The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

The Proposed Rookery South (Resource Recovery Facility) Order

Addendum to Flood Risk Assessment dated 4 August 2010

9 May 2011

Contents

1.0 Introduction

1.1. The Flood Risk Assessment dated 4th August 2010 (Document Reference 4.4) (FRA) was originally prepared to support the Application of Covanta Rookery South Limited (Covanta) for a Development Consent Order (DCO) to the Infrastructure Planning Commission (IPC) for the proposed Resource Recovery Facility (RRF) at Rookery South Pit, Stewartby, Bedfordshire.

1.2. In addition to considering flood risk from both fluvial and surface water flooding, the FRA also set out the strategy for foul water drainage serving the RRF. This was set out within Section 16 of the FRA.

1.3. The foul water drainage strategy was also set out within Chapter 3 of Volume 1 of the Environmental Statement (ES) (document reference 3.1) supporting the DCO application. Chapter 13 of the ES provides commentary on the surface and ground water quality of the Application site, the impacts of the Project and mitigation measures proposed.

1.4. As part of the Application process, key statutory and non-statutory stakeholders, and the public are invited to provide a summary and their views during the Pre-Examination stage. Also, during the Application process and in relation to its applications for Environmental Permits, Covanta has engaged with the Environment Agency (EA).

1.5. This Addendum to the Flood Risk Assessment has therefore been prepared in light of the relevant representation to the IPC from Anglian Water Services Ltd (AWS) dated 19 November 2010 (reference 0101/SP58(017)), and on going discussions with the EA. The AWS representation advised that, contrary to their previous advice, the Stewartby sewage treatment works to which foul water flows from the proposed RRF were proposed to be discharged to, does not have sufficient capacity to accommodate the flows which may be generated by the Project.

1.6. This Addendum therefore sets out an alternative foul water drainage strategy which would not discharge foul water flows to the Stewartby sewage treatment works. Rather, it proposes to treat effluent on site, with discharge following treatment to the surface water system.

1.7. Details of the previous foul water drainage strategy are included in Section 2 of this addendum, together with a brief description of the existing surface water drainage strategy for the site, followed by a description of the proposed changes in Section 3 and an assessment of the environmental impacts of this revised strategy in Sections 4 and 5.

1.8. This addendum is intended to inform the IPC's Examining Authority of the updated proposals. It is also being shared with AWS and the EA.

2.0 Existing Drainage Strategies

2.1. Initial Foul Water Drainage Strategy

2.1.1. The initial foul water drainage strategy for the RRF proposals was set out in Section 16 of the FRA. The initial strategy for dealing with the foul water drainage arising from the Energy from Waste (EfW) facility (domestic flows arising from the toilets, shower rooms, and kitchen facilities etc) comprised the following:

1) A private gravity foul water drainage network within the RRF outfalling to a foul water pumping station located as shown on drawing 21780/77/01 (contained within Appendix L of the FRA).

2) Foul water discharge would then be pumped via a new rising main laid within the verge of the proposed RRF access road, along Green Lane, and then outfall to the existing public sewer within Stewartby Way, Stewartby. The domestic foul water flows were estimated to be approximately 14m^3/day, which equates to 0.16l/s.

3) The foul water flows would ultimately be treated at the Stewartby sewage treatment works.

2.1.2. In addition to dealing with the foul water drainage arising from the EfW, a high level overflow from the water collection lagoon within the Materials Recycling Facility (MRF) was proposed to be connected to the foul water drainage network to allow the discharge of any excess water as trade effluent at a maximum rate of 5l/s. The trade effluent would also be discharged to the foul water pumping station (referred to in section 2.1 (1) above) and similarly pumped to the existing public sewer within Stewartby Way, Stewartby.

2.2. Surface Water Drainage Strategy

2.1.1 The surface water drainage strategy for the RRF proposals was set out in Section 11 of the FRA.

2.1.2 A summary of the key components of the proposed RRF surface water drainage strategy is set out below and was illustrated on Drawing 14081/076/002A (contained with Appendix I of the FRA).

1) Surface water run-off from the EfW building and surrounding service yards, car parks, and internal highways will be conveyed by a private gravity surface water drainage network and will outfall to the LLRS surface water attenuation pond. Surface water run-off which may mobilise as overland flows during peak rainfall events will be conveyed via the on-site car parks and roads and the main access road (within the base of the pit) to the LLRS surface water attenuation pond.

2) All requirements for surface water attenuation storage will be provided by the Rookery South Pit attenuation pond.

3) The southern bank of the Rookery South Pit attenuation pond will be re-profiled to create a beach type feature, noting that re-profiling will not be detrimental to the LLRS surface water drainage strategy (the re-profiling works contributing to an increase in the storage volume of the pond).

4) In respect of the MRF, the concrete base will be set to fall towards a concrete catch-pit and a water collection lagoon, located along the northern boundary of the MRF. Surface water run-off from the MRF area and water draining from the Incinerator Bottom Ash (IBA) will be conveyed through overland flows to the catch pit and into the water collection lagoon. The water collected in the lagoon will be pumped to the process water storage tank located in the EfW for use in the EfW ash quench process.

5) The surface water run-off which collects within the water collection lagoon will be pumped back to the process water storage tank within the EfW building for use in the EfW process. However, for the purposes of assessing the impact of the RRF proposals on the LLRS surface water drainage strategy, it was assumed that all impermeable areas associated with the MRF will shed run-off to the LLRS surface water attenuation pond.

6) Surface water drainage from the access road from Green Lane and to the west of Rookery South will be conveyed via a gravity highway drainage network and will outfall to the LLRS surface water attenuation pond.

7) Surface water run-off that collects within the Rookery South attenuation pond from, both the RRF and the wider pit, will be pumped to Rookery North as a strategic attenuation facility at a rate of 100l/s, and to Mill Brook at a rate of 23l/s (in accordance with an existing Consent to Discharge surface water flows associated with Rookery Pit) as defined by the Low Level Restoration Scheme surface water drainage strategy.

2.1.3 Proposed mitigation measures for the RRF are described in Section 13.8 of the Environmental Statement (document Reference 3.1) and included for impermeable surfacing, flexible drainage systems, and the inclusion of penstock control values and interceptors prior to discharge.

3.0 Alternative Foul Water Drainage Strategy

3.1 As set out in Section 1.4 above, an alternative foul water strategy has now been prepared in response to the relevant representation to the IPC from Anglian Water Services (AWS) Ltd dated 19 November 2010 (reference 0101/SP58(017)),in which AWS advised that the Stewartby sewage treatment works does not have sufficient capacity to accommodate the flows which may be generated by the Project. It has also been prepared in response to ongoing discussions with the EA including as part of the Environmental Permitting application process.

3.2 Therefore in response to the relevant representation from AWS and ongoing EA discussions, an alternative foul water drainage strategy has been developed. This section of the Addendum sets out this alternative strategy for the RRF proposals.

3.1. As a result of AWS response it is necessary for all foul water flows and any excess water from the MRF water collection lagoon to be retained and treated on site. It is intended therefore that the treated effluent will be principally retained on site and used within the EfW process.

3.2. Depending upon the water demand of the EfW process and the residual capacity within storage lagoons to accommodate additional surface water run-off following extreme weather conditions, it may be necessary to allow surplus treated waters to outfall to the Low Level Restoration Scheme (LLRS) surface water attenuation pond. From here water will be pumped from the Rookery South Pit as part of the wider LLRS surface water drainage strategy.

3.3. The treatment processes will therefore form part of the Environmental Permit application for the operation of the MRF, which will set limits for environmental standards.

3.4. The RRF foul water drainage strategy will now therefore comprise the following:

i) Domestic foul water flows (toilets, shower rooms, and kitchen facilities etc) will be drained via a private gravity foul water drainage network within the RRF outfalling to a Rotating Biological Contactor (a well established ‘package’ aerobic biological plant used for treating domestic waste water) for treatment. The domestic foul water flows remain estimated to be approximately 14m^3/day, which equates to 0.16l/s.

ii) Runoff from the MRF water collection lagoon will be drawn down at a maximum rate of 5l/s and treated via a containerised electro-coagulation process with pH correction for general removal of contaminants, sulphates, solids, ammonium etc. The runoff will then be passed through a containerised ultra-filtration / Reverse Osmosis (RO) process for reduction of chlorides.

iii) The treated effluent from the Rotating Biological Contactor (set out above) will be routed through the containerised electro-coagulation and ultra-filtration / Reverse Osmosis process to further improve the effluent quality.

iv) Effluent from the two processes set out above will be returned to the EfW for use in the EfW process.

v) Any surplus treated effluent at any one time in excess of the EfW process requirements or available storage will be discharged to the Low Level Restoration Scheme surface water attenuation pond located to the north of the RRF, and then pumped as part of the wider LLRS surface water drainage strategy. The rate of any such surplus discharge to the surface water attenuation pond would be at a maximum rate of approximately 5l/s.

3.5. The above foul water strategy is presented on Drawings 21780/077/01C and 02D, contained within Appendix A. A summary of the proposed foul water treatment processes and technologies is contained within Appendix B for reference.

3.6. All private foul water drains and on-site treatment processes will be designed to accord with the Building Regulations Part H and BS EN752, and will be maintained by Covanta.

4.0 Potential Impacts Upon Flood Risk and the Surface Water Drainage Strategy

4.1. This section considers any potential impacts upon the conclusions of the FRA as a result of the alternative foul drainage water strategy outlined in Section 3 and the associated proposal to outfall surplus treated effluent to the LLRS surface water attenuation pond at a maximum rate of 5l/s.

4.2. The alternative foul water drainage strategy presents the potential for a further outfall of approximately 5l/s to be discharged to the LLRS surface water attenuation pond. However, it should be noted that the contributing catchment area defined for the purposes of sizing the LLRS attenuation pond includes the impermeable area associated with the MRF (i.e. the LLRS pond has been designed to accommodate unattenuated surface water run-off from the MRF yard - which could range from 20l/s to 2.6m^3/s for a 1 in 100 year rainfall event plus climate change depending upon the storm duration).

4.3. As the 5l/s outfall rate is significantly less than the unattenuated rate of runoff from the MRF which would occur during a 1 in 100 year rainfall event plus climate change, the alternative foul water drainage strategy will have no significant impact on the operation of the surface water attenuation pond.

4.4. As outlined in paragraph 3.3, water from the MRF water collection lagoon would be drawn off at a maximum rate of 5l/s and this is consistent with the rate of draw down set out in Section 11.8 of the FRA. Therefore, on this basis, the design parameters and sizing of the water collection lagoon set out within section 11.8 of the FRA remain appropriate.

4.5. The alternative foul water drainage strategy outlined within this Addendum therefore has no impact upon the conclusions and recommendations set out within the FRA dated 4th August 2010, or any impact on the assessment set out in Chapter 14 ‘Hydrology and Flood Risk’ of the Environment Statement.

4.6. On this basis, no revisions to the surface water drainage strategy set out within Chapter 11 of the FRA are required, and the original strategy as outlined in section 2.1.2 above, other than the treatment of run-off which collects within the water collection lagoon, remains unchanged.

5.0 Environmental Considerations

5.1. Surface Water Quality Baseline Conditions

5.1.1. As outlined within Chapter 13 of the Environmental Statement Volume 1 (document Reference 3.1) accompanying the DCO application, an assessment of the quality of the ground water and surface waterbodies in the vicinity of Rookery Pit has been undertaken since 1999.

5.1.2. During this time surface water samples have been taken from the lakes in Rookery South (prior to the implementation of the LLRS) and Rookery North, Harrowden Brook to the east, Mill Brook tributary to the south, Mill Brook watercourse to the south and west and Stewartby Lake to the west.

5.1.3. Analyses have included testing for a range of potential historical contaminants including List I substances. The determinants tested have included: metals, sulphate, chloride, ammoniacal nitrogen, BOD, COD, electrical conductivity, pH, herbicides, pesticides, PAH, VOC, SVOC, PCBs and hydrocarbons.

5.1.4. In the context of the potential for future contamination to occur as a result of the Project, recent groundwater monitoring has also included analysis of pollutants defined within the Waste Incineration Directive including metals, dioxins and furans.

5.1.5. Historical groundwater monitoring has shown that relatively high levels and concentrations of electrical conductivity, chloride, sulphate and ammoniacal nitrogen are present within the permeable stratum underlying the proposed application site and surrounding area (Kellaways Formation, Cornbrash Formation and Blisworth Limestone Formation). These concentrations occur as a result of natural, rather than anthropogenic, processes and are present both on-site, off-site and in the wider region. At the concentrations recorded and given that the stratum underlying the proposed application site are not sources for potable water abstraction, this is not considered to be a significant hazard.

5.1.6. Relatively high levels and concentrations of electrical conductivity, chloride and sulphate have also been recorded within the surface water bodies within the Rookery North Pit and the Rookery South Pit. These concentrations are also naturally occurring as a result of the geological conditions present and are not considered to be a significant hazard

5.2. Proposed Trade Effluent

5.2.1. The trade effluent quality processes and ultimate discharge to the LLRS surface water attenuation pond will be regulated as part of the Environment Permit.

5.2.2. The proposed treatment plant and technologies, described in outline above and in further detail in Appendix B, has been designed initially on representative surface water sample quality test results taken from a water collection lagoon at a similar United Kingdom Material Recycling Faciltiy operated by Ballast Phoenix, where EfW Incinerator Bottom Ash (IBA) is recycled. The IBA being derived from similar residual waste material to that proposed at the Application Site.

5.2.3. In order to confirm the anticipated treated effluent quality, bench scale trials have been undertaken of the proposed process utilising water samples taken from this similar MRF process plant. Samples of the resultant treated effluent are currently undergoing further laboratory analysis. This analysis will enable further refinement of the proposed treatment process as necessary to ensure that appropriate levels of water quality can be achieved prior to discharge to the LLRS lagoon. The results of this testing will be available shortly and will be made available to the EA, and will form part of both the Environmental Permit application and discharge consenting process. A further update will be provided to the IPC in due course if the Examining Authority consider it appropriate.

5.2.4. As outlined in Appendix B the plant process is designed with various controls and constant quality monitoring systems in place. However in addition to such treatment process controls, the package treatment plant will be constructed such that it is located on areas of impermeable hard surfacing that will have its own separate surface water drainage system, with associated raised kerbs. The drainage system will be provided with separate penstock control values, such that in the event of any spillages or leaks that the waters may be contained and disposed off in a controlled manner. A penstock value will be located in a the chamber located downstream of the treatment process prior to discharge to the LLRS attenuation pond such that representative samples of the effluent discharge can be taken as necessary for laboratory analysis.

5.2.5. Furthermore the plant will be provided with appropriate spill kits or absorbent materials which will be held and maintained on site. Operating staff will be inducted in appropriate training in case of any incidents and an up-to-date drainage plan will be maintained, hazards identified and a contingency plan drawn up, giving advice on what action to take and who to inform. Such plans will be displayed clearly and regular simulations/exercises undertaken.

5.2.6. It is therefore intended that the discharge of treated waters will comply with appropriate Environmental Permit requirements in terms of quantity and quality to ensure that the receiving controlled waters are not adversely impacted. Furthermore, the additional mitigation measures outlined above will be regulated by the Environmental Permit.

5.3. Conclusions

5.3.1. It is therefore proposed that the quality of the proposed trade effluent discharge post treatment will be of sufficient quality not to detrimentally impact the existing surface water quality baseline conditions as described in Section 5.1 above.

5.3.2. The treatment process and discharge to the LLRS surface water attenuation pond will be regulated through an Environmental Permit.

5.3.3. Mitigation measures will be in line with those already proposed in section 13.8 of the Environmental Statement (document Reference 3.1) for the existing RRF and enhanced locally in the vicinity of the treatment plant as discussed above in section 5.2.4 and 5.2.5.

5.3.4. As a result of such, no changes to the conclusions of the topics of Water Quality and Flood Risk within the Environmental Statement (Sections 13 and 14 of document reference 3.1) that accompanied the Application are required as a result of the Alternative Foul Water Drainage Strategy.

6.0 Summary and Conclusions

6.1. In response to the application for the DCO, Covanta has engaged with relevant regulators including the Environment Agency and Anglian Water Services Ltd. As a result, an alternative Foul Water Drainage Strategy has been proposed in case of insufficient capacity at Stewartby sewage treatment works.

6.2. The proposed Alternative Foul Water Drainage Strategy does not affect the outcomes of the Environmental Assessment carried out in respect of the Project.

Appendix A – Alternative Foul Water Drainage Strategy

Drawing 21780/076/001

Drawing 21780/076/002

ROOKERY SOUTH SURFACE WATER ATTENUATION POND

Pit

(disused)

Water

INDICATIVE LOCATION OF OUTFALL PIPE TO SURFACE WATER ATTENUATION POND. OUTFALL PIPE TO BE CONSTRUCTED WITH CATCHPIT CHAMBER TO ALLOW REMOTE SAMPLING, AND THE INSTALLATION OF A PENSTOCK/SHUTOFF VALVE.

EfW

DOMESTIC FOUL WATER FLOWS DRAINED BY GRAVITY TO ON SITE TREATMENT PROCESS

PROCESS WATER STORAGE UNDERGROUND TANK/PIT FOR ASH QEUNCHING ADJACENT TO EfW.

WATER COLLECTION LAGOON, DISCHARGING TO ON SITE TREATMENT PROCESS

LOCATION OF PROPOSED ON SITE TREATMENT PROCESS

MRF

LOW LEVEL RESTORATION SCHEME SURFACE WATER INTERCEPTOR CHANNEL TO BE RE-ALIGNED TO RESPOND TO THE RRF PROPSALS

MP.5

43.9m

El Sub Sta

KEY:

— — EXTENT OF PROPOSED RE-PROFILING TO ROOKERY SOUTH ATTENUATION POND

EfW ENERGY FROM WASTE FACILITY

MRF MATERIALS RECOVERY FACILITY

NOTES:

1. ALL PROPOSALS ARE SUBJECT TO DETAILED DESIGN.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING 21780/077/002.

Mark	Revision	Drawn	Date	Chkd
C	Notes revised following Client's comments	BMP	21/04/11	PJ
B	Drawing updated to reflect new foul water drainge strategy.	BMP	19/04/11	PJ
A	Drawing updated to respond to latest masterplan.	EJC	24/08/10	PJ

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UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

PROPOSED ROOKERY SOUTH RESOURCE RECOVERY FACILITY

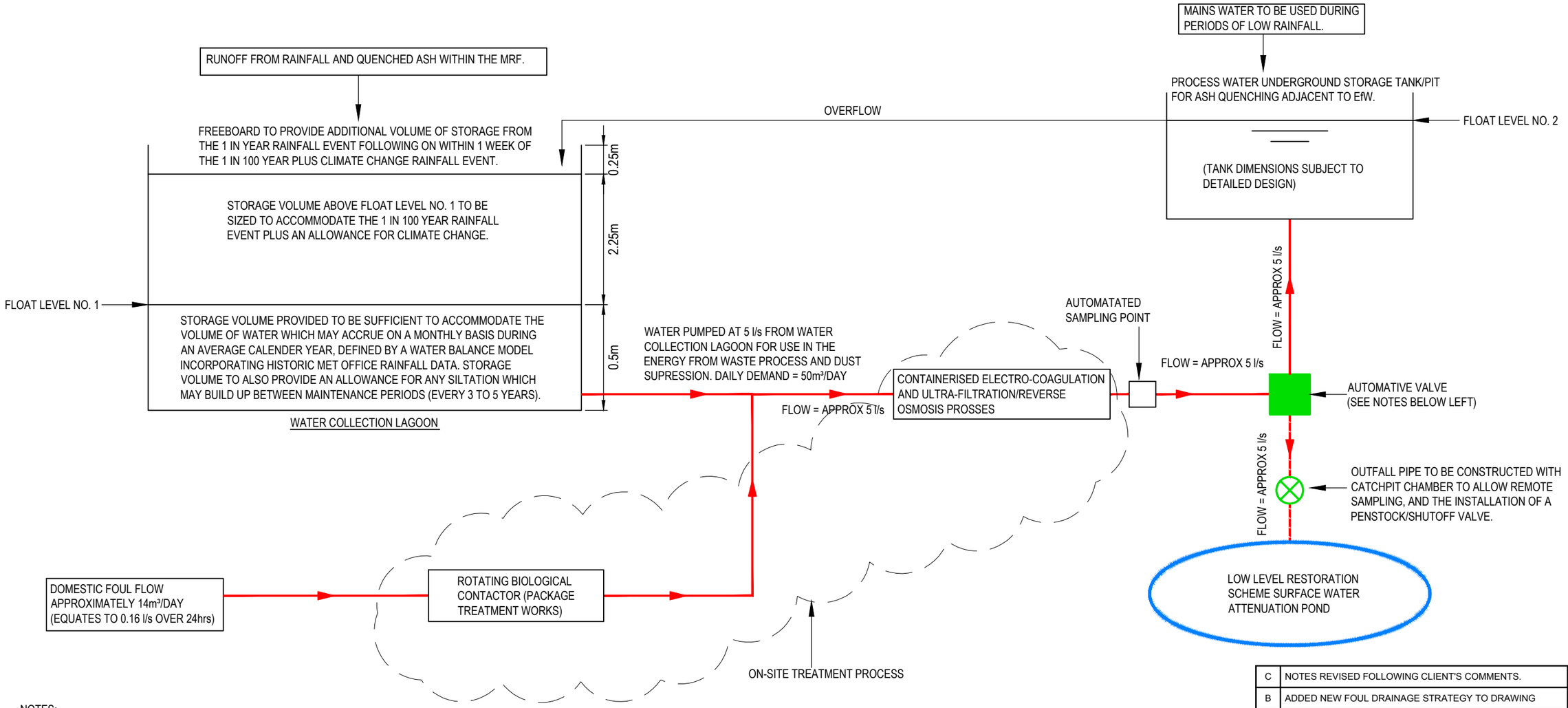
FOUL WATER DRAINAGE STRATEGY

Drawing Status: INFOMATION

Date of 1st Issue	12/03/10
A3 Scale	1:2000
Drawn by	EJC
Checked by	PJ

Drawing Number: 21780/077/001

Revision: C



NOTES:

1. ALL PROPOSALS ARE SUBJECT TO DETAILED DESIGN.

2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING 21780/077/001.

3. THE APPROXIMATE DIMENSIONS OF THE WATER COLLECTION LAGOON ARE 80m X 20m X 3m, APPROXIMATE PLAN AREA 1592m², TAKEN FROM AEW MASTERPLAN DRAWING 33250 F126.

4. DETAILED DESIGN OF PUMPING ARRANGEMENT TO CONSIDER DUTY/STANDBY REQUIREMENTS TO ENSURE REDUNDANT/BACKUP PUMPING PROVISION.

AUTOMATIVE VALVE NOTES

1.AUTOMATIVE VALVE SET TO ALLOW FLOWS TO BE PUMPED TO EfW WATERSTORAGE TANK UNTIL FULL (AS DETERMINED BY FLOAT LEVEL NO.2)

2. IF THE EfW WATERSTORAGE TANK IS FULL AND THE WATER LEVEL IN THE WATER COLLECTION LAGOON IS ABOVE FLOAT LEVEL NO. 1, THE AUTOMATIVE VALVE WILL SWITCH TO ALLOW DISCHARGE OF FLOWS TO THE LOW LEVEL RESTORATION SCHEME SURFACE WATER ATTENUATION POND.

3. IF THE EfW WATERSTORAGE TANK IS FULL AND THE WATER LEVEL IN THE WATER COLLECTION LAGOON IS BELOW FLOAT LEVEL NO. 1, PUMPING FROM THE WATER COLLECTION LAGOON WILL CEASE BUT DOMESTIC FOUL FLOWS WILL CONTINUE TO BE TREATED AND DISCHARGED TO THE LOW LEVEL RESTORATION SCHEME SURFACE WATER ATTENUATION POND.

Mark	Revision	Drawn	Date	Chkd
C	NOTES REVISED FOLLOWING CLIENT'S COMMENTS.	BMP	21/04/11	PJ
B	ADDED NEW FOUL DRAINAGE STRATEGY TO DRAWING	TA	12/04/11	PJ
A	ADDITIONAL NOTATION ADDED TO DRAWING	EJC	24/06/10	CST
D	NOTE REVISED TO CONFIRM TREATMENT TECHNOLOGY	BMP	05.05.11	PJ

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Drawing Issue Status

INFORMATION

PROPOSED ROOKERY SOUTH RESOURCE RECOVERY FACILITY SCHEMATIC OF THE WATER COLLECTION LAGOON AND FOUL WATER DRAINAGE STRATEGY

Client

COVANTA

ROOKERY SOUTH LTD

Date of 1st Issue: 29/04/10	Drawn by: TA
A3 Scale: NTS	Checked by: PJ
Drawing Number: 21780/077/002	Revision: D

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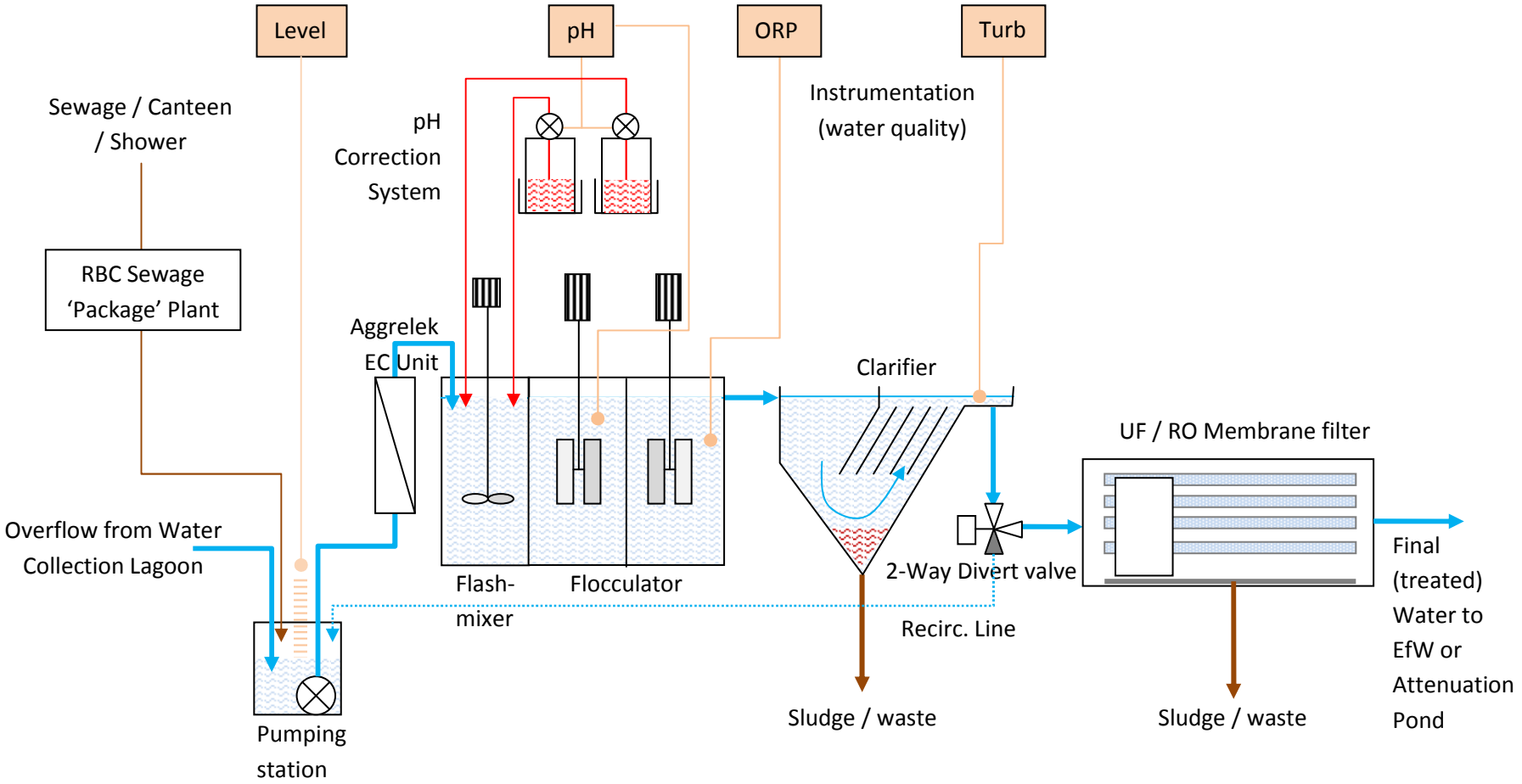
Appendix B – Summary of the Proposed Foul Water Treatment Processes

COVANTA ROOKERY SOUTH Ltd.,

Project Ref: Covanta/rookery/140511

P&ID

FIGURE 1 PROPOSED TREATMENT PROCESS LAYOUT



P&ID

Background

The Resource Recovery Facility at Covanta Rookery, Bedford has been informed by Anglian Water that nearby Stewartby WwTw cannot accept wastewater (trade effluent) from the Covanta site. Accordingly, Covanta Rookery South Ltd., are investigating options for on-site treatment of its wastewater for discharge to the Rookery South Surface Water Attenuation Pond. The attenuation pond ultimately discharges to a local watercourse and Stewartby Lake. This report proposes the design of a wastewater treatment facility that could treat wastewater to achieve a similar water quality to that of the proposed receiving waters.

Treatment Philosophy

It has been assumed that the quality of the wastewater produced from the Inflow from IBAA Yard to the Water Collecting Lagoon is comparable to that produced from a similar Resource Recovery Facility (operated by Ballast Phoenix) which is a similar site to the proposed Materials Recycling Facility at Rookery, and this forms the basis of the design of the treatment plant. The main contaminants of the wastewater are chlorides, sulphates, ammonium together with other low level contaminants (Table 1, attached file) and slightly alkaline (pH ~ 9.3 units). In addition, domestic effluent (sewage, canteen and shower facilities) will be combined with the industrial effluent. The proposed treatment plant will consist of 3 key processes:

1. A 'package' biological treatment plant (e.g. RBC) for treatment of sewage, canteen facilities and showers (14 m^3d^{-1}) (Refer to glossary of terms below);
2. A containerised electro-coagulation process with pH correction for general removal of contaminants, sulphates, solids, ammonium etc (5 ls^{-1}) (Refer to glossary of terms below);
3. A containerised ultra-filtration / Reverse Osmosis (RO) process for reduction of chlorides (5 ls^{-1}) (Refer to glossary of terms below).

P&ID

Treated sewage and excess water from the Water Collecting Lagoon will discharge directly to a Pumping Station which will feed a front-end Aggrelek electro-coagulation and pH correction followed by Ultra filtration and RO treatment (Figure 1) prior to discharge to Rookery South Surface Water Attenuation Pond.

Control Philosophy

Water quality will be measured through the treatment process. Critical measurements include pH, ORP (Redox-potential) to ensure insolubility and precipitation of general contaminants (suspended solids, copper, zinc, sulphate and ammonium) followed by ultra-filtration / RO for the reduction of chloride ions. The plant will start-stop automatically based on the pre-set heights of Ultrasonic Level controller in the Pumping Station (i.e. at high level (HL) event the plant will automatically start and at low level (LL) the plant will automatically stop). Turbidity values measured on the discharge of the Clarifier unit will control feed to the RO process via a 2-way electric actuator valve. Should for any reason for example poor feed-water quality, process parameters values outside pre-set values (e.g. pH, ORP, Turbidity) water will be re-circulated to the Pumping Station for re-treatment through the plant. This will protect and pro-long the life of the Ultra / RO filters. Control of the electro-coagulation process and Ultra / RO filtration processes will be achieved by x2 independent plc controllers on each process. A master control system will ensure correct 'hand-shaking' between the level of wastewater in the Pumping Station and each of the two (Electro-coagulation and Ultra/RO filtration) processes.

Control of the treatment process – Level height, pH, ORP, Turbidity, current density (electro-coagulation) will be set via the HMI display panel on the Aggrelek Power Control unit. A modem can be fitted to this unit to allow remote operation via a virtual HMI (web-based) and automatic SMS text fault dial-out to a designated operator to notify the plant operator (or Watertec Solutions) of any treatment plant problems.

Additional process contingency / treatment options

The above treatment process has been designed prior to the detailed design process and further samples will be taken from the existing Ballast Phoenix site and tested to refine the design. The design has however been based on the collective experiences of using electro-coagulation and UF/RO filtration on other environmentally sensitive ground water and leachate sites. Additional measures and treatment options to ensure that the proposed treatment process can produce the highest quality water include;

1. Upgrading the electro-coagulation process to an Advanced Oxidation (AOP) process, whereby organics are mineralised by powerful OH• (hydroxyl radicals) prior to clarification. This would be achieved by using iron electrodes under slightly acid conditions and supplementing the reaction with hydrogen peroxide dosing (electro-Fenton reaction);
2. GAC (granular activated carbon) adsorption of organics on to highly porous carbon, prior to UF/RO filtration.

Glossary of Terms

Electro-coagulation – is a chemical-free, electro-based process whereby colloids, fines, clays, heavy metals and other inorganic and organic contaminants can be removed from water by a process of 'charge neutralisation' and adsorption. Contaminants can generally be regarded as negatively charged particles, thereby, introducing positive charges (from the electrode) contaminants become charge neutral and 'fall-out' of solution. The amount of positive ions added is a function of electrode area (size of treatment plant) and current density (electric current). Contaminants are subsequently removed by downstream clarification processes (settlement or flotation). Electro-coagulation works optimally within pH range (5.3 – 7.3 pH units).

pH Correction – is a chemical process of adding H^+ (acid) or OH^- (alkaline) ions to solutions to optimise coagulation and maximise the removal of contaminants.

Ultra Filtration / Reverse Osmosis (RO) – is a physical process of squeezing water at very high pressure through a finely chemically charged membrane. It is process used commonly for de-salination of brackish / saline water to produce drinking water. Ultra-filtration / RO works optimally at pH neutral conditions. A course filter (Ultra filtration membrane) is used upstream of the finer RO membrane to both protect the membrane and to extend membrane life.

Rotating Biological Contactor (RBC) – Is a well established 'package' aerobic biological plant used for treating domestic waste water. Aerobic bacteria colonise a series of cylindrical discs which rotate partly in sewage (food source) and partly in air (oxygen). The bacteria feed on the organics producing innocuous carbon dioxide and water and new bacteria (which may become also become a food source). The size of the plant is determined by flow rate and loading and by the area and number of discs within the tank.