NEXT GENERATION HYDRO

Technical Workshop #2

Participant Package

January 29, 2015

nextgenerationhydro.ca

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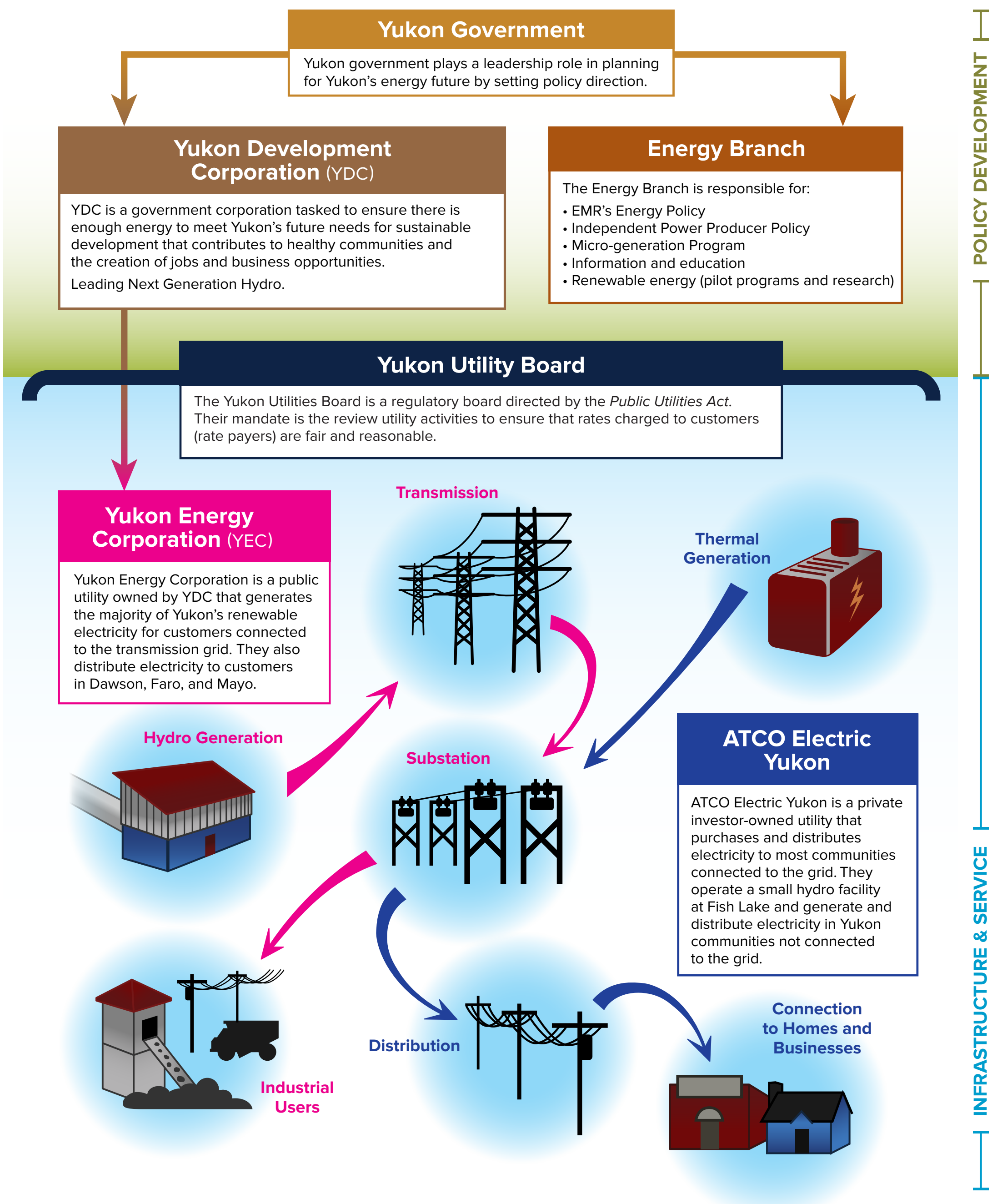
YUKON DEVELOPMENT CORPORATION

NEXT GENERATION HYDRO powering our future

YUKON'S ENERGY PARTNERS

Several key players have a role in ensuring that Yukon's electricity supply remains abundant, reliable, and cost effective for generations to come. Read more about each key organization and their role in the big picture.



YUKON HYDROELECTRIC POWER PLANNING DIRECTIVE CRITERIA

In early 2013, Yukon Government issued the Yukon Hydroelectric Power Planning Directive to Yukon Development Corporation (YDC).

The Directive tasks YDC to plan the development of one or more hydroelectric projects, to ensure together with supporting renewables and to the minimum extent feasible non renewable sources of electrical power, an adequate and affordable supply of reliable and sustainable electrical power in Yukon.

DIRECTIVE CRITERIA 1.0

" Evaluates the expected growth in residential, commercial and industrial demand for electrical power in Yukon."

DIRECTIVE CRITERIA 2.0

" Plans for scalability, so as to allow for the increase of energy supply over time to meet projected demand growth."

DIRECTIVE CRITERIA 3.0

" Assess the project's financial needs and risks, and evaluate options for project financing and financial risk mitigation."

DIRECTIVE CRITERIA 4.0

" Determine the anticipated positive and negative socio-economic and environmental effects of the project, and develop specific means of maximizing its benefits, minimizing its adverse effects and mitigating any unavoidable negative impacts."

DIRECTIVE CRITERIA 5.0

" In respect to the effects have particular regard to the impacts on and opportunities for, the First Nation or First Nations in whose traditional territory the project may be located."

DIRECTIVE CRITERIA 6.0

" Engage with First Nations to explore options for project locations as well as opportunities for partnership in project planning and execution."

DIRECTIVE CRITERIA 7.0

" Consider one or more specific possible locations for the project, taking into consideration the above criteria as well as proximity to the existing and expected future customer base."

MATCHING ENERGY NEED TO ENERGY AVAILABILITY

Electrical systems are built to continuously match the supply of electricity to customer demand. On a minute-by-minute, daily and seasonal basis our demand for electrical **energy peak** goes up and down depending on demand changes such as turning off and on lights, TVs, baseboard heating, stoves etc. To meet these changes in demand, the electrical system must have enough **capacity** to supply **energy** exactly when it is needed. As well, there needs to be enough stored energy to meet upcoming needs for future demand.

Energy and Capacity:

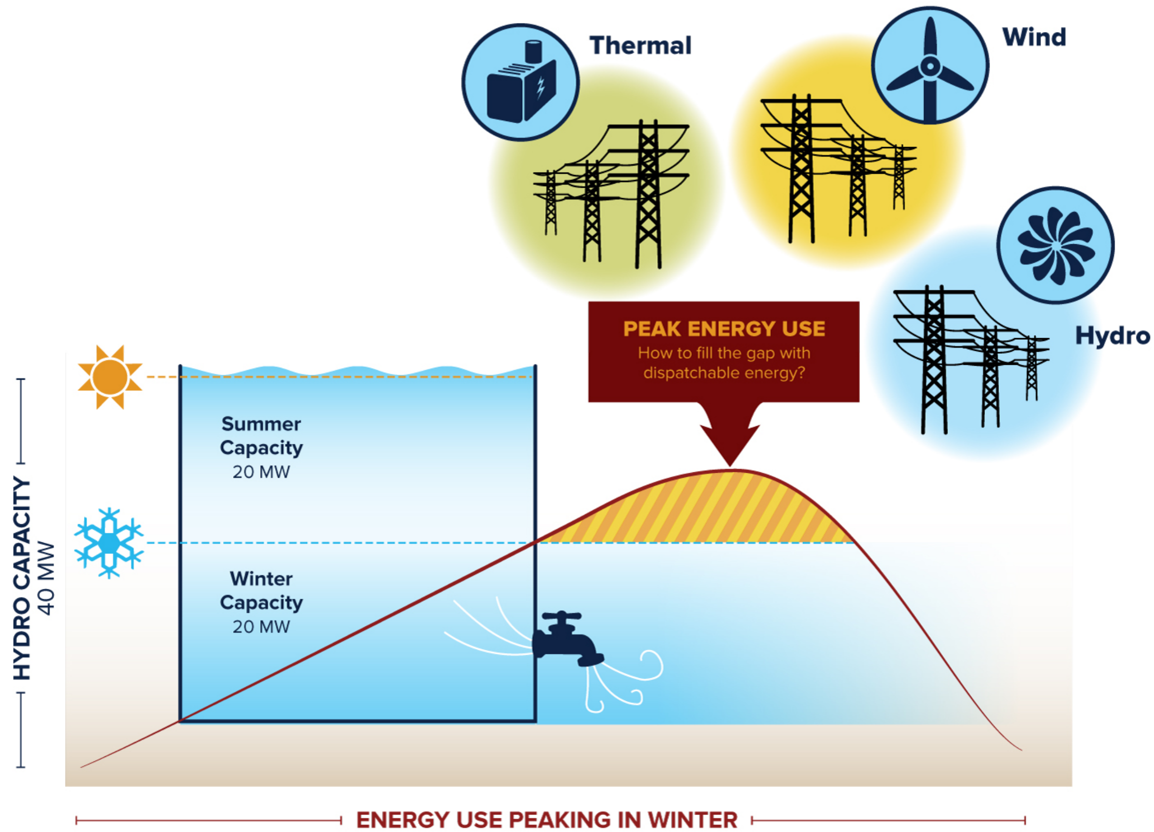
Electricity generation is measured via two related but different measures: **energy** and **capacity.**

Energy is a measure of power used over time and represents the “work” that could be done. For example, a 1 MW plant that operates for 1 hour is said to have produced 1 megawatt-hour (“MWh”) of energy.

Capacity is a measure of the ability of a given power source to produce power, typically measured in watts (“W”), kilowatts (“kW”), or megawatts (“MW”).

The difference between **energy** and **capacity** is important to understand and key to thinking about the requirements of an electrical generation source. Put simply, **energy** is what we consume to do work (e.g. cook food, light & heat our homes) and **capacity** is the assurance that the energy we want to use is instantly available when energy is required.

The image below (next page) shows a reservoir with 40MW total capacity. The bottom half of the tank represents winter capacity. In this case only 20MW of capacity is available in the winter and all 40MW is available in the summer. When capacity is released and put to use it turns into energy. When the energy needed exceeds the capacity (at peak times) held in the tank then other energy sources are needed. These energy sources must be dispatchable (see below) in order to meet the short-term peak need.



Dispatchable and Intermittent Energy sources:

Electric generation sources (hydroelectricity, wind, solar, diesel, natural gas) can be thought of in terms of their ability to supply energy on a longer-term basis, and their capacity to provide energy when the energy is needed (peak times).

Generation sources that can be called upon at any time to generate electricity are said to be **dispatchable**. These **dispatchable** generation sources have dependable capacity and deliver what is called firm energy because energy is consistently available when required. Examples of **dispatchable** generation sources that provide larger quantities of "firm" energy are hydroelectric projects with water storage, natural gas generation and diesel generation.

Generation sources that generate electricity only when their fuel supply is available, and not necessarily when the energy is needed, are called intermittent generators. Examples of intermittent generators are wind, solar power and some run of river hydro projects.

Turning Electricity On and Off

Another important characteristic to consider when comparing different generation options is the speed at which various power sources are able to turn on and off and to change generation levels (e.g. ramp up and ramp down).

For example, coal and nuclear plants need days or weeks to start-up and shut-down. These power sources are run to meet “base loads” or the constant amount of power needed on any given day.

Other generation options, such as hydro-with- storage, simple cycle gas turbines, and natural gas reciprocating engines, can be dispatched quickly to meet short-term changes in demand for power. For example, they can be ramped up to provide lots of power in the morning when everyone wakes up, and ramped down once everyone goes to work. These variable types of generators have the ability to change the amount of energy supplied frequently in response to short term (e.g. hourly, daily) changes in demand.

FORECASTING THE FUTURE – WHAT IF?

The future is unknowable, but certain future events are far likelier to occur than alternative events. Forecasting uses historical and contextual data to predict the likelihood of events with the goal of planning for the future. The purpose of forecasting is to make it easier to make decisions today in order to prepare for future events.

- Forecasting facilitates planning.
  - What are the options?
- Planning facilitates analysis.
  - What are the potential costs, risks and benefits of each option?
- Analysis facilitates decision-making.
  - Given what we know today, what is the most reasonable course of action?

Midgard used a univariate, or single variable, model to forecast future electrical energy demand.

Univariate modeling has the benefit of being easy to understand and to replicate. The alternative method of a multivariate model is more complicated, more prone to errors, and leads to a false sense of accuracy. Given the long period of time into the future that is being forecast and the fact that uncertainty grows exponentially with this period of time, the univariate model is the best approach.

Midgard's Rules of Forecasting:

- Forecasting is doomed to be wrong. But the exercise is worthwhile, in terms of the actual process of identifying trends, the maturity of trends, and the alternatives. Many predictions turn out to be more true than not, but the timing is rarely perfect.
- Trends and equilibriums have remarkable staying power. The forces for change have to be substantially greater than the forces supporting the status quo in order to instigate change.
- Discontinuities do happen. But the greater the resistance to change, the greater the shock and disorder when change does arrive.
- Patterns repeat themselves. The best forecasting methodology often seeks out previous and similar scenarios in order to inform forecasts. History does not repeat itself, but it often rhymes.

"It's tough to make predictions, especially about the future." Yogi Berra

BUILDING SCENARIOS

Envisioning Yukon 20-50 Years From Today

In order to determine the need for Next Generation Hydro the technical team had to forecast energy and capacity need 20-50 years from today. They did this by creating three scenarios for electricity use using a top down, single variable model. The chart below details the three scenarios that were explored.

	Low	**Baseline**	**High**
Population 2035	45,600	48,100	53,400
Population 2065	55,900	64,600	104,500
Non-Industrial Demand	9.8MWh/year per capita	9.8MWh/year per capita	9.8MWh/year per capita
Industrial Demand	- 50 GWh/year - 1 grid connected mine	- 75GWh/year - 1.5 grid connected mines	-100 GWh/year - 2 grid connected mines

Factors that can impact electricity use

Forecasting electricity use in the future is no simple feat. Many factors can affect how we use electricity from the adoption to electric cars, to changes in energy efficiency regulations. Some factors that can impact electricity use include:

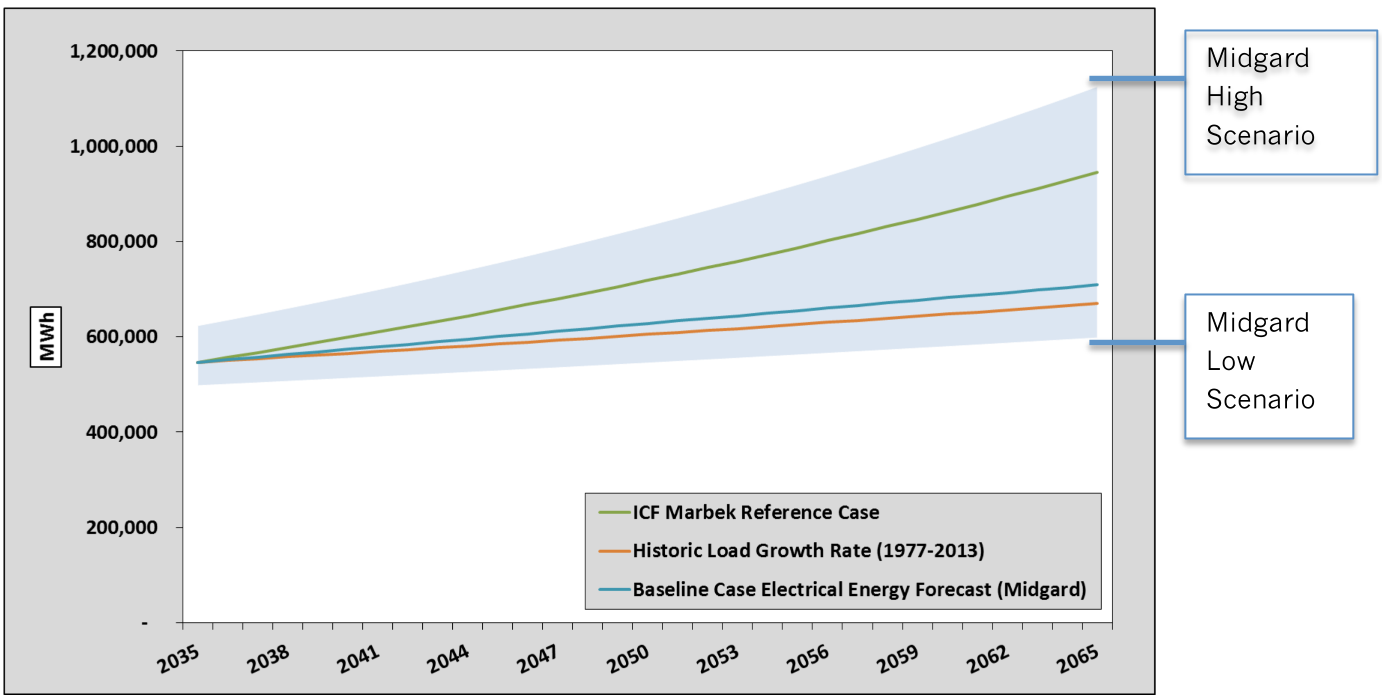
- Climate change impacts
- Technological change
- Regulation and Policy change
- Demographic and population changes

Forecasting is a tool that is used to help plan for the future and minimize risk. If we do not plan today for new hydro we risk having to use a fossil fuel solution.

Midgard's forecast provides high and low scenarios that in turn provide an envelop of plausible future electrical energy consumption over the long-term (the blue zone in the graph below). Figure E-1 below provides different ways of calculating future electricity demand. All three examples fall within the range of Midgards high and low scenarios.

- Example scenario I: The Baseline Case Midgard forecast shows electricity demand if Yukon's population grows to 64,600 people by 2065 and 1.5 mines are operating by 2031.
- Example scenario II: The ICF Marbek Reference Case shows anticipated electricity demand if 75% of new Yukon housing units use electricity heating for space heating in the future.
- Example scenario III: Yukon's historic compounded electrical consumption growth rate for the period between 1977 and 2013. This scenarios shows electricity demand if growth continues at the same rate it has in the past.

Figure E-1: Examples of Growth Scenarios (2035-2065)



NEXT GENERATION HYDRO - ENGAGEMENT AND TECHNICAL PROCESS OVERVIEW

Two teams, engagement and technical, are working together to achieve the work identified in the Next Generation Hydro Work Plan.

The chart below demonstrates the key activities in each stream of work over the course of 2015.

The **Technical Team** will work to the end of 2015 to narrow the number of potential hydro sites based on the criteria identified in the Yukon Hydroelectric Power Planning Directive. The team will draft a number of technical reports that will assess the feasibility of the short listed potential hydro projects against the Directive criteria.

The **Engagement Team** will work along-side the technical team to inform and receive input from First Nations, as well as stakeholders and the public, as technical papers are produced. Engagement feedback will be collected and reported in the Next Generation Hydro Discussion Paper and will be considered in the development of the Next Generation Hydro and Transmission Viability Study.

NEXT GENERATION HYDRO - ENGAGEMENT AND TECHNICAL PROCESS (OCTOBER 2014 – DECEMBER 2015)

Technical stream

OCTOBER – DECEMBER, 2014

- Review and analysis of all potential hydro sites in the Yukon against Directive and Screening Criteria
- Research and analysis of Technical Paper #0: Site Screening Inventory Report
- Research and analysis of Technical Paper #1: Economic Growth Scenarios & Energy Demand Forecasts

JANUARY – FEBRUARY, 2015

- Technical Paper #0 - Site Screening Inventory report completed and short list of potential hydroelectric projects announced
- Release of Technical Paper #1 - Economic Growth Scenarios & Energy Demand Forecasts

MARCH – MAY, 2015

- Research and technical analysis of Technical Papers #2–#6

SEPTEMBER – OCTOBER, 2015

- Release of Draft Technical Papers #2–#6
- Development of Next Generation Hydro and Transmission Viability Study based on the results of the Technical Papers #0–#6
- YDC Board reviews Viability Study and Next Generation Hydro Discussion Paper and makes recommendations for Business Case development

END OF 2015

- Development of Next Generation Hydro Business Case
- YDC Board presents Next Generation Hydro Business Case to Minster Responsible for YDC

Engagement stream

OCTOBER – DECEMBER, 2014

- Letters and calls to First Nations to introduce the project
- Calls and interviews with key stake-holder groups to record interests and concerns
- Technical Workshop #1 – Introduction to Next Generation Hydro Phase 1 Project Identification. The process and rationale are explained, input received and concerns are identified.
- Public Speaker Event #1 – (video to be placed on website)
- Public information household flyer

JANUARY – FEBRUARY, 2015

- Technical Workshop #2 – January, 29-30:
  Day 1: Presentation of the Short List Report
  Day 2: Presentation and input sought on the Draft Technical Paper — Economic Growth Scenarios & Energy Demand Forecasts
- Public Speaker Event #2 - Jan 29 – Presentation of the Site Screening Inventory & Draft Technical Paper – Economic Growth Scenarios & Energy Demand Forecasts
- Public Information household flyer
- On going meetings with affected First Nations and communities

MARCH – MAY, 2015

- Yukon First Nations Energy Forum Part 2 – Energy Investment Opportunities and Best Practices
- Public Speaker Event #3 – First Nation Energy Investment (video to be placed on website)
- On going meetings with affected First Nations and communities

SEPTEMBER – OCTOBER, 2015

- Technical Workshop (2 day) – Presentation and feedback on Draft Technical Papers #2–#6
- Public Speaker Event #4 – Towards a Next Generation Hydro and Transmission Viability Study (video to be placed on website)
- On going meetings with affected First Nations and communities
- Release of Next Generation Hydro Engagement Discussion Paper (summary of engagement feedback received)
- "What we heard" communications to the public from the Discussion Paper
- Release of Next Generation Hydro and Transmission Viability Study
- Public information household flyer

END OF 2015

- Next Generation Hydro Business Case Announcement

Technical Papers:

(#0) Site Screening Inventory **(#1)** Updated Economic Growth Scenarios & Energy Demand Forecasts
(#2) Scalability of Next Generation Hydro Project Options **(#3)** Jurisdictional Transmission Line Technical Logistics Analysis
(#4) Jurisdictional Transmission Connection Market Assessment **(#5)** Project Cost per Hydro Development Phase
(#6) Positive and Negative Socio-economic and Environmental Effects

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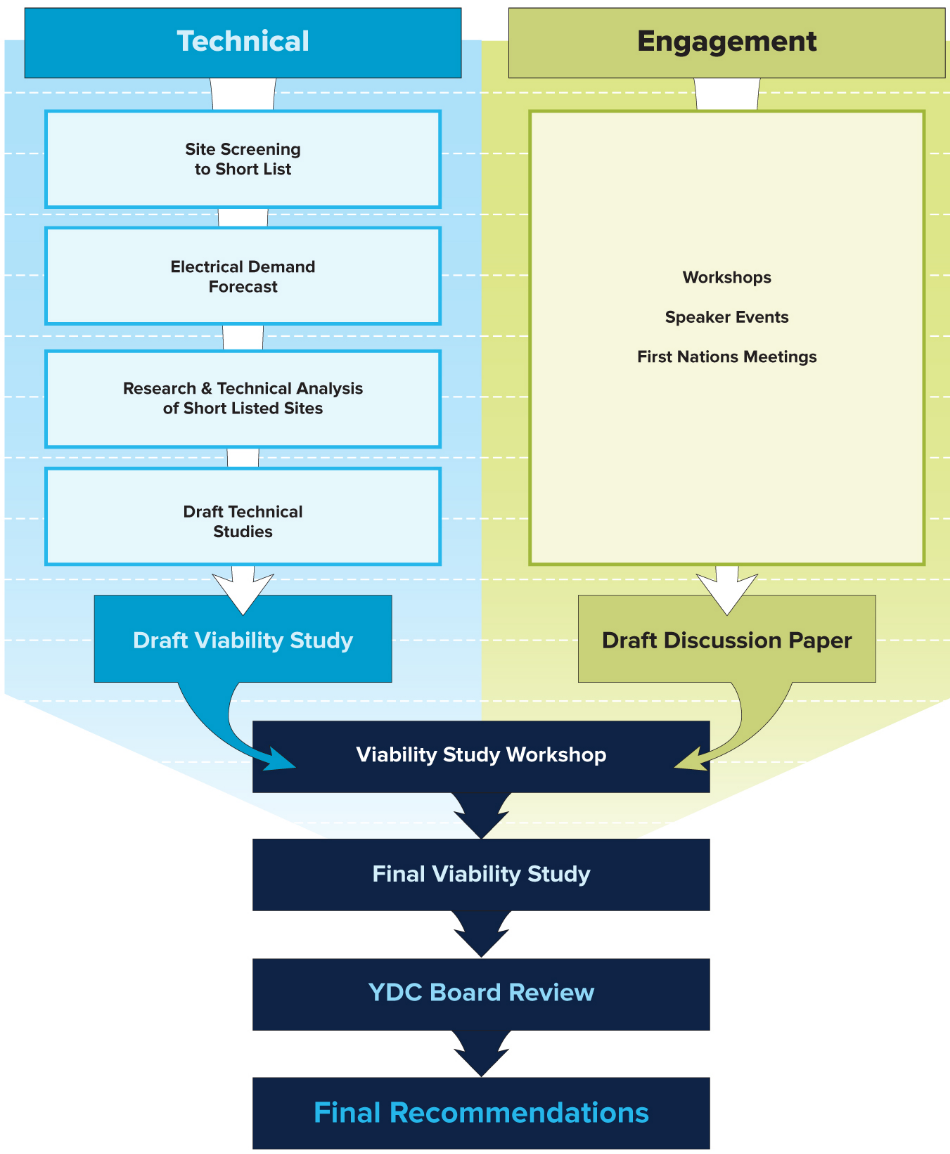
PROJECT PROCESS

Input, comments and feedback will be gathered throughout the course of the year as technical results are shared. Feedback will be compiled in the *Next Generation Hydro Discussion* paper that will be presented to the Yukon Development Corporation (YDC) board together with a summary of all technical work – *the Next Generation Hydro and Transmission Viability Study*. The YDC board will review both documents to develop a recommendation for one or more potential hydro sites.



SITE SCREENING PROCESS

The technical team has reviewed, compared and ranked over 200 potential hydro sites in the Yukon to determine suitable sites to meet our electricity needs 20–50 years from now.

Studies from the last 60 years were reviewed and compiled in this process.
The methodology below provides an overview of how the sites were short listed.

PART 1

SCREEN 0 Reconciliation of Known Projects

Duplicate projects and projects with not enough detail of study were eliminated.

SCREEN 1 Fundamental Development Barrier Screen

Projects that had the following characteristics were eliminated:

- Main stem of the Yukon River
- Urban flooding
- Projects in a National Park
- Projects smaller than 10 MW
- Incorrect project type (projects that were water diversion only, storage only, or pumped storage)

SCREEN 2 Fundamentally Uneconomic Screen

High-level project costing and energy production assumptions were used to eliminated projects that were fundamentally uneconomic. Any project expected to produce energy at a higher cost than the equivalent thermal generator (18.3¢/kWh) were screened out from further study.

16 PROJECTS OF INTEREST

PART 2

The 16 projects of interest were reviewed according to the four following areas.

AREA 1 Environmental Considerations	AREA 2 Surface / Subsurface Considerations	AREA 3 Constructibility Considerations	AREA 4 Economic Considerations
• Fish Habitat • Aquatic Species at Risk • Terrestrial Species at Risk	• Land Tenure (surface & subsurface) • First Nation Settlement Lands	• Permafrost Classification • Terrain Hazards • Bedrock Faults	• Value of Storage • Ability Delivery Winter Energy

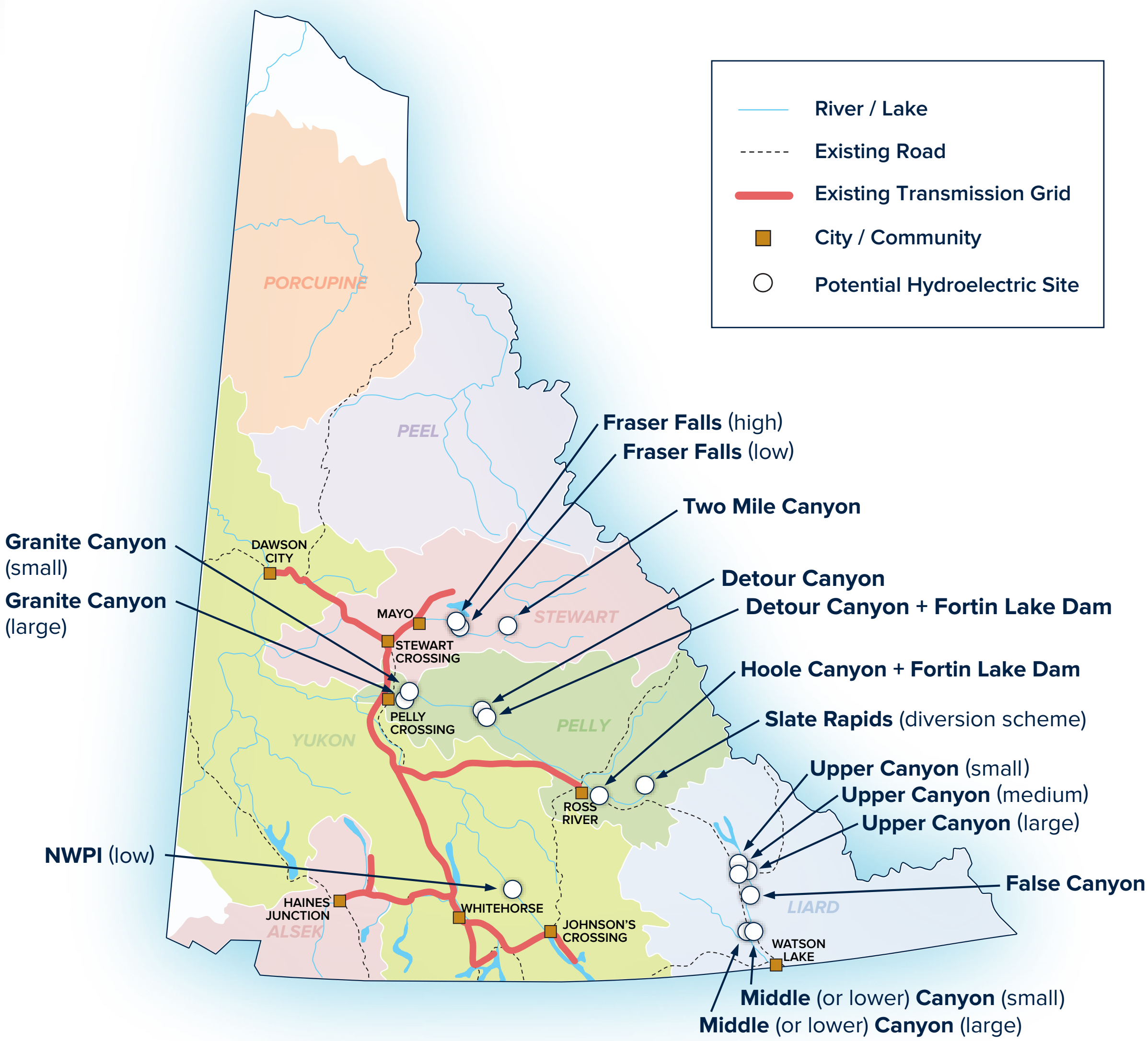
Based on this analysis short-listed sites were recommended to be reviewed as part of the viability study.

SHORT LIST

The next step is to assess the short listed sites against the technical criteria from the Yukon Hydroelectric Power Planning Directive and recommend one or more for business case development.

NEXT GENERATION HYDRO

SHORT LIST SITE MAP | JANUARY 2015



DETOUR CANYON

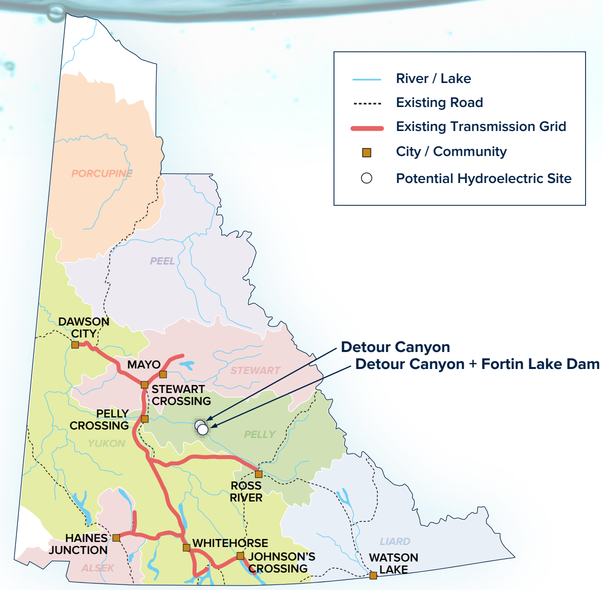
with or without FORTIN LAKE DAM

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
65 - 100 MW	80 km	Faro and Ross River	Acceptable
		RIVER	
		Pelly River	

PROJECT DESCRIPTION

Detour Canyon is a potential 65 MW hydroelectric project on the Pelly River, located in the Pelly River Basin approximately 80 km downstream (northwest) of Faro.

Detour Canyon + Fortin Lake Dam is a two dam project that expands on the above mentioned Detour Canyon project with the addition of a storage reservoir on Fortin Lake. The Fortin Lake dam is located approximately 95 km east of the community of Ross River and provides additional storage capability by flooding Fortin Lake and Pelly Lake. While the design and layout of the main power dam in Detour Canyon remains the same, the additional storage from the upstream Fortin Lake allows for an increased installed capacity of 100 MW.



DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- No Aquatic Species-at-Risk noted
- Good ability to meet long term outlook (50 year) future energy gaps
- Terrestrial Species-at-Risk noted, but no major constraints expected

CONS:

- River deemed as having a high suitability for fish habitat (in both the Detour Canyon and Fortin Lake areas)
- Anvil Creek (which is flooded) is a Special Consideration zone for fisheries
- Presence of Land Tenure, First Nations Settlement Lands, and Interim Projected Lands
- Potential Transboundary issues as per Yukon River Salmon Agreement with USA
- The 100 MW version (with Fortin Dam) is likely oversized
- Fortin Lake Dam Only: Terrestrial SAR flagged as having moderate mitigation issues
- Fortin Lake Dam Only: Constructability risks deemed high

Recommendation: Study further, including scalability analysis to re-evaluate project size (likely resulting in a smaller project)

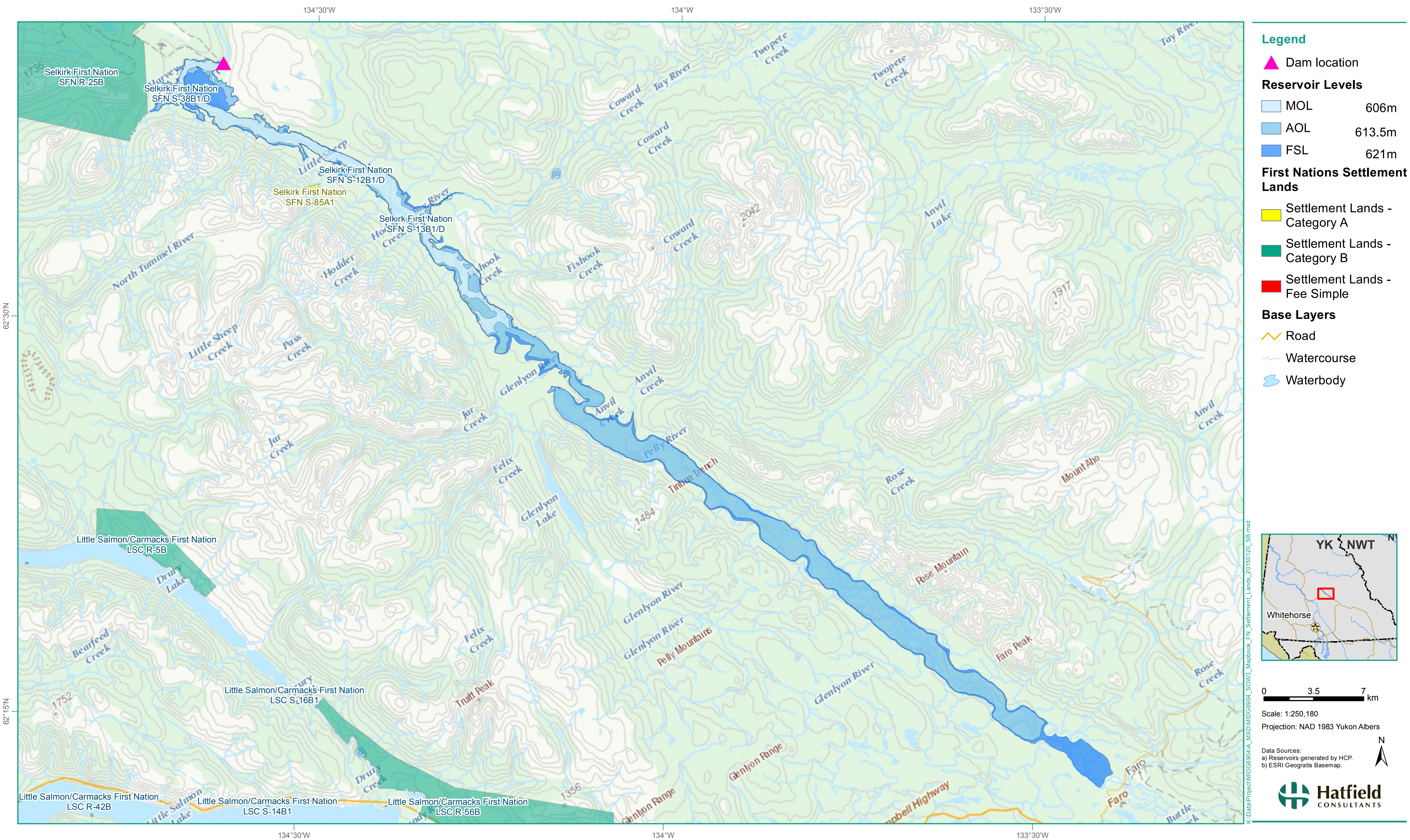
AREA OF STUDY	WITHOUT FORTIN DAM	WITH FORTIN DAM
Environmental (Fisheries)	H	H
Environmental (Aquatic SAR)	L	L
Environmental (Terrestrial SAR)	L	M
Surface/Subsurface Tenure	H	H
Constructability	M	H
Economic (Meeting Gap)	L	L
Economic (Size vs. Need)	M	H

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS

Map 1 – Detour Canyon [Site ID = PELLY-PELLY-0567-A & PELLY-PELLY-0567-B]

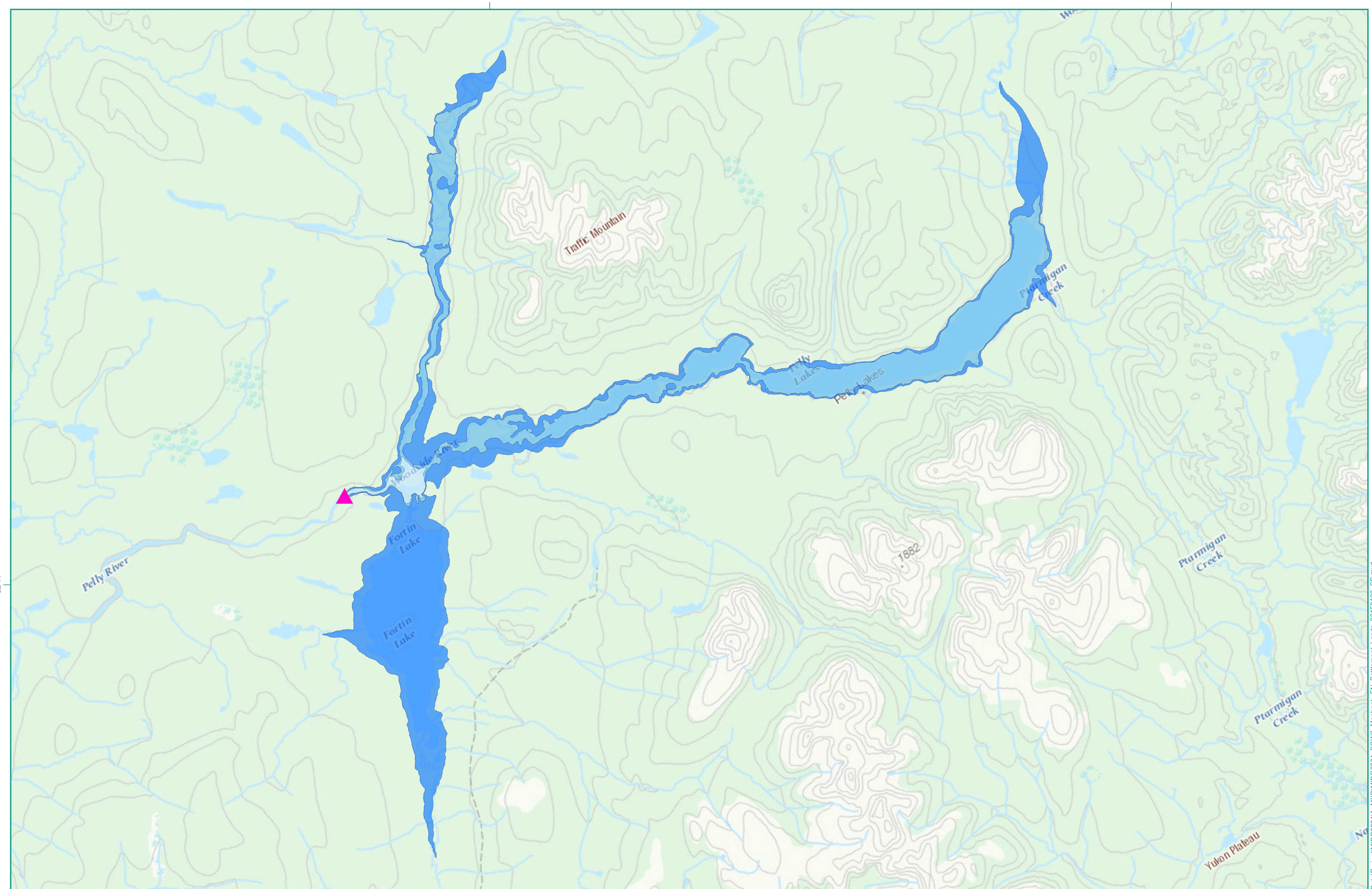
(Note: This map shows the main power dam location only. See Map 2 for the Fortin Lake Dam component of the 'Detour Canyon + Fortin Lake Dam' project.)



FIRST NATIONS SETTLEMENT LANDS

Map 2 – Fortin Lake Dam [Site ID = PELLY-PELLY-0567-B & PELLY-PELLY-0760-A]

(Note: This map shows the Fortin Lake Dam component of the 'Detour Canyon + Fortin Lake Dam' and 'Hoole Canyon + Fortin Lake Dam' projects. See Map 1 and Map 8 for the main power dam components of these projects.)



Legend

- Dam location

Reservoir Levels

MOL	878m
AOL	884m
FSL	891m

First Nations Settlement Lands

- Settlement Lands - Category A
- Settlement Lands - Category B
- Settlement Lands - Fee Simple

Base Layers

- Road
- Watercourse
- Waterbody

0 2 4 km

Scale: 1:150,100

Projection: NAD 1983 Yukon Albers

Data Sources:
a) Reservoirs generated by HCP.
b) ESRI Geogratis Basemap.

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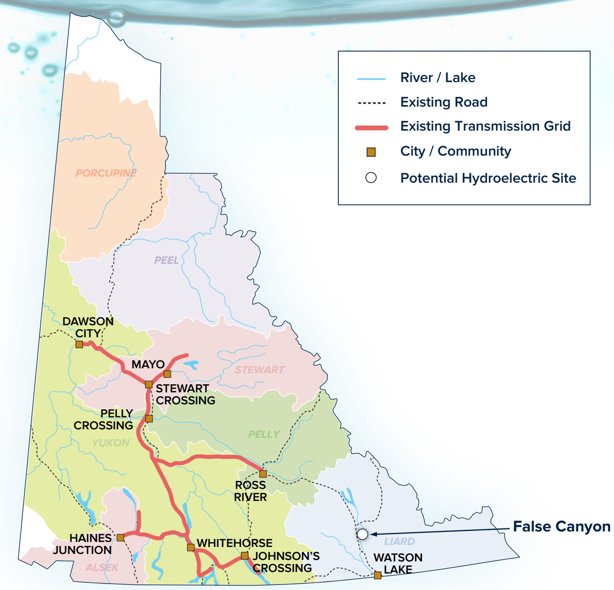
FALSE CANYON

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
58 MW	10 km to potential future transmission 310 km to existing transmission	Watson Lake **RIVER** Frances River	Acceptable



PROJECT DESCRIPTION

False Canyon is a potential 58 MW hydroelectric project on the Frances River, located in the Liard River Basin approximately 75 km north of Watson Lake. The project first appeared in T. Ingeldow & Associates Limited's report entitled "Power Survey of the Liard River Basin and Northwest Territories" in 1970.

DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- Constructability risks deemed low
- Good ability to meet long term outlook (50 year) future energy gaps

CONS:

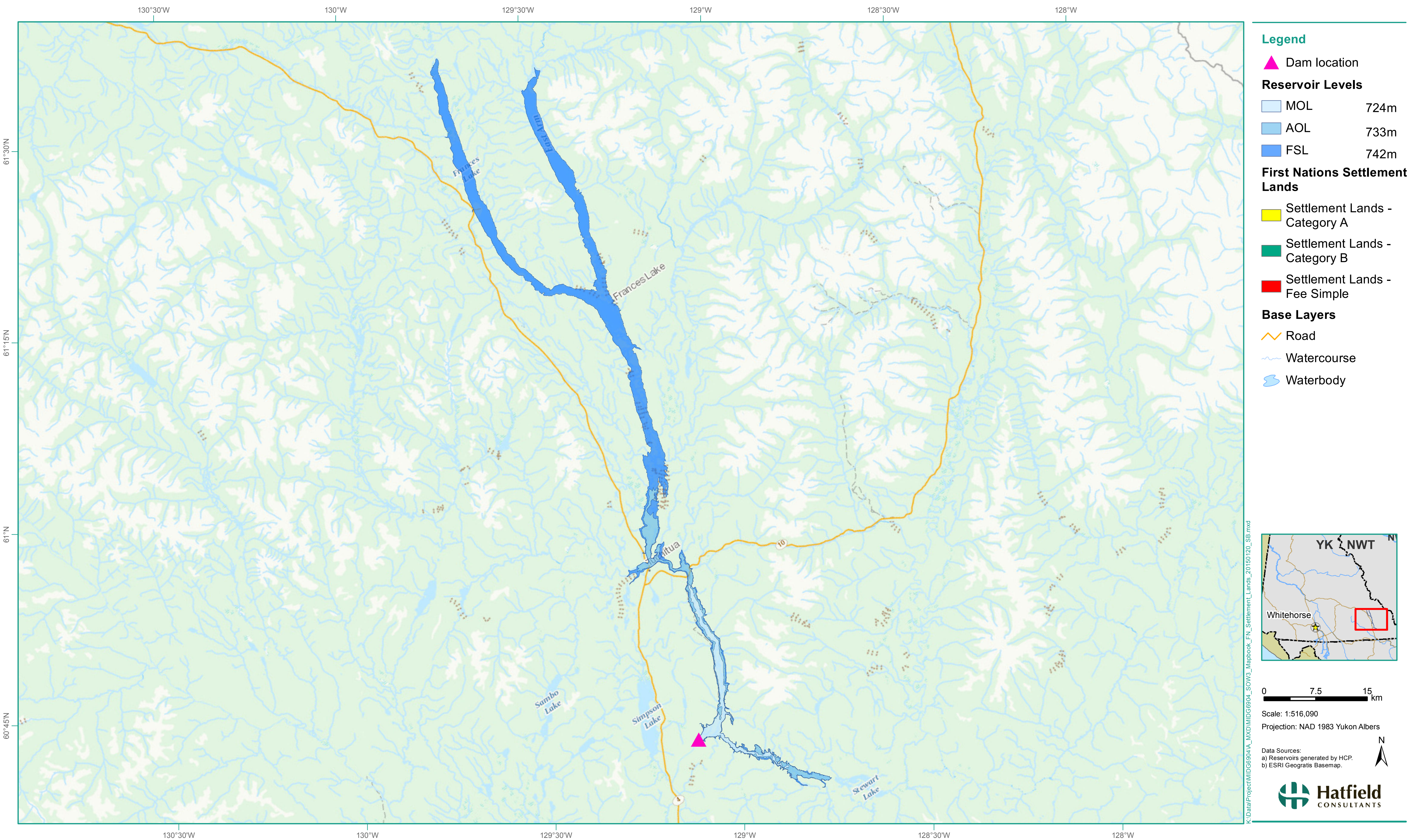
- Relocation of existing highways and bridges required
- Frances Lake (which is flooded) is noted as fisheries Conservation Waters with depressed fisheries stocks
- Frances River is flagged for potential Transboundary fisheries issues
- Aquatic Species-at-Risk present in watershed
- Terrestrial Species-at-Risk flagged as having moderate mitigation issues
- Presence of Land Tenure and Interim Projected Lands noted

Recommendation: Study further, including scalability analysis to re-evaluate project size

AREA OF STUDY	FALSE CANYON
Environmental (Fisheries)	H
Environmental (Aquatic SAR)	H
Environmental (Terrestrial SAR)	M
Surface/Subsurface Tenure	H
Constructability	L
Economic (Meeting Gap)	L
Economic (Size vs. Need)	M

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS
Map 3 – False Canyon [Site ID = LIARD-FRANC-0696]



FRASER FALLS

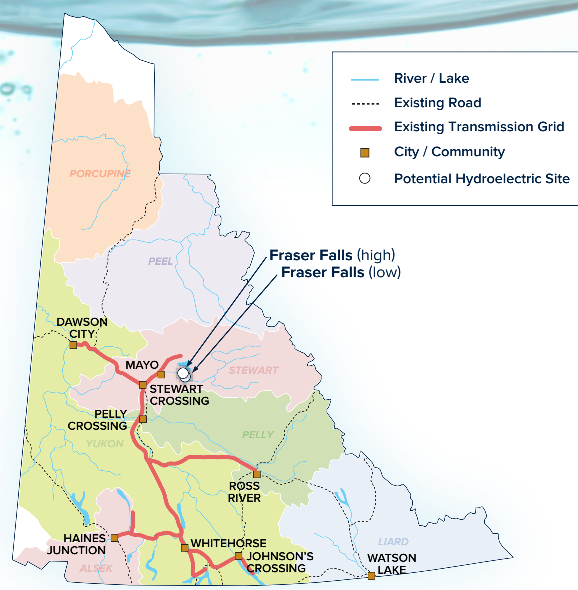
HIGH and LOW

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
100 - 300 MW	80 km	Mayo **RIVER** Stewart River	Excellent

PROJECT DESCRIPTION

Fraser Falls (High) is a potential 300 MW hydroelectric project on the Stewart River, located in the Stewart River Basin approximately 40 km upstream of Mayo.

Fraser Falls (Low) is a 100 MW hydroelectric project that is a smaller alternative to the above mentioned "Fraser Falls (High)" project. The Fraser Falls (Low) project is located at the same location (approximately 40 km upstream of Mayo on the Stewart River).



DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- No Aquatic Species-at-Risk noted
- Good ability to meet long term outlook (50 year) future energy gaps

CONS:

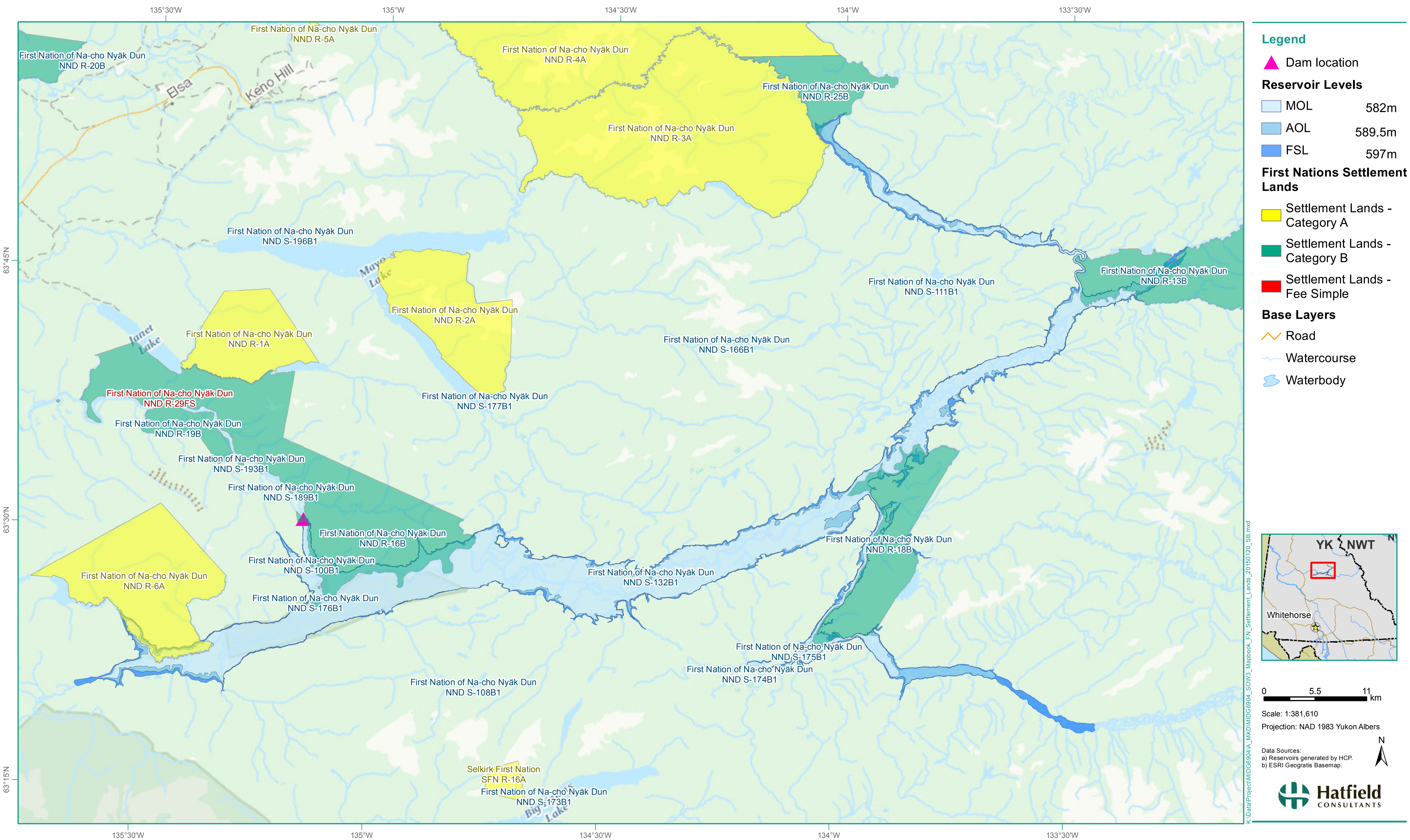
- River deemed as having a high suitability for fish habitat
- Horseshoe Slough (which is flooded) is deemed a Habitat Protection Area
- Potential Transboundary issues as per Yukon River Salmon Agreement with USA
- Terrestrial Species-at-Risk flagged as having moderate mitigation issues
- Presence of Land Tenure (for High option only) and First Nations Settlement Lands noted
- Constructability risks deemed high
- Both the 100 MW and 300 MW versions are likely oversized

Recommendation: Study further, including scalability analysis to re-evaluate project size (likely resulting in a smaller project)

AREA OF STUDY	LOW VERSION	HIGH VERSION
Environmental (Fisheries)	H	H
Environmental (Aquatic SAR)	H	H
Environmental (Terrestrial SAR)	M	M
Surface/Subsurface Tenure	H	H
Constructability	H	H
Economic (Meeting Gap)	L	L
Economic (Size vs. Need)	H	H

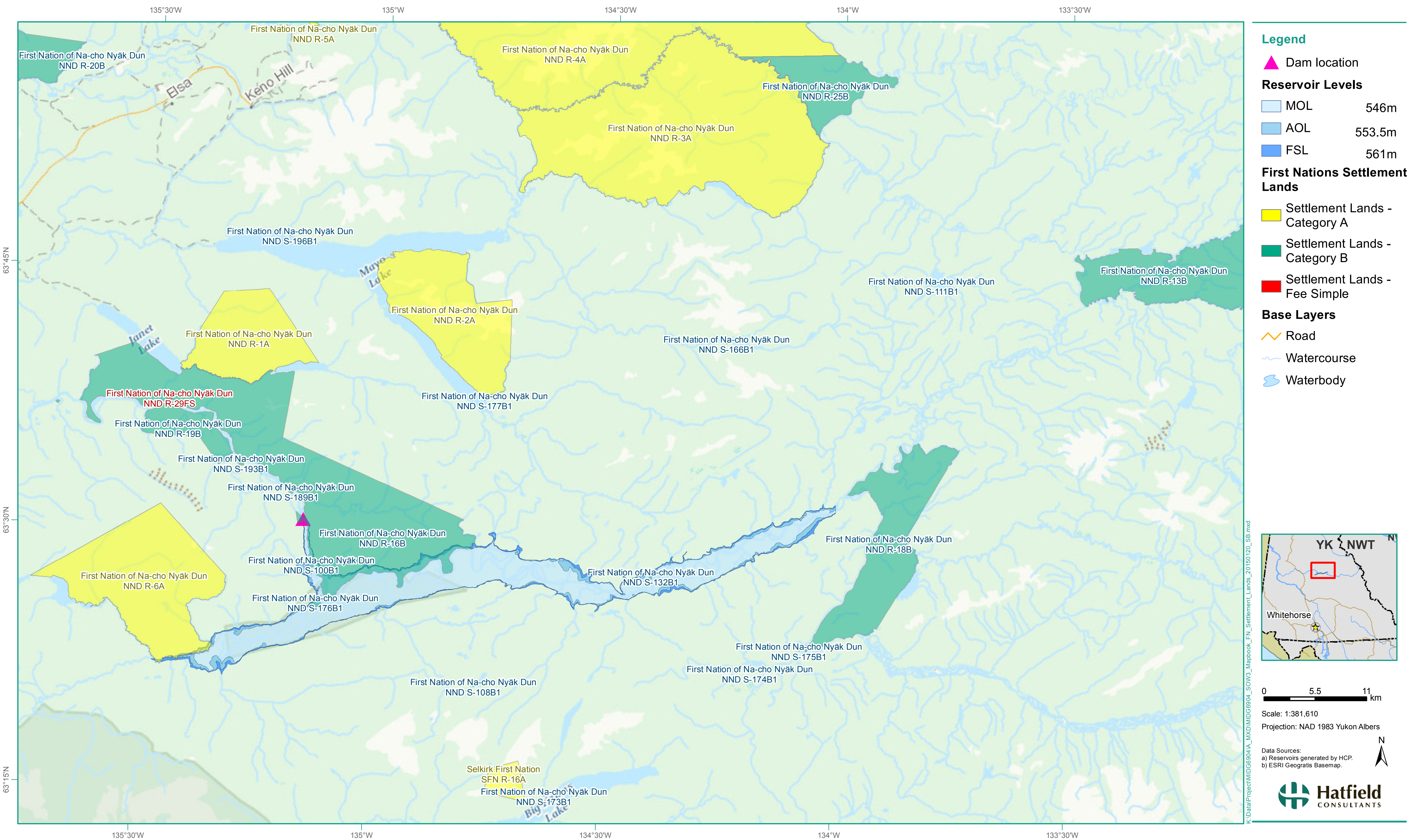
H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS
Map 4 – Fraser Falls (High) [Site ID = STEWA-STEWA-0519-B]



FIRST NATIONS SETTLEMENT LANDS

Map 5 – Fraser Falls (Low) [Site ID = STEWA-STEWA-0519-A]



GRANITE CANYON

LARGE and SMALL

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
80-254 MW	15 km	Pelly Crossing **RIVER** Pelly River	Acceptable

PROJECT DESCRIPTION

Granite Canyon (Large) is a potential 254 MW hydroelectric project on the Pelly River, located in the Pelly River Basin approximately 20 km east of Pelly Crossing.

Granite Canyon (Small) is an 80 MW hydroelectric project that is a smaller alternative to the above mentioned "Granite Canyon (Large)" project. The Granite Canyon (Small) project is located at the same location (approximately 20 km east of Pelly Crossing.)

DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- No Aquatic Species-at-Risk noted
- Good ability to meet long term outlook (50 year) future energy gaps

CONS:

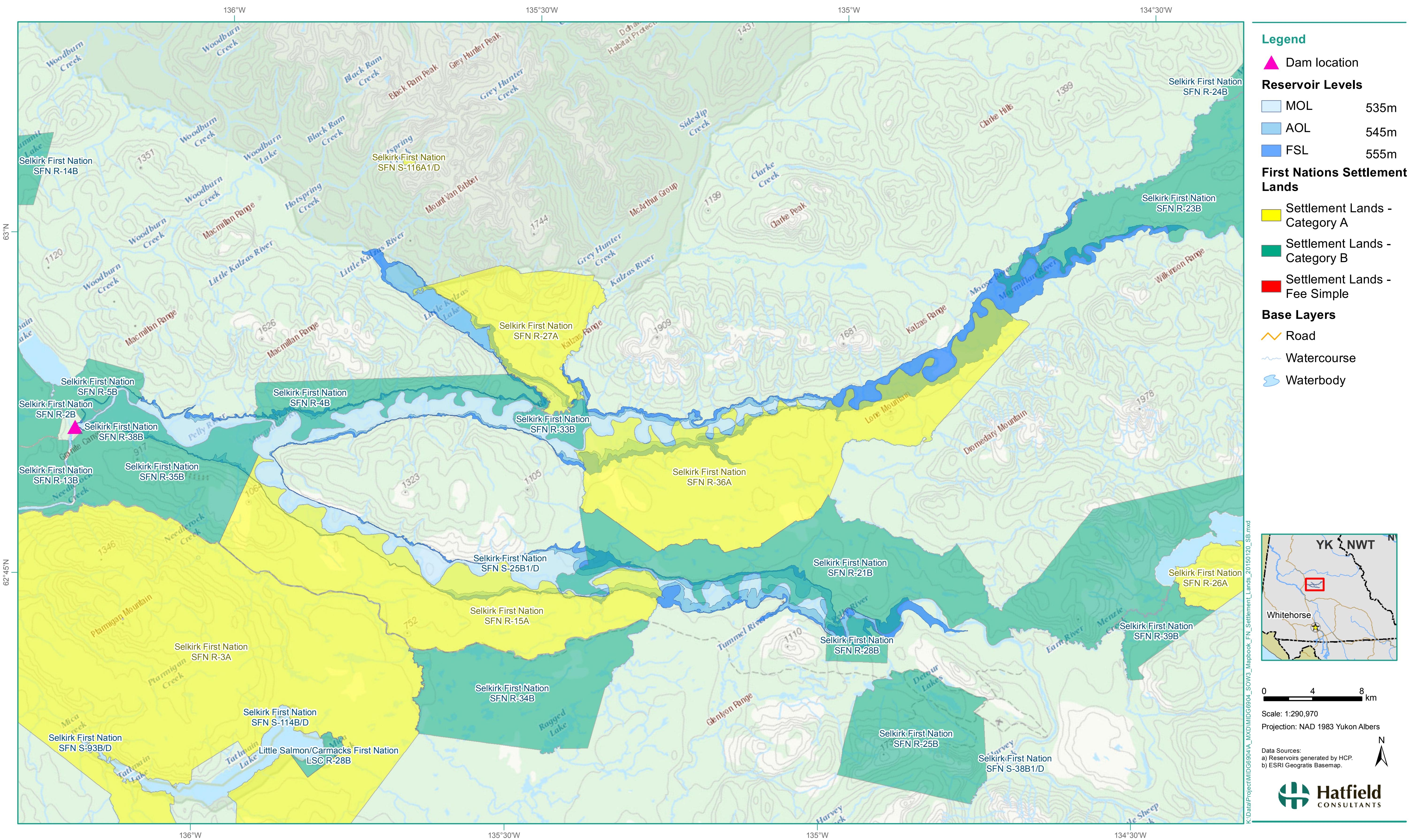
- River deemed as having a high suitability for fish habitat
- Needlerock and Mica Creek are Special Consideration Zones
- Potential Transboundary issues as per Yukon River Salmon Agreement with USA
- Terrestrial Species-at-Risk flagged as having significant mitigation issues
- Presence of Land Tenure and First Nations Settlement Lands noted
- Constructability risks deemed high
- Both the 80 MW and 254 MW versions are likely oversized

Recommendation: Study further, including scalability analysis to re-evaluate project size (likely resulting in a smaller project)

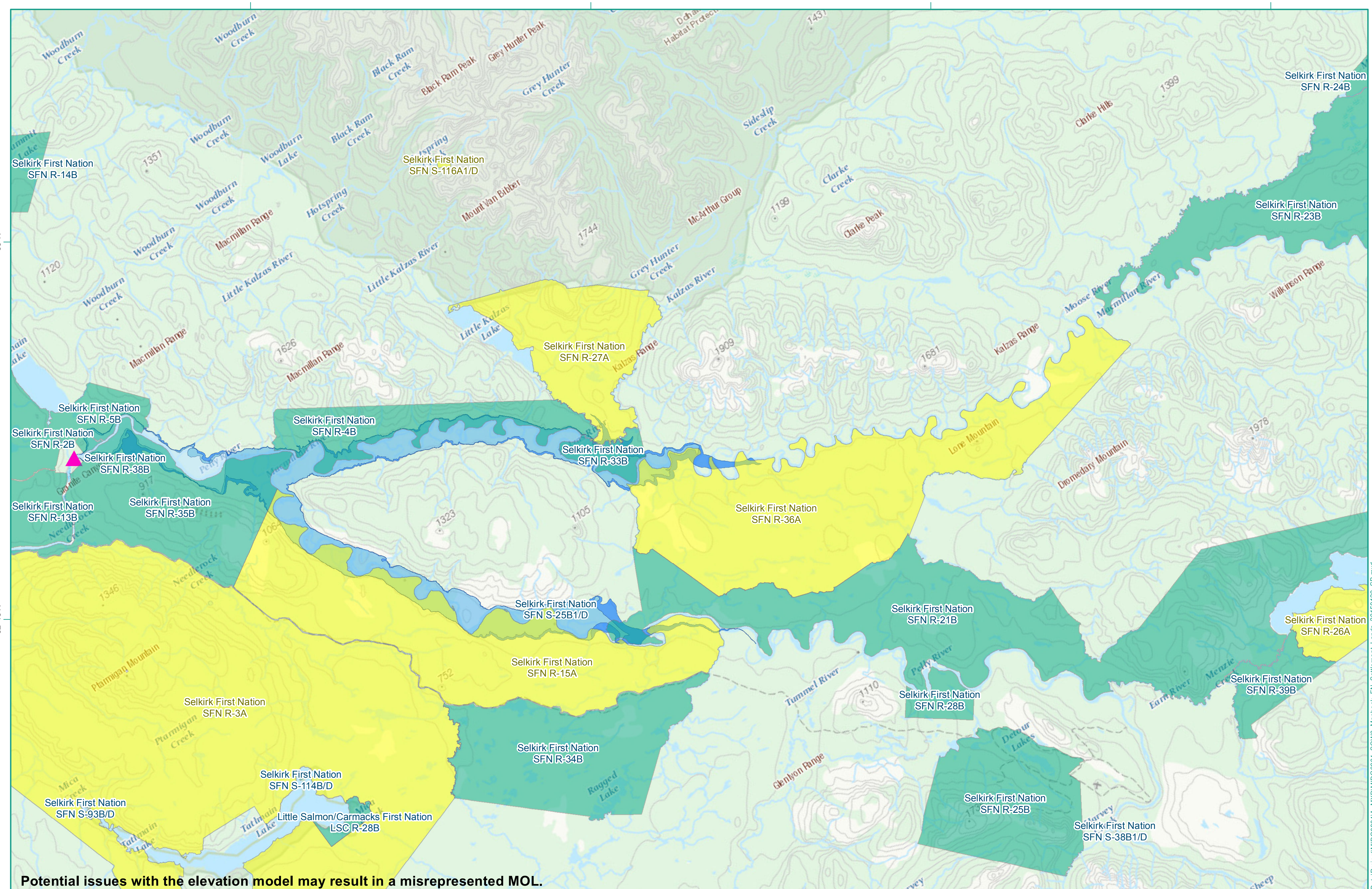
AREA OF STUDY	SMALL VERSION	LARGE VERSION
Environmental (Fisheries)	H	H
Environmental (Aquatic SAR)	L	L
Environmental (Terrestrial SAR)	H	H
Surface/Subsurface Tenure	H	H
Constructability	H	H
Economic (Meeting Gap)	L	L
Economic (Size vs. Need)	H	H

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS
Map 6 – Granite Canyon (Large) [Site ID = PELLY-PELLY-0480-B]



FIRST NATIONS SETTLEMENT LANDS
Map 7 – Granite Canyon (Small) [Site ID = PELLY-PELLY-0480-A]



Legend

▲ Dam location

Reservoir Levels

MOL	513m
AOL	519m
FSL	525m

First Nations Settlement Lands

- Settlement Lands - Category A
- Settlement Lands - Category B
- Settlement Lands - Fee Simple

Base Layers

- Road
- Watercourse
- Waterbody

0 4 8 km

Scale: 1:290,970

Projection: NAD 1983 Yukon Albers

Data Sources:
a) Reservoirs generated by HCP.
b) ESRI Geogratis Basemap.

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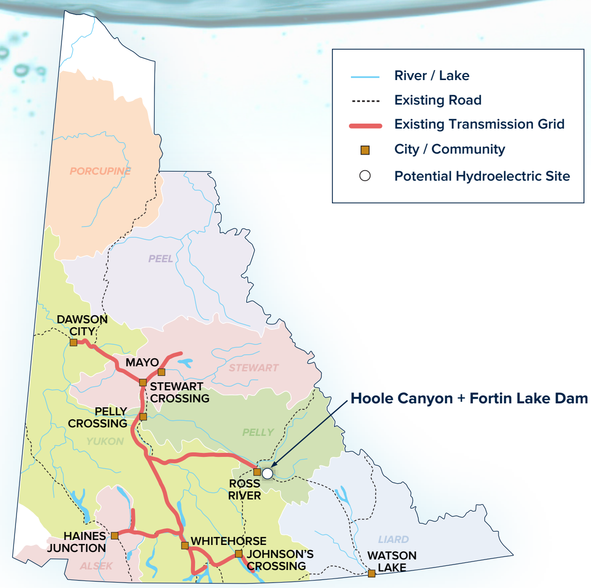
HOOLE CANYON + FORTIN LAKE DAM

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
40 MW	10 km to potential future transmission 85 km to existing transmission	Ross River **RIVER** Pelly River	Acceptable

PROJECT DESCRIPTION

Hoole Canyon + Fortin Lake Dam

is a potential 40 MW hydroelectric project on the Pelly River, with the main power dam located in the Pelly River Basin approximately 30 km upstream of the community of Ross River. The Fortin Lake storage dam is located upstream of the main power dam approximately 95 km east of the community of Ross River, providing additional storage capability by flooding Fortin Lake and Pelly Lake.



DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- No Aquatic Species-at-Risk noted
- Able to meet majority of future energy gaps, although limitations noted when approaching 50 year outlook

CONS:

- River deemed as having a high suitability for fish habitat
- Potential Transboundary issues as per Yukon River Salmon Agreement with USA
- Terrestrial Species-at-Risk flagged as having moderate mitigation issues noted
- Presence of Land Tenure and First Nations Interim Protected Lands noted
- Constructability risks deemed high

Recommendation: Study Further, including analysis to re-evaluate the balance between project size, reservoir storage, and project impacts

AREA OF STUDY	HOOLE CANYON + FORTIN LAKE DAM
Environmental (Fisheries)	H
Environmental (Aquatic SAR)	L
Environmental (Terrestrial SAR)	M
Surface/Subsurface Tenure	H
Constructability	H
Economic (Meeting Gap)	M
Economic (Size vs. Need)	M

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS

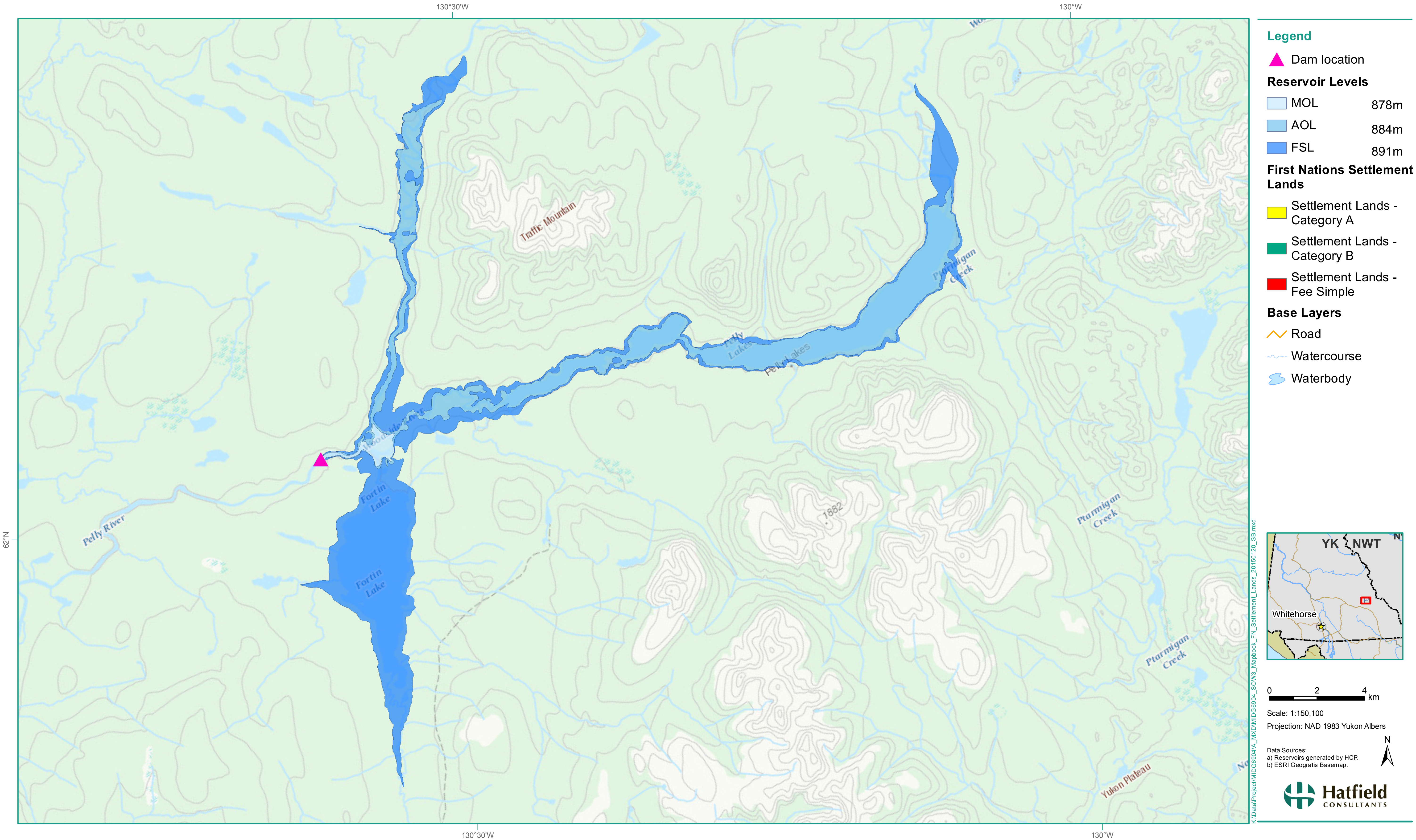
Map 8 – Hoole Canyon [Site ID = PELLY-PELLY-0760-A]

(Note: This map shows the main power dam location only. See Map 2 for the Fortin Lake Dam component of the 'Hoole Canyon + Fortin Lake Dam' project.)

FIRST NATIONS SETTLEMENT LANDS

Map 2 – Fortin Lake Dam [Site ID = PELLY-PELLY-0567-B & PELLY-PELLY-0760-A]

(Note: This map shows the Fortin Lake Dam component of the 'Detour Canyon + Fortin Lake Dam' and 'Hoole Canyon + Fortin Lake Dam' projects. See Map 1 and Map 8 for the main power dam components of these projects.)



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MIDDLE (OR LOWER) CANYON

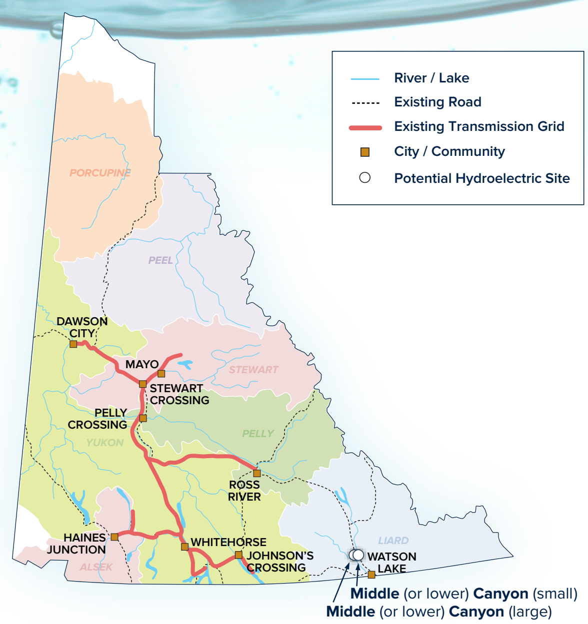
LARGE and SMALL

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
14 – 75 MW	10 km to future transmission 280 km to existing transmission	Watson Lake **RIVER** Frances River	Acceptable

PROJECT DESCRIPTION

Middle (or Lower) Canyon (Large) is a potential 75 MW hydroelectric project on the Frances River, located in the Liard River Basin approximately 40 km northwest of Watson Lake.

Middle (or Lower) Canyon (Small) is a 14 MW hydroelectric project that is a smaller alternative to the above mentioned "Middle (or Lower) Canyon (Large)." The Middle (or Lower) Canyon (Small) project is located at the same location (approximately 40 km northwest of Watson Lake.)



DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- Constructability risks deemed low
- Terrestrial Species-at-Risk noted, but no major constraints expected
- Small Version Only: More efficient use of water available (not oversized in medium term outlook)
- Large Version Only: Better ability to meet long term (50 year) future energy gaps

CONS:

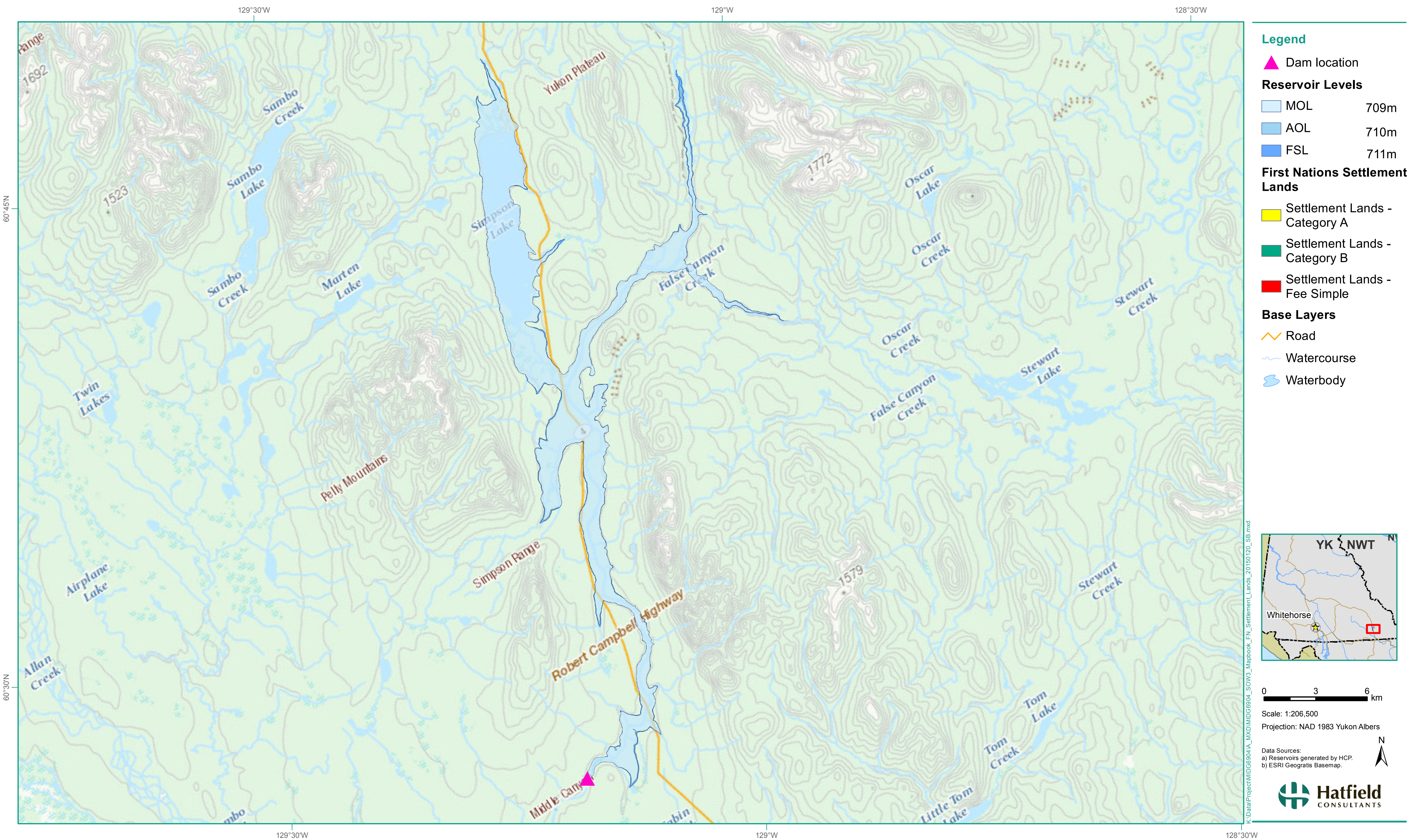
- Frances River is flagged for potential Trans-boundary fisheries issues
- Frances Lake (upstream) is noted as fisheries Conservation Waters and depressed fisheries stocks
- Aquatic Species-at-Risk present in watershed
- Presence of Interim Protected Lands noted
- Small version has lesser ability to meet all energy gaps in long term horizon (50 years)
- Large Version Only: Relocation of existing highways and bridges required

Recommendation: Study further, including scalability analysis to re-evaluate project size

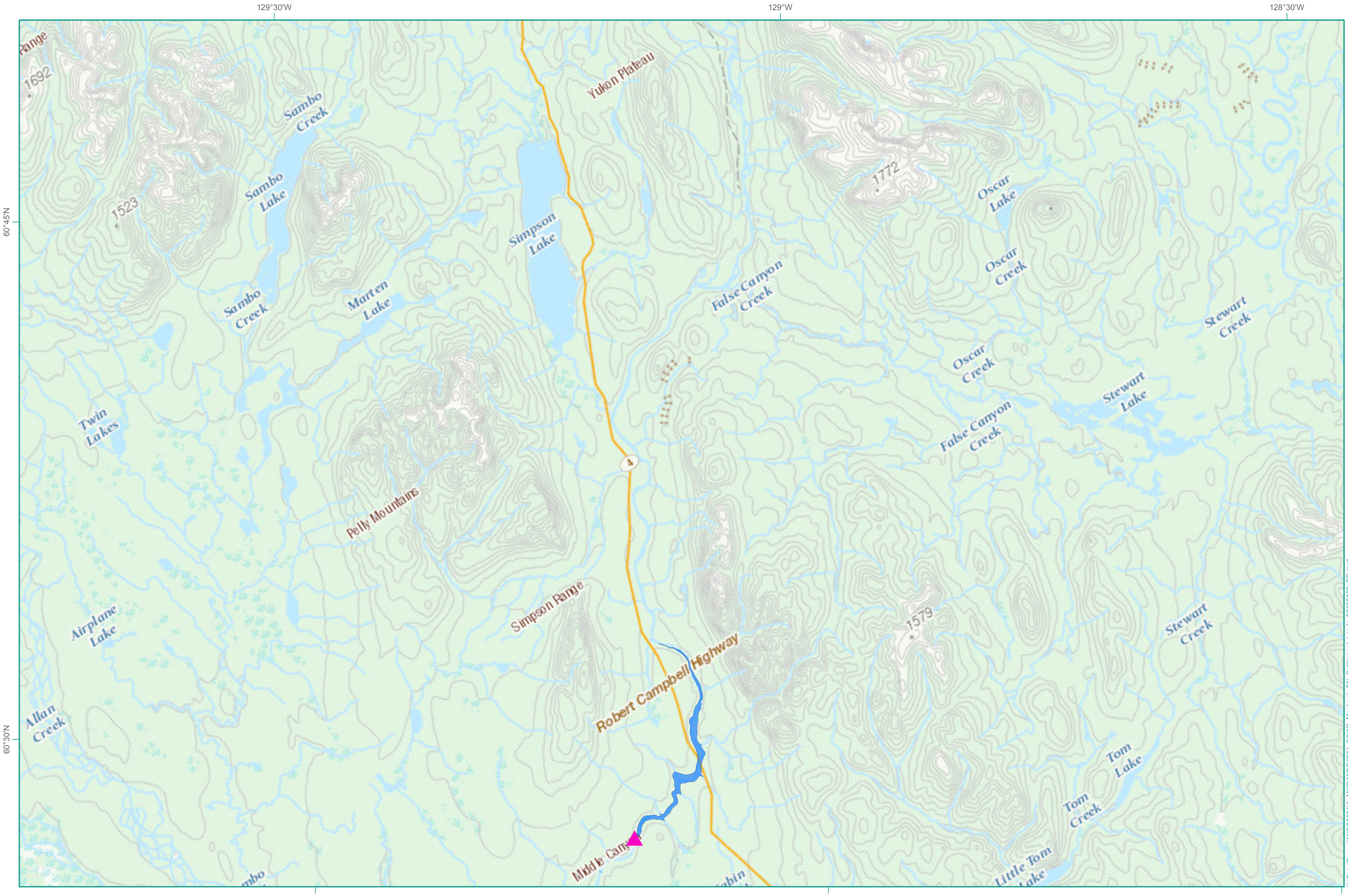
AREA OF STUDY	SMALL VERSION	LARGE VERSION
Environmental (Fisheries)	H	H
Environmental (Aquatic SAR)	H	H
Environmental (Terrestrial SAR)	L	L
Surface/Subsurface Tenure	H	H
Constructability	L	L
Economic (Meeting Gap)	H	L
Economic (Size vs. Need)	L	M

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS
Map 9 – Middle (or Lower) Canyon (Large) [Site ID = LIARD-FRANC-0670-B]



FIRST NATIONS SETTLEMENT LANDS
Map 10 – Middle (or Lower) Canyon (Small) [Site ID = LIARD-FRANC-0670-A]



Legend
- Dam location

Reservoir Levels
- MOL 0m
- AOL 0m
- FSL 690m

First Nations Settlement Lands
- Settlement Lands - Category A
- Settlement Lands - Category B
- Settlement Lands - Fee Simple

Base Layers
- Road
- Watercourse
- Waterbody

0 3 6 km

Scale: 1:206,500
Projection: NAD 1983 Yukon Albers

Data Sources:
a) Reservoirs generated by HCP.
b) ESRI Geogratis Basemap.

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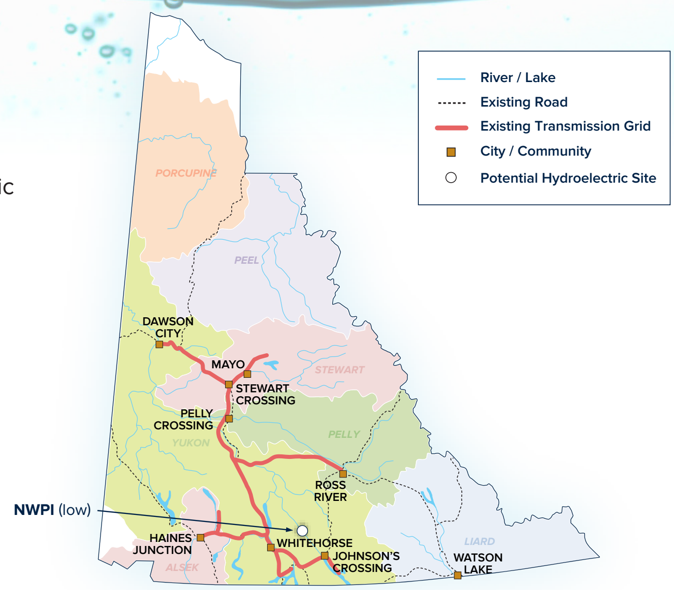
NWPI (LOW)

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
55 MW	110 km	Whitehorse	Acceptable
		RIVER	
		Teslin River	

PROJECT DESCRIPTION

NWPI (Low) is a potential 55 MW hydroelectric project on the Teslin River, located in the Yukon River Basin approximately 65 km downstream of Johnsons Crossing and 60 km east of Whitehorse. The project first appeared in T. Ingledow & Associates Limited's report entitled "Hydroelectric Resources Survey of the Central Yukon Territory" in 1968.



DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- Constructability risks deemed low
- Good ability to meet long term outlook (50 year) future energy gaps

CONS:

- River deemed as having a high suitability for fish habitat
- Teslin Lake is flagged for potential Transboundary fisheries issues and potential Transboundary issues as per Yukon River Salmon Agreement with USA
- Possible Aquatic Species-at-Risk in watershed
- Terrestrial Species-at-Risk flagged as having significant mitigation issues noted
- Presence of Land Tenure and First Nations Settlement Lands noted

Recommendation: Study Further, including analysis to re-evaluate the balance between project size, reservoir storage, and project impacts

AREA OF STUDY	NWPI (LOW)
Environmental (Fisheries)	H
Environmental (Aquatic SAR)	M
Environmental (Terrestrial SAR)	H
Surface/Subsurface Tenure	H
Constructability	L
Economic (Meeting Gap)	L
Economic (Size vs. Need)	M

H = High effects **M** = Medium effects **L**= Low effects

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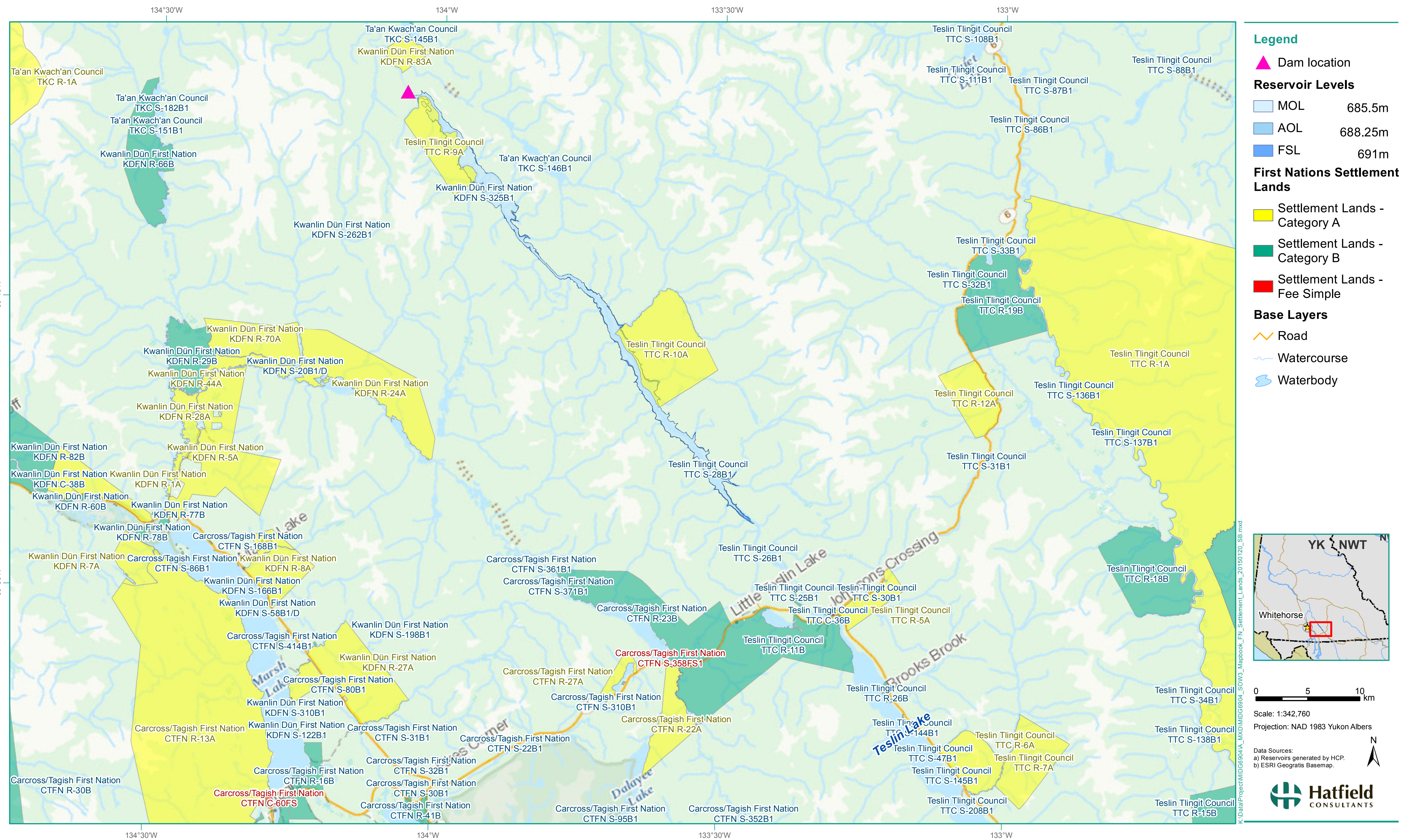
NEXT GENERATION HYDRO powering our future

FIRST NATIONS SETTLEMENT LANDS
Map 11 – NWPI (Low) [Site ID = YUKON-TESLI-0670-B]



SLATE RAPIDS

DIVERSION SCHEME

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
42 MW	**10 km** to future transmission **145 km** to existing transmission	Ross River **RIVER** Pelly River	Excellent

PROJECT DESCRIPTION

Slate Rapids (Diversion Scheme) is a potential 42 MW hydroelectric project on the Pelly River, located in the Pelly River Basin approximately 75 km east of the community of Ross River. The project first appeared in Moneco Consultants Pacific Limited's report entitled "Slate Rapids Hydropower Development" in 1983.

DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- No Aquatic Species-at-Risk noted
- Good ability to meet long term outlook (50 year) future energy gaps
- Project currently sized closed to long term need (not oversized)

CONS:

- River deemed as having a high suitability for fish habitat
- Potential Transboundary issues as per Yukon River Salmon Agreement with USA
- Terrestrial Species-at-Risk flagged as having moderate mitigation issues
- Presence of Land Tenure and First Nations Interim Protected Lands noted
- Constructability risks deemed high

***Recommendation:** Study Further, including analysis to re-evaluate the balance between project size, reservoir storage, and project impacts*

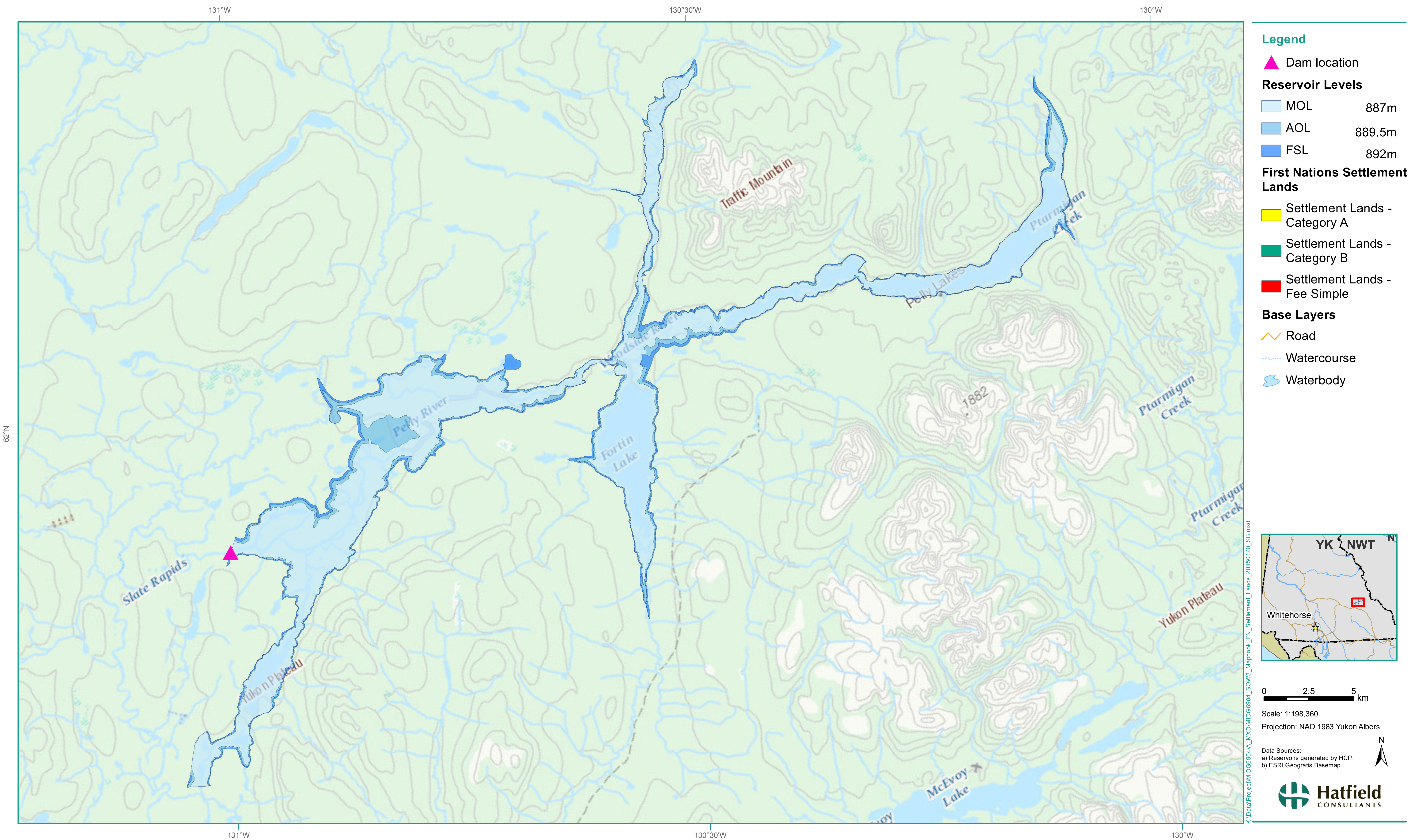
AREA OF STUDY	SLATE RAPIDS (DIVERSION SCHEME)
Environmental (Fisheries)	H
Environmental (Aquatic SAR)	L
Environmental (Terrestrial SAR)	M
Surface/Subsurface Tenure	H
Constructability	H
Economic (Meeting Gap)	L
Economic (Size vs. Need)	L

H = High effects **M** = Medium effects **L**= Low effects

YUKON DEVELOPMENT CORPORATION

NEXT GENERATION HYDRO powering our future

FIRST NATIONS SETTLEMENT LANDS
Map 12 – Slate Rapids [Site ID = PELLY-PELLY-0847-B]



TWO MILE CANYON

CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
53 MW	140 km	Mayo	Excellent
		RIVER	
		Hess River	

PROJECT DESCRIPTION

Two Mile Canyon is a potential 53 MW hydroelectric project on the Hess River, located in the Stewart River Basin, approximately 100km east of Mayo. The project first appeared in T. Ingledow & Associates Limited's report entitled "Hydroelectric Resources Survey of the Central Yukon Territory" in 1968.

DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- No Aquatic Species-at-Risk noted
- Good ability to meet long term outlook (50 year) future energy gaps
- Terrestrial Species-at-Risk noted, but no major constraints expected

CONS:

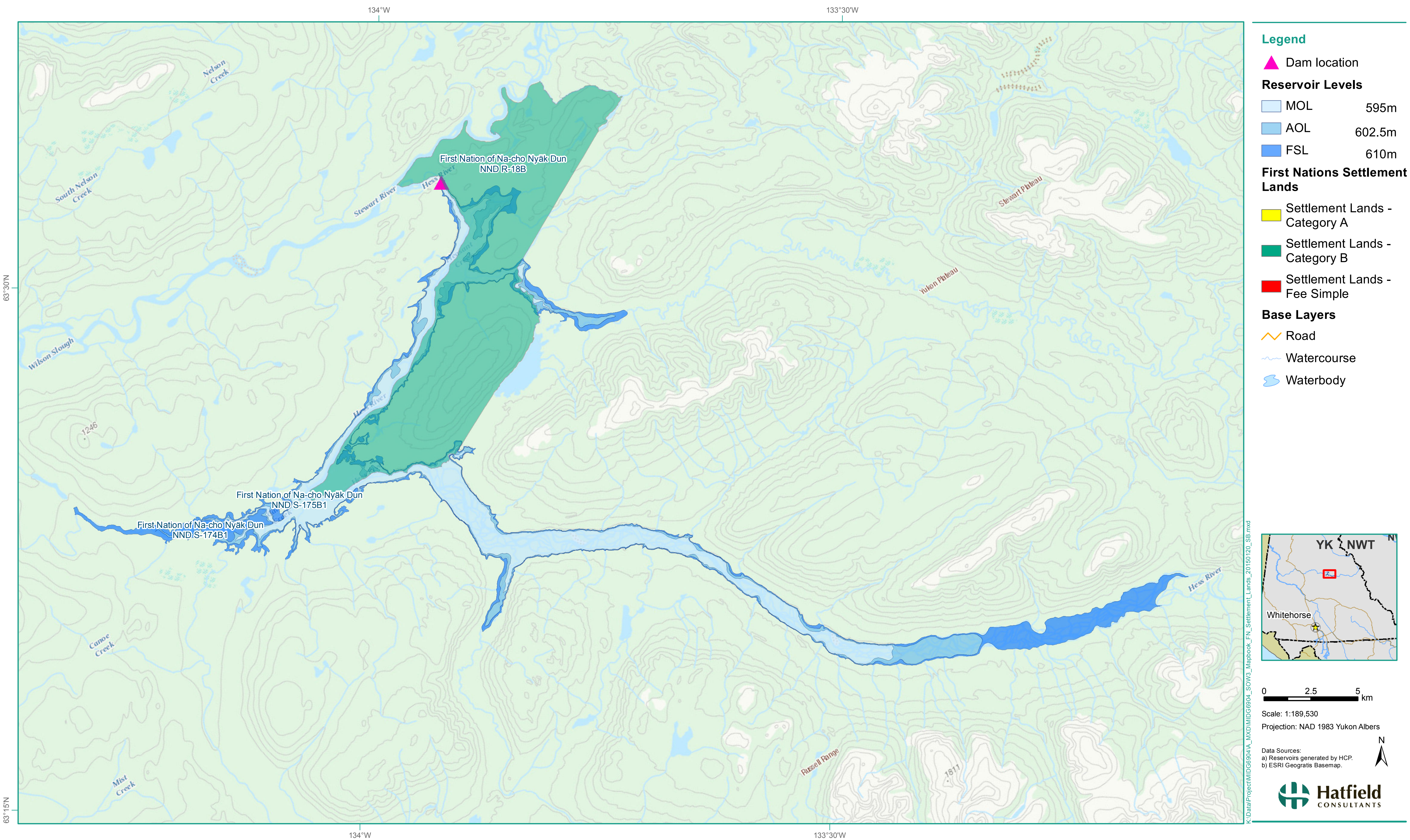
- River deemed as having a high suitability for fish habitat
- Potential Transboundary issues as per Yukon River Salmon Agreement with USA
- Presence of Land Tenure and First Nations Settlement Lands noted
- Constructability risks deemed moderate

***Recommendation:** Study further, including scalability analysis to re-evaluate project size*

AREA OF STUDY	TWO MILE CANYON
Environmental (Fisheries)	H
Environmental (Aquatic SAR)	L
Environmental (Terrestrial SAR)	L
Surface/Subsurface Tenure	H
Constructability	M
Economic (Meeting Gap)	L
Economic (Size vs. Need)	M

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS
Map 13 – Two Mile Canyon [Site ID = STEWA-HESS-0552]



UPPER CANYON

LARGE, MEDIUM and SMALL

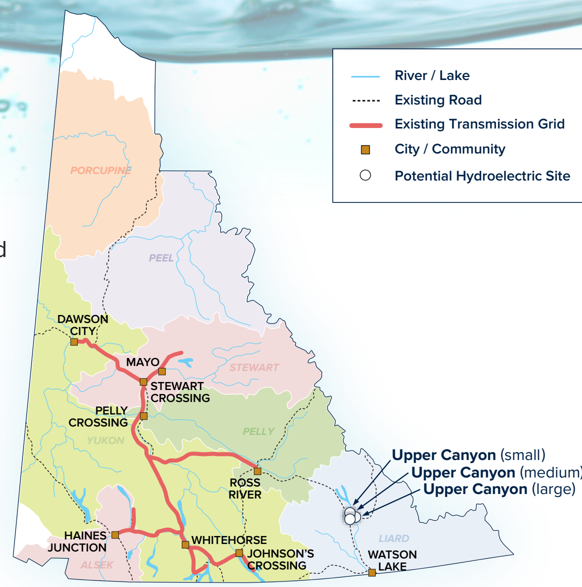
CAPACITY	DISTANCE TO TRANSMISSION	NEAREST COMMUNITY	WINTER ENERGY ABILITY
25 - 75 MW	10 km to future transmission 290 km to existing transmission	Watson Lake **RIVER** Frances River	Excellent

PROJECT DESCRIPTION

Upper Canyon (Large) is a potential 75 MW hydroelectric project on the Frances River, located in the Liard River Basin approximately 95 km north of Watson Lake.

Upper Canyon (Medium) is a 58 MW hydroelectric project that is a smaller alternative to the above mentioned “Upper Canyon (Large)” project. The Upper Canyon (Medium) project is located at the same location (approximately 95 km north of Watson Lake).

Upper Canyon (Small) is a 25 MW hydroelectric project alternative that is smaller than both the above mentioned “Upper Canyon (Large)” and “Upper Canyon (Medium)” project. The Upper Canyon (Small) project is located at the same location (approximately 95 km north of Watson Lake) capacity of 100 MW.



DEVELOPMENT CONSTRAINT FINDINGS

PROS:

- Small Version Only: More efficient use of water available (not oversized in medium term outlook), although limitations noted when approaching 50 year outlook
- Medium and Large Versions Only: Good ability to meet long term outlook (50 year) future energy gaps

CONS:

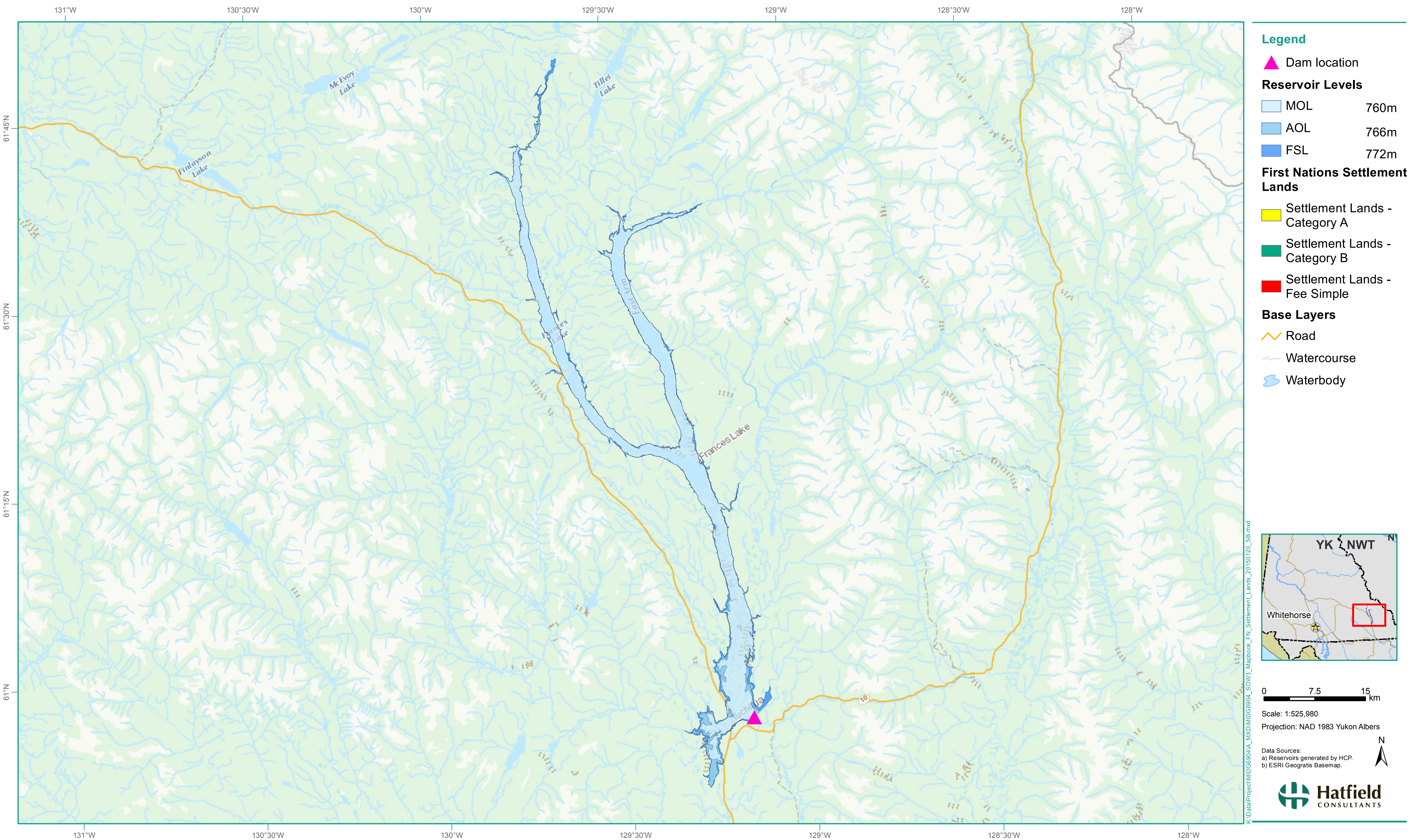
- Frances Lake (which is flooded) is noted as fisheries Conservation Waters and as having depressed fisheries stocks
- Frances River is flagged for potential Trans-boundary issues
- Terrestrial Species-at-Risk flagged as having significant mitigation issues noted
- Presence of Land Tenure and Interim Protected Lands noted
- Constructability risks deemed high (known bedrock faults in dam area)
- Medium and Large Versions Only: May be over-sized relative to long term need

***Recommendation:** Study further, including scalability analysis to re-evaluate project size (potentially finding a project that has lower impacts to Frances Lake by operating reservoir within (or closer to) the range of natural lake levels)*

AREA OF STUDY	SMALL	MEDIUM	LARGE
Environmental (Fisheries)	H	H	H
Environmental (Aquatic SAR)	H	H	H
Environmental (Terrestrial SAR)	H	H	H
Surface/Subsurface Tenure	H	H	H
Constructability	H	H	H
Economic (Meeting Gap)	M	L	L
Economic (Size vs. Need)	L	M	M

H = High effects **M** = Medium effects **L**= Low effects

FIRST NATIONS SETTLEMENT LANDS
Map 14 – Upper Canyon (Large) [Site ID = LIARD-FRANC-0730-C]



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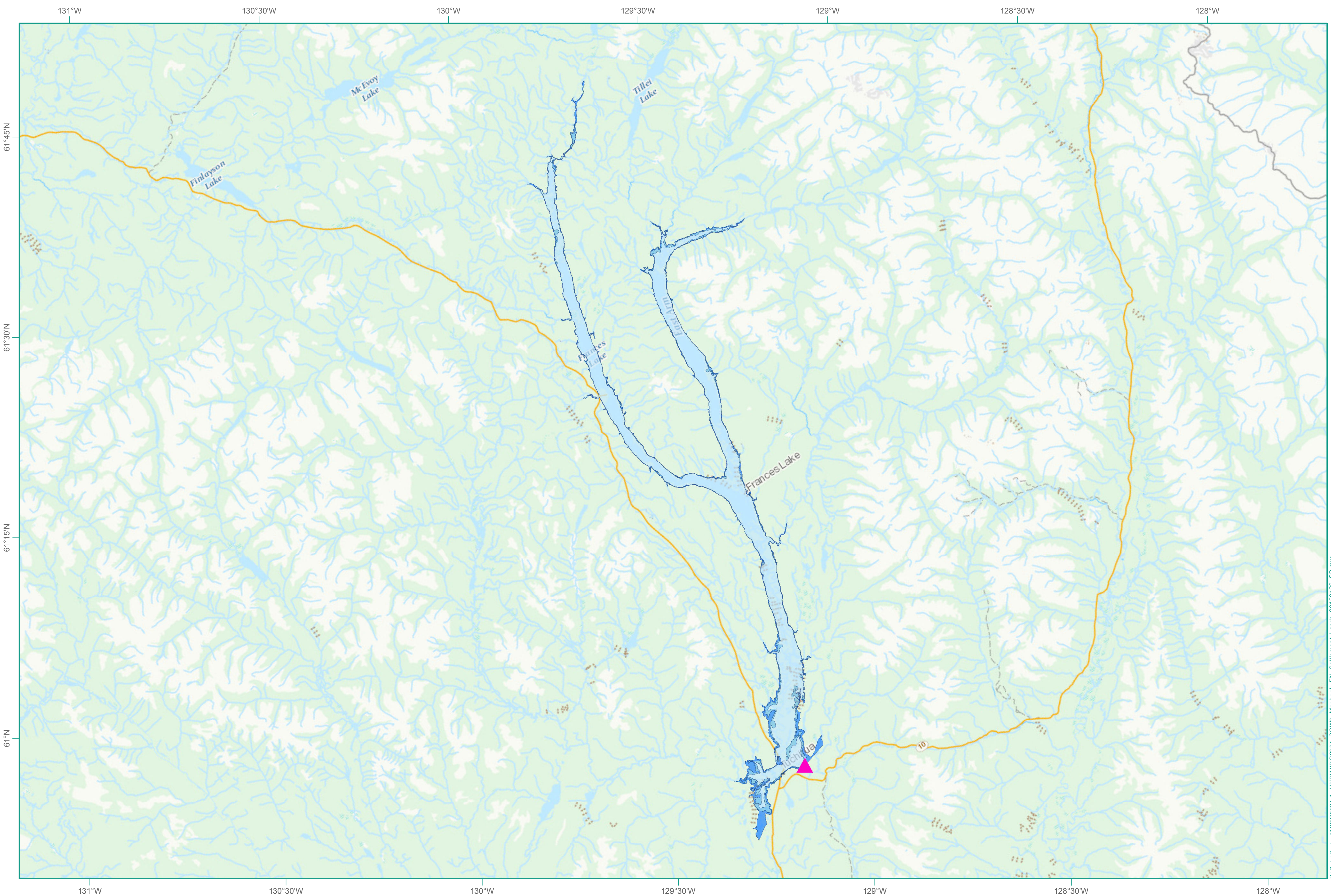
FIRST NATIONS SETTLEMENT LANDS
Map 15 – Upper Canyon (Medium) [Site ID = LIARD-FRANC-0730-B]



Legend

Dam location

Reservoir Levels

MOL	755m
AOL	761.5m
FSL	768m

First Nations Settlement Lands

Settlement Lands - Category A

Settlement Lands - Category B

Settlement Lands - Fee Simple

Base Layers

Road

Watercourse

Waterbody

0 7.5 15 km

Scale: 1:525,980

Projection: NAD 1983 Yukon Albers

Data Sources:
a) Reservoirs generated by HCP.
b) ESRI Geogratis Basemap.

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FIRST NATIONS SETTLEMENT LANDS
Map 16 – Upper Canyon (Small) [Site ID = LIARD-FRANC-0730-A]