



Yukon Next Generation Hydro and Transmission Viability Study: Site Screening Inventory (Part 1 of 2)

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Executive Summary

The Yukon Development Corporation (“YDC”) has commissioned Midgard Consulting Incorporated (“Midgard”) and its team of sub-consultants to complete the *Yukon Next Generation Hydro and Transmission Viability Study*. The study, delivered through a series of technical papers, is intended to help inform the decisions necessary to fill the territory’s growing energy gap and to support the Yukon’s continued economic growth and development.

This report, the *Site Screening Inventory*, is the first of a series of technical papers with the goal of identifying, evaluating, categorizing, and ranking potential hydroelectric projects in the context of current economic, environmental, and societal expectations. To facilitate feedback, refinement, and transparency, the *Site Screening Inventory* is divided into two parts:

- 1) *Part 1 (This Report)* – At the end of three stages of screening (Screen 0, Screen 1, and Screen 2) 16 sites of interest remain for further study. The initial three screening stages include: reconciliation of known sites, screening for fundamental development barriers, and screening for fundamentally uneconomic sites.
- 2) *Part 2* – Taking the 16 sites identified in Part 1, Part 2 contains a ranking (Ranking 3) that has the following sub-components: assessment of a project’s ability to meet the capacity and energy requirements of the Yukon grid, investigation of key environmental considerations, investigation of key socioeconomic considerations, and updated economics. The findings are combined to rank the 16 sites of interest with the goal of identifying a “Short List” of potential sites for further study.

This report is a summary of the *Site Screening Inventory* Part 1 findings. The methodological approach implemented during Part 1 of the *Site Screening Inventory* winnows known hydroelectric projects from 200+ to 16 sites of interest. The Part 1 screening stages and respective refinement of potential hydroelectric sites are summarized in Table 1.

Table 1: Part 1 Screening Stages and Resulting Site Refinement

#	Description	Site Refinement
Screen 0	Reconciliation of Known Project Sites	200+ → 108 Sites
Screen 1	Fundamental Development Barrier Project Screen	108 → 47 Sites
Screen 2	Fundamentally Uneconomic Project Screen	47 → 16 Sites

A listing of the 16 hydroelectric sites identified as advancing to Part 2 study is found in Table 2 below. Note that the list is sorted alphabetically and not in any preferred order or ranking.

It is important to state that many of the 16 sites will be discarded after additional study and that the list of 16 sites only represents projects that have passed the initial first three levels of screening (Screen 0, Screen 1,

and Screen 2). Sites on the list of 16 may still be deemed uneconomic, socially unacceptable, environmentally unacceptable, or technically insufficient when additional study in Part 2 of the *Site Screening Inventory* and the overarching *Yukon Next Generation Hydro and Transmission Viability Study* are performed.

Table 2: Site Screening Inventory Part 1 List of Sites

Site Name	Site ID	Estimated Maximum Size (MW)
Detour Canyon	PELLY-PELLY-0567-A	65
Detour Canyon + Fortin Lake Dam	PELLY-PELLY-0567-B	100
False Canyon	LIARD-FRANC-0696	58
Fraser Falls (High)	STEWA-STEWA-0519-B	300
Fraser Falls (Low)	STEWA-STEWA-0519-A	100
Granite Canyon (Large)	PELLY-PELLY-0480-B	254
Granite Canyon (Small)	PELLY-PELLY-0480-A	80
Hooie Canyon + Fortin Lake Dam	PELLY-PELLY-0760-A	40
Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A	14
Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B	75
NWPI (Low)	YUKON-TESLI-0670-A	55
Slate Rapids (Diversion Scheme)	PELLY-PELLY-0847-B	42
Two Mile Canyon	STEWA-HESS -0552	53
Upper Canyon (Large)	LIARD-FRANC-0730-C	75
Upper Canyon (Medium)	LIARD-FRANC-0730-B	58
Upper Canyon (Small)	LIARD-FRANC-0730-A	25

In addition to the list above, the 16 sites are mapped and labeled as presented in Figure 1 below.

It is acknowledged and recognized that the sites identified in Table 2 are located on, and impact, First Nation traditional territories. Due to the high level and preliminary nature of the study performed in Part 1 of the *Site Screening Inventory*, specific technical details pertaining to the dams, reservoirs, flooded areas, transmission line corridors, and road corridors were not determined. These details, and the impacts associated with the projects, will evolve as project study continues.

The Yukon scale mapping in this report only indicates the approximate locations of the hydroelectric powerhouses, and does not assess the impacts upon First Nations and First Nation traditional territories. The critical task of assessing, and adapting to, project impacts will begin in Part 2 of the *Site Screening Inventory* and will continue throughout the project development process.

Figure 1: Site Screening Inventory Part 1 - Map of Sites

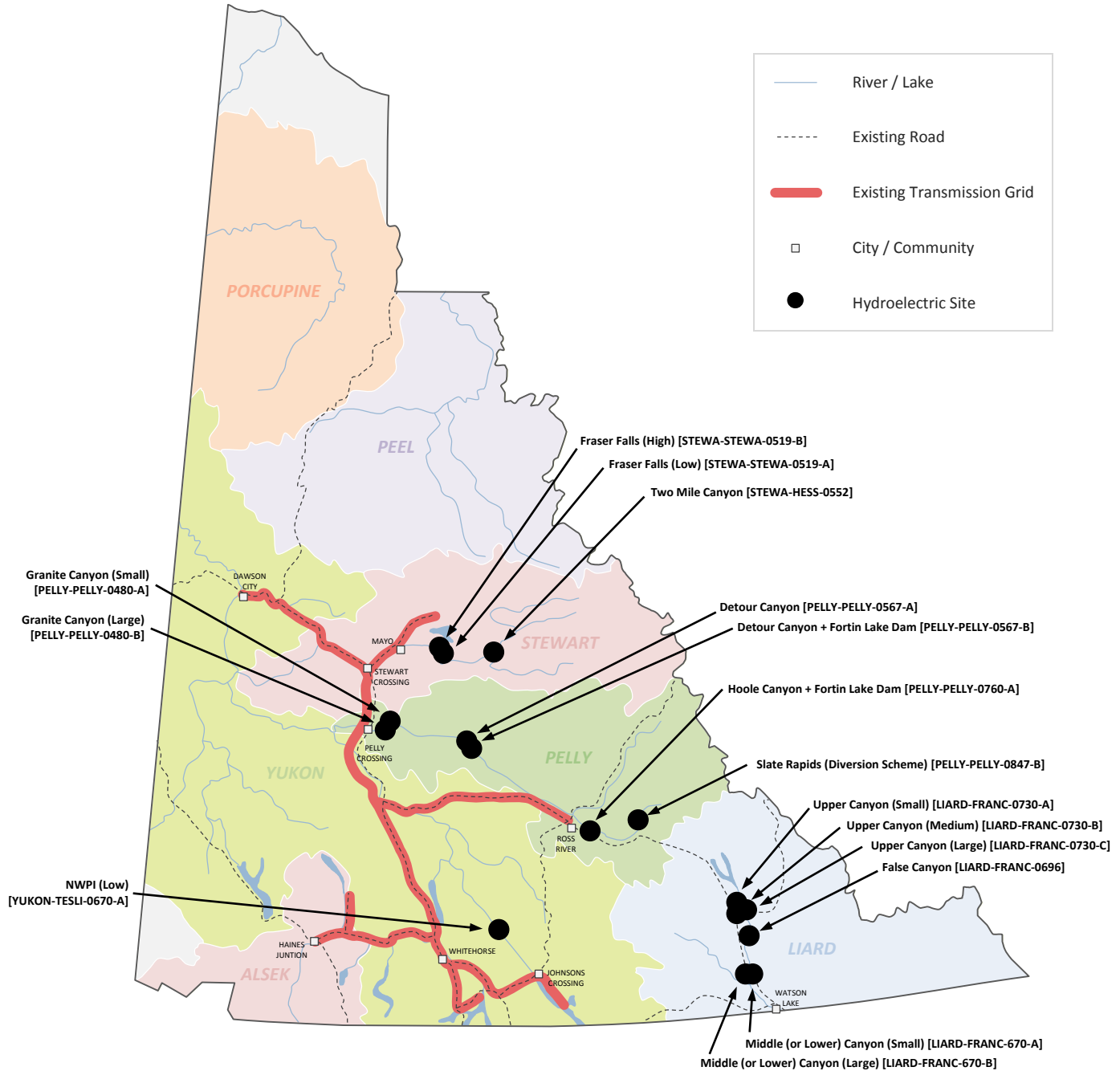


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1 Introduction

The Yukon Development Corporation (“YDC”) has commissioned Midgard Consulting Incorporated (“Midgard”) and its team of sub-consultants to complete the *Yukon Next Generation Hydro and Transmission Viability Study*. The study, delivered through a series of technical papers, is intended to help inform the decisions necessary to solve the territory’s growing energy gap and to support the Yukon’s continued economic growth and development.

This report is the first in a series of technical papers with the goal of identifying, evaluating, categorizing, and ranking potential hydroelectric projects in the context of current economic, environmental, and societal expectations. The overall objective of the technical paper series is to narrow the list of potential hydroelectric project under consideration by YDC from over 200 projects to a few leading candidate projects. This report presents the methodology, assumptions, and results of the *Site Screening Inventory* completed by Midgard and its team of sub-consultants.

1.1 Assessment Team

The assessment team for the *Site Screening Inventory* consists of the following industry experts:

- *Midgard Consulting Incorporated (“Midgard”)* - Midgard provides consulting services to the electrical power and utility industry. Midgard is the lead consultant for the *Yukon Next Generation Hydro and Transmission Viability Study*, with specific components of the assignment sub-contracted to other leading industry experts.
- *SLR Consulting Global Environmental Solutions (“SLR”)* - SLR is part of a multi-disciplinary consultancy providing worldwide environmental sciences, engineering, and socio-economic expertise and high-value advisory services. SLR is recognized as a global leader in the provision of environmental and engineering consulting services with strong Quality Assurance programs and rigorous Health & Safety Systems. SLR has 19 offices and approximately 200 employees across Canada including an office in Whitehorse, Yukon Territory.
- *J.D. Mollard and Associates (2010) Limited (“JDMA”)* - JDMA has experience reaching back to 1956 and has carried out upwards of 5000 consulting assignments for governments, academia, and private industry, across Canada and around the world. JDMA has a long tradition of excellence in applied civil and geological engineering, geology, hydrogeology, geography, biology, remote sensing, terrain analysis, and environmental studies.
- *Yukon Peer Review Panel (“YPRP”)* - The YPRP is an internal review panel that is comprised of four senior and respected Yukoners that provide oversight, feedback, and advice at all stages of the project. The four members of the YPRP ensure that a strong Yukon voice, knowledge, and experience is brought to the project from the perspective of long term residents who collectively have over 130 years of experience living in the Yukon Territory.

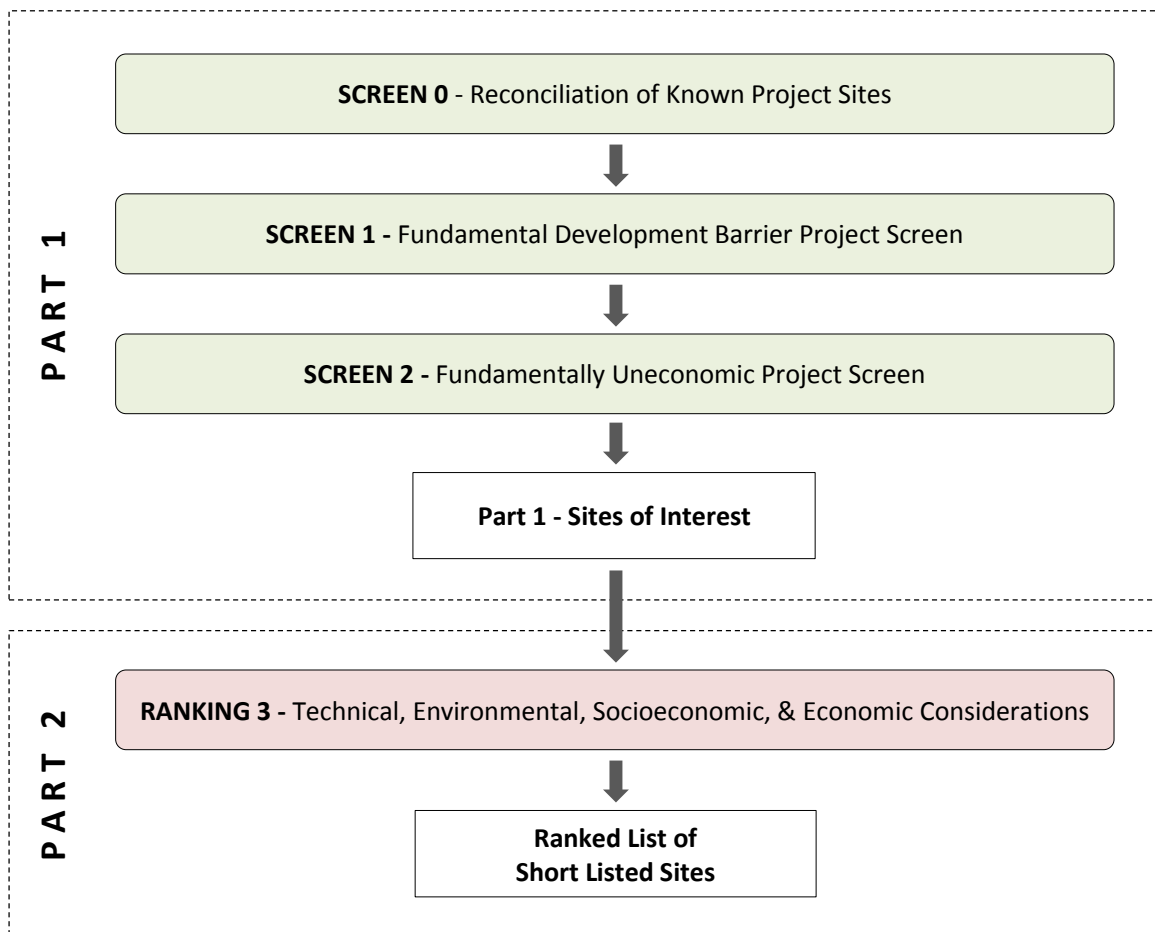
1.2 Overall Site Screening Inventory Structure

The *Site Screening Inventory* is divided into two parts:

- 1) *Part 1* - Three stages of screening (Screen 0, Screen 1, and Screen 2) identify sites of interest and eliminate sites that have little to no potential for development. The screening includes: reconciliation of known sites based on historic studies, screening for fundamental development barriers, and screening for fundamentally uneconomic sites. This report is a summary of the Part 1 findings.
- 2) *Part 2* - Part two contains a ranking (called Ranking 3) that has the following components: assessment of project's ability to meet the capacity and energy requirements of the Yukon grid, investigation of environmental considerations, investigation of socioeconomic considerations, and an update to economics. The findings are combined to rank the sites of interest identified at the end of Part 1 with the goal of identifying a "Short List" of potential sites for further study.

The two-part delivery of the Site Screening Inventory is summarized in Figure 2 below.

Figure 2: Yukon Hydroelectric Inventory Process



1.3 Site Screening Inventory Part 1 - Overview

The methodology, assumptions, and results of Part 1 of the *Site Screening Inventory* are presented within the framework defined below:

- 1) **Screen 0: Reconciliation of Known Project Sites** - Review and extraction of information from previous reports to create a single, reconciled project listing. The Yukon Development Corporation (“YDC”) and Yukon Energy Corporation (“YEC”) provided 25 data sources to Midgard for review. Analysis of these data sources reveals over 200 hydroelectric sites previously studied in the Yukon Territory. A reconciliation and pre-screening process results in a list of 108 sites. A table mapping each of the 108 previously identified hydroelectric sites to prior reports is available in Appendix A.
- 2) **Screen 1: Fundamental Development Barrier Project Screen** - A “showstopper” screening process to cull out projects with poor development outlook or unfavourable economics due to prohibitive features that prevent further project development. These prohibitive features are listed in Table 3.

Table 3: Development Showstoppers

#	Showstopper	Showstopper Descriptions
1	Minimum Project Size	Project, or cluster of scalable projects, is less than or equal to 10 MW in size
2	National Park	Project located in, or inundates (floods), National Park Lands
3	Urban Flooding	Project inundates a titled property or private dwelling within the boundaries of any of the 36 Census Subdivisions (as defined by Statistics Canada) in the Yukon ¹
4	Main Stem of Yukon River Exclusion	Project is located on the main stem of the Yukon River
5	Incorrect Project Type	Projects that are non-hydroelectric generation projects (i.e. water diversion only, water storage only, pumped storage)

- 3) **Screen 2: Fundamentally Uneconomic Project Screen** - This step is an economic screening of projects remaining at the end of Screen 1. High-level parametric costing models in combination with energy production assumptions result in Levelized Costs of Energy² (“LCOE”) for the listed projects. The LCOE is applicable to the *Site Screening Inventory* because it allows for an apples-to-apples comparison of the cost of energy between different projects, therefore providing a method to calculate which projects can produce less expensive energy. Fundamentally uneconomic projects are screened out by comparing the LCOE against the Yukon’s levelized cost of thermal (i.e.: Natural Gas) generation energy. Stated another way, any projects expected to produce energy at a higher cost than the equivalent thermal generator are screened out from further study.

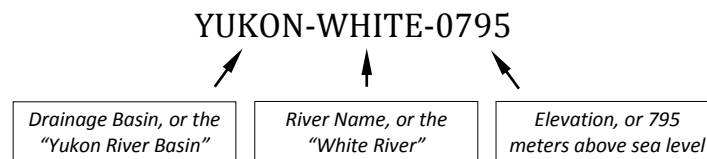
¹ See Appendix C for a listing of Census Subdivisions. Source: Statistics Canada Census Profile Page ([link](#)) accessed on October 7, 2014

² See Section 5.1 for a detail definition of the Levelized Cost of Energy.

2 Establishing an Inventory Identification Code System

To aid in tracking the large number of projects under consideration, a unique identification code is given to each potential site in the *Site Screening Inventory*. The identification code, or “Site ID”, is generated by concatenating the first five letters of the drainage basin name, the first five letters of the river name, and the four digit site-specific elevation separated by dashes (i.e.: <Drainage Basin>-<River Name>-<Elevation>).

Site ID “YUKON-WHITE-0795” is parsed as an example:



In certain cases, multiple project configurations are possible at the same site and these alternatives are distinguished by an alphanumeric suffix added to the Site ID. For example, YUKON-WHITE-0795-A and YUKON-WHITE-0795-B represent two project alternatives, either of which could be located at the same site.

A list of Yukon drainage basins and associated identification codes can be found in Table 4.

Table 4: Drainage Basins

Basin	ID Code
Alsek	ALSEK
Liard	LIARD
Peel	PEEL
Pelly	PELLY
Porcupine	PORCU
Stewart	STEWA
Yukon	YUKON

A list of Yukon river names and associated identification codes can be found in Table 5. This table only includes reaches of rivers referenced in the *Site Screening Inventory*.

Table 5: River Names

River Name	ID Code	River Name	ID Code
Anvil Creek	ANVIL	Little Salmon River	LITTL
Atlin Lake	ATLIN	Lower Yukon River	LOWER
Bates River	BATES	McNaughton Creek	MCNAU

River Name	ID Code
Beaver River	BEAVE
Big Kalzas Lake	BIG K
Big Salmon River	BIG S
Chandindu River	CHAND
Coal River	COAL
Donjek River	DONJE
Drury Creek	DRURY
Earn River	EARN
Ethel River	ETHEL
Fifteen Mile River	FIFTE
Forty Mile River	FORTY
Frances River	FRANC
Gladstone Creek	GLADS
Hess River	HESS
Homan River	HOMAN
Hyland River	HYLAN
Indian River	INDIA
Kathleen River	KATHL
Klondike River	KLOND
Kluane River	KLUAN
Lake Creek	LAKE
Lapie River	LAPIE
Liard River	LIARD

River Name	ID Code
McNeil River	MCNEI
McQuesten River	MCQUE
Mica Creek	MICA
Moon Lake	MOON
Morley River	MORLE
Peel River	PEEL
Pelly River	PELLE
Pleasant Creek	PLEAS
Porcupine River	PORCU
Primrose River	PRIMR
Ross River	ROSS
Sixty Mile River	SIXTY
Squanga Creek	SQUAN
Stewart River	STEWA
Tatshenshini River	TATSH
Tay River	TAY R
Teslin River	TESLI
Tutshi Lake	TUTSH
Watson Lake	WATSO
Watson River	WATSO
White River	WHITE
Wolf River	WOLF
Yukon River	YUKON

3 Screen 0: Reconciliation of Known Project Sites

The first step of the *Site Screening Inventory* involves reviewing and extracting the information made available by YDC and YEC in previously commissioned reports and studies. In total, 25 data sources were referenced as listed in Table 6 below; 24 reports dating from 1966 to 2011 and one e-mail correspondence from September 2014. For additional detail, please see the report/site-mapping table located in Appendix A.

Table 6: List of Reviewed Previous Reports

Date	Author	Title
Aug 1966	Department of Mines and Technical Surveys Water Resources Branch	A Preliminary Appraisal of the Yukon-Taiya and Yukon-Taku Storage and Power Schemes
Jan 1968	T. Ingledow & Associates Ltd.	Hydro-electric Resources Survey of the Central Yukon Territory (Vol I & Vol. II)
Feb 1970	T. Ingledow & Associates Ltd.	Power Survey of the Liard River Basin Yukon and Northwest Territories
Jan 1975	Sigma Resource Consultants Ltd.	The Development of Power in the Yukon (Main Report, Technical Information, & Recommendations)
1977	Montreal Engineering	Francis River - Upper Canyon: Preliminary Study of a 25.2 M.W. Medium Head Hydro Plant
Nov 1980	Monenco Consultants Pacific Ltd.	Mid-Yukon Feasibility Study: Year 1; Vol 1; Summary Report
Oct 1980	Shawinigan Engineering	Teslin River Hydro Power Study
Nov 1980	Monenco Consultants Pacific Ltd.	Yukon Mining Hydro Power Study of Small to Mid-Size Developments in East-Central Yukon
Aug 1981	Shawinigan Stanley	False Canyon Hydro Prefeasibility Study: Mid-Study Report
Oct 1982	Northwest Hydraulic Consultants Ltd.	Environmental and Socio-Economic Studies of Five Hydro Projects in Yukon
Mar 1982	Shawinigan Stanley	False Canyon Hydro Prefeasibility Study
Feb 1982	Acres Consulting Services Ltd.	Granite Canyon Development Pre-feasibility Study
Feb 1982	SNC Consultants Ltd.	Prefeasibility Study of a Hydroelectric Site at Ross Canyon, Yukon
Feb 1982	Crippen Consultants	Hoole Canyon Hydroelectric Project 1981 Site Investigation Report (Draft)
Jun 1982	Crippen Consultants	Hoole Canyon Hydroelectric Project Prefeasibility Study
Sep 1982	Monenco Consultants Pacific Ltd.	Yukon Hydro Investigations Coordination Conclusions from 1981 Investigation Program
Mar 1983	Monenco Consultants Pacific Ltd.	Northern Canada Power Commission Slate Rapids Hydropower Development Preliminary Office Studies Final Report

Date	Author	Title
Oct 1983	Monenco Consultants Pacific Ltd.	The Inventory of Yukon Hydroelectric Sites: A Review of Investigations Carried Out Between 1960 and 1983
Dec 1989	A.S. Demers	Yukon Energy Corporation: 1989 Hydro Investigations
Dec 1990	A.S. Demers	Yukon Energy Corporation: 1990 Hydro Investigations
1991	(No Stated Author, Stored in YEC Library)	1991 Hydro Investigations
Feb 2008	KGS Group Inc.	Assessment of Potential Hydroelectric Sites: Concept Phase Study (Draft)
Jan 2010	AECOM Canada Ltd.	2009 Large Hydro Stage 1: Initial Evaluation Draft Report
Jan 2011	AECOM Canada Ltd.	Preliminary Power Potential Assessment for Homan Lake Site, BC
Sep 2014	Marc-Andre Lavigne	EMAIL: Next Generation Hydro Project

Midgard notes that it also received a partial excerpt from the Department of Northern Affairs and National Resources, Water Resources Branch's 1965 report titled "Report on Hydroelectric Power Resources of the Porcupine, Peel, and Rat River Region: Yukon and Northwest Territories". Midgard has not reviewed the full report and therefore has not included it in the official listing of reviewed documentation in Table 6 above.

Midgard completed a site extraction from the 25 reference documents (24 reports + 1 email) to create a list of known / studied hydroelectric sites in the Yukon Territory.

Three levels of reconciliation are applied to the extraction process:

- 1) **Removal of Duplicate Sites** - Each site is reviewed and compared against any similar projects identified in the area. In many cases, there are potential sites that have been re-visited several times since the 1960's. Midgard reviewed each of these design iterations and used engineering judgment to deem some iterations duplicates (e.g.: the designs are almost the same). Sites that are viable secondary or tertiary options for a particular hydroelectric site (for example, a high dam option and low dam option) are given variant designations.
- 2) **Removal of Indeterminate Sites** - There are several cases where rivers were looked at / flown over in search of hydro potential. However, no actual sites were studied or identified. These sites are not included due to the lack of information or a lack of an identified site.
- 3) **Northwest Territories Sites** - Any sites located in the Northwest Territories are discarded.

The result of this reconciliation is a reduction in hydroelectric sites from an initial number of >200 sites to a more manageable 124 sites. Following completion of the site extraction and reconciliation, a pre-screening analysis is completed to remove sites unsuitable for the *Site Screening Inventory*. Pre-screened sites fell into one of the following two categories:

- 1) **Indeterminate Sites Identified in 2010 AECOM Inventory** - The 2010 AECOM inventory is the latest inventory of hydroelectric potential in the Yukon. Midgard reviewed each of the sites and noted a

total of 14 that are inappropriate for this *Site Screening Inventory*. These sites have little to no information and in several cases have no supporting documentation (no source report in the past). AECOM eliminated all of the 14 sites for lack of documentation. Midgard has elected to remove these sites from further study as well.

- 2) **Insufficient Level of Design** - Some sites are discussed in previous reports at a very high level, but are found to have no usable design features or information to proceed with. Without material information on a project, it was difficult to study further and, therefore, the sites are removed. This pre-screening removes an additional two (2) sites from the *Site Screening Inventory*.

For the purposes of transparency, Midgard has listed all of the sites (16 total) that fail to pass the pre-screening with respective commentary and reasoning for each site (see Table 7 below).

Table 7: Un-located Sites Removed From Site Screening Inventory

Potential Site	Failed Pre-Screen Criterion	Midgard Commentary
Bonnet Plume	Indeterminate Site Identified in 2010 AECOM Inventory	Bonnet Plume was initially identified in 1965. However, the full source report covering this site was not available for Midgard's review. It was subsequently mentioned in other inventory reports, including by AECOM in 2010 (who discarded the site for being a "very distant" site). Due to the lack of available site information, it has been discarded.
Campbell Creek	Indeterminate Site Identified in 2010 AECOM Inventory	The Campbell Creek site was listed in the 2010 AECOM report as "no defined scheme" with a report reference from a 1980 Moneco report. Midgard reviewed the two 1980 Moneco reports available, but neither mentioned the site. The Campbell Creek site was listed in the 1983 Moneco summary report with the statement "not yet studied". Due to the lack of available site information, it has been discarded.
Cassiar Bar	Indeterminate Site Identified in 2010 AECOM Inventory	The Cassiar Bar site was listed in the 2010 AECOM report (with no stated capacity or energy), but was cut due to its location on the main stem of the Yukon River. The only other information available was a brief mention in the 1983 Moneco summary report with the statement "inadequate description and data". Due to the lack of available site information, it has been discarded.
Coal River	Indeterminate Site Identified in 2010 AECOM Inventory	The Coal River site was listed in the 2010 AECOM report (with no stated capacity or energy), but was cut due to being a "very distant site" with "no defined scheme". The Coal River was studied by T. Ingledow & Associates in 1970 and they deemed the Quartz Creek site on the Coal River to be the only economic site. They mention the only other site considered on the Coal River (likely the same site 2010 AECOM is referencing), but discarded it for "poor foundation conditions". The 2010 AECOM report references the 1990 Demers report as a source for the Coal River site. Midgard's review reveals the Coal River was subject to reconnaissance study only in 1990 and no sites were actually identified. Due to the lack of available information on the site and the fact that a more plausible project (Quartz Creek site) has been identified on the Coal River, it has been discarded.

Potential Site	Failed Pre-Screen Criterion	Midgard Commentary
Hoole River	Indeterminate Site Identified in 2010 AECOM Inventory	The Hoole River site was listed in the 2010 AECOM report (without a source), but was cut due to having “no defined scheme”. Midgard’s review of all available previous studies revealed no other mentions of the Hoole River Project. Due to the lack of available information on the site, it has been discarded. <i>NOTE: This site is separate from the well-known “Hoole Canyon” project.</i>
Little Rancheria River	Indeterminate Site Identified in 2010 AECOM Inventory	The Little Rancheria site was listed in the 2010 AECOM report (with no stated capacity or energy), but was cut due to being a “very distant site”. The 2010 AECOM report references the 1990 Demers report as a source for the Little Rancheria River site. Midgard’s review reveals the Little Rancheria River site was subject to reconnaissance study only in 1990, and no sites were actually identified. Due to the lack of available site information, it has been discarded.
Meister River	Indeterminate Site Identified in 2010 AECOM Inventory	The Meister River site was listed in the 2010 AECOM report (with no stated capacity or energy), but was cut due to being a “very distant site”. The 2010 AECOM report references the 1990 Demers report as a source for the Meister River site. Midgard’s review reveals the Meister River site was subject to reconnaissance study only in 1990 and no sites were actually identified. Due to the lack of available site information, it has been discarded.
Middle Canyon (38 MW Version)	Indeterminate Site Identified in 2010 AECOM Inventory	The Middle Canyon (38 MW Version) site was listed in the 2010 AECOM report as a 38 MW project, but it does not include a reference for the source of this version of the site. Two other past reports, T. Ingledow & Associates in 1970 and Sigma in 1975 show a 13.7 MW and 75 MW version of the project, respectively. Given that two other versions of this project exist and the lack of information regarding the 38 MW version, the 38MW version has been discarded.
Middle Site	Insufficient Level of Design	The Middle Site on the Teslin River was referenced in Shawinigan’s 1980 report. Further investigation revealed the site was discarded for the more favourable “NWPI (Low)” site. No other information was available on the Middle Site. Given the lack of information and the fact that a more favourable site was identified on the Teslin River, the Middle Site has been discarded.
Moon Lake B	Insufficient Level of Design	Three options were identified in the 2008 KGS report for development of the Moon Lake Site (A, B, and C). However, KGS did not complete the study of site B and did not present any detailed information (capacity, energy, etc.). Given the limited information available on option B and the fact that two other viable, detailed options are available for Moon Lake, Moon Lake B was discarded.

Potential Site	Failed Pre-Screen Criterion	Midgard Commentary
NWPI (High)	Indeterminate Site Identified in 2010 AECOM Inventory	The NWPI (High) site was listed in the 2010 AECOM report, but was discarded due to “major social and environmental disruption”. 2010 AECOM states Shawinigan’s 1980 report as the reference report. Further investigation revealed the 1980 report discarded the high version of the NWPI site for the more favourable “NWPI (Low)” site. Given the lack of information on this site and the fact that all previous studies have discarded it, NWPI (High) has been removed from this <i>Site Screening Inventory</i> .
Site 124	Indeterminate Site Identified in 2010 AECOM Inventory	Site 124 was initially identified in 1965. However, the full source report covering this site was not available for Midgard’s review. The only other mention was in the 2010 AECOM report, but with no stated capacity or energy and it was ultimately discarded for being a “very distant site”. Due to the lack of available site information, Site 124 has been discarded.
Site 127	Indeterminate Site Identified in 2010 AECOM Inventory	Site 127 was initially identified in 1965. However, the full source report covering this site was not available for Midgard’s review. The only other mention was in the 2010 AECOM report, but with no stated capacity or energy, and it was ultimately discarded for being a “very distant site”. Due to the lack of available site information, Site 127 has been discarded.
Swift	Indeterminate Site Identified in 2010 AECOM Inventory	The Swift site was listed in the 2010 AECOM report in both “high” and “low” versions, but both were “discarded in favour of the NWPI site”. The 2010 AECOM report refers to a 1962 report reference for the high version of the Swift site, but this document was not available for Midgard review. 2010 AECOM refers to Shawinigan’s 1980 report for the low version of the Swift site. Further investigation revealed the 1980 report discarded the low version of the Swift site due to the more favourable NWPI site. Given the lack of information on this site and the fact that all previous studies have discarded it, Swift has been discarded.
Swift River	Indeterminate Site Identified in 2010 AECOM Inventory	The Swift River site was listed in the 2010 AECOM report (with no stated capacity or energy), but was cut due to having “no defined scheme” and being a “remote site and likely too small”. The 2010 AECOM report references the 1990 Demers report as a source for the Swift River site. Midgard’s review reveals the Swift River site was subject to reconnaissance study only in 1990. Some high level design ideas were mentioned in the 1990 Demers report, but there were no substantive design details. Due to the lack of available information, Swift River has been discarded.
Wind	Indeterminate Site Identified in 2010 AECOM Inventory	The Wind site was initially identified in 1965. However, the full source report covering this site was not available for Midgard’s review. It was subsequently mentioned in other inventory aggregation reports over the years, including by AECOM in 2010 (which discarded the site for being a “very distant site”). Due to the lack of available information on the site, Wind has been discarded.

In conclusion, Screen 0 extracted hydroelectric sites from the source reports made available to Midgard. A reconciliation process removed duplicate sites and also removed obvious indeterminate sites, leaving a total of 124 sites. A further pre-screening process discarded an additional 16 projects that had an insufficient level of detail. Screen 0 results in a total listing of 108 potential hydroelectric sites for further study (see Table 8 below).

Table 8: Site Screening Inventory Complete List of Sites @ End of Screen 0

Map #	Site Name	Site ID	Size (MW)
1	Aberdeen Falls	PEEL-PEEL-0250	300
2	Anvil Creek	PELLEY-ANVIL-0634	10
3	Atlin Storage	YUKON-ATLIN-0669	0
4	Bates Canyon	ALSEK-BATES-0448-A	23
5	Bates Canyon + Dezadeash Diversion	ALSEK-BATES-0448-B	110
6	Beaver Crow	LIARD-BEAVE-0429	82
7	Bell	PORCU-PORCU-0263	110
8	Big Kalzas Lake Diversion	STEWA-BIG K-0534	17
9	Big Salmon	YUKON-YUKON-0580	301
10	Boundary	YUKON-LOWER-0284	1006
11	Bradens Canyon	PELLEY-PELLEY-0458-A	100
12	Bradens Canyon + Fortin Lake Dam	PELLEY-PELLEY-0458-B	115
13	Britannia	YUKON-LOWER-0438	459
14	Chandindu River	YUKON-CHAND-0335	5.8
15	Dawson	YUKON-LOWER-0319	571
16	Detour Canyon + Fortin Lake Dam	PELLEY-PELLEY-0567-B	100
17	Detour Canyon	PELLEY-PELLEY-0567-A	65
18	Donjek to White River Diversion	YUKON-DONJE-0606	43
19	Drury Creek	YUKON-DRURY-0630	2
20	Eagle's Nest Bluff (Alone)	YUKON-YUKON-0540-A	80
21	Eagle's Nest Bluff + Rink Rapids (1 PH)	YUKON-YUKON-0540-C	240
22	Eagle's Nest Bluff + Rink Rapids (2 PH)	YUKON-YUKON-0540-B	320
23	Earn Lake	PELLEY-EARN-0575	6.6
24	Ethel Lake Diversion	PELLEY-ETHEL-0465	8.5
25	False Canyon	LIARD-FRANC-0696	58
26	Fantasque	LIARD-BEAVE-0417	78
27	Fifteen Mile Diversion	YUKON-FIFTE-0320	7
28	Finlayson	YUKON-FRANC-0739	17
29	Five Fingers High (150 MW)	YUKON-YUKON-0514-B	150
30	Five Fingers High (455 MW)	YUKON-YUKON-0514-C	455

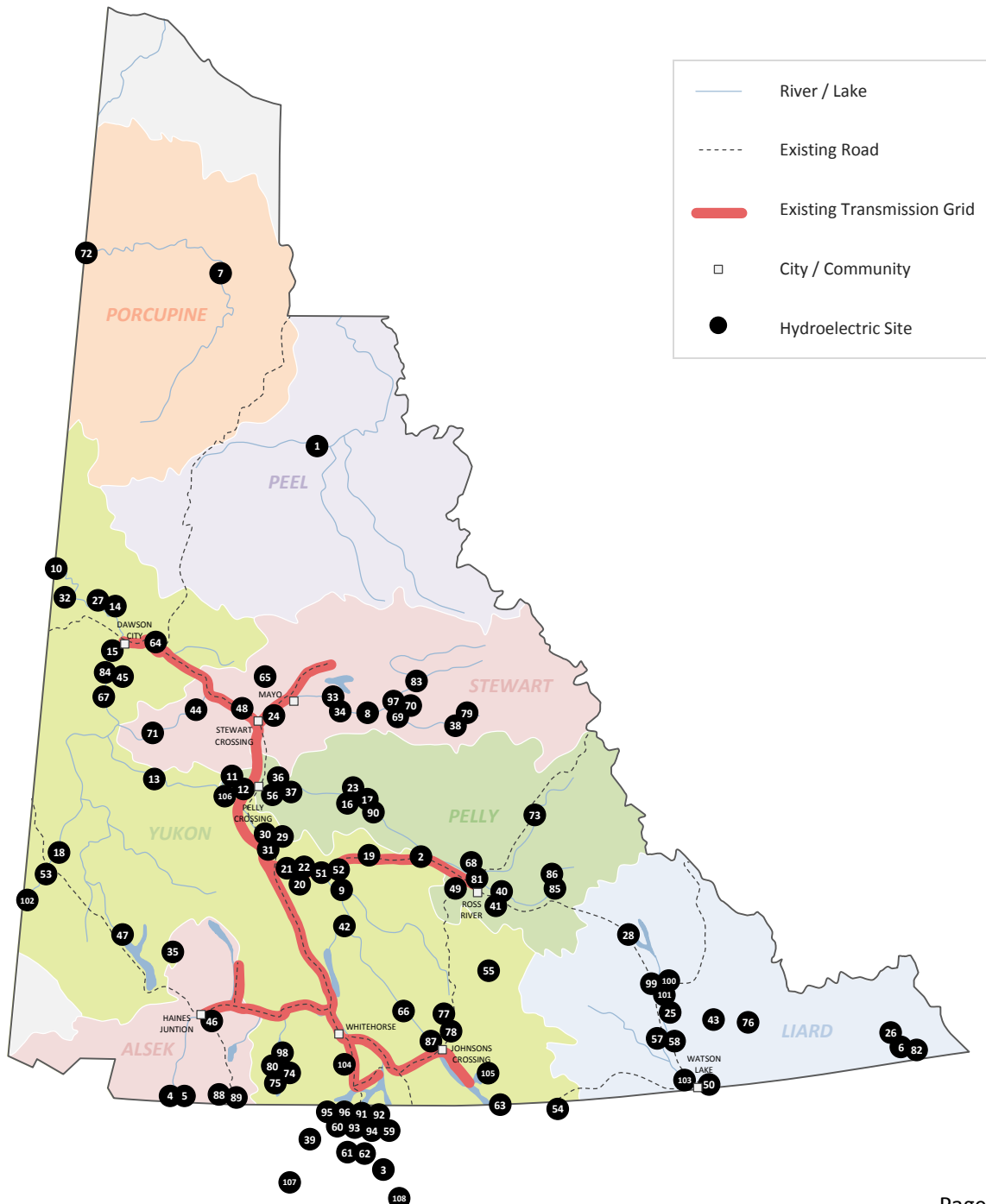
Map #	Site Name	Site ID	Size (MW)
31	Five Fingers Low (75 MW)	YUKON-YUKON-0514-A	75
32	Forty Mile	YUKON-FORTY-0295	16
33	Fraser Falls (High)	STEWA-STEWA-0519-B	300
34	Fraser Falls (Low)	STEWA-STEWA-0519-A	100
35	Gladstone Diversion	ALSEK-GLADS-1153	0
36	Granite Canyon (Large)	PELLY-PELLY-0480-B	254
37	Granite Canyon (Small)	PELLY-PELLY-0480-A	80
38	Hess Canyon	STEWA-HESS-0647	18
39	Homan Lake	YUKON-HOMAN-0746	4.2
40	Hoole Canyon	PELLY-PELLY-0760-B	13
41	Hoole Canyon + Fortin Lake Dam	PELLY-PELLY-0760-A	40
42	Hootalinqua	YUKON-YUKON-0590	259
43	Hyland Diversion	LIARD-HYLAN-0724	0
44	Independence	STEWA-STEWA-0458	450
45	Indian	YUKON-INDIA-0405	6
46	Kathleen Canyon	ALSEK-KATHL-0657	2
47	Kluane Canyon	YUKON-KLUAN-0790	12
48	Lake Creek Diversion	STEWA-LAKE-0469	13
49	Lapie	PELLY-LAPIE-0787	2
50	Liard Canyon	LIARD-LIARD-0641	90
51	Little Salmon Dam	YUKON-LITTL-0560-A	15
52	Little Salmon Diversion	YUKON-LITTL-0560-B	12
53	Lower Canyon on White River	YUKON-WHITE-0710	16
54	McNaughton (Upper & Lower)	YUKON-MCNAU-0852	13
55	McNeil	YUKON-MCNEI-1037	10
56	Mica Creek	PELLY-MICA-0484	10
57	Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A	14
58	Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B	75
59	Moon Lake + Tutshi River Outlet Site A Cluster	YUKON-MOON-0649-A	12
60	Moon Lake + Tutshi Windy Arm Outlet Site B Cluster	YUKON-MOON-0649-B	12
61	Moon Lake A	YUKON-MOON-0715-A	6
62	Moon Lake C	YUKON-MOON-0715-C	5
63	Morley River	YUKON-MORLE-0725	2
64	North Fork	YUKON-KLOND-0420	4
65	North McQuesten	STEWA-MCQUE-0550	5
66	NWPI (Low)	YUKON-TESLI-0670-A	55
67	Ogilvie	YUKON-LOWER-0338	896
68	Orchay	PELLY-TAY R-0760	4

Map #	Site Name	Site ID	Size (MW)
69	Pleasant Creek	STEWA-PLEAS-0553	5
70	Pleasant Creek + Rogue Diversion	STEWA-PLEAS-0553	7
71	Porcupine	STEWA-STEWA-0362	83
72	Porcupine Canyon	PORCU-PORCU-0245	190
73	Prevost Canyon	PELLY-ROSS-0835	12
74	Primrose Diversion Scheme (To Takhini Lake)	YUKON-PRIMR-0708-B	41
75	Primrose Lake to Takhini Lake Diversion	YUKON-PRIMR-0708-A	19
76	Quartz Creek	LIARD-COAL-0726	38
77	Quiet Lake Diversion	YUKON-BIG S-0728-A	7
78	Quiet Lake Diversion + Rose River Diversion	YUKON-BIG S-0728-B	15
79	Rogue	STEWA-HESS-0678	12
80	Rose Lake to Kusawa Lake Diversion	YUKON-PRIMR-0700	17
81	Ross Canyon	PELLY-ROSS-0725	30
82	Saucy Creek	LIARD-BEAVE-0361	23
83	Seven Mile Canyon	STEWA-STEWA-0570	10
84	Sixty Mile River Diversion	YUKON-SIXTY-0380	18
85	Slate Rapids (Diversion Scheme)	PELLY-PELLY-0847-B	42
86	Slate Rapids (Powerhouse in Main Dam)	PELLY-PELLY-0847-A	22
87	Squanga	STEWA-SQUAN-0696	2
88	Tatshenshini + Dezadeash / Kusawa Diversion	ALSEK-TATSH-0590-B	160
89	Tatshenshini + Dezadeash Diversion	ALSEK-TATSH-0590-A	95
90	Tay Diversion	PELLY-TAY R-0604	31
91	Tutshi River Outlet Site A (Lake to Lake)	YUKON-TUTSH-0649-A	6
92	Tutshi River Outlet Site A (Lake to River)	YUKON-TUTSH-0649-B	4
93	Tutshi River Outlet Site A (River to Lake)	YUKON-TUTSH-0649-C	6
94	Tutshi River Outlet Site A (River to River)	YUKON-TUTSH-0649-D	4
95	Tutshi Windy Arm Outlet Site B (East PH)	YUKON-TUTSH-0649-E	6
96	Tutshi Windy Arm Outlet Site B (West PH)	YUKON-TUTSH-0649-F	6
97	Two Mile Canyon	STEWA-HESS-0552	53
98	Upper & Lower Primrose (2008 Layout)	YUKON-PRIMR-0704	16
99	Upper Canyon (Large)	LIARD-FRANC-0730-C	75
100	Upper Canyon (Medium)	LIARD-FRANC-0730-B	58
101	Upper Canyon (Small)	LIARD-FRANC-0730-A	25
102	Upper Canyon on White River	YUKON-WHITE-0795	16
103	Watson Lake (Micro Project)	LIARD-WATSO-0641	1
104	Watson River	YUKON-WATSO-1130	3
105	Wolf	YUKON-WOLF-0720	5
106	Wolverine	YUKON-LOWER-0458	476

Map #	Site Name	Site ID	Size (MW)
107	Yukon-Taiya	YUKON-YUKON-0030	4050
108	Yukon-Taku	YUKON-YUKON-0110	3692

In addition to the tabular results stated above, Screen 0's 108 potential sites are mapped in Figure 3 below. Note that the "Map #" stated for each site in Table 8 above corresponds to the number indicated in each of the site markers in Figure 3.

Figure 3: Site Screening Inventory Complete List of Sites Map @ End of Screen 0



4 Screen 1: Fundamental Development Barrier Project Screen

A preliminary “showstopper” analysis removes sites with obvious development barriers from the ranking process. A total of five development “showstoppers” are utilized during this stage of screening. These five showstoppers are summarized in Table 9.

Table 9: Development Showstoppers

#	Showstopper	Showstopper Descriptions
1	Minimum Project Size	Project, or cluster of scalable projects, is less than or equal to 10 MW in size.
2	National Park	Project located in, or inundates (floods), National Park Lands.
3	Urban Flooding	Project inundates a titled property or private dwelling within the boundaries of any of the 36 Census Subdivisions (as defined by Statistics Canada) in the Yukon ³ . See Appendix C for a listing of Census Subdivisions.
4	Main Stem of Yukon River Exclusion	Project is located on the main stem of the Yukon River.
5	Incorrect Project Type	Projects that are non-hydroelectric generation projects (i.e. water diversion only, water storage only, pumped storage).

The showstopper analysis results in a total of 61 sites being screened out from the ranking process. Table 10 below lists these sites and the corresponding reasons for each site’s exclusion (sorted alphabetically).

Table 10: Sites Removed from Economic Ranking Process Due to Showstoppers

Site Name & ID	Map #	Comments/Explanation
Anvil Creek [PELLY-ANVIL-0634]	2	Minimum Project Size: Project has an installed capacity of 10 MW and therefore fails to meet the criterion of >10 MW
Atlin Storage [YUKON-ATLIN-0669]	3	Incorrect Project Type: Project is a water storage only dam on Atlin lake in British Columbia and provides no direct generation
Bates Canyon [ALSEK-BATES-0448-A]	4	National Park: Project is located within (and has impacts to) the Kluane National Park
Bates Canyon + Dezadeash Diversion [ALSEK-BATES-0448-B]	5	National Park: Project is located within (and has impacts to) the Kluane National Park
Big Salmon [YUKON-YUKON-0580]	9	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Boundary [YUKON-LOWER-0284]	10	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.

³ Source: Statistics Canada Census Profile Page ([link](#)) accessed on October 7, 2014

Site Name & ID	Map #	Comments/Explanation
Bradens Canyon [PELLY-PELLY-0458-A]	11	Urban Flooding: Project floods the Census Subdivision “Pelly Crossing”
Bradens Canyon + Fortin Lake Dam [PELLY-PELLY-0458-B]	12	Urban Flooding: Project floods the Census Subdivision “Pelly Crossing”
Britannia [YUKON-LOWER-0438]	13	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Chandindu River [YUKON-CHAND-0335]	14	Minimum Project Size: Project has an installed capacity of 5.8 MW and therefore fails to meet the criterion of >10 MW
Dawson [YUKON-LOWER-0319]	15	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Drury Creek [YUKON-DRURY-0630]	19	Minimum Project Size: Project has an installed capacity of 2.4 MW and therefore fails to meet the criterion of >10 MW
Eagle's Nest Bluff (Alone) [YUKON-YUKON-0540-A]	20	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Eagle's Nest Bluff + Rink Rapids (1 PH) [YUKON-YUKON-0540-C]	21	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Eagle's Nest Bluff + Rink Rapids (2 PH) [YUKON-YUKON-0540-B]	22	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Earn Lake [PELLY-EARN-0575]	23	Minimum Project Size: Project has an installed capacity of 6.6 MW and therefore fails to meet the criterion of >10 MW
Ethel Lake Diversion [PELLY-ETHEL-0465]	24	Minimum Project Size: Project has an installed capacity of 8.5 MW and therefore fails to meet the criterion of >10 MW
Fifteen Mile Diversion [YUKON-FIFTE-0320]	27	Minimum Project Size: Project has an installed capacity of 6.7 MW and therefore fails to meet the criterion of >10 MW
Five Fingers High (150 MW) [YUKON-YUKON-0514-B]	29	Urban Flooding: Project floods the Census Subdivision “Carmacks”. Main Stem of Yukon River: Project is also situated on the main stem of the Yukon River.
Five Fingers High (455 MW) [YUKON-YUKON-0514-C]	30	Urban Flooding: Project floods the Census Subdivision “Carmacks”. Main Stem of Yukon River: Project is also situated on the main stem of the Yukon River.
Five Fingers Low (75 MW) [YUKON-YUKON-0514-A]	31	Urban Flooding: Project floods the Census Subdivision “Carmacks”. Main Stem of Yukon River: Project is also situated on the main stem of the Yukon River.

Site Name & ID	Map #	Comments/Explanation
Gladstone Diversion [ALSEK-GLADS-1153]	35	Incorrect Project Type: Project is a storage dam only on Gladstone Creek to re-direct water to the existing Aishihik Hydro Facility
Homan Lake [YUKON-HOMAN-0746]	39	Minimum Project Size: Project has an installed capacity of 4.2 MW and therefore fails to meet the criterion of >10 MW
Hootalinqua [YUKON-YUKON-0590]	42	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Hyland Diversion [LIARD-HYLAN-0724]	43	Incorrect Project Type: Project is a diversion dam only without generation. The Project was explored in 1970 to re-direct the Hyland River to the Frances River and increase generation at the False Canyon and Middle Canyon sites. The False Canyon and Middle Canyon sites have been studied since as stand-alone projects that no longer require this Hyland River dam.
Independence [STEWA-STEWA-0458]	44	Urban Flooding: Project floods the Census Subdivisions “Stewart Crossing” and “Pelly Crossing”
Indian [YUKON-INDIA-0405]	45	Minimum Project Size: Project has an installed capacity of 6.3 MW and therefore fails to meet the criterion of >10 MW
Kathleen Canyon [ALSEK-KATHL-0657]	46	Minimum Project Size: Project has an installed capacity of 2 MW and therefore fails to meet the criterion of >10 MW
Kluane Canyon [YUKON-KLUAN-0790]	47	National Park: Project raises the level of Kluane Lake, therefore impacting the Kluane National Park (which borders the lake). Project also floods the Census Subdivisions “Destruction Bay” and “Burwash Landing”.
Lapie [PELLY-LAPIE-0787]	49	Minimum Project Size: Project has an installed capacity of 2 MW and therefore fails to meet the criterion of >10 MW
Liard Canyon [LIARD-LIARD-0641]	50	Urban Flooding: Project floods the Census Subdivision “Upper Liard”
McNeil [YUKON-MCNEI-1037]	55	Minimum Project Size: Project has an installed capacity of 9.5 MW and therefore fails to meet the criterion of >10 MW
Mica Creek [PELLY-MICA-0484]	56	Minimum Project Size: Project has an installed capacity of 9.8 MW and therefore fails to meet the criterion of >10 MW

Site Name & ID	Map #	Comments/Explanation
Moon Lake A [YUKON-MOON-0715-A]	61	Minimum Project Size: Project has an installed capacity of 5.8 MW and therefore fails to meet the criterion of >10 MW
Moon Lake C [YUKON-MOON-0715-C]	62	Minimum Project Size: Project has an installed capacity of 4.9 MW and therefore fails to meet the criterion of >10 MW
Morley River [YUKON-MORLE-0725]	63	Minimum Project Size: Project has an installed capacity of 2 MW and therefore fails to meet the criterion of >10 MW
North Fork [YUKON-KLOND-0420]	64	Minimum Project Size: Project has an installed capacity of 4 MW and therefore fails to meet the criterion of >10 MW
North McQuesten [STEWA-MCQUE-0550]	65	Minimum Project Size: Project has an installed capacity of 5 MW and therefore fails to meet the criterion of >10 MW
Ogilvie [YUKON-LOWER-0338]	67	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Orchay [PELLY-TAY R-0760]	69	Minimum Project Size: Project has an installed capacity of 4 MW and therefore fails to meet the criterion of >10 MW
Pleasant Creek [STEWA-PLEAS-0553]	70	Minimum Project Size: Project has an installed capacity of 5.3 MW and therefore fails to meet the criterion of >10 MW
Pleasant Creek + Rogue Diversion [STEWA-PLEAS-0553]	71	Minimum Project Size: Project has an installed capacity of 7.1 MW and therefore fails to meet the criterion of >10 MW
Porcupine [STEWA-STEWA-0362]	72	Urban Flooding: Project floods the Census Subdivision “Stewart Crossing”
Porcupine Canyon [PORCU-PORCU-0245]	77	Urban Flooding: Project floods the Census Subdivision “Old Crow”
Quiet Lake Diversion [YUKON-BIG S-0728-A]	83	Minimum Project Size: Project has an installed capacity of 7 MW and therefore fails to meet the criterion of >10 MW
Seven Mile Canyon [STEWA-STEWA-0570]	87	Minimum Project Size: Project has an installed capacity of 9.8 MW and therefore fails to meet the criterion of >10 MW
Squanga [STEWA-SQUAN-0696]	88	Minimum Project Size: Project has an installed capacity of 1.75 MW and therefore fails to meet the criterion of >10 MW
Tatshenshini + Dezadeash Diversion [ALSEK-TATSH-0590-A]	89	National Park: Project raises the level of Dezadeash Lake, therefore impacting the Kluane National Park (which borders the lake). Project also floods the Census Subdivision “Klukshu”.

Site Name & ID	Map #	Comments/Explanation
Tatshenshini + Dezadeash / Kusawa Diversion [ALSEK-TATSH-0590-B]	91	National Park: Project raises the level of Dezadeash Lake, therefore impacting the Kluane National Park (which borders the lake). Project floods the Census Subdivision “Klukshu”.
Tutshi River Outlet Site A (Lake to Lake) [YUKON-TUTSH-0649-A]	92	Minimum Project Size: Project has an installed capacity of 5.9 MW and therefore fails to meet the criterion of >10 MW
Tutshi River Outlet Site A (Lake to River) [YUKON-TUTSH-0649-B]	93	Minimum Project Size: Project has an installed capacity of 4.2 MW and therefore fails to meet the criterion of >10 MW
Tutshi River Outlet Site A (River to Lake) [YUKON-TUTSH-0649-C]	94	Minimum Project Size: Project has an installed capacity of 5.9 MW and therefore fails to meet the criterion of >10 MW
Tutshi River Outlet Site A (River to River) [YUKON-TUTSH-0649-D]	95	Minimum Project Size: Project has an installed capacity of 4.2 MW and therefore fails to meet the criterion of >10 MW
Tutshi Windy Arm Outlet Site B (East PH) [YUKON-TUTSH-0649-E]	96	Minimum Project Size: Project has an installed capacity of 5.9 MW and therefore fails to meet the criterion of >10 MW
Tutshi Windy Arm Outlet Site B (West PH) [YUKON-TUTSH-0649-F]	103	Minimum Project Size: Project has an installed capacity of 5.9 MW and therefore fails to meet the criterion of >10 MW
Watson Lake (Micro Project) [LIARD-WATSO-0641]	104	Minimum Project Size: Project has an installed capacity of 1 MW and therefore fails to meet the criterion of >10 MW
Watson River [YUKON-WATSO-1130]	105	Minimum Project Size: Project has an installed capacity of 3 MW and therefore fails to meet the criterion of >10 MW
Wolf [YUKON-WOLF-0720]	106	Minimum Project Size: Project has an installed capacity of 4.8 MW and therefore fails to meet the criterion of >10 MW
Wolverine [YUKON-LOWER-0458]	107	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Yukon-Taiya [YUKON-YUKON-0030]	108	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.
Yukon-Taku [YUKON-YUKON-0110]	109	Main Stem of Yukon River: Project is situated on the main stem of the Yukon River.

In conclusion, 61 of the 108 sites that made it to “Screen 1” are removed from further study in the *Site Screening Inventory*. The remaining 47 sites are carried forward into subsequent analysis steps. The complete list of potential Yukon hydroelectric sites is shown in Table 11 below with the discarded sites (as listed in Table 10 above) highlighted in red.

Table 11: Site Screening Inventory Complete List of Sites @ End of Screen 1

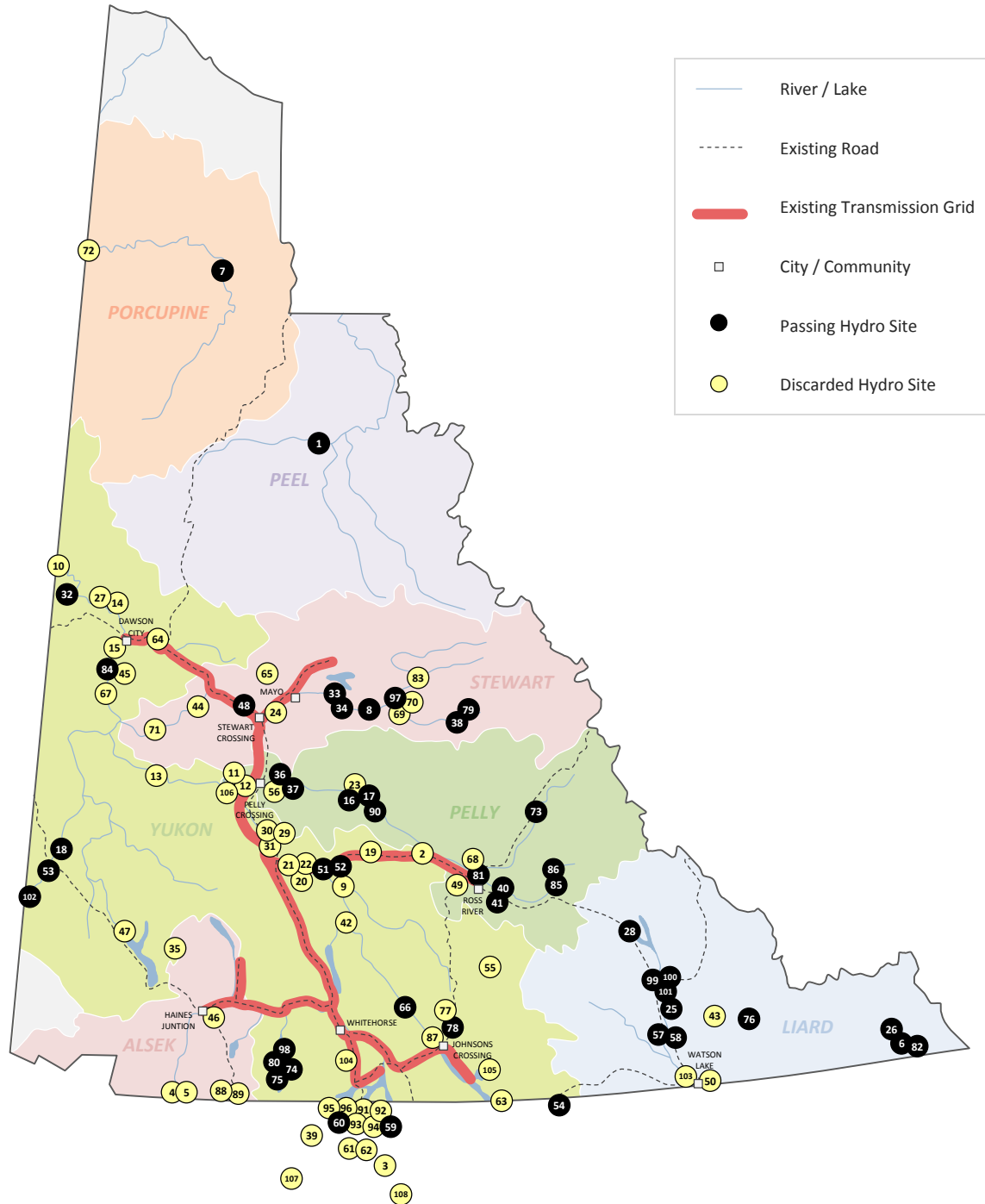
Map #	Site Name	Site ID	Size (MW)	Screen 1 Result
1	Aberdeen Falls	PEEL-PEEL-0250	300	PASS
2	Anvil Creek	PELTY-ANVIL-0634	10	DISCARDED
3	Atlin Storage	YUKON-ATLIN-0669	0	DISCARDED
4	Bates Canyon	ALSEK-BATES-0448-A	23	DISCARDED
5	Bates Canyon + Dezadeash Diversion	ALSEK-BATES-0448-B	110	DISCARDED
6	Beaver Crow	LIARD-BEAVE-0429	82	PASS
7	Bell	PORCU-PORCU-0263	110	PASS
8	Big Kalzas Lake Diversion	STEWA-BIG K-0534	17	PASS
9	Big Salmon	YUKON-YUKON-0580	301	DISCARDED
10	Boundary	YUKON-LOWER-0284	1006	DISCARDED
11	Bradens Canyon	PELTY-PELTY-0458-A	100	DISCARDED
12	Bradens Canyon + Fortin Lake Dam	PELTY-PELTY-0458-B	115	DISCARDED
13	Britannia	YUKON-LOWER-0438	459	DISCARDED
14	Chandindu River	YUKON-CHAND-0335	5.8	DISCARDED
15	Dawson	YUKON-LOWER-0319	571	DISCARDED
16	Detour Canyon + Fortin Lake Dam	PELTY-PELTY-0567-B	100	PASS
17	Detour Canyon	PELTY-PELTY-0567-A	65	PASS
18	Donjek to White River Diversion	YUKON-DONJE-0606	43	PASS
19	Drury Creek	YUKON-DRURY-0630	2	DISCARDED
20	Eagle's Nest Bluff (Alone)	YUKON-YUKON-0540-A	80	DISCARDED
21	Eagle's Nest Bluff + Rink Rapids (1 PH)	YUKON-YUKON-0540-C	240	DISCARDED
22	Eagle's Nest Bluff + Rink Rapids (2 PH)	YUKON-YUKON-0540-B	320	DISCARDED
23	Earn Lake	PELTY-EARN-0575	6.6	DISCARDED
24	Ethel Lake Diversion	PELTY-ETHEL-0465	8.5	DISCARDED
25	False Canyon	LIARD-FRANC-0696	58	PASS
26	Fantasque	LIARD-BEAVE-0417	78	PASS
27	Fifteen Mile Diversion	YUKON-FIFTE-0320	7	DISCARDED
28	Finlayson	YUKON-FRANC-0739	17	PASS
29	Five Fingers High (150 MW)	YUKON-YUKON-0514-B	150	DISCARDED
30	Five Fingers High (455 MW)	YUKON-YUKON-0514-C	455	DISCARDED
31	Five Fingers Low (75 MW)	YUKON-YUKON-0514-A	75	DISCARDED
32	Forty Mile	YUKON-FORTY-0295	16	PASS
33	Fraser Falls (High)	STEWA-STEWA-0519-B	300	PASS
34	Fraser Falls (Low)	STEWA-STEWA-0519-A	100	PASS
35	Gladstone Diversion	ALSEK-GLADS-1153	0	DISCARDED
36	Granite Canyon (Large)	PELTY-PELTY-0480-B	254	PASS

Map #	Site Name	Site ID	Size (MW)	Screen 1 Result
37	Granite Canyon (Small)	PELLEY-PELLEY-0480-A	80	PASS
38	Hess Canyon	STEWA-HESS-0647	18	PASS
39	Homan Lake	YUKON-HOMAN-0746	4.2	DISCARDED
40	Hoole Canyon	PELLEY-PELLEY-0760-B	13	PASS
41	Hoole Canyon + Fortin Lake Dam	PELLEY-PELLEY-0760-A	40	PASS
42	Hootalinqua	YUKON-YUKON-0590	259	DISCARDED
43	Hyland Diversion	LIARD-HYLAN-0724	0	DISCARDED
44	Independence	STEWA-STEWA-0458	450	DISCARDED
45	Indian	YUKON-INDIA-0405	6	DISCARDED
46	Kathleen Canyon	ALSEK-KATHL-0657	2	DISCARDED
47	Kluane Canyon	YUKON-KLUAN-0790	12	DISCARDED
48	Lake Creek Diversion	STEWA-LAKE-0469	13	PASS
49	Lapie	PELLEY-LAPIE-0787	2	DISCARDED
50	Liard Canyon	LIARD-LIARD-0641	90	DISCARDED
51	Little Salmon Dam	YUKON-LITTL-0560-A	15	PASS
52	Little Salmon Diversion	YUKON-LITTL-0560-B	12	PASS
53	Lower Canyon on White River	YUKON-WHITE-0710	16	PASS
54	McNaughton (Upper & Lower)	YUKON-MCNAU-0852	13	PASS
55	McNeil	YUKON-MCNEI-1037	10	DISCARDED
56	Mica Creek	PELLEY-MICA-0484	10	DISCARDED
57	Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A	14	PASS
58	Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B	75	PASS
59	Moon Lake + Tutshi River Outlet Site A Cluster	YUKON-MOON-0649-A	12	PASS
60	Moon Lake + Tutshi Windy Arm Outlet Site B Cluster	YUKON-MOON-0649-B	12	PASS
61	Moon Lake A	YUKON-MOON-0715-A	6	DISCARDED
62	Moon Lake C	YUKON-MOON-0715-C	5	DISCARDED
63	Morley River	YUKON-MORLE-0725	2	DISCARDED
64	North Fork	YUKON-KLOND-0420	4	DISCARDED
65	North McQuesten	STEWA-MCQUE-0550	5	DISCARDED
66	NWPI (Low)	YUKON-TESLI-0670-A	55	PASS
67	Ogilvie	YUKON-LOWER-0338	896	DISCARDED
68	Orchay	PELLEY-TAY R-0760	4	DISCARDED
69	Pleasant Creek	STEWA-PLEAS-0553	5	DISCARDED
70	Pleasant Creek + Rogue Diversion	STEWA-PLEAS-0553	7	DISCARDED
71	Porcupine	STEWA-STEWA-0362	83	DISCARDED
72	Porcupine Canyon	PORCU-PORCU-0245	190	DISCARDED

Map #	Site Name	Site ID	Size (MW)	Screen 1 Result
73	Prevost Canyon	PELLY-ROSS-0835	12	PASS
74	Primrose Diversion Scheme (To Takhini Lake)	YUKON-PRIMR-0708-B	41	PASS
75	Primrose Lake to Takhini Lake Diversion	YUKON-PRIMR-0708-A	19	PASS
76	Quartz Creek	LIARD-COAL-0726	38	PASS
77	Quiet Lake Diversion	YUKON-BIG S-0728-A	7	DISCARDED
78	Quiet Lake Diversion + Rose River Diversion	YUKON-BIG S-0728-B	15	PASS
79	Rogue	STEWA-HESS-0678	12	PASS
80	Rose Lake to Kusawa Lake Diversion	YUKON-PRIMR-0700	17	PASS
81	Ross Canyon	PELLY-ROSS-0725	30	PASS
82	Saucy Creek	LIARD-BEAVE-0361	23	PASS
83	Seven Mile Canyon	STEWA-STEWA-0570	10	DISCARDED
84	Sixty Mile River Diversion	YUKON-SIXTY-0380	18	PASS
85	Slate Rapids (Diversion Scheme)	PELLY-PELLY-0847-B	42	PASS
86	Slate Rapids (Powerhouse in Main Dam)	PELLY-PELLY-0847-A	22	PASS
87	Squanga	STEWA-SQUAN-0696	2	DISCARDED
88	Tatshenshini + Dezadeash / Kusawa Diversion	ALSEK-TATSH-0590-B	160	DISCARDED
89	Tatshenshini + Dezadeash Diversion	ALSEK-TATSH-0590-A	95	DISCARDED
90	Tay Diversion	PELLY-TAY R-0604	31	PASS
91	Tutshi River Outlet Site A (Lake to Lake)	YUKON-TUTSH-0649-A	6	DISCARDED
92	Tutshi River Outlet Site A (Lake to River)	YUKON-TUTSH-0649-B	4	DISCARDED
93	Tutshi River Outlet Site A (River to Lake)	YUKON-TUTSH-0649-C	6	DISCARDED
94	Tutshi River Outlet Site A (River to River)	YUKON-TUTSH-0649-D	4	DISCARDED
95	Tutshi Windy Arm Outlet Site B (East PH)	YUKON-TUTSH-0649-E	6	DISCARDED
96	Tutshi Windy Arm Outlet Site B (West PH)	YUKON-TUTSH-0649-F	6	DISCARDED
97	Two Mile Canyon	STEWA-HESS-0552	53	PASS
98	Upper & Lower Primrose (2008 Layout)	YUKON-PRIMR-0704	16	PASS
99	Upper Canyon (Large)	LIARD-FRANC-0730-C	75	PASS
100	Upper Canyon (Medium)	LIARD-FRANC-0730-B	58	PASS
101	Upper Canyon (Small)	LIARD-FRANC-0730-A	25	PASS
102	Upper Canyon on White River	YUKON-WHITE-0795	16	PASS
103	Watson Lake (Micro Project)	LIARD-WATSO-0641	1	DISCARDED
104	Watson River	YUKON-WATSO-1130	3	DISCARDED
105	Wolf	YUKON-WOLF-0720	5	DISCARDED
106	Wolverine	YUKON-LOWER-0458	476	DISCARDED
107	Yukon-Taiya	YUKON-YUKON-0030	4050	DISCARDED
108	Yukon-Taku	YUKON-YUKON-0110	3692	DISCARDED

Screen 1's 47 passing sites (black dots) and 61 discarded sites (yellow dots) are mapped in Figure 4 below. Note the consistent use of the same "Map #" (as referenced in Table 11 above).

Figure 4: Site Screening Inventory Complete List of Sites Map @ End of Screen 1



5 Screen 2: Fundamentally Uneconomic Project Screen

A high-level estimate of each project's economics is used to screen the remaining 47 potential hydroelectric sites and to advance the remaining sites for further study. The purpose of this process is to screen the hydroelectric potential in the Yukon by removing the fundamentally uneconomic projects.

A high-level, parametric cost model is used to develop initial site costs to inform the economic viability of the 47 potential hydroelectric sites. The goal is to eliminate from further consideration and study projects that will never be economic for the foreseeable future. Note, this does not imply that the remaining projects will be economic, only that the discarded sites are fundamentally uneconomic.

Several key, differentiating quantities are estimated including dam costs, penstock costs, tunneling costs (several of the projects include long-distance underground tunneling), transmission line costs, and access costs. In addition to these differentiating project features, a "balance of plant" cost assumption (that includes all other civil, electrical and mechanical works) and an interest cost from a construction loan are also carried.

The simplified form of the parametric cost model is as follows:

$$\text{Project Cost} = \text{Dam Cost} + \text{Penstock Costs} + \text{Tunneling Cost (if Applicable)} + \text{Transmission Cost} \\ + \text{Access Cost} + \text{Balance of Plant Cost} + \text{Loan Interest During Construction}$$

It is important to note that the project costs estimated for Screening 2 do not account for any site specific conditions (e.g.: permafrost conditions, bedrock conditions, impact mitigations etc.). The costs should be considered optimistic due to lack of consideration given to the site specific conditions and to the complexities of construction in Canada's North. This approach is acceptable because potentially optimistic costs reduce the number of projects that are considered fundamentally uneconomic; thereby allowing more potential projects to pass through the screening for future study. Stated another way, potential projects that are discarded during Screening 2 can be considered fundamentally uneconomic and have little reasonable chance of being a viable development candidate.

Please refer to Appendix B for a full breakdown of Screening 2 cost assumptions.

Projects are compared on a cost per energy generated method called the Levelized Cost of Energy ("LCOE"). The LCOE is applicable to the *Site Screening Inventory* because it allows for an "apples-to-apples" comparison of the cost of generated energy between different projects. To illustrate via a simplified example, although one project may be twice the size of another project, it is the cost per unit energy generated, not the total cost, which becomes the basis of comparison.

5.1 Defining the Levelized Cost of Energy

Screen 2 of the *Site Screening Inventory* screens resources using the major economic drivers. Calculating a unit cost of energy, or a “Levelized Cost of Energy”, provides a consistent means of economically ranking hydroelectric projects. The Levelized Cost of Energy calculation includes both the total energy generated, and the total capital and operating costs, for a generating facility over its expected lifetime. The Levelized Cost model is based on discounting (using the time value of money) all capital costs, operating costs, and energy output to their present value equivalents.

The Yukon Energy Corporation (“YEC”) also makes use of the LCOE calculation. In the 2011-2030 Resource Plan YEC defines the LCOE as:

*"[Levelized Cost of Energy ("LCOE")] indicates on a consistent and comparable basis each option's overall costs per kWh...It includes capital and operating costs and, where specified, any related transmission, storage or capacity costs. This cost is subject to ongoing annual inflation for each subsequent year of operation in order to assess costs over the option's economic life."*⁴

Several inputs are required to calculate Levelized Cost, including annual energy production, costs (in the form of project costs, interest during construction⁵, and operating costs), and economic assumptions (discount rate and project lifetime). These inputs are applied in the following LCOE equation:

$$\text{Levelized Cost of Energy} = \frac{\text{Total Present Value of Costs}}{\text{Total Present Value of Energy Output}}$$

To determine if a project is fundamentally uneconomic, the hydroelectric LCOE is compared against the LCOE of a Yukon based thermal generation asset. If the hydroelectric project's LCOE is higher than the thermal generation LCOE, it is deemed uneconomic and discarded from future study in the *Site Screening Inventory*.

The thermal generation LCOE in the Yukon is \$180/MWh (in \$2013) based on Yukon Energy's December 2013 filing for the Whitehorse Diesel-Natural Gas Conversion Project and assumes Liquified Natural Gas (“LNG”) fueled simple cycle generation as the thermal generation resource. Midgard has escalated this price to \$2014 by increasing it 1.9% (the average inflation rate to date for 2014⁶), for a final Levelized Cost of thermal generation of \$183/MWh.

⁴ Source Details: Yukon Energy Corporation, "20-Year Resource Plan: 2011-2030", December 2011, p. 67

⁵ Interest during construction (or “IDC”) is the sum of interest payments made on project debt during construction prior to loan conversion.

⁶ Source (Accessed on October 28, 2014): <http://www.inflation.eu/inflation-rates/canada/historic-inflation/cpi-inflation-canada-2014.aspx>

5.2 Results

The LCOE for each of the 47 project of interest is calculated and leads to a total of 31 projects with a LCOE greater than the cut-off limit of \$183/MWh. These 31 projects are therefore deemed fundamentally uneconomic and are discarded. Table 12 below lists the discarded sites (in alphabetical order) and their respective LCOE.

Table 12: Projects Deemed Fundamentally Uneconomic

Site Name	Site ID	Map #	Screen 2 LCOE
Aberdeen Falls	PEEL-PEEL-0250	1	\$193/MWh
Beaver Crow	LIARD-BEAVE-0429	6	\$194/MWh
Bell	PORCU-PORCU-0263	7	\$203/MWh
Big Kalzas Lake Diversion	STEWA-BIG K-0534	8	\$458/MWh
Donjek to White River Diversion	YUKON-DONJE-0606	18	\$274/MWh
Fantasque	LIARD-BEAVE-0417	26	\$204/MWh
Finlayson	YUKON-FRANC-0739	28	\$279/MWh
Forty Mile	YUKON-FORTY-0295	32	\$293/MWh
Hess Canyon	STEWA-HESS-0647	38	\$316/MWh
Hoole Canyon	PELLY-PELLY-0760-B	40	\$260/MWh
Lake Creek Diversion	STEWA-LAKE-0469	48	\$532/MWh
Little Salmon Dam	YUKON-LITTL-0560-A	51	\$593/MWh
Little Salmon Diversion	YUKON-LITTL-0560-B	52	\$684/MWh
Lower Canyon on White River	YUKON-WHITE-0710	53	\$448/MWh
McNaughton (Upper & Lower)	YUKON-MCNAU-0852	54	\$312/MWh
Moon Lake + Tutshi River Outlet Site A Cluster	YUKON-MOON-0649-A	59	\$266/MWh
Moon Lake + Tutshi Windy Arm Outlet Site B Cluster	YUKON-MOON -0649-B	60	\$248/MWh
Prevost Canyon	PELLY-ROSS-0835	73	\$264/MWh
Primrose Diversion Scheme (To Takhini Lake)	YUKON-PRIMR-0708-B	74	\$232/MWh
Primrose Lake to Takhini Lake Diversion	YUKON-PRIMR-0708-A	75	\$246/MWh
Quartz Creek	LIARD-COAL-0726	76	\$220/MWh
Quiet Lake Diversion + Rose River Diversion	YUKON-BIG S-0728-B	78	\$1090/MWh
Rogue	STEWA-HESS-0678	79	\$761/MWh
Rose Lake to Kusawa Lake Diversion	YUKON-PRIMR-0700	80	\$367/MWh
Ross Canyon	PELLY-ROSS-0725	81	\$248/MWh
Saucy Creek	LIARD-BEAVE-0361	82	\$279/MWh
Sixty Mile River Diversion	YUKON-SIXTY-0380	84	\$584/MWh
Slate Rapids (Powerhouse in Main Dam)	PELLY-PELLY-0847-A	86	\$344/MWh

Site Name	Site ID	Map #	Screen 2 LCOE
Tay Diversion	PELTY-TAY R-0604	90	\$214/MWh
Upper & Lower Primrose (2008 Layout)	YUKON-PRIMR-0704	98	\$264/MWh
Upper Canyon on White River	YUKON-WHITE-0795	102	\$519/MWh

In conclusion, 31 of the 47 sites that made it to “Screen 2” are removed from further study in the *Site Screening Inventory*. The complete list of potential Yukon hydroelectric sites is shown in Table 13 below with all discarded sites (from Screen 1 and Screen 2) highlighted in red.

Table 13: Site Screening Inventory Complete List of Sites @ End of Screen 2

Map #	Site Name	Site ID	Size (MW)	Screen 1 Result	Screen 2 Result
1	Aberdeen Falls	PEEL-PEEL-0250	300	PASS	DISCARDED
2	Anvil Creek	PELTY-ANVIL-0634	10	DISCARDED	
3	Atlin Storage	YUKON-ATLIN-0669	0	DISCARDED	
4	Bates Canyon	ALSEK-BATES-0448-A	23	DISCARDED	
5	Bates Canyon + Dezadeash Diversion	ALSEK-BATES-0448-B	110	DISCARDED	
6	Beaver Crow	LIARD-BEAVE-0429	82	PASS	DISCARDED
7	Bell	PORCU-PORCU-0263	110	PASS	DISCARDED
8	Big Kalzas Lake Diversion	STEWA-BIG K-0534	17	PASS	DISCARDED
9	Big Salmon	YUKON-YUKON-0580	301	DISCARDED	
10	Boundary	YUKON-LOWER-0284	1006	DISCARDED	
11	Bradens Canyon	PELTY-PELTY-0458-A	100	DISCARDED	
12	Bradens Canyon + Fortin Lake Dam	PELTY-PELTY-0458-B	115	DISCARDED	
13	Britannia	YUKON-LOWER-0438	459	DISCARDED	
14	Chandindu River	YUKON-CHAND-0335	5.8	DISCARDED	
15	Dawson	YUKON-LOWER-0319	571	DISCARDED	
16	Detour Canyon + Fortin Lake Dam	PELTY-PELTY-0567-B	100	PASS	PASS
17	Detour Canyon	PELTY-PELTY-0567-A	65	PASS	PASS
18	Donjek to White River Diversion	YUKON-DONJE-0606	43	PASS	DISCARDED
19	Drury Creek	YUKON-DRURY-0630	2	DISCARDED	
20	Eagle's Nest Bluff (Alone)	YUKON-YUKON-0540-A	80	DISCARDED	
21	Eagle's Nest Bluff + Rink Rapids (1 PH)	YUKON-YUKON-0540-C	240	DISCARDED	

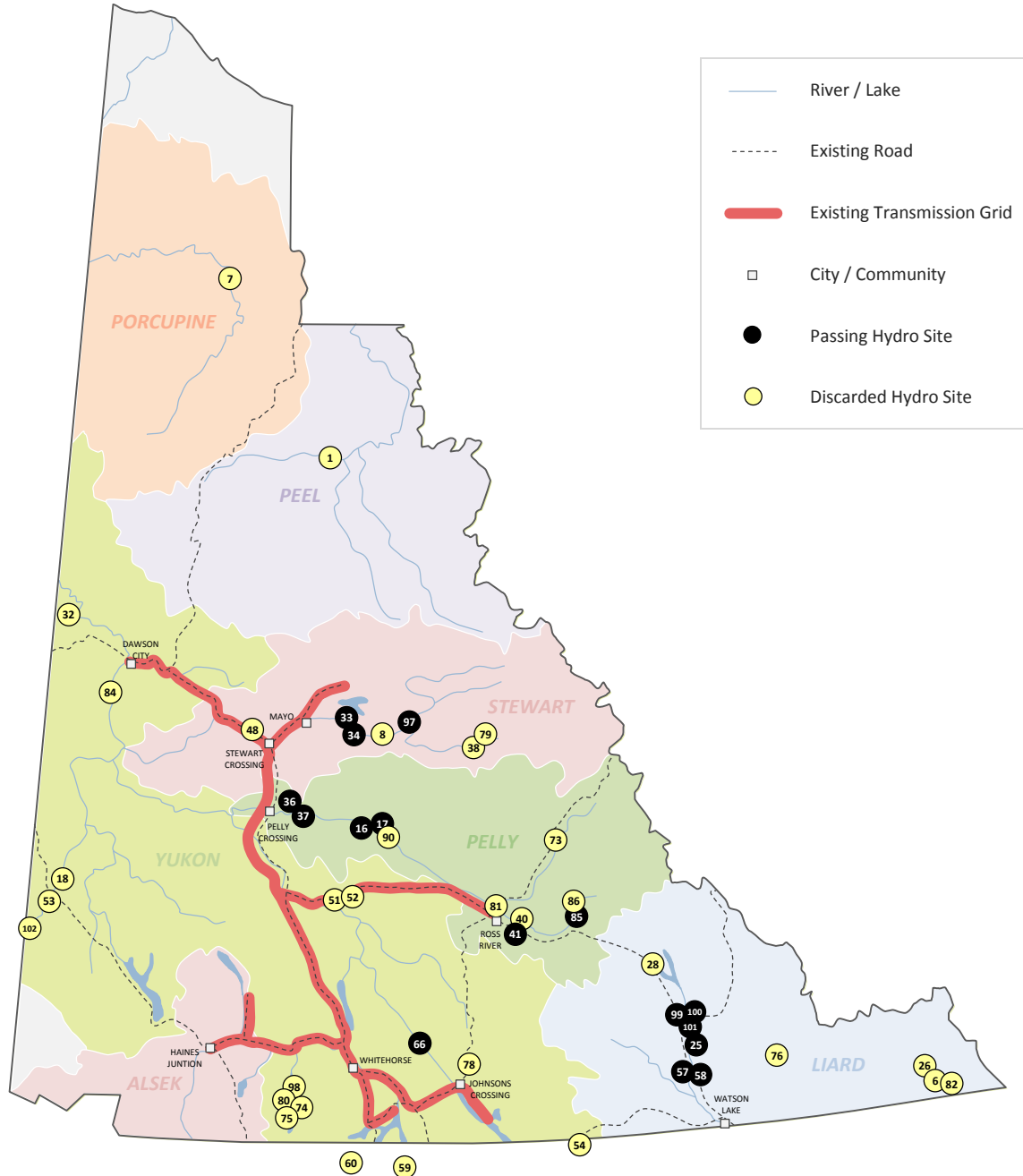
Map #	Site Name	Site ID	Size (MW)	Screen 1 Result	Screen 2 Result
22	Eagle's Nest Bluff + Rink Rapids (2 PH)	YUKON-YUKON-0540-B	320	DISCARDED	
23	Earn Lake	PELLY-EARN-0575	6.6	DISCARDED	
24	Ethel Lake Diversion	PELLY-ETHEL-0465	8.5	DISCARDED	
25	False Canyon	LIARD-FRANC-0696	58	PASS	PASS
26	Fantasque	LIARD-BEAVE-0417	78	PASS	DISCARDED
27	Fifteen Mile Diversion	YUKON-FIFTE-0320	7	DISCARDED	
28	Finlayson	YUKON-FRANC-0739	17	PASS	DISCARDED
29	Five Fingers High (150 MW)	YUKON-YUKON-0514-B	150	DISCARDED	
30	Five Fingers High (455 MW)	YUKON-YUKON-0514-C	455	DISCARDED	
31	Five Fingers Low (75 MW)	YUKON-YUKON-0514-A	75	DISCARDED	
32	Forty Mile	YUKON-FORTY-0295	16	PASS	DISCARDED
33	Fraser Falls (High)	STEWA-STEWA-0519-B	300	PASS	PASS
34	Fraser Falls (Low)	STEWA-STEWA-0519-A	100	PASS	PASS
35	Gladstone Diversion	ALSEK-GLADS-1153	0	DISCARDED	
36	Granite Canyon (Large)	PELLY-PELLY-0480-B	254	PASS	PASS
37	Granite Canyon (Small)	PELLY-PELLY-0480-A	80	PASS	PASS
38	Hess Canyon	STEWA-HESS-0647	18	PASS	DISCARDED
39	Homan Lake	YUKON-HOMAN-0746	4.2	DISCARDED	
40	Hoole Canyon	PELLY-PELLY-0760-B	13	PASS	DISCARDED
41	Hoole Canyon + Fortin Lake Dam	PELLY-PELLY-0760-A	40	PASS	PASS
42	Hootalinqua	YUKON-YUKON-0590	259	DISCARDED	
43	Hyland Diversion	LIARD-HYLAN-0724	0	DISCARDED	
44	Independence	STEWA-STEWA-0458	450	DISCARDED	
45	Indian	YUKON-INDIA-0405	6	DISCARDED	
46	Kathleen Canyon	ALSEK-KATHL-0657	2	DISCARDED	
47	Kluane Canyon	YUKON-KLUAN-0790	12	DISCARDED	
48	Lake Creek Diversion	STEWA-LAKE-0469	13	PASS	DISCARDED
49	Lapie	PELLY-LAPIE-0787	2	DISCARDED	
50	Liard Canyon	LIARD-LIARD-0641	90	DISCARDED	
51	Little Salmon Dam	YUKON-LITTL-0560-A	15	PASS	DISCARDED
52	Little Salmon Diversion	YUKON-LITTL-0560-B	12	PASS	DISCARDED
53	Lower Canyon on White River	YUKON-WHITE-0710	16	PASS	DISCARDED
54	McNaughton (Upper & Lower)	YUKON-MCNAU-0852	13	PASS	DISCARDED
55	McNeil	YUKON-MCNEI-1037	10	DISCARDED	

Map #	Site Name	Site ID	Size (MW)	Screen 1 Result	Screen 2 Result
56	Mica Creek	PELLEY-MICA-0484	10	DISCARDED	
57	Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A	14	PASS	PASS
58	Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B	75	PASS	PASS
59	Moon Lake + Tutshi River Outlet Site A Cluster	YUKON-MOON-0649-A	12	PASS	DISCARDED
60	Moon Lake + Tutshi Windy Arm Outlet Site B Cluster	YUKON-MOON-0649-B	12	PASS	DISCARDED
61	Moon Lake A	YUKON-MOON-0715-A	6	DISCARDED	
62	Moon Lake C	YUKON-MOON-0715-C	5	DISCARDED	
63	Morley River	YUKON-MORLE-0725	2	DISCARDED	
64	North Fork	YUKON-KLOND-0420	4	DISCARDED	
65	North McQuesten	STEWA-MCQUE-0550	5	DISCARDED	
66	NWPI (Low)	YUKON-TESLI-0670-A	55	PASS	PASS
67	Ogilvie	YUKON-LOWER-0338	896	DISCARDED	
68	Orchay	PELLEY-TAY R-0760	4	DISCARDED	
69	Pleasant Creek	STEWA-PLEAS-0553	5	DISCARDED	
70	Pleasant Creek + Rogue Diversion	STEWA-PLEAS-0553	7	DISCARDED	
71	Porcupine	STEWA-STEWA-0362	83	DISCARDED	
72	Porcupine Canyon	PORCU-PORCU-0245	190	DISCARDED	
73	Prevost Canyon	PELLEY-ROSS-0835	12	PASS	DISCARDED
74	Primrose Diversion Scheme (To Takhini Lake)	YUKON-PRIMR-0708-B	41	PASS	DISCARDED
75	Primrose Lake to Takhini Lake Diversion	YUKON-PRIMR-0708-A	19	PASS	DISCARDED
76	Quartz Creek	LIARD-COAL-0726	38	PASS	DISCARDED
77	Quiet Lake Diversion	YUKON-BIG S-0728-A	7	DISCARDED	
78	Quiet Lake Diversion + Rose River Diversion	YUKON-BIG S-0728-B	15	PASS	DISCARDED
79	Rogue	STEWA-HESS-0678	12	PASS	DISCARDED
80	Rose Lake to Kusawa Lake Diversion	YUKON-PRIMR-0700	17	PASS	DISCARDED
81	Ross Canyon	PELLEY-ROSS-0725	30	PASS	DISCARDED
82	Saucy Creek	LIARD-BEAVE-0361	23	PASS	DISCARDED
83	Seven Mile Canyon	STEWA-STEWA-0570	10	DISCARDED	
84	Sixty Mile River Diversion	YUKON-SIXTY-0380	18	PASS	DISCARDED

Map #	Site Name	Site ID	Size (MW)	Screen 1 Result	Screen 2 Result
85	Slate Rapids (Diversion Scheme)	PELLEY-PELLEY-0847-B	42	PASS	PASS
86	Slate Rapids (Powerhouse in Main Dam)	PELLEY-PELLEY-0847-A	22	PASS	DISCARDED
87	Squanga	STEWA-SQUAN-0696	2	DISCARDED	
88	Tatshenshini + Dezadeash / Kusawa Diversion	ALSEK-TATSH-0590-B	160	DISCARDED	
89	Tatshenshini + Dezadeash Diversion	ALSEK-TATSH-0590-A	95	DISCARDED	
90	Tay Diversion	PELLEY-TAY R-0604	31	PASS	DISCARDED
91	Tutshi River Outlet Site A (Lake to Lake)	YUKON-TUTSH-0649-A	6	DISCARDED	
92	Tutshi River Outlet Site A (Lake to River)	YUKON-TUTSH-0649-B	4	DISCARDED	
93	Tutshi River Outlet Site A (River to Lake)	YUKON-TUTSH-0649-C	6	DISCARDED	
94	Tutshi River Outlet Site A (River to River)	YUKON-TUTSH-0649-D	4	DISCARDED	
95	Tutshi Windy Arm Outlet Site B (East PH)	YUKON-TUTSH-0649-E	6	DISCARDED	
96	Tutshi Windy Arm Outlet Site B (West PH)	YUKON-TUTSH-0649-F	6	DISCARDED	
97	Two Mile Canyon	STEWA-HESS-0552	53	PASS	PASS
98	Upper & Lower Primrose (2008 Layout)	YUKON-PRIMR-0704	16	PASS	DISCARDED
99	Upper Canyon (Large)	LIARD-FRANC-0730-C	75	PASS	PASS
100	Upper Canyon (Medium)	LIARD-FRANC-0730-B	58	PASS	PASS
101	Upper Canyon (Small)	LIARD-FRANC-0730-A	25	PASS	PASS
102	Upper Canyon on White River	YUKON-WHITE-0795	16	PASS	DISCARDED
103	Watson Lake (Micro Project)	LIARD-WATSO-0641	1	DISCARDED	
104	Watson River	YUKON-WATSO-1130	3	DISCARDED	
105	Wolf	YUKON-WOLF-0720	5	DISCARDED	
106	Wolverine	YUKON-LOWER-0458	476	DISCARDED	
107	Yukon-Taiya	YUKON-YUKON-0030	4050	DISCARDED	
108	Yukon-Taku	YUKON-YUKON-0110	3692	DISCARDED	

Screen 1's 16 sites to be carried forward (black dots) and 31 discarded sites (yellow dots) are mapped in Figure 5 below.

Figure 5: Site Screening Inventory Complete List of Sites Map @ End of Screen 2



6 Results & Recommendations

Part 1 of the *Site Screening Inventory* winnows known hydroelectric projects from 200+ to 16 sites of interest through a three step screening process. The screening stages and respective refinement of potential hydroelectric sites are summarized in Table 14 below:

Table 14: Screening Stages and Resulting Site Refinement

#	Description	Site Refinement
Screen 0	Reconciliation of Known Project Sites	200+ → 108 Sites
Screen 1	Fundamental Development Barrier Project Screen	108 → 47 Sites
Screen 2	Fundamentally Uneconomic Project Screen	47 → 16 Sites

With Screen 0, Screen 1, and Screen 2 complete, Part 1 of the *Site Screening Inventory* is concluded. Midgard recommends that all 16 sites be moved on to Part 2 of the *Site Screening Inventory*. Part 2 will allow Midgard and its team of sub-consultants to rank the 16 sites remaining to identify and ultimately choose the top 6 to 15 projects to be further studied through additional technical papers and business cases under the larger *Yukon Next Generation Hydro and Transmission Viability Study*.

The complete listing of the 16 sites is available in Table 15 below (sorted alphabetically and not in any preferred order or ranking). It is important to state that many of the top 16 sites will be discarded after additional study and that the list to date only represents projects that pass the first three levels of screening.

Table 15: Site Screening Inventory Part 1 List of Sites

Site Name	Site ID	Estimated Maximum Size (MW)
Detour Canyon	PELLY-PELLY-0567-A	65
Detour Canyon + Fortin Lake Dam	PELLY-PELLY-0567-B	100
False Canyon	LIARD-FRANC-0696	58
Fraser Falls (High)	STEWA-STEWA-0519-B	300
Fraser Falls (Low)	STEWA-STEWA-0519-A	100
Granite Canyon (Large)	PELLY-PELLY-0480-B	254
Granite Canyon (Small)	PELLY-PELLY-0480-A	80
Hoole Canyon + Fortin Lake Dam	PELLY-PELLY-0760-A	40
Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A	14
Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B	75
NWPI (Low)	YUKON-TESLI-0670-A	55
Slate Rapids (Diversion Scheme)	PELLY-PELLY-0847-B	42

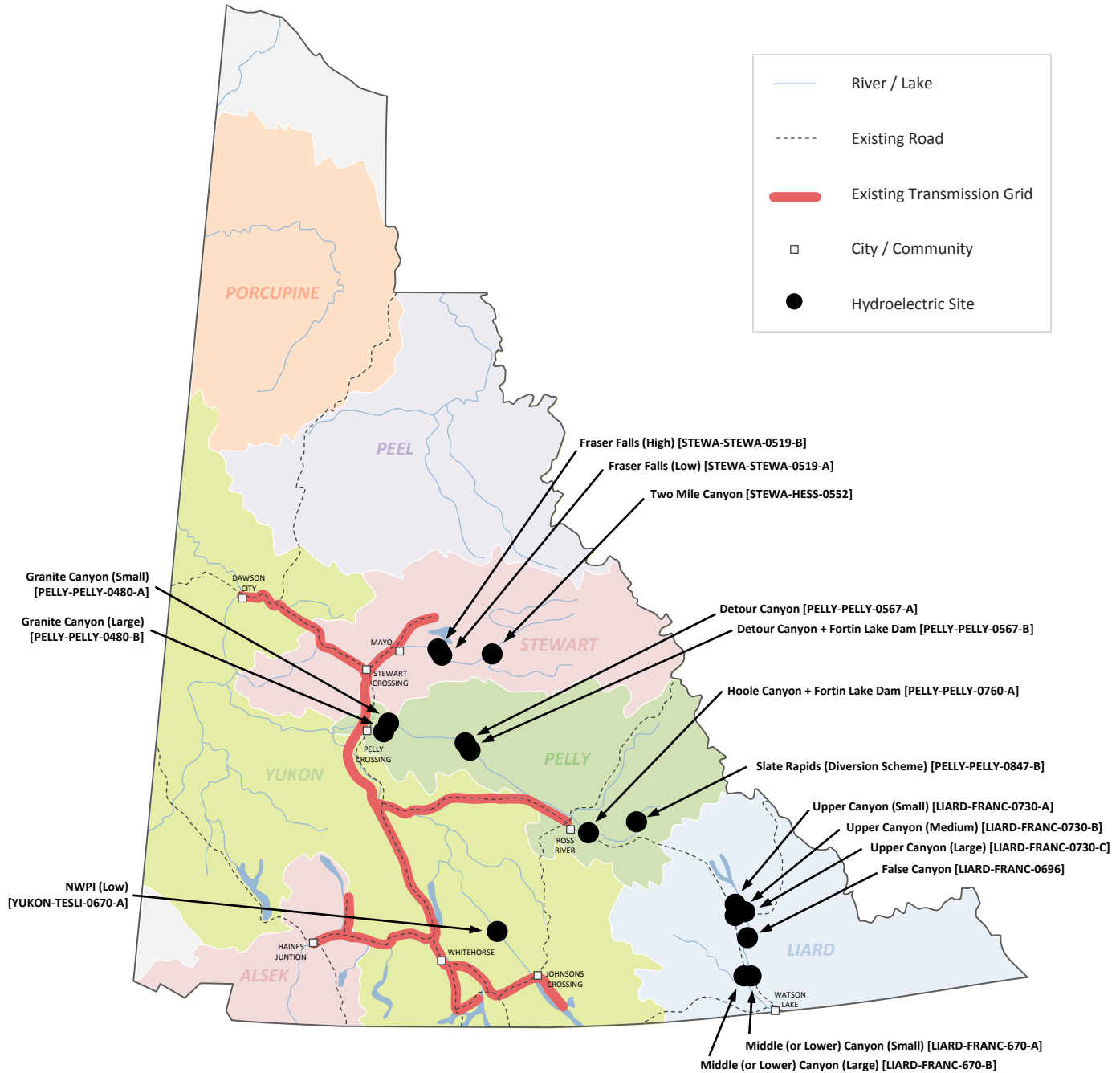
Site Name	Site ID	Estimated Maximum Size (MW)
Two Mile Canyon	STEWA-HESS -0552	53
Upper Canyon (Large)	LIARD-FRANC-0730-C	75
Upper Canyon (Medium)	LIARD-FRANC-0730-B	58
Upper Canyon (Small)	LIARD-FRANC-0730-A	25

In addition to the list above, the 16 sites are mapped and labeled as presented in Figure 6 below.

It is acknowledged and recognized that the sites identified in Table 15 are located on, and impact, First Nation traditional territories. Due to the high level and preliminary nature of the study performed in Part 1 of the *Site Screening Inventory*, specific technical details pertaining to the dams, reservoirs, flooded areas, transmission line corridors and road corridors were not determined. These details, and the impacts associated with the projects, will evolve as project study continues.

The Yukon scale mapping in this report only indicates the approximate locations of the hydroelectric powerhouses, and does not assess the impacts upon First Nations and First Nation traditional territories. The critical task of assessing, and adapting to, project impacts will begin in Part 2 of the *Site Screening Inventory* and will continue throughout the project development process.

Figure 6: Site Screening Inventory Part 1 Results Map of Sites



Appendix A

Project-Report Lookup Table

Project-Report Lookup Table

For future reference purposes, Midgard has mapped each of 108 potential hydroelectric sites of interest to the 25 data sources provided by the Yukon Development Corporation and the Yukon Energy Corporation. Reference numbers for each data source are as follows:

Ref #	Date	Author	Title
1	Aug 1966	Department of Mines and Technical Surveys Water Resources Branch	A Preliminary Appraisal of the Yukon-Taiya and Yukon-Taku Storage and Power Schemes
2	Jan 1968	T. Ingledow & Associates Ltd.	Hydro-electric Resources Survey of the Central Yukon Territory (Vol I & Vol. II)
3	Feb 1970	T. Ingledow & Associates Ltd.	Power Survey of the Liard River Basin Yukon and Northwest Territories
4	Jan 1975	Sigma Resource Consultants Ltd.	The Development of Power in the Yukon (Main Report, Technical Information, & Recommendations)
5	1977	Montreal Engineering	Francis River - Upper Canyon: Preliminary Study of a 25.2 M.W. Medium Head Hydro Plant
6	Nov 1980	Monenco Consultants Pacific Ltd.	Mid-Yukon Feasibility Study: Year 1; Vol 1; Summary Report
7	Oct 1980	Shawinigan Engineering	Teslin River Hydro Power Study
8	Nov 1980	Monenco Consultants Pacific Ltd.	Yukon Mining Hydro Power Study of Small to Mid-Size Developments in East-Central Yukon
9	Aug 1981	Shawinigan Stanley	False Canyon Hydro Prefeasibility Study: Mid-Study Report
10	Oct 1982	Northwest Hydraulic Consultants Ltd.	Environmental and Socio-Economic Studies of Five Hydro Projects in Yukon
11	Mar 1982	Shawinigan Stanley	False Canyon Hydro Prefeasibility Study
12	Feb 1982	Acres Consulting Services Ltd.	Granite Canyon Development Pre-feasibility Study
13	Feb 1982	SNC Consultants Ltd.	Prefeasibility Study of a Hydroelectric Site at Ross Canyon, Yukon
14	Feb 1982	Crippen Consultants	Hoole Canyon Hydroelectric Project 1981 Site Investigation Report (Draft)
15	Jun 1982	Crippen Consultants	Hoole Canyon Hydroelectric Project Prefeasibility Study
16	Sep 1982	Monenco Consultants Pacific Ltd.	Yukon Hydro Investigations Coordination Conclusions from 1981 Investigation Program
17	Mar 1983	Monenco Consultants Pacific Ltd.	Northern Canada Power Commission Slate Rapids Hydropower Development Preliminary Office Studies Final Report

Ref #	Date	Author	Title
18	Oct 1983	Monenco Consultants Pacific Ltd.	The Inventory of Yukon Hydroelectric Sites: A Review of Investigations Carried Out Between 1960 and 1983
19	Dec 1989	A.S. Demers	Yukon Energy Corporation: 1989 Hydro Investigations
20	Dec 1990	A.S. Demers	Yukon Energy Corporation: 1990 Hydro Investigations
21	1991	(No Stated Author, Stored in YEC Library)	1991 Hydro Investigations
22	Feb 2008	KGS Group Inc.	Assessment of Potential Hydroelectric Sites: Concept Phase Study (Draft)
23	Jan 2010	AECOM Canada Ltd.	2009 Large Hydro Stage 1: Initial Evaluation Draft Report
24	Jan 2011	AECOM Canada Ltd.	Preliminary Power Potential Assessment for Homan Lake Site, BC
25	Sep 2014	Marc-Andre Lavigne	EMAIL: Next Generation Hydro Project

The following table maps the 108 potential hydroelectric sites against the 25 data sources above.

Project Name	Site ID	Report Reference Number																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Aberdeen Falls	PEEL-PEEL -0250			X														X					X			
Anvil Creek	PELLE-ANVIL-0634	X		X														X	X						X	
Atlin Storage	YUKON-ATLIN-0669																					X	X		X	
Bates Canyon	ALSEK-BATES-0448-A			X																						
Bates Canyon + Dezadeash Diversion	ALSEK-BATES-0448-B			X														X					X			
Beaver Crow	LIARD-BEAVE-0429			X														X					X			
Bell	PORCU-PORCU-0263			X														X					X			
Big Kalzas Lake Diversion	STEWA-BIG K-0534	X		X														X								
Big Salmon	YUKON-YUKON-0580			X														X					X			
Boundary	YUKON-LOWER-0284			X														X					X			
Bradens Canyon	PELLE-PELLE-0458-A	X		X														X					X			
Bradens Canyon + Fortin Lake Dam	PELLE-PELLE-0458-B	X		X														X					X			
Britannia	YUKON-LOWER-0438			X														X					X			
Chandindu River	YUKON-CHAND-0335	X		X																	X					
Dawson	YUKON-LOWER-0319			X														X					X			
Detour Canton + Fortin Lake Dam	PELLE-PELLE-0567-B	X		X														X					X			
Detour Canyon	PELLE-PELLE-0567-A	X		X																			X			
Donjek to White River Diversion	YUKON-DONJE-0606	X		X														X			X		X			
Drury Creek	YUKON-DRURY-0630	X		X															X	X		X			X	
Eagle's Nest Bluff (Alone)	YUKON-YUKON-0540-A				X						X							X					X			
Eagle's Nest Bluff + Rink Rapids (1 PH)	YUKON-YUKON-0540-C				X						X							X					X			
Eagle's Nest Bluff + Rink Rapids (2 PH)	YUKON-YUKON-0540-B				X						X							X					X			
Earn Lake	PELLE-EARN -0575	X		X														X	X							

Project Name	Site ID	Report Reference Number																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ethel Lake Diversion	PELLEY-ETHEL-0465	X		X															X							
False Canyon	LIARD-FRANC-0696		X	X				X	X	X	X						X						X			
Fantasque	LIARD-BEAVE-0417		X																X				X			
Fifteen Mile Diversion	YUKON-FIFTE-0320	X	X																X		X					
Finlayson	YUKON-FRANC-0739																			X			X		X	
Five Fingers High (150 MW)	YUKON-YUKON-0514-B			X															X				X			
Five Fingers High (455 MW)	YUKON-YUKON-0514-C			X															X				X			
Five Fingers Low (75 MW)	YUKON-YUKON-0514-A			X															X				X			
Forty Mile	YUKON-FORTY-0295	X	X																X		X					
Fraser Falls (High)	STEWA-STEWA-0519-B	X	X																X				X			
Fraser Falls (Low)	STEWA-STEWA-0519-A	X	X																				X			
Gladstone Diversion	ALSEK-GLADS-1153																					X				
Granite Canyon (Large)	PELLEY-PELLEY-0480-B	X	X							X	X								X	X			X			
Granite Canyon (Small)	PELLEY-PELLEY-0480-A	X	X							X	X								X	X			X			
Hess Canyon	STEWA-HESS -0647	X	X																X							
Homan Lake	YUKON-HOMAN-0746																				X		X	X		
Hoole Canyon	PELLEY-PELLEY-0760-B	X								X													X			
Hoole Canyon + Fortin Lake Dam	PELLEY-PELLEY-0760-A	X	X					X	X					X	X	X			X				X			
Hootalinqua	YUKON-YUKON-0590		X																X							
Hyland Diversion	LIARD-HYLAN-0724		X																X	X			X			
Independence	STEWA-STEWA-0458	X	X																X				X			
Indian	YUKON-INDIA-0405	X	X																X		X					
Kathleen Canyon	ALSEK-KATHL-0657																						X			
Kluane Canyon	YUKON-KLUAN-0790	X	X																X	X					X	
Lake Creek Diversion	STEWA-LAKE -0469	X	X																X							
Lapie	PELLEY-LAPIE-0787																				X				X	
Liard Canyon	LIARD-LIARD-0641		X	X															X	X			X			
Little Salmon Dam	YUKON-LITTL-0560-A							X											X							
Little Salmon Diversion	YUKON-LITTL-0560-B	X	X																							
Lower Canyon on White River	YUKON-WHITE-0710	X	X																X							
McNaughton (Upper & Lower)	YUKON-MCNAU-0852																			X		X				
McNeil	YUKON-MCNEI-1037	X	X																X							
Mica Creek	PELLEY-MICA -0484	X	X																X							
Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A		X	X																			X			
Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B			X															X				X			
Moon Lake + Tutshi River Outlet Site A Cluster	YUKON-MOON -0649-A																			X		X	X			
Moon Lake + Tutshi Windy Arm Outlet Site B Cluster	YUKON-MOON -0649-B																			X		X	X			
Moon Lake A	YUKON-MOON -0715-A																			X		X	X		X	
Moon Lake C	YUKON-MOON -0715-C																			X		X	X		X	
Morley River	YUKON-MORLE-0725																			X	X	X			X	
North Fork	YUKON-KLOND-0420																				X					
North McQuesten	STEWA-MCQUE-0550	X	X																X							
NWPI (Low)	YUKON-TESLI-0670-A	X	X				X												X				X			
Ogilvie	YUKON-LOWER-0338			X															X				X			
Orchay	PELLEY-TAY R-0760																				X					
Pleasant Creek	STEWA-PLEAS-0553	X	X																X		X					

Project Name	Site ID	Report Reference Number																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Pleasant Creek + Rogue Diversion	STEWA-PLEAS-0553	X		X																	X					
Porcupine	STEWA-STEWA-0362	X		X															X					X		
Porcupine Canyon	PORCU-PORCU-0245			X															X					X		
Prevost Canyon	PELLY-ROSS -0835	X		X															X	X						
Primrose Diversion Scheme (To Takhini Lake)	YUKON-PRIMR-0708-B																			X						
Primrose Lake to Takhini Lake Diversion	YUKON-PRIMR-0708-A	X																	X							
Quartz Creek	LIARD-COAL -0726		X																X					X		
Quiet Lake Diversion	YUKON-BIG S-0728-A	X		X															X							
Quiet Lake Diversion + Rose River Diversion	YUKON-BIG S-0728-B	X																	X							
Rogue	STEWA-HESS -0678	X		X															X		X					
Rose Lake to Kusawa Lake Diversion	YUKON-PRIMR-0700	X		X															X							X
Ross Canyon	PELLY-ROSS -0725	X		X				X		X			X				X		X	X				X		
Saucy Creek	LIARD-BEAVE-0361		X																X					X		
Seven Mile Canyon	STEWA-STEWA-0570	X		X															X							
Sixty Mile River Diversion	YUKON-SIXTY-0380	X		X															X		X					
Slate Rapids (Diversion Scheme)	PELLY-PELLY-0847-B																	X	X				X		X	
Slate Rapids (Powerhouse in Main Dam)	PELLY-PELLY-0847-A																	X	X				X		X	
Squanga	STEWA-SQUAN-0696																		X		X					X
Tatshenshini + Dezadeash / Kusawa Diversion	ALSEK-TATSH-0590-B			X															X							
Tatshenshini + Dezadeash Diversion	ALSEK-TATSH-0590-A			X																				X		
Tay Diversion	PELLY-TAY R-0604	X		X															X					X		
Tutshi River Outlet Site A (Lake to Lake)	YUKON-TUTSH-0649-A																			X			X	X		
Tutshi River Outlet Site A (Lake to River)	YUKON-TUTSH-0649-B																			X			X	X		
Tutshi River Outlet Site A (River to Lake)	YUKON-TUTSH-0649-C																			X			X	X		
Tutshi River Outlet Site A (River to River)	YUKON-TUTSH-0649-D																			X			X	X		
Tutshi Windy Arm Outlet Site B (East PH)	YUKON-TUTSH-0649-E																						X	X		
Tutshi Windy Arm Outlet Site B (West PH)	YUKON-TUTSH-0649-F																						X	X		
Two Mile Canyon	STEWA-HESS -0552	X		X															X					X		
Upper & Lower Primrose (2008 Layout)	YUKON-PRIMR-0704																			X	X		X	X		
Upper Canyon (Large)	LIARD-FRANC-0730-C		X	X	X														X					X		X
Upper Canyon (Medium)	LIARD-FRANC-0730-B		X	X	X														X					X		X
Upper Canyon (Small)	LIARD-FRANC-0730-A		X	X	X														X					X		X
Upper Canyon on White River	YUKON-WHITE-0795	X		X															X							
Watson Lake (Micro Project)	LIARD-WATSO-0641																									X
Watson River	YUKON-WATSO-1130	X		X																						
Wolf	YUKON-WOLF -0720			X															X		X	X		X		
Wolverine	YUKON-LOWER-0458			X															X					X		
Yukon-Taiya	YUKON-YUKON-0030	X		X															X					X		
Yukon-Taku	YUKON-YUKON-0110	X		X															X					X		

Appendix B

Screen 2 List of Assumptions

Screen 2 List of Assumptions

Several input assumptions are made for Screen 2 to estimate the Levelized Cost for the 48 projects of interest. The following list describes the assumptions made:

- 1) **Estimation of Annual Energy** - Annual energy production is estimated assuming one of two methods:
 - a. Preferred Method: A previous report or study states the annual average energy production.
 - b. Backup Method: If an annual average energy production estimate was not available from previous studies or reports, Midgard used the average capacity factor found across all previous reports (77%) to estimate it.
- 2) **Estimation of Project Costs** - A simplified parametric costing model is used to estimate total project costs. The parametric cost model takes the following form:

$$\text{Project Cost} = \text{Dam Cost} + \text{Penstock Costs} + \text{Tunneling Cost (if Applicable)} + \text{Transmission Cost} + \text{Access Cost} + \text{Balance of Plant Cost} + \text{Loan Interest During Construction}$$

The individual cost assumptions for each component of the parametric cost model are as follows:

The project cost assumptions are as follows:

- a. Dam Cost: Assumed concrete faced rockfill dam type with rough construction volumes estimated from crest heights stated in previous reports / studies and local topography.
 - i. Concrete Rate: \$1,800 per m³
 - ii. Rockfill: \$90 per m³
 - iii. Excavation: \$45 per m³
- b. Penstock Costs: \$13,000 per m
- c. Tunneling Costs: \$25,000 per m
- d. Transmission Cost: \$0.7M per km or \$1.4M per km (see note iii below from selection logic)
 - i. It is assumed that three future transmission “corridors” exist for project interconnections. The corridors include:
 1. Ross River to Watson Lake
 2. Carcross to Skagway
 3. Dawson City to Fairbanks
 - ii. The following rules are assumed for interconnection voltage:
 1. Project less than 15 MW: Interconnect to any voltage
 2. Project between 15 MW and 30 MW: Must interconnect to 69kV or 138 kV

3. Project greater than 30 MW¹: Must interconnect to 138 kV
 - iii. The following rules are assumed for high capacity / long distance projects
 1. Project greater than 100 MW and greater than 200 km from existing transmission grid or assumed future transmission corridors: Assume \$1.4M per km (for increased voltage transmission / substation costs)
 2. All other projects: Assume \$0.7M per km
 - e. Access: \$0.4M per km (from nearest existing road)
 - f. Balance of Plant Costs: \$4M per installed MW (Note: The Balance of Plant parametric cost assumption employed at this level of screening is for an “idealized” project without consideration for actual site conditions, environmental impact mitigations, and social impact mitigations)
 - g. Loan Interest During Construction: 5.55% increase to project costs
 - i. Built on an assumed 60/40 debt-equity split², a three year construction schedule, a levelized draw schedule, and a 6% short term debt rate
- 3) **Economic & Operating Assumptions** - The following economic assumptions are used:
- a. Project Lifespan: 65 years³
 - b. Operating Costs & Capital Reinvestment Costs: 4% of project capital cost per year
 - c. Real Discount Rate: 3.38% (based on a nominal discount rate of 5.45%² and a 2% assumed inflation rate)
 - d. Levelized Cost of Energy Calculation Method: Discounts both costs (numerator) and energy (denominator) using the Real Discount Rate above (3.38%)

¹ Assumption: Current 138 kV transmission system is capable of interconnecting larger hydroelectric projects. Future analysis may reveal operational restrictions on the existing system that will require some or all of the following upgrades: voltage support infrastructure, new transmission line corridors, and/or reduced project sizes.

² As per PDF Page 43 of the Yukon Energy Corporation’s 2012/2013 General Rate Application. Source: http://yukonutilitiesboard.yk.ca/pdf/YEC_Revised_Compliance_Filing_June_20_2013.pdf

³ As per Footnote 29 in the Yukon Energy Corporation’s 20-Year Resource Plan: 2011-2030

Appendix C

Census Subdivisions

Census Subdivisions

Statistics Canada has the following 36 census subdivisions for the Yukon Territory (there is also the remainder of the territory captured under the Yukon Unorganized census subdivision):

- 1) Beaver Creek (Settlement)
- 2) Burwash Landing (Settlement)
- 3) Carcross (Settlement)
- 4) Carcross 4 (Self-government)
- 5) Carmacks (Village)
- 6) Champagne Landing 10 (Indian settlement)
- 7) Dawson (Town)
- 8) Destruction Bay (Settlement)
- 9) Faro (Town)
- 10) Haines Junction (Village)
- 11) Ibex Valley (Hamlet)
- 12) Johnsons Crossing (Settlement)
- 13) Keno Hill (Settlement)
- 14) Kloo Lake (Indian settlement)
- 15) Klukshu (Indian settlement)
- 16) Lake Laberge 1 (Self-government)
- 17) Macpherson-Grizzly Valley (Unorganized)
- 18) Marsh Lake (Unorganized)
- 19) Mayo (Village)
- 20) Moosehide Creek 2 (Self-government)
- 21) Mt. Lorne (Hamlet)
- 22) Old Crow (Settlement)
- 23) Pelly Crossing (Settlement)
- 24) Ross River (Settlement)
- 25) Stewart Crossing (Settlement)
- 26) Swift River (Settlement)
- 27) Tagish (Settlement)
- 28) Teslin (Teslin land)
- 29) Teslin (Village)
- 30) Teslin Post 13 (Self-government)
- 31) Two and One-Half Mile Village (Indian settlement)
- 32) Two Mile Village (Indian settlement)

- 33) Upper Liard (Settlement)
- 34) Watson Lake (Town)
- 35) Whitehorse (City)
- 36) Whitehorse, Unorganized (Unorganized)

The Census subdivisions (with their maps) can be found at:

<http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/search-recherche/lst/page.cfm?Lang=E&GeoCode=60&TABID=1&G=1&Geo1=PR&Code1=01&Geo2=0&Code2=0>