



Initial Water and Effluent Feasibility Study

Project No. 9729
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Certificate No 210299



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Introduction

This report demonstrates a high level concept view of the management of process water at the proposed Rose Energy Project – Biomass Fuelled Power Plant, near Glenavy, Co. Antrim. In particular the report addresses potential water usages requirements and waste water discharges from the normal operation of the proposed Rose Energy Project. The intention is to abstract water for site processes from Lough Neagh and to discharge waste waters and surface waters to the River Glenavy, which in turn empties into Lough Neagh.

This report aims to demonstrate the feasibility of the proposed scheme and takes a conservative approach in assessing the largest potential volumes of water to be consumed and discharged from the site. During detailed design a wide range of technologies will be considered to reduce the volumes and optimise the qualities of the water in and out of the plant. The intention will be to build upon this report during the next stage to provide a detailed and specified design for the holistic view of the water treatment requirements and options associated around recycling of water and energy. The plant operators will adopt a sustainable approach to the use of water resources including that which will be harvested from buildings and hard surfaces on site is illustrated in the submitted planning application and accompanying Environmental Statement, which will be developed at the detailed design stage. This detailed evaluation and optimisation will also be a necessary step in demonstrating compliance with the principles of Best Available Techniques, without which the facility would be unable to gain a permit under the PPC Regulations.

Reference has been made to two ecology reports and a drainage assessment carried out by others. This report should be read in conjunction with these reports, especially the drainage assessment.

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This report has been prepared by Water Development Services Limited (WDS) to provide an overview of the likely worst case water discharges under normal operation from the Rose Energy Power Plant prior to any treatment, and suggested effluent quality after treatment subject to agreement in due course with NIEA for both PPC Permit and Discharge Consent requirements. WDS are a specialist water engineering and environmental business with 20 years experience in the treatment of water systems to minimise operational costs and environmental impact.



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Overall concept

Water will be required on site for various uses, including:

- Vehicle washing.
- Steam boilers.
- Cooling towers.
- Specific plant cooling and cleaning operations.
- Plant washing and housekeeping.
- Domestic use.

A summary of the way that the various elements fit together and what they represent in terms of overall water use and discharge is given below. This concept design is based on currently available water quality information.



Lough Neagh Quality

Water quality analysis has been undertaken as part of this study. To ensure that the final detailed design takes full cognisance of possible seasonal variations further sample analysis will take place as part of the development of the application for a PPC permit. The data gathered is presented in the table below:

Analysis	Unit	02/04/2009
pH		8.89
Conductivity	µS	275
TDS	mg/l	170
Ca	mg/l	37.6
Mg	mg/l	9.02
Na	mg/l	13.9
K	mg/l	3.62
Al	mg/l	0.142
NH4	mg/l	0.03
Sr	mg/l	0.105
Ba	mg/l	0.0183
Fe	mg/l	0.418
Mn	mg/l	0.0449
F	mg/l	0.05
CO3	mg/l	144
HCO3	mg/l	146
SO4	mg/l	16.3
Cl	mg/l	21.7
NO3	mg/l	0.4
SiO2	mg/l	0.2
Total Hardness	mg/l	131
Suspended Solids	mg/l	16



Re-use and Efficiency

During the detailed design phase, options will be addressed for re-using water and for improving the overall efficiency of the process. This detailed options evaluation will be a part of the overall PPC application and will address, amongst other options:

- ◆ Options to reduce the volume of blowdown or backwash effluent from each stage
- ◆ The possible use of high quality blowdown, e.g. that from the boiler, in other process stages
- ◆ The possible use of blowdown water in the fire water storage system
- ◆ Rainwater harvesting and use



Rose Energy Project Process Systems

The total estimated water abstraction for this site will be 160m³/hr. This would supply the following site process systems.

1. Cooling Water System

This is the largest consumer of water on the site. Approximately 90m³/hr will be lost through evaporation from the cooling tower. To maintain optimum conditions in the cooling towers a blowdown of approximately 30m³/hr is required. To protect the environment, the treatment chemistry for the cooling system (to prevent scale, corrosion and fouling) will likely be based on a phosphonate programme rather than a typical zinc phosphate treatment. This eliminates the use of zinc and the phosphonates will not readily degrade to ortho-phosphate.

2. Boiler System

The Lough water will need to be treated by various stages of treatment to meet the design criteria quality¹. It is likely softening² followed by Reverse Osmosis (RO)³ and then a final polish will be required and each stage will generate a backwash or blowdown effluent. In addition there will be a blowdown of water from the boiler itself in order that optimal water conditions can be maintained. The polishing can be achieved with the use of an Electronic De-ionisation (EDI) or by the use of ion exchange demineralisation⁴.

3. Specific Plant Uses

Water is required for specific purposes such as direct Cooling and Sample Cooling

Due to the hardness salts present in the raw water it would be beneficial to feed these systems with treated water to prevent scale and deposition. Either softened water directly from the softeners or RO concentrate water could be used to supply these systems.

¹ Water quality to meet VGB-R 450 standards to ensure safe operation of the boiler plant

² Base Exchange Softening – a process where standard salt is used to remove scales forming hardness from a water supply.

³ RO – a membrane technology which generates ultra pure water

⁴ EDI and Demineralisation – are both methods to enable even higher quality water to be produced.



4. Truck Wash

Water will be required for the washing of the trucks delivering the poultry bedding to site. Modern truck wash facilities with water recovery will be used but there will still be a residual need for water and a residual effluent discharge. Where possible harvested water or re-used water from other elements will be used in the truck wash. The waste stream from the truck wash is likely to contain detergents, however recycling and reuse will ensure optimum use is made of this water. Any waste water will be used for dust suppression to ensure no detergents will be discharged from the site.

5. Basic Lake Water Treatment

The water to be abstracted from Lough Neagh will require basic treatment to make it suitable for use in the systems described above. A coarse, self cleaning screen will prevent larger debris⁵ and fish from being taken into the system.

Further filtration on the Rose Energy site using tangential flow technology⁶, coupled with recycled glass, deep bed filtration⁷ will remove all but the finest material.

Disinfection⁸ of the water to reduce or eliminate troublesome bacteria found in natural waters will be implemented before the water is sent to service. These bacteria would cause fouling in the pipelines and distribution system.

⁵ Lough Neagh water will contain leaves, twigs and other debris as well as fish and other aquatic organisms which will be prevented from entering the pipeline. These will not leave the Lough and the self cleaning mechanism will require very little intrusive maintenance.

⁶ This technology effectively separates easily settleable solids from the water and produces very little waste water compared to more traditional filtration.

⁷ Traditional deep bed filtration uses sand. Recycled glass media is more efficient and sustainable and is made from the bottles and jars recycled by the public.

⁸ Disinfection can be achieved through a number of means but it is likely that low level chemical addition such as chlorine will be used in the same way as swimming pool or drinking water is disinfected.



Plant Processes Discharge

Based on the above concept and, excluding the collected and separated rainfall/surface water, the calculated flow from the plant processes will be 60m³/hr. The expected quality of this water prior to treatment and discharge via the SUDS pond to the Glenavy River is given below based on the quality of the combined discharges of waste water from the processes used on site.

It should be noted that these are conservative estimates based on the overall concept design. During the detailed evaluation of BAT that will be carried out as part of the PPC application process these initial estimates will be refined (including refinements to allow for optimisation of individual treatment stages) and final discharge values agreed with the regulator.

Analysis	Unit	Final Discharge Quality Prior to treatment
pH		8
Conductivity	ms	731.9
TDS	mg/l	452.7
Ca	mg/l	93.8
Mg	mg/l	22.5
Na	mg/l	44.8
K	mg/l	9.5
Al	mg/l	0.4
NH4	mg/l	0.1
Sr	mg/l	0.3
Ba	mg/l	0.0
Fe	mg/l	1.1
Mn	mg/l	0.1
F	mg/l	0.1
CO3	mg/l	383.3
HCO3	mg/l	388.6
SO4	mg/l	43.4
Cl	mg/l	59.7
NO3	mg/l	1.1
SiO2	mg/l	0.5
Total Hardness	mg/l	350.7
Suspended Solids	mg/l	39.4



Treatment Processes

Subject to detailed design and agreement with the Regulator, there are a number of treatment process which can be employed to reduce certain levels in the waste water discharge to eliminate impact on the River environment. The effect of these processes is shown in the table below.

Aeration

Although the cooling water discharge is already highly aerated due to the nature of the process, this oxygen content could be depleted during the residence time within the SUDS lagoon. As such a small fountain will ensure adequate aeration prior to discharge to the River Glenavy. Aeration is also likely to remove most of the ammonia levels to those below the concentrations already found in the river.

Aluminium

Aluminium is an extremely difficult element to remove from water. It does not readily precipitate through changes in pH or the addition of known metal precipitants. It can be removed through the use of activated charcoal filtration. Given the total flow of the waste water at 60m³/hr and the anticipated worst case of 0.4mg/l compared to the existing river quality of 0.31mg/l only a small percentage of the total flow would be required to be filtered in this way.

Iron and Manganese

Both these elements can be described as unstable. This means they have a tendency to precipitate from solution when aerated. Aeration and subsequent filtration, using recycled glass will reduce the levels to well below those found naturally in the river. Suspended solids will also be significantly reduced at this stage.

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Total Hardness

Total hardness is a combination of Calcium and Magnesium hardness salts (CaCO₃ and MgCO₃). These compounds are widely found in nature and are not likely to cause environmental concern when discharged into the river.

Temperature

The various site process systems will produce waste water of varying temperatures. Very warm water will be subjected to heat recovery methods, while other streams will feed into the lagoon. The temperature of the final discharge will be governed by ambient conditions affecting the SUDS lagoon. The levels would not be expected to be significantly above the ambient temperatures of the river.



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Analysis	Unit	Initial Design Estimate of Final Discharge Quality - pre treatment	Post Treatment - discharge to SUDS lagoon	Estimate of Required Discharge Quality Based on Initial H1 Impact Data	Mean river chemistry at Location 2	Discharge Concentration Value
pH		8	8.00		8.08	
Conductivity	ms	731.9	731.90			
TDS	mg/l	452.7	452.7			
Ca	mg/l	93.8	93.8		26.27	26.27
Mg	mg/l	22.5	22.5		12.10	12.10
Na	mg/l	44.8	44.8	65		44.8
K	mg/l	9.5	9.5			
Al	mg/l	0.4	0.28	0.005	0.31	0.28
NH4	mg/l	0.1	0.05	0.015-0.3	0.07	0.05
Sr	mg/l	0.3	0.3			
Ba	mg/l	0	0	0.013		0
Fe	mg/l	1.1	0.5	0.38	0.54	0.5
Mn	mg/l	0.1	0.03	0.01	0.03	0.03
F	mg/l	0.1	0.1	1.9	0.05	0.1
CO3	mg/l	383.3	383.3			
HCO3	mg/l	388.6	388.6			
SO4	mg/l	43.4	43.4	153	16.67	43.4
Cl	mg/l	59.7	59.7	96	22.67	59.7
NO3	mg/l	1.1	1.1	1.513*	1.94	1.1
SiO2	mg/l	0.5	0.5			
Total Hardness	mg/l	350.7	350.7		115.33	115.33
Suspended Solids	mg/l	39.4	5	9.6	6.47	5

* All nitrate values reported as nitrogen equivalent



Summary

This report presents a workable concept for the use and discharge of water associated with the proposed Rose Energy Biomass plant. Based on this concept it is estimated that intake water of some approximately 160m³/hr will be required and there will be a final discharge of >60m³/hr to the River Glenavy.

There are many technologies which can be employed on a site such as the proposed Biomass Power Station. The final design of the plant will examine all of the technologies and look to implement best practice where there is demonstrable environmental advantage and possible economic benefit for the operators of the plant.

The water volumes required by this project should be considered in perspective and in relation to the many other licensed abstraction points from Lough Neagh. The Lough provides much of the potable water for individuals and organisations in Northern Ireland. The current abstraction for these purposes is 540 Megalitres per Day (MLD)⁹. The volume requirements for this project have been calculated to be 3.9MLD and as such this project represents approximately 0.7% of the volume abstracted for drinking purposes alone. The discharge from the plant's operation to the River Glenavy only equates to 1.5 Olympic sized swimming pools per day¹⁰.

A diagram of the flows in and out of the plant can be found in Appendix 1 of this report.

⁹ MLD – 1 Megalitres equals 1,000m³ and is the preferred unit of measurement by Water Authorities

¹⁰ Olympic swimming pools have a standard volume of 2,500m³



References

Doran Consulting (May 2008) Drainage Assessment

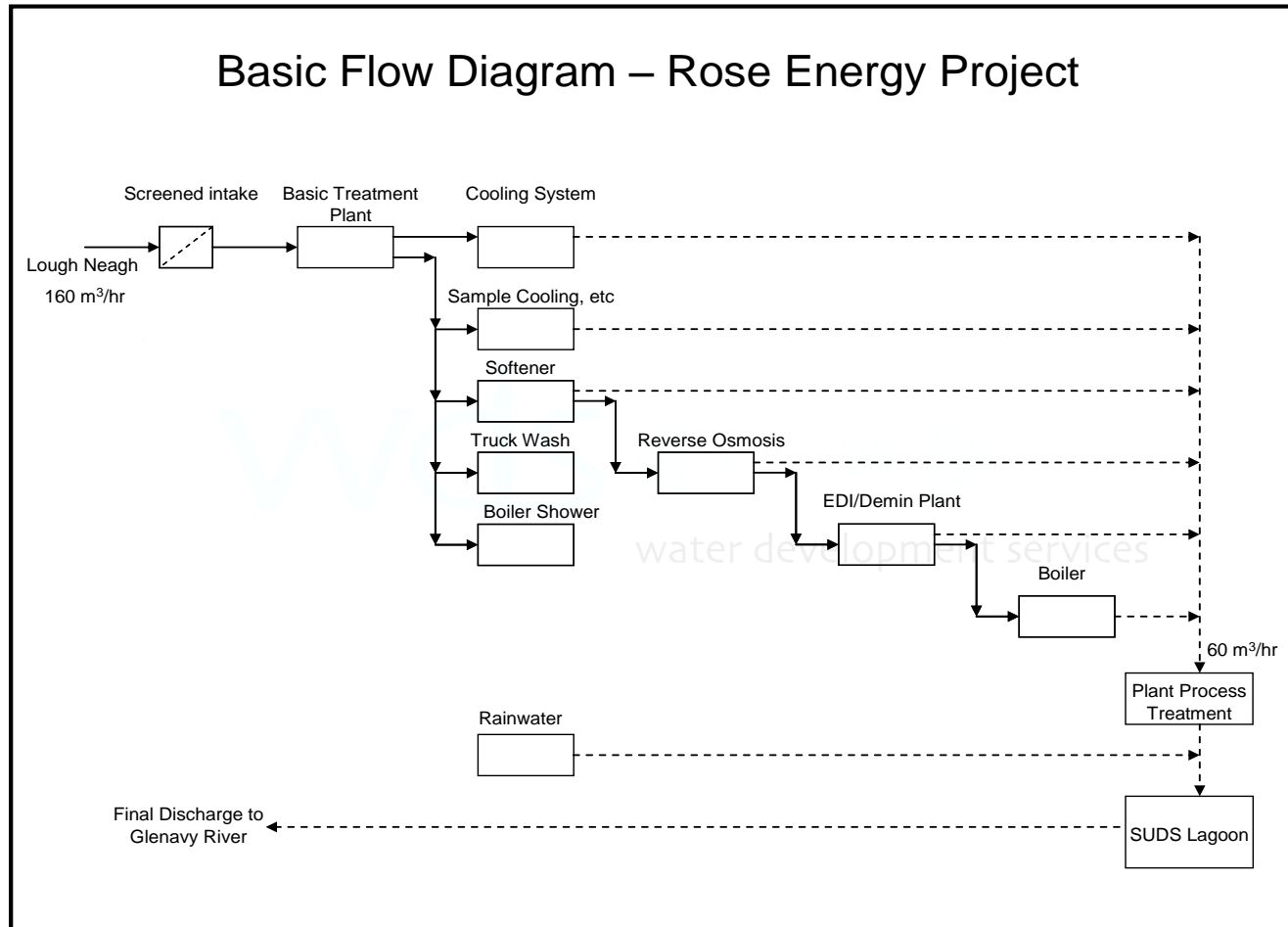
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Marenco Environmental Consultants (August 2007) Rose Energy Project: Lough Neagh Desktop Review



Appendix 1

Basic Flow Diagram of Rose Energy Project



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