



Cherry Creek Waterworks District  
Committed to Providing Clean, Safe Water for All Our Residents

# Lacy Lake Micro-Hydro Generation Project

*(Cherry Creek Green Energy Feasibility Study)*

Location: Lacy Lake & Cold Creek System, Beaufort Range, Vancouver Island, BC

Date: October 31, 2025

Prepared for: Cherry Creek Waterworks District



# LACY LAKE MICRO-HYDRO GENERATION PROJECT

## Feasibility Study for Sustainable Energy Integration

### Report Contents

Feasibility Study for Sustainable Energy Integration .....	1
Report Contents .....	1
Transform Cherry Creek's gravity-fed water system into a dual-purpose renewable energy asset, offsetting Water Treatment Plant electrical demand while maintaining absolute water supply priority.	
.....	4
INTRODUCTION.....	4
Study Scope.....	4
1. HYDROLOGICAL ASSESSMENT OF LACY LAKE AND COLD CREEK.....	5
1.1 Watershed and Flow Characteristics .....	5
1.1 Seasonal Variation and Capacity Factor .....	6
1.2 Turbine Siting Options (Amended 2025).....	6
Table 1.1: Key Points Comparison.....	11
Key Points Table .....	11
Table 1.2: Comparative Pros/Cons Analysis .....	11
Comparative Pros/Cons Table.....	11
2.1 Estimated Power Output.....	12
2.2 Annual Energy and Value .....	13
2.3 Head Sensitivity.....	13
2.4 Load Matching .....	13
2.5 Summary.....	13

<b>3. MICRO-HYDRO TECHNOLOGY OPTIONS AND ELECTRICAL CONFIGURATION.....</b>	<b>14</b>
3.1 Turbine Options.....	14
3.2 Comparative Scorecard.....	14
3.3 Generator Configuration.....	14
3.4 Control Systems .....	15
3.5 Integration with WTP.....	15
3.6 Summary.....	15
<b>4. GRID-TIED VS. OFF-GRID OPERATION.....</b>	<b>15</b>
4.1 Grid-Tied Operation (Recommended).....	15
4.2 Off-Grid Operation.....	16
4.3 Hybrid (Grid + Limited Islanding) .....	16
4.4 Summary and Recommendation .....	16
<b>5. ENVIRONMENTAL AND REGULATORY CONSIDERATIONS .....</b>	<b>16</b>
5.1 Water Licensing .....	17
5.2 Fisheries and Habitat.....	17
5.3 Provincial and Local Framework.....	18
5.4 BC Hydro Interconnection.....	18
5.5 Environmental Assessment .....	18
5.6 Project Impact Assessment .....	18
5.7 Summary.....	19
<b>6. INSTALLATION, MAINTENANCE, AND OPERATIONAL COSTS.....</b>	<b>19</b>
6.1 Capital Costs (Order-of-Magnitude).....	19
6.2 Operation & Maintenance (O&M).....	20
6.3 Financial Outlook (Amended 2025) .....	20
6.4 Lifecycle Considerations .....	20
6.5 Installation Considerations .....	21
6.6 Maintenance and Operations.....	21
6.7 Summary of Costs and Economics .....	21
<b>7. CASE STUDIES OF SIMILAR PROJECTS IN BRITISH COLUMBIA .....</b>	<b>21</b>
7.1 Eagle Lake (West Vancouver, 2003) .....	22

7.2 Nakusp (2014).....	22
7.3 Nanaimo (2014) .....	22
7.4 Lessons for Cherry Creek .....	22
<b>8. CONCLUSION AND NEXT STEPS .....</b>	<b>23</b>
8.1 Key Findings.....	23
8.2 Feasibility Outlook.....	24
8.3 Recommended Next Steps .....	24
8.4 Closing Statement .....	24
<b>APPENDIX A .....</b>	<b>25</b>
List of Tables .....	25
Infographic Charts.....	26
Chart 1: Grant Sensitivity - Payback vs Head .....	26
Chart 2: Key Numbers - Head Sensitivities.....	26
Map: Cold Creek Watershed.....	27
Cold Creek Elevation Profile .....	28
Lacy Lake Cold Creek Profile Data .....	29
<b>APPENDIX B — Glossary of Technical Terms .....</b>	<b>33</b>

**Prepared for:** Cherry Creek Improvement District

**Document Type:** Feasibility Analysis

**Focus:** Renewable Energy Integration with Water Infrastructure

## EXECUTIVE VISION

Transform Cherry Creek's gravity-fed water system into a dual-purpose renewable energy asset, offsetting Water Treatment Plant electrical demand while maintaining absolute water supply priority.

---

## INTRODUCTION

Lacy Lake, a small natural lake in the Beaufort Range on Vancouver Island, serves as the primary water source for the Cherry Creek Improvement District (CCID). Cold Creek flows from Lacy Lake and supplies the Cherry Creek Water Treatment Plant (WTP) by gravity.

This study evaluates the feasibility of installing a micro-hydro generator to harness the elevation drop and flow between Lacy Lake and the WTP. The primary goal is to offset or supplement the electrical demand of Cherry Creek WTP.

### Study Scope

This report addresses the following key considerations:

- **Hydrology** — available flow rates, elevation head, and seasonal variability
- **Power Potential vs. Demand** — alignment of generation capacity with WTP energy requirements
- **Technology Selection** — appropriate turbine and generator types, including single-phase versus three-phase systems

- **Grid Connection vs. Off-Grid** — evaluation of BC Hydro grid integration versus isolated operation
- **Environmental and Regulatory Factors** — anticipated approvals and environmental protection requirements
- **Costs** — capital, operation, and lifecycle costs
- **Case Studies** — precedent projects in BC to guide expectations

The report includes comparative tables for technology options, power-to-demand estimates, and cost projections.

---

## **1. HYDROLOGICAL ASSESSMENT OF LACY LAKE AND COLD CREEK**

### **1.1 Watershed and Flow Characteristics**

The Cold Creek watershed is small and steep, generating abundant runoff during the wet season but minimal flow in summer. Cherry Creek's water supply is entirely gravity-fed from a small diversion dam reservoir which has that is fed from Lacy Lake which has a full-pool elevation of approximately 398 m.

From Lacy Lake, Cold Creek flows down the Beaufort Range to a small diversion dam reservoir located roughly halfway down the slope. At this point, flow is divided into two controlled uses: one portion is directed through a pipeline to supply the Cherry Creek Water Treatment Plant, while the remaining flow continues in the natural creek bed to sustain fish habitat and other environmental values.

Historic modeling showing both typical late-October and extreme drought drawdown patterns confirms that summer baseflow relies almost entirely on Lacy Lake storage, supplemented by limited karst recharge. During late summer, natural runoff beyond potable demand remains negligible.

## 1.1 Seasonal Variation and Capacity Factor

The system operates as run-of-river, with production dependent on real-time flow:

- **Winter (November–April):** Strong flow enables near-continuous generation
- **Summer (July–September):** Extremely low flows could restrict generation to potable diversion only

The expected annual capacity factor is modest, likely at the lower end of the 40–60% range typical of BC run-of-river plants due to severe late-summer limitations.

## 1.2 Turbine Siting Options (Amended 2025)

A revised analysis of turbine siting along Cold Creek and within the Cherry Creek potable system identifies three viable alternatives. Each option differs in location, head potential, accessibility, and regulatory complexity.

### **Option 1: Upper Cold Creek (Lacy Lake to Diversion Dam)**

This option places the turbine along the upper section of Cold Creek, between Lacy Lake outlet and the diversion dam reservoir. QGIS mapping confirms that the lake outlet sits at 397 m elevation (49.3027°, -124.7415°), while the diversion dam is at 224 m elevation (49.29404°, -124.7661°). The creek distance between these points is approximately 1,923 m, resulting in a total gross head of approximately 173 m.

Stepwise slope analysis reveals a varied profile: the first 503 m downstream drops 61 m (to 337 m), followed by a 492 m section that flattens with a 43 m drop (to 294 m). A further 508 m sees a gradual 29 m drop (to 265 m), before the final 420 m descends steeply by 40 m (to 224 m) as the creek approaches the diversion

reservoir. While the overall head is significant, it is distributed unevenly, with the steepest sections occurring near the lake outlet and just upstream of the diversion dam. By capturing this head before potable water diversion, this site offers the strongest energy generation potential in the watershed.

### **Technical Parameters:**

- Start: Lacy Lake outlet (49.3027°, -124.7415°; elevation 397 m)
- End: Diversion reservoir (49.29404°, -124.7661°; elevation ~224 m)
- Length: ~1,923 m
- Gross head: ~173 m
- Terrain: Alternating steep and gradual slopes; forestry road access

### **Advantages:**

- Maximum water volume and head potential
- Potential for BC Hydro grid interconnection and higher revenue
- Shorter seasonal downtime with most flow returned to creek
- Better road access than downstream sections
- Strong eligibility for grant programs

### **Disadvantages:**

- Long penstock and powerline runs increase capital costs
- Winter access challenges due to snowpack
- Remote location increases vandalism and theft risk
- Requires right-of-way easements with Island Timberlands
- Extended regulatory and consultation timelines

### **Limitations:**

Siting at higher elevations near Lacy Lake introduces several constraints. The longer distance to the treatment plant significantly increases penstock and electrical line costs, while winter snowfall complicates access and operations. Site remoteness raises vandalism and theft risks, as the location is accessible from both the Alberni valley side and the east coast of Vancouver Island. This reach of Cold Creek lies within timber company tenure, requiring new right-of-way agreements.

Extensive consultation with First Nations, the Nanaimo Regional District, and other regulatory bodies will likely be required, potentially extending approval timelines.

## **Option 2: Lower Cold Creek (Diversion Dam to Valley Floor)**

This option places the turbine along the lower reach of Cold Creek, downstream of the diversion dam where flows are released for ecological purposes. At the diversion dam outflow (49.2919°, -124.7630°), the creek elevation is approximately 224 m. From there, the channel descends to the valley floor through several distinct slope sections.

Over the first 508 m, the creek drops 45 m to an elevation of 179 m. A further 407 m downstream, elevation falls sharply by 68 m to 111 m—a particularly steep segment corresponding to Lower Cold Creek Falls. The final 296 m section to the valley floor drops another 26 m, bringing the creek to an elevation of 85 m. In total, this ~1.2 km reach provides a gross head of approximately 139 m, with most energy potential concentrated in the waterfall and adjacent steep slopes. Because this section uses water designated for environmental release rather than potable supply, energy potential is inherently limited by instream flow requirements, though the natural gradient offers strong localized head for generation.

### **Technical Parameters:**

- Start: Diversion dam outflow (49.2919°, -124.7630°; elevation ~224 m)
- End: Valley floor (~85 m elevation)
- Terrain: Steep, rocky, unstable; includes hiking trails

### **Advantages:**

- Proximity to treatment plant reduces infrastructure costs
- Significant head in waterfall section

### **Disadvantages:**

- Recreation area may face public opposition
- Flow limited to ecological releases reduces generation
- Stricter regulatory oversight
- Shorter generation season than Option 1
- Steep terrain increases construction costs

### **Limitations:**

This location faces notable limitations related to public use and terrain. The area around Lower Cold Creek Falls is a popular hiking destination, increasing the likelihood of community opposition. Because this section only carries flow reserved for ecological release, it is subject to stricter environmental oversight, and generation potential would be seasonally limited. Physical access presents challenges: the creek bed terrain is rocky, steep, and in places unstable, with displaced boulders and fractured rock. Constructing service access roads in such conditions would be costly, requiring careful investigation of alternative access methods.

### **Option 3: Potable Distribution System (Within CCID Network)**

This option focuses on siting turbines within the potable distribution system itself, utilizing the gravity-fed pipeline that conveys water from the diversion dam through the Cherry Creek Water Treatment Plant (WTP) to the clearwell (CT) reservoir and community distribution network. Because this section is fully contained within existing infrastructure, the opportunity lies in recovering energy from pressure already present in the system.

Current evidence confirms a baseline gross head of approximately 40 m between diversion dam and the WTP. Additional downstream head may be exploitable; therefore, 80 m and 150 m are retained as sensitivity cases pending detailed survey. This replaces the earlier practice of assuming ~150 m as a design standard.

Two sub-options are available: turbine placement between the WTP and CT reservoir, where the turbine serves dual roles of generating electricity and acting as a pressure-reducing valve to regulate excess head pressure; or installation

downstream of the CT reservoir along the main distribution line, performing the same dual function. In both cases, power production is directly tied to community water demand, making the system variable but highly integrated, with the added advantage of supporting operational efficiency within the potable water network.

### **Technical Parameters:**

- Location: Within WTP–CT reservoir pipeline, or further downstream
- Gross head: Limited to available system pressure
- Flow: Dictated by community water demand (variable)
- Integration: In-line with existing system, smaller scale

### **Advantages:**

- Low-cost installation and simplified maintenance
- Minimal regulatory hurdles (part of existing infrastructure)
- Supports WTP operations by controlling excess pressure
- Reliable access and security

### **Disadvantages:**

- Generation limited to demand cycles
- No BC Hydro export potential
- Potable water handling requires specialized turbine design
- Lower power potential compared to creek-based sites

### **Limitations:**

Limitations for this option are primarily operational. Power generation is directly governed by community water demand, meaning flows—and therefore electricity output—decline sharply during low-use periods such as nighttime. While this aligns with lower WTP demand, it creates discontinuity for other electrical loads unless supported by backup power such as batteries, auxiliary generators, or

renewable sources. Because turbines would operate in potable water, equipment design must meet stringent sanitary standards. As this system is isolated from the BC Hydro grid, there is no potential for surplus export; however, this also simplifies installation by removing the need for complex transfer switching.

**Table 1.1: Key Points Comparison**

<b>Key Points Table</b>						
<b>Option</b>	<b>Location</b>	<b>Gross Head (m)</b>	<b>Length (m)</b>	<b>Flow Availability</b>	<b>Access Difficulty</b>	<b>Proximity to WTP</b>
1	Lacy Lake → Diversion Dam	~173	~1,923	High (pre-diversion)	Moderate	Far
2	Diversion Dam → Valley Floor	~139	~1,200	Low–Moderate	High	Near
3	Potable System (WTP–CT)	Variable	N/A	Low (demand-driven)	Low	Very Near

**Table 1.2: Comparative Pros/Cons Analysis**

<b>Comparative Pros/Cons Table</b>			
<b>Factor</b>	<b>Option 1 – Upper Creek</b>	<b>Option 2 – Lower Creek</b>	<b>Option 3 – Potable System</b>
<b>Generation Potential</b>	High – max head & flow	Moderate – ecological flow	Low – demand-limited
<b>Infrastructure Cost</b>	High – long penstock	Medium – tough terrain	Low – uses existing system
<b>Regulatory Risk</b>	High – licences, ROW, FN consult	High – ecological/recreation	Low – minimal change

<b>Community Acceptance</b>	Moderate – remote	Low – recreation conflict	High – low impact
<b>Maintenance &amp; Access</b>	Moderate – road access, snow	Difficult – unstable terrain	Easy – near WTP
<b>Grid Connection Potential</b>	Yes, feasible	Possible but limited	No, in-house only

**Note:** All scenarios are conditional upon maintaining ecological releases from the diversion dam reservoir. Potable supply receives priority, and turbine diversions cannot reduce required instream flows. Final site selection must be based on detailed professional hydrological analysis of the Lacy Lake/Cold Creek system.

## 2. POWER GENERATION POTENTIAL VS. PLANT DEMAND

Cold Creek's power potential can be estimated using the hydroelectric equation:  
 $P \text{ (kW)} \approx 7.8 \times Q \text{ (m}^3\text{/s)} \times H \text{ (m)}$ , assuming ~80% efficiency

### 2.1 Estimated Power Output

<b>Scenario</b>	<b>Flow (L/s)</b>	<b>Power @ 40 m (kW)</b>	<b>Power @ 80 m (kW)</b>	<b>Power @ 150 m (kW)</b>	<b>Seasonal Context</b>	<b>Relation to WTP Demand (~10–20 kW)</b>
<b>Summer – low flow</b>	6	~1.9	~3.7	~7.1	Jul–Sept; drought constrained	Covers only a fraction of demand
<b>Shoulder – median flow</b>	12	~3.7	~7.5	~13.9	Apr/Oct; transitional season	At 40 m, sufficient for baseline load
<b>Winter – conservative diversion</b>	35	~10.9	~21.8	~41.0	Nov–Mar; after instream flow releases	Meets or exceeds demand

<b>Scenario</b>	<b>Flow (L/s)</b>	<b>Power @ 40 m (kW)</b>	<b>Power @ 80 m (kW)</b>	<b>Power @ 150 m (kW)</b>	<b>Seasonal Context</b>	<b>Relation to WTP Demand (~10–20 kW)</b>
<b>Winter – upper diversion</b>	50	~15.6	~31.2	~58.5	Peak winter storm flows	Surplus generation; export potential

## 2.2 Annual Energy and Value

- **40 m head:** ~60 MWh/year (~\$6,000)
- **80 m head:** ~123 MWh/year (~\$12,300)
- **150 m head:** ~230 MWh/year (~\$23,000)

## 2.3 Head Sensitivity

- **40 m:** ~61 MWh/year; payback 40–80 years
- **80 m:** ~123 MWh/year; payback 20–30 years
- **150 m:** ~230 MWh/year; payback 10–15 years

## 2.4 Load Matching

The WTP load is relatively steady with occasional spikes:

- **Grid-tied mode:** Grid supplies deficits and absorbs surpluses
- **Off-grid mode:** Storage or advanced controls would be required

## 2.5 Summary

- **40 m head:** Modest output, covering ~40–60% of annual WTP demand

- **~80–120 m head:** Could supply most or all demand with export potential (150 m scenarios are no longer considered realistic under updated siting analysis)
  - **Grid tie:** Essential for seasonal balancing and maximizing economic value
- 

### 3. MICRO-HYDRO TECHNOLOGY OPTIONS AND ELECTRICAL CONFIGURATION

Selecting an appropriate turbine and generator configuration is critical to maximizing efficiency, minimizing costs, and ensuring long-term operability. Cold Creek's relatively high head and modest flow range point toward impulse turbines, with Pelton and Turgo turbines as primary candidates and crossflow turbines as a fallback.

#### 3.1 Turbine Options

- **Turgo Turbine:** Best for ~40 m; robust with broad flow range
- **Pelton Turbine:** Best for ~80–120 m; very high efficiency (values above 120 m are not achievable under current siting constraints)
- **Crossflow Turbine:** Rugged but less efficient; fallback option

#### 3.2 Comparative Scorecard

- **Turgo:** Best match at 40 m
- **Pelton:** Best match at higher head
- **Crossflow:** Only viable if constrained

#### 3.3 Generator Configuration

**Three-phase induction generator** recommended for grid-tied operation:

- Rugged and cost-effective

- Self-synchronizing with grid
- Proven reliability

Synchronous or inverter-based systems only if off-grid or hybrid operation is prioritized.

### 3.4 Control Systems

- **Mechanical controls:** Nozzle or deflector
- **Electronic protections:** Relays for BC Hydro compliance
- **Electronic Load Controllers (ELCs):** Only needed in off-grid/islanding mode

### 3.5 Integration with WTP

Turbine installed downstream of treatment, replacing or supplementing a pressure reducing valve (PRV). This ensures potable water supply is unaffected in both volume and quality.

### 3.6 Summary

- **Turgo:** Optimal for 40 m
- **Pelton:** Optimal for 80–150 m
- **Three-phase induction:** Best generator option
- **Grid tie with protections:** Simplifies control and maximizes benefit

## 4. GRID-TIED VS. OFF-GRID OPERATION

A Cold Creek micro-hydro installation can operate in two principal modes: grid-tied (connected to BC Hydro) or off-grid (islanded). Each option carries distinct technical, financial, and resilience implications.

### 4.1 Grid-Tied Operation (Recommended)

- WTP draws from turbine first; grid covers deficits
- Surplus export possible under BC Hydro Net Metering ( $\leq 100$  kW) or via small IPP

- Lower control complexity, proven model in BC (Eagle Lake, Nanaimo)
- **Requirements:** Interconnection agreement, utility-grade disconnect, protection relays, and possible transformer

## 4.2 Off-Grid Operation

Enhances resilience during outages.

### Challenges:

- Summer shortfalls
- Complex control requirements
- Surplus management
- Transient load handling

## 4.3 Hybrid (Grid + Limited Islanding)

- Normally grid-tied with ability to supply WTP during outages
- Requires advanced controls and adds cost

## 4.4 Summary and Recommendation

- **Grid tie** is the preferred mode for Cherry Creek
- **Hybrid** may be pursued for resilience if grant-supported
- **Off-grid only** is not recommended due to reliability risks

Grid interconnection is most feasible for Option 1 (Upper Cold Creek). Option 2 faces significant terrain and regulatory barriers, while Option 3 remains in-house only with no export potential.

---

# 5. ENVIRONMENTAL AND REGULATORY CONSIDERATIONS

A micro-hydro project at Lacy Lake/Cold Creek must comply with provincial, federal, and local regulations given its location in a designated community

watershed. The project must prioritize water supply reliability, habitat protection, and cultural values to secure approval.

The existing diversion dam already regulates flows between potable supply and ecological release. Any additional diversion for energy generation must not diminish these ecological releases, making the diversion dam a key regulatory checkpoint for project approval.

## 5.1 Water Licensing

- Requires amendment to existing licence under the **Water Sustainability Act**
- Domestic supply remains priority use

## 5.2 Fisheries and Habitat

Any project impacting a stream in BC must consider fish habitat protection. While it is not explicitly confirmed whether Cold Creek supports fish populations, many small upper watersheds in the Beaufort Range may have resident trout or salmon in lower reaches. Regulatory agencies (DFO and BC Ministry of Environment) will examine flow alterations and infrastructure for potential habitat impact.

### **Key Requirements:**

**Minimum Flow Releases:** If a penstock diverts water for the turbine, bypass flow must remain in the natural creek channel, especially in fish-bearing reaches, to avoid dewatering habitat. This is standard in run-of-river hydro guidelines. During summer, power diversion might be zero (all water either goes to WTP or stays in creek as required). During high flow, diverting a portion with adequate creek flow is usually acceptable if done responsibly.

**Intake Screening:** The intake where water is drawn for the turbine must be screened to prevent fish entrainment, per DFO and provincial standards. Screen sizing and approach velocity must follow guidelines to avoid trapping or harming fish.

**Habitat Alteration:** Construction of penstock, powerhouse, or tailrace can disturb riparian zones. Careful planning is needed to minimize tree removal and soil disturbance along the creek. Using existing disturbances (such as alongside access roads or existing pipelines) is preferable. Techniques like burying the pipe and restoring

vegetation, avoiding sensitive wetlands or spawning areas, and timing construction for least risk should be employed.

**DFO Guidelines:** Canada's Department of Fisheries and Oceans has published guidelines for small hydro to protect fish and habitat. These emphasize maintaining natural flow regimes, ensuring fish passage if appropriate, and achieving no net loss of habitat productivity.

**Baseline fish survey** strongly recommended to confirm presence/absence and inform regulatory requirements.

### 5.3 Provincial and Local Framework

- **Section 11 permit:** Required for instream works
- **Land tenure:** May require easements (Mosaic/private/Crown)
- **Regional oversight:** Involves both RDN and ACRD
- **Watershed protection bylaws:** Prevent erosion, sedimentation, and contamination

### 5.4 BC Hydro Interconnection

- Compliance with Net Metering/Micro-IPP rules
- Protective relays, disconnect, and safety compliance per Canadian Electrical Code and BC Safety Authority

### 5.5 Environmental Assessment

- No full EA required (<0.1 MW)
- Review through permits and licences
- **First Nations consultation mandatory:** Early engagement advised with Tseshah and Hupacasath

### 5.6 Project Impact Assessment

To date, no publicly available surveys conclusively demonstrate the presence of resident or anadromous fish in Cold Creek's upper watershed (above the intake). Some sources identify potential suitable habitat in similar nearby streams, but recorded observations for Cold Creek are lacking. The project should include fish presence/absence surveys and habitat assessments as an early design and regulatory step. If fish are confirmed, regulatory requirements such as fish passage, minimum flows, screening, and habitat protection will apply.

## 5.7 Summary

- Feasible with conditions
  - Must prioritize water supply and creek health
  - Requires proactive First Nations and regulatory engagement
  - Option 2 carries added risks due to reliance on ecological flow releases and location in heavily used recreation corridor
  - Option 1 requires right-of-way agreements and extensive consultation with First Nations
- 

## 6. INSTALLATION, MAINTENANCE, AND OPERATIONAL COSTS

Implementing a micro-hydro system at Cold Creek requires moderate capital investment and low ongoing operating costs. With careful design and grant support, the project can achieve long-term financial and environmental benefits.

### 6.1 Capital Costs (Order-of-Magnitude)

- **Turbine-generator unit:** \$50,000–\$100,000
- **Powerhouse & civil works:** \$30,000–\$60,000
- **Penstock:** \$20,000–\$200,000+ (highly variable with length/material)
- **Controls & electrical:** \$40,000–\$80,000
- **Design & engineering:** \$20,000–\$50,000
- **Permitting & licensing:** \$5,000–\$15,000
- **Contingency (~15%):** \$30,000–\$60,000

**Total installed cost estimate:** \$250,000–\$500,000

**Trade-off:** Shorter penstock reduces cost but provides less head/power; longer penstock (from lake) increases cost but provides greater head/power. In practice, Options 1 and 2 are likely to drive penstock and civil works costs toward the high

end of the estimate (\$200,000+) given their terrain and access constraints. Option 3 offers the lowest installation cost but also the lowest return.

## 6.2 Operation & Maintenance (O&M)

- **Annual O&M:** \$5,000–\$10,000 (intake maintenance, inspections, minor parts, insurance, metering fees)
- **SCADA integration** enables remote monitoring and alerts

## 6.3 Financial Outlook (Amended 2025)

**Table 6.1: Simple Payback Period (Years)**

<b>Head Case</b>	<b>0% Grant</b>	<b>25% Grant</b>	<b>50% Grant</b>	<b>75% Grant</b>
<b>40 m</b>	58.6	44.0	29.3	14.7
<b>80 m</b>	28.6	21.5	14.3	7.2
<b>150 m</b>	15.2	11.4	7.6	3.8

## 6.4 Lifecycle Considerations

- **Service life:** 25–50 years
- **Turbine runners:** Refurbishment after ~20 years
- **Controls:** Replacement every 15–20 years
- **Generators:** Decades of service; periodic bearing replacements

- **Reliability:** Bypass piping ensures potable supply is uninterrupted during maintenance

## 6.5 Installation Considerations

- Intake/dam modifications at Lacy Lake
- Penstock installation (buried HDPE or steel; cost scales with length)
- Small powerhouse near the WTP
- Electrical intertie with BC Hydro

## 6.6 Maintenance and Operations

- **Routine checks:** Debris clearing, lubrication, seals
- **Winterization at intake:** Overflow weir or heat trace
- **Annual calibration:** Protection systems and intertie compliance

## 6.7 Summary of Costs and Economics

- **Capital:** \$250,000–\$500,000; **O&M:** \$5,000–\$10,000/year
- **Economics:** Marginal at 40 m; markedly better at 80–150 m, especially with grants
- **Funding:** CleanBC, FCM Green Municipal Fund, and federal infrastructure programs are key to acceptable payback

---

# 7. CASE STUDIES OF SIMILAR PROJECTS IN BRITISH COLUMBIA

Several precedent projects in BC confirm that integrating micro-hydro generation into municipal water systems is technically viable, financially beneficial, and publicly accepted.

## 7.1 Eagle Lake (West Vancouver, 2003)

- **200 kW Pelton turbine; ~150 m head**
- **Cost:** \$328,000; ~1.1 GWh/year
- **Financial performance:** ~5-year payback; ~\$700,000 net revenue in 25 years
- **Lesson:** High head with steady flow yields strong returns. Unlike Cherry Creek, Eagle Lake had steady flow and a full 150 m head. Cherry Creek sites are limited to ~80 m or lower, making Nakusp and Nanaimo more relevant comparisons.

## 7.2 Nakusp (2014)

- **50 kW Pelton turbine** integrated into potable system
- Near year-round generation; exported to BC Hydro; grant supported
- **Lesson:** Smaller systems can be reliable and effective with funding support

## 7.3 Nanaimo (2014)

- **360 kW energy recovery** at Reservoir No. 1
- 325,000 kWh in first five months (~\$30,000); annual \$70,000–\$90,000
- **Payback:** <10 years
- **Lesson:** Replacing PRVs with turbines is financially and environmentally attractive

## 7.4 Lessons for Cherry Creek

- Integration works without disrupting potable supply
- Grants are often decisive for payback
- Pelton and Turgo technologies are proven and supported locally
- Public acceptance is strong when designs are conservative and habitat is protected
- Regulatory support and funding can often be obtained for such projects, as they align with green energy and climate objectives (e.g., FCM grants, provincial climate action funds)
- Technical challenges such as intake design, grid connection, and control are all solvable with standard approaches; expertise is available from consultants experienced in BC municipal hydro projects

## 8. CONCLUSION AND NEXT STEPS

The feasibility analysis confirms that a micro-hydro project at Lacy Lake/Cold Creek is technically achievable and has the potential to offset a significant portion of Cherry Creek Water Treatment Plant's electricity demand while demonstrating local sustainability leadership.

### 8.1 Key Findings

- **Hydrology:** Winter surpluses allow meaningful generation; summer flows are constrained to potable diversion
- **Head:** 40 m yields modest ~60 MWh/year with limited financial return; 80–150 m improves viability markedly with potential to meet/exceed WTP demand and enable export
- **Technology:** Turgo (~40 m) and Pelton (80–150 m) are preferred; three-phase induction generators recommended for grid-tied operation
- **Operations:** Grid tie is strongly recommended; hybrid (limited islanding) may be pursued for resilience if grants allow
- **Regulatory:** Achievable with conservative design, habitat protection, and early First Nations engagement (Tseshah and Hupacasath)
- **Economics:** Modest without grants; strong with external funding
- **Case Studies:** Eagle Lake, Nakusp, and Nanaimo confirm feasibility, funding pathways, and acceptance
- **Updated Analysis:** A full 150 m head scenario is not practically feasible. Realistic viability is limited to ~40–80 m head sites, with Option 3 providing low-cost but limited return, and Option 1 offering the highest potential output at the highest capital cost

## 8.2 Feasibility Outlook

- Technically feasible
- Financially viable with grants
- Environmental compliance achievable with best practices
- Delivers long-term community and environmental benefits

## 8.3 Recommended Next Steps

1. **Hydrological survey:** Confirm head/flows; conduct LiDAR survey; determine penstock routing
2. **Conceptual design:** Engage qualified engineering firm for refined costing
3. **Regulatory engagement:** Pursue water licence amendment, Section 11 permit, BC Hydro interconnection agreement
4. **First Nations consultation:** Engage Tseshaht and Hupacasath to identify concerns and opportunities
5. **Funding strategy:** Apply for CleanBC, FCM Green Municipal Fund, federal infrastructure programs
6. **Community communication:** Build understanding and support through public engagement

## 8.4 Closing Statement

A micro-hydro installation at Lacy Lake/Cold Creek represents a practical, forward-looking enhancement to Cherry Creek's water system. With careful planning, external funding, and early engagement, the community can transform a natural resource into a long-term renewable energy asset.

**Final site selection must be based on detailed, professional hydrological analysis of the Lacy Lake/Cold Creek water system.**

# **APPENDIX A**

## **List of Tables**

### **Section 1: Hydrological Assessment**

- Table 1.1: Key Points Comparison ..... Page 11
- Table 1.2: Comparative Pros/Cons Analysis ..... Page 11

### **Section 2: Power Generation**

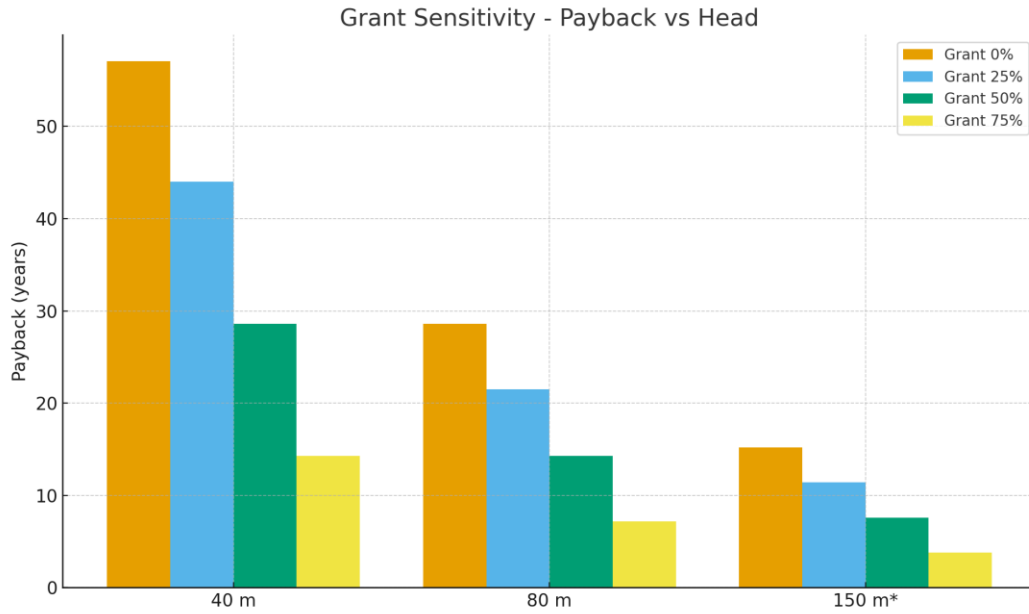
- Table 2.1: Estimated Power Output ..... Page 12

### **Section 6: Installation and Costs**

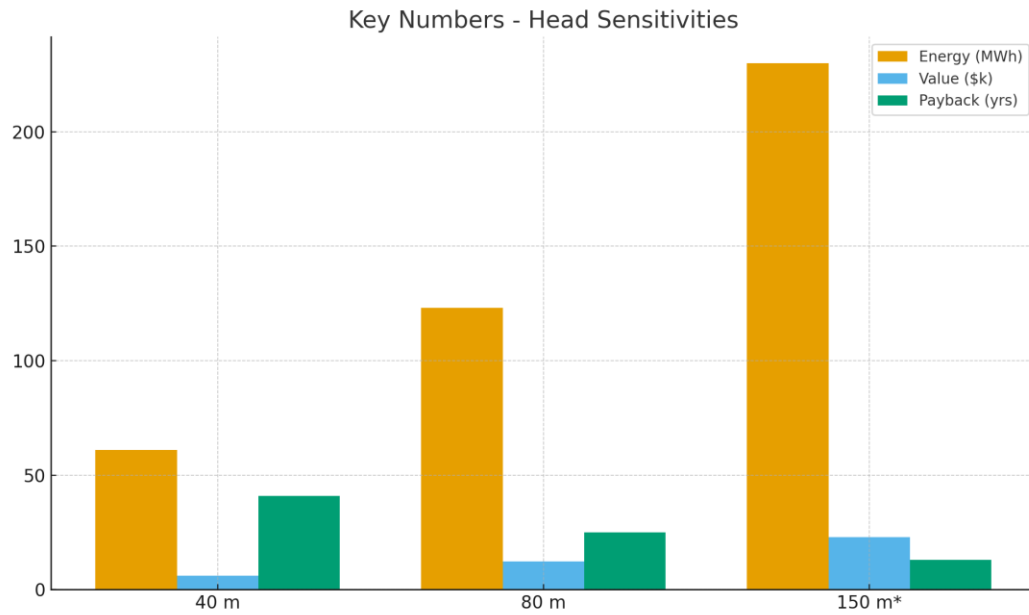
- Table 6.1: Financial Outlook (Amended 2025) ..... Page 20

# Infographic Charts

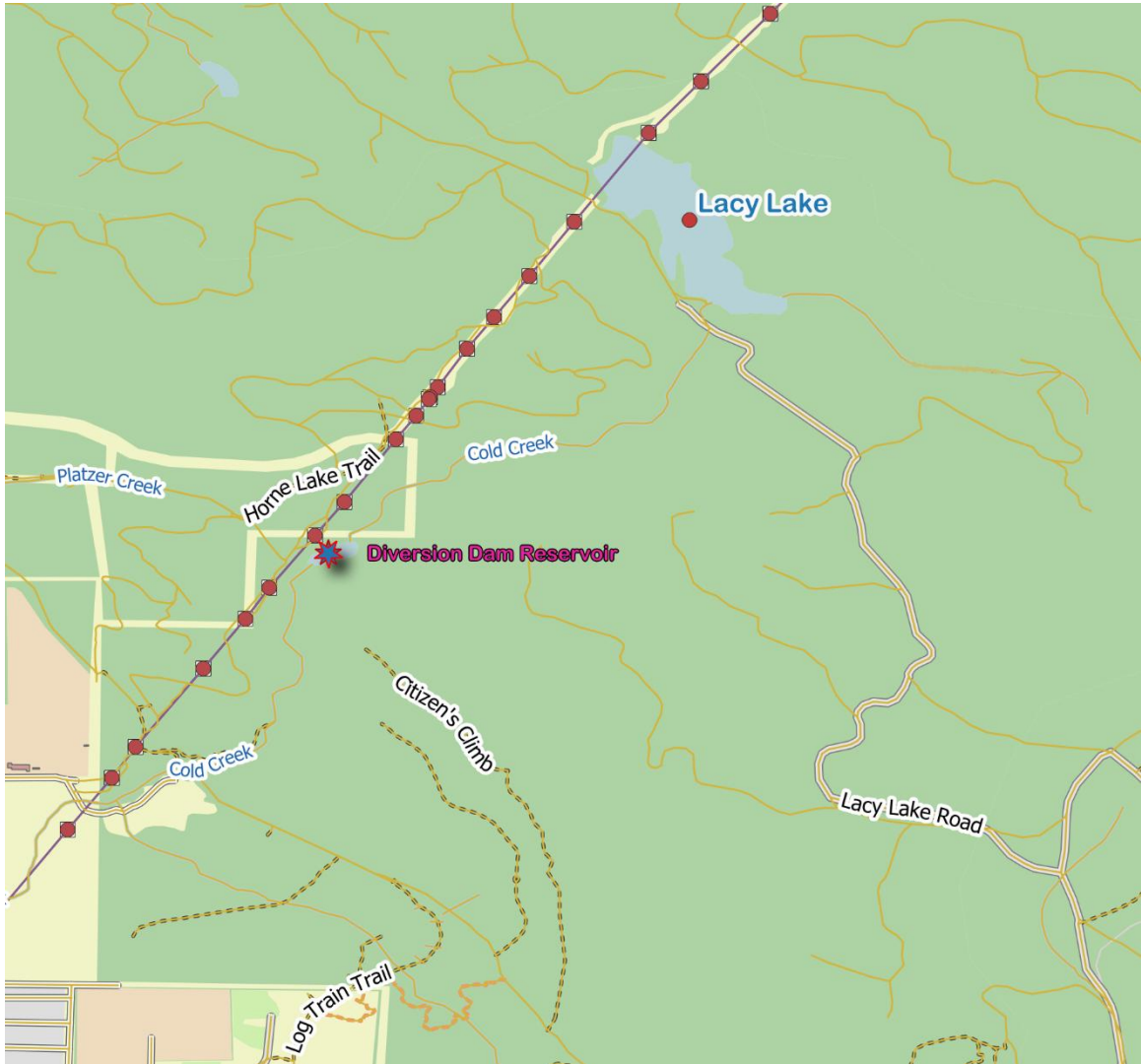
## Chart 1: Grant Sensitivity - Payback vs Head



## Chart 2: Key Numbers - Head Sensitivities

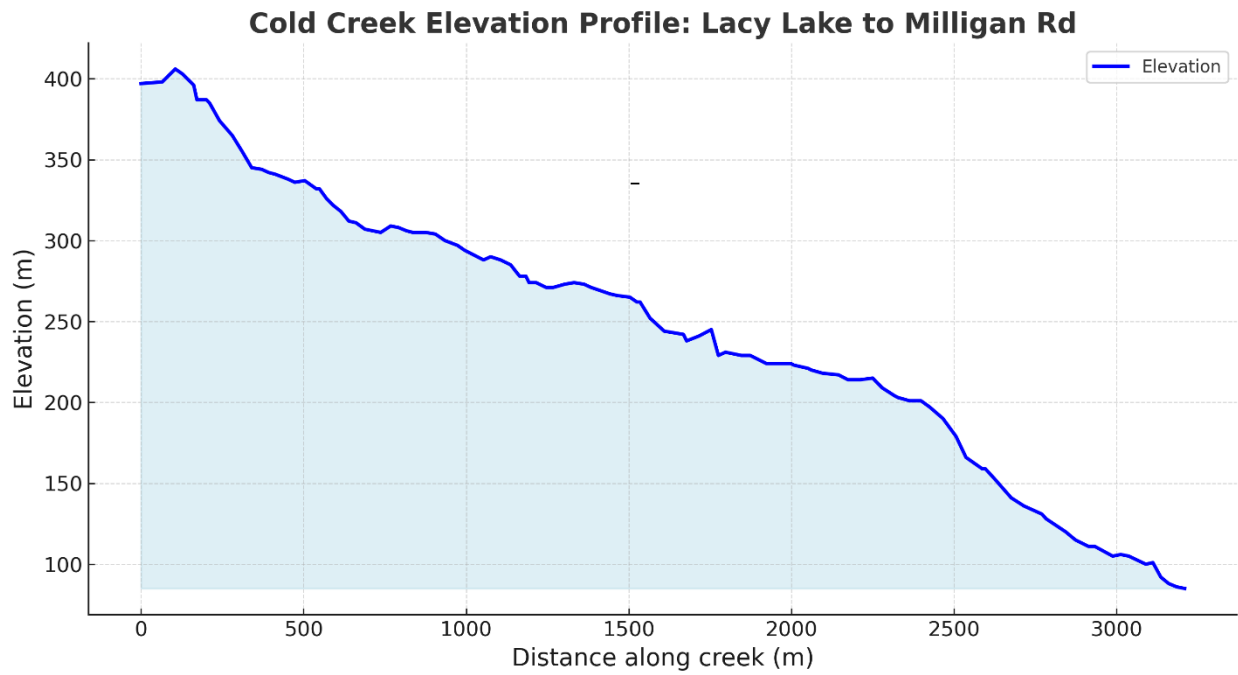


## Map: Cold Creek Watershed



# Cold Creek Elevation Profile

# Cold Creek Elevation Profile



## Lacy Lake Cold Creek Profile Data

Lacy Lake Cold Creek Profile Data			
Distance (m)	Longitude (°)	Latitude (°)	Elevation (m)
0	-124.7482279	49.30291906	397
65.23811917	-124.7486428	49.30239866	398
105.3358352	-124.7487859	49.30205018	406
127.0818749	-124.748657	49.30187362	403
162.1463103	-124.7483969	49.301608	396
171.871435	-124.7483993	49.3015205	387
201.0468088	-124.7484064	49.30125798	387
210.7719334	-124.7485399	49.30125952	385
241.5254777	-124.748943	49.30117666	374
280.4259762	-124.7489525	49.30082663	365
311.1795205	-124.7490931	49.30056566	355
340.3548943	-124.7491002	49.30030314	345
371.1084386	-124.7492409	49.30004216	344
392.8544783	-124.7495104	49.29995775	342
412.3047275	-124.7495151	49.29978273	341
451.205226	-124.7495246	49.29943271	338
472.9512657	-124.7496628	49.29925924	336
503.70481	-124.7498035	49.29899826	337
538.7692455	-124.7500777	49.29873883	332
548.4943701	-124.7500801	49.29865132	332
570.2404098	-124.7503496	49.29856691	326
589.690659	-124.7506167	49.29857	322
614.4849591	-124.7509518	49.2985301	318
639.2792592	-124.7512869	49.29849021	312
661.0252989	-124.7514252	49.29831674	311
688.5321052	-124.7516971	49.29814481	307
688.5321052	-124.7516971	49.29814481	307
737.1577282	-124.7522384	49.29788846	305
767.9112725	-124.752379	49.29762748	309
792.2240841	-124.752713	49.29763134	308
816.5368956	-124.7530469	49.29763519	306
835.9871448	-124.753314	49.29763828	305
876.0848608	-124.7538506	49.29755693	305
905.2602347	-124.7542513	49.29756155	304

934.4356085	-124.7546521	49.29756617	300
973.3361069	-124.7551863	49.29757233	297
995.0821467	-124.7554558	49.2974879	294
1024.25752	-124.7558565	49.29749251	291
1053.432894	-124.7562572	49.29749713	288
1075.178934	-124.7563955	49.29732365	290
1105.932478	-124.7567985	49.29724075	288
1136.686023	-124.7572016	49.29715786	285
1164.192829	-124.7574734	49.29698591	278
1183.643078	-124.7574781	49.2968109	278
1193.368203	-124.7574804	49.29672339	274
1215.114242	-124.7576187	49.29654991	274
1245.867787	-124.7580217	49.29646701	271
1267.613826	-124.7582912	49.29638257	271
1302.678262	-124.7586966	49.29621216	273
1331.853636	-124.7590973	49.29621677	274
1362.60718	-124.7595003	49.29613386	273
1384.35322	-124.7597698	49.29604942	271
1442.703967	-124.7597838	49.29552437	267
1464.450007	-124.7600533	49.29543993	266
1503.350506	-124.7600626	49.2950899	265
1525.096545	-124.7603321	49.29500546	262
1534.82167	-124.7603344	49.29491795	262
1565.575214	-124.7607375	49.29483504	252
1609.067294	-124.7610139	49.29448807	244
1668.222917	-124.7611615	49.29396456	242
1677.948042	-124.7612951	49.29396609	238
1677.948042	-124.7612951	49.29396609	238
1715.925868	-124.761636	49.29370739	241
1753.903693	-124.7619769	49.29344869	245
1775.649733	-124.7622417	49.29353926	229
1797.395773	-124.7623799	49.29336578	231
1846.021396	-124.7629211	49.29310937	229
1873.528202	-124.7631929	49.29293741	229
1923.116802	-124.7633381	49.2925014	224
1984.623891	-124.763085	49.29197329	224
1998.377294	-124.7629538	49.29188426	224
2008.102419	-124.7629561	49.29179675	223
2051.594498	-124.763495	49.29162785	221
2061.319623	-124.7633615	49.29162632	220

2096.384058	-124.7636356	49.29136685	218
2145.009681	-124.7636472	49.29092931	217
2174.185055	-124.7636542	49.29066678	214
2212.162881	-124.7632594	49.29044343	214
2250.140706	-124.7628646	49.29022007	215
2279.31608	-124.7628716	49.28995754	209
2318.216579	-124.7628809	49.28960751	204
2327.941703	-124.7628833	49.28952	203
2363.341691	-124.763025	49.28921525	201
2398.741679	-124.7631667	49.2889105	201
2426.248485	-124.7634384	49.28873854	197
2466.346201	-124.7635813	49.28839003	190
2506.443917	-124.7637242	49.28804153	179
2537.197462	-124.7638647	49.28778053	166
2586.786062	-124.7640099	49.28734451	159
2596.511186	-124.7640123	49.287257	159
2624.017993	-124.764284	49.28708504	153
2676.389391	-124.7645627	49.28665055	141
2715.28989	-124.7650969	49.28665666	136
2770.303502	-124.7656403	49.28631273	131
2784.056906	-124.7657762	49.28622674	128
2813.943978	-124.7660924	49.28605528	124
2843.831051	-124.7664087	49.28588383	120
2873.718124	-124.7667249	49.28571237	115
2913.81584	-124.7672567	49.28580597	111
2923.540965	-124.7673903	49.2858075	111
2933.266089	-124.7675238	49.28580902	111
2988.279702	-124.7680672	49.28546508	105
3013.074002	-124.7684022	49.28542513	106
3037.868302	-124.7687372	49.28538518	105
3090.239701	-124.7690159	49.28495068	100
3111.985741	-124.7692853	49.28486621	101
3136.419814	-124.7696197	49.28484814	92
3160.853887	-124.7699541	49.28483006	88
3185.28796	-124.7702885	49.28481199	86
3209.722033	-124.7706229	49.28479391	85



## APPENDIX B — Glossary of Technical Terms

**BC Hydro Net Metering:** A program that allows small power producers to feed excess energy into the provincial grid for credit or payment.

**Capacity Factor:** The ratio of actual energy produced by a plant to the maximum possible output if it operated at full power continuously.

**CleanBC:** A provincial initiative supporting greenhouse gas reduction and renewable energy development.

**Crossflow Turbine:** A simple and durable turbine type suited for small-scale systems and variable flow rates.

**CT Reservoir (Clearwell Tank):** A treated water storage reservoir used to equalize pressure and supply during peak demand.

**Department of Fisheries and Oceans (DFO):** Federal agency responsible for protecting fish and aquatic habitat in Canada.

**FCM Green Municipal Fund:** A federal funding program that assists municipalities in implementing sustainable infrastructure projects.

**First Nations Consultation:** The required engagement process with Indigenous communities to ensure rights and interests are respected in project planning.

**Flow Rate (Q):** The volume of water passing a given point per unit time, typically measured in litres per second (L/s) or cubic metres per second ( $m^3/s$ ).

**Generator:** An electrical device that converts mechanical energy from the turbine into electrical energy.

**Grid-Tied:** A system connected to the main BC Hydro electrical grid, allowing for energy export or import as needed.

**Gross Head:** The total vertical height difference between the water source and the turbine. It represents the potential energy available for power generation.

**Hybrid System:** A configuration that allows both grid-tied and isolated (off-grid) operation for increased reliability.

**In-Conduit Hydro:** Micro-hydro generation within a pressurized water system, capturing energy normally dissipated by PRVs.

**Inverter:** An electronic device that converts direct current (DC) to alternating current (AC), typically used in off-grid systems.

**Karst:** A landscape formed from the dissolution of soluble rocks such as limestone or dolomite, characterized by sinkholes, underground drainage, and subsurface water recharge zones.

**kW / MWh:** Kilowatt and megawatt-hour; units of power and energy respectively, used to measure electricity generation or consumption.

**LiDAR (Light Detection and Ranging):** A surveying method using laser scanning to create high-resolution terrain models.

**Net Head:** The effective head after subtracting losses due to friction or turbulence in pipes and penstocks.

**O&M (Operations and Maintenance):** Routine activities to ensure the safe and efficient performance of the hydro system.

**Off-Grid:** A system operating independently of the main electrical grid, often requiring batteries or backup generators.

**Pelton Turbine:** A high-efficiency impulse turbine used for high-head, low-flow conditions, common in mountain streams.

**Penstock:** A pipeline or conduit that carries water under pressure from the intake to the turbine.

**Powerhouse:** A small structure that houses the turbine, generator, and control equipment for a hydro system.

**Pressure Reducing Valve (PRV):** A valve that reduces water pressure in a pipeline to safe operating levels; often replaced by turbines for energy recovery.

**psi / kPa:** Units of pressure: pounds per square inch and kilopascals, used to measure water pressure in pipelines.

**Right-of-Way (R/W):** A legal land corridor granting permission to install and maintain infrastructure such as penstocks or powerlines.

**Run-of-River:** A hydroelectric design that uses the natural flow of a stream without large reservoirs, minimizing storage and environmental impact.

**SCADA (Supervisory Control and Data Acquisition):** Remote monitoring and control system for automated equipment.

**Section 11 Permit:** A provincial permit required for any work “in and about a stream” to protect habitat and water quality.

**Turbine:** A mechanical device that converts the energy of flowing or falling water into rotational energy.

**Turgo Turbine:** An impulse turbine suitable for medium to high heads and moderate flows, offering good efficiency and compact design.

**Water Sustainability Act (WSA):** BC legislation governing water use, including licensing for diversion and power generation.

**WTP (Water Treatment Plant):** The facility where raw water is treated to meet potable standards for community use.