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HISTORY OF ISSUES / APPROVALS

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1.0 EXECUTIVE SUMMARY

Sligo Sustainable Energy Community (SEC) have appointed Fingleton White as engineering service providers to develop a Front End Engineering Design (FEED) and Business Case Analysis (BCA) for a proposed satellite gas network in Sligo Town. Sligo SEC requested a two phased approach to the study; this report details the findings of the preliminary phase.

The study contains five key sections as follows:

- Forecast of potential thermal energy demand
- Pipeline route options assessment
- Decanting facility location assessment
- Fuel supply options assessment
- Financial appraisal

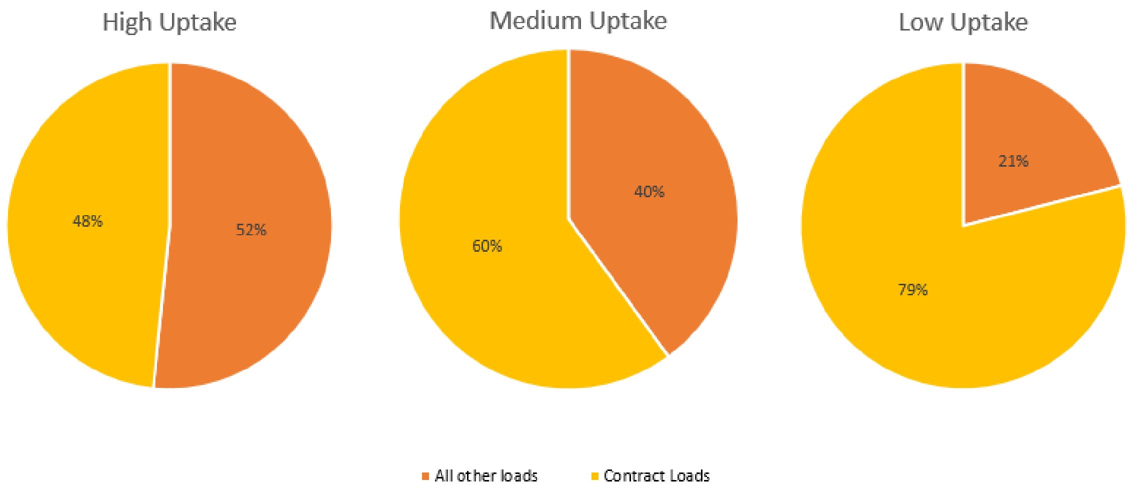
The potential annual gas load and estimated annual consumption of all industrial commercial premises in Sligo town was estimated for High, Medium and Low uptake scenarios. The analysis was based on primary data, interpretation of secondary data and on thermal energy demand alone. The study doesn't consider potential demand related to the uptake of gas fired CHP or CNG for transport though it is considered likely that both would contribute to the overall demand for gas in the catchment area.

The study identified 3no. existing and 1no. potential Contract Industrial/Commercial (I/C) load (annual consumption in excess of 4,395MWh).

Customer	Location	EAC (MWh)
Abbvie - Manorhamilton Road	North Sligo	16,171
Sligo University Hospital	North Sligo	8,024
Abbott Ireland - Finisklin	Finisklin Business Park	6,068
Future Large Industrial	Oakfield Business Park	7,212
Total Contract Loads		**37,475**

The forecast thermal load of these customers' accounts for a substantial portion of the overall potential demand in all three uptake scenarios modelled. The three existing businesses submitted their thermal and electrical energy usage to contribute to the primary data used to forecast network demand. The majority of the thermal energy requirement for these businesses is currently being met by LPG, with oil being used to a lesser extent. It is also worth noting the large electrical demand for these premises.

These Contract I/C customers have been treated as anchor customers; the study assumes all four will connect to the network. The analysis also identified a substantial number of medium and small I/C customers that may benefit from connection to the network.



A financial appraisal was conducted to investigate, at a high level, the financial viability of the project. The appraisal was performed using the simple payback method for both CNG and LNG options in the high, medium and low uptake scenarios. The project was then appraised over a 25-year payback period with the medium uptake scenario as the assumed base case.

The unit price of gas to the consumer for the purposes of appraisal was taken as the rate at which the base case yields a net present value of zero over a 25-year period with a discount rate of 5%. Using this method, the unit cost that satisfied these conditions was calculated for both CNG and LNG, the lower of these values was then utilised to compare the viability of both fuel options across the high, medium and low uptake scenarios. The appraisal indicated that CNG is the most financially attractive fuel supply option.

		Scenarios		
		Low Uptake	Medium Uptake BASE CASE	High Uptake
Discount Rate		5%	5%	5%
CNG	c/kWh	4.52	4.52	4.52
	NPV	-€5,340,326	€0	€5,352,576
	IRR	-1%	5%	9%
LNG	c/kWh	4.52	4.52	4.52
	NPV	-€6,196,578	-€4,055,055	-€1,901,283
	IRR	-	-6%	2%

The appraisal used a +/- 40% budget estimate for total CAPEX and annual OPEX for both CNG and LNG supply options. The resulting budget estimates are as follows:

	CNG	LNG
Decanting Facility	€6,850,000	€2,150,000
Pipeline and Ancillaries	€1,840,000	€1,840,000
Services and Meters	€720,000	€720,000
Total CAPEX (+/- 40%)	€9,410,000	€471,000
Annual OPEX (+/- 40%)	€958,200	€621,400

The business model assumed for LNG is one which is currently in operation in Ireland. With this model the regassification infrastructure is designed, built, owned and operated by the entity supplying the gas to the network. The CAPEX and OPEX associated with establishing, supplying and operating this facility are then borne by the operator and charged to the network through the commodity price and an annual service charge. This accounts for a substantial amount of the difference between the CAPEX and OPEX borne by the network for the two fuel options.

The financial appraisal indicates that, for the base case scenario, under all conditions assumed by the study, a local gas network supplied by CNG or LNG is financially viable, with CNG being the most financially attractive.

The pipeline route options assessment aimed to connect the contract energy users as a priority while also facilitating the connection of smaller industrial and commercial customers where practical and providing opportunity for future growth and development.

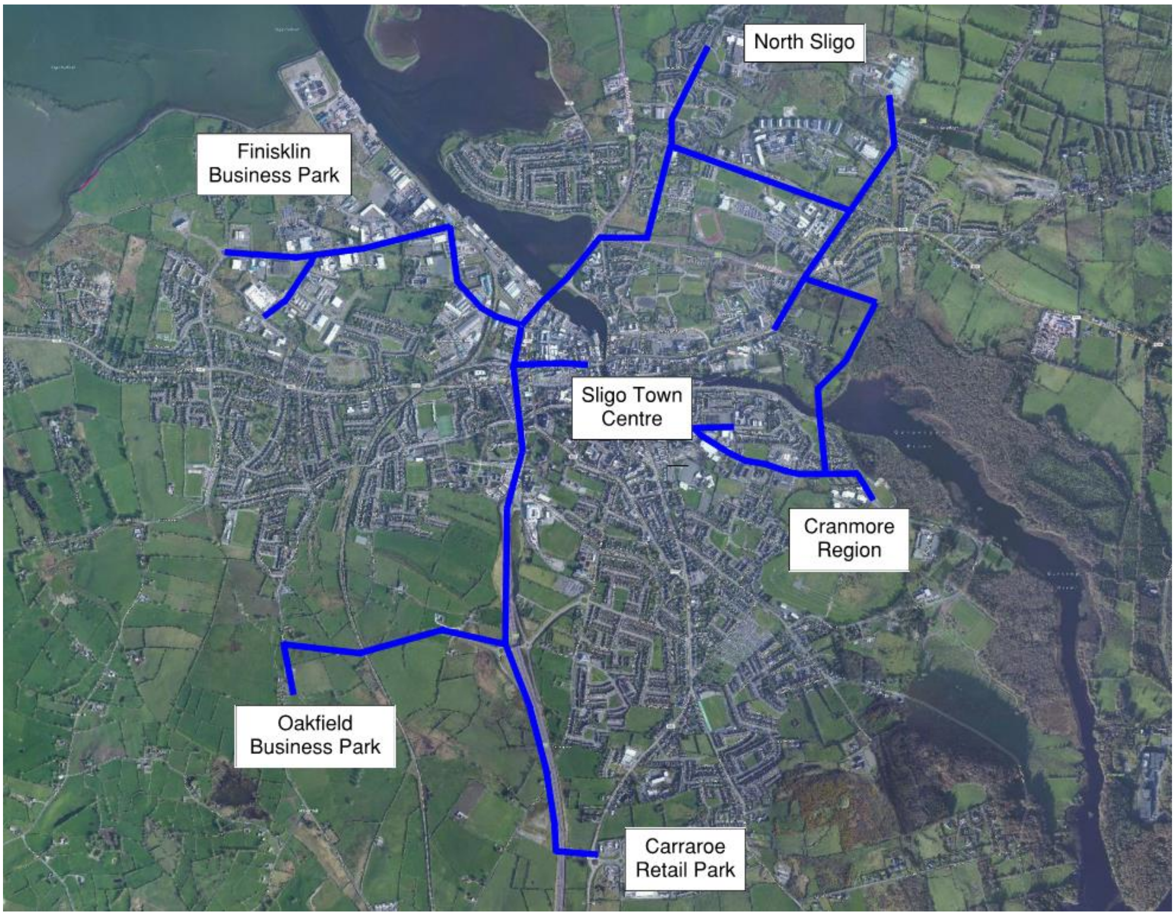
Taking account of the location of these contract loads the network nodes or “energy hubs” were prioritised for connection as follows:

Priority	Fixed Point
1	North Sligo
2	River Crossing & Finisklin Business Park
3	Oakfield Business Park
4	Sligo Town Centre
5	Carraroe Retail Park and Cranmore Region

Analysis of the options for crossing the river Garavogue concluded that Hughes Bridge is the most suitable primary crossing location due to its location in relation to the two priority energy hubs. The bridge has the added advantage of containing existing unused utility ducts which could provide a minimally obtrusive option for accommodation of the gas main.

The proposed Eastern Bridge is also a viable option to connect North Sligo to the Cranmore region and east of Sligo town centre. Consideration should be giving to including ducts within the proposed structure to facilitate this option in the future.

The options assessment analysed the viable routes for connection of the energy hubs, the optimal route, as illustrated below, provides a technically viable pipeline route that satisfies the stated requirements. The route is designed to allow for a staged role out of the network facilitating connection of energy hubs in the order of priority outlined above.



Pipeline Section	Number of Options Considered	Preferred Option
River Crossing	4no. Options considered	Hughes Bridge as primary crossing, Eastern Bridge as supplementary crossing
North Sligo	3no. Options considered	Option B (ref. Section 4.4.1)
Finisklin Business Park	2no. Options considered	Option A (Ref. Section 4.4.2)
Oakfield Business Park	2no. Options considered	Option B (ref. Section 4.4.3)
Sligo Town Centre and Cranmore	3no. Options considered	Hybrid of 3 options with addition of LP network to facilitate town centre connections (Ref. Section 4.4.4
Carraroe Retail Park	3no. Options considered	Option A (ref. Section 4.4.5)

The decanting facility site options analysis identified four potentially viable sites. A detailed comparison of these sites concluded that the preferred site is a greenfield site adjacent to the Abbvie Manorhamilton entrance, along the N16 (Site 2 in the figure below). The key determining factor for this preference was the proximity to the largest energy user and the highest priority energy hub.

Analysis of the potential fuel supply options included a comparison of the relative benefits of compressed natural gas and liquified natural gas giving consideration to their relative energy density, security of supply, decanting facility requirements and routes to decarbonisation. The analysis concludes that both are technically viable options

The chosen fuel supply will depend largely on commercial agreements available and the security of supply. Both fuels allow a future transition to biomethane. The study considers it unlikely that Bio-LNG will be sourced indigenously. Conversely, there is potential for locally produced Bio-CNG to supply the network. The viability of using biomethane within the Sligo network will be highly dependent on energy policy and possible subvention to move the market in this direction. The study also considers the potential for future decarbonisation through the introduction of blends of Hydrogen with natural gas and 100% Hydrogen,

A large proportion of the forecast energy demand is attributed to industrial heat applications, an area which is recognised as being difficult/impractical to decarbonise through electrification. Bio-methane and the move towards green hydrogen provide realistic pathways to net zero carbon in the medium to long term. Medium pressure gas network constructed using Polyethylene pipework are likely to be compatible with 100% Hydrogen and can therefore facilitate this likely transition.

Below is a summary of the recommendations from the study, see section 8.2 for further detail:

- Conduct a detailed survey of all potential I/C customers in the area.
- Commission a detailed Network Routing and Constructability Report
- Prepare a detailed budget
- Investigate and determine the statutory and regulatory requirements relating to a satellite gas network.

- Conduct an analysis of potential subvention options of the network
- Conduct a detailed cost benefit analysis
- Conduct a detailed security of supply analysis
- Conduct an analysis of the potential for CHP and CNG for transport as these will contribute to the demand but also the carbon reducing effect of network.

2.0 INTRODUCTION

Sligo Sustainable Energy Community (SEC) have appointed Fingleton White as engineering service providers to develop a Front End Engineering Design (FEED) and Business Case Analysis (BCA) for a proposed satellite gas network in Sligo Town. Sligo SEC requested a two phased approach to the study; this report details the findings of the preliminary phase.

Sligo SEC is a collaboration across public and private sectors in Sligo. The membership is drawn from Local Authority, Health, Education, Pharmaceutical, Medical Device and Agrifoods sectors. The combined energy demand of the members is significant, and a key aim of the group is to reduce the carbon intensity and cost per kWh of energy use. Sligo SEC has identified the development of a satellite natural gas network as a potentially viable low carbon energy infrastructure project.

This network will be independent from the national gas transmission network and will be supplied by road haulage deliveries to a central injection point on the local network. The vision of Sligo SEC is that the network will initially service Sligo town centre and the large industrial users surrounding the town and provide infrastructure to enable an Anaerobic Digestion Biogas market in the North West.

2.1 Scope

The scope of this preliminary phase of the FEED and BCA is as follows:

2.1.1 Analysis of Network Capacity Requirements

Analysis of the network capacity requirement is required in order to determine the design parameters and develop the pipeline route.

During the conceptual development of the project Sligo SEC conducted an energy requirements study of the large energy users in the catchment area of the proposed network. The study accounted for the annual energy requirements of 24 of the largest energy users in the area.

FW, working with the Client and other stakeholders, carried out a review of the findings of the previous study and conducted a survey of the largest energy users in order to further develop the knowledge and understanding of the user requirements.

Further analysis was conducted to estimate the total number of potential Industrial/Commercial users in the Sligo Town area and their potential gas demand. This analysis was used to determine the system capacity requirements and most economically advantageous pipeline route.

2.1.2 Route Development and Site Selection

The locations of large energy users were mapped and an initial roll out plan was developed for the proposed network. A high-level pipeline routing and network injection facility site analysis was then carried out. This element of the Pre-FEED took into consideration publicly available information as well as information provided by and/or through the client including:

- Proximity issues
- Ground conditions and topography
- Drainage and flooding issues

- Existing underground/over-ground services
- Environmental constraints, including Special Areas of Conservation (SACs)/Special Protection Areas (SPAs)
- Special Engineering Difficulties (SEDs)
- Other Utilities
- Constructability
- Any other relevant considerations and constraints

The findings of this analysis were used to determine the optimum pipeline route options and network injection facility site.

2.1.3 Analysis of Fuel Supply

A high-level comparative analysis of the CNG and LNG fuel supply options was carried out with a view to future supply of renewable gas.

2.1.4 Business Case Analysis

The Business Case Analysis has been initiated with a high-level financial appraisal of the proposed network. The appraisal was developed taking into account the CAPEX, OPEX and potential revenue for the network. The analyses were conducted for high, medium and low uptake scenarios.

2.2 Abbreviations

Abbreviation	Meaning
AD	Anaerobic Digestion
AFT	Applied Flow Technology
BCA	Business Case Analysis
BITP	Business Industry and Technology Parks
CAPEX	Capital Expenditure
CIBSE	Chartered Institution of Building Services Engineers
CNG	Compressed Natural Gas
EAC	Estimated Annual Consumption
ESB	Electricity Supply Board
FEED	Front End Engineering Design
FW	Fingleton-White
GIS	Geographical Information System
HGV	Heavy Goods Vehicle
I/C	Industrial/Commercial
IDA	Industrial Development Authority
IT	Institute of Technology
LNG	Liquefied Natural Gas
LV	Low Voltage
MV	Medium Voltage
OD	Outer Diameter
OH	Overhead
OPEX	Operational Expenditure

PE	Polyethylene
PRAI	Property Registration Authority Ireland
SAC	Special Area of Conservation
SCMH	Standard Cubic Meters per Hour
SDR	Standard Dimension Ratio
SEC	Sustainable Energy Community
SED	Special Engineering Difficulty
SEDP	Sligo and Environs Development Plan
SLR	Strategic Land Reserve
SPA	Special Protection Areas
UG	Underground

Table 1: Abbreviations

3.0 CAPACITY REQUIREMENTS

Analysis of the Industrial and Commercial energy users within the network catchment area has been conducted in order to determine the network capacity requirements. A previous study carried out by Sligo SEC gathered information on the energy consumption of 24 public and private Industrial and Commercial energy users who were mainly located in North Sligo and the Finisklin Business Park. The list contained the largest energy users within the area and other smaller businesses who have expressed interest in the project.

Using the Methodology outlined below, and the information gathered in the previous study, a gas demand model of the potential network users was developed and utilised to plan the layout of the network.

3.1 Methodology

3.1.1 Customer Base Assumption

The network demand forecast has been based solely on the connection of I/C customers, connection of new or existing domestic premises has not been considered.

The exclusion of existing domestic housing from the study is in line with the approach taken in previous analysis carried out by Gas Link on the viability of extending the gas network to new towns within Ireland[1]. Their analysis does however include a forecast gas demand for new housing. Since this study there has been a marked change in the Governments policy toward domestic heating for new housing stock. The governments Climate Action Plan which was published in 2019 clearly indicates that the intention is to phase out the installation of gas boilers in new homes with an effective ban being in place by 2025. For this reason, connection of new homes to the network has also been excluded from this study.

3.1.2 Primary Data Analysis

The methodology for analysing network capacity requirement involved collecting primary and secondary data on all potential I/C users within reach of the network.

In their analysis of New Towns Connections, Gas Networks Ireland categorise I/C users based on their Estimated Annual Consumption (EAC). These same categories have been used for the purposes of this study and are defined as follows:

Category	Energy Consumption Range
Contract I/C	Above 4,395MWh
Large I/C	1,172MWh to 4,395MWh
Medium I/C	200MWh to 1,172MWh
Small I/C	Under 200MWh

Table 2: Industrial/Commercial Categories

For the purposes of this study, EAC includes thermal energy only. For the primary data, the EAC figures are derived from historical Oil and LPG usage provided by the businesses. For secondary data, estimates of thermal energy were made. The study does not consider the potential contribution to overall demand through the uptake of gas fired CHP or CNG for

[1] Gaslink New Towns Analysis Phase III, 2010

transport. The table below shows the historical annual thermal and electrical loads derived from the primary data provided, the figures indicate there may be potential for CHP operations to produce electricity in the Sligo region. This should be considered in further analysis; however, it is not analysed under the scope of this study.

	Thermal Load (kWh)	Electricity (kWh)	Percentage Electricity (%)
North Sligo	38,452,510	30,916,838	45
Finisklin Business Park	6,964,792	12,278,372	64
Sligo Co. Co.	2,540,022	680,241	21

Table 3: Annual Thermal and Electrical Energy Consumption (primary data provided)

As part of this FEED study, a survey questionnaire was circulated to the potential users who formed part of the original study in order to gain an understanding of their energy usage patterns and determine seasonality to the demand. These sites included hospitals, pharmaceutical plants and a university. This data has been taken into account in this analysis and is assumed to be accurate and reflect current usage.

From the data provided, sites were characterised according to size and peak hour loads were calculated.

The primary data gathered is solely in relation to the 24 users who had previously been canvased. Secondary data sources were utilised to estimate thermal energy use for all other potential users within the catchment area of the network.

3.1.3 Secondary Data Analysis

In order to estimate the potential energy requirement of all other Industrial and Commercial premises a method based on estimated floor area and business category was implemented. Energy benchmarks for various business categories were sourced from “CIBSE TM46 Energy Benchmarks and Energy Consumption Guide” and were applied to the floor area data available.

Publicly available data, sourced from Valuation Office Ireland was used to estimate the number of potential additional I/C customers within the network catchment area. The raw data contains estimated floor areas, addresses and business type for all commercial premises in the Sligo County. The list was first filtered to contain only the premises located within the catchment area of the proposed network. The list was then further refined by eliminating all premises with a floor area of less than $10m^2$ as these businesses are deemed too small to be incentivized to connect to the network due to lower energy loads. The energy use benchmarks were then applied to the remaining premises and the estimated annual consumption calculated. Using this approach, a number of premise types are given a benchmark value of zero for gas usage, these premises types have also been removed.

A similar approach has been taken to estimate the demand for Carraroe and Cleveragh retail park.

3.1.4 Uptake Scenarios

In order to further refine the model, uptake rates have been applied and used to develop high, medium and low scenarios. These scenarios are intended to account for premises that are within the study area but for whom connection to the network is not technically or economically viable.

It is assumed that all four users defined as Contract I/C loads will connect to the network as they will see the greatest benefits from the network. Therefore, an uptake rate of 100% has been applied to these users in all three scenarios.

Scenario	Uptake Rate
Contract I/C (All scenarios)	100%
High Uptake	80%
Medium Uptake	50%
Low Uptake	20%

Table 4: Uptake Scenarios

3.1.5 Swing Factors

In order to model the network and define pipeline properties, peak load must first be calculated. This is achieved by applying swing factors to the EACs which then provides an estimated peak load. The swing factors account for seasonality and variances in production output enabling the maximum network capacity to be calculated. The swing factors used in this study have been adopted from the Gaslink New Towns Analysis Phase III 2010. The following table defines the range of the annual loads and the associated swing factors.

Annual Load (MWh)	Swing Factor
Up to 73	2.96
73 – 750	2.08
750 – 2,000	2.09
2,000 – 3,000	1.92
3,000 – 4,000	1.73
Above 4,000	1.62

Table 5: Swing Factors

For the purpose of this study, swing factors were assigned depending on I/C type. There are four discrete I/C types so four discrete swing factors were used. In order to assign these, average EACs were calculated for each I/C type using the primary data gathered. The corresponding swing factor was then assigned for each I/C type. The table below outlines these findings:

I/C Customers	Avg EAC (MWh)	Swing Factor
Contract I/C	6,488	1.62
Large I/C	2349	1.92
Medium I/C	410	2.08
Small I/C	71	2.96

Table 6: Swing Factor Application

3.2 Energy User Hubs

In order to plan the layout of the network in a structured way the locations of the largest energy users were mapped. This involved identifying the locations of the 24 energy users identified in the earlier study and also identifying additional clusters of existing and potential future energy users.

Through this approach a number of existing and potential energy user hubs were identified as listed below:

- North Sligo
- Finisklin Business Park
- IDA Oakfield Business Park
- Carraroe Retail Park
- Sligo Town Centre
- Cranmore Region

3.2.1 North Sligo

The North Sligo hub includes all users north of the River Garavogue. The region contains the two largest identified Contract I/C users, namely Abbvie Manorhamilton and Sligo University Hospital, along with multiple Large, Medium and Small I/C sites. North Sligo contains more key consumers than any other energy hub in Sligo.

The region contains both large educational and health care facilities including IT Sligo, Sligo University Hospital and a number of other smaller health care facilities including St. John's Hospital, St. Columba's Hospital.

There are a number of smaller potential users in North Sligo which could become part of the network. These include schools, banks, churches, pubs and retail units. The R286 provides access to many of these users in North Sligo as well as larger buildings such as The Model Gallery and Sligo Central Library.

North Sligo holds the nodal point of 3 national roads; N4, N15 and N16. It is an attractive site for businesses to set up and develop as a result. The future development plan for North Sligo is outlined in the Sligo County Development Plan 2017-2023 and the Sligo and Environs Development Plans 2010-2016. The edges of North Sligo are part of the Strategic Land Reserve (SLR). Land has been designated as Mix 1 (non-retail). This is to promote the development of commercial (non-retail), residential, leisure, employment/enterprise users in the region and could provide more large users for the network. AbbVie have space/land in which to expand their operations in Sligo thus also increasing the future potential load.

Table 7 summarises the estimated annual consumption of the users which were identified and surveyed as part of the energy users' study and the users identified using the Valuation Office data.

Customer	Category	EAC (MWh)	Peak Hour (SCMH)
Sligo University Hospital	Contract	8,024	215
Abbvie - Manorhamilton Road	Contract	16,171	433
IT Sligo	Large	3,357	126
St. John's Hospital	Large	2,538	95
Abbvie - Ballytivnan	Large	3,312	124
Clayton Hotel	Large	2,813	106
St. Columbas Laundry	Large	1,340	50
Markievicz House	Medium	523	23
Other Small I/C Loads (Medium Uptake)	Small	1,055	47
Total North Sligo		**39,133**	**1,219**

Table 7: North Sligo Gas Demand

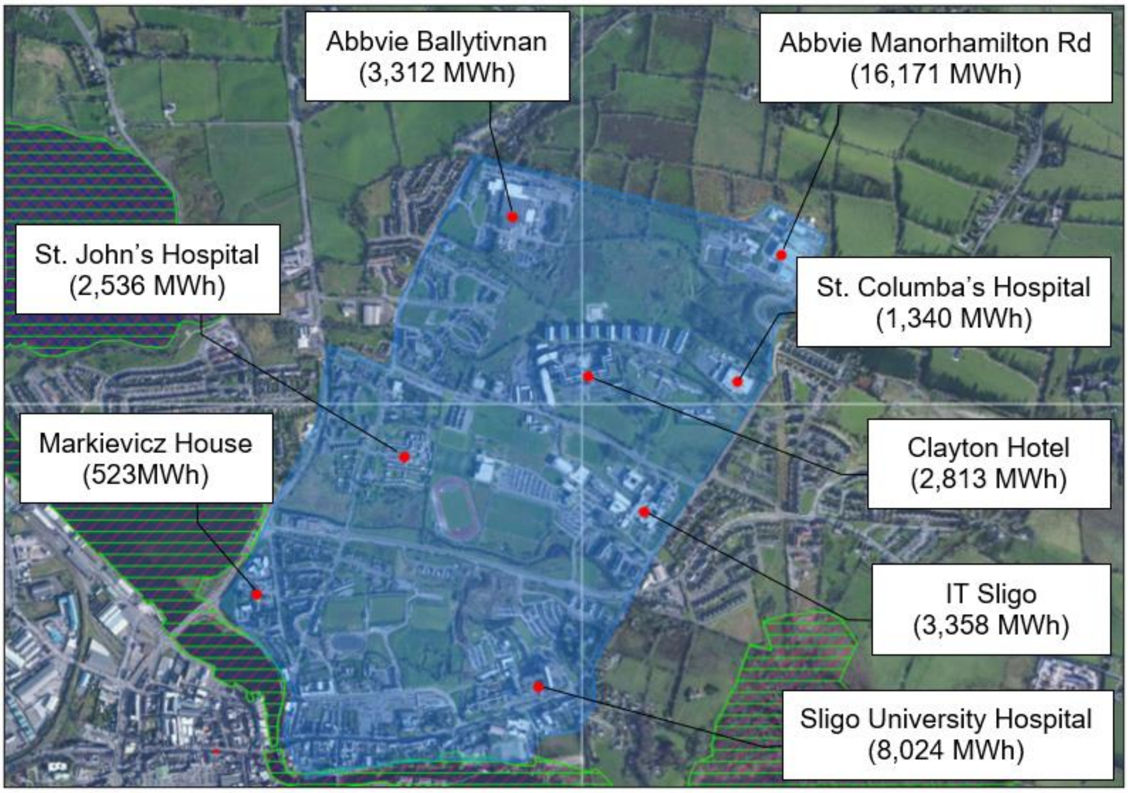


Figure 1: North Sligo Energy Hub

3.2.2 Finisklin Business Park

Finisklin Business Park is a 53-hectare IDA business park located west of Sligo town centre. The park includes a mixture of office and industrial buildings. As part of the previous energy study carried out 10 of the largest consumers within the area provided details on their energy consumption. Abbot Ireland is the largest consumer within the area with one Contract I/C site and one Medium I/C site in the area. The remaining eight customers are Small I/C sites.

Customer	Category	EAC (MWh)	Peak Hour (SCMH)
Abbott Ireland - Finisklin	Contract	6,068	162
Abbott Ireland - Nutrition	Medium	331	15
Avenue Mould	Small	59	5
Enterprise Ireland	Small	85	8
JOD	Small	99	9
Prominent	Small	80	7
Ward Automation	Small	50	4
An Post Mail Centre	Small	150	13
Creche	Small	20	2
Andrew Medical	Small	23	2
Other Small IC Loads (Medium Uptake)	Small	168	15
Other Medium IC Loads (Medium Uptake)	Medium	503	22
Other Large IC Loads (Medium Uptake)	Large	0	0
Total Finisklin Business Park		**7,636**	**265**

Figure 2: Finisklin Business Park Gas Demand

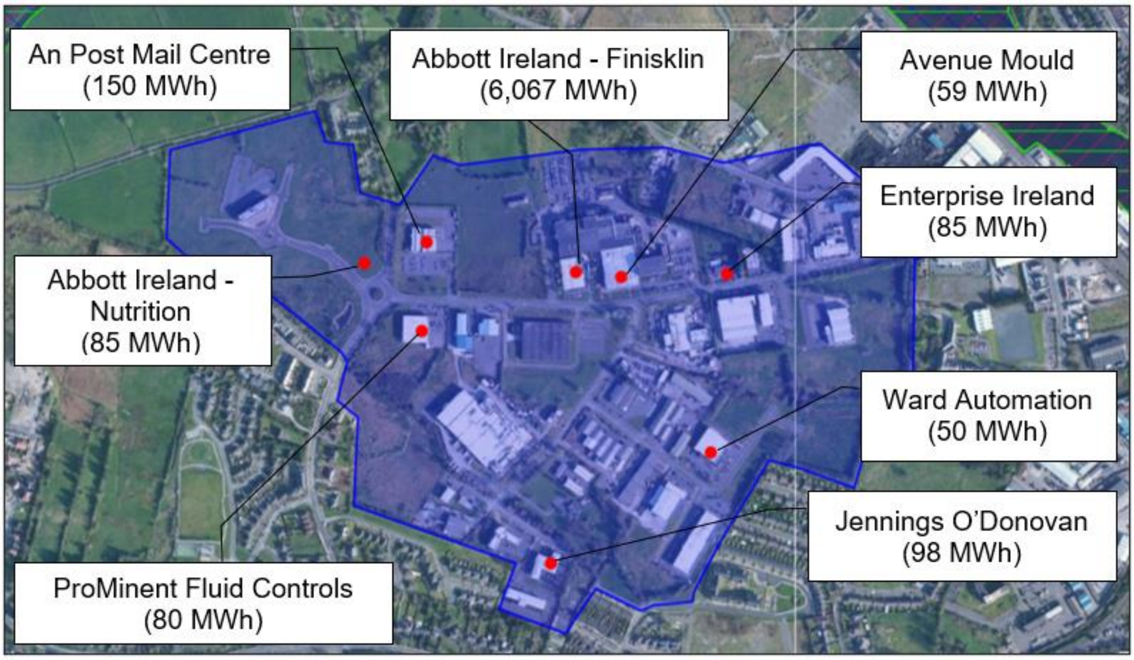


Figure 3: Finisklin Business Park Energy Hub

3.2.3 IDA Oakfield Business Park

Oakfield Business Park is a new business park which is currently under development, the site is a 31-hectare site which is located 3 km South West of Sligo town centre adjacent to the N4. The plans include for 12 light industrial buildings with offices to the front and 1 large industrial building.

The Oakfield site is located 3 km from Finisklin and would make up the South-West area of the gas network. It could be reached via the N4 or via local roads from Finisklin Business Park. Given the potential energy users likely to locate here, it is likely to be beneficial to extend the gas network to Oakfield. It also enables future network expansion further outward along the N4.

A new link road name the Western Distributor Road is currently under development and will serve the Caltragh area linking the new IDA business Park to the transport network. According to Sligo Development Plan, the strategic road is a priority for Sligo County Council and construction has begun. On the Sligo Zoning Map the surrounding fields have been zoned as ‘business, industry and technology parks’ (BITP). The objective of this zone is to promote the development of office-based businesses, technology companies and industrial units in dedicated business industrial parks. This is further incentive to extend the Sligo Gas Network to Oakfield.

A previous thermal energy load assessment study carried out by Arup[2] indicates that IDA Oakfield will have an annual gas demand of 8,011 MWh. The site will include 12no. buildings classified as Advanced Technology Buildings and 1no. Large Industrial Process building.

Customer	Category	EAC (MWh)	Peak Hour (SCMH)
12no Advanced Technology Buildings	Small	798	35
Large Industrial Building	Contract	7,212	193
Total Oakfield Business Park		**8,010**	**228**

Table 8: Oakfield Business Park Gas Demand

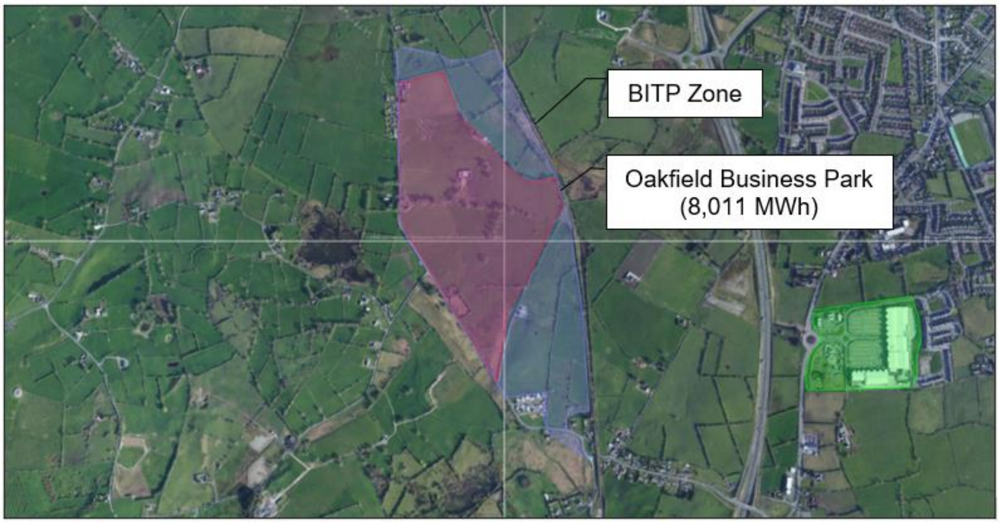


Figure 4: Oakfield Business Park Energy Hub

[2] Arup (2020): “IDA Ireland Oakfield Business Park Thermal Energy Load Assessment”.

3.2.4 Carraroe Retail Park

Carraroe Retail Park is situated approximately 4km south of Sligo town centre. It is adjacent to the R287 and the N4 and there are various ways it could be linked to the Sligo Gas Network – via the N4, from Oakfield IDA Park or from the town centre.

Energy usage for Carraroe Retail Park is unknown and has therefore been estimated. The retail park includes Homebase, McDonalds. KFC, Curry's PC World and Halfords amongst others. EACs were estimated from CIBSE TM46 Energy Benchmarks, based on business activity and floor area.

Extending the network to this point along the N4 may encourage future expansion and development along this corridor.

Customer	Category	EAC (MWh)	Peak Hour (SCMH)
Castle Devitt	Medium	416	18
Costa	Small	171	15
Curry's PC World	Medium	416	18
EZ Living furniture	Medium	416	18
Halford's	Medium	416	18
Harry Corry	Medium	416	18
Homebase	Medium	416	18
Home Store & More	Medium	416	18
KFC	Small	120	11
McDonalds	Small	140	12
Pet Stop	Medium	416	18
Right Price Tiles	Medium	416	18
SMYTH'S	Medium	416	18
Total Carraroe Retail Park		**4,595**	**222**

Table 9: Carraroe Retail Park Gas Demand

Figure 5: Carraroe Retail Park Energy Hub

3.2.5 Sligo Town Centre

The majority of Sligo Town industrial and commercial premises are located south of the Garavogue river. Geographically, they are situated in an advantageous position centrally in the network. To the east is Finisklin Business Park, to the west is the Cranmore Region, south is Carraroe Retail Park and north of the river is North Sligo. Due to the central nature of Sligo Town, it is inevitable that a portion of I/C users will be available to the network.

As these are town centre premises the majority are small retail and office spaces. Premises of this nature will have little incentive to convert to gas due to low space heating requirements, low return on investment and business disruption during installation. There are however a number of larger retail and office premises and hotels which may justify expanding the network to this area.

Customer	Category	EAC (MWh)	Peak Hour (SCMH)
SCC Riverside Offices	Medium	761	34
Sligo Fire Station	Small	122	11
Sligo City Hall	Small	196	18
Nazareth House (South of River)	Medium	374	17
Various Council Offices	Medium	252	11
Other Small IC Loads	Small	11,146	298
Other Medium IC Loads	Medium	6,068	162
Other Large IC Loads	Large	2,129	80
Total Sligo Town		**21,049**	**630**

Table 10: Sligo Town Centre Gas Demand

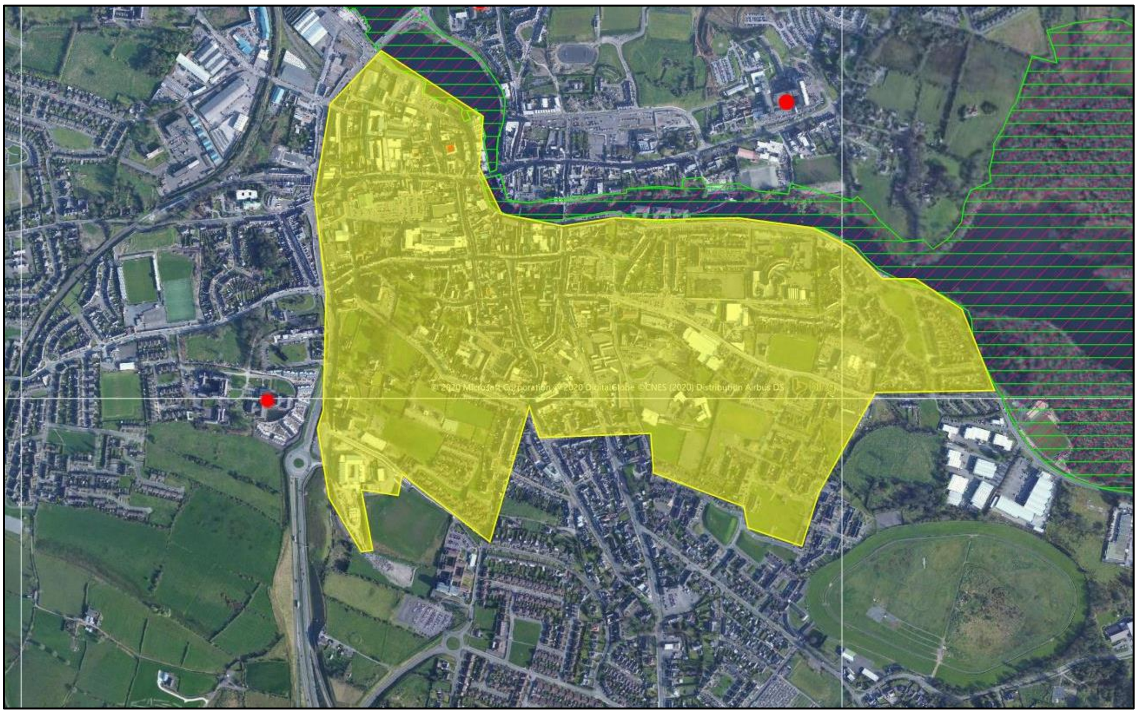


Figure 6: Sligo Town Centre Energy Hub

3.2.6 Cranmore Region

The Cranmore Region is the Eastern-most hub of the Sligo gas network area. It contains Cleveragh Retail Park and Sligo Regional Sports Centre and is located approx. 1.3km from the N4 via Sligo Town. It is situated on the southern bank of the Garavogue river and is linked with Sligo town via Cranmore Rd and Cleveragh Drive. The planned Eastern bridge will link the Cranmore region with North Sligo.

From a geographical standpoint, extending the network to the Cranmore region would serve only to provide gas to the existing premises within the area. Potential for future development in this area is low.

The Sligo Regional Sports Centre is a Large I/C energy user and would requires constant gas supply year-round. It accounts for almost 25% of energy usage in this energy hub. A number of retailers, offices and factories in Cleveragh Retail Park make up the remaining 75%.

Customer	Customer Type	EAC (MWh)	Peak Hour (SCMH)
Retail unit	Medium	1,141	50
Park Alley Café	Small	155	14
Lough Gill Brewery	Small	179	16
Uniphar	Small	95	8
Zero Gravity Skate Park	Medium	321	14
Compupac IT	Small	40	4
Pearse Road Tyre Service	Small	59	5
Abbey Frozen Foods LTD	Small	87	8
Retail Unit	Medium	296	13
Retail Unit	Medium	250	11
Apex Controls	Small	150	13
Verus Metrology	Medium	1,024	45
Sligo Regional Sports Centre	Large	1,209	45
Other Small I/C Loads	Small	52	5
Other Medium I/C Loads	Medium	214	9
Other Large I/C Loads	Large	0	0
Total Cranmore Region		**5,273**	**262**

Table 11: Cranmore Region Gas Demand

Figure 7: Cranmore Energy Hub

3.3 Network Demand Analysis

The key findings of the network demand analysis are as follows:

The 4 Contract I/C loads included in the demand forecast account for a large proportion of the total network demand. For the medium uptake scenario, they account for 60% of the forecast network demand

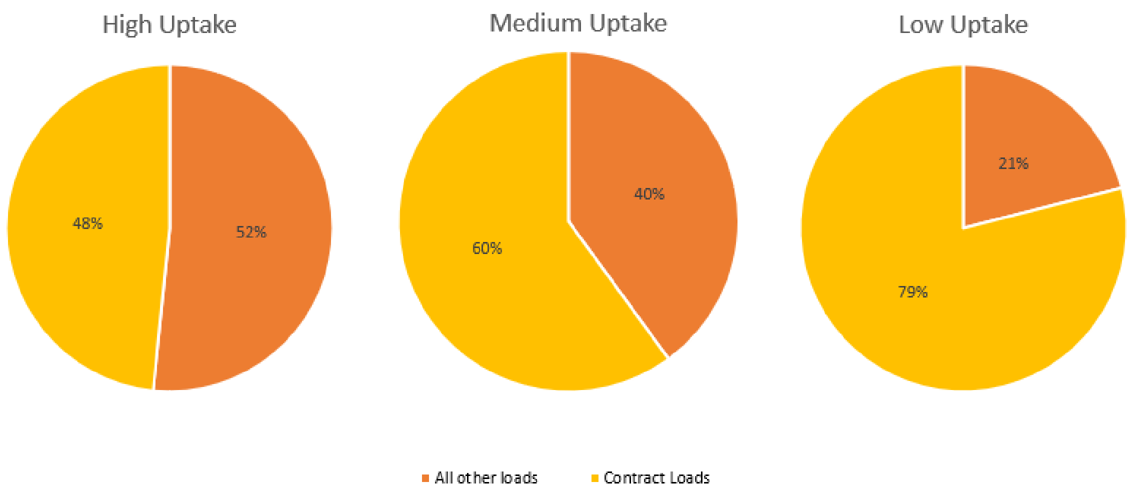


Figure 8: Proportional split of Contract user's vs all other users

The largest energy hub is North Sligo which accounts for 52% of forecast demand for the medium uptake scenario. Sligo Town Centre is the next largest with 17% followed by the Finisklin with 11%.

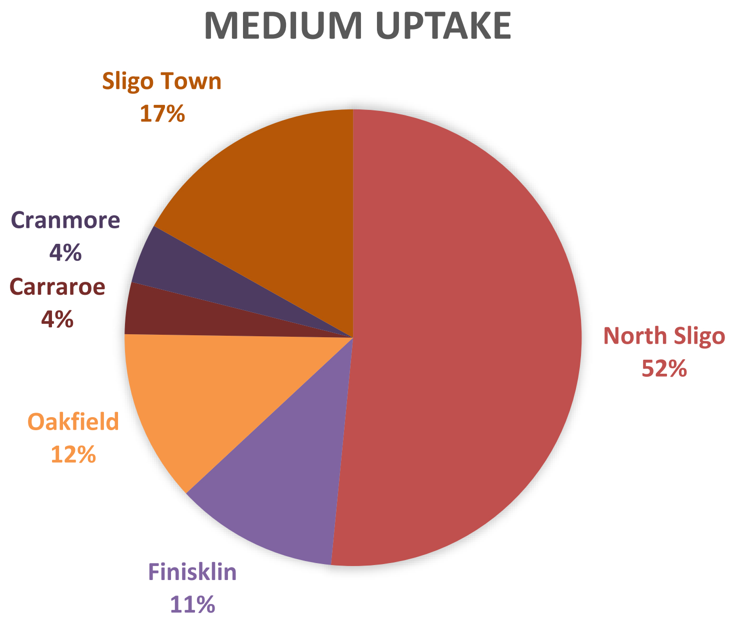


Figure 9: Proportional split of energy hubs in the medium scenario

The full breakdown of demand across the identified energy hubs for the high, medium and low uptake scenarios are as follows:

	High		Medium		Low	
	EAC (MWh)	% of Total	EAC (MWh)	% of Total	EAC (MWh)	% of Total
North Sligo	36,989	48%	32,191	52%	27,393	58%
Finisklin	7,859	10%	7,187	12%	6,516	14%
IDA Oakfield	7,850	10%	7,611	12%	7,372	16%
Carraroe	3,676	5%	2,297	4%	919	2%
Cranmore	4,218	5%	2,637	4%	1,055	2%
Sligo Town	16,839	22%	10,524	17%	4,210	9%
	77,431		**62,448**		**47,464**	

Table 12: Network Gas Demand

4.0 PIPELINE ROUTE DESIGN

To design the gas network route, the required fixed points must first be identified. The network is then developed by creating linkages between these fixed points. The fixed points for the Sligo Gas Network are the critical energy users, user hubs and the river crossing location. The network route must adhere to a set of parameters and restrictions which aim to minimise cost and safety concerns while facilitating supply to as many potential users as possible.

In the analysis that follows the fixed points and route parameters are identified and the different route options are analysed and compared.

4.1 Energy User Hubs

The Network Load Analysis divides Sligo into six energy user hubs; North Sligo, Finisklin Business Park, Sligo Town, the Cranmore Region, Carraroe Retail Park and IDA Oakfield. The network aims to connect the largest users together using the shortest feasible routes.

The first step in the route options assessment is to prioritise which hubs to connect and to identify fixed points on the network.

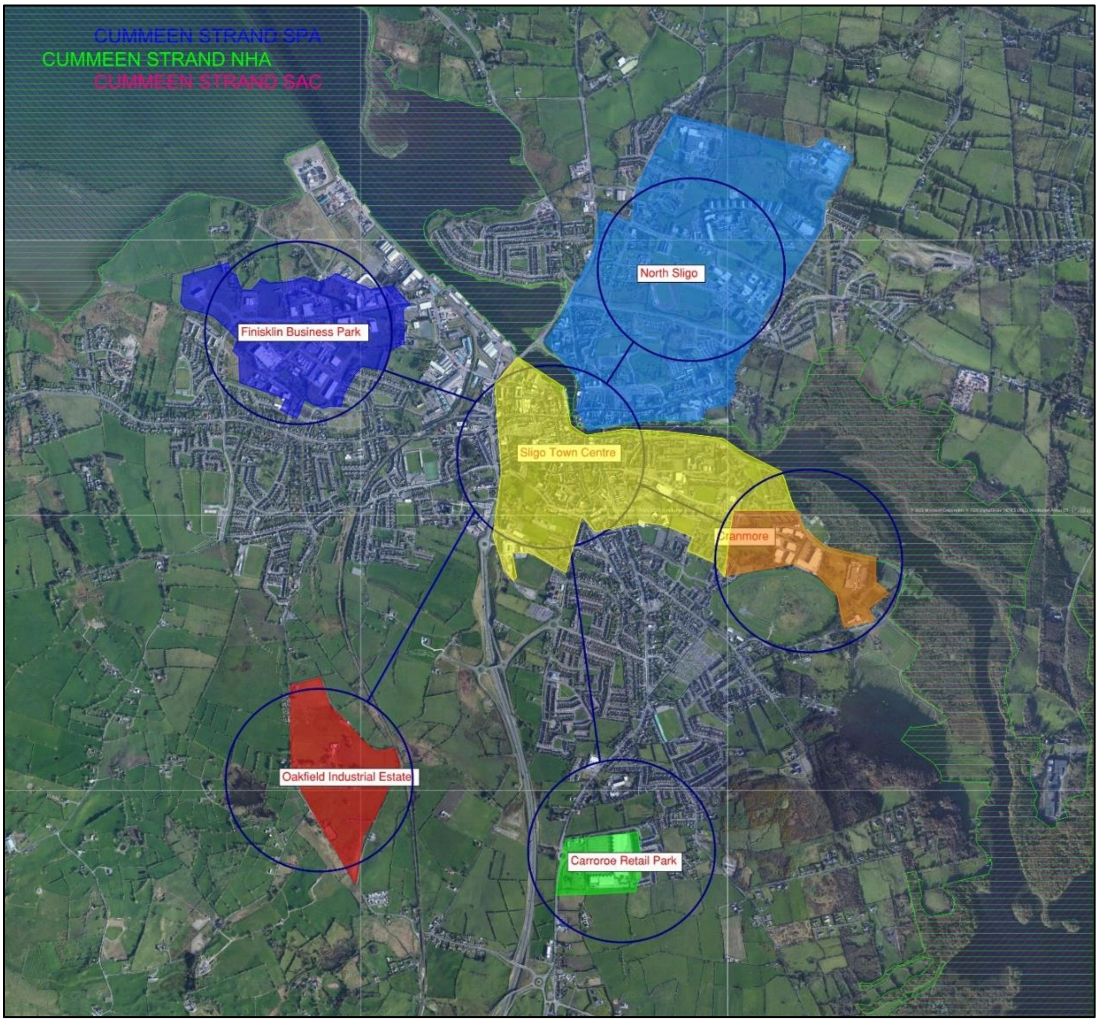


Figure 10: Linking User Hubs

The approach that has been taken is to prioritise the connection of the largest customers identified, namely the 4no. Contract I/C loads located in North Sligo, Finisklin and planned for Oakfield Business Park. These customers are key to the viability of the network. This linkage will form the spine of the network and will facilitate additional hub connections.

The primary priority hubs have been selected as North Sligo and Finisklin Business Park. The linkage of these hubs will serve to ensure a supply is provided North and South of the river and that the largest of the existing contract loads are supplied.

Secondary to this is the network route to feed the Oakfield Business Park. Although the business park is not yet constructed the industrial nature of the proposed development is likely to attract tenants who have significant energy requirements and would benefit from a gas supply. The demand forecast for the park is significant and contains a contract I/C Load. The availability of gas will give the business park and the surrounding area a competitive advantage when trying to attract tenants.

The connection of Sligo town centre is the next priority hub on the network, the forecast load for Sligo town is the 2nd largest in the medium uptake scenario.

Cranmore and Carraroe are treated as tertiary concerns due to the relatively low forecast gas demand in these hubs. It is likely that commitment would be required from a significant number of the I/C customers in these areas to make these connections viable.

The connection of the network hubs is to be prioritised as follows:

Priority	Fixed Point
1	North Sligo
2	River Crossing & Finisklin Business Park
3	Oakfield Business Park
4	Sligo Town Centre
5	Carraroe Retail Park and Cranmore Region

Table 13: Route Priorities

There are additional fixed points within the network due to Sligo town's landscape.

The River Garavogue runs through Sligo town and in order to connect North and South Sligo the pipeline must cross the river. The methods by which the river can be crossed are either within the carriage of an existing bridge or using a trenchless crossing technology to route the main under the river. The river crossing options are discussed in greater detail in Section 4.3.

Gas will enter the network at a decanting facility, this will be another fixed point in the network. The decanting facility location assessment in Section 5.0 analysis the potential site location options.

4.2 Pipeline Parameters and Route Restrictions

The pipeline network route is limited by cost and safety restrictions. The route design must first adhere to all relevant standards and regulations balancing costs and capacity requirements. Where possible, the route planning process prioritises route length, ease of construction as well as minimising the number of wayleaves required.

Network route options were built around these parameters. Key considerations when assessing routes were:

- Route Length
- Future expansion of network
- Proximity to possible future I/C users
- Gas injection location
- Special Engineering Difficulties (SED) (e.g. rivers, trenches, road-crossings)
- Constructability
- Traffic management requirements
- Wayleaves
- National Road Crossings (N4, N15, N16)
- Rail crossings
- Architectural areas
- Environmental concerns
- Network re-enforcement

4.3 River Crossing Options & Analysis

The River Garavogue runs through the centre of Sligo town which must be crossed in order to connect the north and south of the gas network.

River crossings can be relatively expensive operations depending on the method used. In general, crossing using existing infrastructure is preferred to trenchless crossing techniques. This minimises the requirement for specialist contractors and reduces project and health and safety risks. For this reason, the focus of this assessment has been on the viability of using existing bridges which cross the river.

The river currently has 5 bridge crossings in the town; two footbridges and three road bridges. There is also a planned bridge connecting Doorly Road to the R286/N16 junction which is under development.

Bridge Name	Road	Length (m)
Hughes Bridge	N4	140
Hyde Bridge	R292	60
Markievicz Bridge	Bridge St.	45
John Fallon Bridge	Footbridge	130
Unnamed Foot Bridge	Footbridge	35
Eastern Garavogue Bridge	Proposed	90

Table 14: Sligo Town Bridges

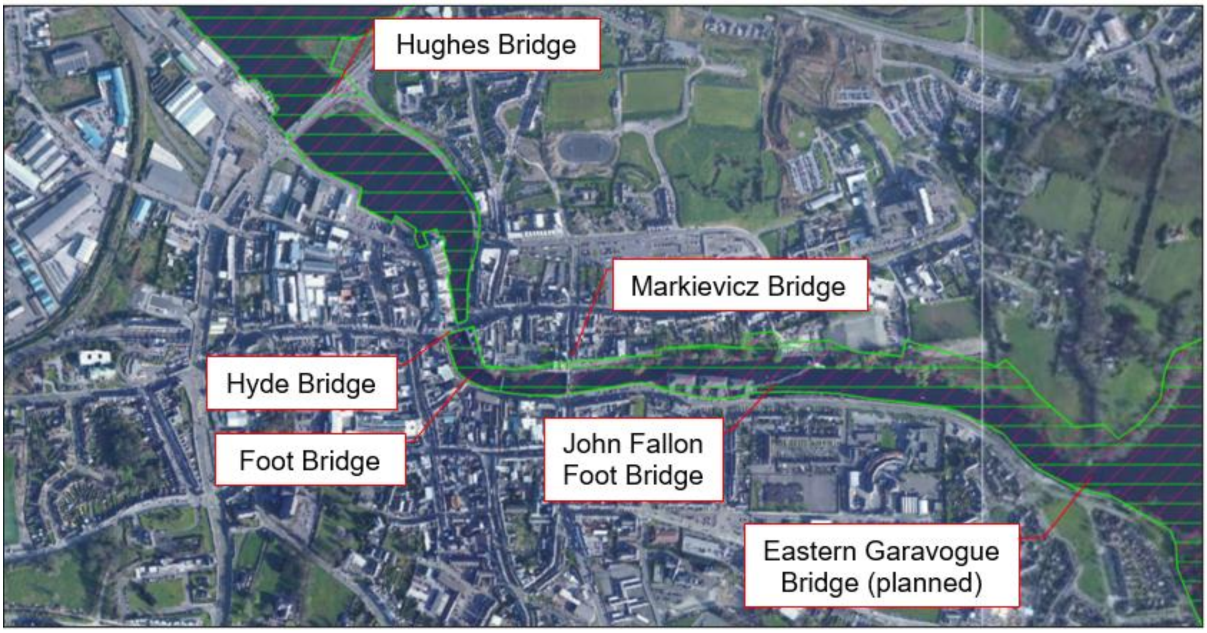


Figure 11: Sligo Town Bridge Locations

The 2no. footbridges are not considered viable options and will be excluded from further analysis.

There are three main methods for crossing via an existing bridge, which are as follows:

1. Existing bridges may incorporate existing service ducts, if this is the case it may be possible to insert the pipeline within them. This is the preferred option as it reduces the risk of damaging the existing infrastructure and is minimally obtrusive.

2. Construct the pipeline within the carriage of the bridge by excavating a new trench. This is highly dependent on the construction of the bridge and the available depth of cover within the carriage. Construction of open cut crossings is obtrusive and will cause traffic disruption.
3. Bracket the pipeline to the side or underside of the structure. This is highly dependent on the construction of the bridge and has inherent security of supply and health and safety risks associated with its construction.

This purpose of the following analysis is to determine if the structure of the existing bridges is suited to accommodating a gas pipeline and eliminates bridges which do not present a feasible option.

After identifying the potential bridging points, key factors to consider include:

- Length of crossing
- Presence of existing ducts/sleeves for insertion
- Road category
- Bridge age
- Traffic conditions
- Accessibility

4.3.1 Hughes Bridge (N4)

Hughes Bridge is the most Westerly bridging point and facilitates the crossing of the N4 national primary road. The bridge was constructed in 1988 and has undergone recent upgrades which served to widen the structure. The bridge accommodates 2 lanes of traffic in either direction and is the heaviest trafficked bridge crossing the Garavogue. It serves as a vital thoroughfare linking the North West counties to the western region.

Examination of the design drawings for the recent bridge modifications indicate the inclusion of utility ducting along the bridge supports on the underside of the new footway on both sides of the structure. The schedule of utilities provided indicates that 3no. 100 OD ducts have been included in either side which have not been reserved for other utilities. From this desktop review it appears that insertion of the gas main would be possible making this a viable option.

Figure 12: Hughes Bridge

4.3.2 Hyde Bridge (R292)

Hyde Bridge was built ~1850, it serves to connect the R292 to the R286 and is the main town centre road bridge. This area has the largest density of retail units and links the largest energy users in north Sligo to the town centre and Cranmore hubs. The bridge accommodates a single lane of traffic with the traffic flowing north.

No detail of the bridge structure has been sourced for this analysis. There may be sufficient cover within the carriage of the bridge to accommodate a gas main. There is visual evidence of water infrastructure in the footpath. The analysis assumes there is sufficient depth of cover, if this is not the case crossing at this point is not possible.

Figure 13: Hyde Bridge

4.3.3 Markievicz Bridge (Bridge St.)

Markievicz Bridge is the oldest bridge crossing the Garavogue having been built in the 1600s. The bridge accommodates two lanes of traffic with flow in the southern direction and a footpath. The bridge is situated to the east of the town centre. The crossing is the furthest existing road bridge from the 2nd largest energy hub in Finisklin.

No detail of the bridge structure has been sourced for this analysis. There may be sufficient cover within the carriage of the bridge to accommodate a gas main. There is visual evidence of water infrastructure in the footpath. The analysis assumes there is sufficient depth cover, if this is not the case crossing at this point is not possible.

Figure 14: Markievicz Bridge

4.3.4 Eastern Bridge

The planned Eastern bridge will connect the east of the town across the river. It will cross from the Doorly road (South) to an access road which will meet the R286/N16 junction (North). This bridge would provide a link between North Sligo energy hub and the Cranmore Region energy hub. It could provide a reasonable method of connecting Cranmore to the network.

As this is a new build, and planning is still in process, capacity for a gas pipeline could possibly be included in the design. This is the most easterly crossing point and is thus furthest from the Finisklin hub.

Figure 15: Drawing of planned Eastern Bridge

4.3.5 Conclusion and Recommendation

The table below compares the key strengths and weaknesses of each crossing option:

Hughes Bridge	
Strength	• Nearest crossing point to the priority user hubs • Presence of existing service ducting which could potentially be utilised • Wide bridge with two lanes of traffic in either direction, traffic flow can be maintained • The bridge is the crossing point for the main corridor between North and South Sligo • Detail of bridge structure available
Weakness	• The bridge is a national road, any impact on traffic flows has large consequence.
Hyde Bridge	
Strength	• Short crossing • Connect town centre to the network
Weakness	• Protected heritage • Age • Unknown depth of carriage • Difficult to maintain traffic flows

Markievicz Bridge	
Strength	• Short crossing • Provides connection to potential customers to the east of the town centre
Weakness	• Protected heritage • Age • Unknown depth of carriage • Difficult to maintain traffic flows • Distance from Finisklin Hub
Eastern Bridge	
Strength	• Proximity to contract loads in North Sligo • Connect Cranmore and east Sligo town • Not yet constructed, presumably service ducts can be accommodated
Weakness	• Furthest crossing point from Finisklin, Oakfield and Carraroe hubs

The analysis shows that Hughes Bridge is the preferred option for crossing the Garvogue. This crossing point provides the shortest route between the 2 largest energy hubs and the 4no. Contract I/C loads, therefore facilitating the highest priority connections. The structure has spare ducts which can have gas pipework inserted which aids greatly in ease and cost of construction and minimises the disruptive impact.

The proposed Eastern Bridge also has some potential, though is not favoured as the primary crossing point. In order to provide for future expansion, it would be prudent to include ducts that can accommodate gas pipework when the bridge is being constructed. This could provide linkage between North Sligo and Cranmore without going through the centre of the town and could aid future growth in the area.

Hyde bridge and Markievicz Bridge are the least likely candidates given their age and protected status and their geographical location in relation to the network's main users.

4.4 Route Options & Analysis

With the fixed points identified and prioritised the network route options can now be analysed. In this section the potential routes are identified and compared. For sections where there are a number of route options to consider the key comparators are as follows:

- Route Length
- Route Conditions and Constructability
- Connection of Potential Customers

4.4.1 North Sligo

As stated in Section 4.1, the network priority is to connect the 4 Contract I/C loads, therefore for the North Sligo area the priority is to connect Abbvie Manorhamilton and Sligo University hospital with the river crossing point at Hughes Bridge. There are a number of additional large energy users in the area for which connections are to be facilitated. Figure 16 below illustrates the geographical location of the main users which have been identified.

Figure 16: North Sligo Users

To connect Abbvie Manorhamilton in the North East to Sligo University Hospital in the south the obvious route is to lay the main south along the N16 and continue on to the R286 as shown below.

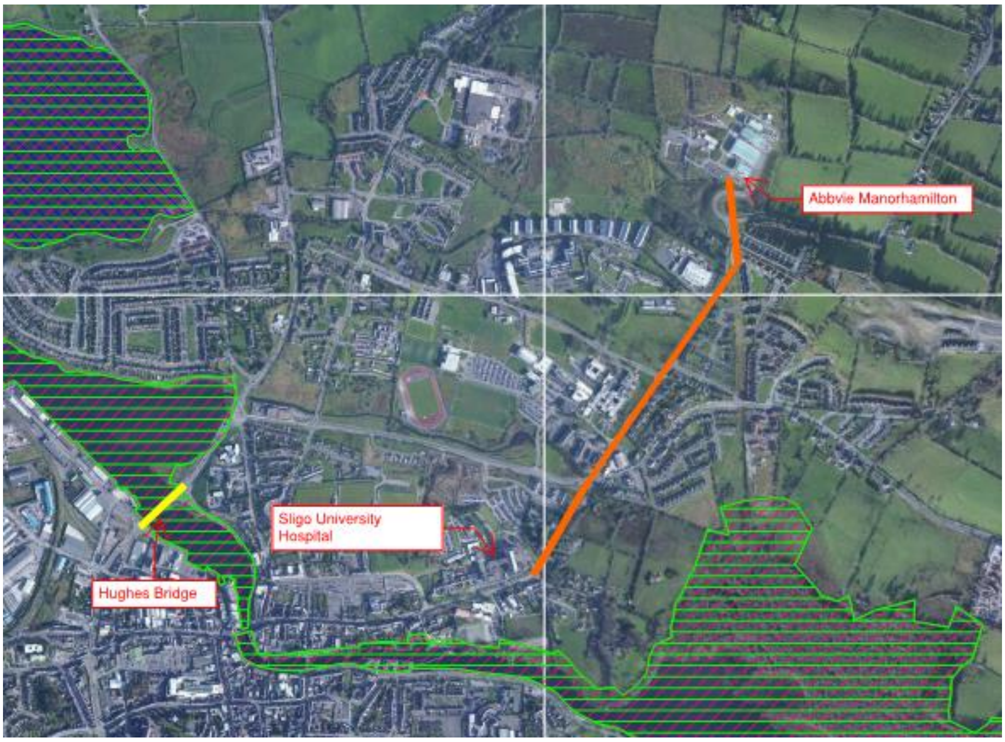


Figure 17: Linking Abbvie Manorhamilton and Sligo University Hospital

This is the shortest and most direct route between the 2no. Contract I/C loads in the area. The route passes the entrance to the centre of Sligo IT Campus and will also facilitate their connection. No other routes have been considered for this connection.

The next step in developing the route is to consider the connection between this fixed run of main to the crossing point at Hughes bridge. There are 3 options to be considered as illustrated in Figure 18**Error! Reference source not found.** below.

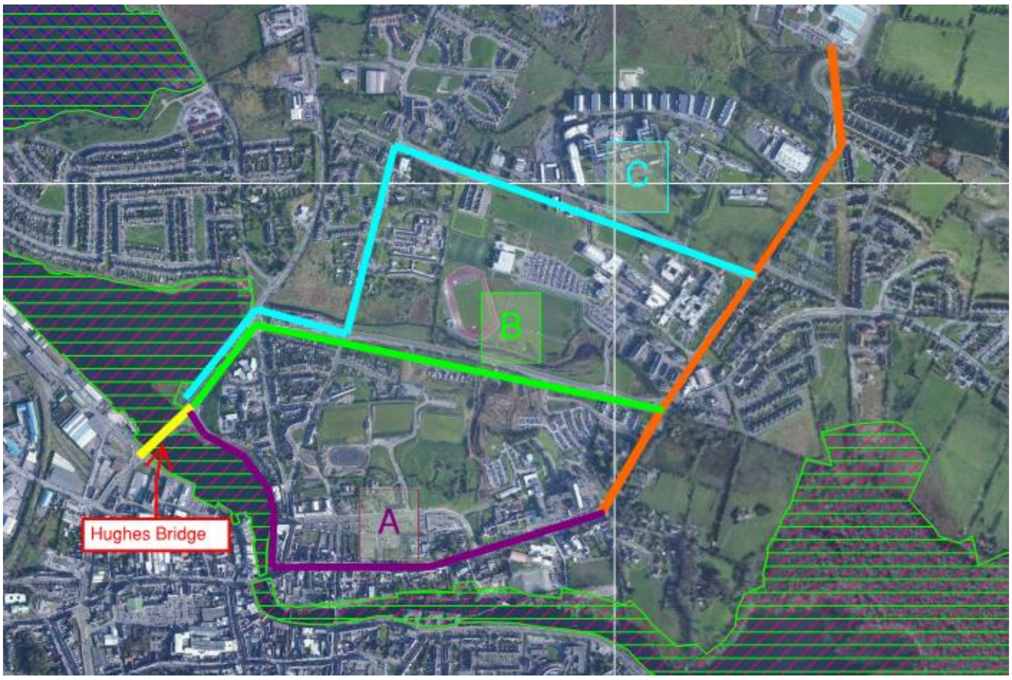


Figure 18: Connection to Hughes bridge

Option A	
Route Description	Option A extends from Sligo University Hospital towards the town centre along the R286, the route turns before Hyde Bridge and continues along the waterfront to connect to Hughes bridge.
Relative Length	The route is a similar length to route option B, both being shorter than route option C.
Conditions/Constructability	The route follows a relatively narrow roadway which is heavily trafficked and passes a number of small business, the potential for traffic and business disruption during construction is high.
Potential Customers	The route does not facilitate the connection of any of the large users identified in the North Sligo area. It does however facilitate the connection of a number of small businesses along the R286.
Option B	
Route Description	Route Option B extends West along the N16 and then South on the N4 to connect to Hughes Bridge.
Relative Length	The route is a similar length to route option B, both being shorter than route option C.
Conditions/Constructability	The N16 is wide along this route and includes a verge and cycle lane, there is ample space to facilitate construction without major interruption to traffic flows. In addition to this there are relatively few openings onto the road, further reducing the impact of the route construction.
Potential Customers	The route facilitates the connection of Markievicz House, all other large users identified are to the North of this route. Additional network branches would be required to facilitate their connection.
Option C	
Route Description	Route Option C extends West along the Clarion Road to the Ballytivnan Road and follows the Ballytivnan road south to the N16 from where it follows the same path as option B to the Hughes Bridge crossing.
Relative Length	This is the longest of the route options.

Conditions/Constructability	Both the Clarion Rd and Ballytivnan Rd are two lane carriageways, both have sections of wide verge and sections where the additional space is narrow. Stop/Go systems would likely be required. Shortly before the junction of the Ballytivnan Rd and the N16 the road crosses a stream. If there is insufficient cover in the deck of the bridge it is likely that an open cut crossing of the stream could be facilitated here.
Potential Customers	Of the 3 options this route facilitates the connection of the most potential customers while achieving its primary goal. The entrance to St. Columba's Hospital, Clayton Hotel and St. John's hospital are all along this route. The route can also connect Abbvie Ballytivnan via the extension of a 500m branch north along the Ballytivnan Rd.
Conclusion	
Route Option C is the preferred option as it serves to connect the priority users to the river crossing while also facilitating the connection of all the large users in north Sligo. Connection of groups of smaller I/C customers like those situated to the north of the town centre on the R286 could be facilitated in the future via smaller branches from the main route.	

Figure 19: North Sligo Preferred Route

4.4.2 Finisklin Business Park

All of the key premises in this area are located along the Finisklin road therefore this is the clear option for facilitating their connection, as illustrated below.

Figure 20: Finisklin Business Park

The Finisklin Rd accommodates two lanes of traffic, one in either direction. Traffic management involving stop/go systems will likely be required to facilitate the works. No other engineering difficulties have been identified. The route will likely include a small branch as shown to facilitate the connection of a number of smaller business premises.

There are then 2 options to consider for connection of Finisklin to the Hughes Bridge crossing.

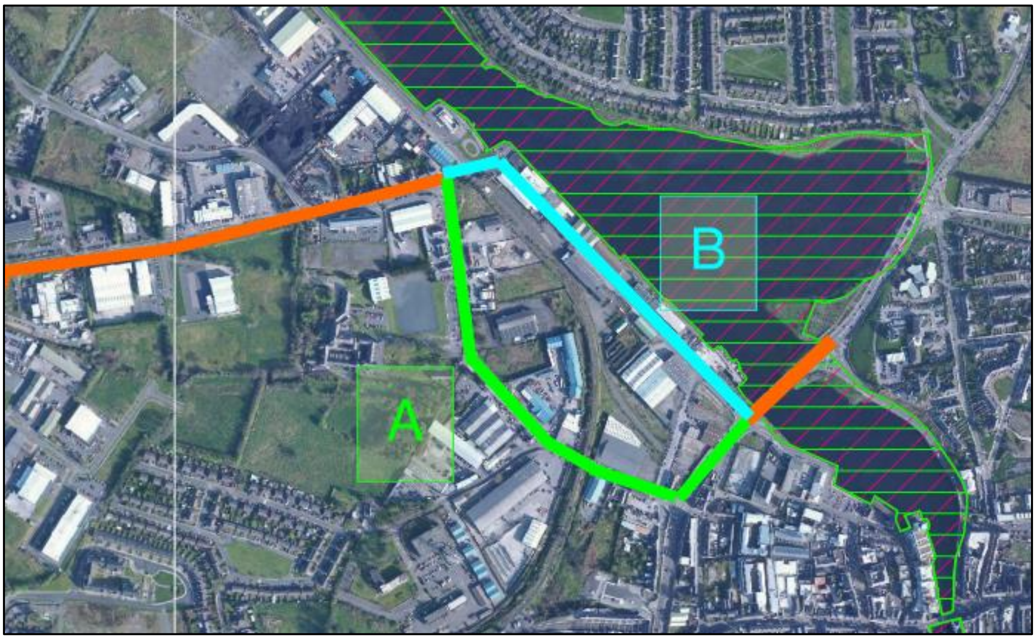


Figure 21: Finisklin to Hughes Bridge

Option A	
Route Description	Route Option A continues along the Finisklin Rd to meet the N4 where it turns right to meet Hughes Bridge.
Relative Length	Route A is the longest route however the difference is not significant.
Conditions/Constructability	Finisklin road contains two lanes of traffic with one in either direction. There is a relatively wide footpath for the majority of the route. A stop/go system would be required to accommodate the works. The route passes beneath a railway bridge.
Potential Customers	There are a number of potential customers along this route including retail warehouses and office buildings, most notable is the Ursuline College.
Option B	
Route Description	Route Option B connects Finisklin Rd to Hughes Bridge via Ballast Quay.
Relative Length	Route B is the shortest route
Conditions/Constructability	Ballast Quay contains two lanes of traffic with one in either direction. There is footpath along both sides of the road. A stop/go system would be required to accommodate the works. There are no engineering difficulties identified.
Potential Customers	There are no significant connection opportunities along Ballast Quay.
Conclusion	
Both route options are similar with regard to length and constructability. Option A has been chosen as the preferred route due to the additional customers connection opportunities.	

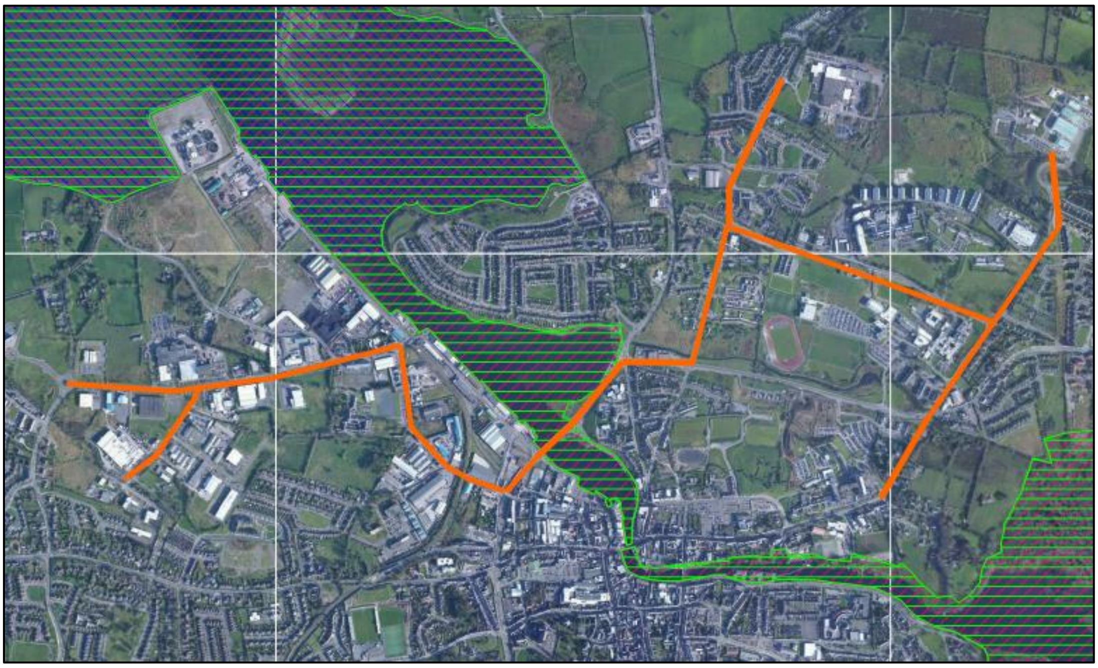


Figure 22: Preferred Route - North Sligo and Finisklin

4.4.3 Oakfield IDA Business Park

The next priority connection to determine a route to is Oakfield Business Park. As mentioned previously, this business park is currently under development, facilitating a gas connection will provide a competitive advantage in attracting tenants to the park. The business park will be connected by road to the N4 and R292 via the Western Distributor Rd which is currently being construction.

Figure 23: Oakfield Route Options

Option A	
Route Description	Route Option A connects the western end of the pipeline in Finisklin Rd to Oakfield Business Park via First Sea Rd and the new Western Distributor Rd.
Relative Length	Option A is the shortest route being approximately 800m shorter than Option B.
Conditions/Constructability	First Sea Rd contains two lanes of traffic with one in either direction. There is footpath along both sides of the road. A stop/go system would be required to accommodate the works. There are no engineering difficulties identified. The road has residential areas on either side and serves as the western entrance to Finisklin Business Park. The Western Distributor Rd is currently being constructed.
Potential Customers	There are no additional significant customers along this route, the route initially travels through a residential area which is not considered to provide potential for future connections. The area either side of the Western Distributor Rd is zoned for industrial and economic development, routing through this area will improve the attractiveness of the area for industrial development.
Option B	
Route Description	Route Option B is routed from the Hughes Bridge crossing southward along the N4 to meet the new Western Distributor Rd.
Relative Length	Option B is the longest route being approximately 800m longer than Option A.
Conditions/Constructability	The N4 is the main route to Sligo town centre and onward to the North West. The road is a dual carriageway which provides ample space for construction of the pipeline with minimal interruption to traffic flows. Once the route passes Summerhill Roundabout there is a wide verge within which the pipe could be laid. The Western Distributor Rd is currently being constructed however the proposed route will cross the railway line. As the Western Distributor is currently under construction it is unlikely that plans for the gas network will be developed in time to include a duct in the road bridge over the railway to accommodate a future gas connection. It is likely that a trenchless crossing would be required in order to traverse the railway.

Potential Customers	Between Hughes Bridge and Summerhill Roundabout there are a small number of potential small I/C customers. There are 3no medium sized I/C premises which would have connections facilitated by taking this route, these are Kingsbridge private Hospital, Summerhill College and Nazareth House Nursing home. The area either side of the Western Distributor Rd is zoned for industrial and economic development, routing through this area will improve the attractiveness of the area for industrial development. This route has the added benefit of providing a means of future expansion further along the N4 corridor further increasing the development potential of this area.
Conclusion	
Option B has been chosen as the preferred route due to the additional customers connection opportunities and provision for future expansion of the network	

Figure 24: Preferred Route

4.4.4 Sligo Town Centre and Cranmore Region

The preferred route to feed Sligo Town and Cranmore region have been jointly assessed due to their location. Three possible route options have been identified. The viability of extending the network to Cranmore will be dependent on an economic test and customer commitments.

Option A&B consider routes from Hughes Bridge to Cranmore, these routes pass through the town centre and facilitate connection of customers within that hub. Option C considers connection of the Cranmore region to the North Sligo hub via the Eastern Bridge, the Sligo town customers could then be facilitated by route options A or B.

It should be noted that the options outlined are the network trunk corridors, the routes may not pass the entrances to potential customers but all potential customers are within reasonable reach of these central routes.

Figure 25: Sligo Town and Cranmore Route Options

Option A	
Route Description	Option A connects the Cranmore region to the Hughes Bridge crossing. The route extends, from the N4, along John St, Grattan St, Castle St and Abbey St where it turns south along Charlotte St. The route then extends onto Cranmore Rd and eastwards to the potential customers within that area.
Relative Length	All 3 route options are of comparable length

Conditions/Constructability	The route passes through the town and is lined throughout by residential and small retail premises. The streets are narrow and reduce to a single lane and one-way flow in a number of places. Construction along this route would provide traffic management and noise impact challenges.
Potential Customers	As mentioned in the introduction the route facilitates the connection of the majority of the I/C customers in both regions with reasonably short branches from this trunk. The route to potential customers in the Wine St area is challenging and would require a branch to be laid along O'Connell St. It is likely that if this was the chosen route and there was sufficient number of customers in the Wine St area a branch would be extended from the trunk main on the N4 along Lord Edward St. The route does directly pass a number of potential customers of note including St. John's Cathedral, St. Anne's Church, ALDI, Dunnes Stores, Lidl as well as local government and ESB networks offices.
Option B	
Route Description	Route Option B extends from the N4 along Lord Edward St, Wine St and O'Connell St, turning east onto Grattan St followed by Castle St and on to Abbey St. The route turns back toward the river onto Abbey St Lwr. and then east along the riverside as far as the Cranmore region
Relative Length	All 3 route options are of comparable length.
Conditions/Constructability	The route passes through the town and is lined throughout by residential and small retail premises. From the N4 to O'Connell St is a two laned passage with a narrow footpath on either side, stop/go systems would be required. O'Connell St itself is a relatively wide street however the area is undergoing extensive upgrade works at the moment including granite paving, reinstatement in this area is likely to be costly. From O'Connell Street to Abbey St. Lwr is the same route as Option A with single lane traffic and narrow streets in places. From there the route travels along the riverside out to Cranmore, this is a two-lane road with footpath and a cycle path along the riverfront. Traffic flows could be maintained with a stop/go system
Potential Customers	This route accommodates the connection of the majority of the potential I/C customers in the town centre the route also passes directly by the Riverside Hotel and Sligo County Council buildings.

Option C	
Route Description	Route Option C connects to the trunk of the network via the new Eastern Bridge and associated link road. After crossing the river, the main is extended south along Doorly Park to Cranmore where it can then tee to feed Cranmore and westward towards the town centre along Route Options A or B. This route has an added benefit of providing an option in future to create a ring main connecting 4 hubs. Constructing a loop in the network would provide greater network security and redundancy. Although this has not been a key consideration when laying out the network it should be considered where the possibility arises.
Relative Length	This route is of comparable length to A&B when extension westwards into the town is taken into account.
Conditions/Constructability	The constructability of this route is dependent on the accommodation of the gas main within the structure of the new bridge. It is assumed that the structure can be designed to include a duct to receive the gas pipe when required.
Potential Customers	There are a number of potential customers between the Carraroe roundabout and the retail park, these include Carraroe National School, Clifford Electrical and Applegreen.
Conclusion	
The route connecting the Cranmore and Town Centre hubs will be largely dependent on customer connection commitments. It is likely that the actual route will be a mixture of the 3 route options outlined above. If a duct can be accommodated within the structure of the new bridge then this should be done. This is the preferred route to supply the Cranmore area and the customers in the east of the town. If there is sufficient interest amongst business's in the Wine St area then a branch could be extended from the N4 to facilitate their supply. The preferred route is a hybrid which aims to minimise disruption to traffic and business in the town centre and avoid the newly refurbished O'Connell St.	

Figure 26: Sligo Town and Cranmore Region Route Options

4.4.5 Carraroe Retail Park

As stated previously Carraroe Retail Park contains a number of warehouse type retail premises as well as fast food restaurants. The viability of extending the network to accommodate these would require an economic viability test and would be largely dependent on the number of premises committing to a gas connection request.

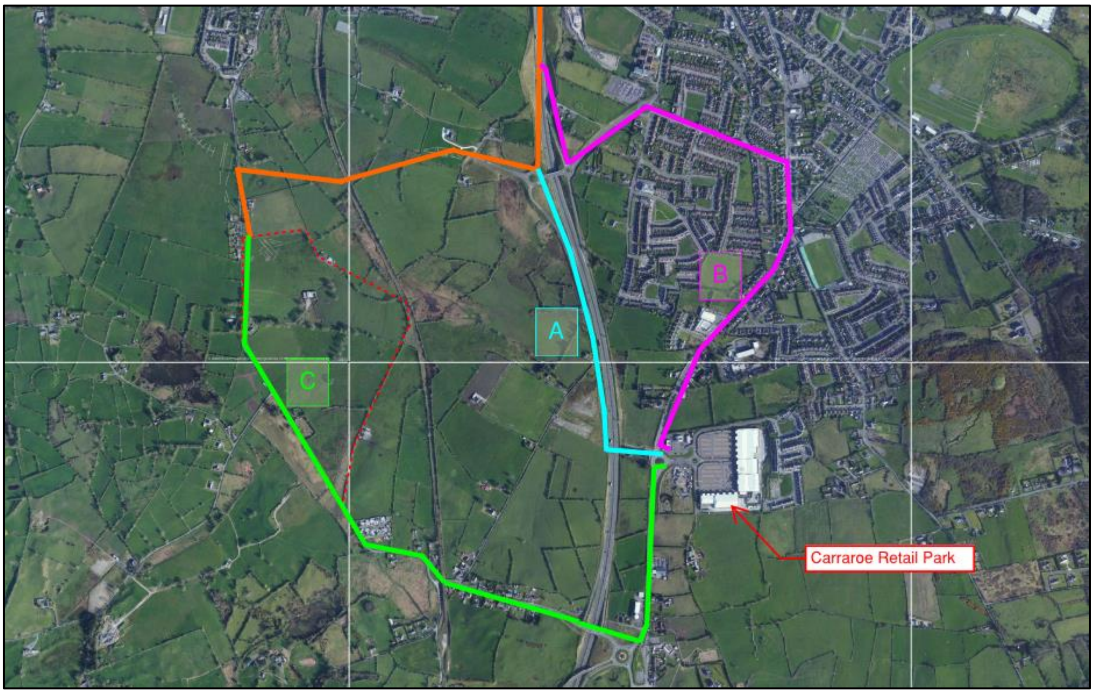


Figure 27: Carraroe Retail Park Route Options

Option A	
Route Description	Option A continues the route further along the N4 corridor as far as the retail park, the route crosses the N4 and then travels across private land for a short distance to meet the R287 outside the retail park.
Relative Length	This is the shortest and most direct route
Conditions/Constructability	The route out along the N4 can be constructed in the verge/hard shoulder. The crossing of the N4 is the biggest difficulty with this route. The crossing can be achieved by open cut or trenchless crossing techniques, this is a relatively short crossing and would cause minimal disruption to traffic flows. A short section of the route crosses private land, a wayleave would be required here.
Potential Customers	The route does not facilitate the connection of any additional potential customers.
Option B	
Route Description	Route Option B crosses the N4 and then extends south along the N4 in the verge/hard shoulder. The pipeline then passes up the exit ramp and on to the Crozon roundabout. At the roundabout the route continues on Circular Rd to the Junction with Pearse Rd. The route goes south along Pearse Rd as far as the retail park.
Relative Length	The route is a considerably longer than A and is comparable to C.
Conditions/Constructability	The route out along the N4 can be constructed in the verge/hard shoulder. The crossing of the N4 is the biggest difficulty with this route. The crossing can be achieved by open cut or trenchless crossing techniques, this is a relatively short crossing and would cause minimal disruption to traffic flows. Circular Rd is a two laned residential road with footpath either side, the pipeline could be easily constructed with a stop/go system in place however the number of residential entrances and proximity to houses would cause some difficulty during construction. Pearse Rd is a relatively wide two laned road with footpaths and cycle lanes, there are similar issues associated with passing through a residential area.
Potential Customers	There are a small number of additional potential customers the largest being Sligo Park Hotel
Option C	
Route Description	Route Option C extends from the entrance to Oakfield Business Park along the narrow secondary road linking to Pearse Rd on the East side of the N4. The route includes a railway crossing and a crossing of the N4.

Relative Length	The route is a considerably longer than A and is comparable to B.
Conditions/Constructability	The secondary road from the business park to the N4 is a narrow two-lane road with minimal verge. The pipe would be constructed in the road and would require a stop/go system to maintain traffic flows. The road passes under a railway bridge before meeting the N4, a wayleave would be required for this section. The road passes over the N4. If there is insufficient cover within the bridge deck this crossing would likely be carried out by routing the pipe down the on-ramp and across the N4 using similar methods as the other two options.
Potential Customers	There are a number of potential customers between the Carraroe roundabout and the retail park, these include Carraroe National School, Clifford Electrical and Applegreen.
Conclusion	
As mentioned in the introduction the viability of this route will be largely dependent on customer connection commitments. Option A is the preferred option as it offers the shortest route, this route would also be cheapest to construct. The additional potential customers that the other route options facilitate are in close proximity to the retail park. These customers could be connected by extending the main north and south along Pearse Rd from the entrance to the retail park.	

Figure 28: Preferred Route

4.4.6 Requirement for Low Pressure Network

As stated previously the route analysis above considers the “trunk” route of a 4 barg medium pressure network. When installing mains in urban areas of higher density such as the town centre it may be advantageous to design for low pressure pipework. The table below indicates the required minimum proximity distance for normally occupied buildings for low pressure and medium pressure pipework per “I.S. 329:2015 Gas Distribution Mains”.

DN/OD	MOP ≤ 100mbar (LP) m	MOP > 100mbar ≤ 5bar (MP) m
≤ 125	1	3
> 125 ≤ 315	1	5
>315 ≤ 400	1	7

Table 15: Minimum proximity distance from normally occupied buildings

As can be seen a 125mm main would require a minimum proximity distance of 5m from normally occupied buildings. It is unlikely that this distance could be maintained within the town centre due to the narrow street layout in many areas. It is also the case that medium pressure gas meters are prohibited from being installed within the building line of normally occupied buildings. This greatly reduces the feasible locations for gas meters within the town centre.

A low-pressure supply to the town centre will likely be required to facilitate connection of the businesses within the area. This would be achieved by installing district regulation installations (DRIs) which serve to reduce the pressure to below 100 mbar.

The possible routes for the low-pressure network have not been assessed as part of this study. In order to further develop this route detailed information about the size and location of the loads within the town centre would be required.

Given that the preferred network layout contains 2 medium pressure feeds to the town centre it is likely that 2no. DRIs will be required and will be located to the East and West of the town centre.

4.4.7 Network Reinforcements

In order to provide redundancy and thus increase security of supply within a network it is beneficial to create loops within the system. There are a number of opportunities to create loops or rings within the proposed network. Figure 29 below illustrates the main locations for these opportunities.

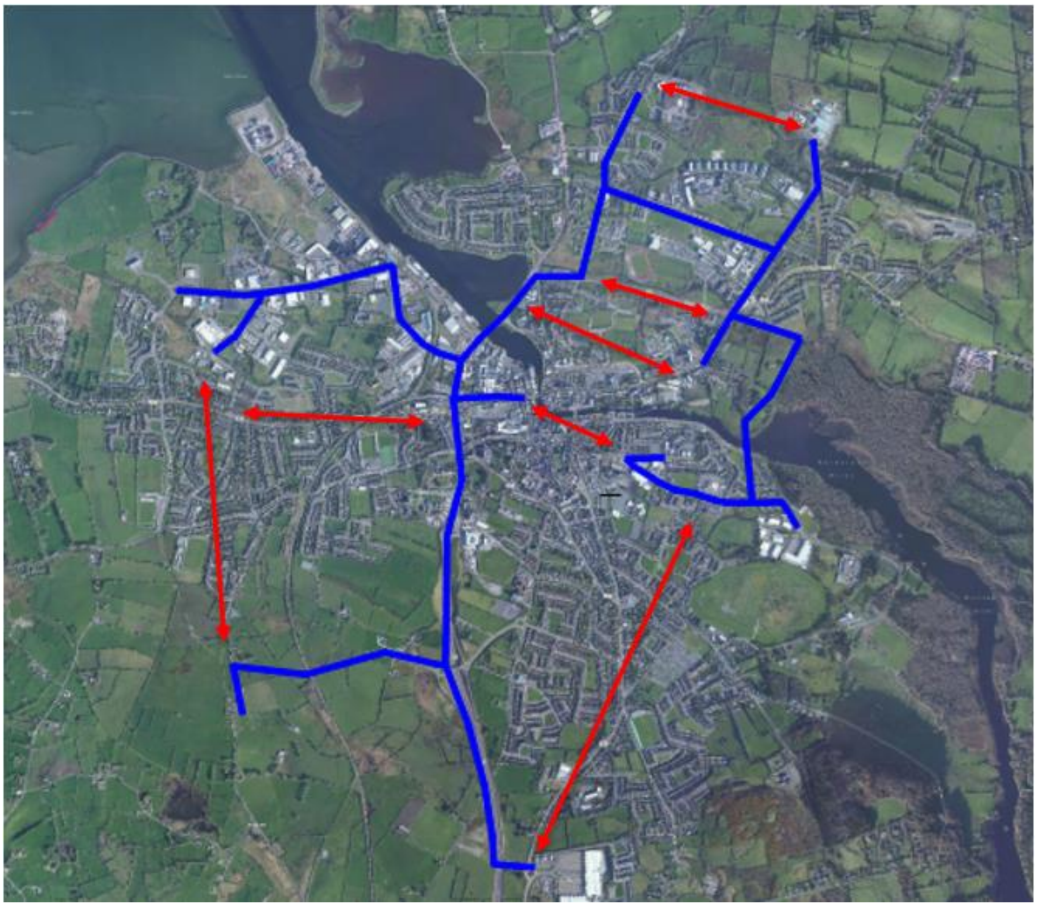


Figure 29: Network Reinforcement Options

These opportunities for network reinforcement have not been included within the preferred route, the main reason for this is to reduce CAPEX to only what is necessary for a viable, safe system. Any network reinforcements can be considered and constructed once the main network is commissioned and operating.

4.5 High Level Network Modelling

The Sligo gas network was modelled using AFT Arrow. AFT Arrow is a fluid dynamic simulation tool used to calculate pressure drop and flow distribution in gas piping and ducting system. The network was modelled for the three different demand scenarios to determine the required pipe size.

The model input parameters were as follows:

Parameter	Value
Pipe Material	Poly Ethylene
Pipe Size	125 PE80 SDR 17.6
Max Operating Pressure	4 barg

Table 16: Network Modelling Parameters

The simplified model contains no valves or other pipe fittings. The pipe lengths have been estimated and do not account for elevation changes. Energy hubs are modelled as a single point load in all cases except for North Sligo where each identified user is modelled as point load due to their size and the fact they are more sparsely located.

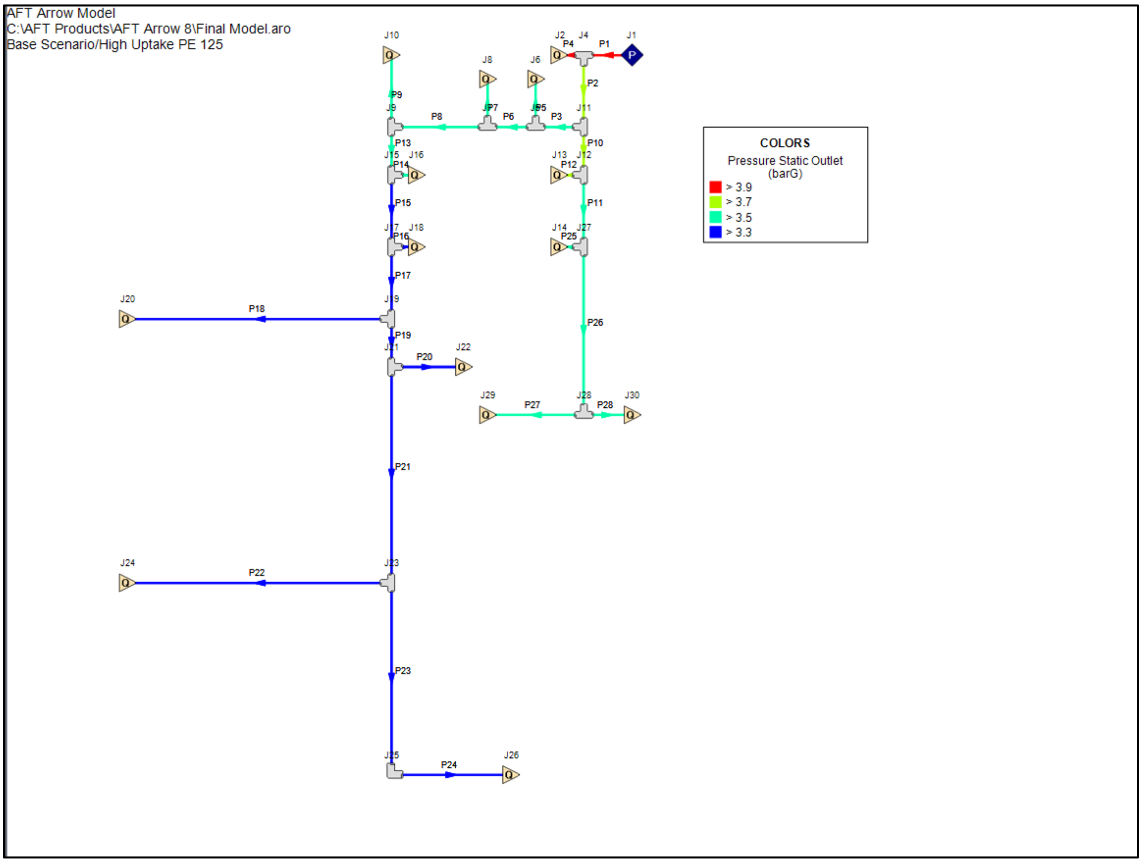


Figure 30: High Uptake Model

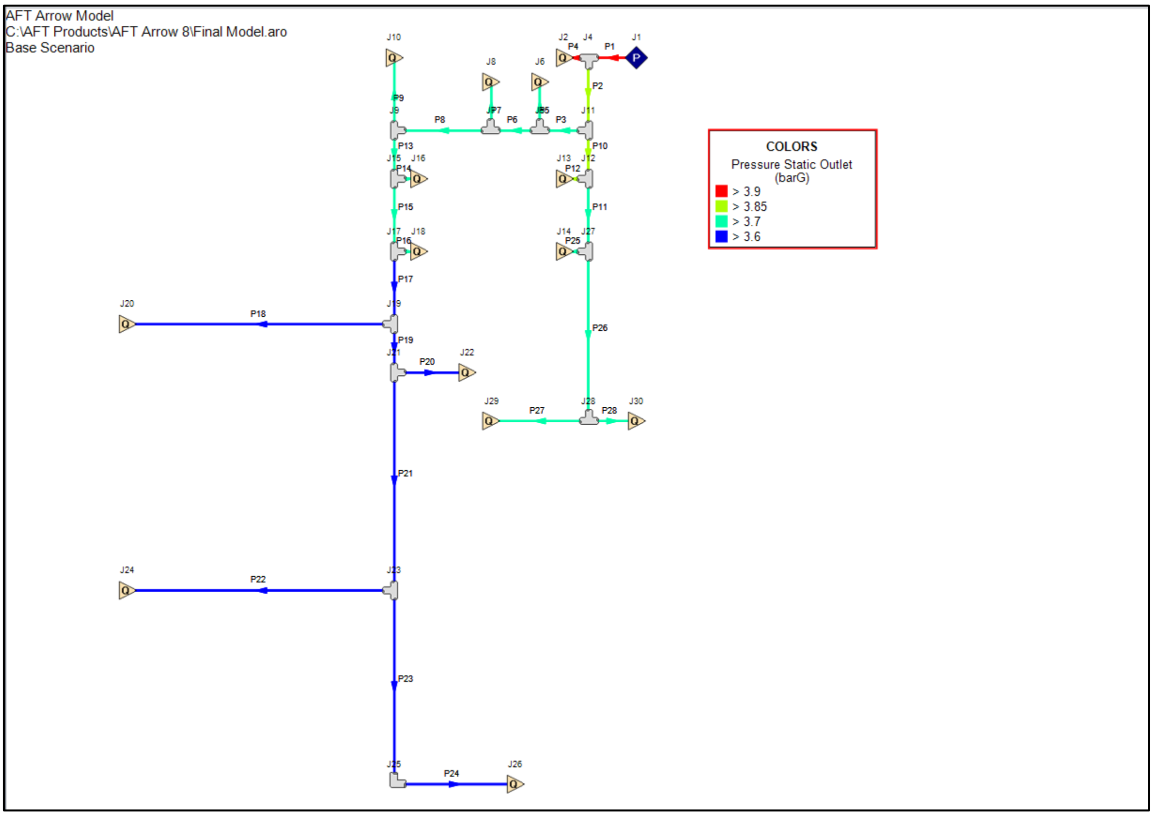


Figure 31: Medium Uptake Model

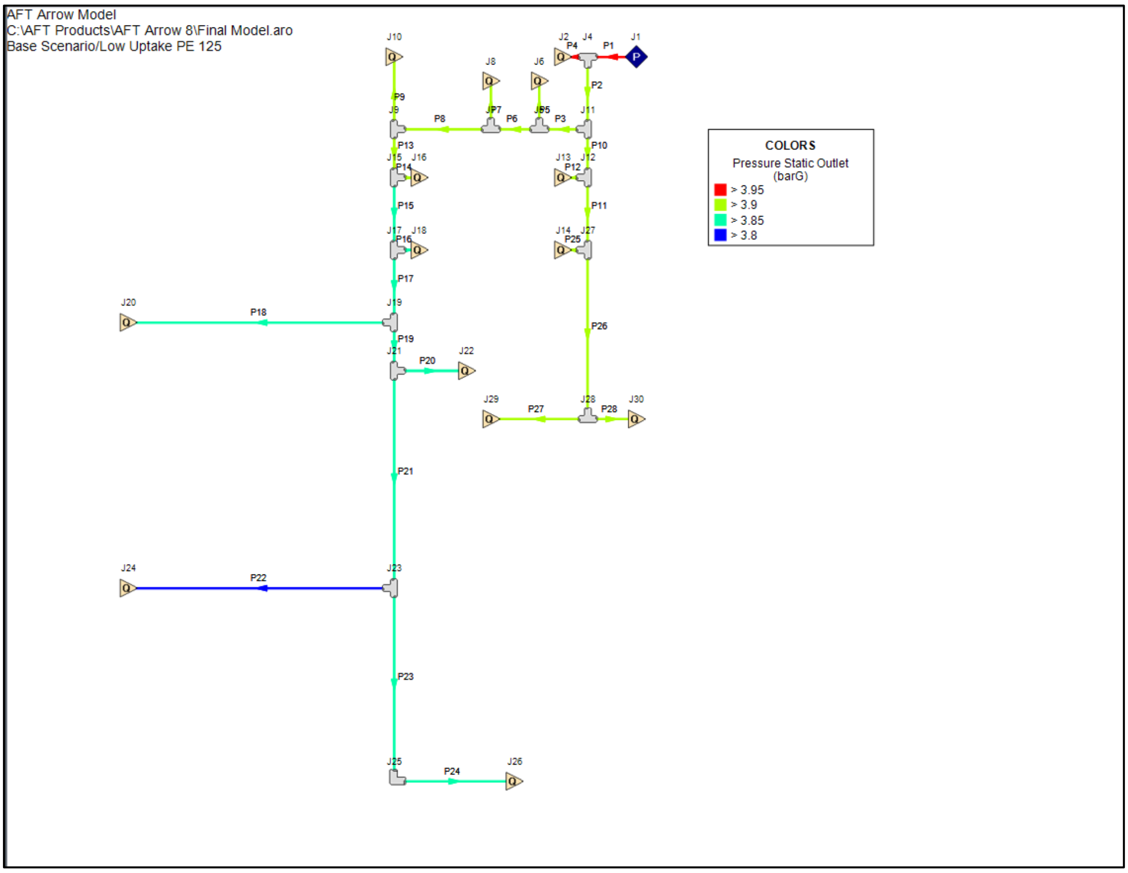


Figure 32: Low Uptake Model

All three demand scenarios show acceptable pressure losses across the network. Lowest static pressure is observed in Pipe 22 – where the network connects to IDA Oakfield. In the high uptake model, Static Pressure reduces to 3.35 barg at this network node.

The network was then modelled as a 90mm PE system to examine the effect of pipe sizing on pressure loss. The model assumes a medium uptake and the following input parameters were used:

Parameter	Value
Pipe Material	Poly Ethylene
Pipe Size	90 PE80 SDR 17.6
Max Operating Pressure	4 barg

Table 17: Network Modelling Parameters

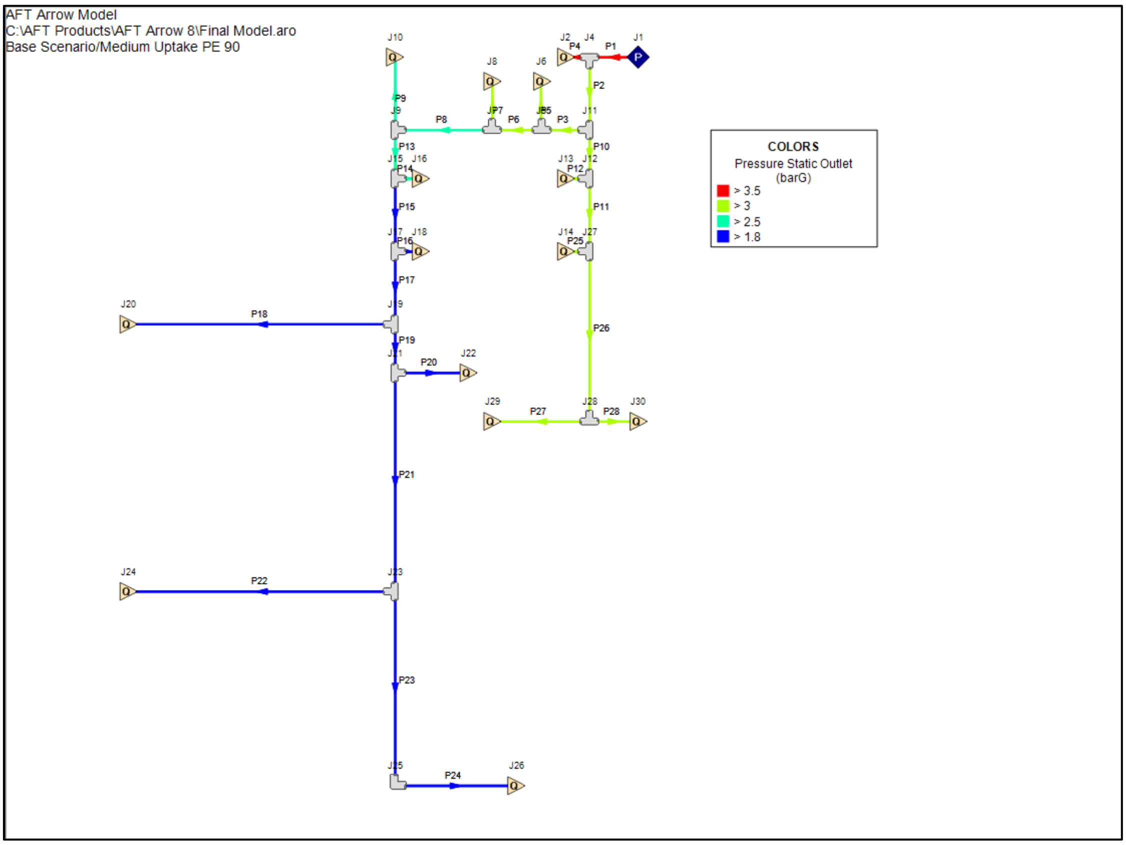


Figure 33: Medium Uptake 90 PE

The model shows much greater pressure drops using 90 PE80 SDR 17.6. At network extremities, static pressure falls below 2 barg and is unacceptable at this level.

In order to test the capacity for future growth the 125mm PE system was modelled with the medium scenario demand increased by 50%. This also resulted in acceptable levels of pressure drop across the system.

In conclusion the model shows that a 125mm diameter network operated at a pressure of 4 barg is sized sufficiently to ensure acceptable levels of pressure are maintained throughout the network and there is capacity for future growth in demand.

5.0 DECANTING FACILITY SITE OPTIONS

The decanting facility site selection is key to the success of the network and will be a key factor in ensuring security of supply while minimising impact on traffic flows within the area. The site must be well situated to accommodate fuel deliveries and consideration must be given to the impacts of the site on the surrounding environs. This section identifies the available site locations in the area, focusing on the physical/geographical characteristics of each site.

The priority energy hubs (as identified in Table 13) are North Sligo and Finisklin Business Park. The analysis of the available decanting facility site options assumes that the network will be developed in phases and that the first phase of development will be the construction of the networks in these two priority hubs. The facility will ideally be located in close proximity to the network route in these areas to allow for commissioning of this section of the network before the development of future phases. Due to the relative high density of development in these areas the number of suitable sites is small. Included in the analysis are a number of additional sites which are not located within these hubs but may prove to be viable.

5.1 Methodology

The steps taken as part of the decanting facility assessment are as follows:

- 14 potential greenfield sites in the Sligo town region were identified, based on analysis of up-to-date satellite imagery of the area.
- Criteria for the decanting facility site were established, based on previous Fingleton White site evaluation surveys for injection facilities and standard requirements.
- A desktop review of the potential sites was conducted. Sites were compared based on the chosen criteria and a shortlist of viable site options was determined.
- The sites deemed to be viable are then compared in detail

5.2 Selection Criteria

The initial 14 sites were assessed using a desktop survey questionnaire, the questionnaire poses 15 questions in order to assess the viability of each site, these questions fall under the following broad headings;

- Location
- Environment
- Services
- Access
- Situation

5.2.1 Location

The geographical location of the site is the first key criteria for site selection. The site must be located within reach of the preferred network route. Assessment of this criteria takes into consideration current land ownership, current land use and future development plans.

The future use of a site was determined by checking against planning permission applications and Sligo County Council's Sligo and Environs Development Plan (SEDP). Sites with current planning permission applications were not chosen for further analysis. The zones outlined in the SEDP were acknowledged and sites within appropriate zones were prioritised. For the purposes of this initial investigation a site footprint of 50 x 50 m has been assumed.

5.2.2 Environment

The potential impact of the site on the surrounding environs as well as the impact of the environs on the viability of the site were the next critical criteria. Certain environmental factors may negatively impact the construction process in terms of constructability, programme and cost. The facility should not be located where it is at risk of degradation over time due to site specific environmental issues.

The site must be relatively flat, not prone to flooding and not located near embankments or steep slopes.

5.2.3 Services

The site will require connection to local power and telecommunications networks, the ideal site will be in close proximity to these services. Existing services/utilities which may obstruct the development of a site are also taken into account. These include the presence of overhead and underground cables, sewage and water pipes, street lighting and network cabling.

5.2.4 Access

Access to and from the site during gas deliveries is a priority when choosing the site location. Gas will be regularly delivered by HGVs. Issues which impact the delivery include local traffic, road types and site vicinity to large roads.

Avoiding areas of high traffic intensity will benefit the haulage process and decrease running costs. It is expected that fuel deliveries will come via N4. The impact of the additional traffic on the surrounding areas is a key selection criterion.

The entrance to the site and requirement for development access roadways is also a consideration. Issues to avoid include narrow roads and entrances, traffic management during construction and wayleaves.

5.2.5 Situation

General properties of each location must be taken into account. This includes consideration of its neighbouring sites, archaeological factors and other issues which could impinge on the site functionality and constructability. The ideal site will be located adjacent to the proposed network and removed from sensitive receptors and residential areas the site will also require good road access.

5.3 Site Options and Analysis

The comparison matrix for the 14 sites initially identified can be found in Appendix 4.

The 4no. shortlisted sites are as follows:

Site Name	Site Number
Finisklin Business Park	Site 1
Barroe, N16	Site 2
Caltragh Roundabout	Site 3
Ballydoogan Road	Site 4

Table 18: Shortlisted Site Options

Figure 34: Decanting Facility Site Options

5.3.1 Site 1 – Finisklin Business Park

This site is located within the Finisklin Business Park energy hub and is in close proximity to the proposed network route.

Figure 35: Site Option 1 & Access Route

Figure 36: Satellite Image

Site 1 - Analysis	
Location	The site is located to the north west of Finisklin Business Park. The site is unregistered on the PRAI website but is understood to be in the ownership of Sligo County Council. The site is located within 500m of the proposed network route and within one of the two priority energy hubs. In the Sligo and Environs Development Plan (SEDP) the site is designated as a mixed-use zone. The objective of this zone is to promote the development of a dynamic mix of uses able to create and sustain vibrant residential and employment areas. Employment and enterprise uses are encouraged in the zone. The decanting facility is assumed to be an appropriate development within such zone.
Environment	The site is a level site with no evidence of embankments or history of flooding. The site is in close proximity to the Cummeen Strand Special Protected Area but is unlikely to have any impact on the SPA, any potential impacts must be considered and mitigated. The site is not in close proximity to residential housing or other sensitive receptors, any noise generated by the normal operation of the facility is unlikely to have a large impact on the ambient noise levels in the surrounding area
Services	There are existing ESB MV/LV cables present in the road adjacent to the site. It is assumed telecoms and water services are within close proximity as the site is within a full services business park.
Access	The preferred route for accessing the site from the south of the town is via the new Western Distributor Rd. Access via this route will eliminate any negative effects the site may have on traffic flows close to the town centre and particularly on the N4 approach to Hughes bridge. This route will be regularly trafficked by HGVs entering the business park. The site has the added advantage of offering an alternative approach via the N4 and the northern entrance to the business park. This offers redundancy in case of disruptions to the main route. The immediate access to the site is off the Finisklin Rd and should have no difficulty accommodating the traffic flows.
Situation	The site is currently unused and is located in close proximity to the Docks area which accommodates fuel stores, waste water treatment and recycling facilities. The site is well removed from residential housing and large offices and is deemed to fit with the surrounding land use. The site is in public ownership which is deemed to be an advantage.

5.3.2 Site 2 - Barrow, N16

This site is located to the north east of the North Sligo energy hub and is in close proximity to the proposed network.

Figure 37: Site Option 2 & Access Route

Figure 38: Satellite Image

Site 2 - Analysis	
Location	The site is located to the north east of the north Sligo energy hub on the N16 and is adjacent to the largest energy user in the network (Abbvie Manorhamilton). The site is registered as privately owned on the PRAI website and is currently agricultural land The site is located within 100m of the proposed network route and within one of the two priority energy hubs. A key benefit of this site is that it is located adjacent to the largest energy user on the network. In the Sligo and Environs Development Plan (SEDP) the site is designated as a Business, Industry and Technology Park (BITP) zone. The development is assumed to be appropriate for this type of zone.
Environment	The site is a level site with no evidence of embankments or history of flooding, although the surrounding fields appear to be soft to marshy. There is a drainage ditch crossing the site. The site is not in close proximity to residential housing or other sensitive receptors, any noise generated by the normal operation of the facility is unlikely to have a large impact on the ambient noise levels in the surrounding area
Services	There are existing ESB MV/LV cables present in the road adjacent to the site. It is assumed telecoms and water services are within close proximity as the site adjacent to a large industrial premise.
Access	The preferred route for accessing the site from the south of the town is via Hughes Bridge and the N16. This route passes through the town centre but has the advantage of being solely on national roads. Once the planned Eastern Bridge is constructed this is likely to offer a more attractive approach route and provide greater redundancy to improve security of supply. A new entrance into the site will likely be required, opening a new entrance onto a national road in close proximity to a roundabout may provide a difficult during the planning process.
Situation	The site is currently agricultural land but is zoned for BITP. The site is well removed from residential housing and large offices and is deemed to fit with the surrounding land use. The site is in private ownership.

5.3.3 Site 3 - Caltragh Roundabout

This site is located adjacent to the N4 at the exit junction for the new Western Distributor Rd. It is not located within close proximity to the two priority hubs however it has been deemed worthy of more detailed analysis due to its accessibility.

Figure 39: Site Option 3 & Access Route

Figure 40: Satellite Image

Site 3 - Analysis	
Location	The site is located to the south of Sligo town adjacent to the N4 at the eastern end of the Western Distributor Rd. The site is not located in close proximity to the high priority hubs but is located on the preferred pipeline route to connect Oakfield business park, which has been treated as a secondary priority for the purposes of this assessment. The site is registered as being owned by Sligo County Council In the Sligo and Environs Development Plan (SEDP) the site is designated as a mixed-use zone. The objective of this zone is to promote the development of a dynamic mix of uses able to create and sustain vibrant residential and employment areas. Employment and enterprise uses are encouraged in the zone. The decanting facility is assumed to be an appropriate development within such zone.
Environment	The site is a level site with established road embankments to the south and east. There is no history of flooding. The site is in relatively close proximity to a residential house. This is not expected to be an issue as the site is adjacent to a busy dual carriageway any noise generated by the normal operation of the facility is unlikely to have a large impact on the ambient noise levels in the surrounding area.
Services	The site has overhead power cables and is traversed by a water main; these services would require rerouting in order to accommodate the site.
Access	The site is easily accessed from the N4 via the existing access. The access is shared with 2no. residences. The access route has no negative impact on the traffic flows within Sligo town.
Situation	The site is currently not in use and is owned by the local authority. The site is in close proximity to a residence and shares access. Due to the location adjacent to a busy dual carriageway the site is unlikely to have a negative impact on the environs. Increasing traffic volumes at the existing access from a national road may provide a challenge during the planning process.

5.3.4 Site 4 – Ballydoogan Road

This site is located at the western end of the Western Distributor rd. Although not within one of the priority hubs the site has been deemed worthy of detailed analysis for similar reasons to site 3.

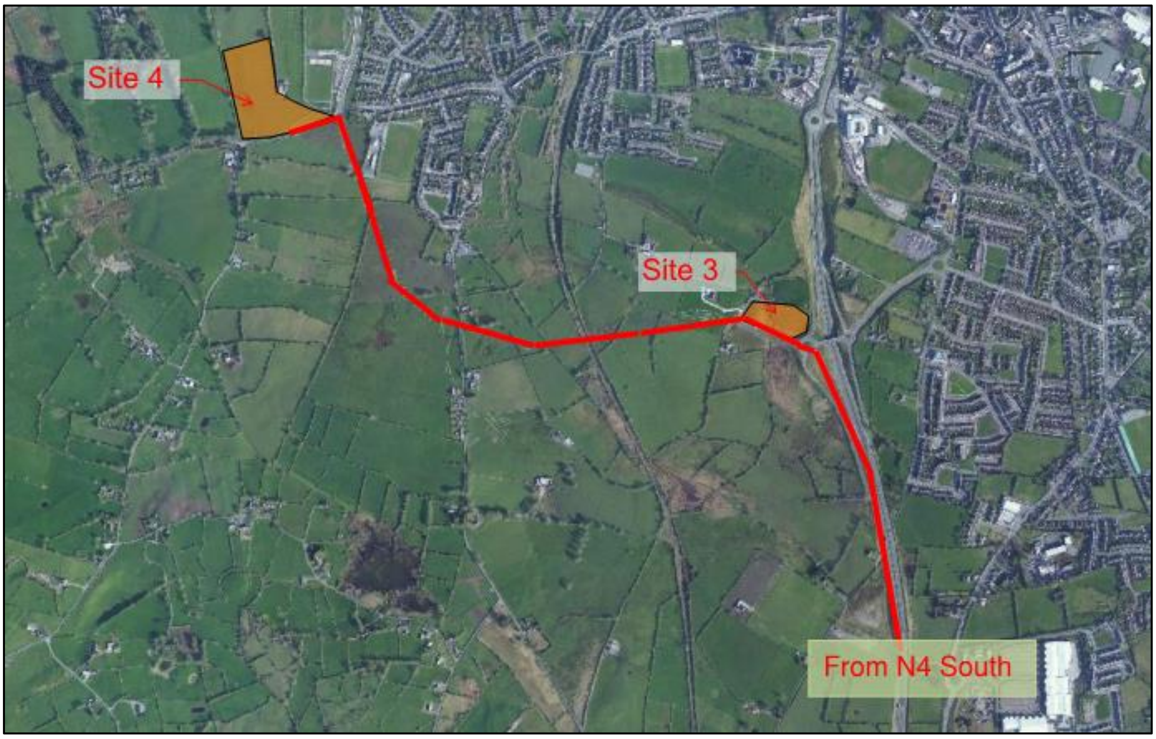


Figure 41: Site Option 4 & Access Route

Figure 42: Satellite Image

Site 4 - Analysis	
Location	The site is located to the south east of Sligo town at the western end of the Western Distributor Rd adjacent to Kevinsfort GAA Club. The site is located approximately 1km from the proposed gas main in Finisklin Business park and approximately 700m from the secondary priority hub of Oakfield Business park. Siting the facility here would offer the potential of creating a ring main loop by connecting Oakfield and Finisklin this would improve network redundancy. The site is unregistered on the PRAI website and is assumed to be privately owned agricultural land. In the Sligo and Environs Development Plan (SEDP) the site lies just outside the development limit outlined, in the buffer zone. This land is used principally for agriculture. New buildings in the buffer zone are to be constructed so as to minimise their visual and environmental impact.
Environment	The site is a relatively level site with no embankments or steep slopes. The normal operation of the decanting facility may increase the ambient noise levels in the environs as the site is not situated near to any other significant noise emitters.
Services	ESB MV/LV overhead cables run adjacent to the site.
Access	The site can be accessed via the Western Distributor Rd, this route avoids any negative impact on traffic flows within Sligo town. There is an existing access to the field which could be used for the decanting facility. The local road has recently been realigned as part of the Western Distributor works.
Situation	The site is currently agricultural land assumed to be in private ownership. There is one private residence within close proximity as well as the neighbouring GAA club. The site access is located almost directly opposite a rural road junction. This may prove a challenge during the planning process.

5.3.5 Conclusion and Recommendation

All four sites are viable options for the location of a decanting facility. The preferred option will be dependent on how the network is to be constructed and decisions on the phasing of the network role out. As stated in the introduction to this section the analysis assumes that the two priority hubs will be constructed in a single phase, this does not however automatically rule out options 3 and 4.

Site 1	
Strength	• Access route that avoids town centre • Proximity to large energy user hub • Industrial area • In public ownership
Weakness	• Traffic must travel through the business park • Potential fire risk posed by proximity to recycling facilities and fuel stores • Potential for contaminated soils
Site 2	
Strength	• Proximity to largest energy user • Proximity to largest energy user hub • Access route that avoids town centre (post construction of Eastern Bridge) • Beside national road (ease of access) • Greenfield site
Weakness	• Requires new entrance from national road • In private ownership
Site 3	
Strength	• Ease of access, avoiding town centre congestion • Lands unlikely to be used for other development • In public ownership
Weakness	• Distance from largest energy users • Proximity to domestic house
Site 4	
Strength	• Ease of access, avoiding town centre congestion
Weakness	• Distance from largest energy users • Proximity to domestic house • Private ownership

Site options 1&2 are the most attractive prospects, both sites are viable and offer the key benefit of being located in close proximity to the largest energy users while being removed from noise sensitive neighbours.

Option 2 is the preferred site; this conclusion is down to the proximity of the site to the networks largest energy users and in particular the largest contract I/C load (Abbvie Manorhamilton).

6.0 FUEL SUPPLY OPTIONS

The key aim of the proposed Sligo gas network is to reduce the carbon intensity and cost per kWh of the town's energy users, this is to be achieved by replacing the current fuel mix with cleaner and cheaper fuel. As is evidenced by the study previously carried out by Sligo IT, the main fuels providing thermal energy to commercial premises in Sligo are Oil and LPG. Both of which are more carbon intensive and likely to be more expensive than natural gas.

The planned network will be independent from the national gas transmission network and as such will be supplied by road haulage to a centralised decanting facility. There are two options for transport of natural gas by road haulage, namely in the form of Compressed Natural Gas (CNG) or Liquified Natural Gas (LNG). Both supply options have been considered and are analysed further in the following sections.

Given Ireland's commitments to reduction of greenhouse gas emissions the ultimate aim of new energy infrastructure of this type must be to achieve a status of carbon neutrality. There are a number of technical solutions at various stages of development which offer the possibility of moving natural gas networks towards this goal. The options for and viability of converting the Sligo Gas Network to non-fossil gas are also discussed in this section.

6.1 Compressed Natural Gas (CNG)

CNG is made by compressing natural gas, which is mainly composed of methane (CH_4), to less than 1% of the volume it occupies at standard atmospheric pressure. Once compressed the gas is stored in cylinders and tankers at pressures of between 200 and 300 bar, allowing for bulk transport of the fuel. CNG is most commonly used as a fuel for vehicles, the technologies which facilitate this are well developed and long established globally.

The CNG market for transport in Ireland is in its relative infancy, there are 2no. publicly accessible CNG forecourts in Ireland and a number more currently in development. GNI have a target of 70 CNG fast fill stations throughout Ireland by 2030.

The basic supply chain for CNG includes a compression facility, CNG road transport and decanting facility. This is commonly referred to as a virtual pipeline. There is currently no such compression facility in Ireland. The analysis for this study assumes that gas will be compressed at centralised compression facility which takes gas from the national transmission system at 70 barg and compresses it directly into bulk haulage trailers. It is further assumed that the compression facility will be owned and operated by Gas Networks Ireland and will be located near Athlone. It has been assumed this facility would require duty / standby compressors in order to provide continuity of supply.

The CNG will then be transported to site on a CNG trailer. These trailers generally contain a number of separate interconnected cylinders with all ancillary equipment.

At the decanting facility, the gas can be stored within the CNG trailer until required. When required, the trailer will decant the gas directly into the network via a pressure reduction skid. This is a relatively simple process with the main ancillary equipment required being a packaged boiler unit to allow for the gas to be preheated prior to the pressure let down.

6.2 Liquified Natural Gas (LNG)

Liquified Natural Gas is natural gas that has been cooled to liquid form for ease of storage and transport. The natural gas is condensed into a liquid at close to atmospheric pressure by cooling it to approximately −162 °C with a maximum transport pressure of around 0.25 Bar.

Traditionally LNG has been transported in bulk storage ships which are specifically designed for the transport of LNG, this allows for the transport of large volumes of gas and is most commonly used to supply large scale transmission or distribution networks in order to diversify supply options. In recent years the quantity of LNG being transported internationally has grown substantially and gas in this format is now being promoted strongly as a fuel for heavy goods transport.

The basic supply chain for LNG involves a liquification facility, bulk transport by sea, containerised transport by sea and by road, and a regasification facility. The supply chain for LNG is a global one. The main suppliers of LNG into Europe are USA, Russia and Qatar.

The LNG is transported by bulk ship freight to reception terminals within Europe, there is currently no LNG reception terminals in Ireland, the nearest being in the UK or on mainland Europe. At the reception facilities the LNG can then be transferred into smaller shipping container size storage vessels. These vessels can then be shipped to Ireland and transported by road haulage to the network decanting facility.

The gas can then be stored or immediately regasified and decanted into the network. The regassification process involves passing the gas through a serious of vaporizers that reheat the fuel for injection into the network. Odorization of the gas is also required as the LNG is not odorised before liquification.

One supplier is currently importing LNG into Ireland in this fashion. The LNG is imported via a reception facility in Rotterdam to Dublin Port where there is a parking facility which can be used to store up to 6.5GW. Trailers can be kept here and used as a buffer storage during peak periods or in bad weather conditions.

6.3 Energy Density

The key feature of LNG and CNG which make them suitable for the bulk transport of natural gas is the energy density of the product. The reduced volume occupied by the gas allows for sensible transport of significant quantities of gas. Table 19 below details the energy density of both.

Energy Density	
LNG (at -160 °C)	22.2 MJ/L
CNG (at 250 bar)	9 MJ/L

Table 19: Energy Density

A key advantage of LNG over CNG is the higher energy density. LNG has a density of almost 2.5 that of CNG, thus reducing the number of shipments required and increasing the stored energy buffer provided by a road transport vessel on site.

When converting these figures to actual number of deliveries required it becomes apparent that the type of transport vessel also has an effect. Table 20 below details the volume of gas contained within a typical CNG road haulage container and an LNG ISO container.

Gas Volume	
LNG (at -160 °C)	32,000 SCMH
CNG (at 250 bar)	9,000 SCMH

Table 20: Transport Volume

From these figures it can be calculated that a single container of LNG is equivalent to approximately 3.6 CNG deliveries.

For the base case scenario, the required number of deliveries weekly for CNG and LNG are:

Number of Weekly Deliveries	
LNG	0.44
CNG	1.6

Table 21: Weekly Delivery Requirements (Trucks)

6.4 Security of Supply

Security of supply is a major concern for an isolated network of this type. In order to attract and maintain customers, guarantees will be required as to the security of supply. Security of supply can be provided by several means including; buffer storage, supply route options, supplier options and fuel type options.

<table>
<tr><th colspan="2">Security of Supply</th></tr>
<tr><td>LNG</td><td>Strengths:
LNG is traded internationally from a number of sea ports throughout Europe, diversification of supply points provides supply chain options and enhanced security
LNG is shipped in standard shipping container sized vessels, these can be received in a number of Irish ferry ports including Cork, Waterford, Dublin and Belfast.
There is an established supply chain for LNG into Ireland using this method which includes for buffer storage space in Dublin port and also in Mayo. This can be expanded and other sites developed if there is sufficient demand for the product.
The energy density of LNG reduces the number of HGVs on the roads and traffic associated with the decanting facility.
The higher energy density also means that more energy can be stored on site for a given area, additional storage allows for short interruptions to the supply chain.
Weakness:
The carbon footprint associated with the LNG supply chain can be larger due to the processing and shipping requirements.
Limited supply chain within Ireland.
Current business model requires contract with a single shipper</td></tr>
</table>

CNG	Strengths: • Gas can be procured from multiple shippers • CNG has the shorter supply chain. Assuming that the likelihood of an interruption of supply in the Irish transmission system is very unlikely and thus taking this to be the start of the supply chain. • The virtual pipeline is, in effect, an extension of the Irish national grid. Weakness: • The lower relative density, greater storage space and number of deliveries required • There is currently no suitable compression facility within Ireland, a suitable site would need to be developed. • Reliance will be on a single compression site, if this facility has any technical or access issues this could cut the supply chain.

6.5 Decanting Facilities

The decanting facility is the key piece of infrastructure connecting the road haulage to the network pipeline. The requirements of the decanting facilities for both CNG and LNG are similar in terms of area and site requirements however there are some key difference in terms of process requirements.

The equipment required for decanting of CNG and LNG is as follows:

Decanting Facility	
LNG	• Truck parking bays • Truck decanting bays • LNG vaporisers • Mercaptan storage bund • Oder injection facility • Gas sampling point and chromatograph • Gas Metering skid
CNG	• Truck parking bays • Truck decanting bays • Heat Exchanger for preheating of gas • Packaged Boiler Unit • Pressure Reduction Skid • Gas sampling point and chromatograph • Gas Metering skid

Operation of the facilities require a similar level of operations and management expertise and resource and are comparable on this front.

6.6 Carbon Neutral & Renewable Fuels

In order to achieve carbon reduction targets and overall reduction in greenhouse gases the gas industry is developing options for conversion of existing fossil fuel gas networks to low or carbon neutral networks. These technologies and markets are not deemed to be sufficiently advanced at this time to consider establishing the Sligo network as a carbon neutral network. However, it is necessary to consider what options are likely to become available and how the network can be designed to easily accommodate the required changes when they become viable.

Biogas is gas which is produced from the fermentation of organic matter through a process called anaerobic digestion (AD). The greenhouse gases created by agricultural and food waste emissions can be captured and converted into energy through this process. The output, biogas can be purified to natural gas standards, and then injected into the natural gas network as biomethane.

Gas Networks Ireland are currently developing Irelands first large scale biomethane injection facility and have embarked on a strategic plan to achieve 20% renewable gas on the network by 2030. If the biomethane market is developed, as is currently planned, this will serve to reduce Ireland's dependence on non-indigenous fuel supplies and potentially provide additional revenue streams to benefit rural agricultural areas.

Previous studies[3] have shown that there is potentially a large quantity of biomass feedstock available in the north west which could be utilised to produce indigenous biomethane through anaerobic digestion. This form of renewable gas production may promote increased employment for rural communities, diversification of farm incomes and community co-operative opportunities.

Biomethane can be treated in the same way as natural gas, therefore it is technically possible for this to be transported and decanted into the Sligo gas network in the same way as CNG or LNG. It is unlikely however that biomethane will be produced in sufficient quantities in Ireland to justify the investment required to develop a liquification plant to produce Bio-LNG, for this reason if the network were to be supplied by Bio-LNG it would be from non-indigenous sources.

As part of this study the availability of Bio-LNG has been discussed with LNG suppliers who have advised that Bio-LNG is likely to be available to the Irish market by 2022/23.

In the coming decades it is looking increasingly likely that gas networks will operate with either a blend of methane and hydrogen or 100% hydrogen. The combustion of hydrogen emits no greenhouse gases and can be produced in a sustainable way through electrolysis powered by renewable generators such as wind or solar. This may prove to be an efficient method of storing and utilising excess wind energy in a way which reduces Sligo's dependence on fossil fuels for industrial heat applications. Gas

Much research is being conducted globally into the technical requirements associated with Hydrogen gas networks. The findings to date indicate that networks constructed largely from Polyethylene pipework can be utilised for the transport of hydrogen. In the future it may be possible to couple the large wind energy resource along the Atlantic coast with a supply of 100% renewable gas to fuel Sligo town. The potential for decarbonisation of industrial heat and transport through the use of Hydrogen has been recognised by Gas Networks Ireland

[3] "Pathways to a renewable gas industry in Ireland" Richard O'Shea, 2017

and is outlined in their Vision 2050 report as a key driver to deliver Irelands net zero carbon gas network[5].

6.7 Emissions Reductions

As is the norm for towns in Ireland which do not have a piped gas supply, the thermal energy fuel mix in Sligo town is likely to be a mixture of Oil, LPG and electricity. Businesses in the area which currently use electricity for their thermal requirements are unlikely to convert to gas as they are likely to be relatively small consumers for whom the financial incentive to convert will not be as great. Table 22 below shows the carbon intensity of LPG, oil and natural gas, from this it can be see that natural gas offers substantial reductions in carbon emissions.

Fuel	Carbon Intensity (gCO_2/kWh)
LPG	229.3
Oil (Kerosene)	257
Natural Gas	204.7

Table 22: Carbon Emissions[6]

The table below illustrates the estimated annual CO^2 emissions reduction associated with those businesses who provided historical usage data for oil and LPG.

Current CO2 Emissions	LPG	Oil	Natural Gas
Current usage (kWh)	30,805,018	17,152,306	47,957,324
Carbon Intensity (gCO^2/kWh)	229.3	257	204.7
Carbon Emissions (tonnes)	7,064	4,408	9,817

Table 23: Potential CO^2 Reduction

This results in a 14% reduction in CO^2 emissions. It is likely that similar reductions would be realised for the network as a whole.

6.8 CNG for Transport

CNG for transport provides a cleaner, affordable and proven alternative to diesel or petrol. CNG as a transport fuel significantly reduces particulate matter emissions and, when renewable gas is introduced, it offers HGVs and buses a realistic pathway to net zero carbon transport. The use of CNG as a transport fuel is in its infancy in Ireland but is well established globally. GNI have outlined in their "Vision for 2050" a plan to facilitate the development of 170-station CNG fuelling network including 40no. public access forecourts. This ambition will help meet Irelands requirements under the EU's Alternative Fuels Infrastructure Directive.

The inclusion of a CNG fuelling station on the Sligo Gas Network has not been considered as part of this study. If one were to be included the most cost-effective location is likely to be adjoining an existing fuelling forecourt or adjacent to the network decanting facility.

[5] https://www.gasnetworks.ie/vision-2050/future-of-gas/GNI_Vision_2050_Report_Final.pdf
[6] https://www.seai.ie/data-and-insights/seai-statistics/conversion-factors/


natural gas
in transport

7.0 FINANCIAL APPRAISAL

The Financial Appraisal seeks to set out, at a high level, the capital cost of establishing the network and the annual operating costs of the network in order to determine whether the network is financially viable and give some indication as to the cost of delivering gas to the end user.

The appraisal has been performed using the simple payback method for both CNG and LNG options in the high, medium and low uptake scenarios and has been conducted with an error margin of +/- 40%. The project is appraised over 25 years using the medium uptake scenario as the base case.

A discount rate of 5% has been applied for the base case. This is in line with published guidance from the Department of Public Expenditure and Reform[8] and previous analysis in Gaslink New Towns Analysis Phase III 2010.

An assumed rate of inflation of 2% has been applied across the payback period in line with the published guidance from the Department of Public Expenditure and Reform[9]

The calculated unit cost of gas to the end user is the rate at which the medium uptake scenario yields a Net Present Value of zero over a 25 year period.

The uptake scenarios that have been applied are intended to account for premises for which connection to the network is not technically or economically viable or where consumers chose not to convert to natural gas. For the remaining premises it is reasonable to expect a gradual increase in numbers connected over the first number of years of operation. In order to account for this a customer growth rate from year 1 to year 7 has been applied to the financial appraisal to provide realistic demand expectations over the period of growth. It has been assumed that the contract loads will be 100% connected in year one. For the other consumer categories, the assumed growth rates are as shown in Table 24 below, resulting in all customers for a given uptake scenario being connected by year 7.

	Growth/Year
Large I/C	25%
Medium I/C	20%
Small I/C	15%

Table 24: Assumed Growth Rates

The price of gas to the network is a key factor in determining the required charge to the customer in order for the network to be viable. The unit costs which have been used for the purposes of this appraisal are as follows:

	Cost
CNG	0.02 €/kWh
LNG	0.034 €/kWh

Table 25: Commodity Price

The assumed price per unit of LNG has been obtained from an estimate provided by current suppliers and is in line with their preferred business model. In this model the regassification infrastructure is designed, built, owned and operated by the entity supplying the gas to the network. Therefore, the costs associated with this are built in to the commodity price. With

[8] https://www.gov.ie/en/policy-information/1a0dcb-project-discount-inflation-rates/?referrer=/en/project-discount-inflation-rates/
[9] https://www.gov.ie/en/policy-information/1a0dcb-project-discount-inflation-rates/?referrer=/en/project-discount-inflation-rates/

this model there is an annual service charge which the network pays to the supplier, this has been accounted for as a separate line item under the annual OPEX.

There is no equivalent model for CNG in operation currently in Ireland, for this reason the CNG price has been calculated. The calculation is based on publicly available information. First the price of price of gas at the Moffat entry point is estimated and then Irish commodity transport cost[10], CRU Levy and Carbon Tax[11] are added. This results in an estimated unit rate for reception from the Irish transmission system. This price does not include the costs associated with compression, transport and injection, these have therefore been accounted for as line items in the CAPEX and OPEX estimates.

7.1 CAPEX

7.1.1 Assumptions & Methodology

Decanting facility CAPEX

The CAPEX estimate presented in this study for the LNG decanting facility excludes the expenditure associated with the decanting facility and transport to the facility where as the CNG CAPEX estimate includes for these costs (for the reasons outlined above).

Pipeline Costs

Pipeline capital costs were calculated for each energy hub, based on the recommended route as detailed in Section 4.0. The per meter rate used for the pipeline costing is based on Fingleton Whites experience and includes for all associated costs including materials, excavation and reinstatement. Costs have been developed for each individual hub.

Services and Meters

The CAPEX estimate also includes for the cost of laying services to customers and installation of gas meters. A customer contribution of 30% toward these costs has been assumed in line with the Gaslink New Towns Analysis Phase III 2010.

District Regulation Installations

The CAPEX estimate for Sligo Town Centre includes for the cost of 2no. district regulation installations to reduce the pressure to low pressure as outlined in Section 4.

[10] https://www.gasnetworks.ie/corporate/gas-regulation/tariffs/transmission-tariffs/GNI-Transmission-Tariff-for-Gas-Year-2019-20.pdf

[11] https://www.revenue.ie/en/companies-and-charities/excise-and-licences/energy-taxes/natural-gas-carbon-tax/rate-of-tax.aspx

7.1.2 CNG Injection Facility CAPEX

The CAPEX associated with the CNG Injection facility has been estimated as follows:

CNG Injection Facility Budget Estimate (Total +/- 40%)		
Project Management (incl. Design Consultancy)	€	200,000
Conceptual Design & Planning	€	80,000
Equipment & Material Procurement:		
Decanting & PRS skids	€	370,000
Package Boiler Units	€	180,000
Other materials	€	150,000
Civil / Utilities	€	160,000
Construction	€	770,000
Site Acquisition	€	-
C&I	€	90,000
Miscellaneous:		
Network Setup costs (Safety Case etc)	€	200,000
Distribution network 1st fill	€	1,150,000
Compression Facility (2 x compressors - duty / standby)	€	2,500,000
CNG Trailers x 2	€	1,000,000
Contingency	€	-
Total	**€**	**6,850,000**

Table 26: CNG CAPEX Estimate

7.1.3 LNG Regassification Facility

The CAPEX associated with the LNG regassification facility has been estimated as follows:

LNG Injection Facility Budget Estimate (Total +/- 40%)		
Decanting facility capex included in gas supply rate + annual service charge	€	-
Site Acquisition	€	-
Miscellaneous:		
Network Setup costs (Safety Case etc)	€	200,000
Distribution network 1st fill	€	1,950,000
Contingency	€	-
Total	**€**	**2,150,000**

Table 27: LNG CAPEX Estimate

7.1.4 Pipeline and Ancillaries CAPEX

The estimate of CAPEX associated with the pipeline and ancillary equipment including services, meters and DRIs for each hub and for the network as a whole is as follows:

Network CAPEX Budget Estimate (Total +/- 40%)	
Energy Hub	**Cost**
North Sligo	€ 635,564
Finisklin Business Park	€ 402,528
IDA Oakfield Park	€ 368,984
Carraroe Retail Park	€ 201,264
Sligo Town	€ 227,720
Total	**€ 1,836,059**

Table 28: Pipeline and Ancillaries CAPEX Estimate

7.1.5 Services and Meters CAPEX

The CAPEX estimate also includes for the cost of laying services to customers and installation of gas meters. A customer contribution of 30% toward these costs has been assumed in line with the previous New Towns Analysis reports.

	Uptake Scenario		
	High	**Medium** **BASE CASE**	**Low**
Small I/C	610	387	155
Medium I/C	30	19	10
Large I/C	9	6	3
Total No. of Meters	649	412	168
Unit Cost (incl. service, meter and install)	€ 2,500	€ 2,500	€ 2,500
Total Cost	€ 1,622,500	€ 1,030,000	€ 420,000
Total Cost less 30% Contribution	**€ 1,135,750**	**€ 721,000**	**€ 294,000**

Table 29: Services and Meters CAPEX

7.1.6 Total CAPEX Estimate

For the base case (medium) scenario the total estimated CAPEX associated with CNG and LNG are as follows:

Total CAPEX (+/- 40%)	
CNG	€9,401,184
LNG	€4,704,298

Table 30: Total Network CAPEX

7.2 OPEX

7.2.1 Assumptions & Methodology

The operational expenditure associated with the network has been estimated based on past experience and previous similar studies conducted by Fingleton White and others. The analysis assumes the following:

- The network maintenance requirements are in line with other towns networks of this size and pressure.
- Emergency response requirements are in line with the requirements for the national distribution system.
- Marketing & Sales costs are in line with other towns networks of this size.

The estimate accounts for all typical costs associated with operating a network of this size and type including Engineering, Fitters, Emergency Response, sales and marketing, management and administration and rental of an office space from which to operate.

For the reasons outlined in Section 7.1 **Error! Reference source not found.** there is a difference in the line items accounted for under OPEX in the CNG and LNG cases. The CNG estimate includes the cost associated with compression and transport whereas the LNG estimate accounts for the service charge associated with the LNG regassification facility.

7.2.2 Network OPEX Estimate

The OPEX estimate associated with both the CNG and LNG cases are as follows:

OPEX ESTIMATE		Total CNG	Total LNG
Operational Requirements			
Engineer		€ 85,000	€ 85,000
1st Response Fitter		€ 80,000	€ 80,000
Emergency Repair Crew		€ 100,000	€ 100,000
Average callout per km/year	2.5		
Callout Cost	€210	€6,458	€6,458
Average Repair callout per km/year	0.065		
Repair Callout Cost	€4,100	€3,278	€3,278
Office/Depot		€ 20,000	€ 20,000
Sales Team		€ 60,000	€ 60,000
Management / Admin		€ 150,000	€ 150,000
Meter replacements after 15yrs/yr		€ 16,667	€ 16,667
CNG Compression & Transport @ 3 deliveries/wk		€ 436,800	
Total OPEX		**€ 958,202**	**€ 521,402**
LNG Facility Service Charge per annum.			**€ 120,000**

Table 31: OPEX Estimate

7.3 Gas Unit Price

The unit price of gas to the consumer must first be set in order to appraise the viability of the network under the fuel supply and uptake scenarios outlined. For the purpose of this study the price to the consumer has been set as the rate at which the base case yields a Net Present Value of zero over a 25-year period with a discount rate of 5%.

Using this method, the unit cost that satisfies these conditions has been calculated for both CNG and LNG (see Table 1 below), the lower of these values has then been set for both fuel options to compare the viability across the high, medium and low uptake scenarios.

		Set Price
CNG	4.52 c/kWh	4.52 c/kWh
LNG	4.99 c/kWh	

Table 32: Gas Unit Price

7.4 Results and Analysis

7.4.1 Simple Payback Results

The table below summarises the comparative viability of CNG vs LNG for the high medium and low uptake scenarios with a set price of 4.52 c/kWh applied to both fuel options.

The analysis illustrates that under the set conditions the Net Present Value for LNG is negative in all scenarios, for this reason CNG is deemed to be the most financially attractive fuel supply option.

		Scenarios		
		Low Uptake	Medium Uptake BASE CASE	High Uptake
Discount Rate		5%	5%	5%
CNG	c/kWh	4.52	4.52	4.52
	NPV	-€5,340,326	€0	€5,352,576
	IRR	-1%	5%	9%
LNG	c/kWh	4.52	4.52	4.52
	NPV	-€6,196,578	-€4,055,055	-€1,901,283
	IRR	-	-6%	2%

Table 33: Scenario Results

The financial appraisal therefore indicates that for the base case, under all conditions assumed by this study, a local gas network supplied by CNG is financially viable.

7.4.2 Cost Comparison

In order to analyse the potential financial incentive for existing I/C premises to convert to natural gas a high-level cost comparison between existing fuel mix and the CNG unit price has been conducted.

The previous study conducted by Sligo IT provides LPG and Oil consumption figures for all energy users who partook in the study. Table 34 below illustrates the potential savings based on conversion of all known LPG and Oil consumption to natural gas. From this high-level comparison, it is clear that converting to natural gas offers substantial savings to the consumer. In the case outlined below the savings offered amount to approximately 47%.

Annual Fuel Usage (known)				
		Total LPG (kWh)	**Total Oil (kWh)**	**Total (kWh)**
North Sligo		22,917,692	15,534,818	38,452,510
Finisklin Business Park		6,556,792	408,000	6,964,792
Sligo CoCo		1,330,534	1,209,488	2,540,022
Totals		**30,805,018**	**17,152,306**	**47,957,324**
Annual Fuel Cost				
	c/kWh	**Total LPG (€)**	**Total Oil (€)**	**Total (€)**
LPG (Bulk 3.1 - 40t)	9.18	€ 2,827,901		
Oil	7.18		€ 1,231,536	
Total (Existing Fuel Mix)		€ 2,827,901	€ 1,231,536	**€ 4,059,436**
Total (CNG)	4.52	€ 1,393,665	€ 775,996	**€ 2,169,661**
Annual Energy Cost Difference				**€ 1,889,776**

Table 34: Fuel Cost Comparison[12]

7.4.3 Commodity Price Sensitivity

It is worth noting that the unit price of gas to the network has been derived from current gas prices which are historically low. For this reason, some analysis of the sensitivity of the business case to increases in gas price has been conducted. The analysis illustrated in Table 35 below shows the required unit price to the consumer to satisfy the zero NPV condition for the base case.

[12] https://www.seai.ie/publications/Commercial-Fuel-Cost-Comparison.pdf

		Scenarios (Gas Supply Unit Cost +40%)		
		Low Uptake	Medium Uptake BASE CASE	High Uptake
Discount Rate		5%	5%	5%
CNG	c/kWh	5.32	5.32	5.32
	NPV	-€5,340,326	€0	€5,352,576
	IRR	-1%	5%	9%

Table 35: Gas Supply Cost Sensitivity

The resulting unit price of gas to the consumer is 5.32 c/kWh. Conducting the price comparison between gas at this price and the existing energy mix for the 24 companies who have provided information results in an annual energy cost difference of ~ €1.5 million equating to a 37% reduction.

7.4.4 The "Do Minimum" Scenario

As a further financial viability test the same appraisal method has been applied to a "do minimum" scenario. In this scenario the network connects only the hubs of Finisklin and North Sligo providing gas to the largest energy hub and connecting the 3 existing Contract energy users. The analysis assumes the low uptake scenario.

	CNG	LNG
Injection Facility	€ 6,266,751	€ 1,165,704
North Sligo	€ 635,564	€ 635,564
Finisklin Business Park	€ 402,528	€ 402,528
Total	**€ 7,304,843**	**€ 2,303,795**

Table 36: "Do Minimum" CAPEX Budget (+/-40%)

	CNG	LNG
Annual OPEX	€ 804,783	€ 516,495
Annual Service Charge	€ 0	€ 120,000
Total	**€ 804,783**	**€ 636,495**

Table 37: "Do Minimum" OPEX Budget (+/- 40%)

		North Sligo & Finisklin (only) - Low Uptake
Discount Rate		5%
CNG	c/kWh	7.60
	NPV	€0
	IRR	5%

Table 38: "Do Minimum" Financial Appraisal

The resulting unit price to the consumer is 7.6 c/kWh which would results in an annual energy cost difference of ~10%.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusion

The potential annual gas load and estimated annual consumption of all industrial commercial premises in Sligo town has been estimated for high, Medium and Low uptake scenarios. The analysis which has been based on collated primary data and interpretation of secondary data sources indicates that there are a number of substantial energy users or “anchor loads” in the area that would be required customers in order for the role out of a local network to be viable. The analysis highlights a large number of medium and small I/C customers who could also benefit from connecting to the network.

The analysis provides a technically viable pipeline route for the network which can provide for connection of the existing large energy users while also providing opportunities for future development and growth within the Sligo Town area. Two bridge crossing points have been identified that present an opportunity for crossing the Garavogue river while avoiding the need for trenchless techniques. The routes identified do not present any additional significant challenges and can be constructed by standard techniques.

The network fuel supply analysis is not conclusive as to whether CNG or LNG would be the preferred option for supplying the network. The chosen fuel source will be dependent on a number of factors the most important of which will be the commercial arrangements available and the security of supply that can be guaranteed. A network design for either of these fuel delivery methods will be technically compatible with biomethane either in the form of Bio-LNG or Bio-CNG. Although it is not clear at this point which low carbon alternative will come to market first, it is thought to be very unlikely that an indigenous source of Bio-LNG will become available.

The potential for locally produced Bio-CNG to fuel businesses within the area is an attractive one, this has the potential to support the local economy and promote jobs and growth within the region. As stated earlier, previous studies have demonstrated the potential availability of agricultural feedstock to support the growth of a biomethane industry in the North West. It has yet to be determined at what price biomethane produced in this way would be sold to the market. The viability of using biomethane within the Sligo network would be highly dependent on energy policy and possible subvention to move the market in this direction.

The financial appraisal indicates that there is sufficient thermal energy demand within the Sligo town area to support a local gas network of this type. The viability of the venture however is highly dependent on the number of customers who connect to the network. For this reason, an important next step will be to canvas all potential customers in the area to gauge interest.

The analysis has shown that the network can provide significant cost savings for energy consumers in the area. Providing a secure gas supply to the business consumers within Sligo town would reduce business overheads and promote the growth of new business within the area.

The analyses also demonstrated that replacing the existing fuel mix of LPG and Oil with natural gas will provide significant reductions in carbon emissions while also reducing NOx and particulate matter thus enhancing air quality. It is also worth noting that inevitable increases in carbon tax will be weighted toward more carbon intensive fuels further incentivising alternatives to oil and LPG, providing this alternative will be essential to maintaining the attractiveness of Sligo town and environs as a place for large energy users to do business.

Bio-methane and the move towards green hydrogen provide realistic pathways for carbon neutrality in the medium to long term. It is worth noting that a substantial amount of the forecast energy requirement for the network is attributed to industrial heat, at this time it seems unlikely that electrification of industrial heat will be a viable means of decarbonising this sector, low carbon gas provides a realistic solution to this issue.

8.2 Recommendations

The analysis carried out as part of the Preliminary FEED has provided a solid foundation for the next phase of detailed FEED. The following are the FW recommendations on the key requirements to enable the project to be progressed successfully:

8.2.1 Customer Survey

The forecast demand plays a major role in determining the economic viability of the network. The method used in the current stage of the study provides a high-level forecast which is heavily reliant on a number of assumptions regarding energy consumption and uptake rates.

In order for the project to be progressed further, a detailed survey of all I/C premises within the area is recommended. The survey would serve to identify all potential customers, provide a clearer insight into their energy usage and gauge the interest in becoming customers of the network.

8.2.2 Network Route & Constructability Report

The routing study conducted as part of this stage of the FEED provides the most likely route for the pipeline through the area. On-site surveys will be required in order to verify the constructability of this route and assess any small route changes which may be required. The detailed routing study would also facilitate a more accurate costing of the network roll out.

8.2.3 Detailed Budget

The financial appraisal has demonstrated the potential viability of the network and energy savings for consumers. The budget estimates for CAPEX and OPEX informing the appraisal are accurate to within +/- 40%. A more detailed budget will be required in order to give a clearer picture of the financial viability of the network.

8.2.4 Statutory and Regulator Requirements

Detailed analysis of the statutory and regulatory requirements associated with establishing a network of this type is required. This should include analysis of:

- Distribution System Owner Licence & Distribution System Operator Licence in accordance with Gas (Interim) (Regulation) Act, 2002 & European Communities (Internal Market in Natural Gas) (BGÉ) Regulations 2005 (S.I. No. 760 of 2005)

- Planning requirements associated with the development and requirements for Environmental Impact Assessment, Strategic Environmental Assessment and Appropriate Assessment (AA) Screening.

8.2.5 Analysis of Potential Subvention Options

The financial viability of the network would be made increasingly attractive by any available subventions. It is recommended that the next phase of the study include analysis of the potential sources for subvention. These options may include:

- Postalised transmission & distribution tariff increases on existing gas users on the GNI gas network
- Direct Government subvention
- EU Funding

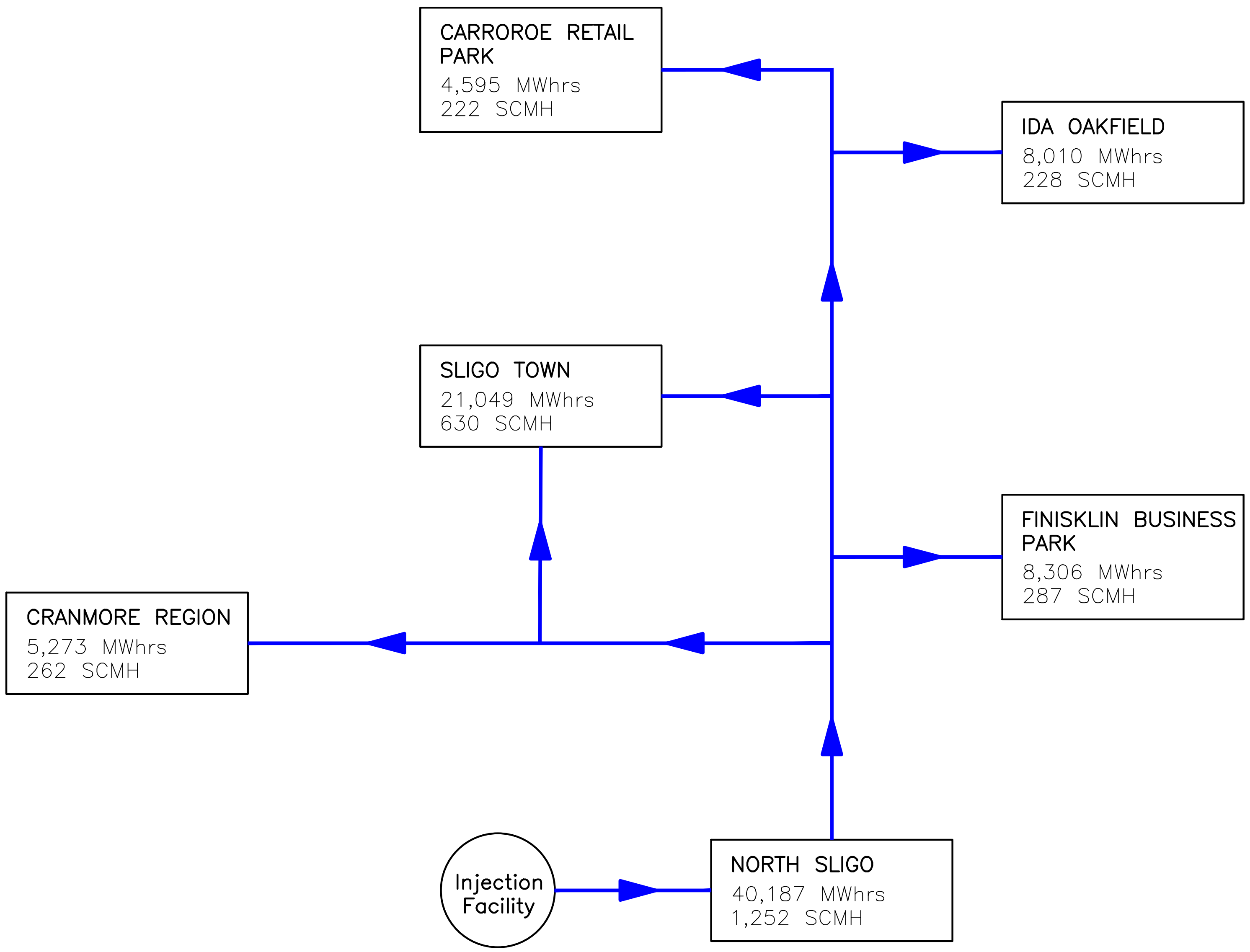
8.2.6 Cost Benefit Analysis

It is recommended that full cost benefit analysis be conducted. The analysis should determine at a strategic level the technical and economic feasibility of constructing the gas network taking into account the full economic costs and benefits.

8.2.7 Security of Supply Analysis

A detailed analysis of the fuel supply chain focusing in particular on security of supply risks is recommended. The success of the network will be largely dependent on the security of supply. Evidence of detailed analysis of the risks to supply will be required in order to attract customers to the network.

APPENDIX 1 – NETWORK DRAWINGS



NOTES

PRELIMINARY DESIGN

REV.	DATE	REVISION	BY	CHKD.	APPR.
0	28/08/20	PRELIMINARY DESIGN	RMD	BOB	IM

Client

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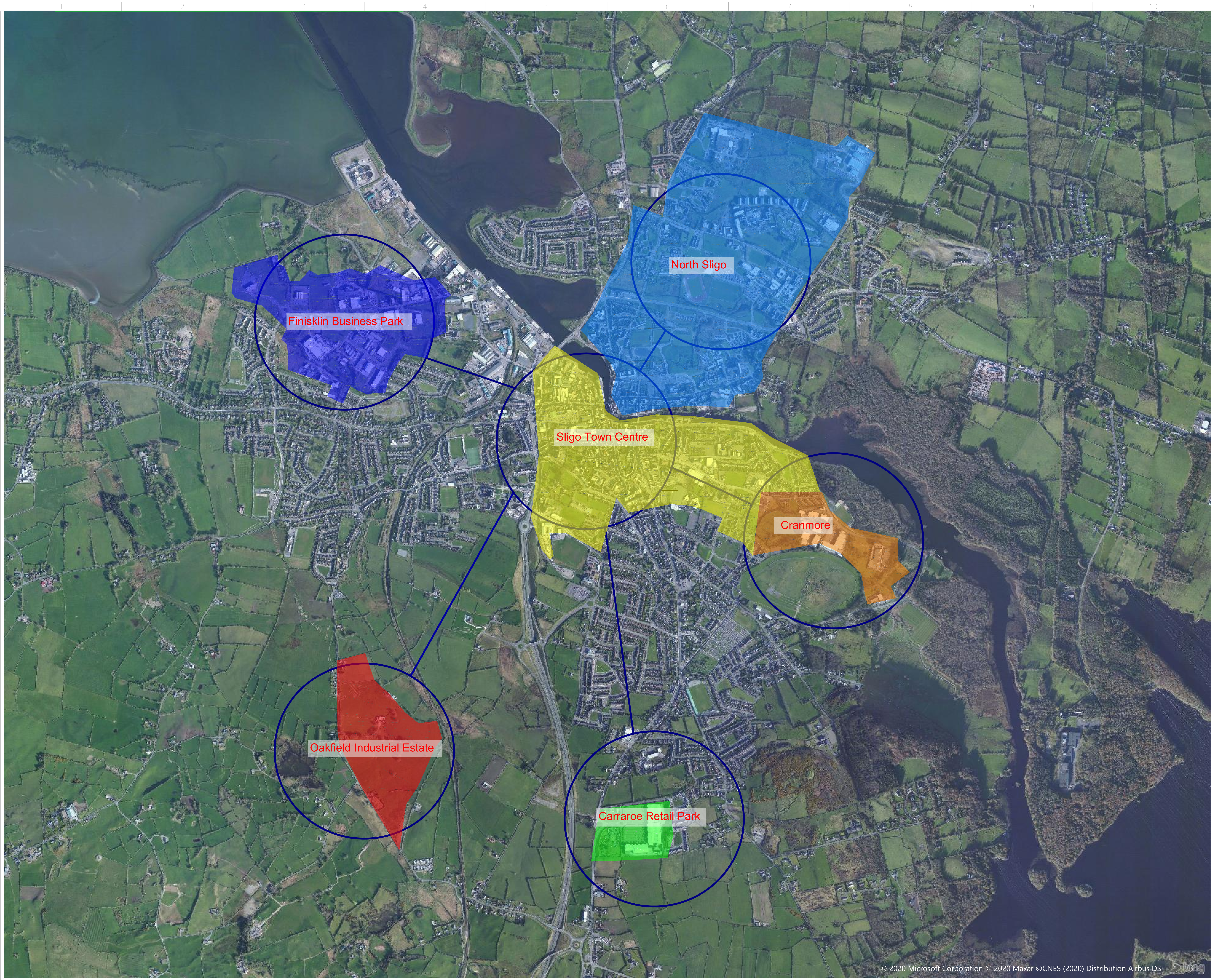
Project

SLIGO GAS NETWORK

PROCESS FLOW DIAGRAM

Drawn: R.McDONNELL	Scale: NTS/A3	Drawing Number: 1271-DP-0001	Rev.: 0
Chkd.: B.O'BOYLE	Date: 28/08/20	sheet 1 of 1	
Appr.: I.MURPHY	Status: ISSUED		



NOTES

ISSUED

REV.	DATE	REVISION	BY	CHKD.	APPR.
0	17/08/20	ISSUED	MAH	CC	IM

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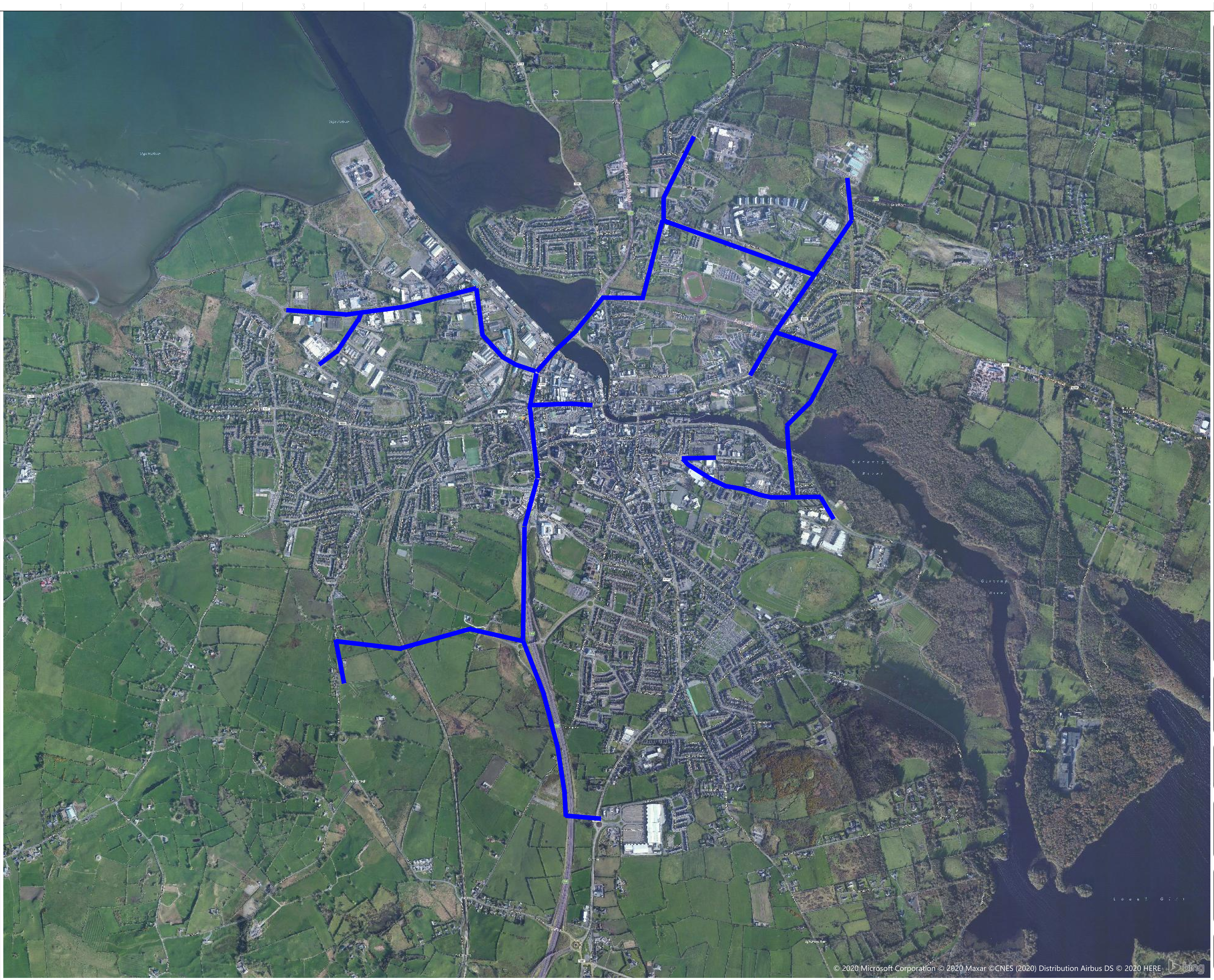
Project

SLIGO GAS NETWORK

Energy Hubs Map

Drawn	Scale	Drawing Number	Rev.
M.ABOUHAJAR	1:10,000	1271-DG-0003	0
Chkd. C.CULLEN	Date 17/08/20	sheet 1 of 1	
Apprd. I.MURPHY	Status ISSUED		



LEGEND:

FINAL GAS PIPELINE ROUTE

ISSUED

REV.	DATE	REVISION	BY	CHKD.	APPR.
0	17/08/20	ISSUED	MAH	CC	IM

Client

Institute of Technology Sligo
Ash Ln, Bellanode, Sligo,
F91 YW50
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Bridge Street Centre
Portlaoise
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Project

SLIGO GAS NETWORK

Final Route

Drawn	Scale	Drawing Number	Rev.
M.ABOUHAJAR	1:10,000	1271-DG-0004	0
Chkd. C.CULLEN	Date 17/08/20	sheet 1 of 1	
Appr. I.MURPHY	Status ISSUED		

APPENDIX 2 – LOAD ANALYSIS

Load Analysis - Sligo Network							
Customer	**Location**	**Customer Type**	**EAC (MWhrs)**	**Ratio Avg Hr. / Peak Hr.**	**Peak Day (SCMD)**	**Ave Hourly per Peak Day (SCMH)**	**Peak Hour (SCMH)**
Sligo University Hospital	North Sligo	Contract	8,024	0.6173	3,181	133	215
Abbvie - Manorhamilton Road	North Sligo	Contract	16,171	0.6173	6,411	267	433
Abbott Ireland - Finisklin	Finisklin Business Park	Contract	6,068	0.6173	2,406	100	162
Large Industrial	Oakfield	Contract	7,212		2,860	119	193
Total Contract Loads			**37,475**		**14,858**	**619**	**1,003**
North Sligo							
Sligo University Hospital	North Sligo	Contract	8,024	0.6173	3,181	133	215
Abbvie - Manorhamilton Road	North Sligo	Contract	16,171	0.6173	6,411	267	433
IT Sligo	North Sligo	Large	3,357	0.5208	1,578	66	126
St. John's Hospital	North Sligo	Large	2,538	0.5208	1,192	50	95
Abbvie - Ballytivnan	North Sligo	Large	3,312	0.5208	1,556	65	124
Clayton Hotel	North Sligo	Large	2,813	0.5208	1,322	55	106
St. Columbas Laundry	North Sligo	Large	1,340	0.5208	629	26	50
Markievicz House	North Sligo	Medium	523	0.4808	266	11	23
Other Small IC Loads	North Sligo	Small	2,109	0.5208	991	41	79
Other Medium IC Loads	North Sligo	Medium	0				
Other Large IC Loads	North Sligo	Large	0				
Total North Sligo			**40,187**		**17,127**	**714**	**1,252**
Finisklin							
Abbott Ireland - Finisklin	Finisklin Business Park	Contract	6,068	0.6173	2,406	100	162
Abbott Ireland - Nutrition	Finisklin Business Park	Medium	331	0.4808	169	7	15
Avenue Mould	Finisklin Business Park	Small	59	0.3378	43	2	5
Enterprise Ireland	Finisklin Business Park	Small	85	0.3378	62	3	8
JOD	Finisklin Business Park	Small	99	0.3378	72	3	9
Prominent	Finisklin Business Park	Small	80	0.3378	58	2	7
Ward Automation	Finisklin Business Park	Small	50	0.3378	36	2	4
An Post Mail Centre	Finisklin Business Park	Small	150	0.3378	109	5	13
Creche	Finisklin Business Park	Small	20	0.3378	14	1	2
Andrew Medical	Finisklin Business Park	Small	23	0.3378	17	1	2
Other Small IC Loads	Finisklin Business Park	Small	336	0.4808	171	7	15
Other Medium IC Loads	Finisklin Business Park	Medium	1,005	0.4808	512	21	44
Other Large IC Loads	Finisklin Business Park	Large	0				
Total Finisklin Business Park			**8,306**		**3,667**	**153**	**287**
Sligo Town							
SCC Riverside Offices	Town Centre	Medium	761	0.4808	387	16	34
Sligo Fire Station	Town Centre	Small	122	0.3378	88	4	11
Sligo City Hall	Town Centre	Small	196	0.3378	142	6	18
Nazereth House (South of River)	Town Centre	Medium	374	0.4808	191	8	17
Various	Town Centre	Medium	252	0.4808	128	5	11
Other Small IC Loads	Town Centre	Small	11,146	0.6173	4,420	184	298
Other Medium IC Loads	Town Centre	Medium	6,068	0.6173	2,406	100	162
Other Large IC Loads	Town Centre	Large	2,129	0.5208	1,001	42	80
Total Sligo Town			**21,049**		**8,764**	**365**	**630**
Oakfield							
12no Advanced Technology Buildings	Oakfield	Medium	798	0.4808	406	17	35
Large Industrial Building	Oakfield	Contract	7,212	0.6173	2,860	119	193
Total Estimated Oakfield IDA Park			**8,010**		**3,266**	**136**	**228**
Carraroe							
Castle Devitt	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Costa	Carroroe Retail Park	Small	171	0.3378	124	5	15
Curry's PC World	Carroroe Retail Park	Medium	416	0.4808	212	9	18
EZ Living furniture	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Halford's	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Harry Corry	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Homebase	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Home Store & More	Carroroe Retail Park	Medium	416	0.4808	212	9	18
KFC	Carroroe Retail Park	Small	120	0.3378	87	4	11
McDonalds	Carroroe Retail Park	Small	140	0.3378	101	4	12
Pet Stop	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Right Price Tiles	Carroroe Retail Park	Medium	416	0.4808	212	9	18
SMYTH'S	Carroroe Retail Park	Medium	416	0.4808	212	9	18
Total Carroroe Retail Park			**4,595**		**2,432**	**101**	**222**
Cranmore							
Retail units (Expert, Argos, C&C etc)	Cranmore Region	Medium	1,141	0.4808	581	24	50
Park Alley Café	Cranmore Region	Small	155	0.3378	113	5	14
Lough Gill Brewery	Cranmore Region	Small	179	0.3378	130	5	16
Uniphar	Cranmore Region	Small	95	0.3378	69	3	8
Zero Gravity Skate Park	Cranmore Region	Medium	321	0.4808	164	7	14
Compupac IT	Cranmore Region	Small	40	0.3378	29	1	4
Pearse Road Tyre Service	Cranmore Region	Small	59	0.3378	43	2	5
Abbey Frozen Foods LTD	Cranmore Region	Small	87	0.3378	63	3	8
Retail Units	Cranmore Region	Medium	296	0.4808	151	6	13
Retail Units	Cranmore Region	Medium	250	0.4808	127	5	11
Apex Controls	Cranmore Region	Small	150	0.3378	109	5	13
Verus Metrology	Cranmore Region	Medium	1,024	0.4808	521	22	45
Sligo Regional Sports Centre	Cranmore Region	Large	1,209	0.5208	568	24	45
Other Small IC Loads	Cranmore Region	Small	52	0.3378	38	2	5
Other Medium IC Loads	Cranmore Region	Medium	214	0.4808	109	5	9
Other Large IC Loads	Cranmore Region	Large	0				
Total Cranmore Region			**5,273**		**2,814**	**117**	**262**
Total Network							
Total Terminal load			87,420		38,070	1,586	2,882
Low Uptake Terminal Load		20%	**47,464**		**19,500**	**813**	**1,379**
Medium Uptake Terminal Load		50%	**62,448**		**26,464**	**1,103**	**1,942**
High Uptake Terminal Load		80%	**77,431**		**33,428**	**1,393**	**2,506**

APPENDIX 3 – FINANCIAL APPRAISAL

LNG - Low Uptake

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.034
Unit Cost - Sligo Gas Network End User	€/kWhr	0.049
CAPEX	€	€4,277,298
OPEX / year	€	€521,402
Service Charge / year	€	€120,000

Inflation 2%

LNG - "5 to 10 year agreement"
LNG - "Service charge 100k - 120k p.a."
LNG - delivered gas 3.1 – 3.6 c/kWh

	Revenue per Year			Years						
Growth		Units	EAC (Low)	1	2	3	4	5	6	7
100% Yr 1	Contract I/Cs (100%)	MWhrs	37475	37475	37475	37475	37475	37475	37475	37475
25% per yr	Large I/Cs	MWhrs	3340	835	1670	2505	3340	3340	3340	3340
20% per yr	Medium	MWhrs	3505	701	1402	2103	2804	3505	3505	3505
15% per yr	Small	MWhrs	3145	472	943	1415	1887	2359	2830	3145
	Load Total	MWhrs	47464	39482	41490	43497	45505	46678	47149	47464
	Unit Cost - Gas Supplier	€/kWhr	0.034							
	Gas Cost per Year	€	€1,613,774	€1,342,402	€1,410,659	€1,478,915	€1,547,171	€1,587,042	€1,603,081	€1,613,774
	Unit Cost - End User	€/kWhr	0.049							
	Revenue per Year	€	€2,335,153	€1,942,475	€2,041,243	€2,140,010	€2,238,778	€2,296,471	€2,319,680	€2,335,153

	Years												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€1,342,402	€1,438,872	€1,538,663	€1,641,870	€1,717,865	€1,769,931	€1,817,371	€1,853,719	€1,890,793	€1,928,609	€1,967,181	€2,006,525
OPEX / YEAR		€521,402	€531,830	€542,467	€553,316	€564,382	€575,670	€587,183	€598,927	€610,906	€623,124	€635,586	€648,298
Service Charge / Year		€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€146,279	€146,279
Annual Gas Revenue		€1,942,475	€2,082,067	€2,226,467	€2,375,809	€2,485,774	€2,561,115	€2,629,762	€2,682,357	€2,736,004	€2,790,724	€2,846,538	€2,903,469
Margin	-€4,277,298	-€41,330	-€8,634	€25,337	€60,623	€83,527	€95,514	€105,207	€109,711	€114,305	€118,991	€97,492	€102,367
Balance	-€4,277,298	-€4,318,627	-€4,327,262	-€4,301,925	-€4,241,302	-€4,157,775	-€4,062,261	-€3,957,054	-€3,847,343	-€3,733,038	-€3,614,047	-€3,516,555	-€3,414,188

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€2,046,655	€2,087,588	€2,129,340	€2,171,927	€2,215,365	€2,259,673	€2,304,866	€2,350,964	€2,397,983	€2,445,942	€2,494,861	€2,544,759	€2,595,654
OPEX / YEAR	€661,264	€674,489	€687,979	€701,739	€715,773	€730,089	€744,691	€759,584	€774,776	€790,272	€806,077	€822,199	€838,643
Service Charge / Year	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€178,314	€178,314	€178,314	€178,314	€178,314
Annual Gas Revenue	€2,961,539	€3,020,769	€3,081,185	€3,142,808	€3,205,665	€3,269,778	€3,335,173	€3,401,877	€3,469,914	€3,539,313	€3,610,099	€3,682,301	€3,755,947
Margin	€107,340	€112,412	€117,586	€122,864	€128,246	€133,737	€139,337	€145,050	€118,842	€124,785	€130,847	€137,030	€143,337
Balance	-€3,306,848	-€3,194,435	-€3,076,849	-€2,953,986	-€2,825,739	-€2,692,002	-€2,552,665	-€2,407,615	-€2,288,773	-€2,163,988	-€2,033,141	-€1,896,111	-€1,752,774

NPV Calculation			
NPV for 25yrs	-€3,045,638	5.00%	Rate
IRR	-5%		

LNG - Medium Uptake (BASE CASE)

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.034
Unit Cost - Sligo Gas Network End User	€/kWhr	0.049
CAPEX	€	€4,704,298
OPEX / year	€	€521,402
Service Charge / year	€	€120,000

Inflation 2%

LNG - "5 to 10 year agreement"
LNG - "Service charge 100k - 120k p.a."
LNG - delivered gas 3.1 – 3.6 c/kWh

Growth	Revenue per Year	Units	EAC (Med)	Years 1	2	3	4	5	6	7
100% Yr 1	Contract I/Cs (100%)	MWh	37475	37475	37475	37475	37475	37475	37475	37475
25% per yr	Large I/Cs	MWh	8349	2087	4174	6262	8349	8349	8349	8349
20% per yr	Medium	MWh	8761	1752	3505	5257	7009	8761	8761	8761
15% per yr	Small	MWh	7862	1179	2359	3538	4717	5897	7076	7862
	Load Total	MWh	62448	42494	47513	52531	57550	60482	61661	62448
	Unit Cost - Gas Supplier	€/kWhr	0.034							
	Gas Cost per Year	€	€2,123,215	€1,444,787	€1,615,427	€1,786,068	€1,956,709	€2,056,385	€2,096,483	€2,123,215
	Unit Cost - End User	€/kWhr	0.049							
	Revenue per Year	€	€3,072,322	€2,090,627	€2,337,546	€2,584,465	€2,831,385	€2,975,618	€3,033,640	€3,072,322

	Years 0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€1,444,787	€1,647,736	€1,858,225	€2,076,475	€2,225,897	€2,314,687	€2,391,085	€2,438,907	€2,487,685	€2,537,439	€2,588,187	€2,639,951
OPEX / YEAR		€521,402	€531,830	€542,467	€553,316	€564,382	€575,670	€587,183	€598,927	€610,906	€623,124	€635,586	€648,298
Service Charge / Year		€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€146,279	€146,279
Annual Gas Revenue		€2,090,627	€2,384,297	€2,688,878	€3,004,688	€3,220,904	€3,349,384	€3,459,933	€3,529,132	€3,599,715	€3,671,709	€3,745,143	€3,820,046
Margin	-€4,704,298	€4,438	€84,731	€168,186	€254,897	€310,625	€339,027	€361,665	€371,298	€381,124	€391,147	€375,090	€385,518
Balance	-€4,704,298	-€4,699,860	-€4,615,129	-€4,446,943	-€4,192,046	-€3,881,422	-€3,542,395	-€3,180,730	-€2,809,431	-€2,428,307	-€2,037,161	-€1,662,071	-€1,276,553

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€2,692,750	€2,746,605	€2,801,537	€2,857,568	€2,914,719	€2,973,014	€3,032,474	€3,093,124	€3,154,986	€3,218,086	€3,282,447	€3,348,096	€3,415,058
OPEX / YEAR	€661,264	€674,489	€687,979	€701,739	€715,773	€730,089	€744,691	€759,584	€774,776	€790,272	€806,077	€822,199	€838,643
Service Charge / Year	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€178,314	€178,314	€178,314	€178,314	€178,314
Annual Gas Revenue	€3,896,447	€3,974,376	€4,053,863	€4,134,941	€4,217,640	€4,301,992	€4,388,032	€4,475,793	€4,565,309	€4,656,615	€4,749,747	€4,844,742	€4,941,637
Margin	€396,154	€407,002	€418,068	€429,355	€440,867	€452,610	€464,588	€476,806	€457,233	€469,944	€482,909	€496,133	€509,622
Balance	-€880,399	-€473,397	-€55,329	€374,025	€814,893	€1,267,503	€1,732,091	€2,208,897	€2,666,130	€3,136,074	€3,618,983	€4,115,116	€4,624,738

NPV Calculation			
NPV for 25yrs	€0	5.00%	Rate
IRR	5%		

LNG - High Uptake

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.034
Unit Cost - Sligo Gas Network End User	€/kWhr	0.049
CAPEX	€	€5,119,048
OPEX / year	€	€521,402
Service Charge / year	€	€120,000

Inflation 2%

LNG - "5 to 10 year agreement"
LNG - "Service charge 100k - 120k p.a."
LNG - delivered gas 3.1 – 3.6 c/kWh

Growth	Revenue per Year	Units	EAC (High)	Years 1	2	3	4	5	6	7
100% Yr 1	Contract I/Cs (100%)	MWhrs	37475	37475	37475	37475	37475	37475	37475	37475
25% per yr	Large I/Cs	MWhrs	13358	3340	6679	10019	13358	13358	13358	13358
20% per yr	Medium	MWhrs	14018	2804	5607	8411	11215	14018	14018	14018
15% per yr	Small	MWhrs	12580	1887	3774	5661	7548	9435	11322	12580
	Load Total	MWhrs	77431	45505	53535	61565	69595	74286	76173	77431
	Unit Cost - Gas Supplier	€/kWhr	0.034							
	Gas Cost per Year	€	€2,632,657	€1,547,171	€1,820,196	€2,093,221	€2,366,246	€2,525,728	€2,589,885	€2,632,657
	Unit Cost - End User	€/kWhr	0.049							
	Revenue per Year	€	€3,809,491	€2,238,778	€2,633,849	€3,028,920	€3,423,992	€3,654,764	€3,747,600	€3,809,491

Years	0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€1,547,171	€1,856,600	€2,177,787	€2,511,080	€2,733,930	€2,859,443	€2,964,799	€3,024,095	€3,084,577	€3,146,268	€3,209,194	€3,273,378
OPEX / YEAR		€521,402	€531,830	€542,467	€553,316	€564,382	€575,670	€587,183	€598,927	€610,906	€623,124	€635,586	€648,298
Service Charge / Year		€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€146,279	€146,279
Annual Gas Revenue		€2,238,778	€2,686,526	€3,151,289	€3,633,567	€3,956,034	€4,137,653	€4,290,105	€4,375,907	€4,463,426	€4,552,694	€4,643,748	€4,736,623
Margin	-€5,119,048	€50,205	€178,096	€311,035	€449,171	€537,722	€582,541	€618,123	€632,885	€647,943	€663,302	€652,689	€668,668
Balance	-€5,119,048	-€5,068,843	-€4,890,747	-€4,579,712	-€4,130,541	-€3,592,819	-€3,010,278	-€2,392,155	-€1,759,270	-€1,111,326	-€448,025	€204,664	€873,332

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€3,338,845	€3,405,622	€3,473,734	€3,543,209	€3,614,073	€3,686,355	€3,760,082	€3,835,284	€3,911,989	€3,990,229	€4,070,034	€4,151,434	€4,234,463
OPEX / YEAR	€661,264	€674,489	€687,979	€701,739	€715,773	€730,089	€744,691	€759,584	€774,776	€790,272	€806,077	€822,199	€838,643
Service Charge / Year	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€178,314	€178,314	€178,314	€178,314	€178,314
Annual Gas Revenue	€4,831,355	€4,927,982	€5,026,542	€5,127,073	€5,229,614	€5,334,207	€5,440,891	€5,549,709	€5,660,703	€5,773,917	€5,889,395	€6,007,183	€6,127,327
Margin	€684,967	€701,592	€718,549	€735,846	€753,488	€771,484	€789,839	€808,561	€795,624	€815,103	€834,971	€855,237	€875,908
Balance	€1,558,299	€2,259,891	€2,978,440	€3,714,286	€4,467,775	€5,239,259	€6,029,098	€6,837,659	€7,633,283	€8,448,385	€9,283,356	€10,138,593	€11,014,501

NPV Calculation			
NPV for 25yrs	€3,057,888	5%	Rate
IRR	9%		

CNG - Low Uptake

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.02
Unit Cost - Sligo Gas Network End User	€/kWhr	0.045
CAPEX	€	€8,974,184
OPEX / year	€	€958,202
Service Charge / year	€	€0

Inflation 2%

Growth	Revenue per Year	Units	EAC (Low)	1	2	3	4	5	6	7
100% Yr 1	Contract I/Cs (100%)	MWhrs	37475	37475	37475	37475	37475	37475	37475	37475
25% per yr	Large I/Cs	MWhrs	3340	835	1670	2505	3340	3340	3340	3340
20% per yr	Medium	MWhrs	3505	701	1402	2103	2804	3505	3505	3505
15% per yr	Small	MWhrs	3145	472	943	1415	1887	2359	2830	3145
	Load Total	MWhrs	47464	39482	41490	43497	45505	46678	47149	47464
	Unit Cost - Gas Supplier	€/kWhr	0.02							
	Gas Cost per Year	€		€789,648	€829,799	€869,950	€910,101	€933,554	€942,989	€949,279
	Unit Cost - End User	€/kWhr	0.045							
	Revenue per Year	€		€1,786,243	€1,877,067	€1,967,891	€2,058,715	€2,111,768	€2,133,111	€2,147,339

Years	0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€789,648	€846,395	€905,096	€965,806	€1,010,509	€1,041,136	€1,069,042	€1,090,423	€1,112,231	€1,134,476	€1,157,165	€1,180,309
OPEX / YEAR		€958,202	€977,366	€996,913	€1,016,852	€1,037,189	€1,057,933	€1,079,091	€1,100,673	€1,122,686	€1,145,140	€1,168,043	€1,191,404
Service Charge / Year		€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0
Annual Gas Revenue		€1,786,243	€1,914,609	€2,047,394	€2,184,725	€2,285,846	€2,355,127	€2,418,252	€2,466,617	€2,515,950	€2,566,269	€2,617,594	€2,669,946
Margin	-€8,974,184	€38,393	€90,847	€145,385	€202,067	€238,148	€256,058	€270,119	€275,522	€281,032	€286,653	€292,386	€298,233
Balance	-€8,974,184	-€8,935,791	-€8,844,943	-€8,699,558	-€8,497,491	-€8,259,343	-€8,003,284	-€7,733,165	-€7,457,643	-€7,176,611	-€6,889,959	-€6,597,573	-€6,299,340

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€1,203,915	€1,227,993	€1,252,553	€1,277,604	€1,303,156	€1,329,219	€1,355,804	€1,382,920	€1,410,578	€1,438,790	€1,467,565	€1,496,917	€1,526,855
OPEX / YEAR	€1,215,232	€1,239,537	€1,264,327	€1,289,614	€1,315,406	€1,341,714	€1,368,549	€1,395,920	€1,423,838	€1,452,315	€1,481,361	€1,510,988	€1,541,208
Service Charge / Year	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0
Annual Gas Revenue	€2,723,345	€2,777,812	€2,833,368	€2,890,035	€2,947,836	€3,006,793	€3,066,929	€3,128,267	€3,190,833	€3,254,649	€3,319,742	€3,386,137	€3,453,860
Margin	€304,198	€310,282	€316,488	€322,817	€329,274	€335,859	€342,576	€349,428	€356,417	€363,545	€370,816	€378,232	€385,797
Balance	-€5,995,141	-€5,684,859	-€5,368,372	-€5,045,554	-€4,716,280	-€4,380,421	-€4,037,844	-€3,688,416	-€3,332,000	-€2,968,455	-€2,597,639	-€2,219,407	-€1,833,610

NPV Calculation			
NPV for 25yrs	-€5,340,326	5.00%	Rate
IRR	-1%		

CNG - High Uptake

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.02
Unit Cost - Sligo Gas Network End User	€/kWhr	0.045
CAPEX	€	€9,815,934
OPEX / year	€	€958,202
Service Charge / year	€	€0
Inflation		2%

	Revenue per Year			Years						
Growth		Units	EAC (High)	1	2	3	4	5	6	7
100% Yr 1	Contract I/Cs (100%)	MWhrs	37475	37475	37475	37475	37475	37475	37475	37475
25% per yr	Large I/Cs	MWhrs	13358	3340	6679	10019	13358	13358	13358	13358
20% per yr	Medium	MWhrs	14018	2804	5607	8411	11215	14018	14018	14018
15% per yr	Small	MWhrs	12580	1887	3774	5661	7548	9435	11322	12580
	Load Total	MWhrs	77431	45505	53535	61565	69595	74286	76173	77431
	Unit Cost - Gas Supplier	€/kWhr	0.02							
	Gas Cost per Year	€		€910,101	€1,070,704	€1,231,307	€1,391,910	€1,485,723	€1,523,462	€1,548,622
	Unit Cost - End User	€/kWhr	0.045							
	Revenue per Year	€		€2,058,715	€2,422,011	€2,785,307	€3,148,603	€3,360,815	€3,446,184	€3,503,097

	Years												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€910,101	€1,092,118	€1,281,051	€1,477,106	€1,608,194	€1,682,025	€1,743,999	€1,778,879	€1,814,457	€1,850,746	€1,887,761	€1,925,516
OPEX / YEAR		€958,202	€977,366	€996,913	€1,016,852	€1,037,189	€1,057,933	€1,079,091	€1,100,673	€1,122,686	€1,145,140	€1,168,043	€1,191,404
Service Charge / Year		€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0
Annual Gas Revenue		€2,058,715	€2,470,452	€2,897,834	€3,341,323	€3,637,854	€3,804,866	€3,945,056	€4,023,957	€4,104,437	€4,186,525	€4,270,256	€4,355,661
Margin	-€9,815,934	€190,413	€400,968	€619,869	€847,366	€992,472	€1,064,908	€1,121,966	€1,144,405	€1,167,293	€1,190,639	€1,214,452	€1,238,741
Balance	-€9,815,934	-€9,625,521	-€9,224,553	-€8,604,685	-€7,757,319	-€6,764,848	-€5,699,939	-€4,577,974	-€3,433,568	-€2,266,275	-€1,075,636	€138,816	€1,377,556

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€1,964,027	€2,003,307	€2,043,373	€2,084,241	€2,125,925	€2,168,444	€2,211,813	€2,256,049	€2,301,170	€2,347,194	€2,394,137	€2,442,020	€2,490,861
OPEX / YEAR	€1,215,232	€1,239,537	€1,264,327	€1,289,614	€1,315,406	€1,341,714	€1,368,549	€1,395,920	€1,423,838	€1,452,315	€1,481,361	€1,510,988	€1,541,208
Service Charge / Year	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0
Annual Gas Revenue	€4,442,774	€4,531,630	€4,622,262	€4,714,707	€4,809,002	€4,905,182	€5,003,285	€5,103,351	€5,205,418	€5,309,526	€5,415,717	€5,524,031	€5,634,512
Margin	€1,263,516	€1,288,786	€1,314,562	€1,340,853	€1,367,670	€1,395,023	€1,422,924	€1,451,382	€1,480,410	€1,510,018	€1,540,219	€1,571,023	€1,602,443
Balance	€2,641,072	€3,929,858	€5,244,420	€6,585,273	€7,952,943	€9,347,966	€10,770,890	€12,222,272	€13,702,682	€15,212,700	€16,752,919	€18,323,942	€19,926,385

NPV Calculation			
NPV for 25yrs	€5,352,576	5.00%	Rate
IRR	9%		

LNG - North Sligo and Finisklin (only) - Low Uptake

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.034
Unit Cost - Sligo Gas Network End User	€/kWhr	0.045
CAPEX	€	€2,497,795
OPEX / year	€	€516,495
Service Charge / year	€	€120,000

Inflation 2%

LNG - "5 to 10 year agreement"
LNG - "Service charge 100k - 120k p.a."
LNG - delivered gas 3.1 – 3.6 c/kWh

Revenue per Year			Years						
	Units	EAC (Low)	1	2	3	4	5	6	7
Contract I/Cs (100%)	MWhrs	30263	30263	30263	30263	30263	30263	30263	30263
Large I/Cs	MWhrs	2672	668	1336	2004	2672	2672	2672	2672
Medium	MWhrs	372	74	149	223	298	372	372	372
Small	MWhrs	602	90	181	271	361	452	542	602
Load Total	MWhrs	33909	31096	31928	32761	33594	33758	33849	33909
Unit Cost - Gas Supplier	€/kWhr	0.034							
Gas Cost per Year	€		€1,057,250	€1,085,562	€1,113,874	€1,142,187	€1,147,787	€1,150,859	€1,152,906
Unit Cost - End User	€/kWhr	0.045							
Revenue per Year	€		€1,406,811	€1,444,484	€1,482,157	€1,519,830	€1,527,283	€1,531,370	€1,534,094

	Years												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€1,057,250	€1,107,274	€1,158,875	€1,212,097	€1,242,402	€1,270,641	€1,298,360	€1,324,327	€1,350,814	€1,377,830	€1,405,386	€1,433,494
OPEX / YEAR		€516,495	€526,825	€537,361	€548,108	€559,071	€570,252	€581,657	€593,290	€605,156	€617,259	€629,604	€642,196
Service Charge / Year		€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€120,000	€146,279	€146,279
Annual Gas Revenue		€1,406,811	€1,473,374	€1,542,036	€1,612,856	€1,653,180	€1,690,756	€1,727,639	€1,762,192	€1,797,436	€1,833,384	€1,870,052	€1,907,453
Margin	-€2,497,795	-€286,934	-€280,725	-€274,200	-€267,350	-€268,293	-€270,137	-€272,378	-€275,425	-€278,534	-€281,704	-€311,218	-€314,517
Balance	-€2,497,795	-€2,784,729	-€3,065,454	-€3,339,654	-€3,607,004	-€3,875,297	-€4,145,434	-€4,417,812	-€4,693,237	-€4,971,771	-€5,253,476	-€5,564,694	-€5,879,210

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€1,462,164	€1,491,407	€1,521,235	€1,551,660	€1,582,693	€1,614,347	€1,646,634	€1,679,567	€1,713,158	€1,747,421	€1,782,370	€1,818,017	€1,854,378
OPEX / YEAR	€655,040	€668,141	€681,504	€695,134	€709,037	€723,217	€737,682	€752,435	€767,484	€782,834	€798,490	€814,460	€830,750
Service Charge / Year	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€146,279	€178,314	€178,314	€178,314	€178,314	€178,314
Annual Gas Revenue	€1,945,602	€1,984,514	€2,024,205	€2,064,689	€2,105,982	€2,148,102	€2,191,064	€2,234,885	€2,279,583	€2,325,175	€2,371,678	€2,419,112	€2,467,494
Margin	-€317,881	-€321,313	-€324,814	-€328,385	-€332,027	-€335,742	-€339,531	-€343,396	-€379,373	-€383,394	-€387,496	-€391,679	-€395,947
Balance	-€6,197,092	-€6,518,405	-€6,843,219	-€7,171,604	-€7,503,631	-€7,839,373	-€8,178,904	-€8,522,300	-€8,901,673	-€9,285,067	-€9,672,563	-€10,064,242	-€10,460,189

NPV Calculation			
NPV for 25yrs	€5,625,902	5.00%	Rate
IRR	10%		

CNG - North Sligo and Finisklin (only) - Low Uptake

Inputs		
Unit Cost - Gas Supply from GNI Network	€/kWhr	0.02
Unit Cost - Sligo Gas Network End User	€/kWhr	0.045
CAPEX	€	€7,304,843
OPEX / year	€	€804,783
Service Charge / year	€	€0
Inflation		2%

Revenue per Year			Years						
	Units	EAC (Low)	1	2	3	4	5	6	7
Contract I/Cs (100%)	MWhrs	30263	30263	30263	30263	30263	30263	30263	30263
Large I/Cs	MWhrs	2672	668	1336	2004	2672	2672	2672	2672
Medium	MWhrs	372	74	149	223	298	372	372	372
Small	MWhrs	602	90	181	271	361	452	542	602
Load Total	MWhrs	33909	31096	31928	32761	33594	33758	33849	33909
Unit Cost - Gas Supplier	€/kWhr	0.02							
Gas Cost per Year	€		€621,912	€638,566	€655,220	€671,874	€675,169	€676,976	€678,180
Unit Cost - End User	€/kWhr	0.045							
Revenue per Year	€		€1,406,811	€1,444,484	€1,482,157	€1,519,830	€1,527,283	€1,531,370	€1,534,094

	Years												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Annual Gas Cost		€1,807	€3,686	€5,639	€7,669	€9,778	€11,968	€13,564	€779,016	€794,596	€810,488	€826,698	€843,232
OPEX / YEAR		€804,783	€820,878	€837,296	€854,042	€871,123	€888,545	€906,316	€924,442	€942,931	€961,790	€981,026	€1,000,646
Service Charge / Year		€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0
Annual Gas Revenue		€4,087	€8,337	€12,756	€17,348	€22,119	€27,073	€30,683	€1,762,192	€1,797,436	€1,833,384	€1,870,052	€1,907,453
Margin	-€7,304,843	-€802,503	-€816,227	-€830,179	-€844,363	-€858,782	-€873,440	-€889,197	€58,734	€59,908	€61,106	€62,328	€63,575
Balance	-€7,304,843	-€8,107,345	-€8,923,572	-€9,753,751	-€10,598,114	-€11,456,896	-€12,330,337	-€13,219,534	-€13,160,800	-€13,100,892	-€13,039,786	-€12,977,457	-€12,913,882

	13	14	15	16	17	18	19	20	21	22	23	24	25
Annual Gas Cost	€860,096	€877,298	€894,844	€912,741	€930,996	€949,616	€968,608	€987,981	€1,007,740	€1,027,895	€1,048,453	€1,069,422	€1,090,810
OPEX / YEAR	€1,020,659	€1,041,072	€1,061,894	€1,083,132	€1,104,794	€1,126,890	€1,149,428	€1,172,417	€1,195,865	€1,219,782	€1,244,178	€1,269,061	€1,294,443
Service Charge / Year	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0	€0
Annual Gas Revenue	€1,945,602	€1,984,514	€2,024,205	€2,064,689	€2,105,982	€2,148,102	€2,191,064	€2,234,885	€2,279,583	€2,325,175	€2,371,678	€2,419,112	€2,467,494
Margin	€64,847	€66,143	€67,466	€68,816	€70,192	€71,596	€73,028	€74,488	€75,978	€77,498	€79,048	€80,629	€82,241
Balance	-€12,849,036	-€12,782,892	-€12,715,426	-€12,646,610	-€12,576,418	-€12,504,822	-€12,431,795	-€12,357,306	-€12,281,328	-€12,203,830	-€12,124,783	-€12,044,154	-€11,961,913

NPV Calculation			
NPV for 25yrs	-€11,612,225	5.00%	Rate
IRR	-13%		

APPENDIX 4 – DECANTING FACILITY COMPARISON MATRIX

NOTES

ISSUED

REV.	DATE	REVISION	BY	CHKD.	APPR.
0	28/08/20	ISSUED	MAH	CC	IM

Client

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Project

SLIGO GAS NETWORK

Injection Site Location Options

Drawn: M.ABOUHAJAR	Scale: 1:10,000	Drawing Number: 1271-DG-0006	Rev.: 0
Chkd.: C.CULLEN	Date: 28/08/20	sheet 1 of 1	
Apprd.: I.MURPHY	Status: ISSUED		

	Location	As marked on map	1	2	3	4	5
Location	**Latitude and Longitud**	If available	54°16'48.3"N 8°29'34.6"W	54°16'37.4"N 8°29'23.2"W	54°16'38.5"N 8°29'59.5"W	54°16'37.3"N 8°30'13.6"W	54°15'56.9"N 8°30'23.7"W
	Land Owner	From landdirect.ie	Sligo County Council	IDA	Abbott Ireland	IDA	Unknown, presumed private agri
	Proximity	Is the site within close proximity of the proposed network	within 500m of main route	Located directly adjacent to the main route	Located directly adjacent to the main r	Located directly adjacent to the main route	Located ~1km from pipeline
Environment	**Flat area**	Be situated on a relatively flat area of land typically 50m x 50m minimum Level and slope of site to be considered with regards to ease of construction.	Yes	Yes	Yes	Slight rise, pond at end	yes
	Embankments	Not be located adjacent to any major (especially newly constructed) embankments. If cut/fill is required to obtain a level site, this shall increase the required lands take.	None present	None present	None present	None present	None present
	Flooding	Liable to flooding?	no	no	no	no	no
Existing Services	**Electrical Services**	Are there signs of ESB, street lighting or traffic lighting lines in the site vicinity?	ESB LV/MV Underground Route on mainroad	ESB LV/MV Underground cable along road	ESB LV/MV Underground cable along road	ESB LV/MV Underground cable along road	overhead wires
	Networks	Are there any signs of network/communications cabling throughout the site?	no	no	no	no	yes
	UG/OH Services	Is the site free from underground/overhead services	Yes	Yes	Yes	Yes	yes
Access	**Access (Heavy construction traffic)**	Have suitable access for heavy construction traffic from a public road (this may require a right of way through the customer's site)	Access from public road available	May require new site acces from public road. Potential for planning issues.	Would require new site acces from public road. Potential for planning issues.	Access from "Technology Drive" a private road within Finisklin Industrial Estate	New access required. Adjacent to junction
	Site vicinity	Is the site in the vicinity of a public road?	Accessed via public road, close to N4	Adjacent to public road, close to N4	Adjacent to public road, close to N4	Near western distributer road, N4	Near western distributer road
	Site Access/Traffic	Is there a high volume of traffic near the site? Are there any risks accessing or egressing the site?	Two access options 1. Along N4 to the river and through the north end of Finsklin Industrial Park. 2. Along Western Distributor Road and through south end of Finsklin Industrial Park. Access is through an industrial area.	On busy main road beside school. Two access options 1. Along N4 to the river and through the north end of Finsklin Industrial Park. 2. Along Western Distributor Road and through south end of Finsklin Industrial Park Proximity to school is a risk	Two access options 1. Along N4 to the river and through the north end of Finsklin Industrial Park. 2. Along Western Distributor Road and through south end of Finsklin Industrial Park	Two access options 1. Along N4 to the river and through the north end of Finsklin Industrial Park. 2. Along Western Distributor Road and through south end of Finsklin Industrial Park	Access by Ballydoogan Road (3rd class road) from Oakfield road which will connect to western distributor road. Dense growing residential area.
Situation	**Neighbouring Sites**	Who are the neighbours that could be affected – How close are they?	Quickfit Tyres, CEF Electrical Wholesale, Greenstar Recycling, Sligo Fuels, Clearway Wastemanagement. No long term impact	Ursuline College, Abtrain Sligo, Avenue Mould Solutions Limited. Proximity to school and office may be a potential risk due to noise generation.	Abbott Ireland, An Post	Orchard Green and Prospect Drive Housing Estates, Overstock Ireland LTD	Kevinsfort/Mitchel Curly Park (Football Pitch), active farmland
	Existing Land	What is the current land use?	Unused site	Greenfield Site	Greenfield Site	Greenfield Site	Farmland
	Construction Issues	Are there any issues you can foresee with construction?	No	IDA may have plans already on this site. Located next to school	Lands are not publicly owned, due to prominent location within the business park it is unlikley that owners would sell lands for this purpose.	Neighbouring housing estate unfinished. Due to prominent location within the business park it is unlikley that owners would sell lands for this purpose.	None forseen

Location	**Location**	As marked on map	**6**	**7**	**8**	**9**	**10**
	Latitude and Longitud	If available	54°15'20.0"N 8°29'34.2"W	54°15'39.0"N 8°29'02.8"W	54°15'18.3"N 8°28'50.3"W	54°15'04.7"N 8°28'46.6"W	54°15'43.3"N 8°28'39.3"W
	Land Owner	From landdirect.ie	IDA	Sligo County Council	Private	Private	Unknown
	Proximity	Is the site within close proximity of the proposed network	within 200m of pipeline	Located directly adjacent to the main route	~1km from main pipeline, dependant on final rout	within 500m of pipeline route	Located within 500m from main pipeline. Crossing of N4 would be required to connect
Environment	**Flat area**	Be situated on a relatively flat area of land typically 50m x 50m minimum Level and slope of site to be considered with regards to ease of construction.	yes	yes, N4 built up beside the site.	Relatively flat	yes	Yes
	Embankments	Not be located adjacent to any major (especially newly constructed) embankments. If cut/fill is required to obtain a level site, this shall increase the required lands take.	None present	Slight embankment for N4 junction	None present	no	no
	Flooding	Liable to flooding?	no	no	no	no	no
Existing Services	**Electrical Services**	Are there signs of ESB, street lighting or traffic lighting lines in the site vicinity?	ESB line on mainroad and to be extended with building of Oakfield Industrial Estate	ESB LV/MV Route Overhead	ESB LV/MV Route Overhead MV Three Phase	ESB LV/MV Route Overhead on mainroad	ESB LV/MV Route Overhead MV Three Phase
	Networks	Are there any signs of network/communications cabling throughout the site?	no	ESB O/H, IW main through	ESB O/H through	no	yes
	UG/OH Services	Is the site free from underground/overhead services	no	yes	yes	no	yes
Access	**Access (Heavy construction traffic)**	Have suitable access for heavy construction traffic from a public road (this may require a right of way through the customer's site)	New access road required, the site is to the rear of the new business park	Entrance from new western distributor rd, proximity to roundabout may be an issue.	Access via slip road from N4 and then narrow rural road	Access via roundabout at wWetern Distributor reoad	Access via quiet side road
	Site vicinity	Is the site in the vicinity of a public road?	At edge of Oakfield Industrial Estate and western distributer road	N4, western distributor road.	Access via slip road from n4.	300m by road from N4.	N4
	Site Access/Traffic	Is there a high volume of traffic near the site? Are there any risks accessing or egressing the site?	Not at the moment. Traffic will increase with the building of the industrial estate.	Access via western distributor rd, proximity to roundabout may be an issue.	Local user traffic only	No major traffic.	Located on exit from N4 . Near busy residential area, but unlikely to be affected by this traffic.
Situation	**Neighbouring Sites**	Who are the neighbours that could be affected – How close are they?	New industrial estate, trainline, farmland. Surrounded by all IDA owned land.	N4, farmland, fields border house	Sligo County Council owned land, farmland, domestic house	N4. Other land owned by Mr Walter Burke. Shared entrance with domestgic house and unkown yard	Carpark, houses face the site.
	Existing Land	What is the current land use?	Farmland	Farmland	Farmland	Farmland	Greenfield site
	Construction Issues	Are there any issues you can foresee with construction?	Development of industrial estate. Roadway to site will need to be improved.	None forseen	none forseen	Shared access	There is a ringfort in the field directly adjacent to the site. Also close proximity to domestic premises

Location	**Location**	As marked on map	**11**	**12**	**13**	**14**
	Latitude and Longitud	If available	54°16'45.1"N 8°27'22.8"W	54°16'58.9"N 8°27'02.4"W	54°17'02.1"N 8°28'17.2"W	54°16'43.0"N 8°28'21.1"W
	Land Owner	From landdirect.ie	Leitrim - Sligo Mental Health Board	Private	Private	Private
	Proximity	Is the site within close proximity of the proposed network	Located adjacent to main pipeline. New entrance required	Located adjacent to main pipeline. New entrance required	Located within 200m of main pipeline	Located within 200m of main pipeline
Environment	**Flat area**	Be situated on a relatively flat area of land typically 50m x 50m minimum Level and slope of site to be considered with regards to ease of construction.	Yes	Yes	Yes	Yes
	Embankments	Not be located adjacent to any major (especially newly constructed) embankments. If cut/fill is required to obtain a level site, this shall increase the required lands take.	no	no	no obvious embankment, but river is located at the edge of the site.	None
	Flooding	Liable to flooding?	no	no	yes	yes, heavy regular flooding
Existing Services	**Electrical Services**	Are there signs of ESB, street lighting or traffic lighting lines in the site vicinity?	Serviced by ESB LV and ESB MV wires	No Electrical serviceS. IW main on mainroad.	ESB LV OH Single Phase	ESB LV/MV Route Overhead MV Three Phase
	Networks	Are there any signs of network/communications cabling throughout the site?	no	no	yes	yes
	UG/OH Services	Is the site free from underground/overhead services	no	no	yes	yes
Access	**Access (Heavy construction traffic)**	Have suitable access for heavy construction traffic from a public road (this may require a right of way through the customer's site)	Access via N16	Access via N16	Access from Elm Gardens, new access required	New opening onto national road required
	Site vicinity	Is the site in the vicinity of a public road?	Adjacent to N16	Adjacent to N16	Beside N15	Beside N15, can be accessed by N16.
	Site Access/Traffic	Is there a high volume of traffic near the site? Are there any risks accessing or egressing the site?	Located next to hospital and college, heavy regular traffic.	Situated on the North East of the town. Access for deliverys would be routed across Hughes Bridge and along the N16	Access from Elm Gardens, new access required. Shared with residential. Access for deliverys would be routed across Hughes Bridge and along the N16	New opening onto national road required
Situation	**Neighbouring Sites**	Who are the neighbours that could be affected – How close are they?	St. Columbas Hospital, IT Sligo, residential	AbbVie Manorhamilton, farmland	Beechwood housing estate, N15, deralict house on site	Funeral Home, retail warehouse, housing
	Existing Land	What is the current land use?	Greenfield Site	Farmland	Greenfield	Greenfield
	Construction Issues	Are there any issues you can foresee with construction?	In 2012 hospital was granted planning to build large carpark on the site.	None forseen	Proximity to river	Flooding problem is too large to overcome.