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NATURAL RESOURCE MONITORING IN BRITISH COLUMBIA: A COMPILATION OF PROVINCIAL GOVERNMENT INITIATIVES

Prepared by:
Mike Fenger and Peter Bradford

Assessing stream health on the north island
Photo: Christina Mardell, North Island Central Coast Resource District

FREP
Forest & Range
Evaluation Program

BRITISH COLUMBIA

Sustainability of Forest and Range Resources Through Science and Stewardship

NATURAL RESOURCE MONITORING IN BRITISH COLUMBIA: A COMPILATION OF PROVINCIAL GOVERNMENT INITIATIVES

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This report will be updated periodically—if you have any edits, corrections, or other feedback, please email Peter Bradford **Peter.Bradford@gov.bc.ca**

FREP monitoring identifies resource practices that have proven effective in sustainably managing forest and range resource values and highlights opportunities for continued improvement.

The FREP Mission:
To be a world leader in resource stewardship monitoring and effectiveness evaluations; communicating science-based information to enhance the knowledge of resource professionals and inform balanced decision-making and continuous improvement of British Columbia's forest and range practices, policies and legislation. *http://www.for.gov.bc.ca/hfp/frep/index.htm*

Management of forest and range resources is a complex process that often involves the balancing of ecological, social, and economic considerations. This evaluation report represents one facet of this process. Based on monitoring data and analysis, the authors offer the following recommendations to those who develop and implement forest and range management policy, plans, and practices.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report summarizes environmental monitoring initiatives undertaken by British Columbia government natural resource agencies and outlines their scope and purpose. This information was collated to provide an overall understanding of the scope and scale of natural resource monitoring within the British Columbia government. In addition, it is hoped that this report will help highlight and facilitate opportunities to improve collaboration between monitoring initiatives. The intended audience for this report is resource managers and professionals who rely on monitoring data to help inform their recommendations and decision making. It is also intended for those who set resource agency priorities and make funding decisions.

Opportunity to collaborate was subjectively rated for each program as "high," "moderate," and "low" based on potential to share data collection protocols, training, data collection, data management, quality assurance, and the potential for co-ordination of monitoring priorities for government. This report does not make recommendations on how programs can improve collaboration with other programs.

Fifty-four monitoring programs are described and classified. Forty are classified as "active" and five as "new" (start-up year), two are "pending," and seven are classified as "inactive" (i.e., they have provided data in the past but are no longer actively managed and contributing new monitoring data). Where possible, contact names for all initiatives are included and websites listed for more detailed information and data.

This survey takes an inclusive approach to the term monitoring and covers research, inventory, implementation, effectiveness, compliance, and state of monitoring initiatives. Some long-standing programs, such as those involved in meteorology and hydrology monitoring, already achieve a high degree of interagency collaboration between federal, provincial, and municipal agencies (e.g., BC Hydro, Alcan, and Metro Vancouver). Many also achieve a significant degree of transparency, providing online access to their data and data-sharing agreements such as those developed between agencies under the Climate Reporting Monitoring Program.

This report is based on the following information sources.

- Initial interviews with 26 government staff representing: Ministry of Forests, Lands and Natural Resource Operations; Ministry of Environment; Ministry of Energy and Mines; the BC Oil and Gas Commission, and two consultants.

- Follow-up with contacts and programs identified by those initially interviewed.

- Information on government websites, accessed as of June 2012.

- Internal monitoring reports made available by personnel from the Ministry of Forests, Lands and Natural Resource Operations and Ministry of Environment.

- Reviewers' edits to the early drafts of this report.

All ninety-two reviewers and contacts are listed in Appendix 1. Appendix 2 contains a list of *FRPA* Resource Values, FREP Contacts, and FREP Questions. Appendix 3 contains a list of acronyms used throughout the report.

BACKGROUND

This report summarizes environmental monitoring initiatives undertaken by British Columbia government natural resource agencies and outlines their scope and purpose. Fifty-four monitoring programs are briefly described. Community monitoring initiatives, such as nest records,[1] Christmas bird counts, Columbia Basin Watershed groups,[2] Babine Watershed Monitoring,[3] and other community monitoring (e.g., see Yarnell and Gayton [2003]) are not included. These initiatives are outside of government; however, these initiatives share the similar challenge of ensuring consistent protocols, sampling, data collection, and training.

The purpose of this project was to identify and catalogue a comprehensive listing of natural resource value monitoring within British Columbia government agencies, with the aim of facilitating opportunities to improve collaboration between monitoring initiatives in areas such as resourcing, staffing, funding, survey equipment, data management, protocol development, quality control, data sharing and priority setting. The audience for this report is resource managers and professionals who rely on monitoring data to help inform their recommendations and decision making. It is also intended for those who set resource agency priorities and make funding decisions.

The report does not include recommendations on how to improve collaboration, leaving this to monitoring program contacts and their managers. In the longer term, it is hoped that improved collaboration and information-sharing between these monitoring programs will help initiate the development of a comprehensive natural resource agency monitoring vision.

Public, First Nations, and stakeholder expectations of monitoring have increased under the results-based legislation. In developing the *Forest and Range Practices Act*, government identified "effectiveness evaluations" as a foundation of the results-based model.

METHODS

This project involved several iterative steps.

1. Review of existing documentation on current provincial monitoring initiatives, including those of the Ministry of Environment (Brown and Dick 2001, 2010) and a draft compilation of monitoring initiatives conducted by the Forest and Range Evaluation Program.

2. Defining of the criteria for inclusion in this survey.

3. Defining a list of attributes to describe each program.

4. Identifying and contacting by email and telephone many of the key contacts for each monitoring initiative – seeking review of draft descriptions of their initiative, making their amendments, and adding initiatives not included in early drafts.

Appendix 1 provides a list of the 92 people contacted during the course of this review and who are either listed as a program contact or who provided advice. This report largely reflects their work.

Monitoring initiatives included in this report are generally "self-identified" by program leads. Initiatives include programs whose activities met the criteria "of data collection and analysis," or whose programs assess or interpret the condition and (or) trends in the state (health) of natural resource values and the extent to which objectives (including desired condition) are achieved. As a result, this report includes monitoring-related research, inventory projects, and government-funded and industry-collected information, such as information generated by the Forest Investment Account program and the newer Land Based Investment program. Web links, references, and contacts are provided to allow readers access to monitoring programs and links to web data, when it is available and accessible. Links provided for programs are current to July 2012.

Opportunities for collaboration was ranked as "high," "moderate," or "low" on the basis of factors such as protocol-sharing, training, data-sharing, and technology sharing.

FINDINGS

Table 1 lists the monitoring initiatives, agency, and status. Following Table 1 is a brief description of each initiative, including its purpose and contact persons. Program status is classified as "active," "start-up year," "pending," or "inactive." "Active" means data collection or analysis of existing data is occurring within an agency. Five programs are identified as being in their "start-up year." Two programs are classified as "pending" because government has not made a decision on how or whether to monitor. Seven programs are classified as "inactive" but are included as they have collected information and written reports containing potentially valuable monitoring data, which may provide benchmark information and (or) influence existing program priorities. The opportunity for collaboration is rated as "high," "moderate," or "low" and appears in the individual program descriptions that follow Table 1.

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1   British Columbia Nest Records Scheme: http://www.wildlifebc.org/index.php?pageid=16

2   Columbia Basin Watershed Network: http://www.cbwn.ca/

3   Babine Watershed Monitoring Trust: http://www.babinetrust.ca/documents.html

Table 1. *Summary of monitoring initiatives by British Columbia government and other government agencies*

	Program	Name	Agency	Status
1	Air Quality Monitoring Program	Air Quality Monitoring Program	MOE	Active
2	C&E Forest	Compliance and Enforcement MFLNRO	MFLNRO	Active
3	Permit (MEM)	Inspection of Mines Permits	MEM	Active
4	EA Certificate	Projects Reviewable under the *Environmental Assessment Act*	EAO + MFLNRO	Active
5	C&E/ Stewardship OGC	Compliance and Enforcement/Stewardship, Oil and Gas Commission	OGC	Active
6	CDC	Conservation Data Centre	MOE	Active
7	CRMP	Climate Related Monitoring Program	MOE + EC + MFLNRO + MT&I + MA +TC	Active
8	WSC and MOE	Water Survey of Canada	EC + MOE	Active
9	SMP	Provincial Snow Monitoring Program	EC + MOE/WAMR + MFLNRO/RFC	Active
10	DSP	Dam Safety Program	MOE + MFLNRO	Active
11	ERP	Ecosystem Restoration Program	MFLNRO Range	Active
12	FHAOS	Forest Health Aerial Overview Survey	MFLNRO	Active
13	FISS	Fisheries Information Summary System	MOE + DFO	Active
14	FDWH	Fish Data Warehouse	MOE	Active
15	FPB Audits	Forest Practices Board Audits/Special Projects	FPB	Active
16	FP-LBI	Fish Passage (Land Based Investment)	MFLNRO + MOE + DFO	Active
17	FREP	Forest and Range Evaluation Program	MFLNRO + MOE	Active
18	IAPP	Invasive Alien Plant Program	MFLNRO Range	Active
19	LBI	Land Based Investment	MFLNRO	Active
20	OWN	Observation Well Network	EPD	Active
21	PSP G&Y	Permanent Sample Plot Growth and Yield Sites	MFLNRO	Active
22	RESULTS	Reporting Silviculture Updates and Land status Tracking System	MFLNRO	Active
23	RRAs	Range Reference Areas	MFLNRO	Active
24	SOER	State of Environment Reporting	MOE	Active
25	TSR	Timber Supply Review	MFLNRO	Active
26	VRI	Vegetation Resources Inventory Audit	MFLNRO	Active
27	NFI	National Forest Inventory	MFLNRO +CFS	Active
28	WQMN	Water Quality Monitoring Network	EPD	Active
29	Forest Certifications (SFI, ISO, FSC CSA)	BC Timber Sales Certification (SFI, CSA, FSC, ISO)	MFLNRO BCTS	Active
30	WSI	Wildlife Species Inventory	MOE EIS	Active
31	FWCP	Fish and Wildlife Compensation Program–BC Hydro	BC Hydro + MOE + DFO	Active
32	RAR	Riparian Areas Regulation	MFLNRO	Active
33	TEI	Terrestrial Ecosystem Information	MOE	Active
34	LTSP	Long-term Soil Productivity Monitoring	MOE + MFLNRO	Active
35	LTRI + SS	Silviculture Research Program	MFLNRO	Active

	Program	Name	Agency	Status
36	FFEI	Future Forest Ecosystems Initiative Monitoring and Research	MFLNRO + MOE	Inactive
37	FGR	Forest Genetics Research	MFLNRO	Active
38	WER	Wildlife Ecological Research	MFLNRO	Active
39	Hydrology/ Geomorphology	Hydrology and Geomorphology Research	MFLNRO + MOE	Active
40	BEC Ecology	Ecology and Biogeoclimatic Ecosystem Classification Research	MFLNRO	Active
41	FIPP	Fish–Forestry Interaction Program	MFLNRO + MOE	Active/
42	YSM	Young Stand Monitoring Inventory	MFLNRO	Pilot/ Start-up
43	LTEMcs	Long-term Ecological Monitoring (Citizen Science) Parks	MOE BC Parks	Pilot/ Start-up
44	CE Pilots	Cumulative Effects	MOE + MFLNRO	Pilot/ Start-up
45	HGSMP	Haida Gwaii Stewardship Monitoring Program	MFLNRO + CHN	Pilot/ Start-up
46	CFIA	Haida Gwaii Cultural Features Identification Audit	MFLNRO + CHN	Pilot/ Start-up
47	SOFR	State of Forests Reporting	MFLNRO	Pending
48	NRR	Natural Resource Roads	MFLNRO + OGC + MT&I	Pending
49	FERNS	Forest Ecosystem Research Network Sites	CFS + MFLNRO	Inactive
50	FIA	Forest Investment Account	MFLNRO	Inactive
51	CMI	Change Monitoring Inventory	MFLNRO	Inactive
52	RLUPs + LRMPs	Land Use Plan Monitoring	MFLNRO	Inactive
53	WRP	Watershed Restoration Program	MOE	Inactive
54	EMAN	Ecological Monitoring and Assessment Network	EC	Inactive

DESCRIPTION OF MONITORING PROGRAMS

Fifty-five monitoring programs are briefly described below. Links are provided to program websites; when data is accessible, a web link is provided. Some programs are no longer active but are ranked as "high" for collaboration because the information they generated may have relevance to current monitoring programs and setting priorities. All programs are actively managed unless marked as "pending" or "inactive." Five are marked as "start-up year." Appendix 3 contains a list of acronyms used in these descriptions.

1. AIR QUALITY MONITORING PROGRAM

http://www.bcairquality.ca/

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE	Air Monitoring Network	Health advice and pollution control linked to air-quality monitoring for almost 100 stations at about 40 communities. Data collected informs the AQHI (Air Quality Health Index) at 19 communities, a real-time index designed to provide up-to date air quality health information for citizens. Data from all communities is also used to issue air quality advisories recommending health advice and pollution control.	Site	A resource for air-quality bylaws and for citizens concerned about air quality in their communities. Ozone, nitrous oxide, particulates, smoke, and dust, etc.	Yes	Continuous and non-continuous ambient air monitoring stations data (see description below for links).	Low	Continuous to periodic to manually collected data at 150 sites. Specialized training and data-sharing.

Description

Network in British Columbia with approximately 100 continuous and 50 non-continuous ambient air monitoring stations. Metro Vancouver (http://www.metrovancouver.org/about/Pages/default.aspx) air quality staff operate approximately 20 of the continuous stations. The 80 continuous stations in the remainder of the province are run and maintained by a combination of MOE and industry staff. Approximately 20 industrial facilities across the province continuously monitor air pollutants emitted directly from their facilities (i.e., at the stack). A further 80 industrial facilities perform yearly or quarterly sampling on emissions from their stacks, as required by permits to operate. For details on the system and locations, go to: http://www.env.gov.bc.ca/epd/bcairquality/assessment/network-description.html. Current air quality and archival data can be accessed at: http://www.bcairquality.ca/readings/index.html. This is information used by health agencies, such as the BC Lung Association, when producing their state of air report, which can be viewed at: http://www.bc.lung.ca/airquality/stateoftheair-report.html.

Contact

Ted Weick
Water and Air Monitoring and Reporting Section
Ted.Weick@gov.bc.ca
250-387-6851

2. COMPLIANCE AND ENFORCEMENT (C&E) MFLNRO

http://www.for.gov.bc.ca/hen/

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	C&E Forest	Compliance inspections are linked to public and licensees statutory requirements; evidence collected on investigations.	Activity or Site	Enforcement of all legislated requirements of forest and range tenures and for members of the public.	No/Limited by FOIPPA	Confidential data (stored in an internal data system) collected through investigation of potential compliance infractions.	High	Training, data collection technology, priority setting, and corporate data management similar to other programs. Expectation from C&E that non-C&E staff will make known any potential infractions observed when in the field.

Description

Compliance and Enforcement (C&E) Natural Resource Officers do more than 11 000 inspections a year to assess compliance with provincial laws. Where evidence of a contravention is noted, an investigation is conducted, which may lead to the issuance of a violation ticket, penalty, or other enforcement action. C&E is the law-enforcement arm of the Ministry of Forests, Lands and Natural Resource Operations. It's main purpose is to make sure that resource management laws are followed on British Columbia's public lands, water, and forests and to take action where non-compliance occurs. Officers actively patrol for, and enforce, a broad cross-section of resource management laws. Examples from over 46 pieces of legislation include: *Forest and Range Practices Act* – practices, measures, results or strategies, stocking standards; *Wildfire Act* – fire-cause investigation (possible arson), fire use on private or Crown lands, such as debris burning, and safe use of campfires; *Forest Act* – cutting of Crown timber, appraisals (timber valuation), monitoring of transportation, marking, scaling, and export; *Range Act* – livestock, hay, Crown pastures; *Forest Practices Code of British Columbia Act* – silviculture/road legacy, special use permits; *Land Act* – unauthorized use of Crown land (i.e., illegal cabin); *Environmental Management Act* – litter, waste, and open burning (smoke emissions); *Fish Inspection Act* – provincial (i.e., processing, vendors, roadside sales); *Water Act* – changes in and about a stream

(Section 9 notifications); *Mines Act* and Mining Code of Practice – activities related to mining and mineral exploration, such as gravel pits/quarries.

Contact

John Harkema
Compliance and Enforcement
John.Harkema@gov.bc.ca
250-356-2069

3. INSPECTION OF MINES PERMITS (MEM)

http://www.empr.gov.bc.ca/Mining/Pages/default.aspx

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MEM	Permit (MEM)	Monitoring as a condition of project approval permits requirements.	Mine site	Industry collected and maintained monitoring data; Data on request; site inspectors verify. Inspector's of Mines collect data for remedial orders and infractions.	No (except for inspectors of mines)	On demand by inspector's of mines. Infraction data kept internal.	High	Training, data collection, protocols, and data management. Could add to sample points (i.e., location of culverts on permitted roads, etc.).

Description

The Mining and Minerals Division of the Ministry of Energy and Mines (MEM) manages British Columbia's mineral resources. This division implements policies and programs that encourage the responsible development of mineral resources and ensures that all mining activities respect the safety of workers, the public, and the environment. When mines are approved, monitoring conditions can be included on permits. Mine inspectors are responsible for mine inspections and focus on safety concerns, as WorkSafeBC has no jurisdiction on mine sites. Inspectors also enforce environmental provisions, when these are included on a permit. Mines sites tend to be small in area so access and other provisions outside of the mine site perimeter are outside of a mine inspector's jurisdiction.

Contact

Jim Dunkley
Inspector of Mines
Jim.Dunkley@gov.bc.ca
250-953-4640

4. PROJECTS REVIEWABLE UNDER THE *ENVIRONMENTAL ASSESSMENT ACT,* C&E (EAO)

http://www.eao.gov.bc.ca/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
EAO + MFLNRO	EA Certificate	Monitoring as a condition of project approval requirements.	Site to landscape and linear development.	Industry collected on site and maintained; site inspection verified; data on request.	Varies; proponent maintained.	On request	High	Industry-collected data has utility beyond meeting EA certificate conditions. Developing compliance management and effectiveness monitoring protocols.

Description

The Environmental Assessment Office (EAO) is a neutral agency that manages the review of proposed major projects in British Columbia, as required by the *Environmental Assessment Act.* The environmental assessment process provides for the thorough, timely, and integrated assessment of the potential environmental, economic, social, heritage, and health effects that may occur during the lifecycle of these projects. The assessment process provides for meaningful participation by First Nations, proponents, the public, local governments, and federal and provincial agencies. The Environmental Assessment Advisory Committee (http://www.eao.gov.bc.ca/EAAC.html) was established as an advisory body to EAO on the environmental assessment process in British Columbia. The location of projects is shown at: http://www.eao.gov.bc.ca/maps.html; this is also available on iMapBC (http://webmaps.gov.bc.ca/imfx/imf.jsp?site=imapbc). A list of certified projects and projects under assessment are a shown at: http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_home.html.

Contacts

Tim Hicks
Manager, Policy and Project Assessment
Tim.D.Hicks@gov.bc.ca
250-387-6758

Michelle Carr
Director, Policy and Quality Assurance
Michelle.Carr@gov.bc.ca
250-387-6748

5. COMPLIANCE AND ENFORCEMENT/STEWARDSHIP, OIL AND GAS COMMISSION (OGC)

http://www.bcogc.ca/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
OGC	C&E/ Stewardship OGC	Compliance with permits and regulation.	Site to landscape and linear development road.	Monitoring as required for enforcement of regulations under *Oil and Gas Activities Act*.	No	Internal	High	OGC enforces the permits it issues under the *Oil and Gas Activities Act*. Collaboration potential for training, data collection, and management.

Description

The Oil and Gas Commission (OGC) was created as a Crown Corporation and has been in existence for 14 years (http://www.bcogc.ca/). In October 2010, the Commission transitioned to the *Oil and Gas Activities Act* (*OGAA*). This regulatory model is designed to provide a streamlined, one-stop regulatory agency. Regulatory responsibility includes specified enactments under the *Forest Act*, *Heritage Conservation Act*, *Land Act*, *Environmental Management Act*, and *Water Act*. The Environmental Protection and Management Regulation of *OGAA* provides the statutory authority to the Minister responsible for administering the Wildlife and Water acts (or delegate) to take a number of actions that contribute to the management and protection of environmental values. These actions are key environmental components of *OGAA*; they must be put in place to establish several of the "government's environmental objectives" and to guide the OGC in making determinations on permit applications. The new one-stop approach is less than 2 years old. Recent direction on resource values and best practices are available online, such as the 2012 *Environmental Protection and Management Guide* (http://www.bcogc.ca/document.aspx?documentID=927&type=.doc) and stewardship forms and guidelines (http://www.bcogc.ca/industryzone/forms/stewardship.aspx). The provisions for protection of natural resource values are clarified at: http://www.env.gov.bc.ca/wld/ogaa/index.html.

Contacts

Howard Madill
Director of Stewardship
Howard.Madill@bcogc.ca
250-419-4424

Dean Zimmer
Director C&E, Fort St John
Dean.Zimmer@bcogc.ca
250-794-5278

6. CONSERVATION DATA CENTRE (CDC)

http://www.env.gov.bc.ca/cdc/index.html

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE	CDC	Database of species and ecosystems at risk including mapped occurrences.	Site	Province-wide species and ecosystems element rankings and location data; scientifically based endangered status and global context.	Yes	Tabular and spatial element data (see links below).	High	Priorities, training, technical data storage and transfer, and use of standard protocols indicate a high potential for collaboration.

Description

The CDC provides provincial lists for species and ecological communities (elements) at risk. CDC staff, in co-operation with scientists and experts throughout the province, rank these elements on the degree of risk. A number of criteria inform this assessment. Elements are assigned a rank that reflects the conservation status of the species. The CDC also maps occurrences of elements using GIS. Both the tabular and spatial data is provided to the public and government agencies, and is accessible in several ways (http://www.env.gov.bc.ca/cdc/access.html). Two main Internet tools are provided: (1) BC Species and Ecosystems Explorer (tabular data): a searchable database that provides details including natural history, status, and legal designation of elements, and provides potential lists of elements at risk based on area of interest (http://www.env.gov.bc.ca/atrisk/toolintro.html); and (2) CDC Internet Mapping Service (spatial data) (http://www.env.gov.bc.ca/atrisk/ims.htm).

Contacts

Eric LoFroth
Manager, CDC
cdcdata@gov.bc.ca
250-387-9798

Katrina Stipec
Information Specialist CDC
Katrina.Stipec@gov.bc.ca
250-356-0928

7. CLIMATE RELATED MONITORING PROGRAM (CRMP)

http://www.env.gov.bc.ca/epd/wamr/crmp.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE + EC + MFLNRO + MT&I + MA + TC	CRMP	Co-ordinated network of operational climate and water monitoring data; includes considerable historic data.	Site	Data used for flood warning, drought advisories, fire weather index, road condition advisories, crop advisories, etc.; supported by government and private sector.	Yes	Air temperature, air pressure, relative humidity, wind speed and direction, snow depth, and snow water equivalency data collected by various agencies (see links below).	Moderate	Climate and water data is linked to stations and fixed sampling points; data collection varies from continuous to periodic reporting.

Description

This monitoring program is managed by a group of agencies and companies that maintain and manage climate and hydrology installations and who collectively share data under a formal agreement. The agencies include Environment Canada, Transport Canada, Ministry of Environment, Ministry of Transportation and Infrastructure, Ministry of Forests, Lands and Natural Resource Operations, and Ministry of Agriculture working together with BC Hydro and Rio Tinto Alcan under a formal agreement to make long-term meteorological data available for professional users involved in climate change analysis and adaptation through the Pacific Climate Impacts Consortium. The information collected includes air temperature, atmospheric pressure, humidity, precipitation, snow depth, snow water equivalent, and wind speed and direction; other parameters are also measured at the sites based on local requirements. Those collecting the data include: Avalanche and Weather Programs (http://www.th.gov.bc.ca/mot_org/const_maint/avalanche_weather/); Wildfire Management Branch (http://bcwildfire.ca/weather/stations.htm); Farmwest, Ministry of Agriculture (http://www.farmwest.com/); Air Quality Network (http://www.bcairquality.ca/assessment/meteorological-monitoring.html); River Forecast Centre (http://www.env.gov.bc.ca/rfc/); and BC Hydro (http://www.bchydro.com/about/our_system/hydrometric_data.html). More on the Water and Air Quality Monitoring Network can be found at: http://www.env.gov.bc.ca/epd/wamr/. Water and air monitoring databases can be accessed at: http://www.env.gov.bc.ca/epd/wamr/ems_internet/index.html.

Contacts

Ted Weick
MOE lead, Chair, Water and Air Monitoring and Reporting
Ted.Weick@gov.bc.ca
250-387-6851

Eric Meyer
MFLNRO, Superintendent Fire Weather
Eric.Meyer@gov.bc.ca
250-387-8744

Vanessa Foord
MFLNRO, Climatologist, Silvicultural Research
Vanessa.Foord@gov.bc.ca
250-565-4333

8. WATER SURVEY OF CANADA (WSC)

http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
EC + MOE	WSC and MOE	Hydrometric monitoring and reporting on standardized water resource data.	Sample Site	Data collected on snow pack, stream flow, and weather used for flood advisories, water supply, and drought advisories.	Yes for public-funded data, but cannot access privately collected data.	Real time and archived hydrometric data on WSC website.	Moderate	Training for site maintenance and data management.

Description

A hydrometric monitoring program is delivered by the Water Survey of Canada (WSC; Environment Canada) and is co-ordinated in partnership with MOE. This program relates to the operation of the hydrometric network in the province. The WSC is the national authority responsible for the collection, interpretation, and dissemination of standardized water resource data and information in Canada. In partnership with the provinces, territories, and other agencies, the WSC operates over 2500 active hydrometric gauges across the country. Locations of stations in British Columbia are available at: http://www.wateroffice.ec.gc.ca/google_map/google_map_e.html?search_by=p&province=BC. Environment Canada (EC) is the federal agency responsible for the collection, interpretation, and dissemination of standardized water quantity data and information in Canada. It has maintained the National Hydrometric Program through cost-shared agreements with the provinces and territories since the mid-1970s.

The River Forecast Centre (RFC; http://bcrfc.env.gov.bc.ca/), which works with the WSC and MOE, is a client/end-user of the hydrometric data. It takes a lead role for the province in the interpretation and analysis of the hydrometric data, including seasonal river runoff forecasts, drought monitoring, and flood advisories. The RFC is the lead agency in British Columbia for: flood advisories and warnings (http://bcrfc.env.gov.bc.ca/warnings/index.htm); and water supply and drought advisories (http://bcrfc.env.gov.bc.ca/bulletins/index.htm).

Also see *No. 7 Climate Related Monitoring Program*.

Contacts

Dan Hogan
Knowledge Management Branch
Dan.Hogan@gov.bc.ca
604-222-6752

David Campbell
River Forecast Centre
David.Campbell@gov.bc.ca
250-387-9472

9. PROVINCIAL SNOW MONITORING PROGRAM (SMP)

http://bcrfc.env.gov.bc.ca/data/asp/realtime/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
EC + MOE/ WAMR + MFLNRO/ RFC	SMP	Snowpack data from a network of sites across the province; Water Survey of Canada, in partnership with Water and Air Monitoring and Reporting and River Forecast Centre, collects and interprets snow, meteorological, and streamflow data.	Sample Site	Data collected on snowpack is used for flood advisories, water supply and drought advisories, and reservoir management.	Yes	Snow pillow data online.	Moderate	Training for site maintenance and data management.

Description

The delivery of the snow program is spread between MOE–WAMR, regional MFLNRO offices (i.e., manual snow surveys are largely conducted by regional offices and funded by WAMR), and the River Forecast Centre (MFLNRO). A description of snow survey stations (active and inactive), reporting frequency, graphs, and reports and bulletins is located at: http://bcrfc.env.gov.bc.ca/about/. MOE–WAMR is the lead for co-ordinating the operation and delivery of the snow monitoring program, which includes a network of manually surveyed snow courses (sampled multiple times per season) and automated snow pillow stations. The RFC inputs snow pillow data, disseminating the real-time data via its website (http://bcrfc.env.gov.bc.ca/bulletins/snowpillow.htm). The automated data archive is maintained by WAMR through the Water Inventory Data Management database (http://www.env.gov.bc.ca/wsd/data_searches/widm/index.html). MOE maintains the database for the manual snow survey data. The RFC is responsible for the interpretation and analysis of the snow data, and during the snow survey season issues monthly (and semi-monthly in May and June) snow bulletins, which includes both the current data and an interpretation of the information with seasonal outlooks for flood risk and water supply.

Contact

Tarik Dessouki
Water Quality Monitoring Specialist
Tarik.Dessouki@gov.bc.ca
250-387-3689

10. DAM SAFETY PROGRAM (DSP)

http://www.env.gov.bc.ca/wsd/public_safety/dam_safety/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE + MFLNRO	DSP	Dam Safety Program; 1900 dams < 9 m high on Crown lands.	Site	Owners of dams are responsible for their dam's condition; their data is maintained and reports are filed.	No	Locations of dams at BC Water Resource Atlas; filed reports kept by government dam inspectors.	Moderate	Training, use of similar field technology, and database management.

Description

In response to the 2010 Testalinden dam failure and recommendations by the Deputy Solicitor General, a new regulation is now in effect to strengthen dam safety and mitigate loss of life and damage to property and the environment from a dam breach. This regulation requires dam owners to: inspect their dams, undertake proper maintenance, report incidents, take remedial action, and ensure that the dams meet current engineering standards. Tracking of data and dam inspections with owners is done by Regional Dam Safety Officers, each responsible for a portfolio of dams and supported by C&E Branch, Emergency Management BC, and Ministry of Energy and Mines. Each year, owners of the approximately 290 high and very high consequence dams are requested to return an Inspection Compliance Monitoring report that determines whether their asset is inspected and maintained as required. The annual DSP report notes there is a backlog of dam safety data. Dam locations are recorded in the *BC Water Resources Atlas*, an online GIS tool found at: http://www.env.gov.bc.ca/wsd/data_searches/wrbc/index.html.

Contact

Wenda Mason
Dam Safety Section
Wenda.Mason@gov.bc.ca
250-356-8384

11. ECOSYSTEM RESTORATION PROGRAM (ERP)

http://www.for.gov.bc.ca/hra/Restoration/index.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO Range	ERP	Monitors implementation of prescribed activities; site ecology assessment, silviculture plot, and cruise tally sheet and site photos are done before activity.	Project (see LBI, below)	Primarily, NDT4 forests and monitoring species diversity, exotic invasive species, forage and browse production change.	No	District office files; potential use of data for site re-assessment.	Moderate	Program is an LBI category but has as many as 12 funding sources through its partner groups; potential for co-ordination of protocols and pre-activity site assessment data.

Description

Ecosystem Restoration is an Land Based Investment category that is delivered at the district level through co-operation with multi-sectoral steering committees, which also source funding. The Ecosystem Restoration Program assists with the recovery of ecosystems that have been degraded, damaged, or destroyed. As such, investments in ecosystem restoration focus on re-establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions. The program's current priorities are "key" in-grown, open forests and native grasslands of the British Columbia Interior. These ecosystems (referred to as "NDT4"), which are naturally maintained by frequent stand-initiating disturbances, have lacked wildfires due to decades of suppression. This absence of frequent wildfires has contributed to tree encroachment onto historic grasslands and excessive in-growth of trees in previously open forests. As a result, hundreds of thousands of hectares now have reduced ecosystem resiliency to climate change pressures, increased fuel loading, reduced understorey forage, and a host of negative trends in open forest and grassland ecosystems. Current data includes pre-treatment silviculture prescription (FS39A), cruise tally sheet and silviculture survey plot cards (FS658), and four cardinal photos at a GPS-referenced site. Implementation monitoring (assessing if planned treatment occurred) is done on 100% of sites. During 2012, the development of a relational database to store site information is planned. In the longer term, this database will aid effectiveness evaluations, helping to determine whether site-specific economic, cultural, ecological, and social ecosystem restoration objectives are achieved.

Contact

Allen Neal
Ecosystem Restoration,
Provincial Strategic Planning Leader
Al.Neal@gov.bc.ca
250-342-4227

12. FOREST HEALTH AERIAL OVERVIEW SURVEY (FHAOS)

http://www.for.gov.bc.ca/hfp/health/overview/overview.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	FHAOS	Annual monitoring of the extent of insects, disease, and abiotic (fire) disturbances.	Forest stand to landscape	Monitoring trends in all visible disturbance patterns across the provincial forested land base (including provincial parks, private land, and TFLs).	Yes	Tree species mortality by agent, such as bark beetles, defoliators, blights, and wildfire.	High	Priority-setting for more detailed disturbance monitoring; integrated with salvage harvest planning and VRI updates. Updates the annual mountain pine beetle projection; updates estimates of non-recoverable losses in the TSR. Used for investment planning; used by industry, academia, federal and provincial government agencies for monitoring impacts of mountain pine beetle and climate change.

Description

Since 1999, the provincial government has monitored most of British Columbia's forested land using the classic sketch-mapping technique known as the "overview survey method." Its purpose is to record and report the general trends in disturbance patterns across the forested land base (including provincial parks, private land, and tree farm licences but not federal parks). Significant damage noted by the FHAOS may then be more accurately surveyed using detailed aerial and ground surveys. The FHAOS has been a key data source, documenting the development of the current mountain pine beetle outbreak in the province's interior. Data from the FHAOS can also be compared to historic data collected by the Canadian Forest Service's former Forest Insect and Disease Survey Unit (FIDS; 1914–1995) and to US Forest Service Forest Health monitoring surveys. The survey's long history is proving extremely valuable when examining changes in landscape-level disturbance patterns due to climate change. Links from the program's web page provide information on current and past conditions reported by the FHAOS, the survey methods, and other supporting information. Key products from FHAOS include:

- tree mortality by agent, such as bark beetles, defoliators, blights, and fire;

- an annual report summarizing forest health conditions;

- digitized maps and tables describing pest conditions by region and district (for eventual inclusion in the Land Data Resource Warehouse, last updated in 2008); and

- mountain pine beetle conditions reported by November 1, and included in the annual update of the Provincial-Level Mountain Pine Beetle Model (BCMPB) impact projection.

Contact

Tim Ebata
Forest Health
tim.ebata@gov.bc.ca
250-387-8739

13. FISHERIES INFORMATION SUMMARY SYSTEM (FISS)

http://www.env.gov.bc.ca/fish/fiss/index.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on collaboration
MOE + DFO	FISS	Spatially summarized fish and fish habitat data for provincial waterbodies.	Watershed, water body	A geo-referenced database of overview macro-reach and lake classification data with known fish distributions, enhancements and management, constraints and obstruction data.	Yes	As of 2006, FISS included records for 88 460 points or zones on 36 973 waterbodies.	High	Data collection protocols and data management, provincial standards, fish passage information, data-sharing and exchange, open data and information for the natural resource sector.

Description

The Fisheries Information Summary System (FISS) provides spatially represented summary-level fish and fish habitat data for waterbodies throughout British Columbia and the Yukon. The information is in database format and can be displayed on the 1:50 000 *BC Watershed Atlas* maps (http://www.env.gov.bc.ca/fish/watershed_atlas_maps/index.html). FISS is jointly funded by BC Fisheries (MOE) and Fisheries and Oceans Canada. FISS consists of data and map components. Fish and fish habitat themes included are: fish distribution; enhancement and management activities along with objectives; gradient and macro-reaches; land use; water use; water-quality activities; obstructions; resource use; flow; fisheries potential and constraints; escapement; value and sensitivity; life history and timing; and harvest and use. For further information on FISS, go to: http://www.env.gov.bc.ca/fish/fiss/background.htm.

Contact

David Tesch
Ecosystem Information Section
David.Tesch@gov.bc.ca
250-387-9588

14. FISH DATA WAREHOUSE (FDWH)

http://www.env.gov.bc.ca/fish/index.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE	FDWH	A collection of databases and applications that enable storage and access to data on freshwater fish and fish habitat for provincial waterbodies.	Watershed, waterbody	Provincial freshwater fish inventory data, accumulated from several different surveys.	Yes	Fish observations, ranges, obstacles, stream and lake physical information, watershed atlas information, fish stocking records, and bathymetric maps.	High	Data collection protocols and data management, provincial standards, fish passage information, data-sharing and exchange, open data and information for the natural resource sector.

Description

The Fish Data Warehouse is defined by a collection of databases and the applications to access them. The databases contain standard Field Data Information Systems, Fish Habitat Inventory and Information Program survey data, MOE Resource Analysis Branch surveys, Lake Survey data, and non-standard Fisheries Information Summary System (FISS) geo-referenced freshwater fish inventory data, as well as stream and lake chemical and physical data. The data can be queried through the following publically accessible, web-based applications.

- *Habitat Wizard* provides a portal to the provincial databases, enabling users to spatially view and query information on fish observations, fish ranges, obstacles, stream and lake physical information, the watershed atlas, fish stocking records, and bathymetric mapping for lakes.

- *Fish Inventory Data Queries* provides a portal to the provincial databases through a set of text-based queries on fisheries inventory data, fish stocking data, lake and stream chemical and physical data, and waterbody location data.

- *EcoCat* provides access to digital reports and publications, and their associated files such as maps, data sets, and published inventory information. It contains reports from various disciplines, including aquatic species and habitats, terrestrial species and habitats, floodplain mapping, reservoirs, groundwater, and vegetation.

Contact

David Tesch
Ecosystem Information Section
David.Tesch@gov.bc.ca
250-387-9588

15. FOREST PRACTICES BOARD (FPB) AUDITS/SPECIAL PROJECTS

http://www.fpb.gov.bc.ca/Audit_Overview.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
FPB	FPB Audits	Independent verification of forest and range practices.	Tenure-specific reporting; site-level data collected.	All forest and range tenure holders on Crown land.	No	Site-level field data internal to FPB; audits and special reports are public.	High	Use of similar protocols for site assessment, similar training, and similar data management needs.

Description

The FPB focusses on whether forest practices have achieved the desired results on the ground and provides assurance on whether forest practices achieve government's objectives. This requires collection of field data and evidence to support conclusions reached in audits and special projects. One of the main ways the FPB gathers information and monitors forests practices is through its random, field-based audits. Audits are limited to full scope, thematic, or enforcement in nature and examine any aspect or combination of aspects of forest practices. The audit results are then published in publicly available reports. Completed and current audit and special project reports are available at: http://www.fpb.gov.bc.ca/reportsearch.aspx.

Contacts

Dave Clarke
Executive Director
Dave.Clarke@gov.bc.ca
250-213-4702

Marvin Eng
Special Projects
Marvin.Eng@gov.bc.ca
250-213-4710

16. FISH PASSAGE INVESTMENT (FPI)

http://www.for.gov.bc.ca/hcp/fia/landbase/standards/fishpassage.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + MOE + DFO	FP-LBI	Assessment, inventory, and removal of barriers to fish.	Site	Removal or replacement of culverts installed prior to the *Forest Practices Code* in 1995.	No	Internally to government	High	Training, protocols, and data management.

Description

As part of the Land Based Investment Strategy, the fish passage program (MFLNRO, MOE, and DFO) is focussed on raising awareness of fish passage concepts; providing training, extension, and guidance; and identifying and remediating the highest-priority stream crossings that impede fish passage. The most common barriers to fish are improperly designed, installed, or maintained closed-bottom structures (culverts) that were installed before the *Forest Practices Code of British Columbia Act* came into effect in 1995.

Remediation of these structures is a "voluntary" government obligation, and usually involves replacement with properly designed embedded structures or with open-bottom structures such as bridges.

The strategic approach that guides delivery of the fish passage program can be found at: http://www.for.gov. bc.ca/Hfp/fish/fishpassage.html. The strategic approach outlines how government prioritizes fish passage assessments and remediation of stream crossings.

Analysis of available stream and road systems indicates approximately 134 000–200 000 stream crossings on British Columbia's resource roads present potential barriers to fish passage. One product of the fish passage program is the Provincial Stream Crossing Information System (PSCIS), which holds assessment data for approximately 12 000 culverts, and data, photos, and other related information on over 100 remediation projects completed. This database is used to identify and prioritize remediation locations.

The fish passage program recently released a revision to the *Fish-stream Crossing Guidebook* as part of its extension/training mandate. The September 2012 update to the guidebook can be found at: http://www.for.gov. bc.ca/Hfp/fish/Fish-stream%20Crossing%20Web.pdf.

Contacts –

Ian Miller
Sustainable Forest Management
Ian.C.Miller@gov.bc.ca
250-387-8398

Richard Thompson
Ecosystem Sustainability
Richard.Thompson@gov.bc.ca
250-356-5467

17. FOREST AND RANGE EVALUATION PROGRAM (FREP)

http://www.for.gov.bc.ca/hfp/frep/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + MOE	FREP	Measuring the effectiveness of forest and range practices on sustaining the 11 *FRPA* resource values of: biodiversity, fish/riparian, timber, water quality, soils, wildlife, forage, resource features, recreation, cultural heritage, and visual quality.	Site (cutblock, stream, road, range tenure areas, etc.) to landscape and watershed level.	Provincial in scope; trained district staff collect monitoring data using checklists and protocols; data is analyzed by subject-area specialists who report results in various formats (extension notes, reports, YouTube videos, etc.).	Yes	Over 7000 assessments to date; data available upon request (some data on FREP website); individual licensee data sent to licensees for their own analysis and use.	High	Protocols and training for 11 *FRPA* resource values available to anyone; available data could assist C&E and FPB in doing assessments with similar protocols.

Description

British Columbia's Forest and Range Evaluation Program (FREP) is led by MFLNRO in partnership with MOE. The *Forest and Range Practices Act* (*FRPA*) provides a results-based, forest and range management framework that includes effectiveness evaluation and professional reliance as foundational principles. Under the results-based model, government evaluates compliance with the law (C&E) and evaluates the effectiveness of forest and range practices (FREP) in achieving management objectives, including sustainable resource management. Annual FREP monitoring targets include evaluation of 40 sites in each district – this is equal to approximately 900 sites per year provincially. Sampling generally includes cutblocks 2 years or older. Evaluation sites include roads, harvest areas, and reserves (e.g., wildlife tree patches and riparian buffers), streams, visual landscapes, and range tenure areas. Sites are randomly selected without replacement (i.e., once a selected site has been assessed, it will not be re-measured in the short term; in the longer term, a subsection of these sites may be re-sampled to help identify or confirm trends). Monitoring is based on a comprehensive set of evaluation indicators and protocols for each of the 11 *FRPA* resource values. FREP evaluates the success of current forest and range practices in sustaining the *FRPA* resource values through site-level, single

point-in-time observations, by answering monitoring questions such as *Are riparian forestry and range practices effective in maintaining the structural integrity and functions of stream ecosystems and other aquatic resource features over both the short and long terms?* See Appendix 2 for a list of the priority FREP questions for the 11 *FRPA* resource values, along with status of each value and team lead contact information. FREP is currently pilot testing a multi-resource value assessment/reporting approach. In addition, the use of FREP protocols to monitor resource sectors such as oil and gas exploration, mining, hydro and non-timber impacts as a component of cumulative effects assessment is also being piloted.

Contacts

Peter Bradford
Program Lead, Sustainable Forest Management
Peter.Bradford@gov.bc.ca
250-356-2134

18. INVASIVE ALIEN PLANT PROGRAM (IAPP)

http://www.for.gov.bc.ca/hra/Plants/application.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO – Range	IAPP	Manages invasive plants on Crown and private land; land owners have a duty to control invasive plants on their property.	Provincial report to site and property levels	Data records for: invasive plants; chemical and mechanical treatment; chemical and mechanical monitoring; bio-control agency release and monitoring; biological control dispersal; and photo plot records and use protocols.	Yes; limited to authorized users.	Site details; invasive plant inventory information; planning; treatment methods and data; and monitoring data.	High	Site-level protocols, training, data management, and web-based data access.

Description

The Invasive Alien Plant Program (IAPP) resides within the Range Branch of MFLNRO (http://www.for.gov.bc.ca/hra/plants/index.htm). The IAPP monitors and manages plants that do not occur naturally in ecosystems in British Columbia. These plants can cause environmental and (or) economic harm, and some species can harm human health. Resilient non-native or alien invasive plants reproduce rapidly and can overwhelm existing native vegetation. A web-based invasive plant tracking application (http://www.for.gov.bc.ca/hra/Plants/application.htm) allows the sharing of information generated by various agencies and non-government organizations involved in invasive plant management. The IAPP application enables the entry, editing, and querying of invasive plant information, including: site details; invasive plant inventory information; planning; treatment methods and data; and monitoring data. This application has two components – a data entry module and a map display module. Access to the data entry module is limited to authorized users, and requires either an IDIR for provincial government staff or a BCeID for MFLNRO clients. The map display module is a freely accessible interactive mapping system that lets the user query the IAPP data directly and creates custom maps of known locations of invasive plant communities. Six types of data are stored in the IAPP web-based application, as are the protocols.

1. Site and Invasive Plant Inventory Record (http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1260.pdf)

2. Invasive Plant Chemical and Mechanical Treatment Record (http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1265.pdf)

3. Chemical and Mechanical Monitoring Record (http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1263_June_2010.pdf)

4. Biocontrol Agent Release and Monitoring Record (http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1262_June_2010.pdf)

5. Biological Control Agent Dispersal Record (http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1261.pdf)

6. Photoplot Record (http://www.for.gov.bc.ca/hra/Publications/invasive_plants/Forms/FS1225_June_2010.pdf)

Contact

Val Miller
Lead, Invasive Plants and Ecosystems
Val.Miller@gov.bc.ca
250-825-1166

19. LAND BASED INVESTMENT (LBI)

http://www.for.gov.bc.ca/hcp/fia/landbase/index.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	LBI	A funding source that supports several resource values: timber, fish, wildlife, ecosystem restoration, recreation, range, water, inventory, and visual landscape re-inventory are eligible for funding.	Site, watershed or landscape	A funding source for some monitoring programs.	No	Timber supply mitigation; fish passage; inventory; forests for tomorrow; tree improvement forest health/ invasive plants recreation ecosystem restoration wildlife (see links below).	High	Priority-setting, use of similar protocols for site assessments, data capture, data management and access, and quality control.

Description

To ensure funding is expended in the most efficient and effective way the Ministry of Forests, Lands and Natural Resource Operations created the Land Based Investment Strategy in 2010. The guidance this strategy provides ensures that the government goals and priorities are achieved economically, efficiently, and effectively in a results-based management framework. Land Based Investment covers many projects with data collection and monitoring components that are eligible for funding (see: http://www.for.gov.bc.ca/hcp/fia/landbase/index.htm), including the following:

- Timber Supply Mitigation
- Fish Passage
- Inventory
- Forests for Tomorrow
- Tree Improvement
- Forest Health/Invasive Plants
- Recreation
- Ecosystem Restoration
- Wildlife
- Range Improvements
- Watershed Assessments

Contact

Al Powelson
Forest Establishment
Allan.Powelson@gov.bc.ca
250-356-6932

20. OBSERVATION WELL NETWORK (OWN)

http://www.env.gov.bc.ca/wsd/data_searches/obswell

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
EPD	OWN	Groundwater monitoring began in 1961; data exists for 145 groundwater observation sites.	Well sites	Observation of groundwater conditions from unused dug and drilled wells primarily in the Lower Fraser and Okanagan valleys.	Yes	Continuous and manual data; water table data; periodic complete inorganic chemical analysis.	Low	Specialized data collection and sampling is unique to aquifer management.

Description

The primary purpose of the Observation Well Network is to collect, analyze, and interpret groundwater hydrographs and groundwater quality data from various developed aquifers in British Columbia. Observation wells are traditionally equipped with automatic water-level recorders, or in situ data loggers that monitor water-level fluctuations on a continuous basis. Recently, many of these in situ data recorders have been replaced with satellite telemetry technology to transmit and report water levels on a near-real-time basis. Additionally, water chemistry samples are collected and analyzed from all provincial observation wells on a rotational basis. Criteria for selecting sampling frequency of observation wells are based on physical characteristics of aquifer development, well construction, and water quality trends. Many of the wells are monitored in co-operation with regional districts, municipalities, and communities utilizing groundwater supplies. Current information on the Observation Well Network and the location of the monitoring sites are available to the public at: http://www.env.gov.bc.ca/wsd/data_searches/obswell/map/obsWells.html.

Contacts

Tarik Dessouki
Water and Air Monitoring and Reporting Section
Tarik.Dessouki@gov.bc.ca
250-387-3689

Jillian Kelly
Water and Air Monitoring and Reporting Section
Jillian.Kelly@gov.bc.ca
250-387-4227

21. PERMANENT SAMPLE PLOT GROWTH AND YIELD SITES (PSP G&Y)

http://www.for.gov.bc.ca/hre/pspdata/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	PSP G&Y	Permanent sample plots where forest stand re-measurements are taken and used to develop growth and yield information.	Site	Volume over age curve data; installations vary in measurements and focus; knowledge gaps in stand performance, forest health, stocking, and volume in second-growth stands.	BCGW	Site description, tree species, diameter, height, condition, pathogens.	High	Potential of shared training.

Description

Map notations exist for all research plot locations and active growth and yield plots. The spatial information for all priority Ministry of Forests, Land and Natural Resource Operations research installations and inventory growth and yield permanent sample plots (PSPs) is currently available to both government and non-government agencies. The data is stored in the BC Geographic Warehouse (formerly Land Resources Data Warehouse–LRDW) and can be accessed by government and industry staff using ArcGIS, iMapBC, and Forest MapView applications (https://apps.gov.bc.ca/pub/geometadata/home.do).

In a report for the Association of BC Forestry Professionals, Moss (2011) notes that PSPs are being maintained through inspection to ensure that tree tags and reference posts remain in place, but only a small number of plots have been re-measured in the last 2 years and there is no commitment to regular periodic re-measurements. The data is stored in a secure location and used for model validation purposes (TASS III, VDYP7, Prognosis BC). For more on PSPs and their protection, go to: http://www.for.gov.bc.ca/hts/vri/psps/psp.html.

Contact

Kevin Hardy
Inventory Forester Nanaimo
Kevin.Hardy@gov.bc.ca
250-751-7093

Ron Planden
Inventory Forester Nanaimo
Ron.Planden@gov.bc.ca
250-387-6867

22. REPORTING SILVICULTURE UPDATES AND LAND STATUS TRACKING SYSTEM (RESULTS)

http://www.for.gov.bc.ca/his/results/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	RESULTS	Mainly industry and government-funded programs are reporting disturbance and silviculture accomplishments for harvested cutblocks; a legal requirement under *FRPA* and *FPCBCA* for industry.	Opening (may include one or more cutblocks)	Forest management activities (reforestation, surveys), reforestation obligations, inventory updates, and land status data.	Need to be a subscriber	Submitted to RESULTS by tenure holders, government-funded programs; replicated to the BCGW	High	Possibly additional information beyond stand establishment could be included (e.g., resource features, research installations, forest carbon projects, oil and gas development).

Description

The RESULTS application is primarily a silviculture reporting tool, but it is also a key business tool that supports land use planning decisions. RESULTS tracks silviculture information by managing the submissions of openings, disturbance activities, stocking standards, silviculture activities, milestones declarations, land status, and most importantly forest cover updates. RESULTS is fully integrated with several other applications (e.g., FTA, VRIMS, FSPTS, SPAR, CIMS, FREP IMS, MapView, BCGW, ILRR), sharing data dependencies with them. For example, VRIMS uses forest cover update information from RESULTS, incorporating it into the vegetation inventory, which feeds directly into the TSR and key planning initiatives. RESULTS information can be viewed via the online application, but it is also available through CRS reports, the Business Views and the BCGW. All RESULTS data (including spatial data) is replicated to the BC Geographic Warehouse (BCGW) and can also be viewed using MapView. Users may subscribe to the BCGW Data Distribution Service where data downloads may be ordered from the warehouse. The Corporate Reporting System currently holds 42 standardized RESULTS canned reports. Of these reports, four Species Monitoring Reports are "Business Intelligence" tools that use multiple sources of data from various applications to demonstrate and address complex issues at a strategic level, such as: species conversion using harvest data from harvest billing (HBS) and RESULTS previous stand label, reforestation efforts – planted species, and regenerated stand composition.

Contact

Caroline MacLeod
Harvesting and Silviculture Practices
Caroline.MacLeod@gov.bc.ca
250-356-2094

23. RANGE REFERENCE AREAS (RRA)

http://www.for.gov.bc.ca/hra/Ecology/RRA.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	RRAs	Benchmark areas of ungrazed range communities; fenced or isolated areas.	Grazing exclosure	Permanent installations in which impact of livestock and wildlife grazing are excluded to understand the site's potential natural climax community.	No	Plant species lists, site occupancy; data kept by Range Branch staff.	High	Training sites; potential natural vegetation references are a baseline for range condition.

Description

Over 360 Range Reference Areas are located in British Columbia in both open and forested range environments. The majority are found in the Cariboo-Chilcotin and Kamloops areas where permanent rangelands represent a larger portion of the total land area. Range Reference Areas are permanent installations in which natural ecosystem condition can be used to monitor the impact of livestock, wildlife, and other disturbances on British Columbia rangelands. Reference areas include permanent vegetation sampling plots in ecosystems that have never been grazed. They also include abandoned grazing areas, relic sites, and fenced exclosures that protect vegetation from grazing and browsing and provide natural vegetation reference areas.

Contact

Rick Tucker
Range (Kamloops)
Rick.Tucker@gov.bc.ca
250-371-3828

Laura Blonski
Range (Northern BC)
Laura.Blonski@gov.bc.ca
250-614-7420

24. STATE OF ENVIRONMENT REPORTING (SOER)

http://www.env.gov.bc.ca/soe/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE	SOER	Analysis and reporting on status and trends of environmental indicators.	Provincial	Provides data, analysis, and information on key provincial environmental values in the following topic areas: air, water, land, plants and animals, climate change, waste, contaminants, marine, and sustainability.	Yes; uses monitoring data from other sources, but provides data used in analyses.	Source and derived data used in analyses is provided on the SOER website and (or) through the DataBC catalogue (see links below).	High	SOER does not have a monitoring program; to effectively report on relevant environmental indicators, it needs strong ties to many monitoring programs, not only to obtain data for reporting, but to ensure the data is used appropriately and to the maximum benefit of the programs that conduct the monitoring.

Description

Environmental reporting, also called *State of Environment Reporting*, refers to the presentation of unbiased information relating to the environment. Environmental reporting takes scientific information and makes it accessible to non-technical audiences. These data and information products help British Columbians: track environmental conditions and trends over time; see the connections between the environment, human wellbeing, and the economy; make informed decisions; and measure our progress towards sustainability. Environmental reporting products are: (1) based on open and best available data, information, and knowledge; (2) based on rigorous scientific investigation; (3) include consideration of community, social, and traditional knowledge; (4) utilize leading edge science communication practices. Effective environmental reporting is about providing the right information to the right people, at the right time. Effective communication of environmental indicators requires an analytical framework that presents the information in a logical, structured way. The reporting framework most often used is the Driver-Pressure-State-Impact-Response (DPSIR) framework for environmental reporting describes human interactions with the environment by looking at the causes (drivers and pressures) and effects (state and impacts) of these activities and the responses society takes to address them.

SOER works with existing program areas to analyze and report on monitoring information, but does not manage its own monitoring program. As of 2012, SOER is moving to a web-based reporting template with more timely, iterative updates to priority environmental indicators. Six State of Environment Reports have been completed, including one themed (marine) report. The first was completed in 1993 and the most recent in 2007. These are available at: http://www.env.gov.bc.ca/soe.

Contact

Stephanie Hazlitt
State of Environment Reporting
Stephanie.Hazlitt@gov.bc.ca
250-387-3270

25. TIMBER SUPPLY REVIEW (TSR)

http://www.for.gov.bc.ca/hts/pubs/tsr/tsrbkg.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	TSR	A legislated periodic AAC determination based on monitoring.	TSA, TFL	Periodic assessment of provincial forest values for a TSA and TFLs.	Public data packages	Data packages and AAC rationale reports.	High	Reporting on more than the timber value is in scope with harvest determinations.

Description

Since 1992, the Timber Supply Review program has regularly reviewed the timber supply and the allowable annual cut (AAC) in each of the 37 timber supply areas (TSAs) and 34 tree farm licences (TFLs) throughout the province. Determining the AAC for public forest lands is the responsibility of the province's Chief Forester. The main objectives of the program are:

- to identify the economic, environmental, and social information that reflects current forest management practices—including their effects on short- and long-term timber supply;

- to identify where improved information is required for future timber supply forecasts; and

- to provide the chief forester with information to use when making AAC determinations that will apply for the next five years.

The AAC Rationale identifies tasks or studies that should be undertaken to support the next determination; these are often noted because improved information will assist in reducing uncertainties in factors evaluated during the current timber supply review (see: http://www.for.gov.bc.ca/hts/index.htm).

The Chief Forester is required under the *Forest Act* (Section 8) to specifically consider the following factors.

1. The rate of timber production that may be sustained from the area, taking into account:
   - the composition of the forest and its expected rate of growth
   - the time that it will take the forest to become re-established
   - silviculture treatments, including reforestation
   - standards of timber utilization
   - constraints on the amount of timber that may be produced due to use of the forest for other purposes.

2. The short- and long-term implications to the province of alternative rates of timber harvesting from the area.

3. The nature, production capabilities and timber requirements of established and proposed processing facilities.

4. The economic and social objectives of the Crown for the area, region and province – as expressed by the Minister.

5. Abnormal insect or disease infestations and major salvage programs planned for the timber on the area.

Contact

Albert Nussbaum
Director, Forest Analysis and Inventory Branch
Albert.Nussbaum@gov.bc.ca or
Forests.ForestAnalysisBranchOffice@gov.bc.ca
250-356-6785

26. VEGETATION RESOURCES INVENTORY AUDIT (VRI)

http://www.for.gov.bc.ca/hts/vri/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	VRI	Vegetation Resources Inventory is land cover information obtained from classification of air photos and updates from various sources.	Stand polygon to cutblock	Update of vegetation, photo interpretation, fire mapping, RESULTS up dating, and roads; all data for TSR.	Yes; BCGW	BC Geographic Warehouse (see link below).	Moderate	Field visits can note inconsistencies with VRI and make these known (i.e., harvested areas shown as forested, absence of roads).

Description

The VRI is a photo-based, two-phase vegetation inventory design consisting of photo interpretation and ground sampling. Within the ground sampling phase, Net Volume Adjustment Factor (NVAF) sampling is a mandatory component that is integral in the calculation of inventory adjustment factors. These inventories are typically funded by government. The decision to conduct a VRI is based on a number of factors, including age of the inventory, known problems of the inventory, recent catastrophic events (such as mountain pine beetle), and other emerging issues requiring a new inventory. Inventory updates to capture changes (e.g., those caused by harvesting, fire, and other catastrophic events) are done through electronic data submissions from licensees and as well through a combination of mapping from satellite imagery, aerial photography, and GPS mapping. In a report for the Association of BC Forestry Professionals, Moss (2011) notes that: "approximately 41.9% of the province is represented by inventories that were completed prior to 1990 and 29.9% prior to 1980." The Vegetation Resource Information Management System (VRIMS) is undergoing final testing. Licensees will provide depletion data to update the inventory on an annual basis. The currency and quality of updates will depend on data submissions to RESULTS, new Landsat imagery, and all other available sources. FAIB is currently developing an inventory audit process based on inventory analysis results and issues with the inventory at the management unit and stratum level.

Contact

Graham Hawkins
VRI Team Lead
Graham.Hawkins@gov.bc.ca
250-387-8893

27. NATIONAL FOREST INVENTORY (NFI)

https://nfi.nfis.org/home.php?lang=en

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + CFS	NFI	Change in land cover is monitored through air photo (plots) and permanent (ground sample) plots.	Stand-level plots; reports generated at various scales (national, provincial, regional [TSA and ecozone]).	Provincial land cover change through re-measurement and reporting on a 10-year basis.	Yes	NFI site map shows available data.	Low	Baseline vegetation monitoring.

Description

Canada's National Forest Inventory (NFI) monitors a network of sampling points covering 1% of Canada's land mass on an ongoing basis to provide accurate, timely, and consistent information on the state and sustainable development of Canada's forests. A NFI website map shows plot locations and data (https://nfi.nfis.org/plot_statistics.php?lang=en). NFI is co-ordinated by Canadian Forest Service, under the guidance of the Canadian Council of Forest Ministers (National Forest Inventory Task Force). The NFI program in British Columbia occurs province-wide on natural treed and non-treed vegetated areas. The monitoring program is based on 2419 aerial photo plots (2 x 2 km) located at permanent transect points on the national 20 x 20 km grid and 268 ground plots in treed areas randomly selected from the photo plot centres. The provincial monitoring network was established between 2000 and 2006, with the federal government providing 30% of the establishment costs. The NFI photo and ground plots are designed to be re-measured on a 10-year cycle with analysis and reporting every 5 years. In 2012, the program is re-measuring the NFI photo plots in the Prince George TSA to improve inventory for changes related to the mountain pine beetle; however, the regular re-measurements and reporting across the province according to the NFI protocol/design are not taking place. In 2012, the Forest Analysis and Inventory Branch produced a summary analysis report of the NFI.

Contact

Xiaoping Yuan
Team Lead, Remote Sensing and Geospatial Application
Xiaoping.Yuan@gov.bc.ca
250-953-3626

28. WATER QUALITY MONITORING NETWORK (WQMN)

http://www.env.gov.bc.ca/wat/wq/wq_sediment.html#attain

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
EPD	WQMN	Tracking of locations with water quality data and interpretation reports.	Specific sites	Non-binding water quality objectives set for protection of water uses and waste discharge.	Yes	Type of data in summary reports includes sediment, toxicity, total dissolved solids, water chemistry, and fecal coliform.	Low	Various purposes and time periods.

Description

The surface water quality monitoring program has three components: (1) provincially co-ordinated networks, (2) regional assessment projects, and (3) science support. Currently, two provincially co-ordinated networks are operated in co-operation with Environment Canada: (1) the Federal-Provincial Water Quality Monitoring Network, which monitors water chemistry and quality in several rivers across the province; and (2) the Canadian Aquatic Biomonitoring Network (CABIN), which uses aquatic invertebrate communities to assess aquatic ecosystem conditions. Regional assessment projects include projects of regional significance such as environmental impact assessments; the development of water quality objectives; or regional trend monitoring in rivers, streams, and lakes. Science support includes the development of guidelines and new tools for toxicity testing. Sampling can include lake sediments, toxicity measurements, and baseline water chemistry. Reports are available at: http://www.env.gov.bc.ca/wat/wq/quality/sowq.html.

Contact

Tarik Dessouki
Water and Air Monitoring and Reporting Section
Tarik.Dessouki@gov.bc.ca
250-387-3689

29. BC TIMBER SALES CERTIFICATION (SFI, CSA, FSC, ISO)

http://www.for.gov.bc.ca/bcts/forestCertification/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO BCTS	Forest Certifications (SFI, ISO, FSC, CSA)	Forest certifications require monitoring of forestry activities and non-forest values and an ability to report on these to auditors to maintain certification.	Stand to landscape	Monitoring information is kept for the benefit of certifications.	No	Internal for certification auditors only.	High	Protocols, training, and data management.

Description

Founded in 2003, BC Timber Sales (BCTS) provides cost and price benchmarks for timber harvested from public land in British Columbia. Through 12 business areas and an operational presence in 33 locations, BCTS manages 20% of the provincial Crown allowable annual cut. It has achieved Environmental Management System (EMS) certification in all 12 business areas to the standard of International Standards Organization. An EMS allows an organization to arrange and focus its management activities into an integrated, functioning system built on ISO 14001 requirements (see http://www.epa.gov/ems/#iso14001), including the monitoring and management of environmental impacts and risks within administrative, planning, and operational activities. An EMS meeting ISO 14001:2004 requirements enables an organization to:

- identify and control the environmental impact of its activities, products, or services;

- improve its environmental performance continually; and

- implement a systematic approach to setting environmental objectives and targets, achieving these, and demonstrating that they have been achieved (see http://www.iso.org/iso/iso_14000_essentials).

BCTS holds several other certifications with varying monitoring requirements. For example, it has a corporate Sustainable Forestry Initiative (SFI) certificate for those management units certified under the SFI 2010–2014 standard. It also has a corporate strategy for certification under the Canadian Standards Association (CSA) National Standard for Sustainable Forest Management (SFM) CAN/CSA-Z809 (see http://www.csa-international.org/product_areas/forest_products_marking/Default.asp?language=english) that integrates performance criteria directing forest management practices over defined forest areas. The SFM plan process includes rigorous public consultation with local stakeholders and a framework to ensure achievement of the identified performance measures. BCTS currently has 99% of its apportioned volume SFM-certified and CSA certificates are held by individual Business Areas. The BCTS Chinook Business Area also holds a Forest Stewardship Council (FSC) Certificate jointly with TAAN Forest Ltd. on their Haida Gwaii operation. Information on the FSC provincial standard is available at: http://www.fsccanada.org/bcstandard.htm. Information on certification is available on the MFLNRO website: http://www.for.gov.bc.ca/het/certification.

Contacts

Rein Kahlke
BCTS, Certification Officer Vernon
Rein.Kahlke@gov.bc.ca
250-550-2247

Tavis McDonald
BCTS, Sustainability Officer Terrace
Tavis.McDonald@gov.bc.ca
250-638-5172

30. WILDLIFE SPECIES INVENTORY (WSI)

http://www.env.gov.bc.ca/wildlife/wsi/index.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE EIS	WSI	This site captures wildlife species observations when submitted and allows sharing of known occurrences.	Site	Data helps population management for setting harvest and conservation goals; an aerial to field survey data repository.	Yes, by project	Wildlife clients can submit data and search for reports and data sets (see link below); spatial data is also available via iMap and the BC Geographic Warehouse.	High	Data collection protocols and data management, provincial standards, data-sharing and exchange, open data, and information for the natural resource sector.

Description

Wildlife Species Inventory (WSI) is managed by the Ecosystem Information Section (EIS) of Knowledge Management Branch in the Ministry of Environment. The Wildlife Inventory Team consists of regional fish and wildlife inventory biologists and EIS staff. The purpose of this team is to obtain, store, and provide access to information about wildlife species in British Columbia. Species information collected includes animal as well as plant species. Inventories include all surveys undertaken to determine the presence or abundance as well as research, modelling, or observations where presence or abundance of wildlife species is incidentally determined. Data submissions are accepted from various sources, including citizen science, professional biologists, government agencies, and non-governmental organizations. Data templates are required and the loading process contains built-in quality controls.

Data held within the Species Inventory Database may be utilized by individuals, groups, and organizations. Data can be either secured or non-secured, depending on its sensitivity. Secured data may be obtained by request and requires the consent of relevant government personnel; the recipient must sign a confidentiality and non-reproduction agreement. Non-secured data is freely available at: http://www.env.gov.bc.ca/wildlife/wsi/siwe.htm.

Contact

David Tesch
Ecosystem Information Section
David.Tesch@gov.bc.ca or
SPI_Mail@gov.bc.ca
250-387-9588

31. FISH AND WILDLIFE COMPENSATION PROGRAM—BC HYDRO (FWCP)

http://www.bchydro.com/about/sustainability/environmental_responsibility/compensation_programs.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
BC Hydro + MOE + DFO	FWCP	Monitoring and enhancement of fish and wildlife species and habitats.	Site	Research, inventory, and restoration projects on species and habitats.	Yes	Searchable online database (see link below).	High	Similar protocols and training for species, data management, and quality control.

Description

BC Hydro's Fish and Wildlife Compensation Program is a partnership between BC Hydro and the Ministry of Environment, and Fisheries and Oceans Canada. BC Hydro provides a total of over $7 million per year (indexed for inflation based on 1995 dollars) in perpetuity, as part of its water license requirement in Peace and Columbia regions and voluntarily in the Coastal region. More than $100 million and 700 projects have been delivered since 1988 to conserve and enhance fish, wildlife, and their supporting habitats affected by the creation of generation facilities that BC Hydro owns and operates. Over 700 reports are available online at: http://www.bchydro.com/about/sustainability/environmental_responsibility/compensation_programs/projects.html. A searchable database of fish and wildlife reports is available at: http://fwcpcolumbia.ca/version2/reports/index.php.

Contact

Patrice Rother
Manager, Regulatory Oversight
Environmental Risk Management
Patrice.Rother@bchydro.com
604-528-2024

32. RIPARIAN AREAS REGULATION (RAR)

http://www.env.gov.bc.ca/habitat/fish_protection_act/riparian/riparian_areas.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	RAR	Evaluation of private land development to ensure riparian setbacks are established and measures to protect riparian values are adhered to by developers.	Site (riparian areas on private land).	Private land developers hire a QEP to complete assessments. MFLNRO staff monitor QEP compliance with the assessment methodology and developer compliance with the QEP assessment.	No; possible upon request.	QEP riparian assessment reports are submitted to a provincial database.	Moderate	Training, protocols, and data management; site assessments potentially relevant to Fish Sensitive Watersheds with private land riparian development.

Description

The Riparian Areas Regulation (RAR), enacted under Section 12 of the *Fish Protection Act* in July 2004, calls on local governments to protect riparian areas during residential, commercial, and industrial development by ensuring that proposed activities are subject to a science-based assessment conducted by a Qualified Environmental Professional (QEP). The purpose of RAR is to protect numerous and varied features, functions, and conditions that are vital in the natural maintenance of stream health and productivity, including such things as:

- sources of large organic debris (e.g., fallen trees and tree roots);

- areas for stream channel migration;

- vegetative cover to help moderate water temperature;

- provision of food, nutrients, and organic matter to the stream;

- streambank stabilization; and

- buffers for streams from excessive silt and surface runoff pollution.

MFLNRO provides local governments with confirmation that an assessment report has been received, enabling local governments to move forward in approving urban development without taking on the liability for reviewing and approving riparian setbacks. To increase the accountability of the QEP and to permit compliance monitoring, the assessment methodology will yield outcomes that are measurable, repeatable, and independent of observer. The assessment methodology will also enable effectiveness monitoring to be undertaken to determine whether impacts from urban development on riparian habitats are being fully avoided when the assessment methodology is used correctly. RAR monitoring has two components: (1) review of QEP reports and (2) field-based review of report implementation. This provincial initiative includes a standard methodology, standard report format for submission to a provincial database, report review checklists, and field monitoring using a province-wide format. Monitoring of reports and implementation is done regionally by MFLNRO staff.

Contacts

Andy Witt
Manager, Habitat Management
Andy.Witt@gov.bc.ca
250-356-2353

Heather Pinnell
Riparian Areas Regulations Co-ordinator
Heather.Pinnell@gov.bc.ca
250-356-9083

33. TERRESTRIAL ECOSYSTEM INFORMATION (TEI)

http://www.env.gov.bc.ca/tei/index.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE	TEI	Ecosystems, terrain, soils, and wildlife habitat mapping, air-photo interpretation, aerial to field survey, resource management planning.	Site to land-scape	Existing terrain and soils and wildlife habitat apply to project assessment and land use planning.	Yes, BCGW and by project.	Map information (see links below).	High	Priority-setting, data collection protocols, data management, training, provincial standards, data-sharing and exchange, open data, and information for the natural resource sector.

Description

Terrestrial Ecosystem Information is managed by the Ecosystem Information Section (EIS) of Knowledge Management Branch in the Ministry of Environment. The Terrestrial Ecosystem Information (TEI) team consists of EIS staff. The purpose of the team is to develop, obtain, store, and provide access to information about ecosystems, terrain, soils, and wildlife habitat in British Columbia. Terrestrial ecosystem information includes all projects undertaken to inventory and map ecological attributes (i.e., ecosystem, terrain, soils, and habitat types). Information is collected by government and non-government organizations. The information available supports and (or) is directly linked to several government inventory and monitoring programs, including: BEC, TSR, LBI, Major Projects (EAO), CDC, and CE pilots. This information is currently available for approximately half of the province and new inventory priorities are based on BEC and LBI site productivity and ecosystem-based management needs. There is a desire to fill existing information gaps through further integration with other inventory program areas (e.g., EAO, CDC, CE pilots) by potentially sharing resources, obtaining existing data, and setting inventory priorities. For access to Terrestrial Ecosystem Information maps and data, go to: http://www.data.gov.bc.ca/ or http://www.env.gov.bc.ca/tei/access_tei.html.

Contact

David Tesch
Ecosystem Information Section
David.Tesch@gov.bc.ca
250-387-9588

34. LONG-TERM SOIL PRODUCTIVITY MONITORING (LTSP)

http://www.for.gov.bc.ca/hre/ltsp/index.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE and MFLNRO	LTSP	Fourteen sites measure changes in forest biomass and other attributes in response to altered soil porosity and site organic matter.	Research plots	Study sites are full-rotation installations (~80–100 years) located through much of the Interior.	See reports or contact study leaders	Reports and publications are online.	High	Related work that contributes to our understanding of the treatment effects is welcomed. No activities are permitted that threaten the long-term integrity of the installations.

Description

The underlying assumption in these soil studies is that forest management practices alter two main soil factors: (1) soil porosity, and (2) site organic matter. These factors largely account for changes in site productivity (biomass production). The LTSP monitoring program includes 14 study sites in British Columbia (over 60 international sites in total) and is the world's largest co-ordinated effort to understand how soil disturbance affects long-term forest productivity. Short-term results confirm that biomass responses are species and site or soil specific. The LTSP sites illustrate the effects of soil disturbance on forest productivity for extension and demonstration purposes. The study measures:

- the effects of different levels of organic matter (above-ground biomass, coarse woody material, and forest floor) retention and soil compaction on long-term forest soil productivity on a range of sites and ecological conditions;

- the long-term effects of organic matter removal and soil compaction on soil nutrient status, soil physical properties, soil microclimate, soil biological activity, biodiversity of soil organisms, and nutrient cycling;

- the causal relationships between soil properties that are altered by soil disturbance and long-term forest productivity; and

- the influence of ecosystem unit on the effects of soil disturbance on long-term soil productivity.

Each of the 14 provincial sites has a specific web listing: https://www.for.gov.bc.ca/hre/ecoearth/Soils/LTSP.htm.

Contacts

Shannon Berch
Terrestrial Conservation Science Section
Shannon.Berch@gov.bc.ca
250-952-4122

35. SILVICULTURE RESEARCH PROGRAM (SRP)

http://www.for.gov.bc.ca/hfp/silstrat/index.htm and
http://www.for.gov.bc.ca/hfp/silstrat/provinfo/prov-home.htm#Anchor2

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	LTRI + SS	Field-based silviculture experiments for growth and yield, habitat response under various silvicultural systems; forest-level strategic analysis for incremental silviculture investment planning.	Site, landscape and TSAs, TFLs	Reforestation, site preparation, stand tending, and harvest method research; strategic planning for stand establishment and tending.	Research reports available from some installations; silviculture strategies available for many TSAs and TFLs.	Research staff, regional offices; silviculture strategy reports online.	High	Protocol-sharing, data collection, and training; habitat and timber supply modelling and analysis to support operational, industry, ministry, and consulting foresters.

Description

The Silviculture Research Program includes the establishment and monitoring of field-based experimental projects that examine the long-term effects of forest management treatments and silvicultural systems on growth and yield of trees, vegetation, wildlife habitat, and other ecosystem services. Management treatments include activities associated with harvest, plantation establishment, density management, fertilization, and wood quality enhancement. The program is maintained through the collaboration of nine provincial silviculture researchers in four MFLNRO regions, the Forest Analysis and Inventory Branch, and the Resource Practices Branch. Examples of core sites for monitoring include Date Creek, Quesnel Highlands, Opax Mountain, Isobel, and Silviculture Treatments for Ecosystems Management in the Sayward Forest (STEMS; http://www.for.gov.bc.ca/hre/stems/publ. htm). Go to FERNS (No. 49 in this report) for the status of monitoring, contacts for individual sites, and a complete list of long-established research installations. Silviculture Strategies are forest-level analyses that guide Forest for Tomorrow initiatives for silviculture investments in all management units across the province. The program includes production of analysis reports for timber quantity, quality, and habitat supply for individual management units (TFL and TSA). Also included are special initiatives examining how silviculture and silvicultural systems may be used to enhance and maintain habitat supply.

Contacts

Louise de Montigny
Louise.deMontigny@gov.bc.ca
250-357-3295

36. FUTURE FOREST ECOSYSTEMS INITIATIVE MONITORING AND RESEARCH (FFEI / FFESC)

http://www.for.gov.bc.ca/HFP/future_forests/
http://www.for.gov.bc.ca/HFP/future_forests/council/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE + MFLNRO	FFEI	Climate monitoring indicators to measure change in ecosystem, biodiversity, and disturbance drivers to understand adaptation options.	Site	Monitoring report recommends 16 indicators to monitor.	No	Monitoring recommendations to government.	Inactive; High	Review of protocols and inclusion of recommended climate change indicators.

Description

The Future Forest Ecosystems Initiative was started to understand the knowledge needed to adapt British Columbia's forest and range management framework so that it continues to maintain and enhance the resilience and productivity of provincial ecosystems as climate changes. FREP Report 20 http://www.for.gov.bc.ca/hfp/frep/publications/reports.htm#rep20) recommends that climate monitoring and adaptation of practices needs to gain understanding by monitoring 16 indicators, which are most responsive to species and ecological processes associated with forests and rangeland. The following are the 16 recommended indicators for monitoring work.

- Ecosystem drivers (7 indicators): precipitation, snow pack, stream flow, water temperature, water quality, glaciers, and extreme weather events.

- Natural disturbance drivers (4 indicators): disease and insects, fire, mass movement, and windthrow.

- Biodiversity drivers (5 indicators): ecosystems distribution and composition, ecosystem productivity, species diversity, ecosystem productivity, genetic diversity, and ecosystem connectivity.

Changes in these indicators affect most *FRPA* values, such as timber (reforestation and disturbances) and range (potential natural community), and the effectiveness of OGMAs, UWRs, WHAs, riparian areas, CWSs, and FSWs. The work begun by FFEI was continued by Future Forest Ecosystems Scientific Council of British Columbia (FFESC) in 2008. Research reports and findings are available at: http://www.for.gov.bc.ca/HFP/future_forests/council/.

Contacts

Don Morgan
FFESC Secretariat (Smithers)
Don.Morgan@gov.bc.ca
250-847-7723

Kristine Weese
FFESC Secretariat (Vernon)
Kristine.Weese@gov.bc.ca
250-558-1760

37. FOREST GENETICS RESEARCH (FGR)

http://www.for.gov.bc.ca/hre/forgen/

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	FGR	Testing or monitoring tree species and genetically improved trees in experimental plantations.	Site	Progeny tests (genetic tests to evaluate superior germplasm), provenance or genecology tests (seed transfer and adaptation trials and evaluation).	High (on request)	Secure, regional research files	High	Regularly collaborates with the Forest Genetics Council of BC, the Provincial Tree Seed Centre, forest industry, other organization units within MFLNRO, various academic institutions, and other forest genetics research organizations worldwide.

Description

Genetics research program includes not only tree improvement, but a wide range of initiatives related to genetic conservation, genetic resources management, and identifying and developing mitigation strategies for climate change impacts. The Forest Genetics Section work at various locations across the province including at two research stations located at Cowichan Lake (Vancouver Island) and Kalamalka Lake (Vernon) and a Research Laboratory at Victoria (http://www.for.gov.bc.ca/hre/stations.htm).

Contacts

Alvin Yanchuk
Research Leader
Alvin.Yanchuk@gov.bc.ca
250-387-3338

Barrie Phillips
Manager Forest Genetics
Barrie.Phillips@gov.bc.ca
250-387-6723

38. WILDLIFE ECOLOGICAL RESEARCH (WER)

https://www.for.gov.bc.ca/hre/ecoearth/wildl.htm

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	Wildlife Ecological Research	Research on habitat selection of selected species of wildlife considerable sensitive to resource development.	Land-scape	Data on wildlife response to management and habitat condition created by natural disturbances, such as beetle mortality and anticipated climate change.	High	Secure, research project level	High	Researchers consult with the regional management teams, district staff, First Nations managers, and other natural resource agencies on topics such as implementation of the Forest and Range Evaluation Program Biodiversity Resource values and implementation of the Species-at-Risk Recovery Plan.

Description

The Wildlife Ecological research program focusses on studying species that are particularly sensitive to resource management activities and resource stewardship. It specifically studies aspects such as habitat selection and use, behaviour, population dynamics, and mortality factors. Researchers seek to develop resource stewardship options that can accommodate natural resource operations, maintain wildlife habitat, and protect biodiversity. Specific research projects and monitoring reports available online include: biodiversity (http://www.for.gov.bc.ca/hre/topics/biodiver.htm), caribou (http://www.for.gov.bc.ca/hre/topics/caribou.htm), and grizzly bears (http://www.for.gov.bc.ca/hre/topics/grizzly.htm). Research results are incorporated into complex analytic and decision-making models that can be used to assess spatial-temporal species habitat supply requirements, integrate economic and social factors into resource management decisions, and account for factors that contribute to uncertainty and risk in decision making.

Contacts

Ian Hatter
Manager, Wildlife Management, Victoria
Ian.Hatter@gov.bc.ca
250-387-9792

Bruce McLellan
Wildlife Research Ecologists
Bruce.McLellan@gov.bc.ca
604-452-3233

39. HYDROLOGY AND GEOMORPHOLOGY RESEARCH

https://www.for.gov.bc.ca/hre/ecoearth/water.htm

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + MOE	Hydrology/ Geo-morphology	Monitoring of weather, snow, streamflow, water quality, aquatic organisms, terrain, and stream channels.	Water-shed, sub-basin, hillslope, stand, and channel reach.	Varies from local to broad hydrologic regimes; understanding impacts of resource management on watershed processes, fish, and other natural resource values.	High	Secure	High	Data sets are shared by provincial and federal government agencies, academia, industry and consultants; research projects are collaborative between government agencies, including First Nations, universities, and industry; generates expertise and consultative advice; collaboration with FORREX occurs on a regular basis (see website for recent publications).

Description

Short- and long-term data sets including records of precipitation, temperature, humidity, wind speed, and solar radiation to World Meteorological Organization standards, snow surveys to MFLNRO standards, and streamflow data to Water Survey of Canada standards. Research, data analyses, and reporting are conducted to standards required for scientific journal publication. Research focusses on quantifying the effects of forest practices and natural disturbance on hydrologic and geomorphic processes at hillslope and watershed scales, water quantity and quality, stream channels, aquatic habitat, and groundwater. Data are also used to develop predictive models, policy guidance, and operational management tools. Specific locations (e.g., Mayson Lake, Carnation Creek, Upper Penticton Creek, and Bowron River Watersheds) provide up to 30 years of record. Environmental monitoring data support studies on the effects of forest practices on hillslopes, streamflow, water quality, stream channels, and fish habitat, with an emphasis on sustainable forest and water resource management. Data sets are also used in assessments of flooding, landslides, and risks to property, lives, and habitat.

Contacts

Dave Wilford
Leader Research Hydrologist
Dave.Wilford@gov.bc.ca
250-847-6392

40. ECOLOGY AND BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION (BEC) RESEARCH

http://www.for.gov.bc.ca/hre/becweb/resources/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	BEC Ecology	Ecological research on provincial ecosystems and interpretation to support management agencies and industry.	Site, regional, provincial	Ecosystem classification, field survey, operational and landscape planning.	Yes, (BCGW)	BEC research reports and publications (see links below).	High	Priority-setting, protocols to collect data, training, and data management; many extension products and training courses are developed to meet specific client needs and uses; plant ecology researchers provide valuable technical support to many provincial-level Ministry initiatives.

Description

Biogeoclimatic Ecosystem Classification (BEC) Program and Plant Ecology research is managed by BEC/Ecology group, which consists of regional MFLNRO ecologists. The purpose of the group is to develop, store, and provide access to information pertaining to BEC in British Columbia. The BEC group expands the scientific foundation for sustainable resource management by providing a comprehensive, multi-level ecological classification system with related interpretations and applications that support the objectives of many agencies. BEC information includes provincial mapping, regional mapping, site-specific ecosystem classification manuals (i.e., regional field guides), and field data. Field information is collected and produced primarily by government staff. The information available is used for applications such as seed zones, protected area and land management planning, forest pest risk, and wildlife habitat management. This information is directly linked to a number government inventory and monitoring programs, including TSR, LBI, VRI, PSP, G&Y, Major Projects (EAO), CDC, TEI, and CE pilots. Although BEC information is available for the entire province, numerous areas require significant updates. Update work is presently done in conjunction with TEI inventory based on LBI site productivity and ecosystem-based management needs. There is a desire to fill information gaps through further integration with other inventory program areas (e.g., EAO, CDC, and CE pilots) by potentially sharing resources, obtaining existing data, and setting inventory priorities. More detailed site units provide the ecological foundation

for interpretation such as tree species selection, site productivity, site preparation, stocking density and free-growing standards, and vegetation competition. Raw ecosystem plot data provides one of the largest data sources of species distribution and habitat relationships in British Columbia and is used extensively in autecological and climate change research. For information, go to: http://www.for.gov.bc.ca/hre/becweb. Publications are available at http://www.for.gov.bc.ca/scripts/hfd/pubs/hfdcatalog/index.asp and on request at http://www.for.gov.bc.ca/hre/becweb/resources.

Contact

Will MacKenzie
Research Ecologist
Will.MacKenzie@gov.bc.ca
250-847-6387

Shirley Mah
Research Ecologist
Shirley.Mah@gov.bc.ca

41. FISH–FORESTRY INTERACTION PROGRAM (FIPP)

(Active/Inactive) http://www.for.gov.bc.ca/hre/ffip/index.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + MOE	FIPP	A 35-year program at six major study locations (fish-forestry interactions).	Watershed	Forestry-related effects on fish and aquatic habitats: physical habitat–structure alterations, water temperature-related shifts, and trophic responses.	Not original plot data; Reports yes.	See data sources below.	Moderate; for the sites where re-measurements occur.	Historic baseline data; training, data transfers, data management, and access common to other monitoring activities.

Description

The broader FFIP was originally a federal/provincial, multi-agency initiative. Issues arising from the interaction between fish and forest resource values have been a major concern to managers and scientists for over 35 years in British Columbia. The FFIP studies were conducted in the province since 1970. To date, six major studies have been carried out to document fish–forestry interactions (see data sources below). FIPP projects fall into one or more of three broad, interrelated categories: (1) physical habitat–structure alterations; (2) water temperature-related shifts; and (3) trophic responses. Co-ordination of quarterly updates is conducted by the respective FFIP researchers. FFIP today is a mix of active (Carnation Creek) and inactive projects (the rest listed in the data sources below). Note that Carnation Creek is one of several place-based, Long-term Monitoring Installations still active and is now in year 42 and monitored by the ESSP Division of the MOE. Other (non-FFIP) LTRIs include Upper Penticton Creek (Rita Winker) and Redfish Creek (Peter Jordan) (see "39. Hydrology and Geomorphology Research" section this report). Research installation and monitoring data is available for these six long-term study areas:

- Bowron River
  (http://www.for.gov.bc.ca/hre/ffip/Bowron.htm)

- Carnation Creek
  (http://www.for.gov.bc.ca/hre/ffip/CarnationCrk.htm)

- Prince George
  (http://www.for.gov.bc.ca/hre/ffip/PGSSP.htm)

- Queen Charlotte Islands
  (http://www.for.gov.bc.ca/hre/ffip/QCIslands.htm)

- Slim-Tumuch
  (http://www.for.gov.bc.ca/hre/ffip/SlimTumuch.htm)

- Stuart-Takla
  (http://www.for.gov.bc.ca/hre/ffip/Stuart_Takla.htm)

Contact

Peter Tschaplinski
Aquatic Conservation Science
Peter.Tschaplinski@gov.bc.ca
250-387-8082

42. YOUNG STAND MONITORING INVENTORY (YSM)

(Pilot/Start-up) (Development and Field Testing)

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	YSM	Monitoring of second-growth stands less than 50 years old based on permanent sample plots.	Site	Growth and yield measurement in stands less than 50 years old	Likely	Just begun; no data	High	Protocol-sharing, training, and data management.

Description

The MFLNRO is initiating a re-measured permanent sample plot program that targets young stands in areas affected by the mountain pine beetle. (Note: This is an adaptation of the Change Monitoring Inventory system [No. 52 in this report], which is distinct from the original permanent sample plot program for monitoring the growth and yield of "Natural Stands.") The primary focus of the YSM program is on young stands under 50 years old in high-risk management units. The YSM program is the result of a business case developed in the report entitled "Why We Need to Monitor Change in Our Managed Forests" (http://www.for.gov.bc.ca/hts/vri/monitoring/dowloads/why_we_need_monitor_change.pdf). This report identified a critical knowledge gap in stand performance, forest health, stocking, and volume in second-growth stands located in high-risk and priority management units based on several key business drivers, including:

- confirming sustainability, especially over the mid-term, and fulfilling forest stewardship core responsibilities;

- providing critical information for AAC determinations;

- checking site productivity and stand performance assumptions;

- providing a continuous feedback loop to improve basic and incremental silviculture, including tree improvement investments; and

- providing information on carbon sequestration and how climate change may be affecting second-growth stands.

In response, the inventory section is developing the YSM program to provide data that will check the growth and yield predictions employed in TSR, silviculture planning, yield modelling, and other key forest management tools and processes. It will target high-risk areas where young stand growth rates are critical to mid-term timber supply. Initial work is focussing on development of a monitoring

mock-up for review by key stakeholders. A monitoring framework and detailed work plans are also being developed at this time. [Note: Young stand monitoring is also occurring under FREP with Stand Development Monitoring (SDM).]

Contact

Tamara Brierley
VRI Monitoring Coordinator
Tamara.Brierley@gov.bc.ca
250-356-0703

43. LONG-TERM ECOLOGICAL MONITORING (CITIZEN SCIENCE) (LTEMCS) PARKS

(Pilot/Start-up) Web Page Under Development

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE BC Parks	LTEMcs	Permanent sample plots and periodic re-inventory for natural area change detection.	Provincial park specific.	Permanent sample plots in parks; protocols for biomes being tested.	Yes; planned for open-source data.	Under development	Start-up year; Moderate	Simple protocols and automated data updates planned.

Description

Protocols are being tested for major biomes (e.g., alpine, forests, intertidal, grasslands, and wetlands). Data management is planned through a government website and data collection is being tailored to hand-held devices and automated Wi-Fi input. Data storage is being developed with the help of the Knowledge Management Branch. Permanent sample sites are being established in parks, protected areas, conservancies, and ecological reserves with a concept of periodic re-inventory.

Contact

Tory Stevens
Protected Areas Ecologist,
Parks and Protected Areas
Tory.Stevens@gov.bc.ca
250-387-3960

44. CUMULATIVE EFFECTS (CE)

(Pilots/Start-up)

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE + MFLNRO	CE Pilots	Pilot projects monitoring and planning to report on the condition of several environmental, economic, and social values	Site to land-scape and water-shed	Decision support for durable decisions; a context for development approvals, mitigation potential, and value trade-offs.	Under development	Under develop-ment	Start-up year; High	Developing or adopting protocols, and methods to assess condition of several renewable resource values.

Description

The Cumulative Effects (CE) project will develop a framework and a suite of tools to enable a consistent and effective approach when assessing cumulative effects in natural resource management decisions. The project has two overarching goals:

1. Improve the quality and benefits of development by proactively avoiding and (or) mitigating adverse cumulative effects to values of primary importance to British Columbians.

2. Improve the transparency, consistency, durability, and efficiency of natural resource management decisions.

As one project under the Integrated Decision-Making Process initiative, the CE project will look at timely and durable resource development decisions. Pilots in the West Okanagan–Nicola (i.e., Tulameen River watershed, including the Similkameen, Tulameen, Otter, and Summers landscape units) and the Northwest (i.e., Nass TSA and Iskut-Stikine LRMP plan area) are examining environmental, economic, and social values, the existing cumulative impacts on the land base, the resource condition, and the government's objectives for sustaining existing resource values. The overall objective is to achieve a level of consistency in decision support with an integrated monitoring program. However, monitoring multiple resource values and applying this information to CE decisions has several data management implications. For example, a significant amount of government-held natural resource information may not be readily accessible or widely known, and some industry-held information may be gathered for operational-level decisions and considered proprietary.

Contacts

Leah Malkinson
Project Manager
Leah.Malkinson@gov.bc.ca
250-387-7977

Tammy Blair
Project Manager
Tammy.Blair@gov.bc.ca
250-356-5908

Don Morgan
Northwest Demo (Regional Pilot)
Don.Morgan@gov.bc.ca
250-847-7723

Doug Lewis
West Okanagan–Nicola Demo (Regional Pilot)
Doug.W.Lewis@gov.bc.ca
250-371-6245

45. HAIDA GWAII STEWARDSHIP MONITORING PROGRAM (HGSMP)

(Pilot/Start-up)

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + CHN	HGSMP	Measuring compliance, implementation, and effectiveness of practices in sustaining and protecting land use objectives identified in the Haida Gwaii Land Use Objectives Order and the objectives set by government under *FRPA*.	Site, watershed and landscape	District in scope, staff from HGNR District, CHN, DFO, and Parks Canada assess practices over Haida Gwaii land base.	No	Under development	Start-up; High	Protocols, data management, and training for monitoring natural resource objectives.

Description

A resource-driven integration is occurring on Haida Gwaii. The Haida Gwaii Natural Resource District (HGNR) is working in collaboration with the Council of the Haida Nation (CHN) to develop an integrated stewardship strategy used to monitor the objectives within the Haida Gwaii Land Use Objectives Order (i.e., Haida cultural features, aquatic habitats, rare and endangered ecosystems, species at risk, and forest reserves) and the objectives set by government under *FRPA*. The HGNR District and the CHN are working together to fill gaps in the monitoring needs on Haida Gwaii, and will jointly develop new protocols and training where appropriate. The Haida Gwaii Stewardship Monitoring Program will incorporate different levels of monitoring: compliance, implementation, effectiveness, and validation. Monitoring will take place annually and use the sampling method of stratified random and target sampling, depending on the natural resource objective being monitored. Note: The name "Haida Gwaii Stewardship Monitoring Program" is subject to change.

Contact

Sean Muise
Stewardship Forester
Sean.Muise@gov.bc.ca
250-559-6216

46. HAIDA GWAII CULTURAL FEATURES IDENTIFICATION AUDIT (CFIA)

(Pilot/Start-up)

Agency	Program	Description	Scale	Scope	Data Availability	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + CHN	CFIA	Auditing program of certified cultural value surveyors.	Site	Ensure that cultural feature identification assessors are meeting the CHN Standards; auditing to be completed by CHN, with support from HGNR district.	No	Under develop-ment	Moderate	Protocols, data management, and training; specific to Haida Nation cultural values.

Description

Cultural Features Identification Auditing is part of a larger monitoring initiative in Haida Gwaii working towards integrated stewardship monitoring between the Haida Gwaii Natural Resource District (HGNR) and the Council of the Haida Nation (CHN). The cultural features included within this auditing program (i.e., Haida traditional heritage features, Haida traditional forest features, cultural modified trees, and monumental cedar) are protected under the Haida Gwaii Land Use Objectives Order. The primary purpose of the CFIA is to audit the certified cultural value assessors, evaluating whether they are implementing cultural feature identification surveys to the CHN standards.

Contact

Sean Muise
Stewardship Forester
Sean.Muise@gov.bc.ca
250-559-6216

47. STATE OF FORESTS REPORTING (SOFR)

(Pending) http://www.for.gov.bc.ca/hfp/sof/

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	SOFR	State of Forests reporting	Provincial	Periodic assessment of provincial forest values and indicators.	No (rely on other sources)	See web links below	Inactive; Low	Data interpreted from existing sources, no new monitoring added.

Description

The *State of British Columbia's Forests* is a report that provides information about the environmental, economic, and social aspects of the province's forests. The report shows to the public the condition and management of its forest and range lands. To date, three editions have been published. The third edition (2010), which builds on the two previous editions, has updated data and analysis on sustainable forest management indicators. Detailed information and assessments are provided for 91 indicators, grouped into 24 topic areas. The indicators follow the Canadian Council of Forest Ministers indicators on Sustainability Forest Management (http://www.ccfm.org/english/coreproducts-criteria_in.asp). State of British Columbia's Forests reports are available for 2010 (**http://www.for.gov.bc.ca/hfp/sof/2010/SOF_2010_Web.pdf**), 2006 (http://www.for.gov.bc.ca/hfp/sof/2006), and 2004 (http://www.for.gov.bc.ca/hfp/sof/2004).

Contact

Pat Martin
Manager, Forest Inventory
Pat.Martin@gov.bc.ca
250-387-3650

48. NATURAL RESOURCE ROADS (NRR)

(Pending) http://www.for.gov.bc.ca/mof/nrra/index.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO + OGC + MT&I	NRR	A proposed web-based database on roads, for holders of road permits and the public.	Linear	Road location and condition of roads, hazard reporting, bridge restrictions, maintenance plans.	Yes	Web-based (under development)	High	Tracking of road permit obligations and road conditions is important for public safety, client liability, and resource value reporting.

Description

Currently, resource roads in British Columbia are administered through provisions found in up to 11 different laws, many of which regulate a specific industry or activity. Often resource roads are built for a specific purpose but used by multiple industries as well as businesses, First Nations, and the public. Roads have a profound influence on resource values and are monitored by C&E staff of different agencies. Information on roads is also sought by others when assessing cumulative effects (e.g., fish passage and stream crossings). A discussion paper on a proposed *Natural Resource Road Act* (November 2011), as well as a summary of public and stakeholder feedback (February 2012) are available at: http://www.for.gov.bc.ca/mof/nrra/documents.htm. As a result of this process, a business model and a web-based information system is under development to monitor roads. A road monitoring system is needed to provide for road administration (who holds what authority/obligation), road use parameters (bridge load ratings), maintenance plans (use restrictions due to bridge replacements, snowplowing plans, etc.), and hazard reporting (landslides, bridges out). The road monitoring system under development will allow public access to information and also meet the business needs of clients who hold road permits and manage roads, and who would supply information.

Contacts

Don Gosnell
Manager, Resource Roads
Don.Gosnell@gov.bc.ca
250-356-5165

Dave Andersen
Business Analyst, Client Business Solutions
Dave.Andersen@gov.bc.ca
250-356-7639

49. FOREST ECOSYSTEM RESEARCH NETWORK SITES (FERNS)

(Inactive) http://www.canadian-forests.com/forest_research.html

Agency	Program	Description	Scale	Scope	Data access	Data Source	Collaboration Opportunity	Comment on Collaboration
CFS + MFLNRO	FERNS	Forest Ecosystem Research Network, Canadian Forest Service and provincial forest researchers.	Site	Various research installations; no longer centrally maintained (see list below)	No	Publications completed; Varied plot data in with regional forest researchers.	Inactive Low	Integrated potential with other monitoring initiatives

Description

A national network of major forest research installations located in each ecosystem across Canada. The installations are focussed on the study of sustainable forest management practices and ecosystem processes at the stand level. Normally, the installations have a substantial research history developed with many disciplines and interest groups. Below are web links to descriptions of each research site in British Columbia.

- Alex Fraser Research Forest: http://afrf.forestry.ubc.ca

- Date Creek Silvicultural Systems Research Project: http://www.for.gov.bc.ca/rni/research/date_creek/mainpage.htm

- Hypermaritime Forests of Coastal British Columbia (HyP3 Project): http://www.for.gov.bc.ca/rni/Research/HyP3/hyp3-pg1.htm

- Itcha–Ilgachuz Alternative Silvicultural: http://www.for.gov.bc.ca/hfd/Pubs/RSI/FSP/EN/RSI_En02.htm

- Mature Lodgepole Pine Management Study: Abstract information

- Montane Alternative Silvicultural Systems: http://pubs.cif-ifc.org/doi/abs/10.5558/tfc75413-3?journalCode=tfc

- Northern Wet-belt Forests of British Columbia: http://wetbelt.unbc.ca/publications.htm

- Quesnel Highland Alternative Silvicultural: http://wetbelt.unbc.ca/publications-03.htm

- Salal Cedar Hemlock Integrated Research Program: http://www.for.gov.bc.ca/hfp/amhome/Projects/Schirp-Program.htm

- Shawnigan Lake and Sayward Forest Research Installations: http://publications.gc.ca/site/eng/414468/publication.html

- Sicamous Creek Silvicultural Research Project: https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp24.htm

Contacts

Use web links to identify regional contacts and their monitoring programs.

50. FOREST INVESTMENT ACCOUNT (FIA)

(Inactive) http://www.for.gov.bc.ca/hfd/library/fia_reports.htm

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	FIA	This fund was established in 2002 and generated numerous projects; it has now been replaced by the LBI program.	Site, Project	Projects on forest health, fertilization, wildlife and habitat mapping, vegetation and ecosystem inventory, road deactivation, and monitoring reports; proponent-driven.	Access to reports; site data may be available	Summary reports online (see link below)	Inactive; Low	Potential historic baseline data; data collected used to write reports and may not be added to corporate database.

Description

FIA is included here because it generated numerous reports that add to monitoring information (see http://www.for.gov.bc.ca/hfd/library/fia_reports.htm).
FIA projects were proponent-driven and priorities were set at a local level. Completed projects may provide data but all reports and data may not have been added to a corporate database and therefore there may be no means to capture plot-level data (e.g., data collected detailing goshawk nest locations in a report aimed at developing best management practices around active nests).
FIA was replaced by Land Based Investment (see http://www.for.gov.bc.ca/hcp/fia/landbase or http://lbis.forestpracticesbranch.com/LBIS/home).

Contact

Now Land Based Investment (this report)
Al Powelson
Forest Establishment
Allan.Powelson@gov.bc.ca
250-356-6932

51. CHANGE MONITORING INVENTORY

(Inactive) http://www.for.gov.bc.ca/hts/vri/standards/gs_cmi.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	CMI	Sampling to adjust forest inventory, which was primarily completed on TFLs by industry; sampling protocols online.	Site	Growth and yield measurements in stands less than 50 years old.	Reports completed (see web link below).	10 years of data primarily TFLs	Low	Protocol-sharing, training, and data management; sampling standards online and adapted to YSM.

Description

Samples were primarily located on TFLs by industry with government setting standards. The CMI developed series of sample plans and analysis reports dating back over 10 years for about a dozen projects (see http://www.for.gov.bc.ca/hts/vri/monitoring/monitoring.html). The inventory focussed on collecting data: to assess free-growing stand performance and site occupancy; to help refine species and stocking standards that met future forest health and climate uncertainties; to evaluate silviculture strategies and forest stewardship plans; and to quantify impacts of damaging pest agents on stand productivity and yields of free-growing stands at a local, regional, and provincial scales. Inventory data were used to revise estimates of stand productivity as expressed through site index. These plans are available on request.

Contact

Tamara Brierley
VRI Monitoring Co-ordinator
Tamara.Brierley@gov.bc.ca
250-356-0703

52. LAND USE PLAN MONITORING (RLUPs AND LRMPs)

(Inactive) http://archive.ilmb.gov.bc.ca/slrp/index.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MFLNRO	RLUPs + LRMPs	Regional Land Use Plans and Land and Resource Management Plans; set strategic land use directions and zones.	Zones and objectives	Information on implementation post-plan adoption may be available at the plan level.	Uncertain	Plan status online	Low	Some implementation committees have generated monitoring-type data.

Description

Strategic Land Use Implementation monitoring was envisaged as part of strategic land use planning. More than 85% of the province's Crown land base is covered by Regional Land Use Plans (RLUPs) such as the Vancouver Island Land Use Plan (http://ilmbwww.gov.bc.ca/slrp/lrmp/nanaimo/vancouver_island/index.html), Kootenay-Boundary Land Use Plans (http://archive.ilmb.gov.bc.ca/slrp/lrmp/cranbrook/kootenay/plan/index.html), and the Cariboo-Chilcotin Land Use Plan (http://ilmbwww.gov.bc.ca/slrp/lrmp/williamslake/cariboo_chilcotin/cariboo.html) and the more detailed Land and Resource Management Plans (LRMPs). The most recent land use plans include First Nations governments such as the Atlin-Taku/Wóoshtin wudidaa (http://www.ilmb.gov.bc.ca/slrp/lrmp/smithers/atlin_taku/index.html). When completed, strategic plans had implementation and monitoring plan components and committees. For example, the Prince George LRMP states: "These guidelines include: objectives and strategies for general resource management; resource management zone boundaries, including protected areas; resource management zone objectives and strategies; and an implementation and monitoring plan." The Kootenay-Boundary LRMP (Chapter 6) has a monitoring and amendment section (see http://archive.ilmb.gov.bc.ca/slrp/lrmp/cranbrook/kootenay/news/files/implementation_strat/6.htm). However, the Integrated Land Management Bureau withdrew support for monitoring committees in 2006. Stakeholder groups in some areas, such as the Bulkley Valley and Kootenays, continue to meet to monitor their plans. Ecosystem-based management along the British Columbia coast is expected to contain a monitoring element (http://www.citbc.org/ebm.html).

Contact

Al Lidstone
Director, Resource Management Objectives
Allan.Lidstone@gov.bc.ca
250-356-6255

53. WATERSHED RESTORATION PROGRAM (WRP)

(Inactive) http://www.env.gov.bc.ca/cariboo/env_stewardship/wrp/watr_restore_main.html

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
MOE	WRP	Watershed Restoration Program (Forest Renewal BC) 1994–2004; restore fish habitat degraded by forest practices.	Watershed	10-year program with all aspects of restoration, from assessment to in-stream work.	No	Reports available online	Inactive; Low	Priority-setting for monitoring; possible to assess effectiveness of works where documentation available.

Description

The Watershed Restoration Program (WRP) was implemented in 1994 through Forest Renewal BC, a program under the *Forest Practices Code Act of British Columbia*. The WRP was active until 2004, when *FRPA* and its regulations took effect. The WRP provided an important opportunity to improve water quality and reverse fish habitat impairment occurring as a result of past forest harvesting practices. The publications in this series provide information on the effects of past forest harvest practices on water quality, fish stock productivity, and habitat of anadromous and resident fish, as well as the impacts on riparian areas. These publications are available at http://www.env.gov.bc.ca/cariboo/env_stewardship/ wrp/reports.html; or by searching for "watershed restoration program" through the EcoCat catalogue at http://www.env.gov.bc.ca/ecocat/ or through the Natural Resources Library at http://www.env.gov.bc.ca/clir/.

Contact

No provincial contact

54. ECOLOGICAL MONITORING AND ASSESSMENT NETWORK (EMAN)

(Inactive) http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=4A26ABC7-93A6-42DA-A6F1-E61FA2B8383D

Agency	Program	Description	Scale	Scope	Data Access	Data Source	Collaboration Opportunity	Comment on Collaboration
EC	EMAN	Co-ordination of groups involved in ecological monitoring in Canada to better detect, describe, and report on ecosystem changes.	Site level	Encouraged individuals and organizations to share data.	Site data not available	Reports available online	Low	Priority-setting for monitoring; possible to assess effectiveness of works where documentation available.

Description

This program was co-ordinated by Environment Canada and linked organizations and individuals involved in ecological monitoring in Canada to better detect, describe, and report on ecosystem changes. The network was a co-operative partnership of federal, provincial, and municipal governments, academic institutions, aboriginal communities and organizations, industry, environmental non-government organizations, volunteer community groups, elementary and secondary schools, and other groups/individuals involved in ecological monitoring. EMAN was established for meet four main objectives.

1. To provide a national perspective on how Canadian ecosystems are being affected by multitude of stresses on the environment.

2. To provide scientifically defensible rationales for pollution control and resource management policies.

3. To evaluate and report to Canadians on the effectiveness of resource management policies.

4. To identify new environmental issues at the earliest possible stage.

The Environment Canada publication Monitoring Biodiversity in Canadian Forests (see http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=4A26ABC7-93A6-42DA-A6F1-E61FA2B8383D) discusses protocols and the five EMAN forest monitoring sites located in British Columbia (i.e., Rocky Point, Royal Roads University, Clayoquot Biosphere Reserve, Galiano Conservancy Association, and Mount Arrowsmith Biosphere Foundation) and the contact persons.

Contact

None

APPENDIX 1 CONTACT LIST

This is a list of those contacted who are either a program contact or who provided advice and revisions.

Contact Name	Agency	Phone	Email
Al Lidstone	MFLNRO	250-356-6255	Allan.Lidstone@gov.bc.ca
Al Powelson	MFLNRO	250-356-6932	Allan.Powelson@gov.bc.ca
Alan Neal	MFLNRO	250-342-4208	Al.Neal@gov.bc.ca
Alanya Smith	MOE	250-387-2406	Alanya.Smith@gov.bc.ca
Albert Nussbaum	MFLNRO	250-356-6785	Albert.Nussbaum@gov.bc.ca
Alvin Yanchuk	MFLNRO	250-387 3338	Alvin.Yanchuk@gov.bc.ca
Andy Witt	MFLNRO	250-356-2353	Andy.Witt@gov.bc.ca
Barrie Phillips	MFLNRO	250-387 6723	Barrie.Phillips@gov.bc.ca
Bill Marshall	MFLNRO	250-953-3678	Bill.Marshall@gov.bc.ca
Brian Clark	MFLNRO	250-387-3561	Brian.J.Clark@gov.bc.ca
Bruce McLellan	MFLNRO	604-452-3233	Bruce.McLellan@gov.bc.ca
Caroline MacLeod	MFLNRO	250-356-2094	Caroline.MacLeod@gov.bc.ca
Chris Ritchie	MFLNRO	250-614-9917	Chris.Ritchie@gov.bc.ca
Christina Mardell	MFLNRO	250-956-5089	Christina.Mardell@gov.bc.ca
Chuck Bulmer	MFLNRO	250-260-4765	Chuck.Bumber@gov.bc.ca
Dan Hogan	MFLNRO	604-222-6752	Dan.Hogan@gov.bc.ca
Dave Andersen	MFLNRO	250-356-7639	Dave.Andersen@gov.bc.ca
David Campbell	MFLNRO	250-387-9472	David.Campbell@gov.bc.ca
Dave Wilford	MFLNRO	250-847-6392	David.Wilford@gov.bc.ca
David Tesch	MOE	250-387-9588	David.Tesch@gov.bc.ca
Dean Zimmer	OGC	250-794-5278	Dean.Zimmer@bcogc.ca
Derek Tripp	Private	250-338-6570	db-tripp@telus.net
Don Gosnell	MFLNRO	250-356-5165	Don.Gosnell@gov.bc.ca
Don Morgan	MOE	250-847-7723	Don.Morgan@gov.bc.ca
Doug Fraser	MFLNRO	250-746-1436	Doug.Fraser@gov.bc.ca
Doug Lewis	MFLNRO	250-371-6245	Doug.W.Lewis@gov.bc.ca
Eric Lofroth	CDC	250-3979798	cdcdata@gov.bc.ca
Eric Meyer	MFLNRO	250-387-8744	Eric.Meyer@gov.bc.ca
Francis Njenga	MFLNRO	250-371-3822	Francis.Njenga@gov.bc.ca
Frank Barber	MFLNRO	25-387-8910	Frank.Barber@gov.bc.ca

Contact Name	Agency	Phone	Email
Fred Parker	FPB	250-213-4702	Fred.Parker@gov.bc.ca
Fern Schultz	MOE	250-952-6898	Fern.Schultz@gov.bc.ca
Graham Hawkins	MFLNRO	250-387-8893	Graham.Hawkins@gov.bc.ca
Howard Madill	OGC	250-419-4424	Howard.Madill@bcogc.ca
Heather Pinnell	MFLNRO	250-356 9083	Heather.Pinnell@gov.bc.ca
Ian Hatter	MFLNRO	250-387-9792	Ian.Hatter@gov.bc.ca
Ian Miller	MFLNRO	250-387 8398	Ian.C.Miller@gov.bc.ca
Jacques Marc	MFLNRO	250-387-8481	Jacques.Marc@gov.bc.ca
James Quayle	MOE	250-387-0060	James.Quayle@gov.bc.ca
Jennifer Maxwell	MOE	250-387-9642	Jennifer.Maxwell@gov.bc.ca
Jim Dunkley	MEM	250-953-4640	Jim.Dunkley@gov.bc.ca
John Harkema	MFLNRO	250-356-2069	John.Harkema@gov.bc.ca
John McClarnon	MFLNRO	250-387-8903	John.McClarnon@gov.bc.ca
Kathleen Hebb	MFLNRO	250-567-6421	Kathleen.Hebb@gov.bc.ca
Kathy Hopkins	MFLNRO	250-387 2112	Kathy.Hopkins@gov.bc.ca
Kathy Paige	MOE	250-356-7788	Kathy.Paige@gov.bc.ca
Katrin Stipec	CDC	250-356-0928	cdcdata@gov.bc.ca
Kevin Hardy	MFLNRO	250-751-7093	Kevin.Hardy@gov.bc.ca
Kristine Ciruna	MOE	250-356-7697	Kristine.Ciruna@gov.bc.ca
Kristine Weese	MFLNRO	250-558-1760	Kristine.Weese@gov.bc.ca
Lars Reese Hanson	MFLNRO	250-387-3980	Lars.ReeseHansen@gov.bc.ca
Laura Darling	MOE	250-387-9842	Laura.Darling@gov.bc.ca
Laura Blonski	MFLNRO	250-614-7420	Laura.Blonski@gov.bc.ca
Laurie Kremsater	Private	604-856 3329	lkrem@shaw.ca
Leah Malkinson	MFLNRO	250-387-7977	Leah.Malkinson@gov.bc.ca
Leon Gaber	MOE	250-387 6481	Leon.Gaber@gov.bc.ca
Louise de Montigny	MFLNRO	250-357-3295	Louise.deMontigny@gov.bc.ca
Mark Graham	MOE	250-387-9941	Mark.Graham@gov.bc.ca
Marvin Eng	FPB	250-213-4710	Marvin.Eng@gov.bc.ca
Michelle Carr	EAO	250-387-6748	Michelle.Carr@gov.bc.ca
Pat Martin	MFLNRO	250-387-3650	Pat.Martin@gov.bc.ca
Nancy Densmore	MFLNRO	250-356-5890	Nancy.Densmore@gov.bc.ca

Contact Name	Agency	Phone	Email
Patrice Rother	BC Hydro	604-528 2024	Patrice.Rother@bchydro.com
Peter Bradford	MFLNRO	250-356 2134	Peter.Bradford@gov.bc.ca
Peter Tschaplinski	MOE	250-387-8082	Peter.Tschaplinski@gov.bc.ca
Ralph Winter	MFLNRO	250-387-8906	Ralph.Winter@gov.bc.ca
Rein Kahlke	BCTS	250-550-2247	Rein.Kahlke@gov.bc.ca
Richard Thompson	MOE	250-356-5467	Richard.Thompson@gov.bc.ca
Rick Tucker	MFLNRO	250-371-3828	Rick.Tucker@gov.bc.ca
Ron Diederichs	MOE	250-751-3223	Ron.Diederichs@gov.bc.ca
Ron Planden	MFLNRO	250-751-7093	Ron.Planden@gov.bc.ca
Sean Muise	MFLNRO	250-559-6216	Sean.Muise@gov.bc.ca
Shannon Berch	MFLNRO	250-952-4122	Shannon.Berch@gov.bc.ca
Shirley Mah	MFLNRO	250-356-2180	Shirley.Mah@gov.bc.ca
Stefan Zeglen	MFLNRO	250-751-7108	Stefan.Zeglen@gov.bc.ca
Stephane Dubé	MFLNRO	250-565-4363	Stephane.Dube@gov.bc.ca
Stephanie Hazlitt	MOE	250-387-3270	Stephanie.Hazlitt@gov.bc.ca
Steve Lehnert			Steve.Lehnert@gov.bc.ca
Stewart Guy	MFLNRO	250-356-0290	Stewart.Guy@gov.bc.ca
Tamara Brierley	MFLNRO	250-356-0703	Tamara.Brierley@gov.bc.ca
Tarik Dessouki	MOE	250-387-3689	Tarik.Dessouki@gov.bc.ca
Tavis MacDonald	BCTS	250-638-5172	Tavis.McDonald@gov.bc.ca
Ted Weick	MOE	250-387-6851	Ted.Weick@gov.bc.ca
Tim Ebata	MFLNRO	250-387-8739	tim.ebata@gov.bc.ca
Tim Hicks	EAO	250-387-6758	Tim.D.Hicks@gov.bc.ca
Tory Stevens	MOE	250-387-3960	Tory.Stevens@gov.bc.ca
Val Miller	MFLNRO	250-825-1166	Val.Miller@gov.bc.ca
Vanessa Foord	MFLNRO	250-565-4333	Vanessa.Foord@gov.bc.ca
Wenda Mason	MFLNRO	250-356-8384	Wenda.Mason@gov.bc.ca
Will MacKenzie	MFLNRO	250-847-6387	Will.MacKenzie@gov.bc.ca
Xiaoping Yuan	MFLNRO	250-953-3626	Xiaoping.Yuan@gov.bc.ca

APPENDIX 2 *FRPA* RESOURCE VALUES, CONTACTS, AND FREP QUESTIONS

FRPA Resource Value and Team Lead(s)	Monitoring Status	FREP Evaluation Questions
Biodiversity Nancy Densmore Nancy.Densmore@gov.bc.ca Richard Thompson Richard.Thompson@gov.bc.ca	• 1868 cutblocks assessed and reported (stand level) (2006–2011) • Province-wide implementation of stand-level biodiversity assessments • Landscape-level indicators under development and pilot testing	*Is stand-level retention providing the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and coarse woody debris?*
Cultural Heritage Kathleen Hebb Kathleen.Hebb@gov.bc.ca Steve Lehnert Steve.Lehnert@gov.bc.ca Peter Bradford Peter.Bradford@gov.bc.ca	• 107 cutblocks assessed and reported (2009–2011) • Limited implementation based on district priorities	*Are cultural heritage resources being protected and conserved for First Nations cultural and traditional activities as a result of forest practices?*
Fish/Riparian Peter Tschaplinski Peter.Tschaplinski@gov.bc.ca Fish Sensitive Watersheds and Temperature Sensitive Streams Lars Reese Hansen Lars.ReeseHansen@gov.bc.ca	• 1668 stream reaches assessed and reported (2006-2011) • Province-wide implementation	*Are riparian forestry and range practices effective in maintaining the structural integrity and functions of stream ecosystems and other aquatic resource features over both the short and long terms?*
Forage (range) Doug Fraser Doug.Fraser@gov.bc.ca	• More than 800 range assessments (including upland areas, wetlands, and streams) (2006–2011) • Range reference area assessments (reporting in 2012) • Implementation based on district priorities	*What impact are range practices having on the desired plant succession? And what impact are range practices having on the water cycle/ hydrologic function?*
Recreation Bill Marshall Bill.Marshall@gov.bc.ca	• 120 recreation sites evaluated and reported (2006) • Inactive for last several years – new assessment question and tools to be developed in 2012	*Are recreation sites providing healthy and safe recreation experiences?*
Resource Features Christina Mardell Christina.A.Mardell@gov.bc.ca	• Karst monitoring protocol in pilot testing, Vancouver Island	*Are current forest practices adequately protecting and maintaining the integrity of karst features?*
Soils Stephane Dubé Stephane.Dube@gov.bc.ca Shannon Berch Shannon.Berch@gov.bc.ca Chuck Bulmer Chuck.Bumber@gov.bc.ca	• 150 cutblocks and reported (2008–2010) • Limited implementation based on district priorities	*Are forest practices successful in preventing levels of site disturbance that are detrimental to soil productivity and hydrologic function?*

FRPA Resource Value and Team Lead(s)	Monitoring Status	FREP Evaluation Questions
Timber Frank Barber (Timber Lead) Frank.Barber@gov.bc.ca Stefan Zeglen (Stand Development Monitoring Lead) Stefan.Zeglen@gov.bc.ca	• 323 post–free-growing cutblocks (2009–2011) • Implemented in approximately one-half of districts	*What are the changes to forest health and productivity (stand density and species composition, pest incidence and site index) in 15–40-year-old second-growth stands?*
Visual Quality Jacques Marc Jacques.Marc@gov.bc.ca	• 234 landforms assessed and reported (2007–2011) • Implemented in approximately one-half of districts	*How well are we managing and conserving views in designated scenic areas? And are established Visual Quality Objectives being achieved?*
Water Quality Dave Maloney Dave.Maloney@gov.bc.ca	• 3423 stream crossings (sediment) and 466 range (2008–2011) assessments completed and reported	*Are forest practices effective in protecting water quality?*
Wildlife Kathy Paige (Wildlife Co-Lead) Kathy.Paige@gov.bc.ca Laura Darling (Wildlife Co-Lead) Laura.Darling@gov.bc.ca Jared Hobbs (Identified Wildlife Management Strategy) Jared.Hobbs@gov.bc.ca Steve Gordon (Ungulate Winter Ranges) Steve.Gordon@gov.bc.ca	• Development and testing of individual wildlife indicators and protocols under way for several species, including mountain goat, badger, tailed frog, northern goshawk, and mountain caribou	*Do ungulate winter ranges (UWRs) and wildlife habitat areas (WHAs) maintain the habitats, structures and functions necessary to meet the goals of the area and is the amount, quality and distribution of these areas contributing effectively with the surrounding land base (including protected areas and managed land base) to ensure the survival of the species now and over time?*

APPENDIX 3 LIST OF ACRONYMS

Acronym	Meaning
AAC	Allowable Annual Cut
BCGW	BC Geographic Warehouse
BCMPB	BC Mountain Pine Beetle
BCTS	BC Timber Sales
BEC	Biogeoclimatic Ecosystem Classification
C&E	Compliance and Enforcement of MFLNRO
CABIN	Canadian Aquatic Bio-monitoring Network
CDC	Conservation Data Centre
CE	Cumulative Effects
CFIA	Cultural Features Identification Audit
CFS	Canadian Forest Service
CHN	Council of Haida Nation
CIMS	Compliance Information Management System
CMI	Change Monitoring Inventory
CRMP	Climate Related Monitoring Program
CRS	Corporate Reporting System
CSA	Canadian Standards Association
DFO	Fisheries and Oceans Canada
DSP	Dam Safety Program
EA	Environmental Assessment
EAO	Environmental Assessment Office
EC	Environment Canada
EMS	Environmental Management System
EPD	Environmental Protection Division of MOE
ERP	Ecosystem Restoration Program
ESSP	Environmental Science and Stewardship Division
FAIB	Forest Analysis and Inventory Branch of MFLNRO
FDHW	Fish Data Warehouse
FFEI	Future Forest Ecosystems initiative
FFESC	Future Forest Ecosystems Scientific Council
FGR	Forest Genetics Research
FHAOS	Forest Health Aerial Overview Survey
FIA	Forest Investment Account
FIDS	Forest Insect and Disease Survey
FIPP	Fish–Forestry Interaction Program
FISS	Fisheries Information Summary System
FOIPPA	*Freedom of Information and Protection of Privacy Act*
FORREX	Forum for Research and Extension in Natural Resources

Acronym	Meaning
FPB	Forest Practices Board
FPCBCA	*Forest Practices Code of British Columbia Act*
FP-LBI	Fish Passage (Land Based Investment)
FREP	Forest and Range Evaluation Program
FREP IMS	FREP Information Management System
FRPA	*Forest and Range Practices Act*
FSC	Forest Stewardship Council
FSPTS	Forest Stewardship Plan Tracking System
FSW	Fisheries Sensitive Watersheds
FTA	Forest Tenure Administration
FWCP	Fish and Wildlife Compensation Program
GPS	Global Positioning System
HBS	Harvest Billing System
HGSMP	Haida Gwaii Stewardship Monitoring Program
IAPP	Invasive Alien Plant Program
ILRR	Integrated Land and Resource Registry
ISO	International Standards Organization
LBI	Land Based Investment
LRDW	Land Resources Data Warehouse
LRMP	Land and Resource Management Plan
LTEMcs	Long-term Ecological Monitoring (citizen science)
LTRI	Long-term Research Installation
LTSP	Long-term Soil Productivity
MA	Ministry of Agriculture
MEM	Ministry of Energy and Mines
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MOE	Ministry of Environment
MPB	Mountain Pine Beetle
MT&I	Ministry of Transportation and Infrastructure
NDT4	Natural Disturbance Type 4 (frequent stand-initiating disturbances)
NFI	National Forest Inventory
NRR	Natural Resource Roads
NVAF	Net Volume Adjustment Factor
OGAA	*Oil and Gas Activities Act*
OGC	Oil and Gas Commission
OGMA	Old Growth Management Area
OWN	Observation Well Network

Acronym	Meaning
PSP	Permanent Sample Plots
QEP	Qualified Environmental Professional
RAR	Riparian Areas Regulation
RB	Range Branch of MFLNRO
RESULTS	Reporting Silviculture Updates and Land status Tracking System
RFC	River Forecast Centre
RLUP	Regional Land Use Plan
RRA	Range Reference Area
SFI	Sustainable Forestry Initiative
SFM	Sustainable Forest Management
SMP	Snow Monitoring Program
SOER	State of Environment Reporting
SOFR	State of Forest Reporting
SPAR	Seed Planning and Registry
SRP	Silviculture Research Program
SS	Silviculture Strategy
TASS	Tree and Stand Simulator
TC	Transport Canada
TEI	Terrestrial Ecosystem Information
TFL	Tree Farm Licence
TSA	Timber Supply Area
TSR	Timber Supply Review
UWR	Ungulate Winter Range
VDYP	Variable Density Yield Prediction
VRI	Vegetation Resources Inventory
VRIMS	Vegetation Resource Inventory Management System
WAMR	Water and Air Monitoring and Reporting
WER	Wildlife Ecological Research
WHA	Wildlife Habitat Area
WQMN	Water Quality Monitoring Network
WRP	Watershed Restoration Program
WSC	Water Survey Canada
WSI	Wildlife Species Inventory
YSM	Young Stand Monitoring

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