



**Forest Productivity Council
of
British Columbia**

Stand Level Working Group

**Five-year Strategic Plan:
2001-2002 Update**

January 29, 2001

Secretariat
c/o Ministry of Forests Executive
4th Floor, 595 Pandora Street
Victoria, BC

January 29, 2000

The Stand Level Working Group submits *Stand Level Working Group Five-year Strategic Plan: 2001-02 Update* to the BC Forest Productivity Council for approval.



Stephen Stearns-Smith, Chair
Stand Level Working Group



Ken Baker, Chair
BC Forest Productivity Council

May 17, 2001
Date

APPROVED/ ~~NOT APPROVED~~

1. Introduction

Stand level growth and yield (G&Y) information is used extensively in forest management for planning (timber supply, habitat, biodiversity, land use), inventory (assigning volumes and updates) and silviculture (prescriptions and strategies). In BC, several agencies and companies are actively collecting data and developing growth and yield models.

The FPC recognized the need for an integrated approach to forest productivity issues and established working groups to provide coordination within focus areas, as well as to provide integration across these areas. The following working groups have been established to date:

- Site Productivity Working Group (SPWG)
- Stand Level Working Group (SLWG)
- Biodiversity /Habitat Working Group (BWG)

The Stand Level Working Group's (SLWG) mandate is to coordinate the collection of stand level data and the development of predictive tools that provide the means to accurately estimate the growth and yield of any forest stand in British Columbia (BC). In pursuit of the mandate the SLWG is to:

- facilitate communication within BC's G&Y community;
- produce and maintain various stand level G&Y standards;
- stay abreast of all stand level G&Y activities in the province;
- encourage G&Y linkages to non-timber values such as forest health;
- assemble and prioritize client needs and knowledge gaps;
- reconcile client needs with strategic direction from the FPC;
- identify priority project areas and occasionally recommend specific projects;
- track and recommend provincial (sector-wide) resourcing levels;
- ensure appropriate peer review processes are utilized;
- maintain and annually update a five-year strategic plan; and
- report annually to the FPC on the state of stand level activities in the province.

In addition, under direction from the FPC, the SLWG may:

- undertake technical reviews and evaluations;
- identify, recommend, develop and/or approve technical details for new stand level data collection, analysis and model development projects;
- discuss and seek resolution on relevant technical issues; and
- prepare special reports and documents.

Unlike FPC's Site Productivity Working Group, the SLWG does not directly solicit, administer or distribute large-scale project funding. Expenditures by, or on behalf of the SLWG relate to committee maintenance, special report commissions and an annual technical community workshop.

In this report to the FPC, the SLWG documents: (1) user needs and information gaps, (2) strategic goals and rationale; and (3) annual resourcing recommendations by activity. Also included are recent activities and accomplishments of the SLWG (Appendix I) and SLWG's recommendations for specific Ministry of Forests (MOF) growth and yield program activities for 2001-02 (Appendix II).

2. User Needs and Information Gaps

2.1 Common Needs

The unique size and character of BC's forest resource and the current direction of forest management in BC, all point to the ongoing need for both natural- and managed-stand G&Y information. Complex stand conditions are a natural feature of many BC forest types. The growing emphasis on partial cutting for both biological and social reasons further increases our need for G&Y information in complex stands. Although broadleaf species are an important component of many complex stands, they are currently absent from many G&Y models.

Existing tools are generally adequate for single-species, even-aged stands from free-to-grow to approximately biological rotation (culmination of mean annual increment). However, models need to be strengthened for young trees (regeneration and establishment), old trees (old-growth creation and retention), complex stands (variable retention, mixed-wood and uneven-age stands) and intensive silvicultural treatments. Complex stand models are currently under active development in southeast and northeast BC and need further improvement and testing. Geographic gaps, particularly in the central interior and coast, still need to be addressed.

Current best-available information needs to be identified to temporarily fill information gaps. Similarly, we need a better understanding of what constitutes sufficient resolution for particular uses. For example, the trend toward use of individual-tree (tree-list) models for complex stands will necessitate development of tree-list generation techniques to link with limited photo-based inventory attributes. Despite the attraction of using tree-list models within forest level analyses, the tradeoffs between model resolution vs. outcome sensitivity should be continually examined.

2.2 *Inventory Needs*

The provincial forest inventory is in a gradual transition to the new BC Vegetation Resource Inventory (VRI) and National Forest Inventory (NFI) protocols. During this transition, over at least the next ten years, we need to maintain G&Y tools to support both the old and new systems. The VRI will continue to require volume predictions from photo attributes. The accompanying increase in ground sampling will provide a supplemental direct source of volume estimates. Emerging technologies for improving the remote sensing of mensurational data need to be constantly monitored and incorporated when appropriate.

Projection tools will still be required to annually update (grow) the inventories between re-inventories every five to ten years (as much as 30 years in some cases). G&Y concerns over this short timeframe do not include long-term processes such as species dynamics.

2.3 *Silviculture Needs*

Large-scale silvicultural investments in BC are being driven by expected increases in timber supply and other resource values. This underscores the need for G&Y tools that reflect our best estimates of treatment response in order to maximize return on investment and avoid inadvertent degrading of future resource values. Wood quality and product merchandizing (size class distributions) are being recognized as important dimensions to silvicultural investment decisions and need to be reflected in G&Y estimates, along with volume, to obtain a complete picture of timber value and return on investment.

Enhanced G&Y linkages to habitat, biodiversity indicators and forest health are needed to strengthen prescriptive abilities in these areas. Consequently, the need for projections of stand structure attributes (tree size and/or spatial distribution) has increased the interest in individual-tree modelling. Despite the direct effects on timber yields, forest health impacts remain the most neglected.

2.4 *Forest and Landscape Level Planning Needs*

The provincial forest inventory will likely remain the primary foundation for forest level planning, including timber supply. The timber supply planning process requires yield curves that project stand volumes in excess of 200 years. Over this timeframe, G&Y issues around stand replacement, mortality and species dynamics become critically important.

Traditionally, forest level planning referred primarily to timber supply planning. Other types of forest level planning are also becoming important, both publicly and corporately. At the corporate level, wood products mills are increasingly interested in expressing harvest flow in terms of product merchandizing (grade and size class distribution). This represents another

application area for linking tree-lists or size-class distributions to inventories via tree-list generation and projection.

In addition to volume projections, timber supply is sensitive to a number of other factors that are currently linked in some way to G&Y. These include green-up, adjacency, habitat supply, biodiversity and forest health. As with silviculture, these G&Y linkages need to be improved.

Better linkages need to be forged between stand level silviculture and forest level analyses to fully realize the benefits of strategic silvicultural investments. Tools used for stand level prescriptions need to agree with tools used in timber supply analysis and vice versa. Public planning tables, such as Land and Resource Management Plans (LRMPs), can also benefit from G&Y related information, including stand and landscape visualization tools.

3. Strategic Goals

As a relatively young discipline, G&Y initially focused on the less demanding task of understanding and predicting simplified systems such as healthy, single-species, even-aged stands. Coincidentally, forest management practices initially developed along those same lines, probably for similar reasons. The current paradigm shift in forest management toward managing for diversity and complexity is accelerating the demand for knowledge and models that address complex stand conditions. Clearly, there is room for better identification of best-available information in areas where data or models are currently inadequate.

Goal Area 1 – Strategy: Strategic planning

Strategic planning provides the rationale and priorities for resourcing and conducting activities in the other four goal areas. Strategic plans are living documents that need to be regularly revised based on knowledge of the changing environments affecting G&Y and feedback from users and resource monitoring. Strategic planning makes up a large part of the SLWG's mandate. SLWG plans are intended to provide guidance at the organizational and program levels.

This plan specifically identifies the goal areas where the SLWG currently feels strategic planning should be a priority at the program level.

Goal Area 2 – Standard Data: Building and maintaining a G&Y data legacy for our future

Standard data refers to multi-purpose data collected to established standards for general model calibration and validation. Some collection of non-standard, single-use data is also expected

within individual modelling and biology projects. However, the SLWG encourages multi-purpose data collection designs where practical.

Models and data function best together when they are designed to serve the same needs. The FPC supports the need for the integrated planning of data collection and modelling. The SLWG has deliberately set for itself a wide and comprehensive scope that includes both these areas.

In G&Y, the only thing that is scarcer and more valuable than data is older data. British Columbia is fortunate to already have a large G&Y data legacy to build upon. BC's G&Y data legacy goes back more than 75 years and is made up of temporary sample plots (TSPs), permanent sample plots (PSPs) and experimental plots (EPs). Traditionally, data collection has focused on model building needs. The scope of data collection has recently expanded to include the monitoring of model predictions at both the forest and stand levels.

Goal 2a: Develop a comprehensive, rationalized G&Y data master plan by 2002. Scope to include data for model calibration, validation and monitoring.

The SLWG's data strategy calls for the development of a re-rationalized, integrated data system, using a mix of PSPs, TSPs and EPs, to address the entire spectrum of G&Y needs including: inventory, silviculture, planning, calibration, monitoring, simple stands, complex stands, managed stands and natural stands. In addition, the SLWG will continue to facilitate the development and maintenance of data standards to facilitate the collection and sharing of data.

Given fiscal realities, we need to strike a balance between our new data needs and preserving valuable portions of our legacy data. Long-term data will become even more valuable as we begin to model long-term processes like species succession, long-term site productivity and climate change. We will also continue initial development and testing of complex models on data from simpler systems.

Goal 2b: Ongoing establishment, remeasurement, and data management of subjectively located PSPs for model calibration.

Although PSP is a generic term, in BC it is currently associated primarily with the extensive Growth Natural Program developed and managed by the MOF in conjunction with the FPC. There is an ongoing need for similar subjectively located PSPs, albeit over a wider range of stand conditions, for model calibration. The original matrix for the Growth Natural PSP Program targets simple stand conditions. Fortunately, this was not strictly enforced and a fair amount of complex stand data already exists.

British Columbia's PSP legacy in natural stands will continue to be valuable despite the increasing emphasis on managed stands—the basic principles of tree growth remain the same. It will also take decades to grow a robust managed stand database. In the meantime, we will continue to rely on data from natural stands as a surrogate, especially in older age classes.

Finally, the Chief Forester is currently espousing a vision for BC forestry emphasizing natural forest management. We need to preserve our options since the future is still uncertain.

The existing Growth Natural PSP Program should be maintained while awaiting development of the new data master plan, although new establishment should focus on complex stands (including broadleaf and mixedwood stands) and other grossly under-sampled stand types.

Goal 2c: Ongoing establishment, remeasurement and data management of randomly located PSPs for monitoring G&Y predictions against actual landbase performance.

The SLWG recognizes the need for both subjectively and randomly located PSPs in a comprehensive G&Y data master plan. Forest managers are pressing for better linkages between G&Y models, the landbase and sustainable forest management. Recognizing the limitations of our current knowledge base, an adaptive management approach is being adopted that includes an emphasis on G&Y monitoring. Monitoring data must come from a representative (e.g., random) sample of the landbase in order to provide feedback on the quality of our G&Y predictions in the context of operational forest management.

Goal 2d: Ongoing establishment, remeasurement, data management and analysis of EPs for quantifying silvicultural response and stand dynamics.

Quantifying G&Y differences between management alternatives or stand characteristics requires statistically rigorous experimental designs that enable us to identify meaningful differences against the background of natural variability found in biological systems. Because EPs require a larger investment per installation than PSPs, they necessarily must be used more sparingly and with more forethought and planning. EPs have always played an important role in the calibration and validation of silvicultural response models. Well-designed EPs focusing on stand dynamics may even provide a cost-effective way to reduce the numbers of PSPs needed in complex stands by contributing more process knowledge to traditional empirical modelling approaches. Our highest priorities for new installations in this area should be well-designed experiments that will quantify the important elements of complex stand dynamics (Goal Area 3), including forest health interactions (Goal 3c).

Goal 2e: Establishment and data management for various types of TSPs including retrospective growth measurements, both destructive and non-destructive.

TSP is another generic term that is currently associated primarily with the volume sampling plots installed as part of the old MOF inventory. In a broader context, currently active TSP sampling programs in BC also include the regeneration plots for PrognosisBC and others. TSPs should be considered in the development of the master data plan.

Goal 2f: The SLWG will oversee the establishment and maintenance of data collection and data management standards for all standard plots types recognized in the data collection master plan.

Data standards have always been a priority for the FPC. Standards for data collection and management help ensure the data are consistent and can be easily shared across the G&Y community. On a priority basis, the SLWG will establish standards and/or guidelines for data collection, database models, sample selection and plot protection.

Goal Area 3 – Modelling: *Building and maintaining a diverse suite of models to address the full range of user needs and forest conditions in BC.*

No one G&Y model will meet all our needs. Different models are needed to meet different needs at different resolutions and scales. BC's growth and yield program needs to cover a wide spectrum from inventory update to forest management sustainability over multiple rotations and the potential impacts of climate change.

The SLWG's strategy encourages model diversity to enhance the potential for innovation and to provide for mutual risk balance. We lack sufficient long-term experience to judge the strengths and weaknesses of various types of models, nor can we justify a preference for just one type of model. Diversity in funding sources, along with the people and organizations involved, will also help balance risks.

Model diversity carries with it the need for greater emphasis on validation and monitoring. This information provides users and organizations with the information they need to make more informed decisions regarding model selection and investments.

The SLWG's strategy encourages model diversity but also encourages shared systems where practical. Examples might include common interfaces and shared components such as taper equations, site productivity models, small tree models and shared data. The SLWG will take an active role in facilitating sharing and cross-fertilization within and between the user and development communities.

Goal 3a: Enhanced modelling capability for complex stands.

This is perhaps G&Y's most widely recognized need today. Although a lot of work already exists, a lot more work is needed to meet the growing needs. The sheer magnitude and complexity of the issue means it may require some new perspectives on the problems to arrive at innovative solutions within a reasonable timeframe and budget.

Long-term projections are still largely an extrapolation of existing data. Biological realism becomes even more difficult to maintain because of the subtleties of species succession and

other complex stand processes. Given the risks and uncertainties, it is perhaps the place where we need to encourage the most model diversity. Empirical, mechanistic and process driven modelling approaches will all have contributions to make at different resolutions and scales.

It is also important to recognize that advancements in complex stand modelling have built on foundations from simple stand modelling, both in terms of biological understanding and modelling techniques. Although broadleaf species are an important part of many complex stands (biologically and economically), few models currently address broadleaf species even in pure stand conditions.

Goal 3b: Enhanced modelling capability in young and old stands of all types.

Regeneration and mortality—the birth and death of a tree—have always been the most difficult G&Y components to model given their probabilistic nature. Quantifying these components is especially important for complex stands since these components drive stand replacement, species succession and, ultimately, long-term yields. Green-up, free-to-grow and retention strategies are making the growth of young and old trees an increasingly important aspect of G&Y. Natural regeneration establishment and the impact of competing vegetation on young tree growth are absent in most existing G&Y models. As trees age, the increasing importance of external growth-modifying factors such as insects, disease and weather damage, has also been largely overlooked in G&Y modelling, largely because of the complexity.

Goal 3c: Enhanced modelling of G&Y forest health interactions.

Meaningful investment analysis of forest health mitigation practices requires the ability to predict the G&Y impacts of various forest health conditions and related treatment effects. New silvicultural systems and strategies, such as variable retention, may have forest health implications that we are currently unable to quantify. Traditional forest health studies need to be supplemented with stronger G&Y connections so that G&Y models can be improved.

Goal 3d: Maintenance and enhancement of existing models to keep pace with evolving user needs and technologies.

The SLWG recognizes that well-established models still need a maintenance and support infrastructure to ensure they continue to meet user needs. Even though further development of simple stand models is currently a lower priority, resources need to be available to support their continued application. New application delivery technology should be adopted whenever it can improve the accessibility and utility of existing models (e.g., Internet interfaces).

Goal Area 4 – Biology: *Advancing our understanding of the biological principles driving stand dynamics through focused investigative studies.*

With the growing emphasis on complex stands, it has never been more imperative that we continue to encourage stand development research. Our models are increasingly being asked to project stand conditions that result from new and innovative silvicultural practices—practices for which we have no operational data to support direct empirical modelling. The segregation between process and empirical models is gradually disappearing as we strive for both biological and quantitative realism to better address complexity. Research installations are expensive necessities that must be well planned in order to realize the intended long-term benefits at a reasonable cost. In addition to the standard silvicultural response experiments, some unique installations are also needed to help us understand the basic stand development principles for various stand structures and conditions.

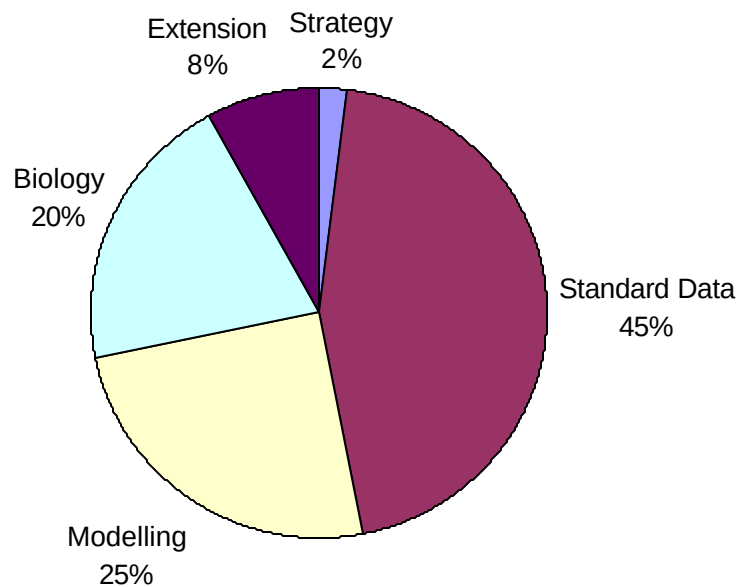
Goal Area 5 – Extension: *Promoting education and communication.*

In order to meet the challenges ahead, G&Y needs more informed users and a larger, well-networked development community. Traditional classroom training, through post-secondary institutions and continuing education providers, can only be one piece of the puzzle due to limited access. We need to develop and support information technology that provides timely and relevant information to practicing professionals at their places of work. We must also realize that encouraging diversity in the development community will further fragment information. The extension partnerships currently forming around the province should be encouraged as a partial solution to this dilemma. In their role as information clearinghouses, the partnerships can facilitate syntheses and linkages to help users locate and tap directly into diverse information sources.

The SLWG's strategy encourages communication and education throughout the G&Y community. The SLWG will take an active role itself by maintaining an Internet discussion forum, a website and hosting an annual workshop to encourage constructive communication among developers and users around timely G&Y issues.

4. Resourcing the Strategic Goals

The following chart indicates approximate, relative resourcing levels the SLWG feels are necessary to realize and maintain a well-balanced, provincial stand level growth and yield program. The five categories in this chart refer to the five main goal areas enumerated in the previous section.



APPENDIX I

SLWG Accomplishments

The SLWG was formed in May 1999. The fiscal year 1999/2000 was its first year of operation. By the end of fiscal 2000/2001, the SLWG will have:

- provided recommendations to the FPC on project areas based on needs and the FPC priorities;
- through members' work and contracts administered by MOF, will have summarized background on:
 - PSP measurements and standards outside of BC;
 - partially inventoried the current G&Y sampling programs in BC;
 - approaches to small tree modelling; and
 - matrix of BC growth and yield model abilities;
- organized a Complex Stand Modelling Workshop to provide direction for developing complex stand tools; and
- established a Growth & Yield list server.

The following table provides a summary of projects completed or initiated during 1999/2000.

Table 1. Expenditures by or initiated by the SLWG for 1999-2000

Project	Overview	Funding Source
General		
Terms of Reference	The SLWG created reference documents on the role and direction of the SLWG in 1999. These were reviewed in May 2000 and no changes were recommended.	
Recommendations to FPC	The SLWG provided recommendations to the FPC in September 1999 and March 2000 about immediate stand level G&Y needs recognized by SLWG members.	
Data Collection, Standards, and Maintenance		
PSP measurements outside of BC	Review of current permanent sample plot methods used across Canada and selected locations worldwide. The document is posted on the FPC website.	MOF RIB
Partial summary of current G&Y sampling programs in BC	Partial summary of current BC sampling programs that collect G&Y data. The document is posted on the FPC web page.	MOF RIB
Communication		

Project	Overview	Funding Source
Awareness of SLWG	Information about the formation of the SLWG was placed on several distribution lists (e.g., RIC Fast Fax).	
Website presence	Information on the SLWG and other background information is present on the FPC website.	
Stand Modelling		
Complex Stand Modelling Workshop	The SLWG hosted a workshop on February 28-29, 2000 with developers of G&Y models used in BC. A summary note is posted on the FPC website.	MOF RIB through MOF executive
Matrix of BC G&Y models	The SLWG prepared a draft matrix of the abilities of G&Y models in BC to address identified needs. The draft matrix and a summary note are posted on the FPC website.	
Small tree modelling	At the encouragement of the SLWG, MOF contracted a review of small tree needs of existing BC G&Y models and a literature review of current modelling approaches. The paper will be posted on the FPC website.	MOF RIB
Documentation/Extension		
G&Y list server	The SLWG established a discussion list on BC G&Y issues for the BC G&Y community. Currently, the list has about 80 members.	MOF maintained
Forest Health		
	SLWG has proposed hosting a forest health G&Y modelling workshop for winter 2001. Logistics and funding are being sought.	

APPENDIX II

SLWG Recommendations to the Ministry of Forests for 2001-02

Strategy

- Adopt a strategic foundation for the G&Y program.
- Implement FPC, SLWG and GYPCC strategic plans.

Standard Data

- PSP program
 - initiate a two-year re-rationalization and possible redesign of the PSP program in the broader context of emerging priorities with G&Y including complex stand modelling, monitoring, etc.
 - if facing fiscal constraints, make complex PSPs highest remeasurement priority and delay new installations
 - work to restore a HQ-funded, PSP installation and remeasurement program
 - increase industry involvement in PSPs
- Monitoring
 - complete pilots
 - establish standards
 - establish a base level provincial program (HQ funded)
 - establish proactive industry involvement
- Forest health growth and yield data program
 - design and begin implementation
- EP program (field experiments)
 - continue to address analysis and reporting backlog
 - maintain remeasurements on a priority schedule
 - explore new EPs as joint ventures with districts & industry

Modelling

- VDYP7: maintenance and support only, further development on hold. Postpone implementation of species dynamics to enable quicker release.
- TASS: extend into mixed-species (including broadleaf) and partial cutting (IDF and coastal variable retention), improve user access (e.g., web-TASS), address leadership transition issue within development team (retirement of team leader).
- TIPSy3: focus on maintenance and support new development only at user request.
- PrognosisBC: complete regeneration model, refit growth and mortality, add broadleaf species, expand into new sub-zones and explore other variants.

- MGM: demonstrate operational use in the boreal and SBS, HQ monitoring of technical progress is a higher priority than participation in development, solicit UNBC as a development partner.
- Other related priorities:
 - ensure project teams produce and update a project plan for annual review
 - implement best available information from research
 - establish model validation standards
 - encourage forest health modelling
 - encourage small tree modelling with broad application
 - explore old tree modelling methods

Biology

- Emphasize research in stand dynamics with relevance to complex stands.
- Leverage current issues and problem forest types.

Extension

- Provide G&Y expertise to the regional Extension Partnerships (coast and southern and northern interior), Forest Management Institute of BC (formerly SIBC) and the BC Forestry Continuing Studies Network.
- Primary responsibility for extension of MOF products and knowledge still rests with the MOF and needs continued resourcing.
- Completely overhaul the entire fragmented G&Y web presence and dedicate resources to regular website maintenance and enhancement.

APPENDIX III

Glossary

SLWG documents use the standard MoF glossary found at:

MoF GLOSSARY

<http://www.for.gov.bc.ca/pab/publctns/glossary/glossary.htm>

MoF ACRONYMS and INITIALISMS

<http://www.for.gov.bc.ca/pab/publctns/acronyms/index.htm>

APPENDIX IV

Stand Level Working Group Members – 2000/01

Ian Cameron, RPF
J.S. Thrower & Associates
Kamloops

Jon Vivian, RPF
Resources Inventory Branch
Ministry of Forests
Victoria

Jeff Stone, PhD, RPF
Timber Supply Branch
Ministry of Forests
Victoria

John Muir, PhD, RPF
Forest Practices Branch
Ministry of Forests
Victoria

Raoul Wiart, RPF
R.J. Wiart & Associates
Victoria

David Carson, RPF
Timberline Forest Inventory Consultants
Victoria

Peter Marshall, PhD, RPF
Faculty of Forestry
University of British Columbia
Vancouver

Pat Martin, RPF
Forest Practices Branch
Ministry of Forests
Victoria

Gordon Nigh, PhD, RPF
Research Branch
Ministry of Forests

Steve Stearns-Smith, RPF
Olympic Resource Management
Vancouver