Greater Dublin Drainage

Alternative Sites Assessment - Phase Two
Sites Assessment and Route Selection Report

Engineering and Design

May 2012

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1 Introduction

1.1 Technical Assessment Criteria

The pipeline corridors to and from each of the nine potential WwTP sites are evaluated under the following technical criteria:

- Topography
- Engineering Design
- Health and Safety
- Access / Rights of Way / Wayleaves
- Crossings – Waterways, Rail, etc.
- Physical Infrastructure
- Strategic Utility Services
- Land Ownership and Titles
- Route Traffic Management
- Construction Risk

1.2 Environmental Assessment Criteria

Phase One of the Alternative WwTP Site Assessment (ASA) / Pipeline and Marine Routes Selection identified nine suitable land parcels within which the proposed Regional WwTP could potentially be located and identified marine outfall locations and transfer pipeline corridors for associated infrastructure in the northern part of the Greater Dublin Area.

Environmental assessments undertaken on each of the land parcels have allowed the identification of the most appropriate site location and orientation within each land parcels and have identified known environmental constraints within the transfer pipeline corridors and marine outfall study areas.

Construction of the wastewater treatment plant on all nine potential sites will be similar in nature and degree of technical difficulty. It is considered that there are no key differentiating criteria associated with any site therefore technical issues associated with the construction of the WwTP are ‘parked’ from evaluation at this stage.

It is feasible to route the Orbital sewers from the load centres to the WwTP and from the WwTP to the outfall within the pipeline corridors to generally avoid impacts on designated sites and significant areas of habitat.

This document therefore focuses on the technical criteria for the routing and construction of the transfer pipelines and marine outfall.

1.3 Pipeline Corridor References

Figure 1 shows the pipeline corridor references referred to throughout this document.

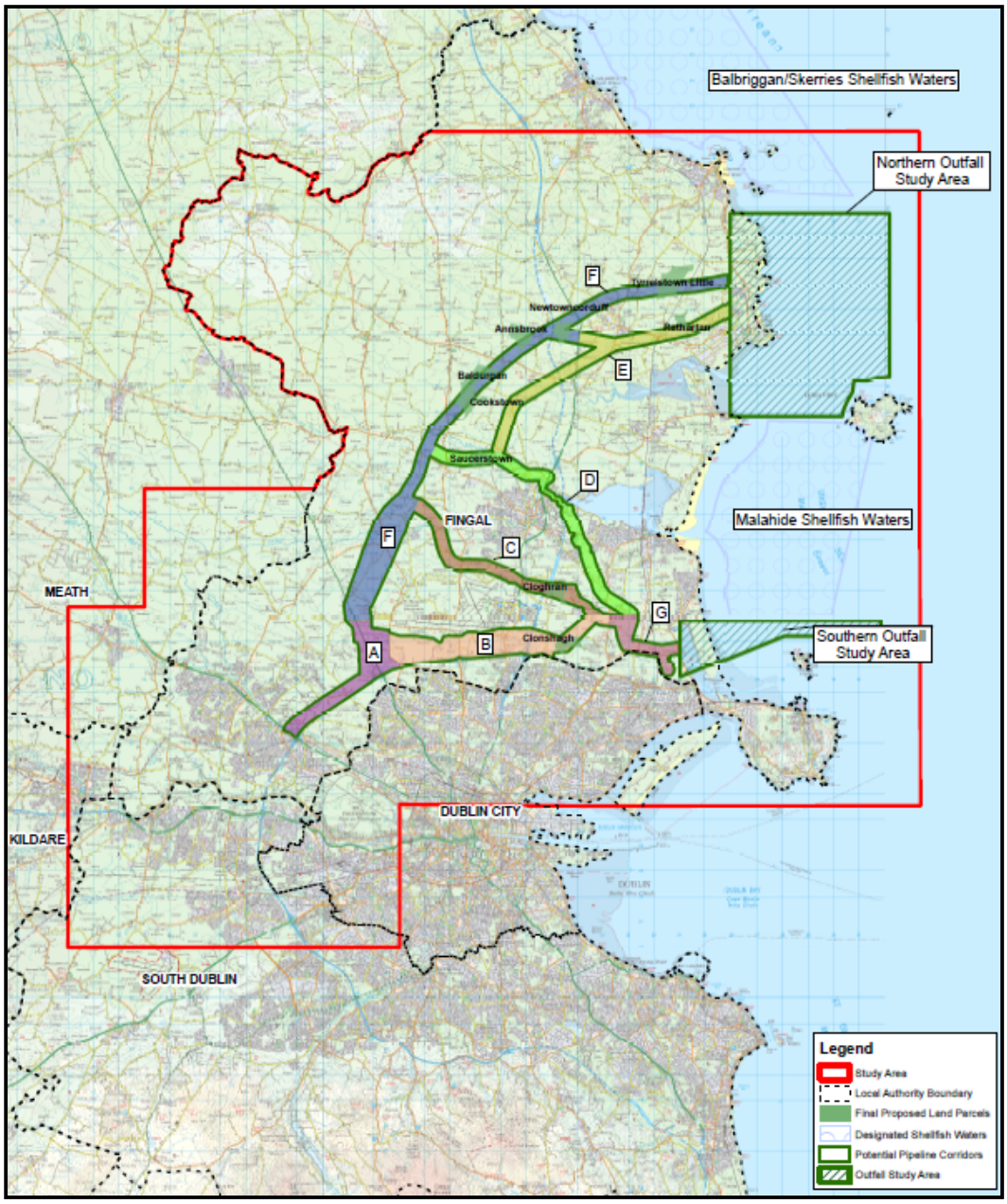


Figure 1: Pipeline Corridor References

2 Topography

2.1 Topography – General Description

The topography along the pipeline corridors is shown in Figure 2.

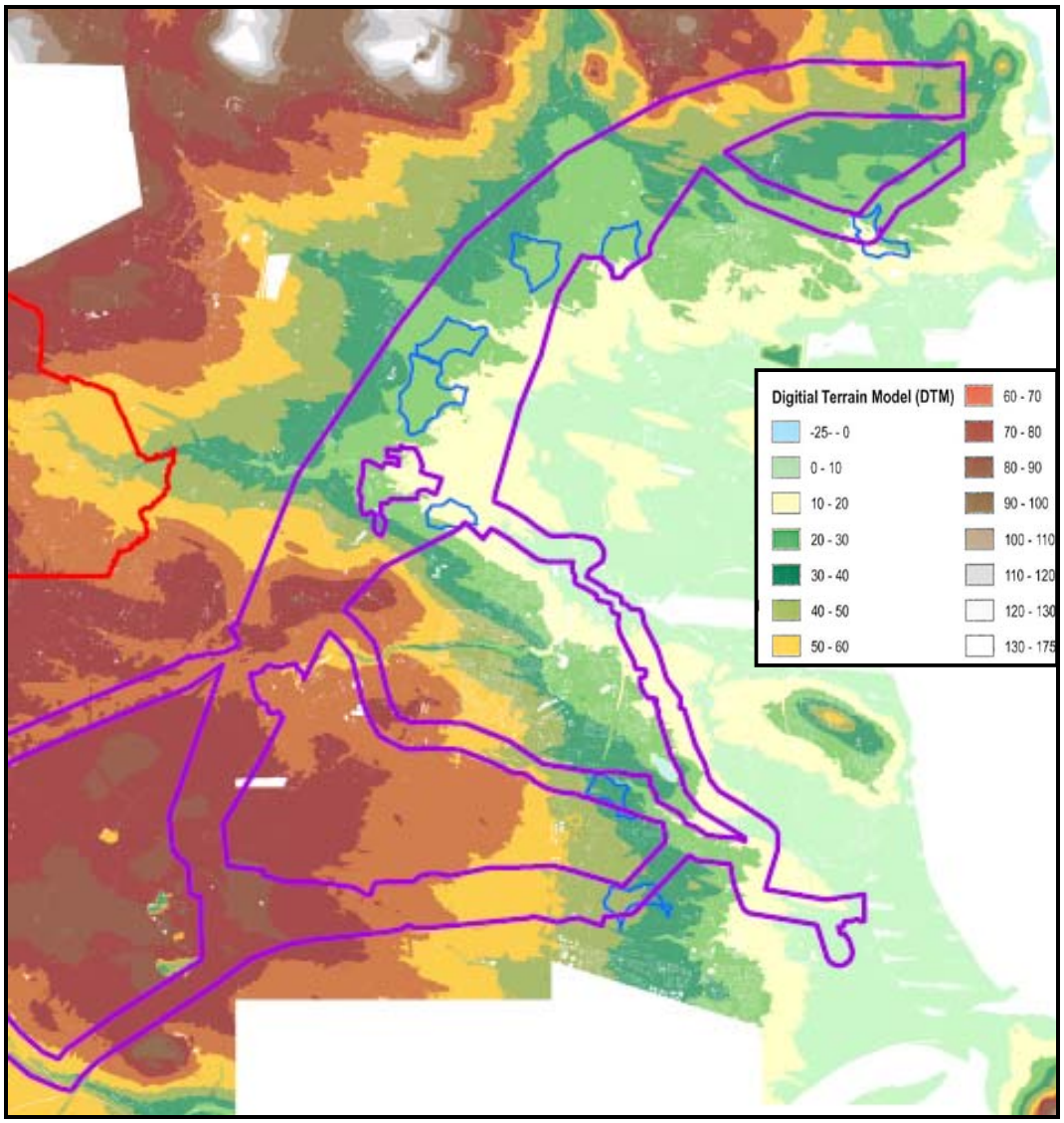


Figure 2: Topography Along Pipeline Corridors

2.1.1 Topography - Blanchardstown to Northern WwTP Site Options

It is proposed to intercept and divert the Blanchardstown Route 9C Sewer to the Orbital Drainage System immediately north west of the M50/N3 Interchange as shown in Figure 3. The point of interception lies in the grounds of James Connolly Memorial Hospital.

The invert level of the existing 9C at the proposed interception point, upstream of the M50, is of the order of 44.7mOD.

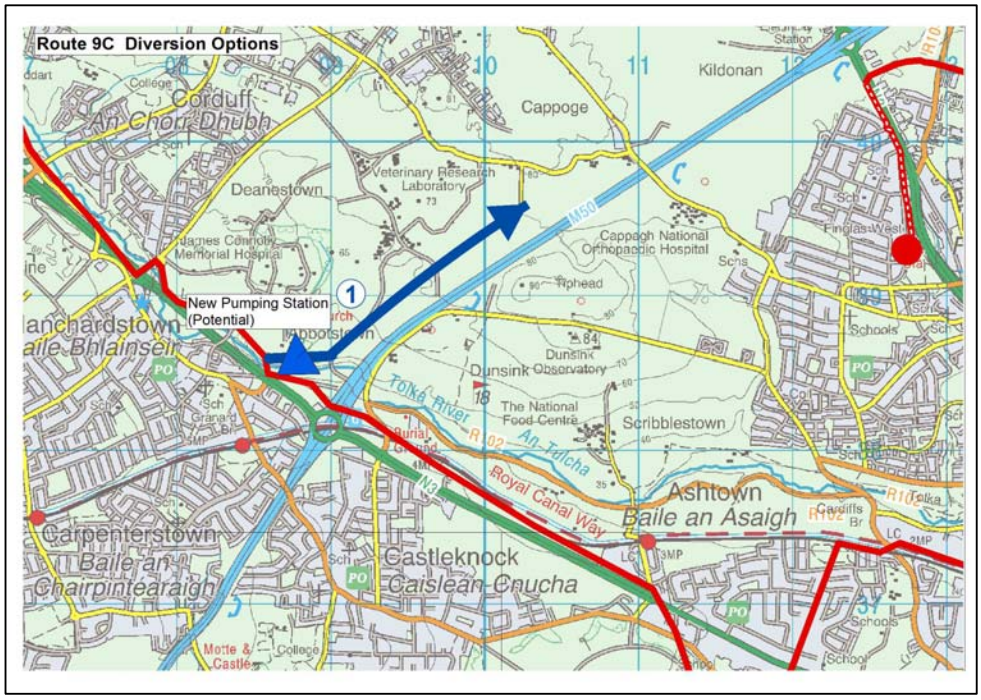


Figure 3: Interception of Blanchardstown Route 9C Sewer

The topography rises from the Tolka River Valley, at approximately the 40mOD contour, to in excess of 80mOD along pipeline corridor 'A'. This high level topography extends for approximately 12km along the pipeline corridors 'A' and 'F' before dropping below the 30mOD contour at the Broadmeadow River (some 14km from the 9C sewer interception point). For a further 8km along pipeline corridor 'F', extending from the Broadmeadow River to the potential WwTP Site at Newtowncorduff, the topography generally lies between the 20mOD and 30mOD contours. The topography generally rises above the 30mOD contour between the potential sites at Newtowncorduff and Tyrrelstown Little.

2.1.2 Topography - Blanchardstown to Southern WwTP Site Options

The topography rises from the Tolka River Valley, at approximately the 40mOD contour, to in excess of 80mOD along pipeline corridor 'A'. This high level topography extends for approximately 7km along the pipeline corridors 'A' and 'B' before gradually dropping towards the potential WwTP site at Clonshagh at a level of the order of 42mOD. Continuing from the potential Clonshagh WwTP site to the potential WwTP site at Cloghran the topography drops to the 20mOD contour before rising to the 40mOD contour at Cloghran.

2.1.3 Topography - North Dublin to the Southern WwTP Site Options

It is proposed to intercept the North Fringe Sewer near the Grange storm tank at Stapolin as shown in Figure 4 and divert flows to a new Grange Pumping Station for transfer to the Orbital Sewer.

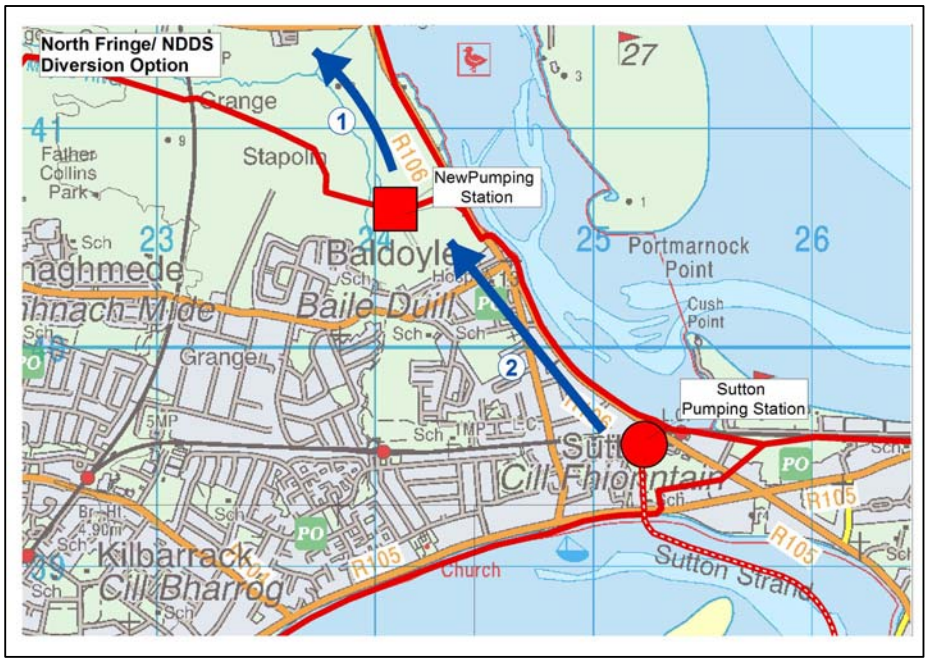


Figure 4: Interception of North Fringe / NDSS Sewers

The invert levels of the North Fringe Sewer (NFS) in the Grange area vary from 1.76mOD to 0.648mOD.

The topography from Grange to the potential Cloghran WwTP site is generally a rising profile from 2mOD to 40mOD.

Similarly, the topography from Grange to the potential Clonshagh WwTP site is generally a rising profile from 2mOD to 42mOD.

2.1.4 Topography - North Dublin to the Northern WwTP Site Options

The pipeline corridor 'C', from the NFS at Grange, is generally a gradually rising profile from 2mOD to 75mOD over a distance of some 10.5km at which point the ground profile drops towards the Ward River, at a level of 42mOD, before rising again to the 80mOD contour at a location some 13.5km from Grange.

Pipeline corridor 'D' from the NFS at Grange has a number of low and high points along the profile as follows:

- 2mOD low point at Grange;
- 20mOD high point 2.9km from Grange;
- 4mOD low point 3.3km from Grange;
- 28mOD high point 5.2km from Grange;
- 2mOD low point 9km from Grange;
- 41mOD high point 14.1km from Grange; and
- 32mOD low point 15.2km from Grange (end of pipeline corridor 'D').

Pipeline corridors 'C' and 'D' can serve the seven potential northern WwTP Sites.). However, pipeline corridor 'D' provides the lowest hydraulic static head for the pumped flows.

It is proposed that transfer pipelines from the Route 9C sewer at Blanchardstown and from the NFS at Grange to the potential WwTP site at Rathartan will be routed along corridor 'E' is. The topography along corridor 'E' varies from 8mOD to 20mOD at the potential Rathartan WwTP and rises to above the 40Mod contour in the northern outfall study area.

2.2 Impact of Topography on Pipeline Design

The following is a brief description of the impact of the topography of North Dublin on the design of transfer pipelines to and from the various potential WwTP Sites. It should be noted that the impact of topography is closely linked to the lengths of pipeline required and these have been referenced below where relevant. Section 3 of this report outlines in further detail the pipeline length requirements for the potential WwTP Sites.

2.2.1 Impact of Topography on Pipeline Design – Blanchardstown to Northern Sites

The topography between Blanchardstown and the seven Northern WwTP Sites will require either:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 3 above, with some 11.5km of rising main followed by a gravity sewer constructed using open cut and/or tunnelling techniques.
- or a gravity sewer constructed using tunnelling techniques at significant depths (of the order of 40m deep)

In addition it will be necessary to provide an inlet lift pumping station at the head of the treatment works at six of the seven potential sites, namely: Cookstown, Baldurgan, Annsbrook, Newtowncorduff, Tyrrelstown Little and Rathartan. It is feasible to achieve a gravitational inflow to the potential site at Saucerstown.

2.2.2 Impact of Topography on Pipeline Design – Blanchardstown to Southern Sites

The topography between Blanchardstown and the Southern WwTP Sites will require either:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 3 above, with some 3.5km of rising main followed by a gravity sewer constructed in part using open excavation and in part using tunneling techniques
- or a gravity sewer constructed using tunneling techniques

In addition it will be necessary to provide an inlet lift pumping station at the head of the treatment works at both potential southern sites.

2.2.3 Impact of Topography on Pipeline Design – North Fringe Sewer to Northern Sites

The topography between the NFS and the Northern WwTP Sites along pipeline corridor 'C' to the potential WwTP sites at Cookstown, Baldurgan, Annsbrook, Newtowncorduff and Tyrrelstown Little, will require:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 4 above, with some 13.5km of rising main connecting to the gravity sewer conveying the Blanchardstown flow diversion.

Similarly, the topography between the NFS and the Northern WwTP Sites along pipeline corridor 'D' to the potential WwTP sites at Cookstown, Baldurgan, Annsbrook, Newtowncorduff and Tyrrelstown Little, will require:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 4 above, with some 15.2km of rising main connecting to the gravity sewer conveying the Blanchardstown flow diversion.

The topography between the NFS and the potential WwTP Site at Saucerstown, along pipeline corridor 'D', will require:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 4 above, with some 13.0km of rising main.

The topography between the NFS and the potential WwTP Site at Rathartan, along pipeline corridor 'E', will require:

- a pumped solution, which will require the construction of a pumping station as indicated in Figure 4 above, with some 21.8km of rising main.

2.2.4 Impact of Topography on Pipeline Design – North Fringe Sewer to Southern Sites

A pumped solution, which will require the construction of a pumping station as indicated in Figure 4 above, will be required to transfer flows from the North Fringe Sewer to either of the two southern sites.

2.2.5 Impact of Topography on Outfall Design

The elevation of the nine potential sites is such that a gravitational outfall can be achieved at all of them. However, the lowest elevated site is at Saucerstown and while in theory it is possible to achieve a gravitational outfall there may be operational issues associated with a long large diameter outfall pipe laid at 'slack' gradients and variable outflows and therefore a pumped solution may be more appropriate.

2.3 Conclusions on Topography

The topography of North Dublin relative to the load centres and the location of the potential WwTP Sites is such that:

- Either a pumped solution, comprising pumping station, rising mains followed by gravity sewers (some in tunnel); or a deep tunnelled gravity sewer solution is required for the transfer of wastewater loads from the Route 9C at Blanchardstown.
- A pumped solution, comprising pumping station, rising mains followed by gravity sewers (some in tunnel) is the only option for transfer of wastewater loads from the North Fringe Sewer.

When comparing options for a pumped solution in general the preference will be for:

- The lowest hydraulic static head;
- And the shortest rising main length.

When comparing the nine potential WwTP sites and a pumped solution from the Route 9C sewer at Blanchardstown the static head would be slightly lower for the two potential southern sites when compared to the seven potential northern sites and the shortest rising main length would also be associated with the two potential southern sites.

The situation with pumping from the North Fringe Sewer to the nine potential WwTP sites is not as simple as comparing the static head and length as demonstrated in the following Table. The shortest rising main length (5,800m) is associated with the highest static head (43.95m) and the lowest static head (22.85m) is associated with the longest rising main length (22,000m). Further analysis is required of the combination of static head and rising main length and this is set out in Section 3.3 in terms of overall pump power requirements.

	Annsbrook	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtown-corduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
Lowest Static Head along Various Pipeline Corridors (m)	43.35	43.35	43.95	43.35	40.85	22.85	22.85	22.85	23.85
Length of Rising Main (m)	15,150	15,150	5,600	15,150	5,600	15,150	11,650	12,650	15,150

With regard to the tunnelled gravitational solution from the Route 9C sewer at Blanchardstown preference would be for the shortest tunnel length coupled with the lowest static lift at the inlet to the WwTP. The following Table outlines the length of tunnel to each potential WwTP site and the static lift at each site, however the shortest length does not correspond with the lowest static head.

	Annsbrook	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtown-corduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
Lowest Static Lift at Inlet to WwTP (m)	16.3	12.8	16.9	11.6	26.0	13.3	18.75	0.0	27.3
Length of Gravity Sewer (m)	19,800	17,550	11,800	16,450	15,450	21,150	27,350	16,200	26,450

As the table indicates, Saucerstown is the only site where a wholly gravitational inflow can be achieve from Blanchardstown, however it should be noted that this table only references pumping requirements at the inlet point to the potential WwTP sites. Saucerstown, as noted above, may require a pumped outfall which would significantly increase the overall pumping requirements for this site.

Overall, the topography has an influence on the design of the flow transfer to and from the potential sites, however further analysis of the combined influence of topography, distance from the load centres and distance from the outfall location needs to be carried out in an effort to further refine the selection of the optimum WwTP Site. Section 3 assesses the combined influences.

3 Engineering Design

3.1 Introduction

The following Sections present a summary of the preliminary design undertaken to date on the load centre's to be diverted to the Regional WwTP and the options for wastewater load transfer from these load centres along the identified transfer pipeline corridors to each of the nine potential WwTP sites. From this initial design, a number of sub-criteria have been identified which are to be used as inputs into the technical matrix for further short listing of the nine land parcel options.

3.2 Gravitational Options

It is feasible to provide a gravitational sewer from Blanchardstown to any of the nine potential WwTP sites. However, it would be necessary to provide an inlet lift pumping station at all but one of the option WwTP's, i.e. at Saucerstown.

The only option for transfer of flows from the North Fringe Sewer is, however, a pumped system.

The following Table summarises the pipeline lengths associated with each potential WwTP site.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Length of Gravity Pipeline from 9C to WWTP Site (m)	19,800	17,550	11,800	16,000	15,450	21,150	27,350	16,200	26,450
Length of Pumped Main from North Dublin to WWTP Site (m)	15,150	15,150	5,600	15,150	5,600	15,150	15,150	12,650	15,150
Length from WWTP Site to Coast (m)	10,400	12,650	7,200	13,800	7,250	9,050	5,400	16,500	3,800
Length of Marine Outfall Pipeline (m)	2,500	2,500	6,000	2,500	6,000	2,500	2,500	2,500	2,500
Total Pipeline Length (m)	**47,850**	**47,850**	**30,600**	**47,900**	**34,300**	**47,850**	**46,900**	**47,850**	**47,900**

The shortest length of pipeline is associated with the potential WwTP site at Clonshagh, followed by the potenatial WwTP Site at Cloghran. The length of pipeline associated with the potential WwTP sites at Annsbrook, Baldurgan, Cookstown, Newtowncorduff, Sucerstown and Tyrrelstown Little are similar at c.47,850km. The length of pipeline associated with the potential WwTP site at Rathartan is c. 46,900km.

Typical power requirements for the nine potential WwTP sites are summarised in the following Table. The power requirements are based on an assumed mid range rising main diameter.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Power Requirement for WwTP Inlet Works Lift	1,950 kW	1,650 kW	2,000 kW	1,550 kW	2,800 kW	1,700 kW	2,150 kW	0 kW	2,900 kW
Power Requirement from North Dublin to WwTP Site	3,000 kW	3,000 kW	2,400 kW	3,000 kW	2,300 kW	2,550 kW	2,600 kW	2,050 kW	2,550 kW
Total Power Requirements	**4,950 kW**	**4,650 kW**	**4,400 kW**	**4,550 kW**	**5,100 kW**	**4,250 kW**	**4,750 kW**	**2,050 kW**	**5,450 kW**

The lowest power requirement is associated with the potential WwTP Site at Saucerstown as a gravitational inflow can be achieved to the WwTP. However, as noted above Saucerstown, may require a pumped outfall which would significantly increase the overall pumping requirements for this site. This is followed by Newtowncorduff. Tyrrelstown Little has the highest power requirement of the nine potential WwTP sites.

3.3 Pumped / Gravitational Options

It is feasible to provide a pumped / gravitational system to transfer wastewater loads from Blanchardstown to any of the nine potential WwTP sites. The pumped element of the system, comprising pumping station and rising main, would be to transfer flows over the elevated topography between Blanchardstown and the Broadmeadow River and the gravitational element would transfer the flows from the Broadmeadow River Valley to the potential sites in the north. In the case of the southern sites the pumped element, comprising pumping station and rising mains, would terminate west of the N2 with the remainder being gravitational to the potential southern sites.

The only option for transfer of flows from the North Fringe Sewer is a pumped system, comprising pumping station and rising mains.

The following Table summarises the pipeline lengths associated with each potential WwTP site.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Length of Pumped Main from 9C to WWTP Site (m)	14,000	14,000	3,550	14,000	3,550	14,000	13,570	13,570	14,000
Length of Gravity Pipe from 9C to WWTP Site (m)	5,800	3,550	8,250	2,450	11,900	7,150	13,780	2,630	12,450
Length of Pumped Main from North Dublin to WWTP Site (m)	15,150	15,150	5,600	15,150	5,600	15,150	11,650	12,650	15,150
Total Length to WwTP Site (m)	**34,950**	**32,700**	**17,400**	**31,600**	**21,050**	**36,300**	**39,000**	**28,850**	**41,600**
Length from WWTP Site to Coast (m)	10,400	12,650	7,200	13,800	7,250	9,050	5,400	16,500	3,800
Length of Marine Outfall Pipeline (m)	2,500	2,500	6,000	2,500	6,000	2,500	2,500	2,500	2,500
Total Length (m)	**47,850**	**47,850**	**30,600**	**47,900**	**34,300**	**47,850**	**46,900**	**47,850**	**47,900**

The shortest length of pipeline is associated with the potential WwTP site at Clonshagh, followed by the potential WwTP site at Cloghran. The length of pipeline associated with the potential WwTP sites at Annsbrook, Baldurgan, Cookstown, Newtowncorduff, Saucerstown and Tyrrelstown Little are similar at c.47,850km. The length of pipeline associated with the potential WwTP site at Rathartan is c.46,900km.

3.4 Pipeline Construction Techniques

The following Table gives a breakdown of the total pipeline into length of pipeline that can be constructed using open trench excavation, length to be constructed using tunnelling techniques and the length of the marine outfall.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Total Length of Open Cut (m)	30,950	28,950	19,600	28,950	18,800	29,450	27,550	26,820	28,950
Total Length of Open Cut as %age of Total Length	65%	61%	64%	60%	55%	62%	59%	56%	60%
Total Length of Tunnel (m)	14,400	16,400	5,000	16,450	9,500	15,900	16,850	18,530	16,450
Total Length of Tunnel as %age of Total Length	30%	34%	16%	35%	28%	33%	36%	39%	35%
Total Length of Marine (m)	2,500	2,500	6,000	2,500	6,000	2,500	2,500	2,500	2,500
Total Length of Marine as %age of Total Length	5%	5%	20%	5%	17%	5%	5%	5%	5%
Total Length (m)	**47,850**	**47,850**	**30,600**	**47,900**	**34,300**	**47,850**	**46,900**	**47,850**	**47,900**

Typical power requirements for the nine potential WwTP sites are summarised in the following Table. The power requirements are based on an assumed mid range rising main diameter.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Power Requirement from 9C to WwTP Site Including WwTP Inlet Works Lift	7,000 kW	6,700 kW	5,450 kW	6,600 kW	6,250 kW	6,750 kW	7,200 kW	5,050 kW	7,950 kW
Power Requirement from North Dublin to WwTP Site	3,000 kW	3,000 kW	2,400 kW	3,000 kW	2,300 kW	2,550 kW	2,600 kW	2,050 kW	2,550 kW
Total Power Requirements	**10,000 kW**	**9,700 kW**	**7,850 kW**	**9,600 kW**	**8,550 kW**	**9,300 kW**	**9,800 kW**	**7,100 kW**	**10,500 kW**

As noted previously, Saucerstown appears to have the lowest power requirements, however this will increase if a pumped final effluent solution is required and Clonshagh is then likely to have the lowest power requirements.

3.5 Conclusions on Engineering Design

The shortest length of pipeline to and from the potential sites is associated with the site at Clonshagh. This is followed by Cloghran in second.

The length of pipeline to Annsbrook, Baldurgan, Cookstown, Newtowncorduff, Saucerstown and Tyrrelstown Little are the same (c.47.85km).

The length of pipeline to Rathartan is c.46,900.

The pump power requirements associated with any of the potential WwTP Sites depends on the selection between a pumped / gravity transfer system or a pumped transfer system. In both cases the site at Tyrrelstown Little has the highest power requirements. Clonshagh would rank as having the lowest power requirements under both scenarios outside of Saucerstown.

4 Health and Safety

4.1 Health and Safety Risks

All construction projects have Health and Safety Risks. Some risks can be designed out and with others control measures need to be put in place to eliminate and mitigate risks as far as reasonably practical. The following Particular Risks, as set out in the Health and Safety Regulations, can arise on construction projects:

- Work which puts persons at risk of falling from height, burial under earthfalls, or engulfment in swampland
- Work which puts persons at work at risk from chemical or biological substances
- Work with ionizing radiation
- Work near high voltage power lines
- Work exposing persons at work to the risk of drowning
- Work on wells, underground earthworks and tunnels
- Work carried out by divers at work having a system of air supply
- Work carried out in a caisson with a compressed air atmosphere
- Work involving the use of explosives
- Work involving the assembly or dismantling of heavy prefabricated components

With respect to the pipeline corridors and the pipeline construction methods likely to be employed the following are the Particular Risks most likely to arise:

- Work which puts persons at risk of falling from height or burial under earthfalls
- Work near high voltage power lines
- Work exposing persons at work to the risk of drowning
- Work on wells, underground earthworks and tunnels
- Work carried out by divers at work having a system of air supply
- Work carried out in a caisson with a compressed air atmosphere
- Work involving the assembly or dismantling of heavy prefabricated components

As outlined in Section 2 it is feasible to transfer flows from Blanchardstown to the optional WwTP Sites either via a gravity system or a pumped system. In the case of transfer of flows from North Dublin the only option is a pumped system. The pumped systems would generally be constructed using open trench excavation methods, whereas the gravitational system would require construction using tunnelling techniques at significant depths below ground. The two construction methods would have the following common Particular Risks:

- Work which puts persons at risk of Falling from height or Burial under earthfalls
- Work near high voltage power lines
- Work exposing persons at work to the risk of drowning

Tunnel construction works would have the following additional Particular Risks:

- Work on wells, underground earthworks and tunnels
- Work carried out in a caisson with a compressed air atmosphere
- Work involving the assembly or dismantling of heavy prefabricated components

Tunnelling and underground construction works impose risks on construction workers as well as third parties. Due to the inherent uncertainties, including ground and groundwater conditions, there may be significant health and safety risks as well as environmental risks associated with tunnelling. There is potential for large scale accidents during tunnelling work and there is a risk of damage to a range of third parties and properties.

4.2 Conclusions on Health and Safety

In general, there are more potential health and safety risks associated with tunnelling as opposed to shallower open trench excavation. On this Project there are options for design and construction of flow transfer pipelines either using deep tunnelling techniques or shallower open trench excavation methods to each of the potential WwTP Sites. The availability of alternative transfer pipeline designs means that Health and Safety Risks can be managed at an early stage in the project development and as such the risks are common to all potential WwTP Sites.

5 Access / Rights of Way / Wayleaves

5.1 Access / Rights of Way / Wayleaves

The pipeline corridors, for all nine potential WwTP Sites, are located off road and access will be required for construction purposes and future maintenance.

The longer the pipeline route the more issues will arise regarding access and right of ways.

The width of wayleave and work strip required for pipeline construction is partly dependant on the size of pipeline, the type of pipeline and the construction methods.

Wide wayleaves and working strips will result in more economical construction methods being employed.

In general the pipeline corridors are routed through open agricultural lands with some restrictions as follows:

- Pipeline Corridor 'A':
  - Partially developed lands between New Rd. and Cappagh Rd.
  - Partially developed lands between North Rd. and the N2.
- Pipeline Corridor 'B':
  - Silloge Golf Course.
  - Airport Car Parks, Playing Pitches east and west of the R132 Swords Road.
  - Development along Clonshagh Road.
  - Woodland to the west of the R107 Malahide Road.
  - Ribbon development on Baskin Lane.
- Pipeline Corridor 'C':
  - Forrest Little Golf Course.
  - Ribbion development along Toberburr Avenue.
- Pipeline Corridor 'D':
  - Ribbon development on Kinsaley Lane.
  - Woodland on Feltrim Rd. to east of Quarry.
  - In Swords between the M1 and the R132.
  - Roganstown Golf Course.
- Pipeline Corridor 'E':
  - Ribbon development on R132 at Corduff.
  - Development on R127 on south side of Lusk.
  - Ribbon development on R128 at Effelstown.
- Pipeline Corridor 'F':
  - Ribbon development on local road at Balcultry.
  - Ribbon development on R125 at Lispopple Cross Roads.
  - Ribbon development on local road near Roganstown Golf Course.
  - Ribbon development on local road to east of Skerries Rd. at Greatcommon.
- Pipeline Corridor 'G':
  - Development east of R107 Malahide Rd. at Agricultural Institute.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Restrictions along Pipeline Corridors to Potential Sites	11	11	8	11	8	11	12	12	11

The Table above summarises the number of potential restrictions for each of the potential WwTP sites based on the associated pipeline corridors.. The two southern sites have eight restrictions with five of the northern sites having eleven restrictions and the other two northern sites having twelve restrictions.

5.2 Conclusions on Access / Right of Way / Wayleaves

The restrictions described above can most likely be overcome by refinement of the route selection and selection of appropriate construction methods.

6 Crossings – Waterways, Rail, etc.

6.1 Introduction

The crossings are described for each pipeline corridor in Sections 6.1 to 6.7.

The pipeline infrastructure, necessary to serve any of the potential WwTP Sites, is made up of a number of the pipeline corridors and these details are combined in Section 6.8.

6.2 Pipeline Corridor 'A'

The pipeline from Blanchardstown along pipeline corridor 'A' will involve the following significant crossings:

- N2 – National Primary Road
- 1nr Regional Road – R135

6.3 Pipeline Corridor 'B'

The pipeline from Blanchardstown along pipeline corridor 'B' will involve the following significant crossings:

- Silloge Golf Course;
- M1 – Motorway;
- 4NR Regional Roads – R122, R108, R132, R107.
- Mayne River.

6.4 Pipeline Corridor 'C'

The pipeline from the North Fringe Sewer along pipeline corridor 'C' will involve the following significant crossings:

- Ward River;
- Sluice River;
- M1 – Motorway;
- 2nr Regional Roads - R132, R108.
- Forest Little Golf Course.

6.5 Pipeline Corridor 'D'

The pipeline from the North Fringe Sewer along pipeline corridor 'D' will involve the following significant crossings:

- M1 – Motorway;
- 4nr Regional Roads – R107, R132, R106, R108.
- Broadmeadow River;
- Gaybrook Stream;

- Ward River;

6.6 Pipeline Corridor 'E'

The pipeline from the North Fringe Sewer along pipeline corridor 'E' will involve the following significant crossings:

- M1 – Motorway;
- 4nr Regional Roads – R129, R132, R127, R128.
- Rail Line;
- Belinstown Stream;
- Ballyboghil River;
- Ballylough Stream;
- Regles Stream;
- Rathmooney Stream;
- Collinstown Stream.

6.7 Pipeline Corridor 'F'

The pipeline from Blanchardstown along pipeline corridor 'F' will involve the following significant crossings:

- M1 – Motorway;
- 8nr Regional Roads – R128, R132, R108, R127, R129, R125, R122, R121.
- Railway Line;
- Ward River;
- Broadmeadow River;
- Ballyboghil River;
- Ballylough River;
- Regles Stream;
- Rathmooney Stream;
- Collinstown Stream.

6.8 Pipeline Corridor 'G'

The pipeline from the NFS along pipeline corridor 'G' will involve the following significant crossings:

- 3nr Regional Roads – R123, R124, R106.
- Railway line;
- Mayne River;
- Portmarnock Golf Course (for southern outfall only).

6.9 Crossings Associated With Serving Each Potential WwTP Site

The following Table summarises the number of crossings associated with each potential WwTP Site.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtown-corduff	Rathartan	Saucerstown	Tyrrelstown Little
Main River Crossings	7	7	2	7	2	7	7	7	7
Stream Crossings	4	4	0	4	0	4	4	4	4
Golf Courses	0	0	2	0	2	0	0	0	0
Canal Crossings	0	0	0	0	0	0	0	0	0
Motorway Crossings	2	2	1	2	1	2	2	2	2
National Road Crossings	1	1	1	1	1	1	1	1	1
Regional Road Crossings	15	15	10	15	10	15	15	15	15
Railway Crossings	2	2	1	2	1	2	2	2	2
Totals	**31**	**31**	**17**	**31**	**17**	**31**	**31**	**31**	**31**

The Table above shows that the least crossing are associated with the potential WwTP Sites at Clonshagh and Cloghran. There would be a similar number of crossings associated with the seven potential WwTP Sites to the north.

6.10 Conclusions on Crossings

The least crossings are associated with the two potential southern sites. There is no difference between the seven potential northern sites.

7 Physical Infrastructure

It is not anticipated that the construction of pipelines to and from any of the potential WwTP Sites would result in any significant impacts on the physical infrastructure in North Dublin, following the implementation of appropriate controls and mitigation measures.

Infrastructure such as the Railway Line, Motorways and Golf Courses would be crossed using tunnelling techniques which when properly designed and constructed will have no significant impacts either during the construction stage or during the operational stage.

Road / laneway crossings would be required but when properly reinstated there will be no lasting impacts.

Access points may have to be established off local roads to the pipeline for maintenance / repair, resulting in some alteration to existing road layouts. The impact of access points will be dictated by the length of the pipeline route, the density of local roads, the nature of the local roads and the condition of the local roads.

8 Strategic Utility Services

8.1 Introduction

The existing strategic utility services in North Dublin include:

i. Gas pipelines
ii. ESB interconnector cables
iii. Fibre Optic cables

8.2 Gas Pipelines

There are high pressure gas transmission pipelines in North Dublin which traverse the pipeline corridors. The following Table lists the number of potential high pressure gas pipeline crossings along the pipeline corridors to each potential WwTP Site.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtowncorduff	Rathartan	Saucerstown	Tyrrelstown Little
High Pressure Gas Pipeline Crossings	5	5	3	5	3	5	5	5	5

There is no significant difference between any of the sites and while it would be desirable to avoid having to cross these high pressure gas transmission lines the risks can be minimised through the appropriate coordination during design and construction stages with the relevant utility owner.

8.3 ESB Interconnector Cables

The ESB East West Interconnector Cable, refer Figure 4, runs from Rush to Ballyboughal, generally in an east to west direction and traverses pipeline corridors ‘E’ and ‘F’.

In addition there are a number of 220Kv, 110Kv and 38Kv overhead transmission power lines, particularly in pipeline corridor ‘A’, which is common to all nine potential WwTP Sites (refer Figure 5).

There is no significant difference between any of the sites and while it would be desirable to avoid having to cross under the transmission line the risks can be minimised through the appropriate coordination during design and construction stages with the relevant utility owner.

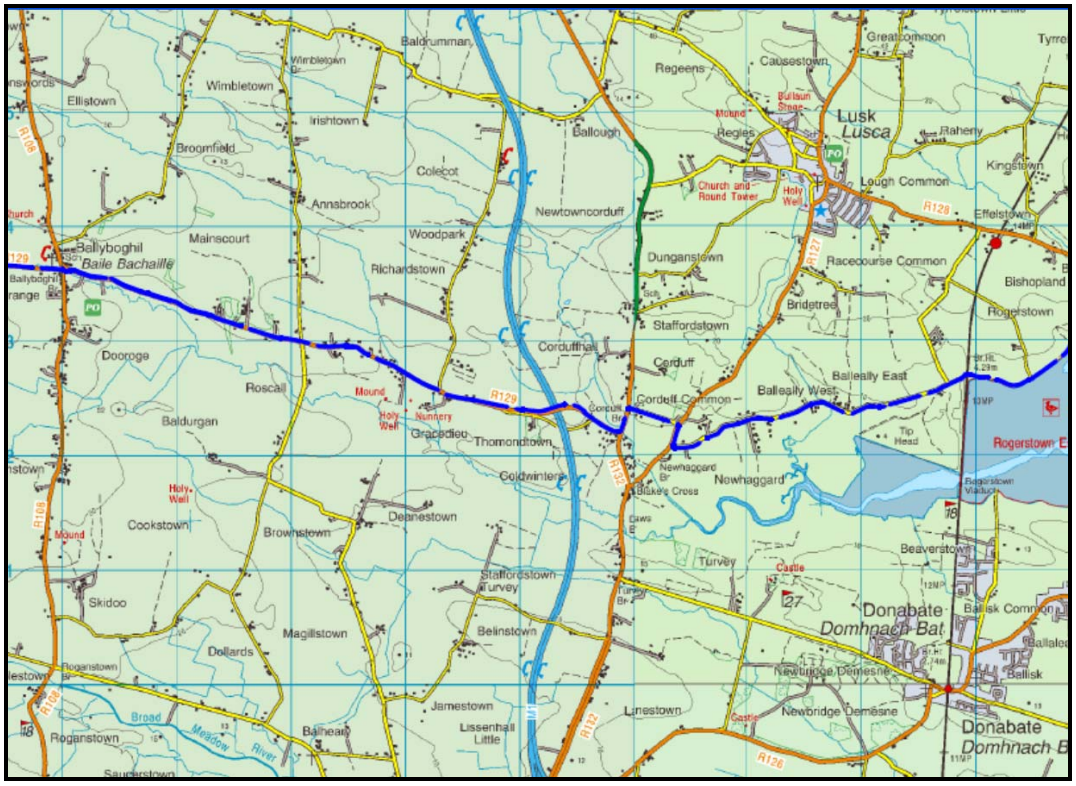


Figure 4: ESB East West Interconnector Cable

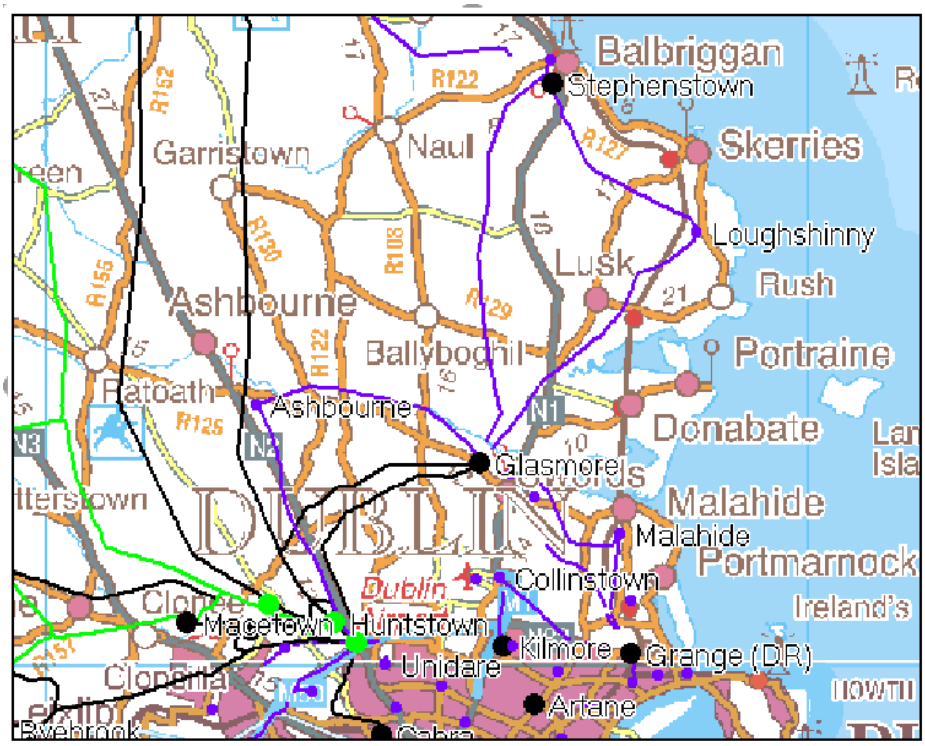


Figure 5: ESB 38Kv, 110Kv and 220Kv High Voltage Power Lines

8.4 Fibre Optic Cables

Geo Networks Ltd and ESB Telecom Ltd are forming a joint venture for the installation and operation of a subsea fibre optic cable between Portmarnock, Dublin and Porth Dafarch, Holyhead. This is located outside the corridor for the potential southern outfall.

8.5 Conclusions – Strategic Utility Services

There is no significant difference between any of the sites with regard to strategic utility services.

9 Land Ownership and Titles

A land registry search has not been conducted along the pipeline corridors.

In general the longer pipeline routes will be expected to have the greater number of landowners and titles.

10 Route Traffic Management

The majority of transport effects associated with the proposed pipelines would be related to the movement of construction traffic to and from the site during the construction phase. Construction workers would also access the site during this time, although the effects are considered to be negligible as the numbers will be relatively low and will mostly be in light vehicles.

The two southern sites are located closest to the major road network in North Dublin, i.e. the M50, N2 and M1, which have a greater capacity for transport movements during pipeline construction than the regional and local roads to the north of Swords. Transport movements during construction are however a short term impact and do not have a significant bearing on the identification of the optimum WwTP site location.

11 Construction Risk

Construction imposes risk on all parties involved and those not directly involved.

In tunnelling works construction risks are related to subsurface and geotechnical issues, utilities and buried structures and differing site conditions. There are also risk issues with water inflows and settlement. There is a higher risk of unforeseen site conditions in tunnelling works as opposed to shallower open trench excavations.

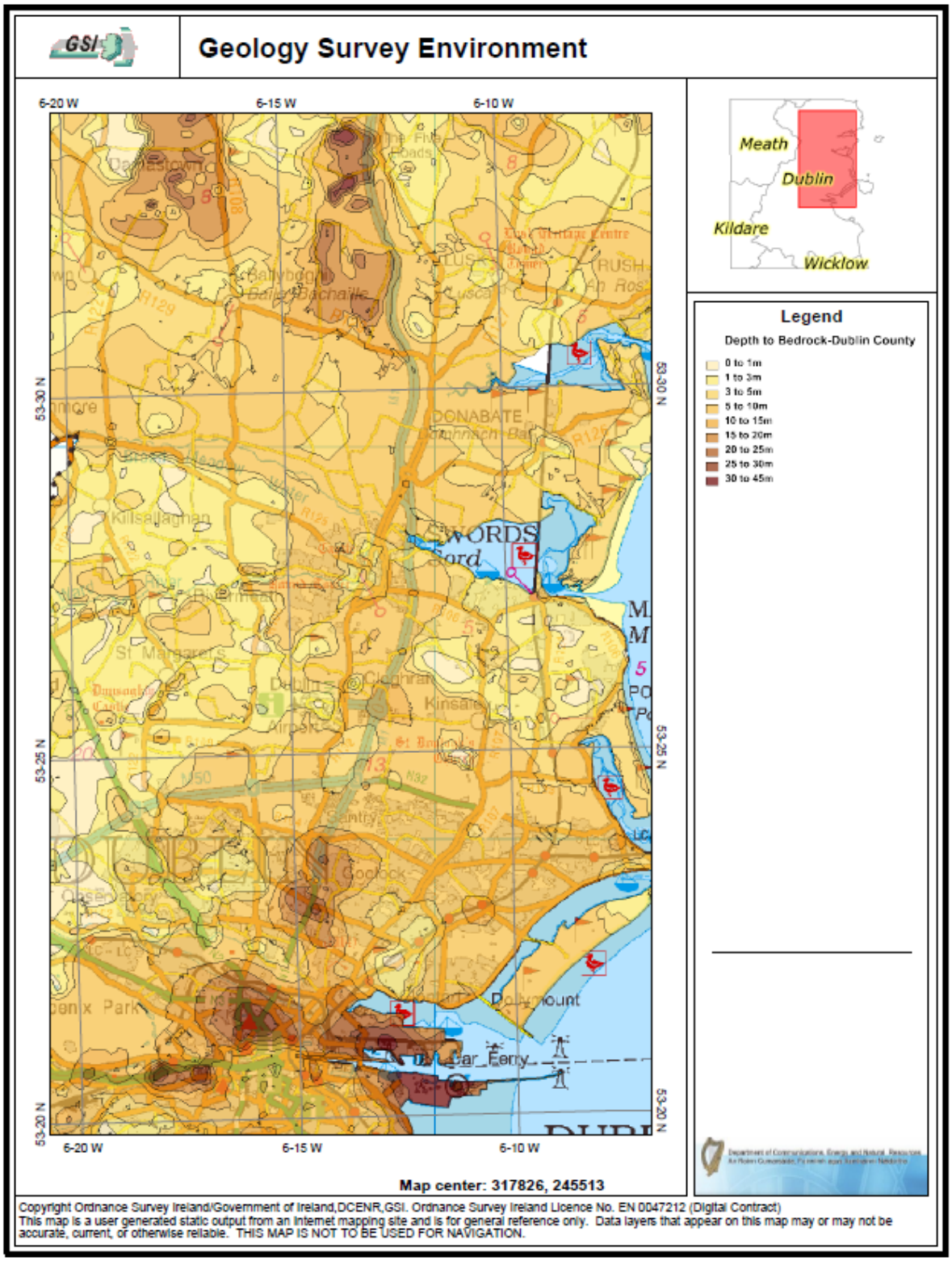
The following Table outlines the tunnelling construction risk items for each potential site.

	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtowncorduff	Rathartan	Saucerstown	Tyrrelstown Little
Construction Risk Items	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site, (2) Difficult Sea Outfall.	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site, (2) Difficult Sea Outfall.	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast. (3) Large dia. outfall pipe required	(1) Deep Tunnel to Site
Total Length of Tunnel – Pumped / Gravity Option(m)	14,400	16,400	5,000	16,450	9,500	15,900	16,850	18,530	16,450
Total Length of Tunnel – Gravity Option(m)	27,400	28,000	14,050	28,200	18,800	28,500	28,500	28,000	28,000

The two southern sites would require the least linear meterage of tunnel construction, however the outfall section of the tunnel could present difficult ground conditions in the vicinity of Baldoyle Bay / Portmarnock Golf Course. The attached GSI Map indicates that the depth to bedrock on land in this area is in the 3m to 5m range however subsurface conditions in the Baldoyle Bay may be different.

For the seven northern sites the construction risks will be similar as the majority of tunnelling works will be along pipeline corridors ‘A’ and ‘F’, which are common to all seven northern sites. The attached GSI Map of depth to bedrock shows rock depth varying from 1m to 45m in North Dublin. Over long lengths of pipeline tunnelling there could be significant changes in subsurface and geotechnical features, particularly along pipeline corridor ‘F’.

Depth to bedrock on pipeline corridor 'B' to the southern sites appears less variable at 1m to 10m.



12 Conclusion

The foregoing sections provide an outline assessment of the technical items associated with the pipeline routes for the potential WwTP sites. These items have been brought into the overall ASA matrix as sub-criteria under the Engineering and Design criteria and used in the identification of the emerging preferred sites, their associated pipeline routes and marine outfall locations.

Phase 2 Alternative Sites Assessment - Technical Criteria Evaluation Matrix
Stage 2 of Criteria Evaluation

Ref	Technical Criteria	Annsbrook	Baldurgan	Clonshagh	Cookstown	Cloghran	Newtowncorduff	Rathartan	Saucerstown	Tyrrelstown Little
1.0	**Topography and Engineering Design**									
1.1	**Pipeline Length**									
	Total Pipeline Length	**47,850 m**	**47,850 m**	**30,600 m**	**47,900 m**	**34,300 m**	**47,850 m**	**46,900 m**	**47,850 m**	**47,900 m**
1.2	**Power Requirements**									
	Total Power Requirements	**10,000 kW**	**9,700 kW**	**7,850 kW**	**9,600 kW**	**8,550 kW**	**9,300 kW**	**9,800 kW**	**7,100 kW**	**10,500 kW**
2.0	**Health and Safety**									
		No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences
3.0	**Access / Right of Way / Wayleaves**									
	Restrictions Along Pipeline Corridors to Optional Sites	11	11	8	11	8	11	12	12	11
4.0	**Crossings - Waterways, Rail, etc.**									
4.1	**Main River Crossings**	7	7	2	7	2	7	7	7	7
4.2	**Stream Crossings**	4	4	0	4	0	4	4	4	4
4.3	**Golf Courses**	0	0	2	0	2	0	0	0	0
4.4	**Canal Crossings**	0	0	0	0	0	0	0	0	0
4.5	**Motorway Crossings**	2	2	1	2	1	2	2	2	2
4.6	**National Road Crossings**	1	1	1	1	1	1	1	1	1
4.7	**Regional Road Crossings**	15	15	10	15	10	15	15	15	15
4.8	**Railway Crossings**	2	2	1	2	1	2	2	2	2
4.9	**Total Crossings**	**31**	**31**	**17**	**31**	**17**	**31**	**31**	**31**	**31**
5.0	**Physical Infrastructure**									
		More Impact on local Roads	More Impact on local Roads	Least Impact on Local Roads	More Impact on local Roads	Least Impact on Local Roads	More Impact on local Roads	More Impact on local Roads	More Impact on local Roads	More Impact on local Roads
6.0	**Strategic Utility Services**									
		No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences	No Significant Differences
7.0	**Land Ownership and Titles**									
		Most Ownerships	Most Ownerships	Least Ownerships	Most Ownerships	Least Ownerships	Most Ownerships	Most Ownerships	Most Ownerships	Most Ownerships
8.0	**Route Traffic Management**									
		No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage	No Significant Impact After Construction Stage
9.0	**Construction Risk**									
		(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site, (2) Difficult Sea Outfall.	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site, (2) Difficult Sea Outfall.	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site	(1) Deep Tunnel to Site, (2) Deep Tunnel to Coast.	(1) Deep Tunnel to Site
		Most Variability in Depth to Bedrock	Most Variability in Depth to Bedrock	Least Variability in Depth to Bedrock	Most Variability in Depth to Bedrock	Least Variability in Depth to Bedrock	Most Variability in Depth to Bedrock	Most Variability in Depth to Bedrock	Most Variability in Depth to Bedrock	Most Variability in Depth to Bedrock
10.0	**Operation and Maintenance**									
		Most Issues	Most Issues	Least Issues	Most Issues	Least Issues	Most Issues	Most Issues	Most Issues	Most Issues