.

In many planning processes, public goals and values are generally not known until members of the public understand options in terms of potential objectives (Innes, 1990). Therefore, planners must inform the public on issues of the planning process that influence those objectives during the onset of the planning process. In this study, the PPGIS tool focused solely on collecting information rather than on informing participants about the planning process. Consequently, the majority of planners indicated that the PPGIS tool should inform members of the public about important issues in the planning process (See table 5.17).

The PPGIS tool is capable of presenting various amounts of readily available information that, if accessed correctly, can assist participants in completing tasks. This information can be examined through numerous multi-purpose tools embedded within the PPGIS tool. For example, the ability to manipulate layers of maps and other kinds of data electronically enables the user to deploy more information than would be practical when using traditional methods (Ives, 1982; Wood, 2005). Furthermore, GIS has the ability to enable the user to efficiently combine multiple map images and features into one display, which can make data analysis easier (Crossland *et al., 1995*). Once trained, many participants considered the use of multi-purpose tools a clear advantage when accessing and providing information. Nonetheless, several participants desired that all information be immediately displayed; they did not want to be obliged to access through multi-purpose tools. The ability to use multi-purpose tools accurately and efficiently requires the user to have at least a basic understanding of GIS. Unless GIS skills learnt by individuals are used regularly, confidence and ability would rapidly decline (Wood, 2005).

### 6.4 Ability of the PPGIS Tool to Shape Participant Knowledge

This section discusses aspects of the PPGIS tool that may have shaped participant information from the perspective of literature on public participation.

Some lay participants exhibited disorientation while attempting to complete their tasks. The disorientation of the participants could be largely the result of mismatching landmarks or features between the PPGIS tool and the participants' cognitive maps. Cognitive maps are "any internal representation of a set of geographic locations that has been learned'' (Lloyd, 2000). According to Siegel and White (1975), levels of cognitive mapping begin with landmark elements. In this study, the majority of the participants indicated a high ease of orientation towards individual landmark elements or features (e.g., lakes, roads), however, the reorientation to scale shifts was poor. Map readers solve the problem of determining their location on the map by recognizing real-world landmarks and relationships, putting those clues together, and placing themselves on the maps (Lobben *et al,*. 2004).

Participant belief and trust in various aspects of the planning process, such as the topic, the decision-makers, and the technology can shape the information they provide. The second convening construct of EAST2, *Group participants influence*, addresses stakeholder perspectives of values, goals, issues, beliefs, and fairness that set the stage for expected benefits and outcomes of the planning process (Nyerges and Jankowski, 2001). In this construct, the goal of planners includes shaping and organizing attention as well as processing information, since planning process outcomes are intended not to dictate decisions but to improve public response and engagement. In this study, the trust and fairness between lay participants and planners would likely increase if, as planners suggested, the comment board and features were reorganized. In contrast, the planners in this study were pleased with the tool's ability to classify information into specific forum groups (See pg. 83). As Holden states (2000), the planners' goal during the data collection phase shifts from the act of gathering opinions to that of gathering the most meaningful opinions. Planners must gather knowledge and opinions in conjunction with the public while seeking rather than avoiding public criticism, in order to check information misrepresentation and ultimately to improve data collection.

### 6.5 Discussion of Secondary Findings

This section discusses findings that may be of interest, but are not associated with the research questions. Findings are linked to convening constructs embedded within EAST2.

The control and implementation of a GIS technology within a public planning process can be affected by influences outside the planning process. The first convening construct of EAST2, *Social-Institutional Influence*, addresses some of these influences including laws, mandates, policies, natural events, or social norms and values (Nyerges and Jankowski, 2001). In this study, outside influences, such as zoning laws, were disregarded since they were believed to distract the participants' ability to use the tool. Nonetheless, planners would need to consider various rural land zoning regulations if any information from this case study, such as potential trails, were to be implemented.

An important aspect of the third convening construct of EAST2, *Public Participatory GIS* addresses the various geographic information aids (e.g., maps, tables, diagrams, etc.) used to support the participatory effort. Langendorf (1995) notes that in his experience with public participation planning in Miami, no single method of problem exploring, problem solving, or design development was always successful. Commonly, data use was intermittent; therefore, different methods were used at various phases of the planning process. In this study, several planners suggested the use of a portable printer in association with the PPGIS tool and one planner suggested the use of an electronic pen as supplementary tools. Al-Kodmany (2002) likewise states that an electronic pen and sketch board provide a forgiving surface which combines high-tech GIS with low-tech sketches.

The sketch can be saved as an electronic file in a graphic format, such as TIFF or JPEG, for future use.

# Chapter 7: Conclusions and Recommendations

## 7.1 Lessons for Future Evaluations of PPGIS Tools

The main goals of this study were to evaluate the use of a PPGIS tool within an environmental planning case study in northern British Columbia. This chapter presents recommendations for improvements to the existing research design and the PPGIS tool, as well as recommendations for future studies and the overall conclusions of this study.

Although the research design and testing procedures used were successful in evaluating the use of the PPGIS tool, improvements to the methods employed may further enhance the results of similar research projects. This section suggests potential improvements to the methods and testing phases of this study.

### *7.1.1 Research Design*

As mentioned in Chapter 3, a 20-minute maximum period of use limited each participant's use of both participatory methods. The timing of participant use of each method could further measure the ease of use of the participatory methods. Mack *et al.* (2005) explain that recording the start and end times of a task, process, or technique can assist in the evaluation of that method.

During the development of the GEOIDE tool, a number of changes in the tool were made to improve it. However, due to time limitations, these changes were restricted to improving the most noticeable errors. As a result, a number of "bugs" were found to be present during the test phase. If time allowed, a pilot test such as with student participants could have been conducted which would have provided a more in-depth investigation for errors or "bugs" within the PPGIS tool.

In this study, potential participants were contacted through local trail groups and governmental agencies. At the time, a sufficient amount of potential participants were expected to be available. However, as testing progressed, additional public and expert planners were needed. Prior communication with local media (e.g., newspaper, radio station) and NGO's, along with the trail groups and government agencies, might have assisted in providing a sufficient number of potential participants.

## 7.2 Recommendations for Future Research

This study determined that the PPGIS tool has the potential to be used independently or in association with some traditional participatory methods in certain public planning processes. It provides insight into how the PPGIS tool should be modified and justifies further study following from several findings of the research.

### *7.2.1 Suggested PPGIS Tool Modifications*

Although the PPGIS tool could be used to gather public knowledge and opinions independently, traditional methods are still more reliable, in most situations, due mainly to their familiarity and simplicity. As Al-Kodmany explains (2002), GIS developers need to adapt "hands on" techniques of traditional methods into computerized tools. Integration of the beneficial aspects of traditional methods and the PPGIS tool would greatly increase the tool's usability and flexibility. Likewise, the implementation of supplementary tools, such as an electronic pen or portable printer, would hybridize the PPGIS tool. Members of the public need flexible tools that assist in integrating real and virtual worlds; it is inappropriate for planners to force a choice between the simplicity of traditional methods and the accessibility and efficiency of GIS-based methods (Arias, 1996).

Participants identified irritations from their use of the PPGIS tool that related to many of the minor "bugs" discovered during the testing phase. The majority of these "bugs" involved the need to provide more distinct colors, organize comments, link features and comments, label more landmarks, and multitask without losing comments. To improve the functionality and reliability of the tool in future planning processes, it is necessary to fix these "bugs".

### *7.3.2 Suggested Follow-up Studies*

Use of the PPGIS tool as the sole participatory method may be desirable from some perspectives. However, it is unrealistic in relation to current rural planning processes. The most ideal situation for members of the public and planners would be the use of the PPGIS tool as a secondary tool to complement a traditional participatory method. Use of both the PPGIS tool and a traditional method would allow members of the public their choice of each participatory method. A municipal or governmental planning process such as an OCP process would allow the PPGIS tool to be applied in a different context. An internet-based version of the PPGIS tool could allow stakeholders to provide knowledge in future planning processes without time or space limits. However, as Wood (2005) argues, a dedicated GIS technician who understands the main issues would be needed to manage data and solve problems as they arise.

### 7.4 General Conclusion

This study determined that lay participant preferences between the PPGIS tool and traditional paper methods in an environmental planning case study in northern BC were mixed. Simplicity and ease of use were strengths of the paper PP method. However, traditional methods lacked the PPGIS tool's ability to access and manipulate large amounts of information. At times, the PPGIS tool's complexity may have disoriented and confused certain participants. The lack of accurate digitizing (e.g., digitizing curvy lines), along with participant disorientation, perhaps restricted lay participant's ability to provide accurate spatial information.

In this study, the majority of expert planners believed that the PPGIS tool would be an appropriate tool for the accurate collection of information from the public. However, due to ethical implications, many planners maintained that use of this tool should be limited to certain groups and planning processes, such as computer-literate individuals.

At times, the PPGIS tool's capabilities were affected by the rural location of the case study. Expert planners expressed concern about the tool's ability to gather community knowledge from rural areas, including indigenous groups. At this time, rural technological infrastructure in north-western BC cannot support universal use of the PPGIS tool. However, as rural infrastructure develops and more of the public becomes computer literate, the demand for GIS-based participatory tools will likely increase. Although many planners may contest the need to use computer-based tools rather than equally efficient traditional methods, the amount of data being produced in today's society overwhelms traditional methods. Communities and public organizations must understand and apply these tools when contending with other stakeholders, such as large corporations, who can easily access and manipulate data potentially for their own gain.

In conclusion, although implementing the GEOIDE "*Promoting Sustainable communities through Participatory Spatial Decision Support*" PPGIS tool in a public planning process could assist public members to provide and planners to gather information, others would not have an equal ability to use and provide information at the same level as others. As technological infrastructure becomes more readily available and commonplace in rural areas, computer-based participatory methods such as the PPGIS tool will become more accessible to members of the public. Overall, the potential to use the PPGIS tool for public participation purposes in future planning processes is promising. Despite this promise, future research is required to understand the benefits and limitations of the PPGIS tool in various public planning situations.

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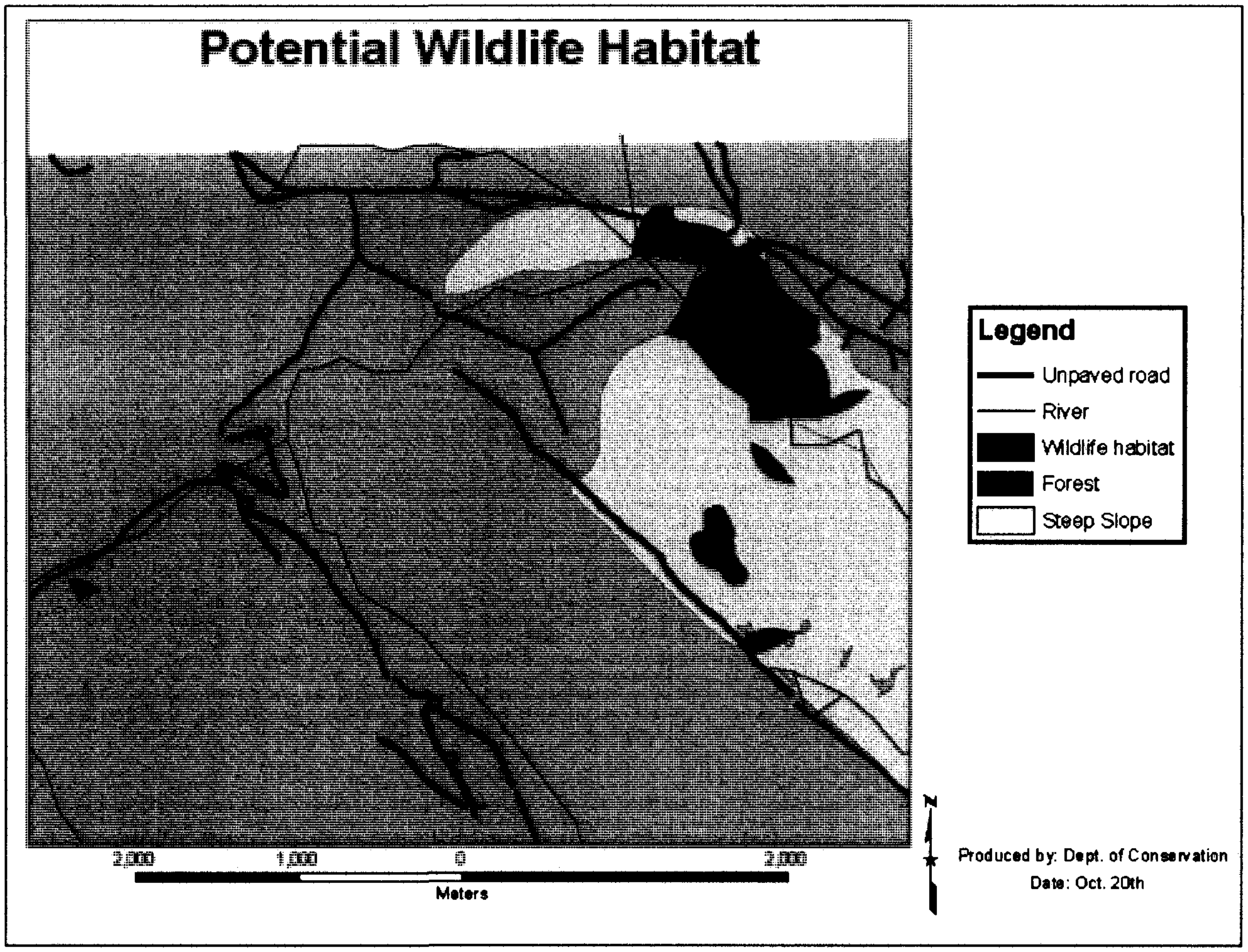
## Appendix A- Pretest

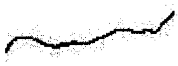
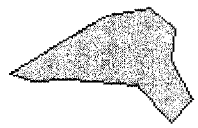



(1) Match the Correct term to the Statement or Question.

| | | |
|---|---|---|
| A. Roads | E. North-east | I. Legend |
| B. South-West | F. Scale | J. Equator |
| C. Rivers | G. Layers | K. Compass Rose |
| D. Habitat | H. Structures | L. Mercator |

(a) What do the brown lines represent? _______________
(b) What do the blue lines represent? _____________
(c) What do the pink areas represent? _____________
(d) Where is the majority of the Wildlife habitat located? ______________
(f) The __________ is the distance on earth represented on the map.
(g) The___________ shows the maps user what the different symbols mean.
(h) The __________ indicates the direction on the map.

(2) Please match the following GIS features:

(a) Polygon (b) Point (c) Buffer (d) Arc

(3) Please match the following symbol to its term.

(a) Zoom Out

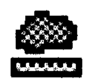
(b) Measure Distance

(c) Measure Area

(e) Select by Layer

(f) Zoom In

(g) Identify



(h) Pan

(i) Draw Line

Please check the appropriate category.
How often do you use the following in a year?

| | Computers | Paper Maps | Computer-based Maps |
|---|---|---|---|
| 0 | ☐ | ☐ | ☐ |
| 1-5 times a year | ☐ | ☐ | ☐ |
| 5-10 times a year | ☐ | ☐ | ☐ |
| 10-15 times a year | ☐ | ☐ | ☐ |
| 15-25 times a year | ☐ | ☐ | ☐ |
| 25-35 times a year | ☐ | ☐ | ☐ |
| 35-50 times a year | ☐ | ☐ | ☐ |
| Over 50 times a year | ☐ | ☐ | ☐ |

In your experience with paper maps, how would you evaluate the following factors of performance?
Please circle your choice.

| | 1=Low 4=Moderate 7=High |
|---|---|
| Difficulty of Use | 1 - 2 - 3 - 4 - 5 - 6 - 7 |
| Quality of Design | 1 - 2 - 3 - 4 - 5 - 6 - 7 |
| Amount of relevant information | 1 - 2 - 3 - 4 - 5 - 6 - 7 |
| Efficiency | 1 - 2 - 3 - 4 - 5 - 6 - 7 |

In your experience with computer-based maps, how would you evaluate the following factors of performance?

| | 1=Low 4=Moderate 7=High |
|---|---|
| Difficulty of Use | 1 - 2 - 3 - 4 - 5 - 6 - 7 |
| Quality of Design | 1 - 2 - 3 - 4 - 5 - 6 - 7 |
| Amount of relevant information | 1 - 2 - 3 - 4 - 5 - 6 - 7 |
| Efficiency | 1 - 2 - 3 - 4 - 5 - 6 - 7 |

Which do you prefer:
(1) Paper Maps
(2) Computer-based Maps
(3) Don't know/ Unsure

Why:

______________________________________________

______________________________________________

______________________________________________

______________________________________________

Sex: Male____ Female____

Are you colorblind?
Yes____ No____

If Yes, what kind of colorblindness? (For example: Green Colors look like black)

______________________________________________

______________________________________________

Select the age group you are in:
(a) 0-19
(b) 20-24
(c) 25-34
(d) 35-44
(e) 45-54
(f) 55-64
(g) 65-74
(h) 75-older

What is the highest level of education you have completed? (Circle number.)
(1) No formal education
(2) Some Grade School
(3) Completed Grade School
(4) Some high school
(5) Completed High School
(6) Some diploma
(7) Completed diploma
(8) Some University
(9) Completed University
(10) Some Graduate School
(11) A Graduate Degree

What is your current job title? ______________________

## Appendix B- Traditional Method Questionnaire

This questionnaire is designed to gather your opinions concerning the overall use of the participatory method used in the planning process.
A participatory method refers way that your opinions about the planning process are collected. In this case, the participatory method refers the traditional participatory method (paper maps, satellite photos, etc.) which will assist in gathering your opinions about the planning of a long range trail system within the Bulkley Valley.

(1) Planning processes have many roles within communities, including assessing needs, determining basic goals, and directing policies. For example, a planning process may include but is not limited to the designation of subdivisions, the implementation of a road network through a town, city, or region, and the sustainability of natural resources.

Have you ever participated in a planning process before? Yes___ No____
If no, please go to Question #2

If yes, please complete the following:

I have participated in a planning process as a: Planner____ Citizen_____ Both_____

I last participated in a planning process in the year ____

The kinds of planning processes I have participated in are:

Official Community Plan ___ (City ___ Town ___ Village ___ Regional district ___)
Provincial Park plan ___
National Park plan ___
Forest plan ___
LRMP plan ___
SRMP plan ___

Other:

______________________________________________________________

______________________________________________________________

(2) How did you feel about the following factors when using the traditional method?
Please circle your choice.

| | 1=Low | 4=Moderate | 7=High |
|---|---|---|---|
| Difficulty of Use | 1 - 2 - 3 - 4 - 5 - 6 - 7 | | |
| Quality of Design | 1 - 2 - 3 - 4 - 5 - 6 - 7 | | |
| Amount of Relevant Information | 1 - 2 - 3 - 4 - 5 - 6 - 7 | | |
| Efficiency | 1 - 2 - 3 - 4 - 5 - 6 - 7 | | |

(3) Please check the box that best represents your opinion when using the traditional method.

(a) Do you feel better informed about trails in the Bulkley Valley than you did before you used the traditional method?

| No better informed | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Better informed |
|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(b) Do you feel you were able to provide a lot of your knowledge about the trails in the Bulkley Valley when using the traditional method?

| Provided nothing | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Provided a lot |
|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(c) Do you feel this method made it easy or hard for you to offer your knowledge and opinions?

| Very hard | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very easy |
|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(d) How quickly were you able to move between the various maps?

| Very slowly | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very quickly |
|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(e) Did you feel it was easy or hard to draw a trail or area on the paper maps?

| Very hard | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very easy |
|---|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(f) How quickly could you find the following features on the paper maps?

| Very slowly | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very quickly |
|---|---|---|---|---|---|---|---|---|
| Lakes | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| Roads | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| Existing Trails | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| Mountains/Glaciers | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(4) Please check the box that best represents your opinion of the traditional method.

| | Very Much | Somewhat | Neither | Somewhat | Very Much | |
|---|---|---|---|---|---|---|
| Complex | ☐ | ☐ | ☐ | ☐ | ☐ | Simple |
| Useless | ☐ | ☐ | ☐ | ☐ | ☐ | Useful |
| Slow | ☐ | ☐ | ☐ | ☐ | ☐ | Quick |
| Uninformative | ☐ | ☐ | ☐ | ☐ | ☐ | Informative |
| Unfriendly | ☐ | ☐ | ☐ | ☐ | ☐ | Friendly |
| Uncomfortable | ☐ | ☐ | ☐ | ☐ | ☐ | Comfortable |
| Boring | ☐ | ☐ | ☐ | ☐ | ☐ | Interesting |
| Hard | ☐ | ☐ | ☐ | ☐ | ☐ | Easy |
| Distrust | ☐ | ☐ | ☐ | ☐ | ☐ | Trust |
| Did not enjoy | ☐ | ☐ | ☐ | ☐ | ☐ | Enjoy |

(5) What would you change about this traditional method?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

(6) What pleased you about using the traditional method (For example: provided knowledge quicker)

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

(7) What irritated you about using the traditional method (For example: could not zoom in)?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

(8) (a) Please list up to five tasks you tried to perform with the traditional method.
(For example: Wanted to show that the trail should run parallel with the Bulkley River)

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

(b) How many of these tasks did you accomplish?

_____

(c) If you did not accomplish all your tasks, what do you suppose prevented you from accomplishing them?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

***Thank you for answering this questionnaire for the evaluation of this GIS tool.***

## Appendix C- PPGIS Tool Questionnaire

This questionnaire is designed to gather your opinions concerning the overall use of a certain kind of participatory method applied in some kinds of land use planning processes. A participatory method is one used to collect your opinions. In this case, the participatory method refers to the computer-based mapping tool that assisted in gathering your opinions about some of the trails within the Bulkley Valley.

(1) How did you feel about the following areas of operation when using the GIS tool in the exercise you have just completed?
Please circle your choice.

| | 1=Low | | | 4=Moderate | | | 7=High |
|---|---|---|---|---|---|---|---|
| Difficulty of Use | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Quality of Design | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Amount of Relevant Information | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Efficiency | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

(2) Please check the box that best represents your opinion of the GIS tool.

(a) Do you feel better informed about trails in the Bulkley Valley than you did before you used this tool?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No better informed | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Better informed |
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(b) Do you feel you were able to provide a lot of your knowledge about the trails in the Bulkley Valley when using this tool?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Provided nothing | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Provided a lot |
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(c) Do you feel this tool made it easy or hard for you to offer your knowledge and opinions?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Very hard | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very easy |
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(d) How quickly were you able to move between the map areas on the screen?

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Very slowly | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very quickly |
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(e) Did you feel it was easy or hard to draw a trail or area on the maps?

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| Very hard | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Very easy |

(f) How quickly could you find the following features on the screen?

| | Very slowly 1 | 2 | 3 | 4 | 5 | 6 | 7 Very quickly |
|---|---|---|---|---|---|---|---|
| Lakes | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Roads | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Existing Trails | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Mountains/Glaciers | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

(3) Please check the box that best represents your opinion of the GIS tool.

| | Very Much | Somewhat | Neither | Somewhat | Very Much | |
|---|---|---|---|---|---|---|
| Complex | ☐ | ☐ | ☐ | ☐ | ☐ | Simple |
| Useless | ☐ | ☐ | ☐ | ☐ | ☐ | Useful |
| Slow | ☐ | ☐ | ☐ | ☐ | ☐ | Quick |
| Uninformative | ☐ | ☐ | ☐ | ☐ | ☐ | Informative |
| Unfriendly | ☐ | ☐ | ☐ | ☐ | ☐ | Friendly |
| Uncomfortable | ☐ | ☐ | ☐ | ☐ | ☐ | Comfortable |
| Boring | ☐ | ☐ | ☐ | ☐ | ☐ | Interesting |
| Hard | ☐ | ☐ | ☐ | ☐ | ☐ | Easy |
| Distrust | ☐ | ☐ | ☐ | ☐ | ☐ | Trust |
| Did not enjoy | ☐ | ☐ | ☐ | ☐ | ☐ | Enjoy |

(4) What would you change about this GIS tool?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

(5) What pleased you about using this GIS tool (For example: can draw in trails)?

________________________________________

________________________________________

________________________________________

________________________________________

(6) What irritated you about using this GIS tool (For example: too slow to offer knowledge)?

________________________________________

________________________________________

________________________________________

________________________________________

(7) (a) Please list up to five tasks you tried to perform with the tool.
(For example: Wanted to show that the trail should run parallel with the Bulkley River)

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

(b) How many of these tasks did you accomplish?

______

(c) If you did not accomplish all your tasks, what do you suppose prevented you from accomplishing them?

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

(8) Do you have any suggestions or feedback for this study?

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

(9) Overall, which did you prefer to use in this planning process:
Please circle your choice.

(a) Paper Maps
(b) Computer-based Maps
(c) Don't know/ Unsure

Do you believe that this GIS-based tool is more efficient at gathering local knowledge and opinions than more traditional tools (For example: paper maps)?
Yes_____ No_____

Please explain:

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

***Thank you for answering this questionnaire for the evaluation of this GIS tool.***

## Appendix D- Planner Questionnaire

This questionnaire is designed to gather a planner's knowledge as whether they would use this GIS tool as a method for collecting public knowledge concerning a publicly involved planning process.

(1) Planning processes have many roles within communities, including assessing needs, determining basic goals, and directing policies. For example, a planning process may include but is not limited to the designation of subdivisions, the implementation of a road network through a town, city, or region, and the sustainability of natural resources.

Have you ever participated in a planning process before? Yes___ No____
If no, please go to Question #2

If yes, please complete the following:

I have participated in a planning process as a: Planner____ Citizen_____ Both_____

I last participated in a planning process in the year ____

The kinds of planning processes I have participated in are:

Official Community Plan ___ (City ___ Town ___ Village ___ Regional district ___)
Provincial Park plan ___
National Park plan ___
Forest plan ___
LRMP plan ___
SRMP plan ___

Other:

______________________________________________________________

______________________________________________________________

(2) How did you feel about the following areas of operation when using the GIS tool as a method for gathering public knowledge?

Please circle your choice.

| | 1=Low | | | 4=Moderate | | | 7=High |
|---|---|---|---|---|---|---|---|
| Difficulty of Use | 1 - | 2 - | 3 - | 4 - | 5 - | 6 - | 7 |
| Quality of Design | 1 - | 2 - | 3 - | 4 - | 5 - | 6 - | 7 |
| Amount of Relevant Information | 1 - | 2 - | 3 - | 4 - | 5 - | 6 - | 7 |
| Efficiency | 1 - | 2 - | 3 - | 4 - | 5 - | 6 - | 7 |

(3) Please check the box that best represents your opinion of the GIS tool.

(a) Do you feel better informed about trails in the Bulkley Valley than you did before you used this tool?

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| No better informed | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Better informed |

(b) Do you feel this tool made it easy or hard for you to gather local knowledge and opinions?

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| Very hard | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Very easy |

(c) How quickly were you able to move between the map areas on the screen?

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|
| Very slowly | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | Very quickly |

(d) Compared to more traditional tools (for example: paper maps) you have used, how quickly was it to gather the following information?

| Very slowly | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Very quickly |
|---|---|---|---|---|---|---|---|---|
| Public Opinions | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| Public Trail Sketches | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| Existing Trails | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

(e) How did you feel about the following areas of operation when using the GIS tool as a method for gathering public knowledge compared to more traditional participatory tools (for example: paper maps)?

Please check the appropriate box that would be the best represent your opinion.

| | GIS tool | Trad. Participatory tools | Unsure |
|---|---|---|---|
| Greater Efficiency | ☐ | ☐ | ☐ |
| Greater Amount of relevant information | ☐ | ☐ | ☐ |
| Greater Quality of Design | ☐ | ☐ | ☐ |

(4) Please check the box that best represents your opinion of the GIS tool.

| | Very Much | Somewhat | Neither | Somewhat | Very Much | |
|---|---|---|---|---|---|---|
| Complex | ☐ | ☐ | ☐ | ☐ | ☐ | Simple |
| Useless | ☐ | ☐ | ☐ | ☐ | ☐ | Useful |
| Slow | ☐ | ☐ | ☐ | ☐ | ☐ | Quick |
| Uninformative | ☐ | ☐ | ☐ | ☐ | ☐ | Informative |
| Unfriendly | ☐ | ☐ | ☐ | ☐ | ☐ | Friendly |
| Uncomfortable | ☐ | ☐ | ☐ | ☐ | ☐ | Comfortable |
| Boring | ☐ | ☐ | ☐ | ☐ | ☐ | Interesting |
| Distrust | ☐ | ☐ | ☐ | ☐ | ☐ | Trust |
| Did not enjoy | ☐ | ☐ | ☐ | ☐ | ☐ | Enjoy |

(5) What would you change about this GIS tool?

________________________________________

________________________________________

________________________________________

________________________________________

(6) What pleased you about using this GIS tool (For example: public information was organized efficiently)?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

(7) What irritated you about using this GIS tool (For example: too slow to gather public knowledge)?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

(8) (a) Do you believe you would use this tool in a planning process?

Yes___ No ____

If you answered No, please go to question 8(c).

(b) If yes, what kind of planning process would the tool be best suited for?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

(c) Why?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

(9) Do you feel that this participatory GIS tool should be solely gathering the public's knowledge and opinions or also providing the public with an opportunity to be involved in the decision-making process?

Solely gathering the public's knowledge and opinions ________
Also providing the public with an opportunity to be involved in the decision making process ________
Don't know/Don't have an opinion _______

Why:

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

(10) Do you feel that this participatory GIS tool should be solely concerned with collecting the publics' knowledge and opinions or also informing the public about the planning process?

Solely concerned with collecting the publics thoughts______
Also informing the public about the planning process______
Don't know/ Don't have an opinion _____

Why:

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

(11) Overall, which did you prefer to use in this planning process:
Please circle your choice.

(a) Traditional Participatory Methods (Paper maps)
(b) Computer-based Maps
(c) Don't know/ Unsure

Do you believe that this GIS-based tool is more efficient at gathering local knowledge and opinions than more traditional tools (For example: paper maps)?

Yes_____ No_____

Please explain:

(12) Do you have any suggestions or feedback for this study?

***Thank you for answering this questionnaire for the evaluation of this GIS tool.***

## Appendix E- Letter of Informed Consent

**Purpose** – The purpose of this study is to evaluate the use of PPGIS tools that aims to enhance public participation within a public planning process in northern BC. The utility of this tool will be evaluated based three subjects of evaluation:

- the usefulness of the tools in planning processes;
- the willingness of community planners (including participating members of the public) to use them;
- the chances that planners (including members of the planning public) would actually prefer the tools over traditional decision-making tools

**How Respondents Were Chosen** –Within the Bulkley Valley, there are a number of trail groups that function to maintain, build, and use the trails. In addition, many of the members of these trail groups have local knowledge and opinions that would assist in the conservation of existing trails and the planning of new trails. The members of the trail groups were chosen as participants since they could use the paper maps and GIS tool to provide their knowledge and opinions concerning local trails.

**What The Participants Will Be Asked To Do** –
(1) Write a computer-literacy pretest
(2) Using paper maps to provide opinions and knowledge relating to the planning process (boundaries, unknown roads, etc.), then answer an evaluation questionnaire
(3) Using a GIS tool to provide opinions and knowledge on the planning process (boundaries, unknown roads, etc.), then answer an evaluation questionnaire

**Anonymity And Confidentiality** – The names of participants will not be used in any reporting, nor will any information which may be used to identify individuals. Each participant will have a code name when participating in the Delphi process. All information shared in these pretests and questionnaires will be held within strict confidence by the researchers. All records will be kept in a locked office room at UNBC and accessible only to the research team. The information will be kept until the final report of the project is complete. After this time, shredding will destroy all information related to the pretests, questionnaires and Delphi forms.

**Potential Risks And Benefits** - The project team does not consider there to be any risks to participation.

**Voluntary Participation** - Your participation in the research project is entirely voluntary and, as such, you may chose not to participate. If you participate, you may choose not to answer any question that makes you uncomfortable, and you have the right to terminate your participation at any time and have all the information you provided withdrawn from the study.

**Research Results** - In case of any questions that may arise from this research, please feel free to contact Conor Tripp (250-552-9694), Dr. Ray Chipeniuk (chipenir@unbc.ca), or Dr. Roger Wheate (250-960-5865) at UNBC. If the participants would like a copy of the final project report, it can be distributed to them upon request by calling Conor Tripp.

**Complaints** - Any complaints about this project should be directed to the Office of Research at UNBC: (250) 960-5820.

**I have read the above description of the study and I understand the conditions of my participation. My signature indicates that I agree to participate in this study.**

(Name -please print) (Signature) (Date)

## Appendix F-SPSS Database Guidebook-Descriptors

**<u>Demographics and Pretest:</u>**

**Scores for each sections of the Pre-test:**

*(a) Map literacy* *(b) Computer Icons* *(c) GIS features* *(d) Overall*

Scores are entered in as numbers themselves (See SPSS file)

**(A4) How often do you use the following in a year?**
**Please check the appropriate category.**

*(a) Computers* *(b) Paper Maps* *(c) Computer-based Maps*

1 = 0 times a year
2 = 1-5 times a year
3 = 6-10 times a year
4 = 11-15 times a year
5 = 16-25 times a year
6 = 26-35 times a year
7 = 36-50 times a year
8 = Over 50 times a year

**(A5) In your experience with paper maps, how would you evaluate the following factors of performance?**

*(a) Difficulty of Use (b) Quality of Design (c) Amount of relevant information (d) Efficiency*

1 = Very low
2 = Low
3 = Fairly low
4 = Neutral
6 = Fairly high
7 = High
8 = Very high

**(B5) In your experience with computer-based maps, how would you evaluate the following factors of performance?**

*(a) Difficulty of Use (b) Quality of Design (c) Amount of relevant information (d) Efficiency*

1 = Very low
2 = Low
3 = Fairly low
4 = Neutral
6 = Fairly high
7 = High
8 = Very high

**(A6) Which do you prefer:**

1 = Paper Maps
2 = Computer-based Maps
3 = Don't know/Unsure

**(A7) Sex:**

1 = Male
2 = Female

**(A8) Are you colorblind:**

1 = Yes
2 = No

**(A9) Select the age group you are in:**

1 = 0-19
2 = 20-24
3 = 25-34
4 = 35-44
5 = 45-54
6 = 55-65
7 = 65-74

**(A10) What is the highest level of education you have completed? (check this one out)**

1 = With bachelor's degree or higher
2 = Some University
3 = Completed Diploma
4 = Some Diploma
5 = Completed High School
6 = Some High School
7 = Less than Grade Nine

## <u>Traditional Method Questionnaire</u>

**(A11) (a) Have you ever participated in a planning process before?**

1 = Yes
2 = No

**(b) If yes, please complete the following:
I have participated in a planning process as a:**

1 = Planner
2 = Citizen
3 = Both

**(c) The kinds of planning processes I have participated in are:**

*(A) Official Community Plan* *(B) LRMP* *(C) Provincial Park Plan*
*(D) Forest Plan* *(E) SRMP* *(D) National Park Plan*

1 = Yes
2 = No

**(A12) How did you feel about the following factors when using the traditional method?**

*(a) Difficulty of Use (b) Quality of Design (c) Amount of relevant information (d) Efficiency*

1 = Very low
2 = Low
3 = Fairly low
4 = Neutral
6 = Fairly high
7 = High
8 = Very high

**(A13) (a) Do you feel better informed about trails in the Bulkley Valley than you did before you used the traditional method?**

1 = Informativeness - none
2 = Informativeness - very little
3 = Informativeness - little
4 = Informativeness - fair
5 = Informativeness - large
6 = Informativeness - very large
7 = Informativeness - a lot

**(b) Do you feel you were able to provide a lot of your knowledge about the trails in the Bulkley Valley when using the traditional method?**

1 = Info provided - none
2 = Info provided - very little
3 = Info provided - little
4 = Info provided - fair
5 = Info provided - large
6 = Info provided - very large
7 = Info provided - a lot

**(c) Do you feel this method made it easy or hard for you to offer your knowledge and opinions?**

1 = Very hard
2 = Hard
3 = Fairly hard
4 = Neutral
5 = Fairly easy
6 = Easy
7 = Very easy

**(d) How quickly were you able to move between the various maps?**

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(e) Did you feel it was easy or hard to draw a trail or area on the paper maps?**

1 = Very hard
2 = Hard
3 = Fairly hard
4 = Neutral
5 = Fairly easy
6 = Easy
7 = Very easy

**(f) How quickly could you find the following features on the paper maps?**

*(a)Lakes (b) Roads (c) Mountain (d) Existing trails*

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(A14) Please check the box that best represents your opinion of the traditional method**

*(a)Simple* *(b) Useful* *(c) Quick* *(d) Informative* *(e) Friendly*
*(f) Comfortable* *(g) Interesting* *(h) Easy* *(i) Trustable* *(j) Enjoyable*

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

## PPGIS Tool Questionnaire

**(B15) How did you feel about the following areas of operation when using the GIS tool in the exercise you have just completed?**

*(a) Difficulty of Use (b) Quality of Design (c) Amount of relevant information (d) Efficiency*

1 = Very low
2 = Low
3 = Fairly low
4 = Neutral
6 = Fairly high
7 = High
8 = Very high

**(B16) Please check the box that best represents your opinion of the GIS tool.**

**(a) Do you feel better informed about trails in the Bulkley Valley than you did before you used this tool?**

1 = Informativeness - none
2 = Informativeness - very little
3 = Informativeness - little
4 = Informativeness - fair
5 = Informativeness - large
6 = Informativeness - very large
7 = Informativeness - a lot

**(b) Do you feel you were able to provide a lot of your knowledge about the trails in the Bulkley Valley when using this tool?**

1 = Info provided - none
2 = Info provided - very little
3 = Info provided - little
4 = Info provided - fair
5 = Info provided - large
6 = Info provided - very large
7 = Info provided - a lot

**(c) Do you feel this tool made it easy or hard for you to offer your knowledge and opinions?**

1 = Very hard
2 = Hard
3 = Fairly hard
4 = Neutral
5 = Fairly easy
6 = Easy
7 = Very easy

**(d) How quickly were you able to move between the map areas on the screen?**

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(e) Did you feel it was easy or hard to draw a trail or area on the maps?**

1 = Very hard
2 = Hard
3 = Fairly hard
4 = Neutral
5 = Fairly easy
6 = Easy
7 = Very easy

**(f) How quickly could you find the following features on the screen?**

*(a) Lakes (b) Roads (c) Mountain (d) Existing trails*

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(B17) Please check the box that best represents your opinion of the GIS tool.**

| | | | | |
|---|---|---|---|---|
| *(a)Simple* | *(b) Useful* | *(c) Quick* | *(d) Informative* | *(e) Friendly* |
| *(f) Comfortable* | *(g) Interesting* | *(h) Easy* | *(i) Trustable* | *(j) Enjoyable* |

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

**(B18) Overall, which did you prefer to use in this planning process:**

1 = Paper Maps
2 = Computer-based Maps
3 = Don't know/ Unsure

**(B19) Do you believe that this GIS-based tool is more efficient at gathering local knowledge and opinions than more traditional tools (For example: paper maps)?**

1 = Yes
2 = No

## Planner Questionnaire

**(C1)(a) Have you ever participated in a planning process before?**

1 = Yes
2 = No

**(b) I have participated in a planning process as a:**

1 = Planner
2 = Citizen
3 = Both

**(c) The kinds of planning processes I have participated in are:**

| | | |
|---|---|---|
| *(a) Official Community Plan* | *(b) LRMP* | *(c) Provincial Park Plan* |
| *(d) Forest Plan* | *(e) SRMP* | *(d) National Park Plan* |

1 = Yes
2 = No

**(C2) How did you feel about the following areas of operation when using the GIS tool as a method for gathering public knowledge?**

*(A) Difficulty of Use (B) Quality of Design (C) Amount of relevant information (D) Efficiency*

1 = Very low
2 = Low
3 = Fairly low
4 = Neutral
6 = Fairly high
7 = High
8 = Very high

**(C3) Please check the box that best represents your opinion of the GIS tool.**

**(a) Do you feel better informed about trails in the Bulkley Valley than you did before you used this tool?**

1 = Informativeness - none
2 = Informativeness - very little
3 = Informativeness – little
4 = Informativeness – fair
5 = Informativeness – large
6 = Informativeness - very large
7 = Informativeness - a lot

**(b) Do you feel this tool made it easy or hard for you to gather local knowledge and opinions?**

1 = Very hard
2 = Hard
3 = Fairly hard
4 = Neutral
5 = Fairly easy
6 = Easy
7 = Very easy

**(c) How quickly were you able to move between the map areas on the screen?**

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(d) Compared to more traditional tools (for example: paper maps) you have used, how quickly was it to gather the following information?**

*(a) Public Opinions (b) Public trail sketches (c) Existing trails*

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(e) How did you feel about the following areas of operation when using the GIS tool as a method for gathering public knowledge compared to more traditional participatory tools (for example: paper maps)?**

*(a) Greater efficiency (b) Greater amount of relevant information (c) Greater quality of design*

1 = GIS tool
2 = Traditional participatory tool
3 = Unsure

**(C4) Please check the box that best represents your opinion of the GIS tool.**

*(a) Simple (b) Useful (c) Quick (d) Informative (e) Friendly*
*(f) Comfortable (g) Interesting (h) Easy (i) Trustable (j) Enjoyable*

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

**(C5) Which do you prefer:**

1 = Paper Maps
2 = Computer-based Maps
3 = Don't know/Unsure

**(C6) Compared to more traditional tools (for example: paper maps) you have used, how quickly was it to gather the following information?**

*(a) Greater efficiency* *(b) Greater amount of relevant information*
*(c) Greater quality of design* *(d) Greater Ease of Use*

1 = Very slow
2 = Slow
3 = Fairly slow
4 = Neutral
5 = Fairly quick
6 = Quick
7 = Very quick

**(C7) Do you believe you would use this tool in a planning process?**

1 = Planners that would use the PPGIS tool
2 = Planners that might use the PPGIS tool
3 = Planners that would not use the PPGIS tool

**(C8) Do you feel that this participatory GIS tool should be solely gathering the public's knowledge and opinions or also providing the public with an opportunity to be involved in the decision-making process?**

1 = PPGIS tool should solely collect public information
2 = PPGIS tool should collect public information and allow them to be involved in the decision- making process
3 = Don't know/Unsure

**(C9) Do you feel that this participatory GIS tool should be solely concerned with collecting the publics' knowledge and opinions or also informing the public about the planning process?**

1 = PPGIS tool should solely collect public information
2 = PPGIS tool should collect public information and inform the public about the planning process
3 = Don't know/Unsure

**(C10) Overall, which did you prefer to use in this planning process:**

1 = Traditional participatory method
2 = PPGIS tool
3 = Don't Know/Unsure