Alternatives North

YELLOWKNIFE BIOMASS DHS FEASIBILITY STUDY

SYSTEM EXPANSION REPORT

SUBMITTED ON: MARCH 22, 2023

SUBMITTED BY:

FVB ENERGY INC

CELEBRATING 30 YEARS | 1992 - 2022

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Final	Bard Skagestad, P.Eng.	2023-03-22

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Mar 22, 2023
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PERMIT TO PRACTICE
FVB ENERGY INC.
Signature
Date Mar 22, 2023
PERMIT NUMBER: P 381
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

Permit to Practice #P381

CONTENTS

1 INTRODUCTION

On January 13th, 2023, FVB issued the final report for the 'Yellowknife Biomass DHS Feasibility Study'.

FVB was requested to provide two incremental 'expansion' concepts that build from the 'For-Profit' base concept defined in the feasibility study. This includes a 'south expansion' and a 'west expansion' concept that would serve additional buildings neighbouring the central downtown core.

This report provides loads and energy estimates for the target buildings identified in the two expansion areas, defines the district heating system additions technical requirements, performs an incremental 30-year financial analysis for each concept, and provides summary remarks.

The key results of this report will inform whether the 'south expansion' or 'west expansion' concept would strengthen the biomass district heating system of the 'For-Profit' base concept.

1.1 RELATIVE ACCURACY

In preparing this report, FVB has relied upon the accuracy and completeness of the information provided by Alternatives North (Client) and has not made particular or special enquiries outside of, or in addition to such information.

The analysis provided is general in nature and intended to convey opinions & observations of FVB based on our extensive experience with district energy. The accuracy of the presented results should be considered as indicative only. This is attributed to variability in the historical annual data, metering data inaccuracies, energy reduction potential, climatic variability, and variability in building operation. Regardless of the relative accuracy, the presented information should be considered the best information available for future planning. Improvements in data collection at the building level can help improve future load and energy projections.

1.2 ACKNOWLEDGEMENTS

FVB would like to thank and acknowledge support from the following parties:

- Alternatives North
- Arctic Energy Alliance
- The City of Yellowknife
- Fink Machine Inc.

1.3 REFERENCE MATERIAL

This document is based on the following reference materials:

- 'Yellowknife Biomass DHS Feasibility Study' report prepared by FVB Energy Inc, dated January 13th, 2023.
- Fuel oil usage data for select target buildings, collected by Alternatives North.
- Biomass usage data for select target buildings, collected by Alternatives North.
- Gross floor area data for select target buildings, provided by Alternatives North.
- Google Earth satellite imagery.

2 TARGET BUILDINGS

This section outlines the methodology used to estimate the building heating requirements of the target buildings. A combination of actual buildings fuel usage collected by potential customers and FVB's in-house database was used to determine the peak heating demand and annual thermal energy of the target buildings.

2.1 TARGET AREAS

Two expansion areas were explored: one west of the downtown core, and one south of the downtown core.

The 'west expansion' target area expands west along Franklin Avenue, as shown in the following figure:

Figure 1: West Expansion Target Area Source: Google Earth

The 'south expansion' target area expands south of 52nd Avenue, as shown in the following figure:

Figure 2: South Expansion Target Area Source: Google Earth

2.2 TARGET CUSTOMER BUILDINGS

Target buildings were selected based on direction provided by the client[1], and were based on the criteria outlined in the 'Yellowknife Biomass DHS Feasibility Study'. This memo defines the general requirements and considerations used when selecting buildings.

The following table summarizes the key incremental results of the target building estimates for each expansion area, with expanded system totals in parenthesis:

Table 1: Target Customer Building Estimates[2]

Description	'For-Profit' Base Concept	West Expansion	South Expansion
# of Buildings[3]	50 buildings	20 buildings (70 bldgs. Total)	18 buildings (68 bldgs. Total)
Gross Floor Area[4]	244,000 m²	107,000 m² (351,000 m² Total)	83,000 m² (327,000 m² Total)
Peak Heating Demand	21.9 MW_t	9.6 MW_t (31.5 MW_t Total)	7.5 MW_t (29.4 MW_t Total)
Annual Thermal Energy	43,600 MWh_t	19,700 MWh_t (63,300 MWh_t Total)	13,500 MWh_t (57,100 MWh_t Total)

The following summarizes the incremental results compared to the 'For-Profit' base concept:

- 'West Expansion':
  - 20 additional buildings
  - ~44% increase in the serviced gross floor area.
- 'South Expansion':
  - 18 additional buildings
  - ~34% increase in the serviced gross floor area.

[1] Buildings that have recently installed new heating equipment are excluded. However, these may be a considered when the equipment is due for replacement. Buildings with existing biomass heating systems are considered on a case-by-case basis.
[2] The report used a combination of historical fuel oil usage, historical biomass usage, and FVB's in-house database to estimate the peak heating demand and annual thermal energy of the target buildings.
[3] This refers to the number of district heating system connections; multiple buildings may be served from the same connection point.
[4] Where available, gross floor areas were provided by the client. In absence of this, areas were estimated using Google Earth.

3 BIOMASS DISTRICT HEATING SYSTEM EXPANSION CONCEPTS

This section provides a general description of the expansion requirements of the biomass district heating system to serve the expansion concepts. Additional details of the 'For-Profit' base concept are provided in the 'Yellowknife Biomass DHS Feasibility Study'.

3.1 System Diversification

A system diversification factor of 85% was chosen to be consistent with the 'For-Profit' base concept. It should be noted that as the system grows, the diversification factor may be further reduced as additional building categories are added (e.g., recreation facilities). However, for the purpose of the expansion concepts, the same diversification factor is used.

The following table summarizes the incremental diversified load and energy estimates for the target customer buildings, with expanded system totals in parenthesis:

Table 2: Target Buildings Estimated Diversified Heating Demand & Annual Thermal Energy Requirements

Description	'For-Profit' Base Concept	West Expansion	South Expansion
Undiversified Peak Heating Demand	21.9 MW_t	9.6 MW_t (31.5 MW_t Total)	7.5 MW_t (29.4 MW_t Total)
System Diversification Factor	85%	85%	85%
Diversified Peak Heating Demand	18.6 MW_t	8.2 MW_t (26.8 MW_t Total)	6.4 MW_t (25.0 MW_t Total)
Annual Thermal Energy Requirements[5]	43,600 MWh_t	19,700 MWh_t (63,300 MWh_t Total)	13,500 MWh_t (57,100 MWh_t Total)

The following summarizes the incremental results compared to the 'For-Profit' base concept:

- 'West Expansion': ~44% increase in the diversified peak heating demand.
- 'South Expansion': ~34% increase in the diversified peak heating demand.

3.2 Load Duration Curves

A load duration curve represents the distribution of the district heating system's diversified heating demand requirements over the course of a year. The load duration curve is a powerful tool used to optimize heating equipment sizing and estimate the thermal energy provided.[6]

A load duration curve is prepared for both the 'west expansion' and the 'south expansion' concepts added to the 'For-Profit' base concept, as shown on the following pages.

[5] System diversification does not impact the building's annual thermal energy requirements.
[6] As represented by the shaded area beneath the load duration curve.

3.2.1 West Expansion Load Duration Curve

The following load duration curve is provided for the 'west expansion' district heating system concept:

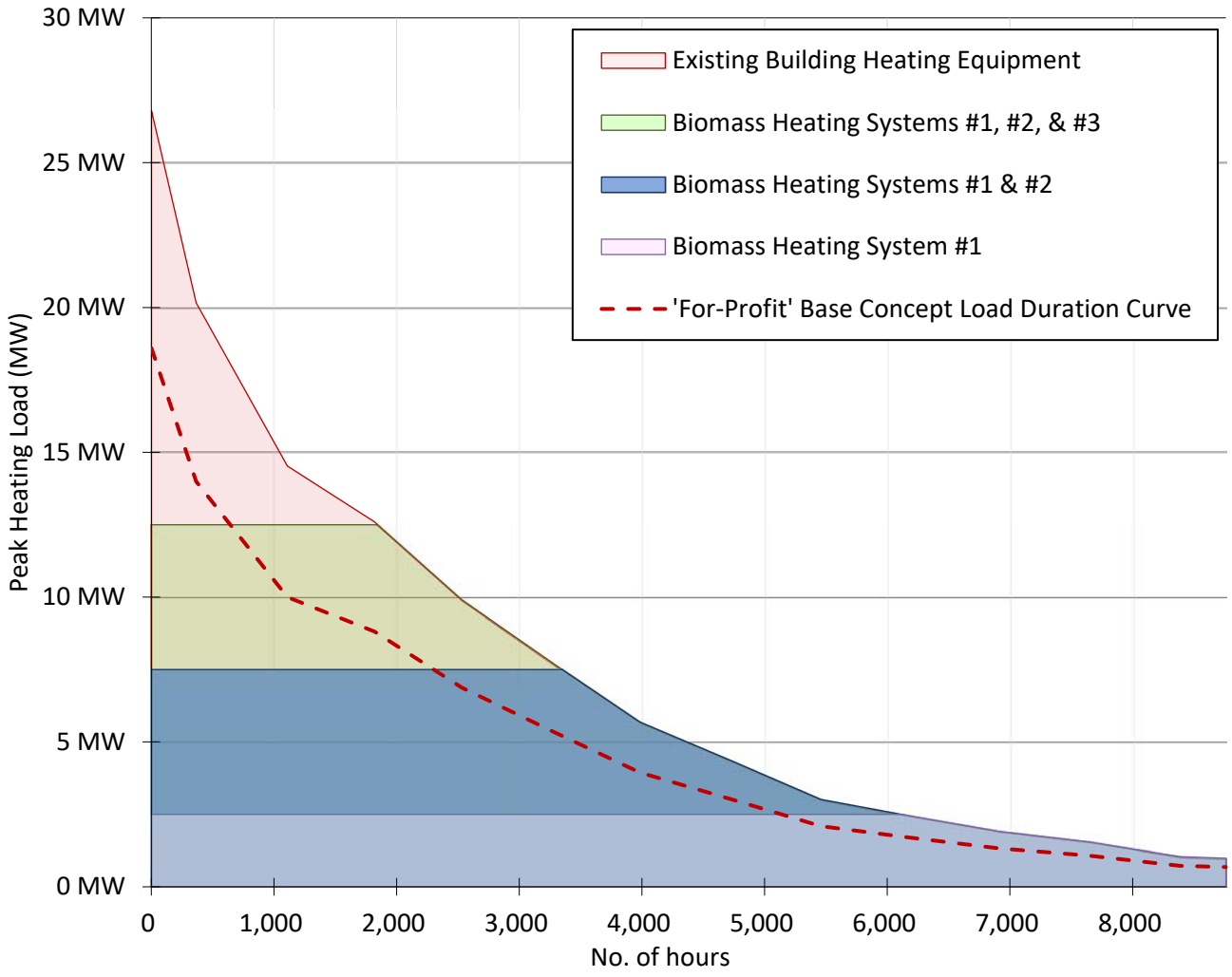


Figure 3: West Expansion Load Duration Curve

A 12.5 MW_t biomass heating system (consisting of the one @ 5 MW_t, and one @ 2.5 MW_t biomass heating systems from the 'For-Profit' base concept with the addition of one @ 5 MW_t biomass heating system) is estimated to provide ~87% of the system thermal energy requirements.[7]

The remaining thermal energy and back-up heating capacity is provided by the target customer's existing heating equipment, as represented by the area shaded in red.

[7] The combined capacity of the biomass heating systems is estimated to operate for ~1,800 full load hours per year, as indicated by the horizontal 'green' line. Systems #1 & #2 are estimated to operate for ~3,300 full load hours per year, as indicated by the horizontal 'blue' line. The smallest biomass heating system (capacity of 2.5 MW_t) is estimated to operate with over 6,000 full load hours per year, as indicated by the horizontal 'purple' line. With an expected turndown of ~30% the installed capacity, the 2.5 MW_t biomass heating system would be able to operate at low system load throughout the year.

3.2.2 South Expansion Load Duration Curve

The following load duration curve is provided for the 'south expansion' district heating system concept:

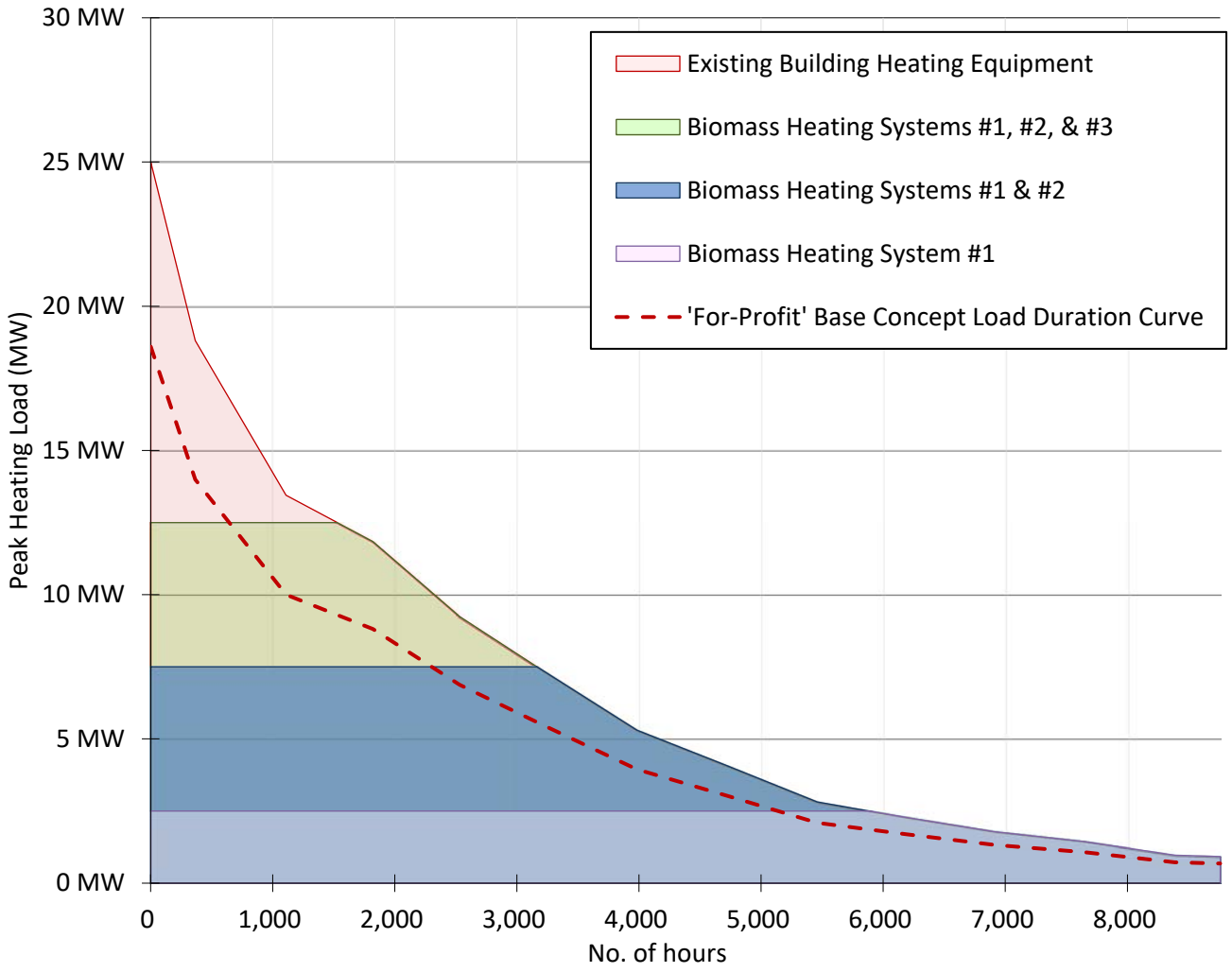


Figure 4: South Expansion Load Duration Curve

A 12.5 MW_t biomass heating system (consisting of the one @ 5 MW_t, and one @ 2.5 MW_t biomass heating systems from the 'For-Profit' base concept with the addition of one @ 5 MW_t biomass heating system) is estimated to provide over 89% of the system thermal energy requirements.[8]

The remaining thermal energy and back-up heating capacity is provided by the target customer's existing heating equipment, as represented by the area shaded in red.

[8] The combined capacity of the biomass heating systems is estimated to operate for ~1,500 full load hours per year, as indicated by the horizontal 'green' line. Systems #1 & #2 are estimated to operate for ~3,200 full load hours per year, as indicated by the horizontal 'blue' line. The smallest biomass heating system (capacity of 2.5 MW_t) is estimated to operate with nearly 6,000 full load hours per year, as indicated by the horizontal 'purple' line. With an expected turndown of ~30% the installed capacity, the 2.5 MW_t biomass heating system would be able to operate at low system load throughout the year.

3.3 BIOMASS DISTRICT HEATING SYSTEM

The annual thermal energy that can be provided to the target buildings is defined as the thermal energy sales. The annual thermal energy sales are used to estimate the biomass district heating system's revenue.

The district heating system would also need to produce additional thermal energy[9] annually to overcome system thermal losses and internal thermal energy usage in the energy centre. The annual thermal energy production is used to estimate the biomass district heating system's fuel expenses.

The following table summarizes the installed biomass heating system capacity, and annual thermal energy estimates for the biomass district heating systems:

Table 3: District Heating System Installed Capacity & Annual Thermal Energy Estimates

Description	'For-Profit' Base Concept	West Expansion	South Expansion
Installed Biomass Heating System Capacity	7.5 MW_t	Additional 5 MW_t (12.5 MW_t Total)	Additional 5 MW_t (12.5 MW_t Total)
Annual Thermal Energy Sales	35,500 MWh_t	17,100 MWh_t	12,100 MWh_t
Annual Thermal Energy Production	37,300 MWh_t	18,000 MWh_t	12,700 MWh_t

The following summarizes the incremental results compared to the 'For-Profit' base concept:

- 'West Expansion': ~48% increase in annual thermal energy sales.
- 'South Expansion': ~34% increase in annual thermal energy sales.

Note, as described in section 3.2, by installing additional biomass heating equipment capacity there would also be an impact to the annual thermal energy sales to the 'For-Profit' base concept customer buildings.

For simplicity[10], this report ***excludes*** the additional annual thermal energy sales from the target customer buildings of the 'For-Profit' base concept.[11]

[9] Estimated at 5% of annual thermal energy sales.

[10] This report reviews the financial analysis of each expansion zone in isolation from the financial analysis of the 'For-Profit' base concept. If an expansion concept were to proceed, it is recommended to further review the financial analysis of the expansion concept in combination with the 'For-Profit' base concept at later stages of design development.

[11] It is estimated that an additional ~6 to 10% annual thermal energy sales would be added to the 'For-Profit' base concept shown in the 'Yellowknife Biomass DHS Feasibility Study'. The additional thermal energy sales would improve the business case of the 'For-Profit' base concept.

3.4 BIOMASS DISTRICT HEATING SYSTEM ADDITIONS

The 'For-Profit' base concept provides for allowances that simplify the expansion of the biomass district heating system.

This section describes the incremental modifications of the biomass district heating system that would be required to serve each expansion concept.[12]

3.4.1 Biomass Energy Centre

The 'For-Profit' base concept included for additional equipment bays, services, and pipe headers that could allow for expansion of the energy centre plant without major modifications or retrofits.

The expansion concepts allow for the following major equipment additions:

- One (1) 5 MW_t biomass heating system,
- One (1) distribution pump, and
- Two (2) fuel storage silos.

The scope would include for additional auxiliary systems.

A schematic drawing of the proposed biomass energy centre expansion concept can be found in Appendix A.

3.4.2 Distribution Piping

The 'For-Profit' base concept included for up-sized distribution piping mains that could allow for expansion of the district heating system without demolition and replacement of major sections of piping.

The expansion concepts allow for the extension of the distribution piping mains to serve the new target areas and for the branch piping required to new target building connections.

Drawings of the proposed distribution piping systems for the two concepts can be found in Appendix A.

3.4.3 Building Connections

The expansion concepts allow for energy transfer station (ETS) thermal energy interfaces, interconnecting piping, controls and metering required to connect the target customer buildings to the biomass district heating system. This includes a typical allocation for building modifications that would be required to be compatible with the district heating service.

[12] This report did not review the technical feasibility of a concept that combines both the 'west expansion' and 'south expansion' concepts.

4 ECONOMIC EVALUATION

This section summarizes the 30-year financial analysis that evaluates the economic feasibility of the biomass district heating system expansion concepts. This analysis considers the incremental project revenues, project expenses, and greenhouse gas emission reductions.

The financial analysis provided for each expansion concept is independent of the 'For-Profit' analysis to provide a comparison against whether the 'west expansion' or 'south expansion' of the biomass district heating system would strengthen or weaken the original 'For-Profit' base concept business case[13].

Unless otherwise indicated, this analysis assumes the 'Base Case' inputs as assumed for the 'For Profit' analysis as outlined in the 'Yellowknife Biomass DHS Feasibility Study'.

All values are shown in 2022 Q3 Canadian dollars, unless otherwise indicated.

4.1 PROJECT REVENUE

The financial analysis assumes that project revenue is provided solely from thermal energy sales. This report assumes the thermal energy rate determination is consistent with the 'For-Profit' financial analysis.

4.1.1 Implementation Schedule

The financial analysis assumes the following implementation schedule[14] to reflect project market penetration and a multi-year construction period:

Table 4: Implementation Schedule

Description	2024	2025	2026	2027	2028	≥ 2029
Thermal Energy Sales	-	20%	40%	60%	80%	100%

Many factors could influence the actual timing of the system expansion. As such, this report makes no prediction as to the actual implementation schedule of the expansion concepts in relation to the 'For-Profit' base concept.

[13] This study does not review the scenario where both the 'west expansion' and 'south expansion' occurs concurrently.
[14] The implementation schedule, market penetration, and system build-out require further review at later stages of design development.

4.2 PROJECT EXPENSES

The following section defines the incremental project expenses of each concept, including capital costs, utility costs, and operation & maintenance costs.

4.2.1 Project Capital

The annual project capital expenses are based on the overall project capital costs, access to grants, debt/equity assumption, and capital spend schedule.

The following table summarizes the key capital cost assumptions for each concept:

Table 5: Project Capital Assumptions

Description	'For-Profit' Base Concept	West Expansion	South Expansion
Project Capital Cost[15]	$ 71.7 million	$ 31.7 million	$ 25.2 million
Grant Funding (% of Project Capital)	10%	10%	10%
Project Equity Capital Amount	-	-	-
Project Debt Financing Principal Amount[16]	$ 64.5 million	$ 28.5 million	$ 22.7 million

The following summarizes the incremental results compared to the 'For-Profit' base concept:

- 'West Expansion': ~45% increase in the project capital cost.
- 'South Expansion': ~35% increase in the project capital cost.

Refer to Appendix B for a summary of the expansion concept incremental capital cost estimates.

[15] Shown in 2022 Q3 Canadian Dollars. As previously noted, the financial analysis considers the incremental capital cost only.

[16] This financial analysis assumes that the remaining project capital costs after grant funding would be 100% financed. Project debt is assumed to be repaid over a 20-year period, at an interest rate of 3.5%.

4.2.1.1 Capital Spend Schedule

The financial analysis assumes that project capital costs are incurred over multiple years. The project capital costs are assumed to escalate by 2% per year and are adjusted based on the year the capital is spent.

This financial analysis assumes the following capital spend schedule[17]:

Table 6: Capital Spend Schedule

Description	2024[18]	2025	2026	2027	2028	≥ 2029
Biomass Energy Centre	50%	50%	-	-	-	-
Distribution Piping System	20%	20%	20%	20%	20%	-
Building Connections	20%	20%	20%	20%	20%	-

4.2.2 Utility Costs

This report follows the same utility cost assumptions outlined in the 'Yellowknife Biomass DHS Feasibility Study'.[19]

[17] The capital spend schedule, market penetration, and system build-out require further review at later stages of design development.
[18] Year 2024 is assumed to align with the timeline shown for the 'For-Profit' base concept. The actual date of the system expansion requires further review at later stages of design development.
[19] No additional operators are expected for the expansion concepts.

4.3 ANALYSIS RESULTS

The following section summarizes the financial analysis results for the 'west expansion' and 'south expansion' concepts.

4.3.1 Net Project Cashflow

The net project cashflow represents the net incremental project revenues and net incremental project expenses over the 30-year project horizon.

The following table summarizes the project cashflow of the two incremental expansion concepts, and the original 'For-Profit' base concept for comparison:

Table 7: Project Cashflow

Description	'For-Profit' Base Concept	West Expansion	South Expansion
Project Revenues			
Thermal Energy Sales	$318.0 million	$150 million	$106 million
Total Project Revenues	*$318.0 million*	*$150 million*	*$106 million*
Project Expenses			
Project Capital			
Project Capital Equity Amount	-	-	-
Project Debt Repayment Cost	-$96.5 million	-$46 million	-$36 million
Salvage Cost	-	-	-
Utilities			
Biomass Feedstock Cost	-$79.3 million	-$37 million	-$26 million
Fuel Oil Cost	-	-	-
Electrical Utility Cost	-$21.9 million	-$10 million	-$7 million
Operation & Maintenance	-	-	-
Maintenance & Repair Cost	-$36.3 million	-$14 million	-$12 million
Operating & Admin. Cost	-$27.9million	-$1 million	-$1 million
Insurance	-$6.3 million	-$2 million	-$2 million
Total Project Expenses	*-$268.3million*	*-$110 million*	*-$84 million*
Net Project Cashflow	**$49.7 million**	**$40 million**	**$22 million**

From the above table, the expansion concepts result in a positive average annual cashflow (profit) as follows:

- West Expansion: $1.3 million (~80% increase to the 'For-Profit' base concept).
- South Expansion: $0.7 million (~45% increase to the 'For-Profit' base concept).

4.3.2 Accumulated Project Cashflow

The following figure shows the accumulated cashflow for the 'west expansion' and 'south expansion' concepts:

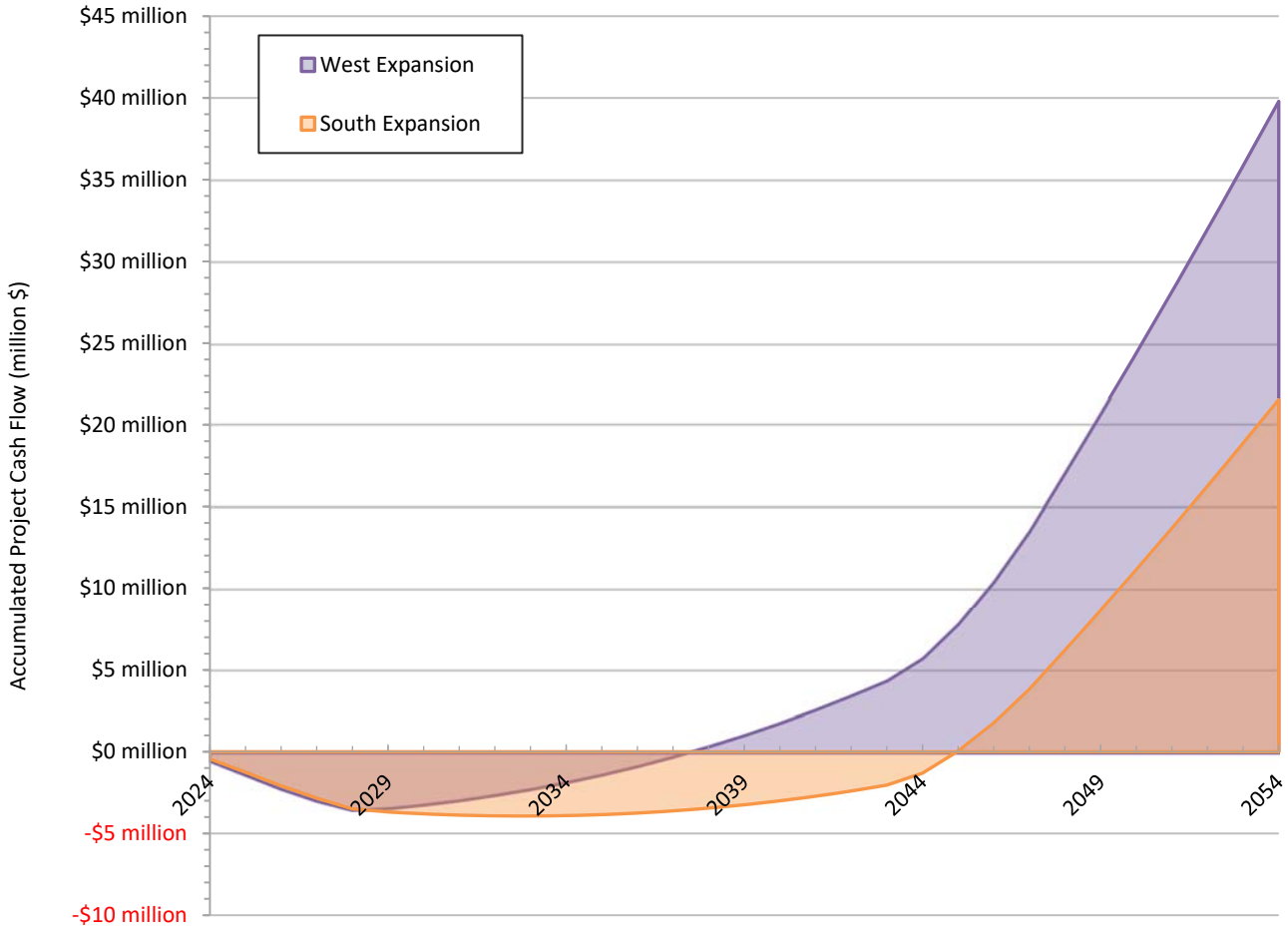


Figure 5: Accumulated Project Cashflow

The shaded areas of the curve represent the accumulated incremental cashflow over the 30-year project horizon.

From the above figure, the concepts result in a positive accumulated incremental cashflow period as follows:

- West Expansion: 14 years, or by the year 2038.
- South Expansion: 21 years, or by the year 2045.

4.3.3 Total & Annual GHG Emissions Reduction

The following summarizes the financial analysis results for the total project incremental greenhouse gas emission reductions over the 30-year project horizon:[20]

- West Expansion: 180,000 tonnes of CO_{2e}.
- South Expansion: 130,000 tonnes of CO_{2e}.

The following figure shows the average annual GHG emissions reduction and average annual project profit:

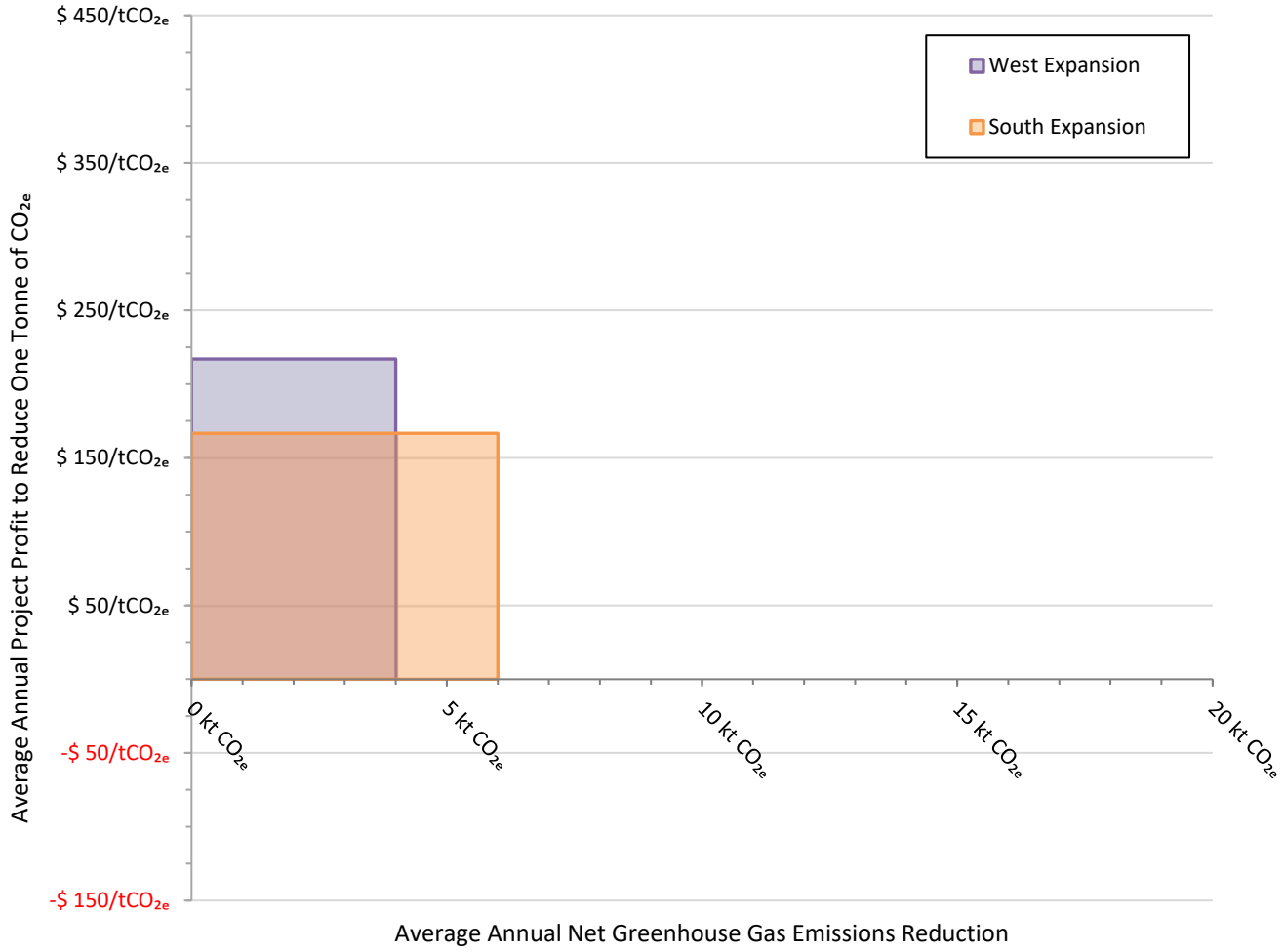


Figure 6: Average Annual Profit per Unit of GHG Emissions Reduction

The shaded area above represents the average annual results over the 30-year project horizon.

[20] Based on the assumptions noted in the 'Yellowknife Biomass DHS Feasibility Study'.

4.3.4 Key Financial Metrics

The following table summarizes the key financial metrics for the financial analysis:

Table 8: Financial Analysis Results

Description	'For-Profit' Base Concept	West Expansion	South Expansion
Project Return (%)	8.2%	15.6%	9.7%
Net Present Value	$16.5 million	$18.0 million	$8.3 million
Levelized Cost of Energy	$ 16.0 / MWh	$ 37.6 / MWh	$ 24.6 / MWh
Levelized Cost of GHG Reduction	$ 42.0/tCO_{2e}	$ 98.4/tCO_{2e}	$ 64.4/tCO_{2e}

These values are different than the previous costs previously shown in the report. These levelized cost metrics evaluate the total project costs over the project horizon with consideration to the assumed project discount rate.

Note: the levelized costs shown above are positive, indicating a profit.

Both expansion concepts independently provide a more favourable financial result than the 'For-Profit' base concept, indicating that expansion to either target area would strengthen the business case of the base project.

5 SUMMARY REMARKS

Either the 'west expansion' or 'south expansion' concepts demonstrate an opportunity to grow the 'For-Profit' base concept by ~20 buildings, representing an additional serviced gross floor area of ~45% (west) and ~35% (south) respectively.

The biomass district heating system infrastructure provided in the 'For-Profit' base concept would allow for expansion of either concepts without major modifications or retrofits. To serve the additional target customer buildings, the 'For-Profit' base concept would generally require the installation of additional biomass heating system capacity, extension of the DPS main piping, and provision for branch piping & building connections to new target customer buildings.

The expansion concepts represent an additional project capital cost of ~$32-million (west) and ~$25-million (south) respectively. The extension of the distribution piping system mains accounts for a large portion of the construction scope and capital cost for the system expansion concepts.

The biomass district heating system would provide >87% of the target building connections heating requirements. This represents additional annual thermal energy sales of ~45% (west) and ~35% (south) respectively.

The incremental project expenses are estimated to increase proportionately less than the incremental project revenues. This is partially due to expansion synergies (i.e., no additional operational staff requirements) and other fixed operating costs.

There are many reasons why a district energy developer may consider system expansion beyond the core target area. ***This report demonstrates that expansion to either target area would strengthen the business case of the base project.***

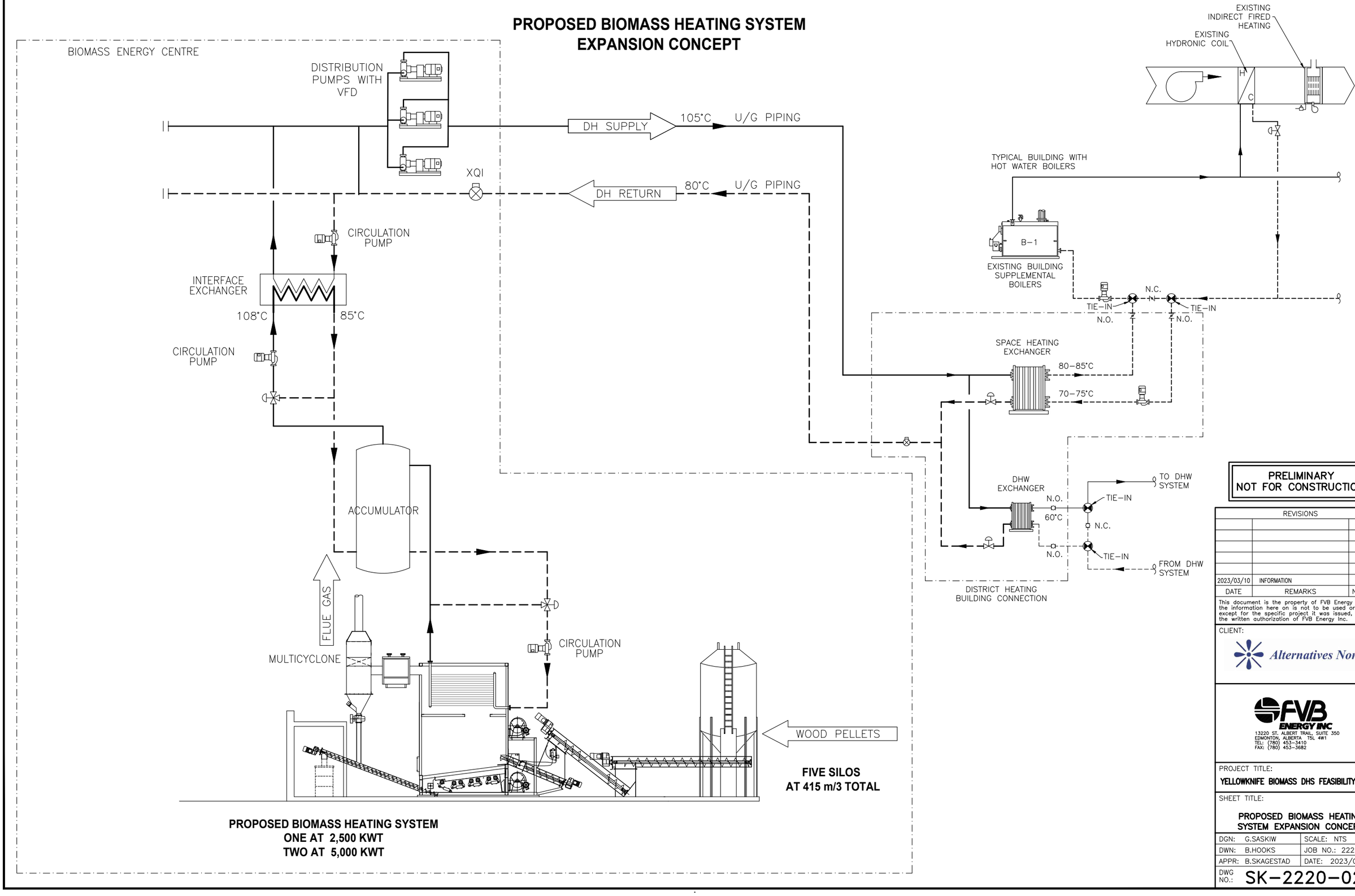
If expansion of the 'For-Profit' base concept is pursued, further review of the overall project economics and project risk is recommended in the context of developing a larger biomass district heating system.

*** End of Main Document ***

APPENDICES

APPENDIX A SUPPORTING DRAWINGS

PROPOSED BIOMASS HEATING SYSTEM EXPANSION CONCEPT



PROPOSED BIOMASS HEATING SYSTEM
ONE AT 2,500 KWT
TWO AT 5,000 KWT

PRELIMINARY
NOT FOR CONSTRUCTION

REVISIONS			
2023/03/10	INFORMATION	A	
DATE	REMARKS	NO.	

CLIENT:
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PROJECT TITLE:
YELLOWKNIFE BIOMASS DHS FEASIBILITY STUDY

SHEET TITLE:
PROPOSED BIOMASS HEATING SYSTEM EXPANSION CONCEPT

DGN: G.SASKIW	SCALE: NTS
DWN: B.HOOKS	JOB NO.: 222220
APPR: B.SKAGESTAD	DATE: 2023/02/15
DWG NO.: SK-2220-02	

0 50 100 200m

SCALE 1:2000

LEGEND:

- CENTRAL CORE AREA BOUNDARY
- CENTRAL CORE DPS PIPING
- EXISTING BIOMASS HEATING SYSTEM PIPING
- WEST EXPANSION AREA BOUNDARY
- WEST EXPANSION DPS PIPING
- [#] BUILDING LOAD NUMBER
- [EC-#] ENERGY CENTRE LOCATION
- BIOMASS SYSTEM
- 250Ø PIPING LINE SIZE

PRELIMINARY
NOT FOR CONSTRUCTION

REVISIONS			
2023/03/10	INFORMATION	A	
DATE	REMARKS	NO.	

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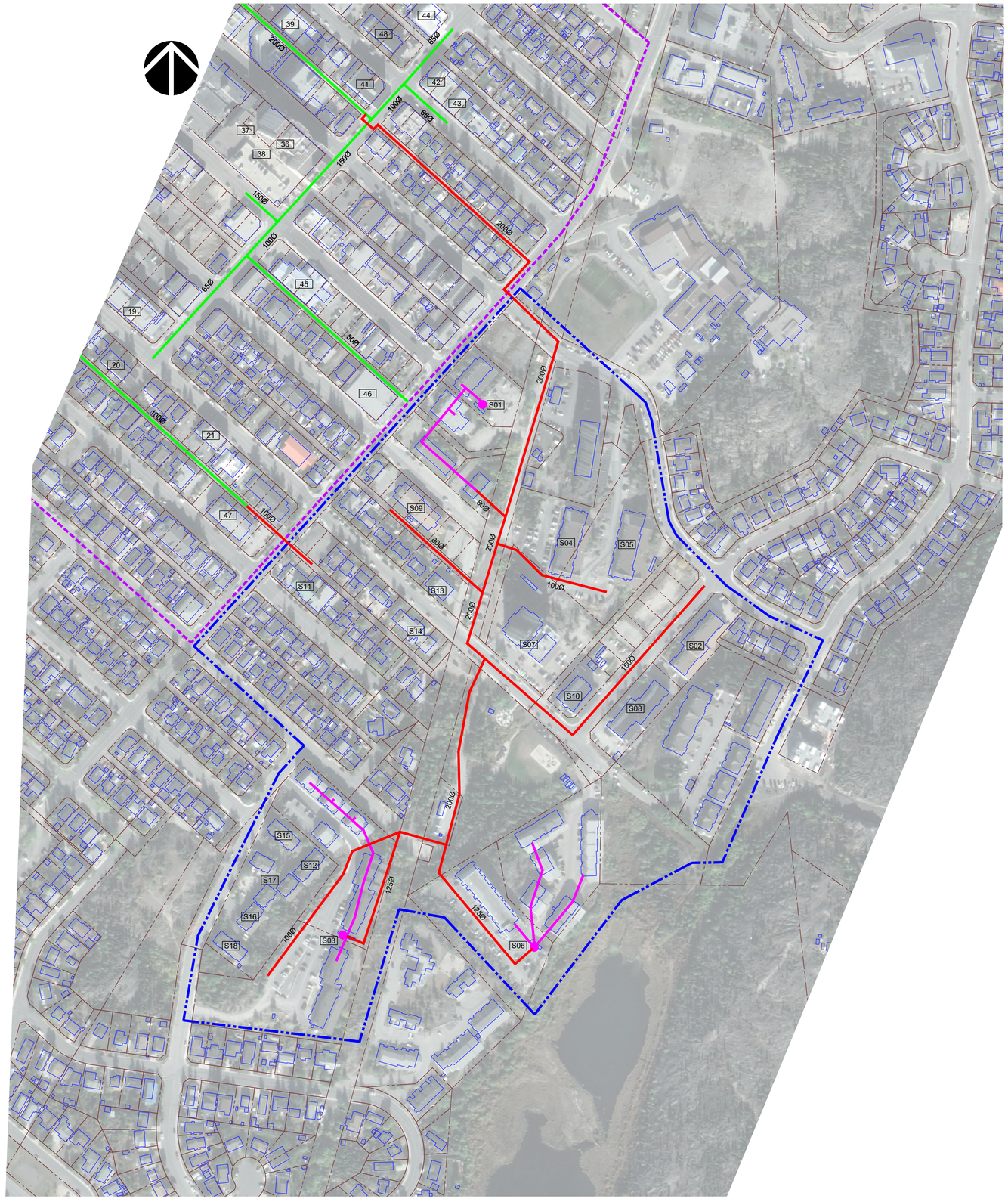
PROJECT TITLE:
YELLOWKNIFE BIOMASS DHS
FEASIBILITY STUDY

SHEET TITLE:
WEST EXPANSION
AREA PLAN

DGN: S.KERR	SCALE: 1:2000
DWN: B.HOOKS	JOB NO.: 222220
APPR: G.SASKIW	DATE: 2022/05/13

DWG NO.: D-2220-03



0 50 100 200m

SCALE 1:2000

LEGEND:

- CENTRAL CORE AREA BOUNDARY
- CENTRAL CORE DPS PIPING
- EXISTING BIOMASS HEATING SYSTEM PIPING
- SOUTH EXPANSION AREA BOUNDARY
- SOUTH EXPANSION DPS PIPING
- # BUILDING LOAD NUMBER
- EC-# ENERGY CENTRE LOCATION
- BIOMASS SYSTEM
- 250Ø PIPING LINE SIZE

PRELIMINARY
NOT FOR CONSTRUCTION

REVISIONS			
2023/03/10	INFORMATION	A	
DATE	REMARKS	NO.	

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PROJECT TITLE:
YELLOWKNIFE BIOMASS DHS FEASIBILITY STUDY

SHEET TITLE:
SOUTH EXPANSION AREA PLAN

DGN: S.KERR	SCALE: 1:2000
DWN: B.HOOKS	JOB NO.: 222220
APPR: G.SASKIW	DATE: 2022/05/13

DWG NO.: D-2220-04

APPENDIX B PROJECT CAPITAL COST SUMMARY

Incremental capital cost estimates were prepared for both expansion concepts that include the major components of the biomass district heating system: the Biomass Energy Centre, the Distribution Piping System, and the Building Connections.

The following table summarizes the capital cost estimates in 2022 Q3 Canadian dollars:

Table 9: Project Capital Cost Estimates

Cost Component	West Expansion	South Expansion
Construction Costs		
Biomass Energy Centre	$ 4.5 million	$ 4.5 million
Distribution Piping System	$ 13.3 million	$ 9.3 million
Building Connections	$ 4.7 million	$ 4.1 million
Subtotal Construction Costs	*$ 22.5 million*	*$ 17.9 million*
Owner's Costs		
Owner's Contingencies	$ 5.7 million	$ 4.4 million
Owner's Soft Costs	$ 2.9 million	$ 2.4 million
Owner's Project Development Costs	$ 0.5 million	$ 0.4 million
Land Cost	-	-
Subtotal Owner's Costs	*$ 9.1 million*	*$ 7.2 million*
TOTAL Project Costs	**$ 31.7 million**	**$ 25.2 million**

The cost estimates provided are Class 5 (as per AACE International No.17R- 97 Rev August 7, 2020) are considered preliminary with an expected level of accuracy of +50% and -15%.

It should be noted that the above capital line items have been rounded to the nearest $100,000. This rounding may lead to slight discrepancies between section totals and the subtotals/totals shown.