

“Green” Hydro Power

Understanding Impacts, Approvals, and Sustainability of Run-of-River Independent Power Projects in British Columbia



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Summary

Since 2002, the provincial government has required that new sources of electricity come from the private sector. The most popular type of power project now being developed is “run-of-river” hydropower. Large numbers of these projects are now being built and planned, province-wide. The rush for run-of-river power has prompted numerous questions—from anglers, kayakers, hunters, and other concerned citizens—about how run-of-river projects work, how they affect the environment, how the projects are approved and monitored, and how citizens’ input will be treated.

Watershed Watch Salmon Society recognized the need to answer some of the many questions being raised on run-of-river hydroelectric development in British Columbia. Three questions in particular stood out: 1) How are these projects assessed and approved? 2) What environmental impacts can we expect from these projects? and, 3) How can ordinary citizens provide effective feedback and ensure their concerns are heard?

Currently, there are two largely uncoordinated levels of approvals for run-of-river projects. Both also require consultation with affected First Nations—a third level of approval. BC Hydro first determines which projects can be constructed to supply power to the grid. All run-of-river power projects are considered potentially ‘green’ by BC Hydro—that is, eligible for certification by independent auditors as meeting minimum criteria for green (sustainable) energy. BC Hydro pays a premium for this green energy. Yet, because this green designation is optional and the audit happens after a project is already constructed, it is not particularly meaningful during the project approval phase. Provincial and federal government staff are generally unaware of BC Hydro’s green criteria and do not rely on it when giving advice, requiring studies, or issuing approvals.

The provincial and federal government approval process and supporting laws are described in detail in this document, as it is this process that determines potential environmental impacts of each project. Though projects are unique, all require similar types of infrastructure, meaning it is possible to define potential impacts to be considered during project planning. All forms of electricity generation will cause some environmental damage, and the potential effects of run-of-river projects include impacts to aquatic and terrestrial ecosystems, wildlife, species at risk, recreational and aesthetic values, and First Nations and communities. Potential impacts to fisheries values are addressed in much more detail during the approvals process than other types of impacts. At times, impacts to aquatic ecosystems can be significant, as large volumes of water are removed for power generation, significantly reducing flows along stretches of river often four to five kilometres in length.

Of all possible impacts, cumulative impacts are currently one of the biggest concerns. The term ‘cumulative impact’ refers to combined effects on the environment from separate activities, including other hydroelectricity projects and other land uses, such as forestry and agriculture. While small numbers of projects may have acceptable impacts, larger numbers might not, and the degree and types of cumulative impacts are very poorly understood. Concern about cumulative impacts has been prompted because of the large and growing number of projects

concentrated in certain areas of the province—areas that are attractive to power producers because of their high densities of suitable rivers and streams, and their proximity to existing transmission grids. BC currently has no strategic planning process to manage the cumulative impacts of these projects, or to ensure that development avoids sensitive areas with high environmental values. While run-of-river power projects can be environmentally sustainable, their green status becomes questionable when entire landscapes are affected by multiple power lines, roads and water diversions.

British Columbia does not currently have legislation to reliably address the conservation of wildlife and plants. Concerns about effects on terrestrial species are thus often poorly addressed in planning to mitigate impacts of run-of-river projects. Better coordination between BC Hydro and the agencies is needed to address conservation values, particularly for terrestrial issues largely ignored by current laws.

Impacts to First Nation values are addressed on a project-specific basis and will depend on the nature of the consultation process between the independent power producer and the First Nation, and the capacity of individual First Nations. First Nation concerns must be addressed to the degree that their interests are seen to be affected. In some cases, run-of-river projects can provide significant benefits to First Nations.

While the public is not currently asked to approve or reject projects (or to provide much input at all), the amount of public attention a project receives does have bearing on how well environmental concerns are addressed. Public input is critical, but community and stakeholder consultation varies widely in quality and coverage. Suggestions for providing feedback to power projects are thus provided in 1) Watershed Watch's "Top 10 List of Considerations" for assessing the sustainability of run-of-river hydro projects (Appendix 3), and 2) Key strategies for stakeholders and communities to ensure run-of-river power projects are sustainable (Appendix 4).

Watershed Watch believes that informed citizens can play a significant role in determining how future energy supplies are responsibly developed in British Columbia. This document and the accompanying "Citizen's Guide" provide information and suggestions for both citizens and government to ensure run-of-river hydropower becomes a more sustainable option in the future. We also believe that careful scrutiny must be given to the available mix of renewable energy projects in BC, in order to maximize the benefits and minimize environmental and social costs. To that end, it is imperative that BC develop a strategic plan for run-of-river and other power projects throughout the province, a plan that will also see better coordination of approval processes and public input, and the continued development of effective monitoring programs.

Acknowledgements

The Habitat Conservation Trust Fund financed this document. This report and a shorter *Citizen's Guide* are available at www.watershed-watch.org. Craig Orr of Watershed Watch Salmon Society saw the need to develop this project to provide non-experts with information to improve their ability to contribute to better-planned small hydropower projects in BC. Michael Harstone, Andrea Estergaard, various Ministry of Environment (Scott Babakaiff, Steve Rochetta, Ross Vennesland, Ron Ptolemy) and BC Hydro employees (Joanne McKenna) provided advice and information for this report. We also thank the Independent Power Producers Association of BC (IPPBC) and Scott Babakaiff and Steve Rochetta of the Ministry of Environment for excellent photographs, and Soren Henrich for his drawing of a 'typical' run-of-river project. Cover photo from Steve Rochetta.

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1. Introduction

New energy sources are needed to meet British Columbia's (BC's) increasing electricity demands. A large number of private 'run-of-river' hydropower projects are currently being developed to help meet these demands. Some 25 projects were built prior to 2006, and 41 more have received approval-in-principle from BC Hydro and are now under construction or seeking final government approval. Many more projects are in conceptual stages, and hundreds of 'claims' have been staked on promising streams through the provincial water licensing process.

This wave of power development activity stems from provincial policies laid out in BC's 2002 Energy Plan. This plan directed that all new sources of power to meet BC's growing demand come from private sources. BC Hydro is no longer involved in developing new public sources of energy, unless it successfully competes against private companies for larger-scale projects. However, BC Hydro does continue to maintain existing facilities and is also responsible for developing the transmission infrastructure needed to support run-of-river hydropower.

Currently, successful private Independent Power Producers (IPPs) receive a 25-year purchasing contract from BC Hydro, after which time they are free to sell their power to the highest bidder in the western North American electricity market. BC Hydro pays IPPs a premium for 'green' energy (as defined by EcoLogo standards described later in this document). Because they are relatively inexpensive to develop and seemingly have the lowest environmental impact, run-of-river projects are widely viewed as the most viable type of 'green' energy in BC.

Increasingly, however, questions are raised about the actual 'greenness' or sustainability of run-of-river projects. There are environmental concerns related to individual projects, and where multiple projects occur, or are proposed, there is concern regarding possible cumulative impacts. Questions have also been asked about the nature of the planning (including public involvement), and the permitting and monitoring of run-of-river projects.

This document attempts to help concerned citizens understand the issues and the complex and evolving approvals process around run-of-river power generation in BC. It describes the difference between 'green' and 'clean' (non-greenhouse gas emitting) energy, and what may be required to ensure that run-of-river projects are ultimately sustainable. The intent is to provide helpful and accurate information to assist the public in the feedback process for proposed projects. The information provided in this document does not address certain overarching policy issues such as public concerns about energy ownership, electricity rates, public input, and public costs vs. benefits of these projects (i.e., benefits received by the public in return for absorbing the impacts of for-profit hydropower, including rent charged for public water and land).

An accompanying "Citizen's Guide" distills the information found here into a shorter format¹.

¹ See: http://www.watershed-watch.org/programs/green_power.html to download a copy of this document

Approval process for private hydropower projects in BC

Concern has been expressed about the degree to which private companies developing green power are accountable to the public compared to BC Hydro. Also, private companies typically possess less technical capacity and experience than Crown corporations in addressing environmental and social issues. Therefore, the quality of the approval process is important.

It is important to note that there are two separate approval processes for IPP projects: BC Hydro, and agency approvals. The coordination of these two processes would significantly improve the approvals process; however, this is presently not done. Currently, BC Hydro approval creates a high degree of pressure for agency approval, as BC Hydro approval comes with a contract to provide power within a limited timeframe, as well as a requirement to have all necessary agency approvals.

There are also two types of processes for securing agency approvals for power projects. Projects with a generating capacity of 50 mega-watts (MW) or more are screened by the BC Environmental Assessment Office (as are smaller projects that were initiated before 2002). Most run-of-river power projects fall under the 50 MW threshold (50 MW is sufficient to power about 25,000 homes), some purposely so to avoid the more stringent process (e.g., Kwoiek Creek near Lytton, see page 38). While the same approvals are required, the BC Environmental Assessment Office process coordinates the different agency approvals, is highly transparent, and allows for formal public input.

First Nations are a third level of approval separate from BC Hydro and other agency processes. Their concerns must be consulted and accommodated to the degree that the First Nation is adversely affected.

Scope of independent power producer projects in BC

Independent producers currently supply about ten percent of the province's electricity (Anderson 2006), and this proportion will likely expand given the provincial government's policy to have new incremental energy supply contracted to private producers (BC Hydro 2006). Independent Power Producers can develop any type of energy project, though historically the majority (in numbers, if not in capacity) has been small run-of-river hydro projects. Run-of-river power projects are sometimes known as 'small hydro' projects, though not all are small. For example, the proposed 900 Mega-watt Site C Dam on the Peace River is a run-of-river project.

As of August 2006, run-of-river projects make up 64% of all existing and planned IPP projects approved (given Electricity Purchase Agreements) by BC Hydro, and are predicted to represent 27% of the total energy capacity provided by these projects. Of the new projects approved by BC Hydro in 2006, 64% were waterpower projects, accounting for 41% of the projected capacity. Run-of-river projects are particularly favoured because they are one of the most inexpensive options for new electricity supply. BC's terrain and abundant streams create many opportunities for these kinds of developments, and unlike wind energy and some other types of projects, they can be located near transmission corridors and markets.

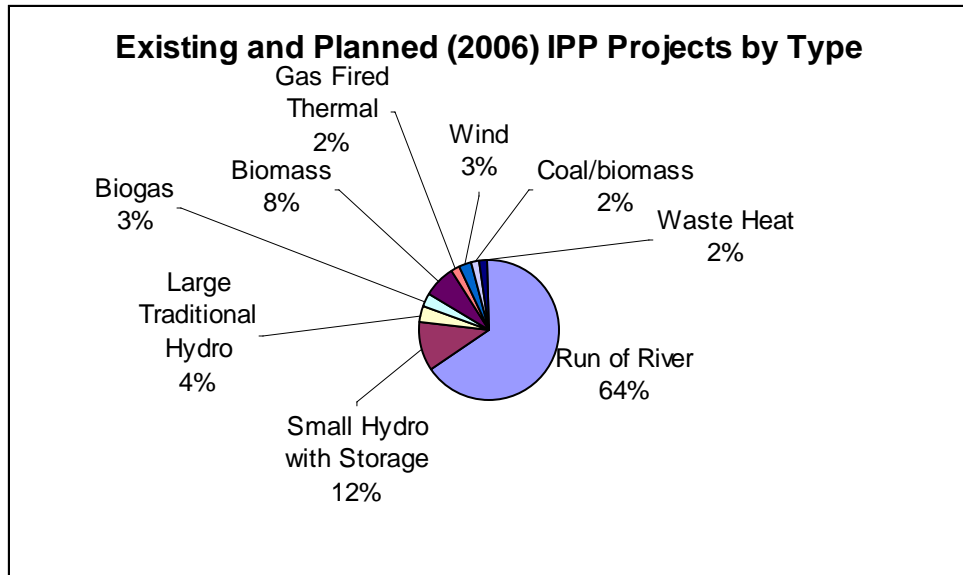


Figure 1: Existing and planned IPP projects by type

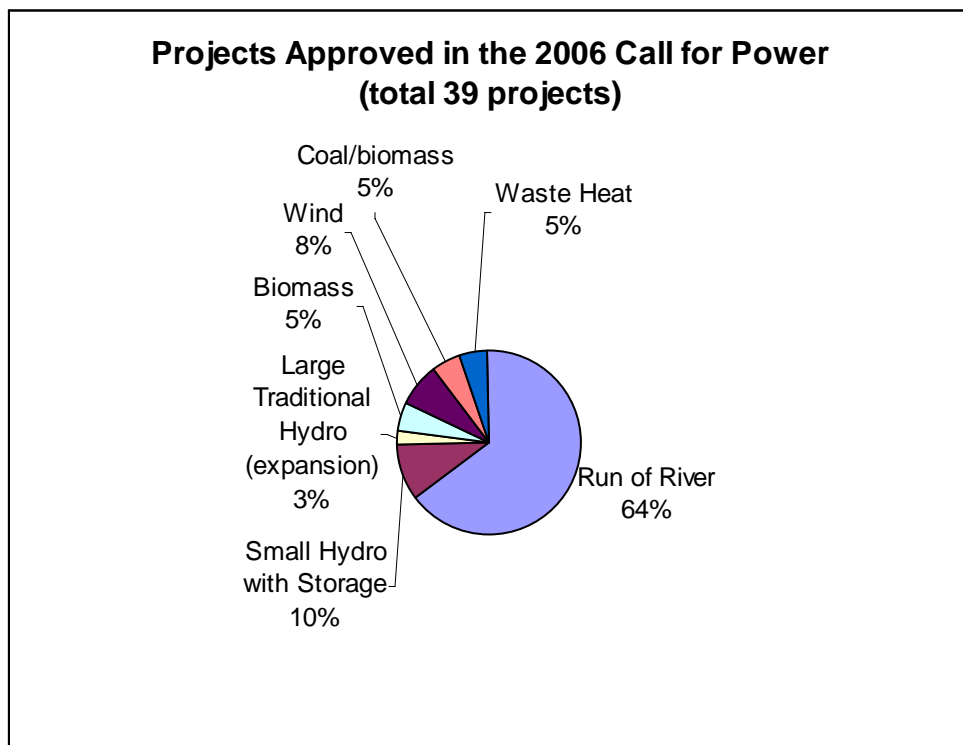


Figure 2: Project types approved in the 2006 call for power

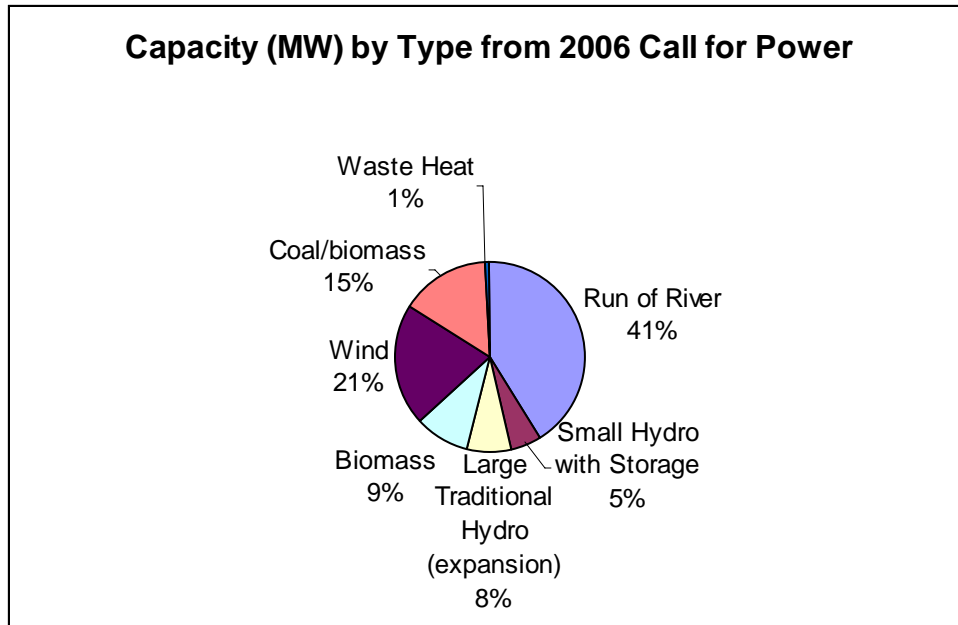


Figure 3: Capacity provided by the different types of power generation approved in the 2006 call for power

Other kinds of small hydro projects (those with ‘storage’ that allows water to be drawn down behind a dam) are also counted among current and projected projects approved by BC Hydro in August 2006. Small hydro with storage totals 12% of the number of projects and 5% of the total energy capacity currently to be provided by IPPs. In addition to the concerns related to run-of-river projects, these projects have additional impacts related to how water is stored and diverted on an hourly, daily and seasonal basis.

According to the Ministry of Energy and Mines,² there were 25 IPP run-of-river projects already constructed and operating prior to 2006. As of August 2006, a further 41 run-of-river projects had Electricity Purchase Agreements with BC Hydro, and more are expected in response to future calls from BC Hydro. The degree of interest in developing small hydro projects is reflected in the number of applications for water licences, which at the time the Ministry data was provided numbered 281, with 82 existing licences. However, the number of active applications for water licences for the purposes of hydroelectricity depends on how the licences are counted and the date on which the topic is researched. A search done in May 2007 revealed 348 active applications, which also included a minority of applications from BC Hydro and other public interests. The locations of these applications and the applicants, as well as current water licences for power production can be seen on Google Earth. This file and the free Google Earth program is available from Watershed Watch at the following address: http://www.watershed-watch.org/programs/green_power.html.

The priority for issuing water licences on any given stream is given to the first applicant in line, effectively allowing proponents to stake the rights to promising streams for hydropower. While not all licences proceed to project stage, the intense interest in these projects has been described

² Data provided by the Ministry of Energy and Mines in August 2006 related to projects given Electricity Purchase Agreements by BC Hydro in 2006 and earlier.

as a ‘gold rush mentality’ by some local governments and agency staff. BC Hydro’s calls for power also generate high levels of interest. Energy Minister Richard Neufeld described the private sector response to the most recent call for power as “overwhelming” (Anderson 2006).

In total, the 2006 call for energy resulted in a projected production of 7,125 GWh of energy per year from 39 projects. In addition, BC Hydro plans to make calls for additional power in 2007 and 2009 to acquire another 10,000 gigawatt hours (GWh) per year by 2015 (BC Hydro 2006). Many of the IPPs with Electricity Purchase Agreements will not yet have secured agency approvals, though separately obtained agency approval is ultimately required for all projects. A significant amount of input will be required from agencies, First Nations and other interested parties for these projects and for those approved by BC Hydro in response to future calls for power.

Current context for agency approvals

BC Hydro’s criteria for green power (Section 6) are applied after project construction and BC Hydro is not involved in the environmental details of a project until after it is built. Designation as ‘green’ is optional, but agency approval is mandatory. Agency approvals will be initiated before an Electricity Purchase Agreement is obtained from BC Hydro, but final approvals will generally be obtained by proponents who already have Electricity Purchase Agreements.

The process and guidelines for agency approvals have been evolving and improving, but remain complex. Agency approval is not currently a ‘one window’ approach. Significant numbers of privately owned run-of-river power projects are a recent phenomenon, even though some date to the first days of the mining industry. While BC Hydro’s first call for such projects occurred in 1989, large numbers of proposals were not received until after government policy clearly described a desire for these projects in the 2002 Energy Plan.

The result has been a strain on Provincial agencies, whose capacity has not increased proportionately. Changes within the agencies themselves have further complicated the approval process, with responsibility for *Land* and *Water Act* approvals moving multiple times between agencies. Fisheries and Oceans staff response to IPP projects tends to depend on the individual and region involved. Jurisdictions also overlap between the Ministry of Environment and Fisheries and Oceans Canada in enforcing and interpreting the *Fisheries Act*, though Fisheries and Oceans has the final responsibility.

Regulatory agencies also face challenges in reconciling the needs of aquatic life with the requirements for economically viable power projects. One of the most significant potential impacts from a run-of-river project is the reduction of flows between the point where water is drawn into ‘penstocks’ (pipes leading to the turbines) and where it is returned to the river (see Section 2 for an in-depth discussion). This distance varies, and can be several kilometres. A large proportion of stream flow must be diverted to create a financially viable project, and the small ‘instream flows’ that are left are those deemed by the proponents and agencies to meet the minimum needs of fish.

From a scientific standpoint, there is a high degree of uncertainty surrounding the appropriate levels of in-stream flows for fish. While rules of thumb can be applied, variability and uncertainty remain inherent, and given the variability of project sites, there is no single 'right' method to determine minimum flows. Conservative rules that do protect fish across a variety of locations (Hatfield *et al.* 2003) will generally not provide the necessary diversion flows for project viability. Instream flows are thus determined on a project-by-project basis, and are not based on an agency standard.

Run-of-River projects and BC's Energy Plan

The 2002 Energy Plan provided the policy basis for the development of independent power projects in BC. It also set a target for new energy to be 50% "clean" (Province of BC 2002). This target was not particularly onerous, as currently some 90% of BC Hydro's energy is generated by hydropower projects that fit the 'BC Clean Energy' definition, which includes projects that can be certified as green as well as large hydro and other projects that are seen as better than conventional fossil-fuel burning power plants (BC Ministry of Energy, Mines and Petroleum Resources 2005). For example, the Minister of Energy, Mines and Petroleum Resources has defined the proposed (and controversial) Site C (900 MW) hydropower project on the Peace River as clean. Large projects such as Site C that go through the Environmental Assessment Office and that are lower-impact than conventional fossil-fuel burning power plants found elsewhere will likely also be recognized as BC Clean Energy.

The BC Energy Plan released in February 2007 (Province of BC 2007a) boasts higher targets than the 2002 plan, requiring all new electricity generation projects have zero net greenhouse gas emissions (i.e., to be 'clean' by the commonly understood definition). The plan also has a goal of ensuring that clean or renewable energy generation continues to account for at least 90 percent of total generation, and electricity self-sufficiency by 2016. BC Hydro currently imports and exports electricity where this trading allows it to maximize income, and according to a 2005 report by BC Stats³, exports have exceeded imports in most years, with net imports required only in those years with low water levels.

The 2007 Energy Plan describes bio-energy, geothermal energy, tidal, run-of-river, solar, and wind power as being potential energy sources in a clean, renewable future. While some of these power sources are yet to be developed in BC, run-of-river hydro projects are an important part of this future energy generation as they are cheaper and can be developed close to transmission corridors and markets. The 2007 Energy Plan may have given even greater incentive to develop small run-of-river projects, as it includes a new policy that promotes and streamlines the development of power projects less than 10 MW capacity (Province of BC 2007a).

2. Potential impacts of run-of-river power projects

Run-of-river power projects must divert water into penstocks (pipes) that bring water to turbines in a power plant at lower elevation. The elevation difference between the intake and the powerhouse provides the kinetic energy that powers turbines that produce electricity. Such

³ <http://www.bcstats.gov.bc.ca/pubs/exp/exp0512.pdf>

projects require that water be diverted from a section ('reach') of the river, in some cases several kilometres in length (Figure 4). A 'headpond' is almost always required at the intake located at the top of the diversion reach, to ensure the intake pipe is always submerged and has sufficient flow. This headpond can flood a significant area, and is created by a low elevation dam that extends across the stream. Below the powerhouse, a 'tailrace' is required, which is typically a short channel that moves water back into the stream. Aside from the intake, headpond, dam, penstocks, powerhouse, and tailrace, run-of-river power projects also require road access and power transmission lines. These various physical aspects of the project are sometimes referred to as the project 'footprint'. The footprint can be considered separate from potential ongoing impacts related to low flows and other operational decisions related to flow releases.

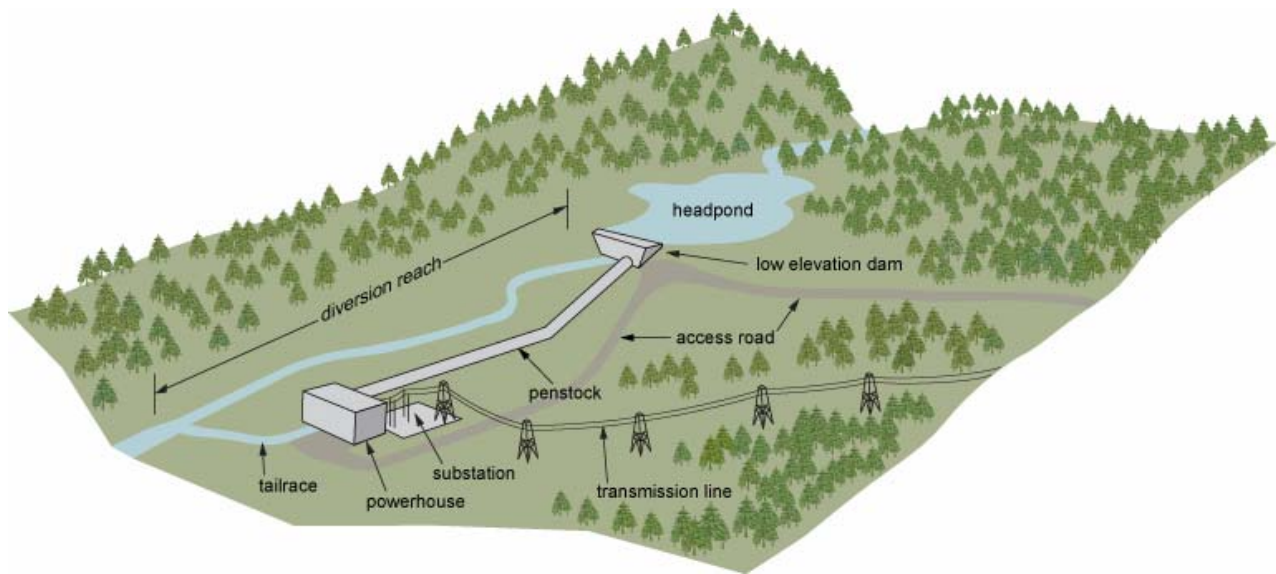


Figure 4: Drawing of a 'typical' run-of-river hydro project.



Photo: Independent Power Producers of BC

Figure 5: Weir, intake and headpond at Furry Creek.



Photo: Ministry of Environment

Figure 6: Looking upstream at the diversion dam on the Lower Mamquam River



Photo: Independent Power Producers of BC

Figure 7: Construction of penstock at Furry Creek.



Photos: Independent Power Producers of BC
Figure 8: Furry Creek penstock on its way to the powerhouse (left); the Furry power sub-station (right).



Figure 9: Powerhouse at Furry Creek.

Photo: Independent Power Producers of BC

Additional impacts may be caused during construction, and through increased human access to wilderness areas. Construction impacts are hard to avoid when major infrastructure is placed in or near streams. Environmental concerns are not always well addressed or monitored during construction activities near streams, and even when care is taken, accidents may deposit harmful materials into the stream (e.g., concrete, silt, hydrocarbons), or cause unintended alterations to flows. Other short-term construction impacts include increased noise and human activity that can affect wildlife. With good planning construction impacts can be minimized, and in most cases these impacts can be reversed.

While each project is unique, it is possible to define the various potential ongoing (post-construction) impacts that should be considered during project planning. All projects will cause some environmental damage—no form of electricity is impact-free, even the ‘greenest’ of projects. These potential ongoing impacts are described below.

Impacts to aquatic ecosystems and fish

Potential impacts may be separated into effects at and above the dam, and effects in the diversion reach below.

Impacts at and above the dam

Dams are typically migration barriers to fish and other aquatic life. Generally, regulatory agencies require that anadromous (sea-going) fish passage be unimpeded. Often the diversion is above anadromous barriers like waterfalls or canyons. However, the dams should also be engineered to allow resident fish to move above and below. Impeded resident fish movement at various life stages is a likely potential impact of dam construction.

Potential impacts above the dam include:

- Stranding of fish in and around the headpond, as a result of varying water levels;
- Increasing water level variability and resulting alterations to riparian vegetation communities and usable habitat area for fish;
- Conversion of valuable riffle habitat to less valuable run habitat, thus lowering the fish use and carrying capacity of the headpond area;
- Fish being swept over the dam at critical life stages;
- Debris clogging the intake and causing outages (which in turn increases the likelihood of fish stranding events below the powerhouse in the tailrace); and,
- Entrainment of fish through the intake, and impingement against the intake.

Fish impingement refers to fish being pinned against the intake to the penstocks. Fish entrainment refers to fish being drawn into the penstocks, and then passing through the turbines. Depending on the type of turbine, mortality rates range from low to total. In BC, the *Water Act* and the Federal *Fisheries Act* empower the regulatory agencies to require that fish entrainment and impingement be addressed in project design. The *Fisheries Act* is a strong piece of legislation that is also used to mitigate other effects run-of-river power projects on fish and their habitat. A more detailed description of this and other legislation is found in Appendix 1.

Impacts below the dam

Impacts below the dam will extend throughout the diversion reach (the section between the dam and where the water is returned to the river), and potentially further if sediment regimes, large woody debris movement, and food chains are affected. A key concern is the amount of water remaining in the diversion reach. A significant amount of water needs to be extracted in order for a run-of-river power project to be economically profitable. A guideline that is often applied as a starting point is the diversion of a volume equal to the 80th percentile of stream flows (Hatfield *et al.* 2003). In other words, the volume of water that is present 80% of the time might be taken (see Figure 9: the 80th percentile is not equal to 80% of the annual flow, and the proportion of total flows taken will vary by stream). The abstraction of these large volumes means that the remaining flows are significantly lower and less variable. It is important to note that the 80th percentile is not a standard used in BC but rather a starting point for discussions, and each project will negotiate flows based on the aquatic values and risks.

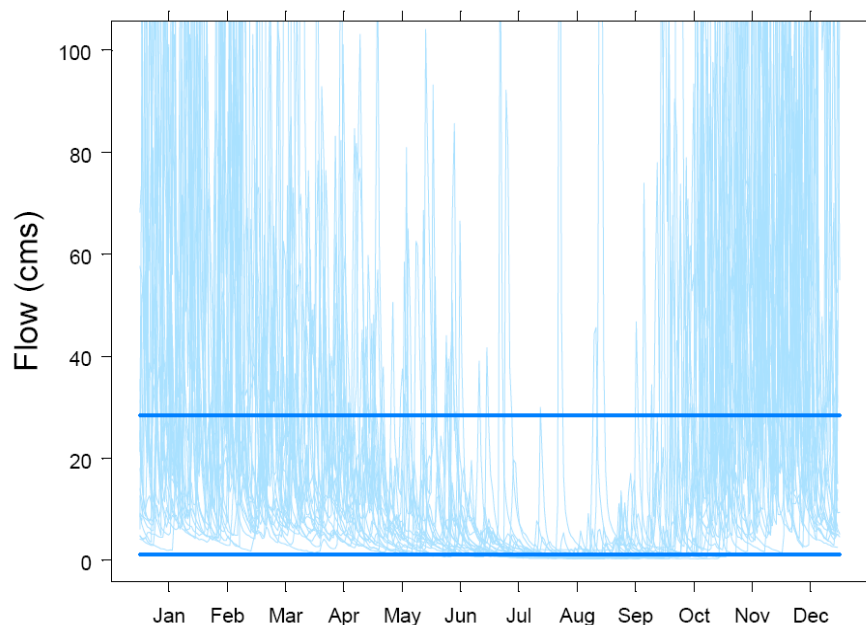


Figure 10: From Hatfield *et al.* 2004: Natural mean daily flows for a coastal river, with different years on record superimposed. The upper blue line represents the 80th percentile of stream flows, in other words the volume that is present 80% of the time. This is a potential amount that may be taken in a stream but the actual amount taken will depend on the values and risks in the individual stream and may exceed the 80th percentile.

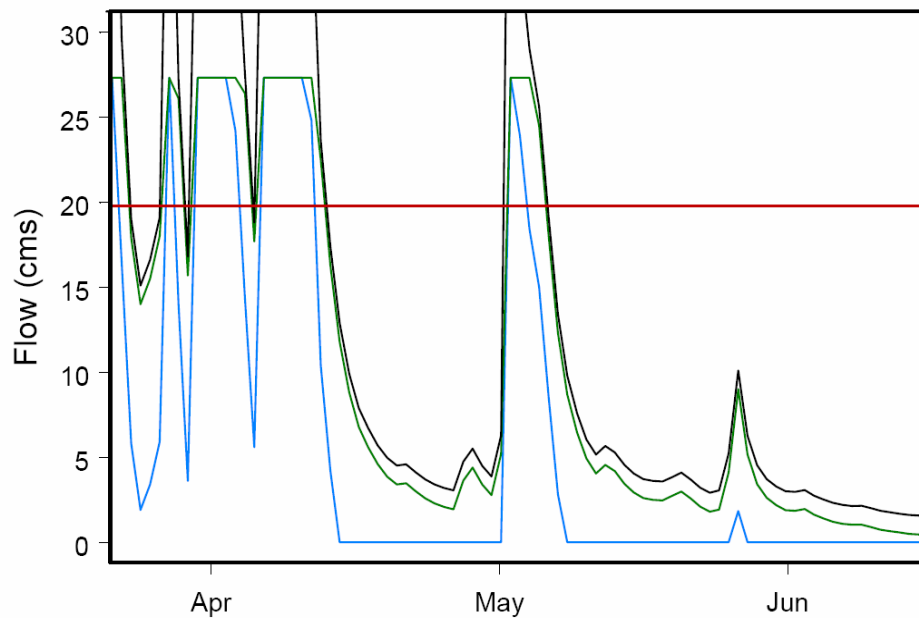


Figure 11: From Hatfield *et al.* 2004: For the same coastal stream in Figure 9, a comparison of stream flow for three months in 1996. The black line is total stream flow, and the green line is the 80th percentile that may be available for diversion – note how the majority of available flows could be diverted at most times during these months. The blue line is proposed diversion levels for a fish-bearing stream. (The blue line represents diverted flows much lower than the 80th percentile and is based on a risk-averse guideline developed with Fisheries and Oceans Canada. This lower, conservative level of diversion is generally not implemented because it allows insufficient flow for a project to be economically profitable.)

Typical impacts below the dam include alterations to velocity, depth, temperature, flow variability and sediment movement, which in turn affect the quality, quantity and type of habitat available. These changes in habitat affect many ecosystem components and processes such as aquatic invertebrates, fish, plants, microbes, and nutrient dynamics. When benthic invertebrate (organisms that live on the stream bottom) productivity declines it typically affects fish in the immediate vicinity, and possibly downstream as well. In the diversion reach, reduced habitat area or increased flow variability may decrease fish numbers or viability. Reduced flows can have a large impact in winter, when lower flows increase the probability of anchor ice formation. Anchor ice can isolate, strand and kill fish during this vulnerable more dormant over-wintering period.

A ‘tailrace’ is the outlet channel below the powerhouse that carries diverted water back to the stream. Depending on the power generating equipment (i.e., whether or not a fish by-pass flow valve is present), unplanned power outages can cause a rapid drop in water levels in the tailrace and downstream, causing fish to be stranded. In general, variable flows can make the tailrace area inhospitable for fish. For this reason, ‘ramping’ rates are often agreed upon with Fisheries and Oceans Canada staff for day-to-day operations of the power plant. In some cases fish access to the tailrace may be blocked to minimize fish mortality.

Other likely impacts below the dam include the reduction of downstream large woody debris and sediment movement, and changes to groundwater interactions and water quality. From an operational standpoint, woody debris is managed to prevent the intake to the penstock from clogging. However, large woody debris is integral to the health of lower gradient streams, and its abundance is a key determinant of fish habitat quality. A lack of gravel recruitment below the dam is another significant potential impact of run-of-river power facilities (depending on dam design), and can affect the channel form and fish habitat. Reduced gravel recruitment can mean channel erosion and a lack of spawning gravels.

The removal of large volumes of water will affect surface water-groundwater exchange. Groundwater is always exchanging with surface water, and stream reaches are either ‘gaining’ (receiving groundwater), or ‘losing’ (losing flow to the ground to replenish the underlying aquifer), and the direction of flow can vary depending on time of year. Losing stream reaches can be important as source areas for groundwater, and removing significant flows means that groundwater recharge will be less (Douglas 2006). This factor is not typically considered in project design.

Water quality is a concern. The below-dam water quality parameters which can be altered include temperature, dissolved oxygen and total gas pressure. Construction activities and methods can also have an effect, e.g., with pH changes brought by acid rock drainage, as most aquatic life is drastically affected when pH drops below normal levels. Total gas pressure refers to air (primarily oxygen and nitrogen) dissolved in the water and can be elevated by dam spillways and turbine venting. A high total gas pressure or “supersaturation” of gases below a dam can cause serious problems for fish and invertebrates, including large-scale mortality. However, newer small hydro plants generally reduce the total gas pressure (which can be naturally high in high-gradient streams) leaving the plant, instead of increasing it. Of these water quality issues, temperature changes are the most likely to occur, particularly in winter.

Lastly, climate change is expected to further affect precipitation patterns, including increasing the low flow period during summer. Water licences should include measures to address the changing availability of water over time, to ensure the needs of fish are met.

Impacts to riparian communities and species

The word ‘riparian’ refers to plant communities and species that are influenced and sustained by the presence of nearby water. Riparian vegetation stabilizes, shades, and provides structure and nutrients to the aquatic habitat it surrounds. Riparian habitat also supports wildlife diversity, and serves as a corridor for wildlife movement. In general, riparian areas are known to be biodiverse and important features on the landscape, and many wildlife species rely on them for their needs and use them disproportionately compared to other parts of the landscape.

Streamside vegetation has varying degrees of connectivity to the stream itself, and in steep-sided bedrock channels, there is less interaction. In areas with lower banks, changes in flows can affect the type of vegetation present. The elevated water level in headponds will likely influence the adjacent riparian community. Below the dam water levels are lower, and associated impacts to the riparian community will depend on its degree of connectivity to the stream. Additionally,

infrastructure and construction activity in riparian areas can cause impacts to the stream channel (e.g., through sediment deposition or stream bank hardening), as well as to the diverse plant communities, and wildlife populations. New roads associated with facility construction make it easier to access riparian areas, often with adverse consequences. Because of the variability inherent in different projects, the precise impacts will always be site specific.



Photo: Ministry of Environment

Figure 12: Riparian and stream channel impacts are seen in this photo showing a diversion dam at Rutherford Creek. Riparian vegetation has been lost and exposed sediments increase the likelihood of sediment deposition into the stream. Fish passage would not be possible over the diversion dam, and the channel downstream of the dam appears to be without flows and without a clearly defined channel.

Impacts to terrestrial ecosystems and species

Terrestrial ecosystems include the riparian ecosystems (mentioned above) and the forests and other ecosystems in the surrounding watershed. Impacts occur when terrestrial areas are converted to power-related infrastructure, mainly roads, transmission corridors, penstocks, and powerhouses. Roads and transmission corridors can cover extensive areas: this increased access and habitat fragmentation typically has serious negative effects.

Projects constructed in remote areas or areas of high ecological values increase human activity and road and transmission line access, leading to a number of negative effects on plant and wildlife communities. A 2001 Strategic Ecological Restoration Assessment (Holt 2001) identified access (primarily roads but also transmission corridors, seismic lines and off-road and backcountry travel) as a prime factor in ecosystem degradation across the province. Ecological problems related to access (infrastructure development) include introduction of invasive species (e.g., Scotch Broom), increased hunting, poaching, and disturbance, disruption of movement corridors and gene flow among and between populations, and physical reduction of habitat. Impacts are wide-ranging, affecting many species and biodiversity in general, yet can be difficult

and expensive to address and monitor—at least compared to more typical aquatic monitoring—meaning terrestrial impacts are often poorly addressed. The discrepancy between how aquatic and terrestrial impacts are addressed for run-of-river power projects is a concern (see Appendix 1).



Photo: Ministry of Environment

Figure 13: The access road to the Rutherford run-of-river power project. The terrestrial impacts of a run-of-river power project can extend over a much greater area than the aquatic impacts.

Impacts to species at risk

Species at risk are those designated as threatened, endangered or ‘of concern’ by the provincial and/or federal governments. These species include both aquatic and terrestrial organisms. By definition these species are few in numbers and are sensitive to even small habitat changes. Where sufficient information is provided on a species at risk in a specific project area, the proponents are fairly likely to address the species’ needs. In the absence of such detailed data, species at risk may not be properly protected. Thus, the level and quality of existing information has a large bearing on the accommodations made to protect species at risk.

Unfortunately, available data are often inadequate to assess whether a species is present, how it uses the area, and how the proposed project might affect it. Legislation protecting species at risk is weak in British Columbia, unless the species is aquatic, occurs on federal land, or has its critical habitat defined under the federal *Species at Risk Act*.

Impacts to recreational and aesthetic values

Rivers appropriate for power generation are also frequently used by kayakers, backpackers, skiers, hunters, fishers, wildlife and bird watchers, and other recreationalists. Diverting significant flows from a section could significantly alter a kayaker’s experience, though in some cases flow reduction could make the reach accessible to more paddlers. A common implication

of a power project from a recreationalist's point of view is reduced wilderness aesthetics. New roads and transmission corridors generally reduce the natural beauty and value of an area to outdoor enthusiasts.

Once a project is built there are also new liability issues that may lead to restrictions on access and use of river areas near facilities. It is fairly common for rivers upstream of headponds to be closed to the public for safety reasons, and the area from the headpond down past the tailrace is usually designated a 'no trespassing' zone.

Impacts to First Nations and communities

All power projects will occur in the traditional territory of at least one First Nation, and may have impacts on cultural and ceremonial practices, archaeological sites, traditional fishing and hunting territories, or other general conservation values. Canyon areas suitable for run-of-river power projects can be areas of great natural beauty and also culturally important to First Nations. Wildlife or fish species important to First Nations can be affected by power developments, both by the project footprint and by increased human access. First Nations may also contend that certain areas are simply inappropriate for new industrial developments. Actual impacts are dependent on the site and the associated First Nation and their specific values and culture.

Power projects may also confer significant benefits to First Nations. These projects can have positive economic implications: acting as sources of employment, training and revenue, though the number of jobs post-construction may be low. The arrangements made between proponents and First Nations will vary widely. On the Kettle River a project in progress had proposed to build a museum that showcases First Nation history as well as the history of alternating current power, and on the Ashlu River, the proponent plans to give the facility to the local First Nation after 40 years. Revenue sharing agreements or one-time payments may also be part of the arrangements.

Communities (including First Nations) are affected by the construction phase of a project, and segments of a community are also affected when local recreational, tourism, aesthetic and conservation values are altered. Communities can also benefit from construction activity, related amenities and/or tax revenues created by the project.

Cumulative impacts

Cumulative impacts are the total of all the environmental impacts, and they constitute the most serious and least understood environmental concern. A run-of-river project might have acceptable environmental impacts by itself, but when combined with other power projects or land uses could result in a level of environmental damage that citizens deem unacceptable. Given the current push to develop IPP projects, the potential cumulative effect of multiple run-of-river power projects in a region is a major issue. Multiple power projects developed without consideration of joint impacts could trigger watershed-level impacts to aquatic health. Similarly, expanding road systems and transmission corridors could increase human activity and habitat fragmentation to a point causing unwanted harm to wildlife populations, particularly those that do not co-exist well with humans. There is also a cumulative visual impact of multiple power

projects in natural landscapes, and this affects the enjoyment of people who value wilderness. Even projects that are done in isolation from other power projects can contribute to cumulative effects. For example, a power project proposed for a stream already negatively affected by forestry or agriculture could further alter conditions to a degree that causes harm to fish populations (Figure 11).

The Sea-to-Sky corridor on BC's south coast has been the subject of concern regarding cumulative effects. In this area, seven run-of-river projects have been constructed since the early 1990s. Recently, a new project on the Ashlu River was also approved. Several other projects are proposed and are in various stages of the approval process. In addition, many more streams have water licence applications that may allow for future power plant development.

Before a 2006 change to provincial laws that removed the local government's jurisdiction over power plant zoning, the Squamish-Lillooet Regional District denied rezoning approval to a project on Ashlu Creek. This decision was in large part due to concerns over cumulative effects and lack of strategic regional planning regarding which areas were suitable for these types of development. The Ashlu Creek project was high profile and highlighted community concerns regarding cumulative effects of many power projects on a single area. Currently, no process or measures have been initiated to address cumulative effects of projects, aside from a federal screening review that happens for individual projects under the *Canadian Environmental Assessment Act*. Fisheries and Oceans Canada is usually the federal agency responsible for this review of potential cumulative effects. However, this review does not tend to take a strategic planning approach that includes all the factors of concern, and does not allow a chance for public input.



Photo: Ministry of Environment

Figure 14: This location on the Green River between Squamish and Whistler suffers from cumulative impacts of the Sea-to-Sky highway, a railway, transmission lines and infrastructure for the Rutherford run-of-river power project. The cleared area in the foreground was a former gravel pit and was re-opened to become a staging area for plant construction. This area became a permanent footprint when it was converted to a cement plant. The Rutherford tributary and power plant is visible in the middle distance.

3. Summary of agency approval process

Provincial and federal agencies determine how a project will mitigate and monitor its impacts to the surrounding environment. BC Hydro has an approval process of its own that looks at technical and operational concerns, and also uses an independent body to certify projects applying for green power status once they are constructed (Section 6). However, BC Hydro is not involved in the various environmental approvals and studies done while a project is in its planning phase, and therefore is not involved in determining and mitigating a project's environmental impact. Generally, BC Hydro has approved a project (i.e., given it an Electricity Purchase Agreement) before the project receives its final agency approvals. An Electricity Purchase Agreement places a tight deadline for the proponents to obtain the various mandatory approvals and begin construction. It is possible that agency staff could decline approvals for a project with an Electricity Purchase Agreement based on unacceptable environmental impacts. However, that has not yet occurred, except in the case of one local government decision that was later over-ruled by the provincial government (Section 5).

The project proponent will apply for a water licence under the *Water Act* to initiate their project, and will generally make this application well in advance of most other preparations. The proponent will often also require *Land Act* approvals to occupy or buy Crown land for their facility. This process of provincial *Water/Land Act* approvals usually proceeds at the same time as federal *Fisheries Act* approvals and other legislative requirements are pursued. (The legislation referred to in this section is described in detail in Appendix 1.) The Ministry of Environment (Water Comptroller and Water Stewardship Division) is in charge of the water licence, and refers information to Fisheries and Oceans Canada (DFO) for review under the *Fisheries Act* and *Canadian Environmental Assessment Act*. The Ministry of Environment (MOE) also refers the application to other provincial ministries to inquire about conflicts with forest and mining tenures, or agriculture lands, as well as referring to the Canadian Coast Guard under their mandate to manage navigable waters (Minister of Environment Barry Penner, Hansard Transcript, 2006 Legislative Session, April 6, 2006⁴). According to Minister Penner, when a water licence is applied for, the MOE looks at possible impacts to fish, recreation impacts, access roads, and conflicts with wildlife, and does an assessment on the overall ecosystem impact on the watercourse, in addition to referring to other agencies. Based on our knowledge of project approvals to date, Minister Penner describes a best-case scenario and project reviews don't necessarily address access, ecosystem or wildlife impacts in a consistent way.

Fisheries and Oceans Canada staff will typically work cooperatively with the MOE in requesting and reviewing information to mitigate impacts and determine whether there is potential for a harmful alteration, disruption or destruction (HADD) of fish habitat under the *Fisheries Act*. If trout, char or other non-pacific salmon species are involved, the DFO will typically defer to MOE expertise in determining potential impacts. However, the *Fisheries Act* authorization (regarding a HADD and the associated habitat compensation plan) is always issued by DFO.

⁴ see:

<http://www.ipabc.com/media/Hansard%20Min%20of%20Environment%20Estimates%20hydro%20wind%20IPPs%20April%202006.doc> for the Hansard transcript

Increasingly, water licences issued under the *Water Act* stipulate that fish populations and habitat must be monitored, and depending on the DFO staff member involved, *Fisheries Act* authorizations may contain measures that address wildlife related concerns (Scott Babakaiff, MOE, personal communication).

Staff from different agencies and departments will usually work with each other to varying degrees, but the issuance of *Water Act*, *Land Act*, and *Fisheries Act* and other federal and provincial approvals are not done with a ‘one window’ (i.e., one application) approach. This means that the approval process is complex for applicants and also more difficult for the public to understand and participate in.

4. Agency guidelines to mitigate and monitor environmental impacts

In addition to laws that apply to run-of-river projects (Appendix 1), there is government guidance for developing aspects of these projects. This guidance is intended to help agency staff and proponents understand the process and understand how to minimize environmental harm and collect appropriate information and data. The newest guidance document was released in May 2007 from the Lower Mainland Region of the Ministry of Environment, and is entitled “Guidelines for the collection and analysis of fish and fish habitat data for the purpose of assessing impacts from small hydropower projects in British Columbia” (Hatfield *et al.* 2007). Currently, this guidance does not officially extend to the rest of the province, but as it provides the clearest and most detailed guidance to date, it is likely that staff in other regions will also benefit from its use. It is possible that this document will be used as an informal source of guidance for proponents in other regions even if it is not eventually adopted as a formal provincial guideline. If followed, proponents will be providing more specific and consistent detail on their proposed infrastructure as well as for local hydrology, geomorphology and biological and ecological information. This will allow government staff and interested members of the public to better understand potential project impacts. As the title suggests, this government document is mostly focused on fish and stream conditions, but it also requires limited information on wildlife, plants and species at risk.

Other prior documents continue to offer useful technical and background information and portions are referred to in the newest document for guidance on data collection and suggested procedures. One of these documents gives technical guidance on instream flow assessment methods (Lewis *et al.* 2004) and other technical procedures, and is frequently referred to in the newest document (Hatfield *et al.* 2007) for this background information. Another provincial document (Hatfield *et al.* 2003) describes instream flow thresholds to protect fish habitat and contains good technical background information; however, proponents do not usually follow its specific recommendations as the instream flow thresholds are seen as conservative. A summary of this document is made in Hatfield *et al.* 2004 with specific examples of how the proposed flow thresholds could be applied. Two further guidance documents for developing hydropower projects are available from Land and Water BC (Land and Water BC 2003, 2004), and are useful and referred to for details on hydrology requirements. These documents are partially out of date and do not deal directly with *Fisheries Act* or other environment-related concerns.

Pre-existing draft regional guidelines to address species at risk are adopted into the newest guidance document for the Lower Mainland Region. The exact manner in which species at risk are handled depends on which of the nine Ministry of Environment regions are involved. It is the Lower Mainland and Vancouver Island Regions' protocols that are described in this section.

The documents mentioned above provide the sum total of specific guidance to address and mitigate the environmental risks of run-of-river power projects. However, the documents mentioned here are additional to BC Hydro/EcoLogo criteria and guidance for green power (Section 6). These are also additional to Fisheries and Oceans Canada guidance and policies regarding no net loss of fish habitat and related mitigation and compensation measures, which are policies developed to help define compliance with the *Fisheries Act* (Fisheries and Oceans Canada 1986). Fisheries and Oceans and/or Ministry of Environment Staff apply these policies on a project-specific basis.

More information is provided below regarding how these power project-specific guidelines address fish and fish habitat, wildlife, wildlife habitat, and species at risk.

Agency guidance addressing fish and fish habitat

The majority of agency guidance and involvement relates to setting of appropriate instream flows to protect fish populations, as well as collecting appropriate data to monitor and understand project effects on fish and fish habitat. This data will also be important to check assumptions about project effects that were made during the planning process. This focus on fish instead of ecosystems or other affected species reflects existing legislation (i.e., the *Fisheries Act*) and reflects the difficulty or short-term economic cost of taking an ecosystem approach. The fish species in question are often rainbow trout (*Oncorhynchus mykiss*), or other provincially managed, non-pacific salmon species.

The agency guidance developed to help set appropriate instream flow levels for the diversion reach (Hatfield *et al.* 2007, Lewis *et al.* 2004) takes a reductionist approach, where the habitat conditions during the limiting times of year, for the fish species and life stages that are most sensitive, are used to determine minimum required instream flows. In areas where fish are not present, the required instream flows in the diversion reach will usually be less, but information on stream insects (benthic invertebrates) is of interest for the fish food they provide. In other words, fish are the species of interest, even when they are absent, as sufficient water is required to maintain the benthic invertebrate community 'drift' (potential fish food) provided to downstream reaches. Very specific detail is provided and referred to regarding appropriate fish and benthic invertebrate sampling techniques.

In the Lower Mainland Region document, information is requested regarding hydrology (regional and stream-specific water flow data), water quality, and geomorphology, to assist in making an assessment of instream flow needs. Operational monitoring guidance describes a need for collection and analysis of no less than one year of pre-diversion fish abundance and/or baseline data (e.g., macroinvertebrate drift estimates).

Agency guidance addressing wildlife and wildlife habitat

Compared to guidance for fish and fish habitat, very little guidance exists for dealing with wildlife impacts from run-of-river independent power projects. The newest guidance document for the Lower Mainland Region of the Ministry of Environment is the only document that specifically addresses wildlife, and wildlife is a very minor focus of the document. It requests information mainly related to species at risk (described below). The document also notes that operational monitoring may include terrestrial species impacted by the proposed project during migration or from seasonal use of an area (e.g., grizzly bears or ungulates). For the preliminary project information that a proponent is requested to provide, Wildlife Habitat Areas (WHAs), Ungulate Winter Ranges (UWR) and other habitats required under the *Wildlife Act* are to be compiled and mapped. For the more detailed Development Plan, consideration must be given to how these specific areas and species will be affected.

Guidance for addressing wildlife is very general and will typically apply to few wildlife species in a project area. This is a reflection of existing legislation in British Columbia (Appendix 1), which does not protect wildlife habitat except in specific cases where habitat areas are designated. The involvement of Ministry of Environment staff and members of the public in a project and the degree to which their advice is incorporated will often determine the level of consideration given to wildlife species.

Agency guidance for species at risk

The Lower Mainland Region of the Ministry of Environment (Hatfield *et al.* 2007) provides basic guidance addressing for species at risk while saying that the assessment used must follow the most up to date guidelines. There is currently only one draft document available for guidance and this is also from the Lower Mainland Region (MOE 2006). Its general advice is similar to that provided in Hatfield *et al.* (2007), which states that irrespective of the guidance used, the assessment should include:

1. Presence/absence assessment on red- and blue-listed animals, plants and plant communities, Committee on the Status of Endangered Wildlife in Canada (COSEWIC) *Species At Risk Act* (SARA) -listed species and regionally significant species as identified in the Preliminary Project Description. (Also a requirement of the preliminary project description.)
2. An assessment and summary of project construction and operation effects on identified red- and blue-listed species and ecosystems, SARA-listed species and regionally significant species.
3. Consideration of how project construction and operation will affect Wildlife Habitat Areas (WHA), Ungulate Winter Ranges (UWR) and other habitats requiring assessment or protection under the *Wildlife Act*. Field verification of information provided in the Preliminary Project Description (i.e., based on the IWMS website for WHAs, <http://www.env.gov.bc.ca/wld/frpa/iwms/index.html>) may be required, based on input from an experienced wildlife biologist.
4. Consideration of cumulative impacts to wildlife and habitat.

Cumulative impacts are a very significant consideration and it is important that they are mentioned in the Lower Mainland Region guidelines. However, these impacts are difficult to assess and agree upon and still may not be well addressed, particularly as ‘consideration’ of them can take various forms. It is noteworthy that field verification may be required for the certain species covered under the *Wildlife Act*, but not for other species. Presence/absence of other species at risk will likely be determined without a field inspection.

Each MOE region handles IPP projects in a somewhat different way. In the Vancouver Island Region there is no written guidance for managing effects on species at risk. The ecosystem biologist provides project-specific information to proponents (Grant Bracher, MOE, personal communication), with input from MOE fisheries biologists. Often, the MOE recommends that the proponent carry out specific studies on water flow, fish, wildlife and vegetation, with focus on identified species of concern (i.e., provincially red and blue listed species, *Species at Risk Act* listed species, and regionally significant species). The MOE Vancouver Island Region also recommends the proponent carry out specific actions to mitigate typical project effects. This approach is likely typical of most regions, though regions tend to vary in their capacity to address individual projects.

5. Local government zoning approval

Local government zoning approval of IPP projects was required until spring 2006. In one instance—Ledcor Inc.’s Ashlu project in the Squamish-Lillooet Regional District—the Regional District denied zoning approval after all other levels of approval were obtained. This was done citing concerns about grizzly bear (*Ursus arctos*) impacts among other concerns including lack of regional planning. The Province subsequently (May 2006) enacted Bill 30, which amended the *Utilities Commission Act*, to limit local government involvement in IPP project review and approval processes, and remove the ability of local governments to prevent IPP projects from going ahead. As a result, the Ashlu project was approved regardless of the local government’s concerns. Because of Bill 30, future projects that face opposition from local governments, but are endorsed by other levels of government, will likely be approved.

6. BC Hydro criteria and approval process

Calls for Power and Electricity Purchase Agreements

BC Hydro has issued calls for private power starting in 1989, though projects were slow to advance in the 1990s. From 2001 to 2003, three power acquisition processes were held (IPPBC 2007), and a further call for power was held in 2006. BC Hydro plans to issue at least two further calls for power, with the next one occurring in 2007. These calls invite private companies to submit proposals to develop energy facilities based on very specific criteria. Once these proposals are reviewed and screened, BC Hydro issues Electricity Purchase Agreements (EPAs) to successful proponents. Successful proponents must secure all approvals and initiate construction on their project within two years for the EPA to remain valid. An important note: BC Hydro does not require approvals to be obtained or consultations to be completed prior to issuance of an Electricity Purchase Agreement. A project that is delayed by consultations and

approvals (or is denied approvals) may not meet the deadline in the EPA, or will require an extension.

The project mix adopted by BC Hydro is determined largely by the private sector response to its calls for power within the above criteria, and is not set by provincial policy. Existing projects and BC Hydro-approved⁵ future projects not only include run-of-river but also other forms of hydropower, gas fired plants, biogas, biomass, wind, biomass/coal, and waste heat facilities. Following the 2006 Call for Power, two coal-fired plants were approved. However, the 2007 Energy Plan has brought the development of these projects into question by requiring zero net greenhouse gas emissions by creation of offsets or 100 percent CO₂ sequestration. The provincial policy for carbon offsets is yet to be released and could include financial contributions to a special clean energy fund (Province of BC 2007b).

BC Hydro Criteria

BC Hydro criteria for Electricity Purchase Agreements (EPAs) include commercial issues taken into account by BC Hydro, such as: development and operating organization and experience, financial capacity and credit-worthiness, project development schedule, site acquisition/control, site services, and fuel supply (IPPBC 2006), in addition to approval permits, community consultation, and First Nation consultation.

Permits refer to the various agency approvals described in Appendix 1. The proponent does not need agency approval to receive an EPA, but must have applied for all necessary permits and approvals, and advanced the applications to a stage where the project can be developed within the proposed schedule and EPA terms.

Regarding community consultation, BC Hydro requires that the proponent:

- has issued a public notification in the local community regarding its intentions to develop the project;
- has a viable plan to provide adequate information about the project to the community; and,
- provides a reasonable opportunity for members of the community to respond to the information.

For First Nation consultation, the proponent must have:

- identified the First Nations to be consulted on the project,
- communicated with those First Nations and provided to them sufficient information concerning the project to enable those First Nations to take an informed view of the nature and extent of consultation required; and,
- afforded, or have a viable plan to afford, those First Nations a reasonable opportunity to pursue such consultations.

⁵ These projects are noted as BC Hydro-approved because final agency approvals are generally obtained at a later date, and it is possible that not all projects will be ultimately approved. Additionally, some projects given EPAs may not be ultimately constructed for various logistical reasons.

EcoLogo Certification – BC Hydro’s Green Criteria

The current BC Hydro standard for green, renewable power projects is based on EcoLogo certification. This certification is sponsored by The Environmental Choice Program, which is a Canadian program offering voluntary standards that can be adopted by projects, businesses and jurisdictions in North America.⁶ BC Hydro made EcoLogo their standard in 2004, previously using their own, similar (though more detailed) Green Criteria. The EcoLogo criteria are optional and are not part of the criteria by which BC Hydro awards Electricity Purchase Agreements.

A brief description of how EcoLogo certification is applied is given here, as run-of-river projects will typically be applying for this designation, and will indicate their intention to do so when they submit proposals to BC Hydro. A more detailed summary and analysis is found in Appendix 2. The EcoLogo criteria are important for BC Hydro and for the power producers that receive extra payment for green power, but they have little bearing on the agency approval process for power projects. Because the EcoLogo criteria are optional, applied after the fact and are largely based on the paper trail of agency approvals, they are not an accurate predictor of the degree of environmental protections undertaken for a project, or the project’s ultimate impact.

The EcoLogo criteria provide valuable guidelines, but not a great deal of detail in recognition that each project is different. The EcoLogo criteria are generic enough to be applied across various jurisdictions. Hence, expert (e.g., agency staff and skilled consultants’) involvement is required to ensure the power projects meet the general descriptions in the criteria. An example of the types of general descriptions provided in the criteria includes: “Electricity must be generated in a manner such that no adverse impacts are created for any species designated as endangered or threatened”. EcoLogo auditors will visit a power plant on its first day of commercial operation to begin the certification process. With the former BC Hydro Green Criteria, certification was done following three years of commercial operation.

7. The parallel BC Hydro and agency approval processes and associated issues

BC Hydro requires that a project meet EcoLogo criteria in order to receive a premium for green power. Even though this EcoLogo designation is optional, receiving a premium rate for green power is important to IPPs, and they will do what they perceive is necessary to obtain and maintain it. In determining whether these criteria are met, auditors rely on information submitted by the IPPs to BC Hydro and the agencies, as well as subsequent agency approvals. However, agency staff are generally unaware of EcoLogo criteria and do not rely on it when giving advice, requiring studies, or issuing approvals. There is a lack of a cooperative process between BC Hydro and the agencies.

⁶For EcoLogo criteria see:

<http://www.environmentalchoice.com/English/ECP%20Home/Products%20&%20Criteria/Electricity%20Products/Electricity%20-%20Renewable%20Low-impact>

Typically, the permitting agencies will initiate a dialogue with the IPPs to request appropriate information and studies, the outcome of which is provided by the IPP to EcoLogo auditors upon project completion. The auditors do not conduct any independent studies or field checks to understand project effects, but rely on the paper trail that a project generates (i.e., correspondence with agency staff, permits and authorizations and studies paid for by the proponent). Until a project is audited after completion, the project is assumed to meet the BC Hydro (EcoLogo) criteria based on the information the IPP provides BC Hydro. Based on this information, BC Hydro issues a letter to proponents along with their Electricity Purchase Agreement, which indicates whether their project (as described) is likely to obtain EcoLogo certification.

The EcoLogo criteria require that all laws and applicable performance standards are met and licences granted. (Details on the various legislation and approvals are found in Appendix 1.) This requirement is both obvious and important. It acknowledges that agency staff are the technical experts in charge of stewarding various aspects of the province's resources, including providing input to mitigate impacts to various species or ecosystems, and granting approvals for use of water and Crown land. However, there appears to be an underlying and often questionable assumption that if agencies were contacted, and approvals and licences were obtained, then all the necessary information was obtained, appropriate actions were undertaken to mitigate impacts, and the level of environmental impact is acceptable. This may not be true. Environmental issues may not be adequately addressed due to inherent weaknesses in BC legislation and the sometimes limited capacity of agency staff—even when proper approvals and EcoLogo certification is obtained. Agency staff are empowered to deal with only some of the concerns in the EcoLogo criteria. Agency approvals to date have been very complex and inconsistent. Levels of agency input and requirements have been changing over time and continue to change. Where agency staff have more capacity and expertise, the quality and number of studies and mitigative measures for IPP projects tends to increase.

Because BC Hydro can withdraw the premium paid for green power, it has the clout to ensure that agency concerns are addressed. However, BC Hydro is currently not engaging with or supporting agency staff. Essentially, BC Hydro delegates project planning responsibilities associated with environmental concerns to Ministry of Environment and Fisheries and Oceans staff, without the provision of adequate quality control or resources.

The regulatory environment is important, because if an EcoLogo criterion is not directly related to strong supporting legislation (e.g., the *Fisheries Act*), it is less likely to be addressed by agency staff. This is because agency staff direct their resources to areas where they have legislative clout. In cases where agency staff do provide input or make requests for information not clearly backed by legal requirements, this input may not be considered by the IPP. Given time and financial pressure, IPPs will address environmental issues that are clearly necessary but will ignore those that are not, even though EcoLogo certification may imply otherwise. This issue pertains particularly to terrestrial impacts, as issues surrounding terrestrial species and impacts are poorly dealt with by legislation. Again, BC Hydro has the power to require that EcoLogo criteria are met—and withhold premiums for green energy if not—but does not involve itself in the approvals process.

Some issues related to the permitting process are slowly becoming resolved as agencies organize themselves around the workload. Current changes in the Ministry of Environment may translate into a more comprehensive review process for run-of-river IPP projects. However, barring changes to laws, issues associated with terrestrial and cumulative impacts are unlikely to be resolved without increased participation from BC Hydro.

The lack of coordination between BC Hydro and agencies also means a complicated and somewhat risky approval process for proponents. Once a project receives an Electricity Purchase Agreement (EPA) from BC Hydro, the proponents need to secure all remaining agency approvals within a two-year period. If the parallel approval processes were merged, it would improve conditions for both proponents and the environment.

8. First Nation approval

Altering watercourses and creating industrial sites in natural areas may adversely affect aboriginal interests. Almost no First Nations have signed treaties, and when treaties are negotiated, they are expected to enshrine First Nation rights to certain resources and cultural sites. Meanwhile, government agencies have a duty to meaningfully consult with First Nations to avoid or minimize infringement of aboriginal rights and/or title. Legally, the sole responsibility for consulting and accommodating First Nation interests lies with the Crown. The government agencies in turn require individual proponents to work with First Nations. Each developer must work with the First Nations on whose territory they propose to build, and government staff may become involved to ensure that consultation and accommodation is adequate. According to BC Hydro (2004), the Province generally requires the proponent to address aboriginal interests before it gets involved. In most cases (depending on the 'soundness' of the aboriginal claim), the duty of the proponent will be to substantially address the concerns of the appropriate First Nations. When consultation is required, the Province recommends a four-step process (BC Hydro 2004):

1. initiate consultation (e.g., meetings, correspondence, site visits, studies, and determination of consultation protocols);
2. consider the impact of the decision on aboriginal interests;
3. consider whether any likely infringement could be justified in the event that those interests were subsequently proven to be existing aboriginal rights and/or title; and
4. look for opportunities to accommodate aboriginal interests and/or negotiate resolution bearing in mind the potential for setting precedents that may impact other ministries or agencies.

The current provincial Liberal government has a policy for interacting with First Nations called 'The New Relationship'. The Liberals and aboriginal leaders have agreed to a new government-to-government relationship based on respect, recognition and accommodation of aboriginal title and rights. It is not clear whether this changes the recommended consultation process described above. It is likely that the consultation process will remain unchanged while government leaders recognize the urgency and need for resolution of aboriginal claims.

According to the Independent Power Producers Association of British Columbia (IPPBC 2006), the areas of special focus by First Nations are: 1) archaeological identification and protection, 2) environmental assessment (wildlife and fisheries), and 3) conservation.

9. Opportunities for stakeholder input to the approval process

BC Hydro requires community consultation for all projects. Additionally, the optional EcoLogo criteria used by BC Hydro for 'green' projects state that consultation must occur and that issues must be reasonably addressed. The level of consultation is up to the IPP. Generally, when a project is higher-profile (nearer populated areas) there will be more information provided to the public, more meetings held, and more accommodation made on issues of concern to stakeholders and communities. In general, little information exists on how stakeholder and community concerns are to be addressed. At one time, the former provincial agency, Land and Water BC, helped to coordinate public meetings and handled referrals to stakeholders. Since Land and Water BC disbanded, it appears that government has had no role in ensuring stakeholder and community concerns are addressed. We asked a government official in the Lower Mainland Region how stakeholders could provide meaningful input to IPP projects, and received no reply.

The stakeholder process is most transparent and effective when a project is large enough to be handled through the BC Environmental Assessment Office. For these projects greater than 50 MW, public input is solicited through a formal process. For projects less than 50 MW, which form the majority, meaningful stakeholder and community input may require persistence.

First Nations are considered separately from stakeholders and other community members, as mentioned above in Section 8. While there is more government guidance related to involving First Nations compared to stakeholders and communities, the appropriate level of consultation and accommodation is also left to the discretion of the IPP. Because First Nations have significant political clout based on unsettled land claims, they are typically consulted and accommodated to a greater degree.

Resources for providing feedback to power projects are contained in Appendices 3 and 4. Appendix 3 is a checklist that stakeholders can use to understand what a sustainable project must take into account during project planning. Appendix 4 focuses on the environmental issues where public input can be most effective.

10. Summary of key sustainability issues for run-of-river hydropower projects in British Columbia

There are a number of key concerns related to the long-term sustainability of run-of-river IPP projects in British Columbia. Firstly, the lack of coordination between BC Hydro and other government agencies means that the criteria that are meant to ensure green power may not be particularly meaningful. Currently, agency staff are generally unaware of the EcoLogo criteria used by BC Hydro when they are asked by IPPs to provide input and approvals.

Secondly, neither the provincial agencies nor BC Hydro are currently empowered to deal with problems related to cumulative effects. The federal government—usually Fisheries and Oceans Canada—requires proponents to address cumulative effects under the *Canadian Environmental Assessment Act*, but so far, the process is not very meaningful. It is difficult to address cumulative effects during planning and approvals of individual projects, and cumulative effects appear to be the largest problem related to run-of-river IPP projects. Strategic regional planning is the only way to determine acceptable numbers and appropriate locations for run-of-river IPP projects. Independent Power Producer project supporters will usually cite that it is difficult to bring a project to completion, and therefore not all streams with water licences will see a power project completed. While true, this is not an acceptable way of determining which areas will have IPP projects. Instead, areas that are unsuitable for this type of development for a variety of reasons (e.g., wildlife, wilderness values, recreation, tourism) need to be set aside from development. Run-of-river power projects can certainly be green, but this status becomes questionable when entire landscapes are affected by multiple power lines, roads and water diversions.

The amount of public attention a project receives has great bearing on how well environmental concerns are addressed. The scrutiny and concern of communities, stakeholders and First Nations has a large influence on the numbers of studies and amount of mitigation undertaken. Therefore, public involvement is critical, yet we are not aware of any consistent process that solicits this input. While IPPs are required by the EcoLogo criteria and BC Hydro to ensure that community and stakeholder consultation occurs and issues are reasonably addressed, we believe the lack of any consistent referral and consultation process is a shortcoming that the provincial government needs to address.

British Columbia does not have effective laws regarding wildlife and plant conservation. Therefore, agency staff have little clout in asking for studies and mitigation, with the following exceptions: when the terrestrial species is already known to be present and is listed as endangered or threatened, when the species is regionally significant, or when there are provisions under the *Wildlife Act* (Wildlife Habitat Area or Ungulate Winter Range) for certain species. As a result, concerns regarding effects on terrestrial species are often poorly addressed in run-of-river IPP projects. We understand that Ministry of Environment requests for information, studies and mitigation are not always accommodated by IPPs, even with respect to species at risk. However, if BC Hydro was involved in the process they could persuade proponents to provide relevant terrestrial species information and mitigation according to EcoLogo criteria, despite the lack of legislation. BC Hydro decides whether or not IPPs receive premiums for green power, a fact that gives them significant clout. Harmonizing the BC Hydro and agency requirements would be extremely helpful in addressing environmental concerns.

It is quite possible to have a truly green power project using the broad EcoLogo criteria. However, the subjective nature of parts of the criteria (e.g., flows that must be ‘adequate’ and not ‘detrimental,’) requires expert involvement in the planning details. Projects will have varying levels of expert input for a variety of reasons. The current agency processes and legislation result in inconsistent levels of oversight and effort between projects and between criteria. Terrestrial concerns are dealt with on an *ad hoc* basis and in large part due to the level of public concern. Geographically remote projects are less likely to have as many environmental concerns

addressed, particularly terrestrial concerns. The same is true for projects in stream reaches that do not support fish populations. The type of fish present (i.e., anadromous or resident) also determines the level of effort imparted by Fisheries and Oceans Canada to enforce mitigative or protective measures in association with *Fisheries Act* authorizations. Internal agency processes, particularly within the Ministry of Environment, have much room for improvement. Some Ministry regions are aware of this issue and are working to improve their internal processes.

Effective monitoring is key to ensure the long-term sustainability of run-of-river power projects. There is a great deal of uncertainty regarding the magnitude of impacts of individual run-of-river power projects. Monitoring is the only way to document the kinds and levels of impacts occurring due to changes to streams and landscapes. Monitoring is particularly important in understanding instream flow needs for fish because of the current scientific uncertainty inherent in determining minimum flow requirements. However, by the time these monitoring data are available, the current wave of run-of-river IPP project construction may be largely complete. Strategic planning is one approach that could ameliorate this risk, by ensuring that projects do not proceed on sensitive streams, and by managing risks related to cumulative impacts.

All energy sources have impacts to the environment. Careful consideration must be given to the mix of renewable energy projects adopted in BC to maximize benefits and minimize environmental and social costs. Run-of-river power projects need to be considered at a strategic level along with other renewable power options (such as wind, solar and wave energy) to achieve the lowest impact, truly green power that can be developed in British Columbia. As part of these considerations, the impact of many small capacity run-of-river power projects needs to be compared to the impact of fewer, larger facilities such as the traditional large hydropower currently supplying most of BC's electricity.

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Appendix 1: Relevant agency legislation and approvals

With the exception of *Species at Risk Act* and *Wildlife Act* details, the information below is taken largely from the Handbook for Developing Micro Hydro in British Columbia (BC Hydro 2004) and from the instream flow threshold guidance document (Hatfield *et al.* 2003).

Provincial Acts

The British Columbia Water Act

The province owns all water in the streams, rivers and lakes of British Columbia and manages it for the public good. Individuals or companies who wish to divert, use or store this “surface” water are required by law to obtain a licence under the *British Columbia Water Act*. The *Water Act* regulates diversion and storage of water, construction in and around streams, alterations of a stream or channel, and the installation of fish screens or guards. All applications are treated on a first come, first served basis until such point that all available water (not considered necessary for fish) is allotted. However, even though *Water Act* approval is obtained, a proponent may not proceed to take water until *Fisheries Act* and other legislation is complied with, as applicable.

The water licence specifies the terms and conditions under which the right to use water is granted, including the maximum quantity and rate of water use. There are restrictions on many aspects of the facilities that manage water, such as structures and operating procedures, and environmental protection measures for fish are also specified. Increasingly, because of the *Fish Protection Act* (see below), there are also requirements for operational monitoring of impacts to fish as well as monitoring of flows. The newest Water Licences for IPP projects include very detailed fish-related monitoring requirements. These licence conditions reflect the uncertain science of determining instream flows for fish.

Once a water licence is granted, the provincial Crown will charge an annual fee for the water used. A water licence is legally considered part of (or “appurtenant to”) the land or project of the licensee. If the land or project is sold, the water licence automatically passes to the new owner. Currently, water licences are issued by the Ministry of Environment. Power projects are given water licences for terms of 40 years, after which they can be renewed. This will allow adjustment for changing environmental conditions as well as for changing societal expectations.

The British Columbia Land Act

In many cases the developer of a hydro project will require the use of land owned by the Province, and must apply for the land. The Province may sell, lease, grant a right of way over or grant a licence to occupy Crown land. In the sale or use of Crown land, the minister may impose various conditions including that the applicant must occupy and/or do work on the land within a specified period of time. Crown land located below the natural boundary of a body of water generally cannot be sold or leased but rights of occupation can be granted.

Applicants under the *Land Act* may be required to provide further information, which could include feasibility studies, environmental assessments, timber cruises or land valuation

appraisals. Crown land tenures are currently issued by the Ministry of Agriculture and Lands, Integrated Lands Management Bureau.

Fish Protection Act

The objective of the *Fish Protection Act* is to protect the health of fish bearing streams, including water flows in these streams. The *Fish Protection Act* states that, when reviewing an application for a water licence, the Comptroller of Water Rights or the Regional Water Manager may consider impacts on fish and fish habitat. The Comptroller may set conditions to protect fish or fish habitat, including a requirement for the licensee to monitor stream flow. Where regulatory conflict arises, the *Fish Protection Act* and regulations supersede the *Water Act*.

A key feature of the Act is Section 4, which prohibits new dams on 17 protected rivers. The definition of dam would preclude the creation of a headpond, which is a key feature for most run-of-river projects. However there is still an opportunity to withdraw water from intakes placed in the channel.

Section 6 of the *Fish Protection Act* was brought into force on March 10, 2000 and allows the province to designate certain streams as “sensitive streams” in order to protect fish populations considered to be at risk. Sensitive streams are those that require special protection because of inadequate water flows, or because fish habitat is damaged or endangered. Fifteen streams have been designated as sensitive streams to date. A water licence on a sensitive stream may be issued only if there is no significant adverse impact on fish or if the impact is fully compensated for by an enhancement elsewhere. Sensitive streams are listed in the Section 6 Regulation under the *Fish Protection Act*. Unless otherwise stated, the sensitive stream includes tributaries as well as the main stream.

The Act gives authority to designate water management areas for the evaluation of water availability and the planning of water use when there is conflict among water users or between users and instream flow requirements, risks to water quality (including those caused by water withdrawal), or concerns relating to fish or fish habitat. The Act suggests that water management plans may contemplate reducing water rights to provide more water for fish and fish habitat, and allows for the ordering of a temporary reduction in licenced water use in cases of drought.

The Act also allows for streamflow protection licences. Such licences may be issued only to organizations considered to have a community-based interest in the stream, and the licensee must undertake works or activities in relation to fish and fish habitat in the stream.

BC Environmental Assessment Act

The *BC Environmental Assessment Act* (BCEAA) is directly relevant only for those projects with a capacity of 50 megawatts (MW) or higher, and therefore is not applicable to most run-of-river hydro projects. However the minister may designate a project as reviewable if there is a public interest in doing so or if a significant adverse effect is expected. The Environmental Assessment Office (EAO) is a neutral provincial agency that coordinates assessment of the impacts of major development proposals. They administer the Act to prevent or mitigate adverse effects and provide a neutral process that invites participation by the public, proponents, First Nations and the different levels of government. Environmental, economic, social, heritage and health effects

are considered. Therefore, projects of 50 MW or higher are subject to more scrutiny than those with lesser capacities, and they are also reviewed in a more transparent fashion on a specified timetable. The BCEAA has three phases: an application phase in which detailed, but not exhaustive, information on the project is provided; a project report review phase where report specifications are designed by multi-stakeholder technical committees, and technical studies are undertaken (these studies can be intensive, even for small hydroelectric projects); and a public hearing phase. Following the completion of the three phases, a decision is made by the Cabinet of the British Columbia government.

As of May 2007, the BCEAO website⁷ lists four approved run-of-river projects, and five in the EAO process. The Cascades Heritage Hydro Project (Kettle River) is an example of a recently approved project that falls under the BCEAA even though its capacity is 25 MW, because it was initiated before changes to the Act. An example of a project under review is one 100 km north of Powell River (the East Toba River Montrose Creek Hydroelectric Project) that consists of a 119 MW and a 50 MW facility. An example of a project designed to fall just under the limit required for assessment under the BCEAA is the Kwoiek Creek project near Lytton, which was successful in securing an Energy Purchase Agreement in BC Hydro's 2006 call for tenders. This is a 49.9 MW project done in partnership with the Kanaka Bar Indian Band, and scheduled to begin construction in December 2007 after obtaining all permits and approvals.

The BC Wildlife Act

The *Wildlife Act* deals in large part with hunting and angling. It also protects nesting birds and the nests of certain bird species and so can be a consideration in the construction phase of a project. Otherwise, the *Wildlife Act* is not generally a consideration in IPP project development, as it does not protect wildlife habitat except in special cases. The act does protect virtually all vertebrate animals from direct harm, except as allowed by regulation (e.g., hunting or trapping). Legal designation under the Act may confer special protection for selected red- and blue-listed species, their residences, or their critical habitat. Designating a species as Endangered or Threatened increases the penalties for harming a species, and also enables the protection of habitat in a Critical Wildlife Management Area. At present, only four species are legally designated: the Vancouver Island Marmot, American White Pelican, and Burrowing Owl as Endangered, and the Sea Otter as Threatened.

Other Acts

According to BC Hydro (2004), there are many other acts that may apply to different phases or aspects of a small hydro project, including its construction. For example, *Forest Act* approvals are given to cut trees and use roads. Other acts include the *Canadian Environmental Protection Act* among others. More details are available in BC Hydro (2004)—though the main acts that apply to project approvals have been described above. The Independent Power Producers Association of BC (IPPBC 2006) gives an alternative view of the involvement of different government agencies and the approvals required, and mentions further considerations to those described here.

⁷ see: <http://www.eao.gov.bc.ca/> for information about projects screened by the BCEAO

Federal Acts

Federal Fisheries Act

The federal *Fisheries Act* deals with fish passage and fish habitat protection including water quality, riparian areas, and vegetation. The *Fisheries Act* defines fish habitat to be “spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes”. Based on this definition, a small steep tributary to a fish-bearing stream could be considered fish habitat, even though there may never actually be fish present in the stream.

Several sections of the Act define offences that may occur during withdrawal and release of instream flows. Section 22 requires sufficient flow for spawning grounds and free passage of fish during construction. Section 35 prohibits the harmful alteration, disruption or destruction of fish habitat (HADD), and Section 36 prohibits the deposit of any deleterious substances (substances that would degrade or alter the water quality) into water frequented by fish. Under the federal *Fisheries Act*, the Minister (usually through Fisheries and Oceans Canada) will request plans, studies or other information from a person proposing work that may disrupt or alter fish habitat or water frequented by fish or water flowing into an area frequented by fish. The Minister may then restrict the proposed work or require modifications or additions to the work. A permit may be issued to authorize a HADD, subject to provisions of mitigation or compensation. Most of the environmental studies required will need to be conducted by a qualified professional such as a registered professional biologist (R.P.Bio.). If the proposed water source supports fish life, the intake must be properly screened to prevent the passage of small fish.

Under the federal *Fisheries Act*, persons who damage fish habitat or pollute water frequented by fish have a duty to compensate or mitigate the adverse effects and to report the incident to a fisheries inspector. Also under the Act, anyone who damages fish habitat or pollutes water frequented by fish may be charged with an offence punishable by a fine and/or imprisonment.

Fisheries and Oceans Canada (DFO) have issued policy documents to support their mandate under the *Fisheries Act* (e.g., Fisheries and Oceans Canada 1986). For water licence applications, the conservation of the current productive capacity of habitats is the most relevant DFO policy. This is implemented using the No Net Loss Guiding Principle, where mitigation and compensation are used where necessary to prevent a net habitat loss. Guidelines are applied that identify a hierarchy of options in order of preference. The preferred options are relocating or redesigning a project to eliminate negative impacts on fish habitat. Otherwise, compensation is done, following a hierarchy of preferred compensation options. Compensation is the least preferred outcome and must be included in a *Fisheries Act* authorization and formalized through legal agreement. Detailed multi-year studies may be required to define the compensatory needs. (Note: Compensation includes enhancing existing habitat as well as building habitat, though habitat construction usually occurs only for anadromous fish (salmon), in part because these species are often viewed as being more valuable. For rainbow trout and other resident fish, building compensation habitat is generally not feasible based on their habitat requirements, though there may be other actions that are possible, such as replacing culverts, stream fertilization, or creating instream habitat features like large woody debris clusters). However, it is

not clear how well this policy works in truly sustaining fish habitat, because constructed habitat may not always adequately compensate for what was lost.

A policy framework is also defined around managing “HADDs”. A HADD is ultimately defined by DFO habitat managers, and professional judgment plays a large role. DFO issues authorizations for HADDs only when other options are unworkable, though “unworkable” has no strict definition. The proponent is required to give specific reasons why mitigation or design changes cannot reasonably be made. *Fisheries Act* authorizations are not strictly required to allow a project to proceed, but without an authorization any resulting damage to fish habitat will be liable to prosecution.

Canadian Environmental Assessment Act

The CEAA is primarily involved when Fisheries and Oceans Canada issues an authorization to a project. Also, if the *BC Environmental Assessment Act* is triggered (see below), reviews are coordinated with CEAA reviews. A CEAA review is done before DFO or another federal department issues an authorization. This is typically a ‘screening review’ that documents predicted environmental effects, specifies redesign options or mitigation, and identifies additional studies required. Projects with greater potential environmental impacts may require a comprehensive study that can lead to detailed assessment. If environmental effects of a project are uncertain or potentially significant, or if public concern warrants, a review by an independent EA review panel or mediator may be required.

An important focus of the CEAA is cumulative effects. Therefore the DFO will generally require a proponent to consider cumulative effects. (DFO is the only permitting agency to consider cumulative effects in IPP project approvals. However, in practice cumulative effects are not a large DFO or proponent focus.)

Species at Risk Act

The *Species at Risk Act* applies to species that are listed in Schedule 1 of the Act. Protections are extended to these species and recovery planning is done to increase their numbers and manage their habitats. However as this is a federal law, the kind of protection depends on the location of the species in question. For terrestrial species, protections are given if they reside on federal land (a small percentage of the province), or if critical habitat is designated on other lands. In practice, critical habitat has not yet been designated in BC, as its designation is politically contentious. However, for aquatic species the Act does not require critical habitat designation, as aquatic habitats are under federal jurisdiction.

Navigable Waters Protection Act

The federal Ministry of Transportation (Canadian Coast Guard) is empowered by the *Navigable Waters Protection Act* to ensure that navigable waters are not blocked. This is pertinent in areas that could possibly be navigated by boat. In the case of rivers with applications for run-of-river hydro, the types of boats involved are typically kayaks. According to the Independent Power Producers Association of BC (IPPBC 2006), compliance with this act means that flow releases must continue for in-stream use, portage routes must be created around in-stream structures, and flow ‘ramping’ (rates of change) specifications are required.

Appendix 2: Summary and Analysis of BC Hydro Criteria for Green Projects

Summary and Analysis of the EcoLogo Criteria

EcoLogo certification is a national standard under the Environmental Choice Program, and is supported by Environment Canada. EcoLogo certification is used to certify over 3,000 products and services in Canada and elsewhere, including the certification of renewable and low-impact electricity. The EcoLogo symbol tells the consumers buying from utilities and electricity manufacturers that the electricity production meets a well-known standard, and is audited by a credible third party.

The Environmental Choice Program defines “Renewable Low-Impact Electricity” as electricity from renewable energy sources that are likely to have relatively low impacts on the environment and produce potential benefits including among others, low net greenhouse gas emissions, limited or no depletion of non-renewable resources, reduced emissions of other pollutants and reduced impacts on aquatic, riparian and terrestrial ecosystems and species (BC Ministry of Energy, Mines and Petroleum Resources 2006).

Any IPP signing a new Electricity Purchase Agreement (starting in 2004) with BC Hydro will be required to meet these criteria in order to be considered clean. Therefore the EcoLogo criteria are the most relevant to projects being developed today. For existing IPPs, the BC Hydro green criteria must be met (see below), and most are also transitioning to the EcoLogo standard with the support of BC Hydro (Joanne McKenna, BC Hydro, personal communication). Therefore existing projects are audited to both criteria, or to the Green Criteria alone where EcoLogo certification is not obtained.

EcoLogo (Environmental Choice Program) criteria for low-impact, water-powered electricity contain less detail than the BC Hydro Green Criteria that came before. Unlike the Green Criteria, they do not contain any specific guidance about how these criteria can be demonstrated as being met, but mention that it is up to the applicant to provide sufficient proof – including all documentation produced in the context of the environmental assessment (i.e., the agency approval process). The Environmental Choice program has a third party auditor called Terrachoice, who will audit on an unannounced basis, and who are present on the first day of commercial operation (Joanne McKenna, BC Hydro, personal communication). This differs from the Green Criteria process, where BC Hydro would audit three years after the project has been in operation, or at other times with notice. This is in addition to providing paper documentation to BC Hydro immediately upon operation to demonstrate that all required approvals were obtained. Both the EcoLogo and Green Criteria are not met until the project is operational. Prior to that time, projects that have EPA with BC Hydro (contracts to buy power for proposed projects that successfully meet BC Hydro’s various requirements) receive a letter indicating their projects appear to meet the Green/EcoLogo criteria based on how they are described by the proponent (Joanne McKenna, BC Hydro, personal communication).

EcoLogo certification criteria require that all applicable government, industrial safety and performance standards are met, and that all applicable government acts, by-laws and regulations

are met, including the *Fisheries Act* and *Canadian Environmental Protection Act*. They detail requirements for renewable low-impact electricity in general. These requirements include a requirement that community and stakeholder consultation occurs and issues are reasonably addressed, including mitigation of impacts where reasonable. Evidence must be provided that conflicting land use, biodiversity losses and scenic, recreational and cultural values have been addressed, and that the project will not result in irreparable/immitigable degradation or loss of the site's heritage, cultural, recreational and/or tourist values. Electricity must be generated in a manner such that no adverse impacts are created for any species designated as endangered or threatened.

The above criteria apply to all EcoLogo-certified renewable low-impact electricity. There are then criteria that apply specifically to water-powered electricity. Again there is a requirement for operating in compliance with all licences and laws. The criteria very specifically mention that the *Fisheries Act* and other requirements/licences regarding water flows must be adhered to without regard to waivers or variances that may be granted or authorized. We believe this refers to changes allowed by regulatory bodies after EcoLogo certification is obtained – any waivers or variances of initial conditions are not acceptable under EcoLogo criteria. Additionally, the EcoLogo standard is higher than simple regulatory approval with respect to fisheries habitat. The facility would not be allowed to operate under any federal *Fisheries Act* authorization that allows the harmful alteration, disruption or destruction (HADD) of fish habitat, unless:

- The HADD is not affecting the limiting factor controlling productive capacity; or,
- loss of the affected habitat is compensated by the creation of similar habitat, supporting the same stock, at or near the development site within the same ecological unit such that the created habitat replaces lost productive capacity, within an approved safety factor.

The EcoLogo criteria direct plant operations to be coordinated with other facilities on the same waterway, within practical limits. They specifically note that this provision is to mitigate impacts and protect indigenous species and the habitat upon which they depend.

A key criterion notes that “as a maximum (the facility) causes as much water to flow out of the head pond as is received in any 48-hour period”. This means that the facility is operated as a ‘run-of-river’ hydropower facility, since it does not allow for storage capacity. This is in recognition of the higher environmental impact of facilities with storage, due to flooding as well as modifying the natural flow regime downstream. While this criterion does not exclude facilities with reservoirs, the storage capacity would need to be unused in order to be certified. However, the criteria go on to say: “in cases where this particular criterion cannot be met, the Environmental Choice Program will nonetheless consider certification if the applicant submits evidence that indicates those hydrological and ecological components key to sustainability of the surrounding watershed are maintained. As a minimum, this evidence must include environmental impact assessments and documentation from a formal public consultation process. In cases where neither of the above conditions is met, the applicant can opt to apply to a multi-stakeholder and public Electricity Review Process to demonstrate equal or lower adverse environmental impacts”. This clause allows hydro facilities that are not run-of-river to attempt to demonstrate their low impact.

The criteria go on to discuss water flows and quality. Reduced flows in the bypassed reach (and below dams and/or dykes) must not be detrimental to indigenous aquatic and riparian species, and flows downstream of the tailrace are adequate to support downstream indigenous aquatic and riparian species at pre-project ranges. Water quality must be comparable to pre-project quality in unaltered bodies of water in the local watershed. Fish passage and migration must be provided. In addition, other measures must be taken to minimize fish mortality through impingement and entrainment.

The EcoLogo criteria also include various clauses relating to how the renewable electricity is marketed and presented to the consumer and regulatory agencies.

In order to verify that a facility meets all the criteria, the Environmental Choice Program (who provide EcoLogo certification) specifically state they require access to relevant quality control and production records and the right of access to production facilities on an unannounced basis. They also note that it is up to the applicant to provide sufficient information to allow verification of the claim that the facility is in conformity with the criteria documents. In particular, all documentation produced in the context of the environmental assessment of a facility for which certification is sought shall be made available to the ECP.

Lastly, with respect to verification, compliance with certain aspects of the criteria must be attested to by a signed statement by the CEO. These sections are those that relate to compliance with governmental acts, by-laws and regulations, without regard to waivers or variances that may be granted. Compliance must also be confirmed by additional evidence including agency correspondence related to the licence and/or operating permit.

The difficulty of measuring impacts

As a green power expert Raphals (2002) notes, determining the actual environmental impacts of a hydropower facility is a daunting challenge. Many of the Environmental Choice Program EcoLogo criteria (e.g., flows that support species at pre-project ranges, or water quality that is comparable to unaltered water bodies) cannot be evaluated by examining production records or even by site visits. Raphals points out that the great strength of the Environmental Choice Program (ECP) criteria is that they are specific regarding acceptable levels of impacts. He also points out the difficulty involved in determining whether or not an applicant actually meets these criteria.

It is this difficulty that we examine in detail here. The inclusion of the requirement to provide the environmental assessment information (i.e., the detailed studies used to evaluate the facility plans by agency staff) may in some cases provide enough information for the ECP to make an informed judgement. As mentioned above, the burden of proof rests with the applicant. Much will depend on the information reasonably available to the auditors.

The auditors will rely in large part on information provided by the IPP to agency staff regarding potential issues and impacts and measures to address them. The amount of involvement of (and cooperation with) agency experts in the planning stage (i.e., requests for information, studies and mitigation) will determine the level of detail of the information that auditors have to work with.

We examined the EcoLogo criteria relative to the potential impacts of run-of-river power projects, and have found some areas that may not be well addressed by the criteria, or by the current application of the criteria. We discuss these issues below.

Cumulative impacts

The greatest issue we discovered was the lack of strategic regional planning regarding acceptable numbers and locations for run-of-river IPP projects. Aside from location issues related to project feasibility, BC Hydro has no legal ability to differentiate between locations for IPP projects as part of their tendering process. The merits of each individual IPP project are evaluated by the Environmental Choice Program (EcoLogo) without consideration of their broader context. Inherent in this is a lack of management of cumulative impacts (i.e., impacts from multiple projects related to increased human activity, roads and transmission lines, as well as potential cumulative impacts to fish habitat). Currently, the only provision (in both the EcoLogo and former Green Criteria) that addresses cumulative effects is one that asks that facility operations be coordinated with other facilities on the same stream, within practical limits. We believe problems related to this lack of a strategic approach have the potential to dwarf all other issues that we describe below. Appropriate development is likely only when a strategic, coordinated approach is taken. A strategic approach is particularly important given the sheer number of run-of-river IPP projects underway and proposed.

Aquatic and riparian species

As described in the EcoLogo criteria, reduced flows in the bypassed reach (and below dams and/or dykes) must not be detrimental to indigenous aquatic and riparian species, and flows downstream of the tailrace must be adequate to support downstream indigenous aquatic and riparian species at pre-project ranges. The EcoLogo standard also describes types of ‘harmful alteration, disruption or destruction’ (HADDs) are acceptable under any *Fisheries Act* authorization, and refers to adhering to requirements/licences regarding water flows—which in BC means following Water License (*Water Act*) terms, and potentially *Fish Protection Act* directives (Appendix 1).

There is a high degree of subjectivity in determining whether something is ‘detrimental’ or ‘adequate’ and it is critical that these decisions involve agency experts. Determining what ‘detrimental’ and ‘adequate’ means for any one project is where the issue of agency involvement and capacity can arise. The IPP will generally hire a consultant to help determine and mitigate impacts to the extent required, but these consultants will not necessarily have the local knowledge and expertise of agency staff, or the mandate to initiate significant studies. It is also important to note that while ‘aquatic and riparian species’ are referred to in the criteria, in practice the focus is almost exclusively on fish and fish habitat requirements. This is because of an unequal legislative focus on fish in comparison to terrestrial species (see comparison of aquatic and terrestrial criteria section below). However, aquatic species at risk could receive similar attention to sport fish, particularly if they are named or likely to be named in Schedule 1 of the *Species at Risk Act*.

Fisheries and Oceans Canada (DFO) is the agency in charge of *Fisheries Act* authorizations. Their level of interest and involvement depends on if fish are present and whether fish are resident or anadromous (salmon and steelhead). This is despite the fact that the *Fisheries Act*

applies to all non-fish-bearing tributaries to fish habitat and all fish species. Non-fish bearing tributaries tend to receive little attention from DFO. Streams with resident fish are overseen by the Ministry of Environment together with DFO. Fisheries and Oceans Canada is usually thoroughly involved where anadromous species are potentially affected. The majority (approximately 80%) of run-of-river IPP projects are in fish bearing sections. The fishes are usually year-round resident species such as rainbow trout.

In summary, existing legislation and the policy approach taken by DFO and MOE means that riparian and non-fish aquatic species are typically not well addressed, unless they are recognized species at risk at the provincial or federal levels. The type of fish present (i.e., resident or anadromous) usually determines the level of mitigation and compensation required of a project under a *Fisheries Act* authorization. This approach and the general level of subjectivity inherent in determining 'detrimental' and 'adequate' means that the actual level of impacts can vary widely among projects. There is no pre-set threshold (e.g., % fish population change) beyond which impacts are determined to be detrimental.

The level of monitoring data collected before and after a project is constructed is an important aspect of ensuring there are no detrimental effects of reduced flows, no matter how 'detrimental' is defined. Monitoring programs will typically select certain variables or indicators, and lengthy post-impact monitoring will generally be required to statistically measure changes to these variables/indicators. A high-quality monitoring program is therefore essential to determining whether or not significant changes have occurred. In practice, monitoring requirements have been specified by the agencies and have varied widely. Currently, agencies tend to require extensive pre- and post-project monitoring to understand potential impacts to fish, and in some cases to other species that are identified as potentially affected (Scott Babakaiff, MOE, personal communication).

The monitoring data collected will generally include stream flows, fish population/density estimates, and measures of fish habitat quantity and quality. Measuring the existing conditions before construction is highly important, in order to provide a baseline against which changes can be compared. Because annual conditions vary, it is best to collect data over multiple years. The longer the study, the easier it is to see trends and fluctuations over time; therefore, it is less likely that an anomalous year will be used as a baseline. However, the timeframe over which pre-construction data is collected is likely to be less than ideal, due to time and financial pressures. Generally, one or two years of pre-project hydrologic and biotic data are the maximum that are likely to be collected. These lesser amounts of data collected pre-construction mean longer time periods post-construction to determine statistically significant changes. While some changes may be evident immediately after construction, it may take several years to measure the chosen indicator(s) with statistical certainty.

Water licences for power projects are issued for periods of 40 years and are renewable. Presumably, the licence renewal gives the issuing agency the opportunity to adjust for changing societal and environmental conditions and expectations. So far there are no examples of water licences for power projects that were altered as a result of information gained from monitoring. This is in part because there are currently insufficient data (insufficient time elapsed) to determine impacts for any run-of-river project, at least in quantitative terms. This issue is

compounded by laxer monitoring requirements for older projects, which might otherwise have been able to yield preliminary results by now. Additionally, it is unclear whether water licences for new projects can be drafted in such a way that flows can be significantly modified to reflect new knowledge. IPPs make significant initial investments and require some level of certainty about future returns; hence are unlikely to agree to a conditional water licence that includes terms that have the potential to significantly reduce their water use and profitability. It remains to be seen how significant impacts related to diverted flows will be dealt with if and when they become evident through a monitoring program. Nevertheless, the monitoring data collected by IPPs are very valuable, and at minimum will increase knowledge of instream flow needs to the benefit of future projects—assuming that the IPP industry is not completely built out by the time substantial results are available.

The EcoLogo criteria state that fish passage and migration must be allowed and fish mortality through impingement and entrainment must be minimized. These are important considerations and the EcoLogo direction is clear and unambiguous. These concerns are paramount to agencies and are considered under the *Water and Fisheries Act*. These conditions will generally be addressed by run-of-river IPP projects, though the degree to which a headpond weir will restrict resident fish movements may not be clearly addressed.

Social and economic pressures have caused net loss of fisheries habitat in various instances in the past, despite the provisions of the Federal *Fisheries Act*. For example, the unique fishery in Star Lake, Newfoundland was destroyed for a new hydroelectric dam built in 1998 (Gibson 2002). So while the EcoLogo criteria state that the *Fisheries Act* must be adhered to, community members have valid concerns over whether fish and fish habitat will in fact be protected.

Terrestrial plants and wildlife

The EcoLogo criteria state that the project must be “accompanied by evidence that conflicting land use, biodiversity losses and scenic, recreational and cultural values have been addressed during project planning and development”. In addition, electricity must “be generated in a manner such that no adverse impacts are created for any species designated as endangered or threatened”.

Terrestrial species are very poorly addressed under the criteria as currently written and applied. Addressing “biodiversity losses” is the only language pertaining to terrestrial species, aside from species at risk (see section below). The evidence required to prove that these are addressed is unclear, because as with all EcoLogo criteria, the onus is on the proponent to provide proof, and the auditors will decide if this proof is sufficient. Proof is typically generated in the IPPs’ dialogue with the permitting agencies, as well as by consultants hired by the IPP itself. Therefore, much depends on how the agencies interact with the IPPs and their consultants on terrestrial issues. Currently, terrestrial issues are dealt with on an ad hoc basis. Anecdotal information provided by agency staff (Ross Vennesland, MOE, personal communication September 2006) suggests that in some cases IPPs do not provide the level of detail required to evaluate terrestrial effects (e.g., location and length of access roads and transmission corridors). This problem may be resolved if new guidelines issued by the Lower Mainland Region Ministry of Environment are used (Hatfield *et al.* 2007). Another MOE staff member (Steve Rochetta, MOE, personal communication) suggests the level of public interest is key to achieving

appropriate consideration of terrestrial concerns, in the absence of supporting legislation. Thus, terrestrial concerns are less likely to be addressed in remote areas not generally used by members of the public. In general, terrestrial issues are dealt with to the extent that information is available, and if the IPP is willing. This willingness may hinge on how high profile and substantiated the terrestrial concerns are. Some terrestrial concerns are not well addressed in any project to date (e.g., impacts on wildlife species other than a few deemed important to agency officials, and impacts of invasive plant species).

Ecologists commonly cite invasive species as the second greatest threat to biodiversity after habitat loss. Construction practices can have a massive impact on invasive species colonization and dispersal. Invasive plant species are common along transmission line corridors (as a result of the disturbed and open conditions) and are brought into wilderness areas by new roads. Preventative measures are the only effective way to deal with invasive species.

Species at risk (threatened and endangered)

Endangered and threatened species are the terrestrial species that are best addressed under the criteria. However in practice it is not clear how well addressed they are. Species at Risk are defined in different ways. Our understanding of species at risk includes both the species listed as ‘at risk’ by the COSEWIC, as well as those on the ‘red’ and ‘blue list’ generated by the BC Conservation Data Centre (CDC). Species on the red list are considered threatened or endangered, and species on the blue list are not immediately threatened but are ‘of concern’. COSEWIC also lists species that ‘may be at risk’ but have not yet been formally assessed.

The EcoLogo criteria state “electricity must be generated in a manner such that no adverse impacts are created for any species designated as endangered or threatened”. EcoLogo defines endangered and threatened species as those listed by COSEWIC, or that are listed provincially where designations are more stringent. This is the case for BC, as many species are red-listed provincially by the CDC, but are not yet listed by COSEWIC.

As with other issues, the EcoLogo criteria are brief and do not specify how to ensure there are no adverse impacts on species at risk. Therefore, the responsibility is on agency staff, the IPP and its consultants to determine impacts. In practice, little information appears to be provided to enable an agency assessment of whether or not endangered or threatened species may suffer adverse impacts, or even if they are present in the project area. An endangered or threatened species will likely be addressed if it is high profile and known to be in the area; otherwise it likely will not be considered. However, changes associated with an IPP project in even a small area can have significant negative effects on endangered or threatened species, or blue-listed species of concern. Generally we believe that endangered and threatened species (particularly if they are terrestrial) are poorly dealt with under the criteria as currently applied. A lack of data is a common problem—it is not always known if a particular species uses an area. This information can only be obtained if the IPP is willing to conduct a study to find out.

Species that are ‘of concern’ (provincial blue list) are not a part of the criteria for endangered and threatened species, and can be expected to fall under ‘biodiversity’ in the EcoLogo criteria. By comparison, under the former Green Criteria, power projects also were expected to specifically avoid impacts to these species of regional concern.

The Ministry of Environment (MOE) Lower Mainland Region has issued a new guidance document that deals briefly with species at risk (Hatfield *et al.* 2007). If these guidelines are followed by IPPs, then species at risk could be reasonably well addressed in this region, which contains a significant proportion of IPP projects. We are not aware of conditions in other MOE regions aside from Vancouver Island, where staff work with IPPs to directly address species at risk. Generally, species at risk are dealt with region by region, and this is another instance where the application of the EcoLogo criteria creates potential problems.

Comparison of aquatic and terrestrial criteria

In general, terrestrial criteria and impacts are less well defined than aquatic criteria and impacts. This occurs for two reasons. First, the potential for aquatic (fish-related) impacts is clear due to changes to stream flows, and relatively speaking, impacts to stream flows and habitat are more thoroughly studied and defined than are terrestrial impacts. Second, the legislation protecting fish habitat is much stronger than that protecting terrestrial wildlife (except for where critical habitat is designated under the federal *Species at Risk Act*, which is generally not occurring in BC). This means that agencies are much more involved in protecting fish habitat than in protecting wildlife habitat, or at least that their input regarding fish habitat is more binding. It is important to note that terrestrial impacts may still be high, but given the diversity of locations and terrestrial ecosystems and species involved, and given the lesser focus on these issues, these impacts will likely remain less well understood and managed.

Community and stakeholder consultation

Regarding community and stakeholder consultation, the EcoLogo criteria simply state that consultation must occur and that issues be reasonably addressed, including mitigation of impacts where reasonable. It does not say who determines what is reasonable. Community members and stakeholders may disagree with the IPP. The level of consultation is also up to the discretion of the IPP. In practice, the level of public opposition will determine the level of consultation and projects in remote areas will have lesser consultation, though the local First Nations will likely always be consulted.

Recreational, aesthetic and cultural values

The criteria require evidence that conflicting land use, and scenic, recreational and cultural values have been addressed, and that the project will not result in irreparable/immitigable degradation or loss of the site's heritage, cultural, recreational and/or tourist values.

The criteria cover the issues in a broad sense but do not indicate what levels of impact are acceptable to scenic, recreational and cultural values before they are seen to be 'irreparable/immitigable', and how these issues can be seen to be addressed. Persons concerned with scenic, recreational and cultural values may not agree with the IPP's interpretation of whether things are addressed or what level of mitigation is reasonable.

First Nations are not specifically mentioned in the EcoLogo criteria, and we assume that they are included in the mention of heritage and cultural values, as well as in the mention of community described above. First Nations are important for the IPP to consult and this will generally occur.

Summary and Analysis of the Green Criteria for Low Impact Hydroelectricity

For small hydro and other renewable energy independent power producers (IPPs) developed up until 2004, the BC Hydro green criteria must be met. Projects developed under these criteria will continue to be audited under these criteria, even if EcoLogo certification is also achieved. Therefore, the most important aspects of these criteria will relate to flows in the diversion reach and any other aspects of plant operation. While we analyze all the criteria here, many criteria relate to project design and are not currently relevant since they do not apply to new projects.

In summary the Green Criteria are (BC Hydro 2004):

Renewable

The energy source must be replenishable by natural processes in a reasonable length of time—at longest, within an average human life span. For example, hydroelectric generation relies on water, which is a renewable energy source.

Low-Environmental Impact

The project must avoid unacceptably high environmental impacts such as damage to fish populations, endangered species, or air quality. This criterion is evaluated on a site and technology-specific basis.

Socially Responsible

The energy must not be generated in a way that conflicts with key community and First Nation values. This must be judged on a site-specific basis.

Licensable

The project must meet all relevant regulations and standards. As of 2004, BC Hydro transitioned to EcoLogo's low-impact renewable criteria. Any IPP signing an Electricity Purchase Agreement (EPA) with BC Hydro after this date will be required to meet those criteria in order to be considered green. The Provincial Government also has guidelines that will provide direction on what resources/projects are considered clean (BC Hydro 2004).

We investigated the Green Criteria (BC Hydro 2003) specific to low-impact hydroelectricity. We found it to provide more detail than the EcoLogo criteria, though they are substantially similar in many respects. This is unsurprising since it was developed from earlier versions of EcoLogo criteria. The key issue of the lack of criteria to adequately manage cumulative impacts remains.

We found that the Green Criteria specifically address most of the various ecological and social issues that can be associated with these types of projects on an individual basis. Unlike the EcoLogo criteria, they include ways that the criteria can be demonstrated as being met. The Green Criteria cover fish and fish habitat, aquatic ecosystem integrity, water quality and quantity, threatened and endangered species, species of regional concern, wildlife and wildlife habitat, terrestrial ecosystem impacts, scenic and recreational values, cultural values, and social responsibility. However when we analyzed how the criteria would be applied in practice, we did discover some concerns.

Criteria for fish and fish habitat

Regarding fish and fish habitat, the criteria state that the facility must preserve the ability of anadromous fish to migrate. Usually, facilities will be above gradient barriers to anadromous fish. They also state the facility must preserve resident fish communities, and meet the Federal *Fisheries Act* ‘no net loss’ objective for conserving fish and fish habitat. There must be minimal impact on water quality in the headpond, diversion reach, and reaches downstream of the tailrace and diversion dams/dykes. Flows in the bypassed reach and downstream of the tailrace must be adequate to support indigenous aquatic and riparian species at pre-facility ranges. The facility must be operated in a manner to ensure conservation of fish habitat, including aquatic or terrestrial organisms. This includes monitoring key variables for the life of the facility. A minimum flow in the river and a minimum wetted channel perimeter must be maintained at all control structures, with a constant flow in the river throughout the year. The proponent is required to explain how this commitment will be achieved in dry-year conditions. The facility will avoid designated “sensitive streams” (those designated under the *Fish Protection Act*—see Appendix 1) and will not threaten or harm migration or habitat of endangered species, threatened species, or species of regional concern. Natural upstream barriers that may separate distinct fauna on a waterway (i.e., barriers that separate downstream and upstream fish and other aquatic species) must not be removed or submerged. The general aquatic ecosystem is also considered. A criterion states that the integrity of the current downstream ecosystem must be maintained (i.e., the downstream ecosystem is not changed significantly from existing conditions). An example of an ecosystem indicator for this criterion is the benthic invertebrate community.

Entrainment (when fish are drawn into the penstocks and pass through the turbines) is not specifically mentioned in the Green Criteria. Entrainment can kill or injure fish, and actions need to be taken to avoid this. Avoiding entrainment is explicitly covered by laws such as the *Fisheries and Water Acts*; therefore, this may be the reason they are not mentioned.

Green Criteria appear to comprehensively cover most issues related to power project developments and fish. However, in practice meeting these criteria does not guarantee that these projects will be without significant impacts. A written statement by a reputable scientist (or regulatory agency) is sufficient to demonstrate that the criteria are met. This level of proof can create conflict between different professional opinions. Given that the science of instream flow requirements is not well established, different professionals can have widely differing opinions.

Detailed post-construction monitoring is required to determine actual effects on chosen indicators, and to mitigate these effects. Monitoring and any necessary corrective action are described in the Green Criteria, but no mention of specific monitoring variables is given. In practice, monitoring requirements have been specified by agencies and have varied widely. Currently, agencies tend to require extensive pre- and post-project monitoring in order to understand potential impacts to fish and sometimes other species (Scott Babakaiff, personal communication). This is more stringent than older projects that have fewer monitoring requirements. Levels of impact to fish or other values will not be understood until the project is operational. Monitoring programs will typically select certain variables or indicators, and lengthy post-impact monitoring will generally be required to statistically measure changes to these variables/indicators.

The lack of quantifiable targets in the Green Criteria provides flexibility for experts to decide what constitutes an impact for each individual project. However, it also means that the Criteria do not specify what level of impact is considered acceptable. For example, what percent decrease in a fish population would be required for impacts to be considered high? What thresholds should be used to decide if fish communities or habitat have been conserved? Other examples of lack of quantifiable measures include the absence of a definition of minimal impact to water quality, and the absence of a definition regarding what kinds of minimum flows are necessary in the bypassed reach, and how these minimum flows should be determined.

A Green Criteria that is difficult to evaluate is “maintenance of the integrity of the downstream ecosystem”. This is difficult to prove without extensive monitoring data over a range of annual conditions (including the pre-construction period).

Written statements by a reputable scientist (or regulatory agency) will discuss the nature and degree of fish and aquatic impacts and will describe how conservation measures (including flows) are adequate. It is difficult to measure these statements against any objective standard and a high degree of subjectivity is inherent in these determinations. Independent, consistent assessments by regulatory agency staff would largely address this problem, though agency input is not necessarily binding.

Criteria for endangered/threatened species and species of concern

BC Hydro’s Green Criteria state that, to be ‘green’, the facility must not threaten or harm migration or habitat of endangered species, threatened species or species of regional concern. This applies to terrestrial or aquatic species. A written statement by a reputable scientist or regulatory agency is required to comply with this condition. The Green Criteria require identification of all threatened species, endangered species and species of regional concern, as designated federally (by the Committee on the Status of Endangered Wildlife in Canada – COSEWIC), or provincially (red or blue listed species identified by the Conservation Data Center). The Criteria require an explanation regarding why the facility will or will not impact identified species based on field reconnaissance, literature review and professional experience.

These criteria provide a reasonable approach to avoiding harm to endangered/ threatened/of concern species. However, there is no objective standard regarding what is meant by ‘threaten’ or ‘harm’ to habitat or species, and therefore this could lead to duelling professional opinions. A lack of data could contribute to this conflict and detailed studies may need to be done to properly assess the issue.

Wildlife and terrestrial criteria

The Green Criteria state that the facility will have no significant impact on existing wildlife habitat and populations. They require identification of key wildlife habitat and populations in the facility area, and ask for an explanation regarding how each facility will (or will not) impact the identified species.

There are potential issues related to power lines and roads. Effects of road access and power lines may or may not be evaluated under the criteria relative to wildlife or endangered/threatened/of concern species. Effects of access may be evaluated under a separate

criterion related to terrestrial impacts, which states that the facility development must have a low environmental impact on land resources. This refers to the incremental increase in transmission and distribution components of the facility (including access roads and land clearing) as well as the generating facilities, which collectively must have a minimal impact on the terrestrial ecosystem. A reputable scientist (or regulatory agency) must confirm that there is minimal environmental impact. Similar to other Green Criteria, there is no objective standard regarding what kind of impact is 'minimal' and thus the level of impact is subject to interpretation, as are the parameters used in coming to this determination. Each site will be different, so some flexibility regarding the definition of environmental impacts makes sense. However the absence of information in the criteria regarding what impacts may occur and how to assess them means that important features and issues may not be included. We believe that this criterion regarding low environmental impact on land resources may be aimed more at non-ecological impacts (see below), since fish, aquatic ecosystems, wildlife and species at risk are already addressed.

Noise levels and scenic, recreational and cultural values are included in the above criterion regarding low environmental impact on land resources. A reputable scientist (or regulatory agency) must confirm that scenic and recreational values will not be adversely affected and noise by-laws or regulations are adhered to. An archaeological/cultural specialist (or regulatory agency) must confirm that cultural values will not be adversely affected.

The Green Criteria do not specifically consider or mention prevention of invasive species establishment during project activities and construction. This would fall under the criterion of 'minimal environmental impact' on the terrestrial ecosystem, but in practice may not be a consideration.

Criteria for social responsibility

The Green Criteria include criteria for social responsibility, which stipulate that community values must be taken into account. These criteria specify that the public be involved in processes that help create the facility plan, and require that no important community values be adversely affected and that existing recreational access be maintained. IPPs in higher profile areas generally solicit and receive a large amount of public input. However, it is the proponent that must document how important community values and recreational access are protected. Some members of the community may disagree with the process and its outcome.

BC Hydro's Green Criteria for socially responsible facilities also state that relevant members of the aboriginal community must be contacted and communicated with, allowing for informed decision making by the aboriginal community. Aboriginal communities may have concerns related to general sustainability and particular fish and wildlife species, as well as concerns relating to archaeological and cultural sites. Each IPP must develop a relationship with the local First Nations appropriate to local conditions. While it is unclear what exactly is required for informed decision-making, we believe that given the diversity of First Nations in BC it is not possible for the Criteria to be more specific.

Appendix 3: Watershed Watch's Top 10 List of Considerations

Determining whether an individual project is sustainable requires an in-depth analysis of a variety of data. Nevertheless, Watershed Watch's "Top 10 List of Considerations" helps people reach reasonable conclusions. It is unlikely that any project in British Columbia will meet all the criteria on the list—simply because the existing BC process does not allow for all the criteria to be met.

Here is Watershed Watch's Top Ten List of considerations.

1. The project is located wisely—where adding roads, power lines, human activity and a river diversion will not significantly compromise existing wilderness refuge areas, species of concern, or established recreational opportunities.
2. Cumulative effects have been seriously considered, and the project does not create an unacceptable incremental impact, including effects cumulative to other power projects, water diversions, forestry, mining, and agriculture.
3. Affected First Nations, communities and stakeholders have been contacted early enough in the planning process to become well informed, have been given ample opportunity to provide meaningful input to the project, and their input has been taken seriously, and incorporated where appropriate.
4. Potential risks to species and ecosystems have been identified (appropriate surveys have established animal and plant status and potential threats), and impacts have been avoided or mitigated.
5. Sufficient monitoring data on stream flows and biota (e.g. fish or wildlife populations that might be affected) have been collected for a reasonable period of time prior to construction (i.e., two or more years), and these baseline data are used in the planning and mitigation processes, as appropriate.
6. A qualified professional has participated in the setting of conditions and criteria to mitigate impacts associated with ongoing operations, including: low flow thresholds in the diversion reach (to support local fish populations and other aquatic life), ramping rate, and maintenance operations. Input from the Ministry of Environment and Fisheries and Oceans Canada has been considered, and any concerns regarding minimum flows, aquatic habitat requirements, mitigation, and compensation have been incorporated.
7. The headpond, weir and intake associated with the diversion are designed to minimize impacts, including those affecting fish migration, sediment movement, and flooding.

8. The locations and extent of roads and power lines have been identified, their individual and cumulative impacts on wildlife habitat and plant and animal species of concern have been considered, and qualified professionals decide whether the impacts are acceptable, how mitigation should be incorporated, and how they will work with appropriate Ministry of Environment staff.

9. The powerhouse includes fish by-pass valves to mitigate river stage impacts and fish stranding associated with unplanned and forced power outages.

10. Post-construction monitoring occurs, and includes provisions for modifying plant operations when unacceptable impacts are revealed.

Appendix 4: How can citizens and communities make a difference?

In addition to conducting their own check-list surveys, individuals and communities have other means of influencing run-of-river projects. While it's unlikely projects can be halted, public scrutiny and involvement can greatly improve the project's quality. Independent power producers are required to engage in community and stakeholder consultation and to reasonably address the issues raised. Because of unceded rights to traditional territories, First Nations must be consulted during project development, and can have a major influence on how a project unfolds.

There are four key subjects around which individual and collective contributions can be particularly effective:

The land-based impacts on wildlife species. Neither BC's legislation, nor its agencies, adequately address the public's concerns about the impact of roads, power lines, construction and increased human activity.

The impacts on recreational, cultural and wilderness/aesthetic values. Independent power producers are required to address conflicts over land use, loss of biodiversity, and concerns about scenic, recreational and cultural values. It is up to the public to make these concerns known to the IPP as well as to the agencies in charge of issuing project approvals.

The impacts on non-fish and species at risk. Though agencies do deal with these concerns, strong expression of public concern is needed to ensure that these concerns are properly addressed. This is particularly true of species at risk, which are dealt with inconsistently due to weak legislation.

The planning which addresses the cumulative effects of development, the exclusion of development in sensitive areas, and the maximizing of public benefits.

Appendix 5: Glossary of terms

Benthic invertebrates: organisms that live on the bottom of streams or lakes and that have no backbone, e.g., dragonflies, mayflies, worms, snails.

Clean energy: energy from renewable sources (e.g., wind, solar, hydropower).

Cumulative impact: the sum total of all effects of multiple projects or land uses.

Diversion reach: the section of river in a run-of-river hydropower project between the intake to the penstocks and the tailrace. The diversion reach is the river section with reduced water flows.

Electricity Purchase Agreement: 25-year agreement between BC Hydro and an Independent Power Producer that describes the terms under which BC Hydro will purchase electricity.

Entrainment: when fish are drawn into the penstocks and pass through the turbines.

Green energy: energy that is renewable and has low environmental impacts. Green energy is often certified according to specific criteria, e.g. EcoLogo criteria (see www.environmentalchoice.com).

Groundwater: water located underground, in the cracks and spaces in soil, sand and rock.

HADD: harmful alteration, disruption or destruction. Refers to temporary or permanent negative changes to fish habitat under the federal *Fisheries Act*.

Headpond: area flooded upstream of a small dam on a river to ensure sufficient flow at the penstock.

Impingement: when fish are pinned against the intake to a penstock.

Independent Power Producer (IPP): any corporation or entity potentially eligible for an Electricity Purchase Agreement with BC Hydro.

Megawatt (MW): energy sufficient to power 500 homes.

Penstock: pipe that brings water from the river to power turbines located at a lower elevation.

Powerhouse: the building that contains the turbines.

Renewable energy: energy sources that can be replenished on a human time scale such as biomass (wood) or sources that are essentially inexhaustible such as wind, solar or geothermal energy.

Riffle: fast flowing shallow section of a stream.

Riparian: pertaining to the banks of a stream. Often used to refer to plant communities and species influenced and sustained by nearby water.

Run: fast flowing section of a stream with low turbulence.

Run-of-River: a type of hydropower project with little or no reservoir storage capacity. Power is derived from only the river's natural flow.

Small hydro: the threshold between small and large hydro is not well defined, but small hydro projects generally have a generating capacity of less than 50 megawatts.

Species at Risk: species designated as threatened, endangered, or 'of concern' by the provincial and/or federal governments.

Tailrace: short man-made channel between the powerhouse (that contains the turbines) and the river to which diverted water is returned.

Transmission line: the wires (usually overhead, but sometimes buried) that convey electricity from its point of production to population centers.

Turbine (water): a rotary engine that converts power from moving water into electric energy.

Water Licence: a licence granted by the Province of BC's water comptroller that allows for the diversion, use and/or storage of a predetermined quantity of surface water. Water licences are currently granted for a renewable term of 40 years, and were formerly granted in perpetuity.