Limerick WWTP Upgrade and Regional Bioresource Centre

Engineering Services Report

June 2026

Formerly JB Barry Partners who became part of Egis in 2023

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LIST OF ABBREVIATIONS

AD	Anaerobic Digestion
AGS	Aerobic Granular Sludge
AER	Annual Environmental Report
BOD	Biochemical Oxygen Demand
CAS	Conventional Activated Sludge
CEMP	Construction Environmental Management Plan
CHD	Combined Heat and Power
COD	Chemical Oxygen Demand
DWF	Dry Weather Flow
DS	Dry Solids
EIAR	Environmental Impact Assessment Report
ELV	Emission Limit Value
EPA	Environmental Protection Agency
EU	European Union
FFT	Flow to Full Treatment
FRA	Flood Risk Assessment
GBT	Gravity Belt Thickener
ISL	In situ Leaching
LPT	Liquefaction Process Technology
NIS	Natura Impact Statement
NRV	Non-Return Valves
PE	Population Equivalence
PFF	Pass Forward Flow
PS	Pump Station
PST	Primary Settling Tank
SHC	Sludge Hub Centre
SID	Strategic Infrastructure Development
SRT	Sludge Retention Time
THP	Thermal Hydrolysis Process
TSS	Total Suspended Solids
UE	Uisce Eireann
UV	Ultraviolet
VSD	Variable Speed Drive
WAS	Waste Activated Sludge
WFD	Water Framework Directive
WWDL	Wastewater Discharge Licence
WWPS	Wastewater Pump Station
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

1.1 Background of the Scheme

EGIS Engineering Ireland have been commissioned by Uisce Éireann (formerly Irish Water) to prepare a planning application for permission for the proposed upgrade of Limerick Wastewater Treatment Plant (WWTP) in the townlands of Ballykeeffe and Corcanree in Limerick City.

1.2 Applicant Details

The applicant for this planning application is:

- Name: Uisce Éireann
- Address: Colvill House, 24–26 Talbot Street, Dublin 1

As of 14th January 2014, Uisce Éireann assumed responsibility from local authorities for water services functions nationally. Uisce Éireann is a regulated water services utility. The Environmental Protection Agency (EPA) is the technical and environmental regulator and, amongst other things, issues and enforces authorisations for wastewater discharges. The Commission for Regulation of Utilities (CRU) is the financial regulator and aims to ensure water services are delivered in a safe, secure and sustainable manner and that Uisce Éireann operates in an efficient manner. One of the keyways in which the CRU does this is through the revenue control process.

1.3 Purpose of the Report

The purpose of this Engineering Services Report is to support a planning application being made as a Strategic Infrastructure Development (SID) under Section 37B of the Planning and Development Act 2000 (as amended), and it provides a description of the proposed development, how it will function and how it will serve Limerick (Bunlicky) and the surrounding areas.

This report should be read in conjunction with the entire planning package which includes:

- Cover Letter
- Planning Statement
- Engineering Drawings
- Appropriate Assessment Stage 2 Natura Impact Statement (NIS)
- Construction Environmental Management Plan (CEMP)
- Flood Risk Assessment (FRA)
- Environmental Impact Assessment Report (EIAR)
- Consultation Report
- Statutory notices, application form.

1.4 Brief Outline of Development

The main Limerick WWTP was constructed in the early 2000's. The plant is situated approximately 3km south-west of Limerick City and adjacent to the Shannon Estuary. An overview of the site and local surrounds is presented in Figure 1-1.

The sources of wastewater loading are from the residential population of Limerick City and environs, commercial and industrial sectors. The plant also treats imported sludges and leachates. The plant receives pumped flows from Corcanree Pumping Station (PS) and Mungret PS.

Incoming flows discharge to the inlet works at Limerick WWTP. There is also a sewer connection upstream of the main inlet wet well which serves as a discharge point for leachate. Discharge of effluent from the plant is to the Lower River Shannon. The agglomeration was issued a wastewater discharge licence by the EPA in April 2009 (EPA ref D0013-01).

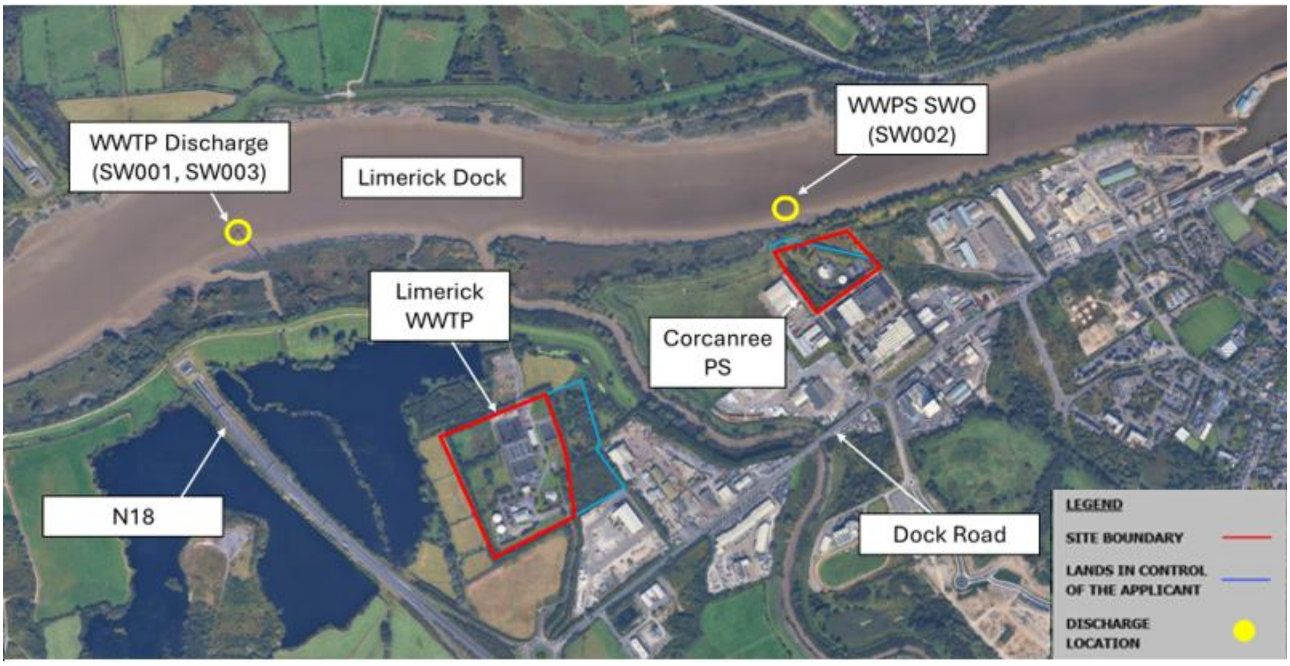

FIGURE 1-1: LOCATION MAP

The Proposed Development will increase the treatment capacity of the existing WWTP, provide additional storm water storage capacity and the existing sludge treatment facility will be developed into a Regional Bioresource Centre (RBC). The proposed upgrade works are spread over two sites, namely the Limerick WWTP and the Corcanree PS. Both sites are in an industrial location near the Dock Road in Limerick. The existing land use at both locations comprises wastewater treatment activities.

1.5 Planning Application

The objective of this project and the purpose of this planning application is:

- To upgrade the existing Limerick WWTP to cater for a 10-year growth period (up to the year 2033) to 285,000 PE (with provision in the civil infrastructure to meet the +25-year growth period of 325,000 PE). This upgrade will allow for domestic, commercial, institutional, and industrial future projected loadings.
- To provide a new 12,500m^3 storm water storage tank at Corcanree PS
- To develop a regional bioresource centre at the Limerick WWTP.

This upgrade will ensure compliance with the requirements of Urban Wastewater Treatment Directive and with Wastewater Discharge Authorisations requirements while providing appropriate capacity as per relevant Uisce Éireann policies.

1.5.1 Strategic Infrastructure Development

Pre-application discussions have been entered with An Coimisiún Pleanála (ACP) under Section 37B of the Act to determine whether the proposed development project for Limerick (Bunlicky) will be classified as Strategic Infrastructure Development (SID).

SID development is defined in the 7th Schedule of the Planning and Development Act 2000 (as amended). It is any development that is of strategic economic or social importance to the state or a region. It includes development that contributes significantly to the fulfilment of the objectives of the National Spatial Strategy or Regional Spatial and Economic Strategy (RSES) for an area, or which would have a significant effect on the area of more than one planning authority. It also includes 'Environmental Infrastructure' development, which refers to wastewater treatment plants with a capacity greater than 10,000 PE. Planning applications for SID are made directly to An Coimisiún Pleanála and not to the Local Authority.

The existing plant exceeds the 10,000 PE (population equivalence) threshold and the proposed development will provide for an uplift of treatment capacity up to 325,000 PE. Therefore, it constitutes to Environmental Infrastructure and requires an EIA to be conducted. Based on this condition and considering impacts in relation to other terms within the 7th Schedule, as such the proposed development is classed as SID.

1.5.2 Environmental Impact Assessment Report (EIAR)

An Environmental Impact Assessment (EIA) for the proposed upgrade has been undertaken as part of the planning process and in accordance with the EIA Directive (2014/52/EU). The Environmental Impact Assessment Report (EIAR) details the potential environmental impacts which may arise because of the construction and operational phases of the proposed development.

2 OVERVIEW

2.1 Proposed Development

The proposed development comprises the construction of wastewater and sludge treatment plant upgrades at the existing Limerick WWTP and associated works to provide storm water storage at Corcanree PS.

The constituent elements are described below:

2.1.1 WWTP Capacity Upgrade

- Retain the existing inlet works and construct an additional new inlet works designed for flows up to 1,110 l/s to feed the proposed new water treatment stream. The new inlet works will include screening with screenings removal, washing and compaction, grit trap, grit classification and inlet flow measurement.
- Installation of a new odour control unit at the inlet works.
- Retain the existing conventional activated sludge (CAS) stream and construct an additional new parallel 157,000 PE Activated Granular Sludge (AGS) process stream incorporating two AGS tanks with five compartments per tank, one water level correction (WLC) tank and one sludge buffer tank.
- Repairs to the existing final effluent pumps and connection of the new AGS final effluent line to the existing upgraded outfall arrangement.

2.1.2 Storm Water Storage Upgrade

- Construction of a new 12,500 m^3 storm water storage tank at Corcanree PS.
- Interception of four storm pumps at Corcanree for diversion to the new storm tank with a maximum inflow rate of 4,800 l/s.
- Provision of a gravity overflow from the new storm tank to the existing Corcanree outfall chamber.
- Installation of a variable-speed storm tank return pump with a maximum return rate of 670 l/s.
- Increase of the foul pumping capacity of Corcanree wet well No.2 to 879 l/s and direct flows to the new process stream.
- Increase of the foul pumping capacity of Corcanree wet well No.1 to 1,110 l/s (FFT flows to existing treatment stream) and direct flows to the existing treatment stream and excess flows spilling to the WWTP storm tank.
- Opening of the variable sluice between Corcanree inlet and foul wet well No.2 so both wet wells fill during normal operation.
- Development of a control philosophy to balance spill rates between the WWTP and Corcanree storm tanks.

2.1.3 Regional Bioresource Centre

- Retention/refurbishment of existing imported sludge reception tanks.
- Installation of a new dewatered sludge cake reception facility.
- New mechanical thickening for WAS, including new polymer dosing systems.
- Refurbishment of two existing digester feed tanks for use as pre-THP dewatering feed tanks.
- Upgraded mixing systems and transfer pumps for the pre-THP blend tank.
- Installation of a new odour control system to serve the overall sludge hub installation.
- Installation of new dewatering centrifuges for pre-THP dewatering based on 12-hour/day operation.
- Provision of a new dewatered sludge cake silo for blending and storage of cake imports and pre-THP dewatered sludge.
- Construction of a new Thermal Hydrolysis Process (THP) installation.
- Allow for a new anaerobic digestion (AD) tank to increase operational flexibility.
- Biogas production and storage infrastructure including options for CHP and biomethane recovery.
- Construction of a new covered digested sludge tank connected to the existing digester gas headspace.
- Installation of a new digested sludge dewatering system based on full digested load and 12-hour/day operation.

- Construction of a new centrate return pumping station and evaluation of struvite risk in the return line routing.
- Provision of treated cake export storage silos and associated pumping equipment.
- Upgraded wash water system including UV treatment to meet enhanced Regional RBC operational demands.

3 PROJECT BACKGROUND

3.1 Existing Wastewater Facilities

The existing Limerick WWTP was originally designed for a PE of 130,000. The agglomeration was issued a wastewater discharge licence by the EPA in August 2009 (EPA ref D0013-01). The plant treats both domestic and non-domestic wastewater and was designed to cater for the following:

- Biological Load: 7,800 kg BOD / day
- Dry Weather Flow (DWF): 29,250 m3/day

The plant was designed to achieve the following discharge limits:

- BOD: 25 mg/l
- Suspended Solids: 35 mg/l
- COD: 125 mg/l
- Ammonia: 20 mg/l

It should be noted that there was no discharge limit for Orthophosphate at the time of construction. A discharge limit of 6.5 mg/l was applied retrospectively by the EPA in the wastewater discharge licence.

As the WWTP was being constructed, significant upgrades to the sewer network were also carried out. This included approx. 45km of large diameter interceptor sewers within Limerick City that discharged to the newly constructed pumping station at Corcanree.

Corcanree PS is the main pumping station in the network and accounts for 90% of the flow from the network. The second pumping station is Mungret PS which is located on the WWTP site. Flows from both pumping stations discharge to preliminary treatment with flows up to 3DWF going forward to primary and secondary treatment. Flows more than 3DWF discharge to the storm water holding tank and are pumped back for treatment when incoming flows allow. If the incoming flows remain high and cannot be treated in the WWTP, the storm tank overflows directly to the Shannon River via the Outfall. In certain high rainfall events, the Corcanree storm water overflow is also activated.

The existing Limerick WWTP operates as a plug flow activated sludge plant and consists of the following elements:

- Mungret Pumping Station
- Fine inlet screening complete with screenings removal, washing and compaction
- Grit trap complete with classifier
- Inlet flow measurement
- Primary treatment tanks complete. Chemical enhanced treatment can be used for phosphates removal in future
- 3 No. plug flow rectangular aeration tanks with FBDA
- 5 No. rectangular secondary clarifiers
- 1 No. Storm holding tank
- Final effluent Pumping Station
- Outfall to River Shannon
- Sludge treatment facility
- 2 No. Anaerobic digestors
- 1 No. 400kW$_e$ CHP
- 1 No. Sludge drying facility (currently mothballed)
- Sludge dewatering building complete with 3 No. centrifuges
- Administration/Control Building
- Emergency gravity overflow to outfall

Treated effluent from the WWTP and stormwater overflows are discharged via a 1.1km long outfall pipe to the Upper Shannon Estuary/ Limerick Dock, a designated Natura 2000 site. The treated effluent generally flows by gravity to the outfall but is pumped when the tide/river level is high. The River Shannon is designated both a Special Area of Conservation (Lower River Shannon) and a Special Protected Area (River Shannon and River Fergus Estuaries). The agglomeration was issued a wastewater discharge licence by the EPA in August 2009 (EPA ref D0013-01).

Indigenous sludge from the WWTP process and imported sludges are treated with anaerobic digestion and dewatered by centrifuges before removal off site. Centrate returns from the sludge treatment facility are re-circulated to the front end of the WWTP for full treatment.

3.1.1 Existing Effluent Quality

The 2023 EPA Annual Environmental Report (AER) reports a peak week organic collected load of 122,317 PE, and an annual max hydraulic loading rate of 83,395m^3/day. The organic loading is within the design capacity, but at peak flows the WWTP experiences significant hydraulic overloading.

This is reflected in the WWDL compliance status, with failures in effluent standards for COD, Suspended Solids and Ortho-P in the reporting year. There were 7 no. environmental incidences relating to ELV breaches and spillages due to issues such as WWTP overloading, plant equipment failure and adverse weather conditions. Since 2020, the plant has had on average of 10 no. EPA reportable incidences per year.

3.2 Existing Storm Water Storage

There is an existing 7,500m^3 storm water storage at the WWTP, but it does not have sufficient capacity to manage excess flows from the drainage network. The current baseline scenario, derived from Drainage Area Plan (DAP) modelling and verified through TSR simulations, indicates an annual average of 213 spills from the stormwater overflows (SWOs) serving the wastewater treatment plant. These uncontrolled spills are discharged with minimal treatment to the Shannon Estuary, which forms part of a designated Special Area of Conservation (SAC) under the Habitats Directive 92/43/EEC (Commission of the European Communities, 2007). The frequency of spills exceeds the limits set by the Urban Wastewater Treatment Directive (UWWTD) and the current Uisce Éireann Technical Standards.

The Proposed Development includes the installation of a new 12,500 m^3 stormwater storage tank at Corcanree PS, together with upgraded pumping and flow management arrangements. These improvements will substantially reduce the annual number and volume of uncontrolled spills to the Shannon Estuary, bringing the WWTP into compliance with environmental legislation and UWWTD objectives.

3.3 Existing Sludge Storage & Treatment Facilities

The existing Sludge Hub Centre at the Limerick WWTP was upgraded in 2017 to include an Anaerobic Digestion (AD) facility, which enables treatment of sludge produced onsite as well as sludge imported from Castletroy WWTP and smaller plants serving towns and villages in the surrounding area. The Limerick facility has been identified as the preferred location for the development of a Regional Bioresource Centre to serve the south-west region. This designation reflects the site's strategic location, existing infrastructure, and capacity to accommodate additional sludge treatment and processing.

The development of a Regional Bioresource Centre at Limerick forms part of the National Wastewater Sludge Management Plan (NWSMP), which seeks to deliver a sustainable, standardised, and long-term approach to the management of wastewater sludge across Ireland. The NWSMP promotes a hub-and-satellite approach, optimising treatment efficiency, supporting energy recovery through anaerobic digestion, and producing biosolids suitable for reuse in line with environmental and circular economy objectives. The proposed upgrades will ensure that the Limerick WWTP continues to provide a sustainable solution for sludge arising from the agglomeration while also meeting national sludge management standards.

3.4 Need for Development

The key objectives for the Limerick agglomeration include:

- The provision of sufficient treatment capacity to consistently meet the required discharge standards.
- The provision of adequate capacity to facilitate the planned development and growth of the agglomeration.
- The provision of stormwater storage to reduce the number of independent storm events discharged via the storm water overflows.
- The development of a Regional Bioresource Centre at Limerick which forms part of the National Wastewater Sludge Management Plan (NWSMP), which seeks to deliver a sustainable, standardised, and long-term approach to the management of wastewater sludge

It is proposed to upgrade the existing Limerick WWTP to cater for a +10-year growth period (up to the year 2033) to 285,000 PE (with provision in the civil infrastructure to meet the +25-year growth period of 325,000 PE). This upgrade will allow for domestic, commercial, institutional, and industrial future projected loadings. Upgrade works will be undertaken within the existing WWTP site boundary.

As noted previously, stormwater storage is currently provided at Corcanree PS only by means of limited storage within the inlet pumping station sump through active operations management of the pumps. Stormwater which exceeds the hydraulic capacity of the treatment plant currently discharges via the treated final effluent outfall to the Lower River Shannon.

The Lower River Shannon is classified as contact/recreational waters, therefore the parameters as set out within Uisce Éireann's Technical Standard "Storm Water Overflows" (Document No. IW-TEC-800-03) require the overflow to be designed so that the maximum number of independent storm events discharged via the storm water overflow must, on average, not exceed 7 per bathing season. The bathing season in Ireland runs from 1st June to 15th September each year.

Storm water storage volumes were calculated based on providing 2-hours retention for Formula A flows less flow to full treatment (FFT). Formula A was calculated based on the design projected loadings (domestic, commercial, institutional, and industrial) previously calculated. Allowances for water consumption and infiltration per head per day are in accordance with Uisce Éireann Document No. IW-TEC-700-99-02 "Inlet works & stormwater treatment (wastewater)". A further allowance of 20% was included to account for additional future storm flows resulting from climate change. Stormwater storage for a volume of 12,500 m^3 is proposed for the development.

Further details of the WWTP and storm storage tank will be provided in the later sections of this report, with details of both shown on the drawings in this planning application submission.

The existing sludge treatment plant on the Limerick WWTP site is also at capacity. As part of Uisce Éireann's National Sludge Management Plan, the southwest regional hub (regional bio centre) will be required to treat a significantly higher volume of sludge from the counties of Limerick, Clare, Tipperary, Kerry and North Cork than there is currently capacity for in Bunlicky. This is restricting the continued development in this region as there is insufficient capacity to treat the sludge produced from the anticipated increased volume of wastewater to be produced. Having identified these two shortcomings with the current treatment systems, the following economic objectives have been identified:

- Implement sufficient wastewater treatment capacity to support the planned sustainable future development of Limerick City.
- Install the required sludge treatment capacity to handle the biosolids extracted from the regional wastewater treatment plants in Limerick, Clare, Tipperary, Kerry and North Cork, which is intended to be sent to the new regional SHC, therefore allowing for the continued development of the region.
- Install the required treatment processes to keep the effluent discharged from the plant within the designated pollutant limits as defined by the appropriate authorities to preserve the environment in the Shannon Estuary and maintain and enhance the recreation and amenity value of the surrounding area.

4 DESIGN REQUIREMENTS

4.1 WWTP Capacity Upgrade Design Requirements

4.1.1 Organic Loading

4.1.1.1 Domestic, Commercial and Industrial Contribution

Uisce Éireann has projected an increase in urban average annual percentage growth for the Limerick metropolitan area of 2.21% up to 2043, reducing to 0.63% thereafter. Projections are in accordance with objectives of the National Development Plan and National Planning Framework. It assumes that the non-domestic PE (commercial and institutional) will grow at the same rate as the domestic PE.

A headroom allowance is also applied in the assessment of future PEs, in accordance with the Water Services Strategic Plan (WSSP). The WSSP outlines the long-term objective to provide for and maintain headroom capacity based on the size of the settlement served and the likely growth potential in line with the settlement hierarchy. It provides a requirement for large urban settlements (such as Limerick) to have 20% headroom under SG2d of the WSSP.

The headroom factor is particularly necessary in wastewater planning, where peak loads can reach multiples of the average daily load. This has been applied to the calculations for the domestic, commercial, and institutional related agglomeration growth projections, in accordance with the WSSP.

Details of urban growth rate and headroom projections are further outlined in the UÉ Wastewater Asset Planning Growth and Headroom Technical Guidance Notes (TGN).

A summary of PE figures according to baseline and projected design periods of 1, 10 and 25 years are provided in Table 4-1 below. The calculated growth PEs are as agreed between UÉ and Limerick County Council Forward Planning. This meets Ireland 2040 strategy for Limerick e.g. grow population by 50%.

The projected PE figures take account of the following:

- Capacity to accept 50% industrial licence allowance and future industrial commitment is included from construction commencement (2028) and increased to 100% after construction.
- Headroom allowance is included from project completion project (2031).
- 2.21% growth rate is predicted up to year 2040, and growth rate reduces to 0.63% thereafter.

TABLE 4-1: SUMMARY OF PE FIGURES
ACCORDING TO BASELINE & PROJECTED DESIGN PERIODS OF 1, 10 & 25 YEARS

Design Year	Baseline	Current	Year 1	Year 10	Year 25
Domestic PE Growth @ 2.21% /.63%	92,964	105,992	115,677	140,828	166,777
Non-Domestic PE Growth @ 2.21% /.63%	20,467	23,336	25,468	31,005	37,325
Incl. 20% Headroom	_		-	206,199	244,923
Industrial PE -Existing	35,302	35,302	25,000	50,000	50,000
Industrial PE - Future	_	_	13,750	27,500	27,500
Toal PE	**148,733**	**164,630**	**179,895**	**285,000**	**<325,000**

4.1.1.2 Industrial Contribution

Industrial growth and new industrial connections are assessed under a separate licencing process. As outlined previously, total existing licensed industrial allowances in the agglomeration amounts to 50,000 PE. There is also a commitment to provide an additional 27,500 PE for future industrial expansions. Total existing and future industrial PE requirements are summarised in Table 4-2 below.

TABLE 4-2: SUMMARY OF THE TOTAL EXISTING AND FUTURE INDUSTRIAL PE REQUIREMENTS

Facility	Licensed PE
Regeneron Ireland	30,000
Howmedica	20,000
IMAG Optical Storage Ltd	63
Future Industrial Commitment	27,500
Total Industrial	**77,563 PE**

4.1.1.3 Summary of Design Loadings

TABLE 4-3: SUMMARY OF PE LOADINGS, FROM THE VARIOUS SECTORS AND THE TOTAL BASELINE PE

Sector	PE Contribution
Total Domestic Population	92,964
Commercial Load (16% of Domestic)	14,874
Institutional – Schools & Colleges	2,158
Hospitals, Nursing Homes & Prison	1,564
Tourism – Hotels	1,871
Industrial	35,302
Total Loading	**148,733 PE**

TABLE 4-4: FUTURE LOADING SCENARIOS

Scenario	PE	DWF (m^3/day)	FFT (m^3/day)	Formula A (m^3/day)	BOD Load (kg)	BOD Conc. (mg/l)
Current	148,733	42,104	84,629	199,195	8,924	212
Scenario 1	220,000	53,486	116,817	287,886	13,200	247
Scenario 2	260,000	65,109	149,386	386,834	15,600	240
Scenario 3	285,000	66,109	152,386	389,834	17,100	259
Scenario 4	325,000	67,709	157,186	394,634	19,500	288

4.1.2 WWTP Hydraulic Loading

4.1.2.1 Domestic, Commercial and Industrial Contribution

Hydraulic and organic loading parameters for the agglomeration, given the projections recommended by UÉ, are listed below in Table 4-5 below. The calculations have been based on a combination of standard design parameters (60g BOD /PE and 175l/pp) and factors unique to the WWTP such as high network infiltration and measured/ licenced industrial flow contributions.

90% of the flows to the WWTP are pumped forward from Corcanree PS and 10% remaining flows are from Mungret PS. PE split differs at 70%: 30% as more high concentrate industrial flow enters the WWTP via Mungret PS. The flow to full treatment for Mungret PS is 200l/s.

TABLE 4-5: HYDRAULIC & ORGANIC LOADING PARAMETERS FOR THE AGGLOMERATION, BASED ON RECOMMENDED PROJECTIONS

Scenario	PE	DWF		FFT		Formula A	
		(m^3/day)	l/s	(m^3/day)	l/s	(m^3/day)	l/s
PE Assessment 2018	148,733	42,104	487	84,629	980	199,195	2,305
Year 10	285,000	66,109	765	152,386	1,764	389,834	4,512
Year <25	325,000	67,709	784	157,186	1,819	394,634	4,568

4.2 Stormwater Tank Storage Design Requirements

4.2.1 Stormwater Tank Storage Volumes

At 95%ile flow in the river (22.5 m3/s), there are approximately 28 dilutions available for the projected normal wastewater discharge (DWF 66,109 m3/d and 67,709 m3/d). In accordance with UÉ-TEC-700-99 and UÉ-TEC-800-03, the discharge significance is low, and the stormwater design standard is for Formula A – FFT for two hours storage.

The required stormwater storage volume of Formula A – FFT for two hours for the projected 10-year design load of 285,000 PE and future expansion to 325,000 PE is 19,787 m3 as per Table 4-6 below. The existing stormwater holding tank at the WWTP can accommodate 7,500 m3 which leaves an additional design storage volume of approximately 12,500 m3 to be accommodated as part of the upgrade works.

TABLE 4-6: STORMWATER STORAGE VOLUMES

PE	285,000	+10 year		PE	325,000	<25 year
Formula A	389,834	m^3/day		Formula A	394,634	m^3/day
Formula A	16,243	m^3/hr		Formula A	16,443	m^3/hr
Flow to Full Treatment	152,386	m^3/day		Flow to Full Treatment	157,186	m^3/day
Flow to Full Treatment	6,349	m^3/hr		Flow to Full Treatment	6,549	m^3/hr
Storm storage volume				Storm storage volume		

PE	285,000	+10 year		PE	325,000	<25 year
Formula A - FFT @ 2 hours	19,787	m^3		Formula A - FFT @ 2 hours	19,787	m^3
Less existing 7,500 m3 storage	7,500	m^3		Less existing 7,500 m3 storage	7,500	m^3
Additional storage required	12,287	m^3		Additional storage required	12,287	m^3

4.3 Regional Bioresource Centre (RBC)

The new Regional Bioresource Centre (RBC) is required to treat indigenous and imported sludge load for Limerick County, and all sludge imports from Clare and Tipperary. Sludge will be transported via tankers and trucks from various WWTPs. The increased sludge load in the RBC will add an associated increased ammonia load for the WWTP to treat. This will be addressed by the addition of a liquor treatment plant (LTP) to remove the majority of ammonia load before return to the liquid line.

The main source of future sludge loading will be municipal wastewater treatment plants, with a small proportion of sludge coming from water treatment plants and industrial customers.

The new regional RBC will accommodate a design load of **41 TDS/day** with capacity to treat **50 TDS/day** in the future based on the +10-year design horizon. Refer to Table 4-7 below.

TABLE 4-7: SLUDGE HUB DESIGN LOAD

Description - 2030 Sludge Load to RBC	Value	Units	Reference
Imported Sludge – Clare	2,437	TDS/year	Estimated
Imported Sludge - Tipperary	2,890	TDS/year	Estimated
Imported Sludge - Limerick County	1,204	TDS/year	Estimated
Total Imported Sludge load (Clare, Tipperary and Limerick County)	**6,531**	TDS/year	Estimated
Castletroy WWTP (77,500 PE) (Inc. 20% headroom) Imported Cake Sludge	1,465	TDS/year	Estimated
Limerick WWTP (285,000 PE) (Inc. 20% headroom) Indigenous Sludge	7,175	TDS/year	Estimated
Sludge Load to Bioresource (Annual - Peak) **(Sum of Imported Sludge load peak, Castletroy & Limerick)**	**15,171**	TDS/year	Estimated
Sludge Load to Bioresource (Annual- Average) (Exc. 20% peak)	12,534	TDS/year	Estimated
Sludge Load to Bioresource (Daily- Peak over 365 days)[1]	**41.2**	TDS/day	Estimated
Imported Sludge Load to Bioresource – Over Weekdays	30.3	TDS/day	Estimated
Indigenous Sludge	19.7	TDS/day	Estimated
Total (Daily peak – Imports + Indigenous)[2]	**50**	TDS/day	Estimated

[1] *Figure used for design of pre-THP centrifuges, THP unit, Buffer Storage, AD, general sludge treatment.*

[2]*Figure used for design of Import facilities and Buffer storage. Imported Sludge infrastructure to be designed for peak imported sludge*

5 WATER QUALITY AND DISCHARGE REQUIREMENTS

5.1 Introduction

The proposed WWTP at Limerick will be designed to provide treatment to result in a discharge standard that complies with the relevant Irish and European legislation. The following sections set out the approach that has been undertaken with respect to the assessment of the discharge standard requirements, and wastewater treatment process options and design.

5.2 Proposed Wastewater Treatment Standard

The Urban Wastewater Treatment Regulations, 2001 (S.I. No. 254 of 2001) have replaced the Environmental Protection Agency Act, 1992 (Urban Wastewater Treatment) Regulations, 1994, as amended in 1999. These Regulations give effect to the Council Directive 91/271/EEC of 21st May 1991, as amended, concerning Urban Wastewater Treatment. In these Regulations, requirements for the provision of urban wastewater collection systems and wastewater treatment, together with an associated timeframe in which these requirements must be met, are set out.

As discussed previously, the EPA issued a wastewater discharge licence (WWDL) for the agglomeration of Limerick and its environs on the 22nd of April 2009 under Regulation 28(1) of the Wastewater Discharge (Authorisation) Regulations 2007. The licence register number is D0013-01 and the Licensee was Limerick County Council. The discharge location is the Lower River Shannon EU (WFD Code: IE_SH_060_0900).

On the 16th of December 2016 the EPA issued a Technical Amendment to the original WWDL. This amendment included changing the Licensee to Uisce Éireann, an amendment to the Glossary of Terms and some changes to monitoring frequency and exceedances.

Emission Limit Values included in Schedule A of the WWDL can be seen listed in Table 5-1 below.

TABLE 5-1: LIMERICK WWTP DISCHARGE LICENCE ELVS

Parameter	ELV
BOD	25 mg/l (750kg/day)
COD	125 mg/l
Suspended Solids	35 mg/l
Orthophosphate (as P)	6.5 mg/l
pH	6.0-9.0

Chapter 16 (Water Environment) of the Environmental Impact Assessment Report (EIAR) applied reduced ELVs for the purpose of assessing the impact of final effluent on the receiving water. There should be no reduction in WWTP performance compared to the current situation regarding quality of the final effluent. And therefore, meeting more stringent ELVs will be achievable. The BOD ELV is reduced for the future scenario to compensate for the expansion of the WWTP and increased outflows. Characteristics of future WWTP discharges used in the model analysis are outlined in Table 5-2 below.

TABLE 5-2: CHARACTERISTICS OF FUTURE WWTP DISCHARGES USED IN THE MODEL ANALYSIS

ELV Concentrations (at DWF)			285,000PE / 10 Yr Design	325,000PE / 25 Yr Design
BOD (mg/l)	MRP (mg/l)	DIN (mg/l)	DWF * 1.5 [m^3/day`]	DWF * 1.5 [m^3/day]
20	1	30	99,164	101,560

6 PROJECT DESCRIPTION AND PROPOSED DEVELOPMENT WORKS

6.1 Overview

The proposed upgrades will be developed at the existing Limerick WWTP site and the existing Corcanree PS and will provide preliminary, primary, and secondary treatment of the wastewater and adequate stormwater storage prior to discharge to the Lower River Shannon. Stormwater storage, sludge treatment and disposal and ancillary process elements such as pumping, control and measurement will also be provided. Ancillary site works such as buildings, kiosks, and site roads will also be constructed.

6.2 WWTP Capacity Upgrade

6.2.1 Preliminary Treatment – New Inlet Works

The proposed inlet works have been designed to receive flows from the incoming rising mains, screen incoming flows, remove grit, measure flows and sample wastewater concentrations. The inlet works will be covered, and odours will be treated by an adjacent odour unit. The proposed new inlet works has been designed for peak flows up to 1,100 l/s. The proposed new inlet works will provide preliminary treatment to the wastewater prior to discharge into the proposed New Nereda® process stream to provide secondary treatment.

The new inlet works will be constructed above ground on a reinforced / piled plinth foundation and will be integrated into the structure for the new AGS infrastructure. The plinth will be designed to accommodate equipment associated with the inlet works and AGS process, as seen in Figure 6-1 and Figure 6-2 below.

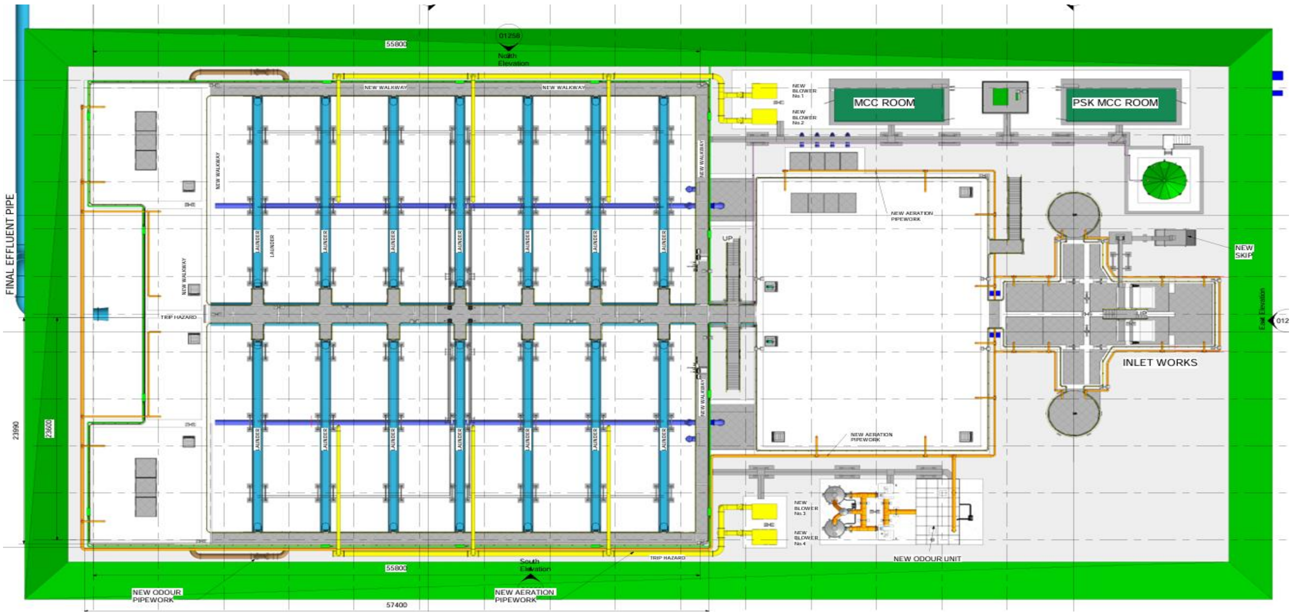

FIGURE 6-1: PROPOSED NEW INLET WORKS & AGS TANK PLAN

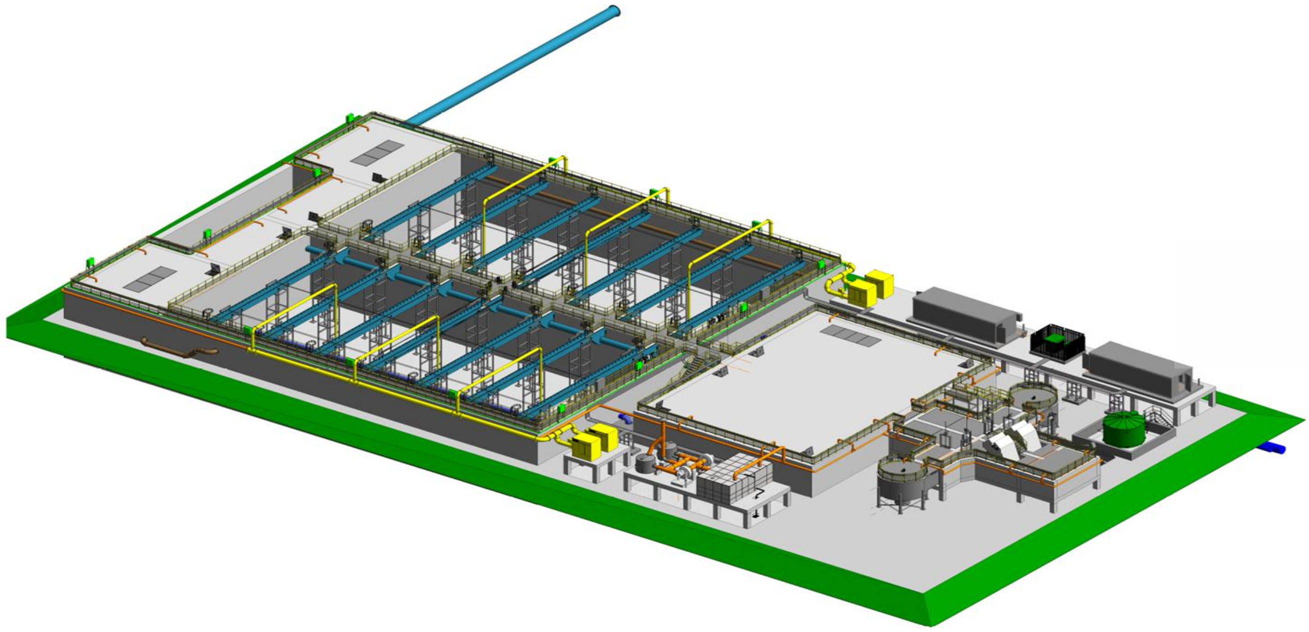

FIGURE 6-2: PROPOSED NEW INLET WORKS & AGS TANK 3D VIEW

There is potential to convert the existing CAS process to a 'AGS Hybrid' process for uplift to 325,000PE, with a portion of granular sludge diverted to the existing CAS. This will allow for more improved sludge settling in the secondary settlement tanks, which facilitates an increase in hydraulic capacity within the CAS itself.

The rising mains will discharge through a 90° bend and bell mouth arrangement to allow the rising mains to discharge vertically within the chamber. An access hatch will be provided to allow for visual inspection of the chamber.

The inlet chamber will be designed to meet the following requirements.

- Accept flows from the new 500mm and 900mm rising mains.
- Maintain minimum approach velocity to the inlet works.
- Prevent solid deposition.

The inlet chamber will be benched and incorporate baffling arrangements to achieve the above. Additional process connection(s) will be required for the screening wastewater return and other process return pipework.

Flows received in the inlet chamber will be monitored via inlet flowmeters, a level transmitter and a level switch installed in the inlet chamber. The level units in the inlet chamber will provide level information to the operator, which will notify them of potential accumulation of solids within the inlet chamber or approach to the inlet screens.

Flows will be directed from the inlet chamber to the inlet screens via 2 no. main channels. An additional bypass channel will also be available when necessary. The channels will be designed to achieve a constant flow velocity to the inlet screens of 0.6m/s to 1.2m/s.

There will be no requirement for a storm overflow from the proposed new inlet channel as the storm storage down at Corcanree PS will be utilised and flows in excess of FFT of the proposed new stream will not be delivered to the WWTP.

6.2.1.1 Screening

The design of the inlet screens has been carried out in accordance with Table 4.2 of Uisce Éireann technical standard IW-TEC-700-99-02.

Two high-capacity band type screens (capable of screening to 6mm particle size in 2D) with automatic compaction will be located downstream of the inlet chamber. The screens will operate as duty/standby and will alternate on a timed or assist basis as required. A manual screen will be positioned in the bypass channel.

The inlet screens will operate on differential level control. When the level in the inlet chamber reaches a setpoint level the duty inlet screen will commence operation and continue until the level reduces below the stop level setpoint. Screens shall be designed to cope with a minimum of 110% of design capacity for works of sizes greater than 2500PE - IW-TEC-700-99-02, allowing for a blinding factor of 50%.

The maximum daily screening volume has been calculated in accordance with the UÉ design standard for the proposed +10year PE. Using the peaking factor, the max. daily volume is calculated as 14.72m^3. However, given the industrial contribution and infiltration in the network there will be a consistent throughput in the process stream, and so the measured daily volume 7m^3 should be adopted as the appropriate design parameter.

The inlet screens will include brushes and a screw conveyor to remove screened solid. Screenings will be washed to prevent the removal of biologically active waste off site meaning that the remaining screenings can be disposed of to landfill. The existing final effluent wash water system will be extended to supply the new screens.

The screens will have reverse functionality built in on start up to allow screen to unload. The screened solids will be disposed of into a screening bin for removal off site. In the event of a blockage or should the maximum capacity of the two screens be exceeded, flow will overflow into the bypass channels where the manual bypass screen is located. A facility is available to manually remove screenings from this screen into the screenings screw conveyor.

Actuated penstocks will be installed to isolate the inlet and outlet channels of the fine screens for maintenance and repairs. It is proposed to actuate the penstock with electric actuators. The actuators will provide the following minimum signals back to the PLC; open/close, fail to open/close, local or auto operation, fault/trip.

An automatic sampler will be installed at the inlet works downstream of the screens. The sampler will be capable of taking wastewater samples from a non-pressurised sampling point.

6.2.1.2 Grit Removal

After larger solids are screened out of the effluent, raw sewage flows into the grit chamber. Removing grit is important to protect downstream mechanical equipment and to reduce deposits from forming in the pipelines. The design of the grit removal system must be in accordance with Table 4.3 of Uisce Éireann's technical standard IW-TEC-700-02 for WWTPs more than 25,001 PE. Also, to enable optimal performance in the AGS tanks, the flow feed from the inlet works must meet the following criteria.

- Minimum 90% removal of all grit particles with a specific gravity of 2.65 t/m3 and with a size of 0.3 mm diameter and higher.
- FOG content in the feed must be less than 60 mg/l (average composite sample) and 90 mg/l (grab).

The grit removal process system is shown in Figure 6-3 below.

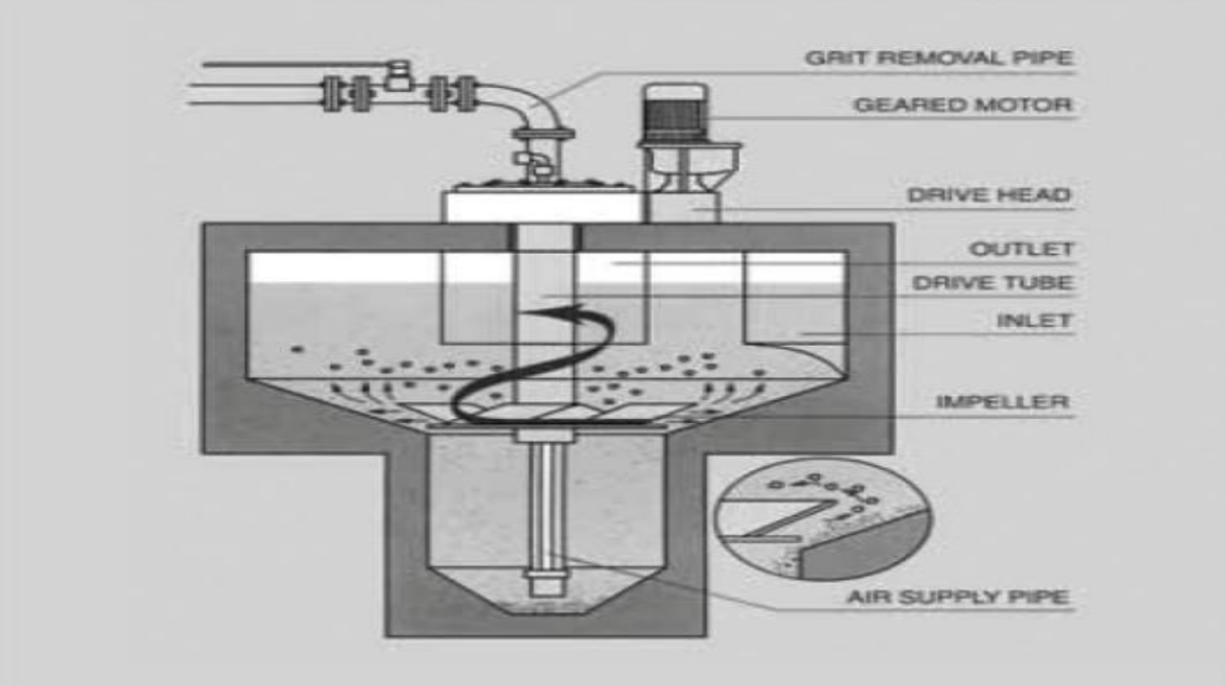

FIGURE 6-3: GRIT REMOVAL PROCESS DIAGRAM

Installation of 2 no. cross flow grit chambers on duty/standby mode is the recommended for design loadings more than 25,001 PE. Aerated chambers will be considered as they can achieve a high removal efficiency with a smaller physical footprint compared to traditional sedimentation-based grit chambers. Figure 6-3 above depicts an example of an aerated grit removal system.

In this system, effluent enters horizontally, flows around the tank and exits parallel to the inlet. The impeller creates radial forces that allow the grit to fall into the collection hopper. Grit settles within the lower hopper, then transferred to the washing, classification and dewatering plant. Standard design allows for the use in construction of the Jeta® chamber of pre-cast concrete rings and site formed civil structure. The calculation of the grit volume production is as per Uisce Éireann specification and is shown in Table 6-1 below.

TABLE 6-1 : GRIT PRODUCTION CALCULATION

Parameter	Quantity	Unit
Works Dry Weather Flow	370	l/s
Works Daily Flow	31,967	m3
Grit Production Rate	0.005	m3/1000 m3
Daily Volume	0.160	m3/day
Hourly Volume	0.007	m3/hr
Peak Multiplier	10.00	
Maximum Grit Load	0.067	m3/hr
Grit Removal and Grit Handling equipment to be sized based on the Maximum Grit Load.		
Grit Storage i.e. skips or wheelie bins, to be sized based on Daily Volume.		

6.2.2 Secondary Treatment – New AGS Tank

6.2.2.1 Activated Granular Sludge (AGS) Design

Nereda® is an innovative and advanced biological wastewater treatment technology that purifies wastewater using the unique features of aerobic granular biomass. The following sequential steps and processes occur in the Nereda® system.

Simultaneous fill and draw. During the fill phase, influent wastewater is fed to the bottom of the reactor and flows under near-plug flow conditions through the settled granular biomass. As a result of the plug flow there is no contact between the purified effluent at the top of the reactor and the raw influent wastewater at the bottom, enabling wastewater treated in the previous cycle to be displaced or "pushed" out of the reactor as well-treated effluent, whilst the reactor is simultaneously being fed. Unlike SBR systems, Nereda does not require a separate time consuming decant phase. More importantly, static fixed overflow weirs are used instead of the moving and maintenance intensive decanters typically applied in SBR systems.

Aeration. During the aerated reaction phase all biological processes take place. Fine bubble aeration generates an oxygen gradient in the compact structure of the granular biomass. At the aerobic outer layer of the granule organic pollutants are efficiently oxidized. Nitrifying bacteria also accumulate in the outer layer of the granules and convert ammonium to nitrate. The produced nitrate diffuses into the anoxic core of the granule where it is simultaneously denitrified. In addition, enhanced and extensive biological phosphate fixation takes place.

Fast settling. In this phase the biomass is separated from the treated effluent. As result of the excellent characteristics of the biomass, the required duration for settling is short and this phase is also used to discharge excess biomass formed because of growth and accumulation during the aeration phase.

Some of the process steps are also envisaged as part of the process cycle:

Water level correction – The water level is dropped just before the biological phases are initiated. The purpose of this step is to ensure that there are no suspended solids discharged over the effluent decanter weirs due to the bulking of the mixed liquor that occurs during aeration.

Sludge discharge – Once the biological phase is completed the sludge starts to settle. After a set settling period, the sludge wasting valve is opened and excess sludge is discharged into the sludge buffer tank.

Design Assumptions

The following assumptions have been applied to the design calculations listed in Table 6-2.

Unless otherwise stated in the project specific assumptions, the design is made for 95%ile loads applying the following standard AGS configuration:

- AGS influent buffer.
- AGS reactor(s).
- AGS sludge buffer(s)

The system is hydraulically designed to accept peak flows up to 1,110 l/s. This avoids the need to discharge flows greater than FFT from the new stream to the existing storm tank.

There is a maximum Ammonia demand of 10 mg/l (in a 24-hr composite sample), coinciding with a minimum temperature of 10 ^{o}C, which dictates the loading rate in the reactor.

The incoming wastewater is screened and de-gritted. Excessive FOG (Fats, Oils and Greases) are envisaged to be removed prior to coming to the treatment plant. To protect the AGS influent distribution system, a perforated screen with 6 mm 2D (or smaller) is required. Unscreened bypasses must be actively prevented.

- The grit removal system will be designed to remove 90% of all the grit with a specific gravity of 2.65 t/m3 and with a size of 0.3 mm diameter and higher.
- FOG content of the AGS feed should be less than 60 mg/l (average composite sample) and 90 mg/l (grab).

The composition and procedure of any industrial (trade) wastewater discharges to the sewer system are such that they will not inhibit the biological process.

Because bacteria are sensitive to salinity and salinity fluctuations may cause hydraulic issues due to density variations inside the reactor, it is assumed that the salt absolute concentrations (i.e., conductivity) and its fluctuations will stay under the limits that could affect the expected biological and/or hydraulic performance.

The 95%ile peak and average design loads were determined via 24 hours composite flow proportional sampling.

The COD/TKN, COD/BOD_5 and BOD_5/TP ratios are constant, independent of the incoming pollution loads.

The maximum non degradable phosphorous concentration in the effluent is 0.1 mg/l (i.e., Porg (dissolved) = TP (filtered) – P-PO_4 < 0.1 mg/l).

The maximum non degradable nitrogen concentration in the effluent is 1.0 mg/l (i.e., Norg (dissolved) = TKN (filtered) – NH_4-N < 1.0 mg/l).

The installed aeration capacity of the biological treatment is designed for the 95%ile (peak) loads at the maximum temperature.

Sufficient alkalinity is assumed.

All area estimations are based on the following (net) depths:

- Influent buffer 6.0 m.
- AGS reactor process depth 7.5 m.
- AGS sludge buffer(s) 5.5 m.

TABLE 6-2: DESIGN CALCULATIONS

Process Unit	Unit	Value
AGS Influent Buffer		
Volume (net)	m^3	3,000
Number of AGS feed pumps	-	2
Capacity each	m^3/h	2,600
AGS Reactors		
Number of reactors	-	2
Volume each reactor (net)	m^3	7800
Total volume (net)	m^3	15600
Surface each reactor (net)	m^2	1040
Water depth (process)	m	8
Water depth weirs	m	8
Aeration		
Max SOR per reactor	kgO^2/h	2,000
Max simultaneous aeration	Nm^3/h	11700
Number of blowers (excluding standby)	-	3
Estimated blower capacity (each)	Nm^3/h	3900
Estimated blower power (each)	kW	116

Daily average airflow	Nm^3/d	108000
Anticipated energy use	kWh/d	3000
AGS Sludge Buffers		
Number of buffers	-	2
Volume of each buffer (net)	m^3	560
Water depth (net)	m	5.5
Number of pumps per buffer	-	2
Flow range per pump	m^3/h	90 - 180

6.2.3 Final Effluent Outfall

It is proposed to retain the existing 1,110mm diameter outfall pipe. The current outfall pipe can transfer all flows coming from both the existing treatment stream and the proposed treatment stream as well as any storm overflows from the existing storm tank on the WWTP site. The current outfall arrangement on site has a dedicated connection available for the proposed new AGS connection. Details of the outfall pipework arrangement can be seen in Figure 6-4. Current and proposed design flows to the outfall are listed in Table 6-3.

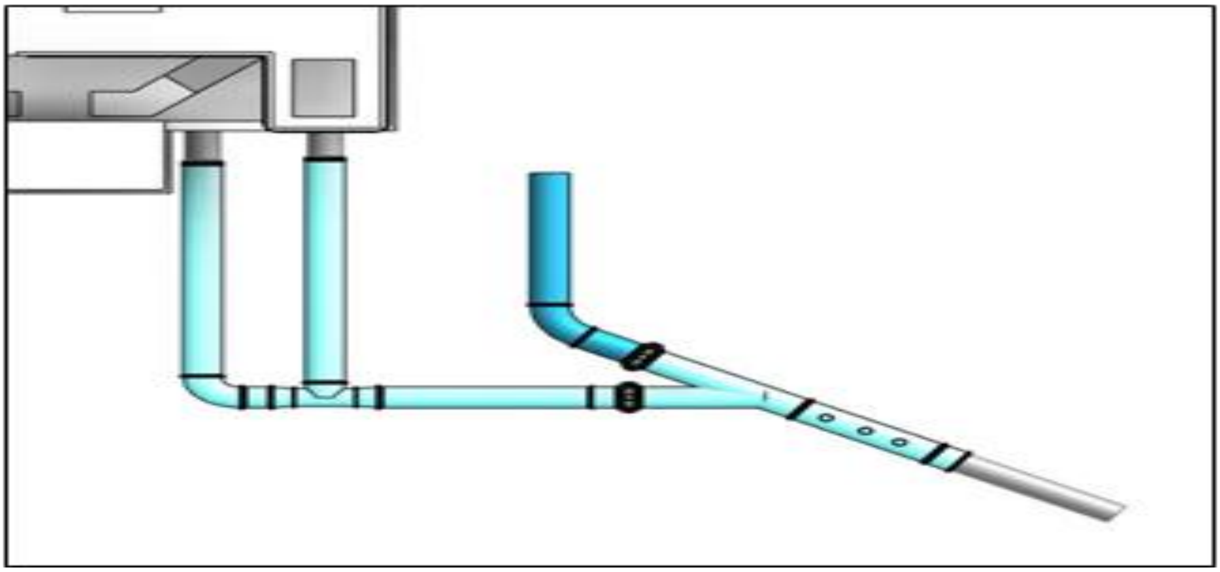

FIGURE 6-4: CURRENT OUTFALL ARRANGEMENT WITH AGS CONNECTION

TABLE 6-3: CURRENT AND PROPOSED DESIGN FLOWS TO THE OUTFALL

Item Description	No.	Units
WWTP Outfall Pipe Diameter	1,100	mm
Current Design Outflow	1,850	l/s
Current Design FFT	865	l/s
Current Storm Overflow	985	l/s
Corcanree Current Flow	1,250	l/s
Mungret Current Flow	220	l/s
Proposed Maximum Flows		

Item Description	No.	Units
Proposed Design Maximum Outflow (l/s)	2,440	l/s
Proposed Corcanree Max. Pass Forward Flow (90% Flow)	2,220	l/s
Proposed Mungret Max. Formula A Flow (10% Flow)	220	l/s
Proposed Flow to existing Storm tank (l/s)	621	l/s
Retention Time (@ PFF-FFT) - hours	3.36	hours

The velocity in the pipe increases to c. 2.4 m/s at the higher flow rate of 2,440 l/s, but it remains within the maximum allowable design velocity of 2.5m/s, as per Uisce Éireann standards. However, the existing pumps will not be able to handle the additional friction head and will need to be upgraded. 3 no. duty pumps can achieve the 2,440 l/s at various static heads from 0m to 3m. There are 2 no additional connection points if additional pumps are required in future. See pump performance curve and datasheet in Figure 6-6 that illustrates operating the pump on variable speed control. See also the pumping station layout in Figure 6-5, noting there are 2 no additional connection points if additional pumps are required in future.

It should be noted that following the outfall repair works, the existing NRVs began experiencing water hammer and severe back slam from air trapped in the upper section of the pipeline. VSDs and air valves have since been installed which have alleviated the issue.

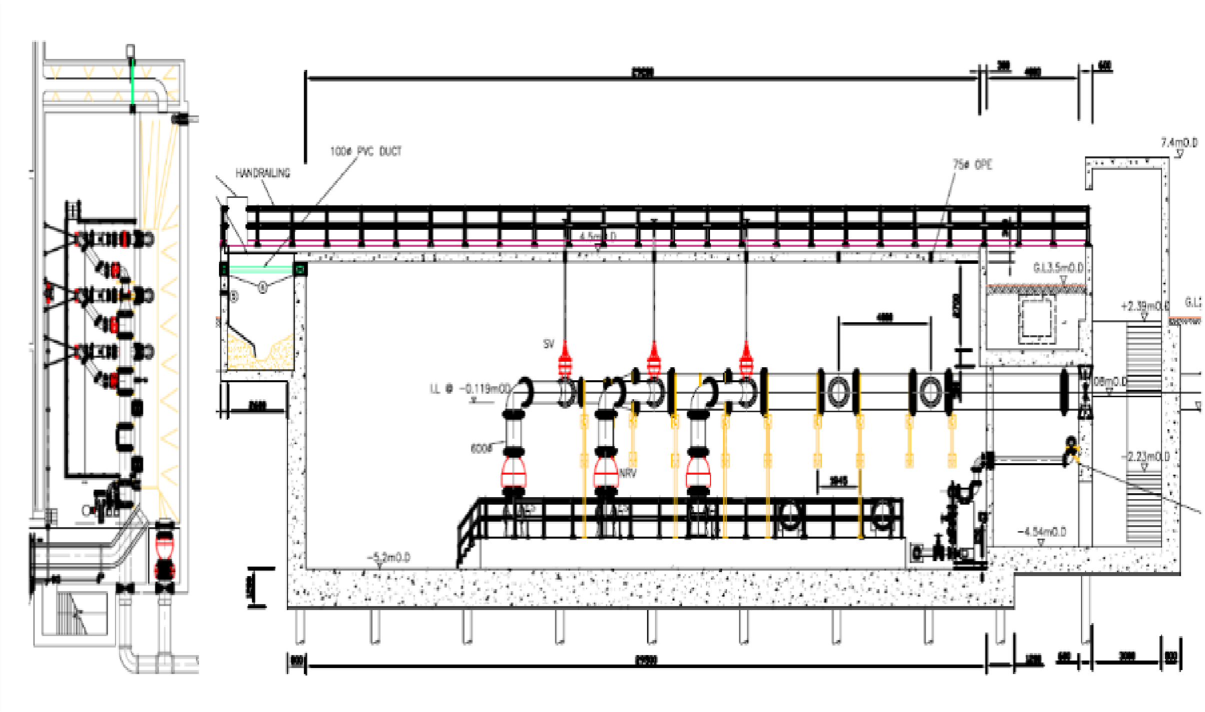

FIGURE 6-5: FINAL EFFLUENT PUMP STATION LAYOUT

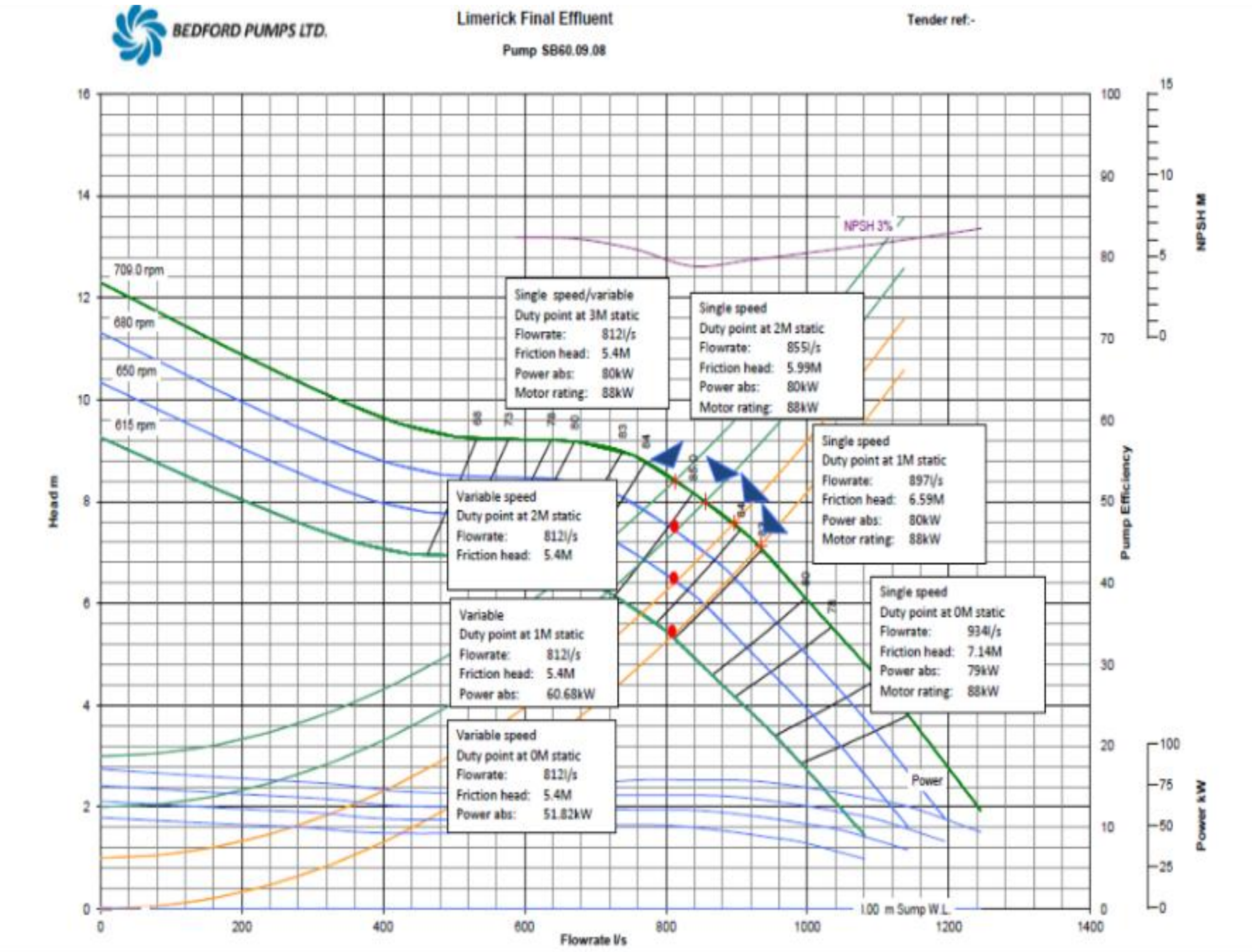

FIGURE 6-6: PUMP PERFORMANCE CURVE AND DATASHEET

6.3 Storm Water Storage Tank at Corcanree PS

6.3.1 Stormwater Proposed Layout

The civil and structural design elements include construction of a new 30-40m diameter storm tank, new manholes and new pipework to connect the new storm tank to the existing pumping station, overflow and interceptor sewer manhole. The proposed layout and 3D view are shown in Figure 6-7 and FIGURE 6-8 below.

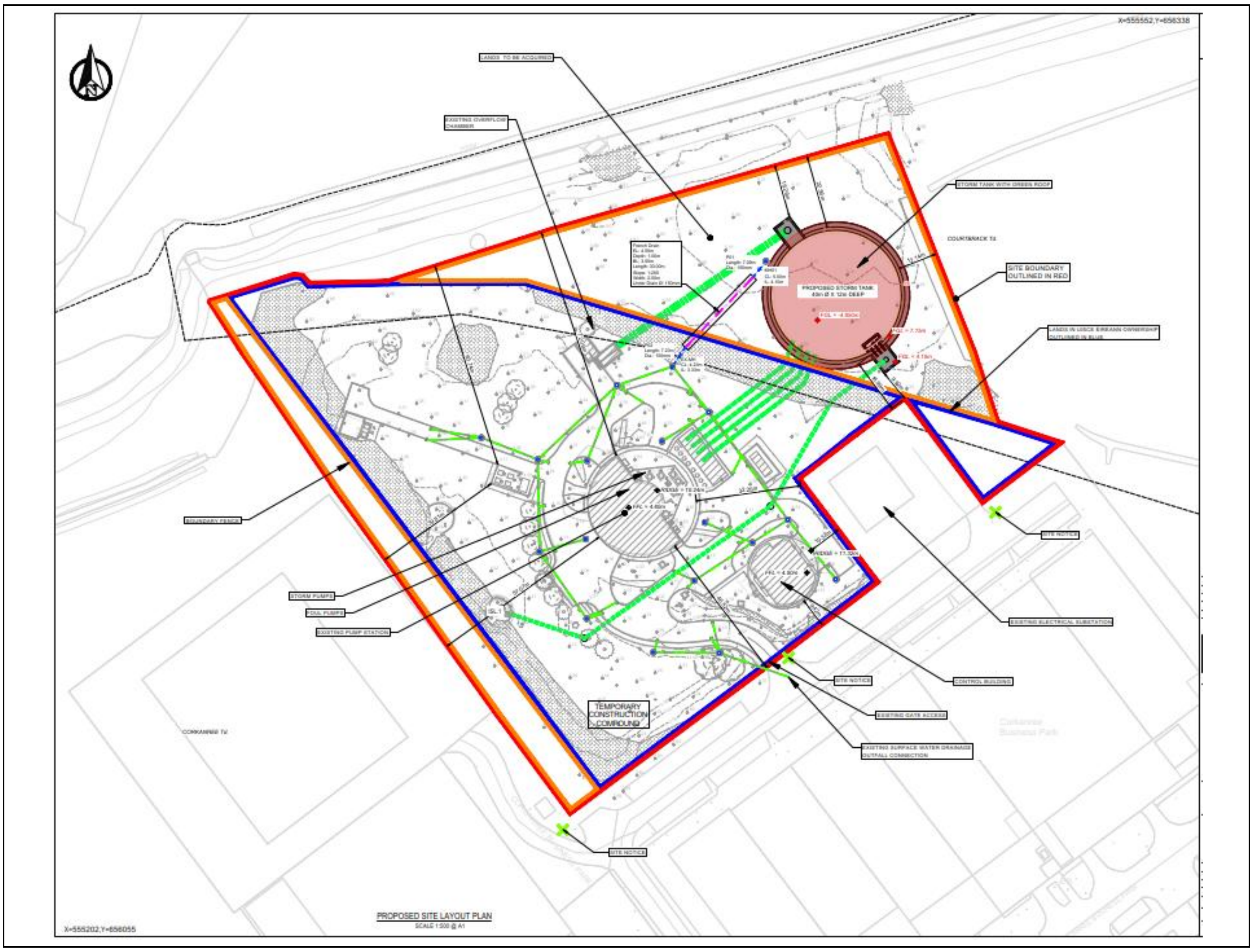

FIGURE 6-7: PROPOSED PLAN LAYOUT OF NEW STORM STORAGE TANK

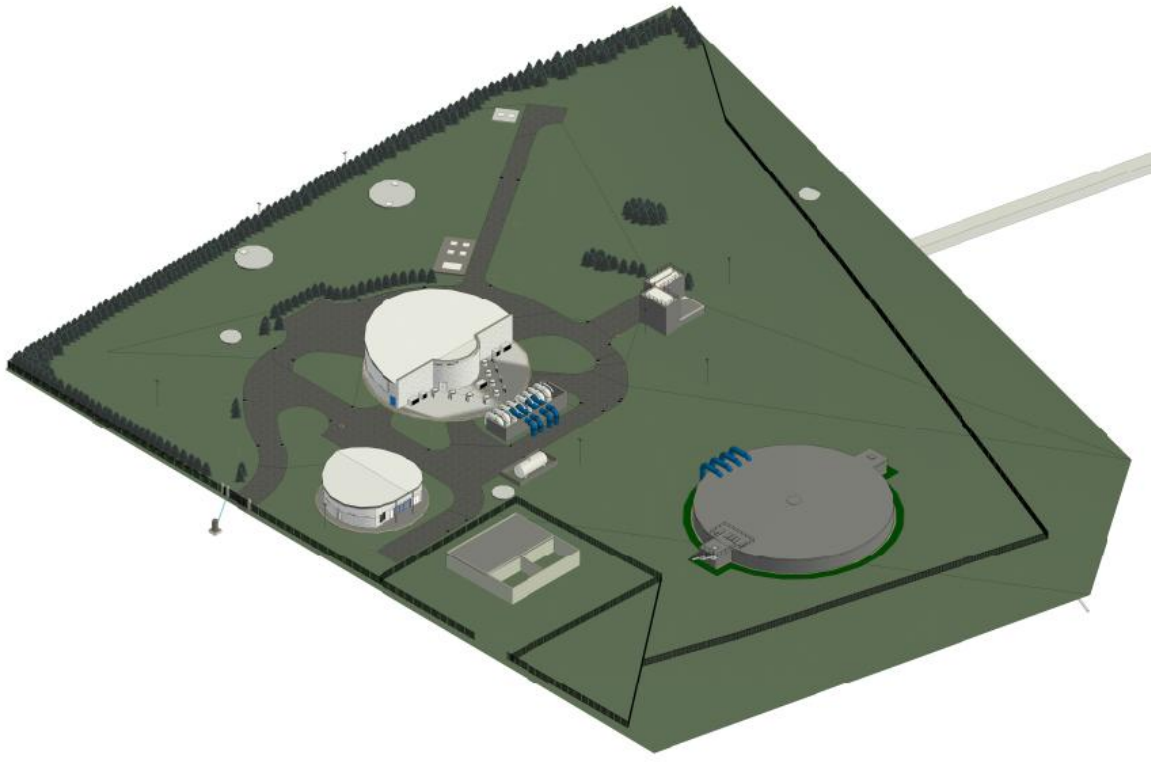

FIGURE 6-8: CORCANREE PS SITE – 3D LAYOUT OF CORCANREE PUMP HOUSE AND STORM TANK

Site investigation works consisting of cable percussion boreholes, rotary core boreholes and trial pits were undertaken in 2021 in respect of the proposed works. Preliminary results from these investigations indicate Made Ground consisting of sandy gravelly clay is present to between 2.5 and 4.9m depth, over very soft gravelly silt/organic silt to between 5.9 and 8.9m depth, over medium dense to dense sandy gravels with occasional cobbles and boulders. Rock described as medium strong to strong partially weathered to un-weathered limestone was encountered at depths of between 6.5m and 7.6m. Groundwater was generally encountered in the gravels between depths of 5.8m and 7.4m with slow but steady rises noted within twenty minutes. Shallower strikes were noted in three boreholes at 3.5m and 4.1m depth with gradual rises.

Four of the existing storm pumps will be intercepted at the syphon chamber and brought across to the new storm tank via four new rising main pipelines. A new storm return pipeline will connect the storm tank back to the interceptor sewer manhole 1. A new storm tank overflow pipeline is also required between the storm tank and existing outfall chamber.

The 30-40m diameter storm tank will be founded between approximately 10-15m depth with 3m extending above ground to account for tidal variations in the Shannon Estuary.

6.3.2 Stormwater Storage Tank Cleaning System

The Storm Flush (flushing bell system) is a simple method for sediment removal. Storm water is held in reserve in the storage reservoir, filled during the tank filling process. At the end of a storm event and after the system has emptied, the retained flushing water is released via the vacuum break within the flushing vessel. This creates an RFP (Roughing, Fine and Polishing) staged flushing regime which mixes and carries the sediment from the base of the tank to the receiving sump. The simple and robust design of this flushing system provides a reliable solution to tank cleansing requirements challenges. The CWF Storm Flush is engineered in high quality stainless steel providing a long product life, has no moving parts within the storm tank, with all necessary valve arrangement s are built into a control manifold located in a small manhole chamber at ground level. Figure 6-9 indicates the operating principle of the flushing bell system whereas Figure 6-10 shows an example of the system.

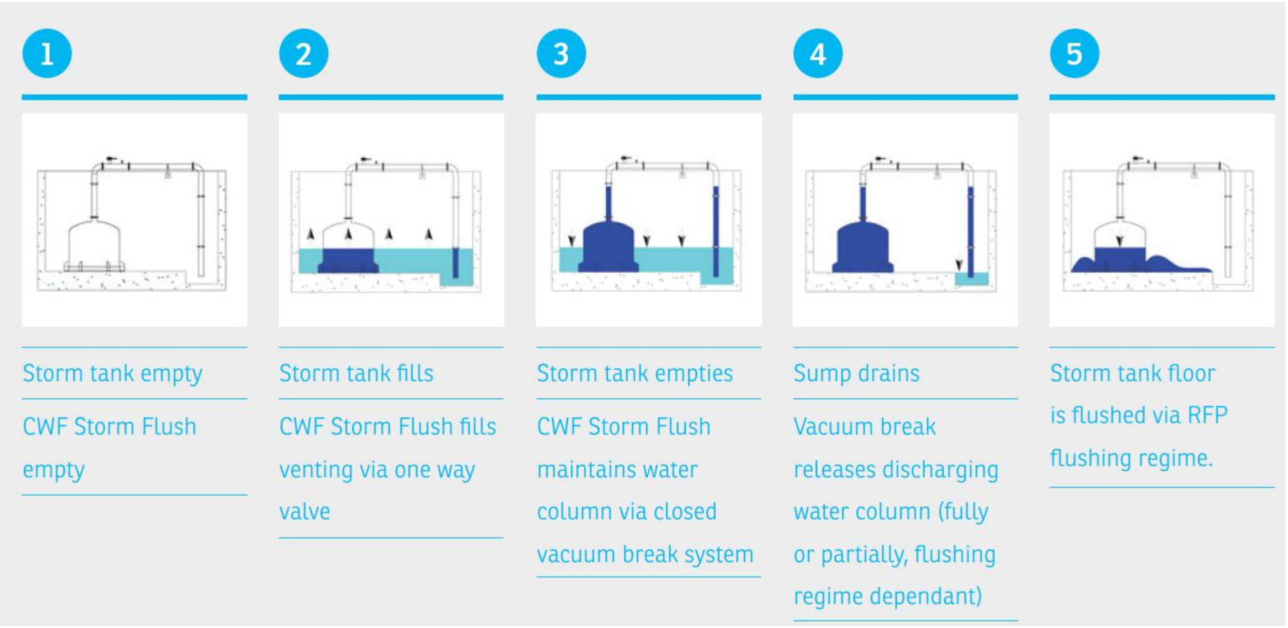

FIGURE 6-9: OPERATING PRINCIPLE (COURTESY OF HYDROK)

FIGURE 6-10: EXAMPLE OF FLUSHING BELL SYSTEM

Selected advantages of the system are noted as follows:

- Requires no power, water supply or controls
- Flushes even after partial fillings
- Fully self-priming and flushing operation
- No moving parts
- Utilises storm water for the flushing process
- Retains total volume of storm tank
- Final flush polishing stage utilizes settled storm water

6.4 Regional Bioresource Centre

The Limerick Sludge Hub facility has been identified as the preferred location for the development of a Regional Bioresource Centre to serve the south-west region. This designation reflects the site's strategic location, existing infrastructure, and capacity to accommodate additional sludge treatment and processing.

6.4.1 Sludge Storage and Reception

The following design has been selected for the Regional Bioresource Centre to increase treatment capacity and accommodate the future regional sludge load. The design outlines the handling of sludge from the point of acceptance through to the treatment of all associated solids, liquors, and biogas. The upgraded sludge treatment process is designed to achieve Class A biosolids suitable for land application in agriculture.

Table 6-4 below provides a summary of the existing sludge storage tanks and their estimated retention capacity based on future loading.

TABLE 6-4: OVERVIEW OF EXISTING SLUDGE STORAGE TANKS

Existing Sludge Tank Sizes (Working Volume)	Total Height	TWL (m)	Internal Diameter (m)	Total Volume (m3)	Working Volume (m3)	Days Storage at Future Loading
Import Primary Balancing Tank No.1 (Future Primary Only)	6.33	5.5	17.062	1,447	1,257	5 to 10 days
Import Primary Balancing Tank No.2 (Future Import Only)	6.33	5.5	17.062	1,447	1,257	Approx 2 days

Existing Sludge Tank Sizes (Working Volume)	Total Height	TWL (m)	Internal Diameter (m)	Total Volume (m3)	Working Volume (m3)	Days Storage at Future Loading
WAS Balancing Tank	6.33	5.6	19.624	1,914	1,693	Approx 1 day
Digester Feed Tank No.1 (Formerly Mixed Sludge Tank No.1)	6.33	5.4	11.09	611	521	Approx 0.6 days
Digester Feed Tank No.2 (Formerly Mixed Sludge Tank No.2)	6.33	5.4	11.09	611	521	Approx 0.6 days

6.4.2 Indigenous Sludge

6.4.2.1 Indigenous Primary Sludge Storage

There are 2 no. existing Import / Primary Balancing Tanks in operation at Limerick. Both tanks are newly replaced as part of the Interim Sludge Works. These tanks are the same GLS tanks of the same volume that are lined internally with an HDPE liner along with new GRP roofs.

It is proposed that one of the current 'Import Primary Balancing' Tanks will be retained for use exclusively for primary sludge, providing equivalent to 7 days of storage at future primary sludge production of approximately 1,850 TDS per year. This figure based on a conservative concentration of 3%DS (170 m3/day) compared to the current draw off at 4%DS (equivalent to 127m3/day at future loading).

The PST sludge draw-off is controlled using 16 No. hydraulically operated actuated knife gate valves. All the valves are scheduled to be replaced. There are two sets of primary de-sludge pumps operating duty/standby on a timer, in average condition. These existing pumps is proposed to be replaced as part of the upgrade.

6.4.2.2 Indigenous WAS Storage

The proposed upgrade works to Limerick WWTP include introduction of an AGS type treatment process whereby just over 50% of the future design indigenous load will be sent directly to the AGS treatment process. The system will not include dedicated primary sludge treatment and so the proportion of indigenous sludge produced as Waste Activated Sludge (WAS) will increase significantly.

To the Regional Bioresource Centre it is estimated that approx. 4,675 TDS of WAS per year will be produced. Using 0.5%DS as the minimum expected concentration, this would equate to 2,560 m per day of thin WAS, therefore the current WAS Balancing Tank can accommodate approximately 15 hours of storage when operating at its full design capacity of 1,693m^3. WAS will then be sent for mechanical thickening.

WAS from the new AGS process will be pumped separately from the WAS from the existing process.

6.4.2.3 Indigenous Sludge Screening

It is important that screening of 6 mm ahead of THP for both indigenous and imported sludge is in place for a good functioning THP system. Both the indigenous primary sludge and the waste activated sludge (WAS) will flow through a strain press with a perforation diameter of 5mm, ensuring the removal of coarse materials and reducing the risk of downstream process blockages. The strain press is proposed to be installed post Gravity Belt Thickeners and Primary Sludge Storage Tank. The proposed strain press can handle a thickened sludge volume of up to 33 m^3/hr at 5%DS from the GBTs and 170 m^3/d of primary sludge at 3%DS.

6.4.2.4 Imported Sludge

The Regional Bioresource Centre will accept sludge from all of Co. Limerick, including the Castletroy WWTP, Co. Clare and Co. Tipperary. Table 6-5 itemises the sources of the imported sludge.

TABLE 6-5: IMPORTED SLUDGE

Imported Sludge Load	Value	Units	Reference
Imported Sludge – Clare	2,437	TDS/year	Estimated

Imported Sludge - Tipperary	2,890	TDS/year	Estimated
Imported Sludge - Limerick County	1,204	TDS/year	Estimated
Castletroy WWTP (77,500 PE) Imported cake	1,465	TDS/year	Estimated
Imported Sludge Load to Bioresource – Over Weekdays	30.3	TDS/day	Estimated

The estimated imported sludge load by PE from Limerick, Clare and Tipperary is as shown in Table 6-6 below:

TABLE 6-6: IMPORTED SLUDGE LOAD BY PE

Local Authority	No. of WWTPs	Connected Load PE for 2030
Limerick	50	123,336
Clare	30	100,428
Tipperary	40	128,297
Total	120	352,061

Liquid Sludge Imports from Limerick County will be received by sludge tanker at a minimum concentration of 2%DS and screened prior to arrival at Limerick SHC.

6.4.2.5 Liquid Sludge

Liquid sludge imports up to 6%DS will be screened through a newly installed screen on site. The installation of this screen has been a part of the Interim Sludge Works. The newly installed sludge import screen, CDE SMAX SRU 25G (Rag & Grit Removal), will be capable of handling up to 66 l/s at 6%DS. Rag and grit will be removed from the sludges and segregated into different skips, with a roof over the skip to prevent rainwater infiltration. Screened sludges will then proceed to a new pump sump equipped with Duty/Standby sludge pumps, and these will be pumped to the Import Sludge Blend Tank (formerly one of the Primary Import Balancing Tanks).

The storage volume necessary to accommodate liquid imports arriving on site is heavily dependent on the %DS of the sludge, which is presented in Table 6-7 with the variation of sludge volumes at different %DS.

TABLE 6-7: IMPACT OF CHANGES TO IMPORTED SLUDGE VOLUMES

TDS Volumes for Future Imports / day	1%	2%	3%	4%
Limerick Imports Only as Liquid Sludge, ~6.2 TDS/day	620 m^3	310 m^3	207 m^3	155 m^3
Limerick Liquid Imports + Rewetted Cake Imports, 11.7 TDS/yr	1,170 m^3	585 m^3	390 m^3	293 m^3
All imports as Liquid Sludge 30tds	3,025 m^3	1,513 m^3	1,008 m^3	756 m^3

A minimum of 2% DS is accepted at liquid reception and any less will go through the existing inlet works as is the current arrangement. Table 6-8 presents the potential storage durations for imported liquid sludge under various sludge loads at 2% DS. Table 6-8 also shows imported sludge storage volumes.

TABLE 6-8: IMPORTED LIQUID SLUDGE STORAGE

Process Asset	Import Primary Balancing Tank No.2 (T212) (Future Import Only) Volume	Storage Duration @ 2% DS
Limerick Imports Only as Liquid Sludge, ~6.2 TDS/day	1,250 m^3	4 Days
Limerick Liquid Imports + Rewetted Cake Imports, 11.7 TDS/ yr	1,250 m^3	2 days
All imports as Liquid Sludge 30tds	1,250 m^3	19 hours

The UÉ technical specification IW-TEC-700-99-06 for import facilities states that a maximum imported sludge reception tank volume of 250m^3 should be provided – *"If greater volume is required then multiple tanks should be provided"*. The proposed solution is in consideration of the current arrangement on site, and therefore more economical solution than construction of lesser tank volumes. A new mixer will be installed to the Sludge Import Tank as part of the Interim Sludge Project.

6.4.2.6 Cake Sludge

The RBC will be designed so that imported cake sludge undergoes screening prior to delivery onsite. Consequently, no new screening equipment is included in the design of the reception area for cake imports.

In cases where the imported sludge is not pre-screened, it will be necessary to rewet the material at the existing cake import reception to facilitate effective screening. This ensures that coarse solids are adequately removed, preventing potential blockages and maintaining the efficiency of downstream operations. Screened cake imports will be received directly into the sludge silo/s prior to the THP.

Unscreened Cake Sludge Imports will continue to be received at the existing sludge cake reception bunker in the short term. For this reason, it is recommended that a condition assessment and refurbishment work be carried out to ensure asset availability. It is estimated that the bunker currently receives in the range of 1,000 + deliveries each year, equivalent to ~19 per week. This figure is expected to increase to 55 per week in the next 10 years. The increase in sludge imports received as dewatered cake will mean a corresponding drop in liquid sludge imports and therefore a significant drop in vehicle numbers on site.

The current sludge cake reception bunker carries out a rewetting process to reliquefy the sludge for transfer to the imported sludge reception tank. This cake reception bunker and rewetting facility will be retained for use at the Regional Bioresource Centre. Currently there is a wide range of thick and cake imports received at the site. It is assumed that sludge cake of >6% is delivered to the existing cake bunker and this capacity will remain going forward. Table 6-9 shows the liquid and cake sludge imports below.

TABLE 6-9: LIQUID & CAKE SLUDGE IMPORTS

Sludge Load	Vol. Connected 2030	TDS /yr Connected 2030	Estimated No. of Deliveries /yr	Estimated No. of Deliveries / week	Estimated No. of Deliveries / working day
Liquid Sludge Imports at 2%DS (Limerick excl. Castletroy)	80,000 m3/yr	1,670 TDS/yr	4,000	77	16
Cake Sludge Imports for Rewetting	11,688 wet tonne (2021)	1,361 TDS/yr	1,079	21	4 – 5
Cake Sludge Only (Clare, Tipperary & Castletroy)	34,422 wet tonne/yr	6,196 TDS/yr	2,869	55	11

6.4.3 Sludge Thickening and Storage

6.4.3.1 Gravity Belt Thickener

WAS from the existing CAS system and the proposed AGS system will be blended in the existing WAS tank and transferred to 2no. new Gravity Belt Thickeners (GBT) for thickening which will replace the old DEWA units which are over 20 years old. According to the USF Bowen Process Description document from 2001, the original GBTs were "sized to operate 24 hours per day, five days per week at a feed of 0.35%DS", with a target thickness of 4-5%DS. Design capacity for the units is listed with a feed rate of 83m^3/hr and feed DS capacity of 6,882.3kg/day (note this is understood to be the max in both cases, i.e. Volume and DS capacities must be considered separately.

The new units have been sized to cater for the full design horizon load of WAS only and for the purpose of this report it has been assumed that WAS will be extracted at 0.5%DS. Two no. 2.5m belt width GBTs have been allowed for to accommodate higher volumetric flows associated with such thin sludges. Each unit referenced has a thickening capacity of 300 to 2,000 kgDS/hr.

With design horizon capacity for the WAS buffer tank in the range of 15 hours storage, the mechanical thickening installation has been based on 24/7 operation with units sized for operation duty / assist based on 12 hours per day. Table 6-10 indicates the WAS thickener sizes.

TABLE 6-10: WAS SLUDGE THICKENER SIZING

Parameter	Current WAS	Future WAS	Units
Thin Solids Feed	1,808	4,672	TDS/yr
Daily Average Thin Sludge (5 day week)	7.0	18.0	TDS/day
Thin	0.5%	0.5%	% DS
Volume of Thin	1,391	3,594	m^3/day
Assumed Hours Operation	24	12	hrs/day
Thickener feed	0.3	1.5	TDS/hr
Thickener feed	290	1,497	kgDS/hr
Thickener feed Volume	58	299	m^3/hr
Thickened Sludge	4%	5%	% DS
Vol of Thick Sludge	7	33	m^3/hr
	174	399	m^3/day
Filtrate Returns	51	266	m^3/hr
	1,217	3,195	m^3/day
Note: Currently WAS is the only sludge thickened via the 2no. Existing GBTs. This calculation assumes dedicated GBT thickening for WAS only going forward.			

Filtrate from the thickeners will be returned to the head of the works via below ground pump sump. Thickened sludge will be stored in the new Thickened Sludge Tank. The 700m^3 tank will provide a > 24 hours storage based on sizing from the thickened sludge produced by the GBTs.

6.4.3.2 Polymer dosing

The new Regional Bioresource Centre will include three processes requiring polymer dosing, mechanical thickening for WAS, pre-THP dewatering and digested sludge dewatering. Testing should be carried out by the polymer supplier on the SHC sludge once commissioned to advise on what type of polymer is required. Package plant options with offsite build are available for both powder and liquid options. For planning, one no. powder (active) polymer makeup and dosing kiosk should be allowed for each branch of the thickening and dewatering processes both pre and post digestion, three systems in total, with a capability to accommodate liquid polymer supply.

Makeup dilution water for active powder polymer is assumed to be 0.5% wt/wt with an aging time of 1 to 2 hours, and dilution carrier water to a solution strength of 0.1% wt/wt.

6.4.3.3 Pre-THP Dewatering Balancing Tank

The blended import sludges will be further blended with primary and thickened sludge from the GBTs at the Pre-THP Dewatering Balancing Tank. This fully blended sludge (imports, indigenous primary sludge and thickened WAS) will be fed to the pre-THP centrifuges for dewatering. The existing pre-digester tanks will be repurposed as new Thickened Sludge/ Pre-THP Dewatering Balancing Tanks.

Thickened sludge will be stored in the new Thickened Sludge/ Pre-THP Dewatering Balancing Tank where it will be blended with primary and liquid imports and fed forward to the pre THP dewatering centrifuges.

Unscreened imported sludge cake to the existing cake reception bunker will be diluted from ~ 18%DS to ~ 6%DS using final effluent. The thickened sludge storage capacity has been sized based on current load of daily liquid and cake imports (to the existing bunker) averaged over a 5-day week and full indigenous sludge load all at 4%DS to ensure available capacity.

6.4.4 Advanced Anaerobic Digestion-Thermal Hydrolysis Process (THP)

The Thermal Hydrolysis Process (THP) is considered to be economically viable for a sludge load over 300,000 PE. The liquid line upgrade is designed for 285,000 PE and the regional sludge load for treatment at Limerick at the current design horizon is 325,000 PE. Therefore, the new Regional Bioresource Centre will cater for over 600,000 PE. In addition, the upgraded wastewater treatment plant design does not currently include any additional primary settlement and so the expansion will produce WAS only. In conventional mesophilic anaerobic digestion, activated sludge has a lower biogas yield and higher residence time compared with primary sludge. For anaerobic digestion calculations all sludge sources other than Primary and Alum are categorised as 'WAS', and so effective treatment of this type of sludge requires a process that can address inherent inefficiencies to extract more biogas in a reasonable residence time. In addition, to achieve the code of good practice standard for spreading biosolids on land, sludge must also be pasteurised, i.e. heat treated to above a specified temperature for a specified time.

Therefore, UÉ have selected the thermal hydrolysis process as the preferred form of advanced anaerobic digestion for development. Hydrolysis is the slowest stage in the AD process. Thermal hydrolysis is an AD pre-treatment which is designed to speed up the hydrolysis by heating the sludge to 160°C at a pressure >7bar. This process causes rapid de-structuring of sludge at a cellular level significantly reducing the viscosity and increasing the rate of release of biogas in the AD tanks.

Pasteurisation as a standalone process was ruled out at the previous stage of this project as while it meets the heat treatment requirements, it would offer no benefits gained from de-structuring of activated sludge reduced viscosity of sludge at higher %DS, reducing the required AD volume overall.

There are two thermal hydrolysis installations currently in operation on Uisce Eireann sites which have been designed and installed by two different suppliers.

As the thermal hydrolysis process will add a high degree of complexity compared with the existing sludge treatment arrangement, it is recommended that the THP product selected be process proven on at least 3 No. WWTPs in the EU.

The proposed THP installation will include:

- 2/3 No. new pre-THP dewatering units operating duty / assist
- Pre-THP Sludge Silo
- Sludge feed pump to THP to be based on 16 - 20 %DS.
- THP installation sized for 15,000 TDS/yr, equivalent to 50 TDS/day
- Batch cycle time for the proposed THP is 20 to 40 minutes, allowing continuous feed to the digesters
- Very clean water supply required for THP steam process, (UV treated)
- Coolers for THP treated sludge upstream of AD

6.4.4.1 Pre-THP Dewatering

The thermal hydrolysis process is fed at between 16%DS and 20%DS. To achieve this a pre-THP dewatering stage is required to dewater mixed sludge (primary, liquid imports and thickened WAS).

The proposed feed rate for the system 55m^3/hr per unit at 4.5%DS. Dewatered sludge is proposed to be stored in the Pre-THP Sludge Silo before fed forward directly to the THP plant. This phase of the design has allowed for 1 No. Pre THP Sludge Silo to be installed adjacent to the existing dryer building which shall be equipped with 3 no. duty/assist/standby progressive cavity type pumps. Figure 6-11 shows an example of a silo tank.

Imported sludge cake will be delivered to the proposed Cake Reception Bunker, which has a working capacity of 30 m^3 and is sized to accept a full 20 m^3 trailer load. Sludge is discharged directly from the trailer into the bunker.

Transfer of material from the bunker is facilitated by large progressive cavity pumps equipped with bridge breakers. These pumps convey screened sludge cake at approximately 18% dry solids across the access road via a pipe bridge to the Pre-THP Sludge Silo. Addition of final effluent can be applied at this stage, if required, to ensure appropriate transfer consistency. Within the silo, imported sludge is blended with dewatered indigenous sludge and import sludge.

The proposed Pre-THP Sludge Silo is designed to handle dewatered sludge cake with a dry solids content of 22% ± 1% (operational range 18–24%). The silo incorporates a conical base to promote reliable discharge and is fitted with roof, handrails, mesh infills, and a self-closing gate forming an integral central walkway. Three side inlets are provided (one from the cake reception facility and two from indigenous sludge dewatering), each with independently supported pipework. The roof accommodates two laser level sensors and an ultimate high-level switch for process monitoring and control.

Sludge transfer from the silo to the THP system is achieved via two duty/standby progressive cavity feed pumps. Each pump is designed to deliver 6.7–18.9 m^3/h of sludge cake at 14–18% dry solids (design point: 16.1 m^3/h at 16.5% DS). An example of a THP silo tank is shown in Figure 6-11.

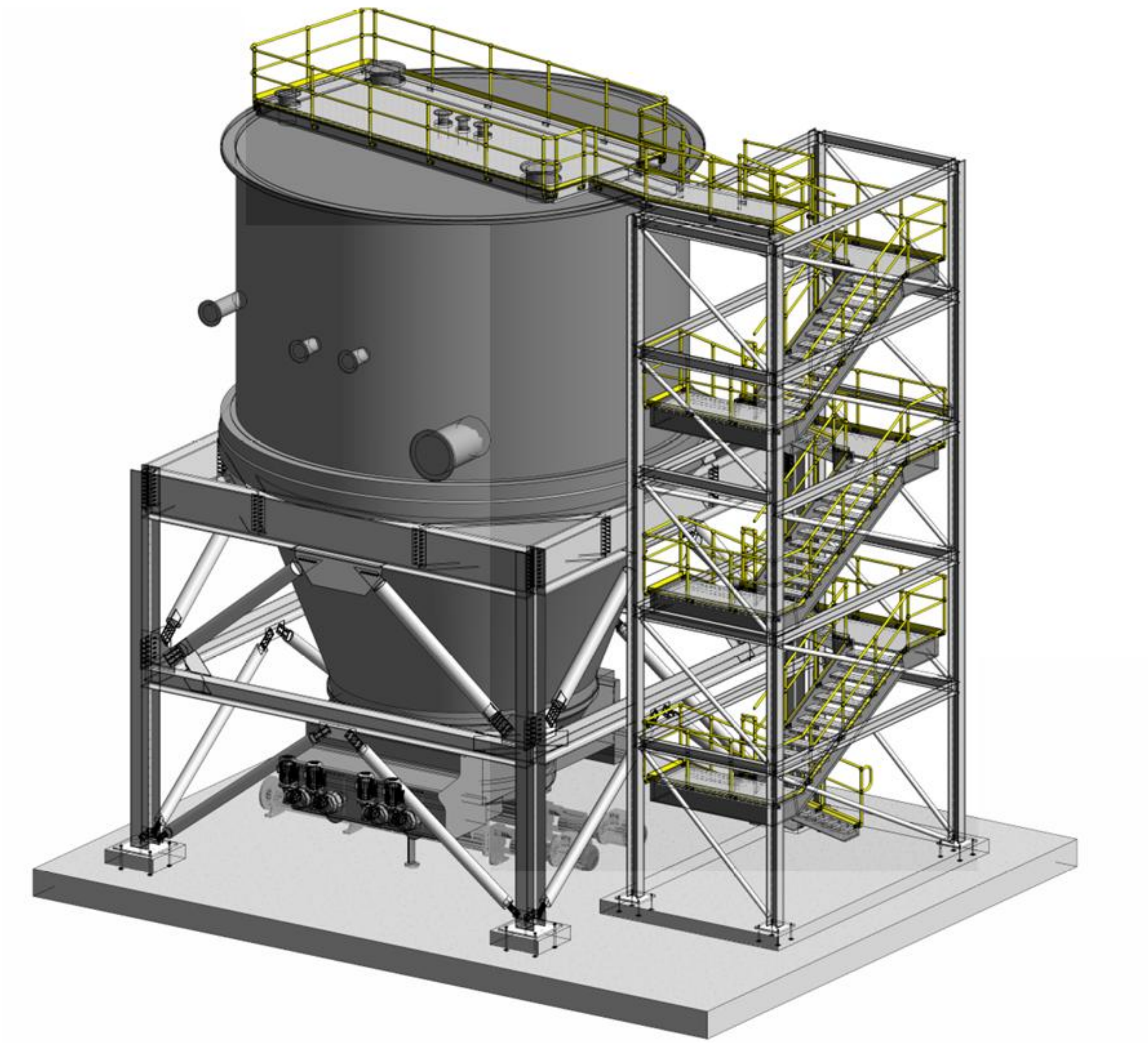

FIGURE 6-11: 3D VIEW OF PRE-THP SILO TANK

6.4.4.2 Thermal Hydrolysis Process (THP)

After pre-dewatering, the 16 - 20 %DS sludge first passes to the pulper, where it is homogenised and pre-heated to approximately 100 °C using steam recovered from the flash tank. From the pulper, sludge is fed sequentially to a bank of batch reactors (typically 2–5 per train, depending on sludge throughput, reactor size, and required hydraulic retention time).

In the reactors, sludge is exposed to steam at 160–180 °C and ~6 bar for 20–30 minutes. This combination of heat and pressure achieves complete pathogen destruction and hydrolyses cellular material. The sterilised sludge is then discharged to the flash tank, where rapid depressurisation enhances cell lysis. Steam released at this stage is recycled to pre-heat incoming sludge in the pulper, improving energy efficiency.

Following the flash stage, the hydrolysed sludge is cooled in heat exchangers to the required temperature for anaerobic digestion and subsequently transferred to the digesters for further stabilisation and biogas production.

After the THP process, the treated sludge is rapidly cooled to 40°C for feed to the digester. The surplus heat from this cooling process. There is a significant amount of excess heat energy which may be used to pre heat the sludge or recovered for use in the liquor treatment process and associated dilution water for same. The energy requirements for the THP are shown in Table 6-11.

TABLE 6-11: ENERGY REQUIREMENTS FOR THP + AD

Thermal Hydrolysis	Units	RBC Load
Temperature of feed sludge	°C	8 - 15
Operating temperature for THP	°C	165
DS Content	%	16%
Volumetric Throughput per Day	m3/day	246
kg steam / tonne sludge heating to 165°C	kg steam / wet tonne	180
Energy in Steam	kJ/kg	2,674
Heat demand	MJ/d	118,405
Energy consumption	**kWh/day**	**32,890**

6.4.5 Anaerobic Digestion

6.4.5.1 Anaerobic Digester Tanks

The existing AD tanks are Permastore Model No. 76.35 with a gross volume of 4,049m^3 and a working volume of 3,667m^3. Both tanks are glass lined with Trifusion Plus in the gaseous zone (top ring only) and Isofusion V700 in the liquid zone and were installed in 2016. The tanks are suitable for operation with Anaerobic Digestion for operating temperatures of up to 55ºC and so it is considered the are suitable for retention for the new Regional Bioresource Centre.

Egis have undertaken an analysis to assess the requirement for a third digester tank to accommodate increased organic load and associated uncertainties. The addition of a third digester would improve operational flexibility, support commissioning and process management, and provide volumetric capacity beyond the current design horizon. It would also enhance redundancy during maintenance periods and increase overall biogas headspace through the inclusion of an additional membrane roof.

Under the current two-digester arrangement, the removal of one tank would reduce AD capacity and biogas storage by 50%, creating bottlenecks and increasing process risks such as foaming. While a third digester of equal capacity would exceed requirements for process efficiency and redundancy, the analysis indicates that operational and treatment benefits would still be achieved through the installation of an additional tank.

To planning, the new digester tank is proposed to have a similar diameter (c. 23 m) and height (9.6 m) to the two existing digester tanks.

Benefits of 3rd digester at similar size of existing digesters:

- **Cost** – constructing a third digester at the same height and volume as the existing tanks is likely to be a similar cost to providing a smaller third tank (e.g., same diameter but lower height at ~50% volume), while delivering greater long-term operational benefit.
- **Operational flexibility** – a third digester allows the plant to accommodate what-if scenarios such as:
    - Lower sludge dry solids (e.g., 8% DS)
    - Increased organic loadings beyond forecast
    - Downtime of the THP unit or 1 No. AD
    - Option to operate the 3rd digester as parallel or feeding to the existing anaerobic digesters

The current best practice for managing process risks relating to high organic loading rates facilitated by the THP process includes a continuous return feed of sludge from the digesters to the THP inlet, thereby balancing pH across the system.

The new digester can either be installed upstream of the existing AD tanks and feed both the existing AD tanks, and to be operated in parallel. As the tanks are to be pH balanced by continuous recirculation of flow, it is understood that there would be no 'phase' difference between the new and existing tanks.

The new AD installation has been designed to operate at an optimum mesophilic temperature of 38°C. The design figures for the process are presented in Table 6-12 below, detailing process performance for future loading for the THP + AD option based on an 18.6-day SRT.

TABLE 6-12 ANAEAROBIC DIGERSTER DESIGN

Description	2030	Units
Operating Temperature	38	°C
Organic load	3.6	kg ODS /m3 /d
Organic Dry Solids Reduction	53	%
% Dry Solids Reduction	38	%
Biogas production	12,961	m^3/day
Biogas methane (CH4) content	60	%
Methane (CH4) production	7,777	m^3/day

6.4.5.2 Biogas Generation

The design for the Regional Bioresource Centre AD process will be based on continuous operation of the THP and the corresponding sludge feed at 10%DS for the future design load of 39.4tDS/day.

The following tables (Table 6-13 and Table 6-14) outline the corresponding biogas production and renewable energy generation of the RBC. Biogas production will increase significantly following installation and commissioning of the new THP plant and operation with the increased imported sludge load. For the purposes of biogas production all sludge imports have been categorised as WAS. The exiting AD tanks were designed for a sludge thickness range of 5% - 7% DS and operating temperatures in the range of 32C.

The future system for advanced AD process will be required to handle hotter sludge feed of up to 40C and a higher solids and organic loading concentration of 10%DS.

TABLE 6-13: RENEWABLE ENERGY SOURCE - DESIGN LOAD & BIOGAS PRODUCTION

Description	Regional Bioresource Centre Design Values	Units
Total treated sludge amount	39.4	tDS/day
Sludge Dry Solids Concentration	10	% DS
Total treated sludge volume	394	m^3/day
Organic Load	3.6 kg	ODS/m^3/d
Biogas production	12,916	m^3/day
Biogas methane (CH4) content	≥ 60%	
Methane (CH4) production	7,777	m^3/day
Digested Sludge suitable for reuse on land	26,405	kg DS/day

TABLE 6-14: RENEWABLE ENERGY GENERATION - HEAT & POWER

Description	Regional Bioresource Centre Design Values	Units
Biogas Generated	12,916	m^3/day
Heat Generation from Boiler (using up to 16% of Biomethane produced)	≤ 40,367	MJ/d
Heat Generation from CHP	~117,737	MJ/d
Total Heat Generation	158,104	MJ/d
Proportion of Biogas converted to Electrical Power – from CHP Only	37%	
	1,100	kW
Potential Power Generation at full Load	26,400	kWh/day
Estimated Total Power Demand of WWTP & Bioresource Centre	23,560	kWh/day
Additional Heat Demand for Plant when Power Generation Potential is realised	0	MJ/d
External Power Demand for Plant when Power Generation Potential is realised	≥ 0	kWh/day

6.4.5.3 Biogas Storage

The existing digesters are equipped with integrated roof-mounted gas storage, each providing a capacity of 750 m^3. This volume equates to approximately two hours of biogas production under projected future loading conditions. Additional gas storage will be provided i.e. the 3rd digester with integrated gas storage.

The digested sludge storage tanks will be covered, and its headspace will be shared with the AD tanks. Additional gas boosters will be required to maintain pressure in the overall headspace to compensate for the minimal rate of biogas production in the digested sludge tanks.

6.4.5.4 CHP Engines and Boiler

Biogas from the AD process will be fed forward to be used as heat generation via combined heat and power engines (CHPs) and a dual fuel boiler.

As outlined in Table 6-13, the new SHC will generate up to 12,900 m^3 of biogas per day. Biogas storage capacity is generally based on 2 to 4 hours of gas production which is accounted for in the membrane domed roofs of the existing AD tanks (and proposed 3rd digester) of a reported 750m^3 of gas storage capacity each. A full assessment of the gas storage requirements will be carried out at the next phase of development.

There are two options for providing heat for sludge treatment through energy recovery from biogas - combined heat and power (CHP) engines and / or dual fuel boilers. The heat demand can be met either by a boiler only installation or by CHPs for the average load.

6.4.5.5 Digested Sludge Storage

Digested sludge or 'digestate' will be transferred forward to the digested sludge tanks at approx. 6.7% DS. For completeness on this description of the AD process, Table 6-15 below summaries the digested sludge load.

TABLE 6-15: DIGESTED SLUDGE LOAD

Description	Units	2030
Digested Sludge dry solids	kg DS/day	26,405
	ton DS/yr	9,638
Dewatered Sludge Dry Solids	%DS	25
Sludge cake to final treatment	**Wet tonne cake/yr**	**38,552**

Generally, 1 day of storage is sufficient for digested sludge buffering as processing of the sludge is a 7-day operation, however as there will be a time delay for the plant to transition from the current digested sludge concentration of ~3.5%DS to the future ~7%DS, there is an operational benefit to increasing the capacity of the digested sludge tanks.

For planning, the tanks will be replaced with 2 no. 6 m high tanks with the same diameter of 10.2 m, thereby maintaining the existing footprint while providing increased storage capacity and ensuring compliance with planning constraints.

6.4.5.6 Digested Sludge Dewatering

Digested sludge will be pumped to the new digested sludge dewatering installation and dewatered to >25%DS. Dewatered sludge will be pumped to the dewatered sludge silo ready for export offsite.

6.4.6 Liquor Treatment Process

Liquors resulting from the dewatering of digested sludge at the Regional Bioresource Centre will introduce a significant organic load for treatment by the effluent stream. An estimate has been prepared for each SHC indicating the concentrations of each pollutant for removal. Figure 6-12 shows examples of LPT tanks.

Filtrate from thickening and dewatering operations upstream of digestion have very low BOD and COD compared with digestate dewatered liquor. As per industry best practice, the liquor treatment requirements are based on the digestate dewatering liquors only.

It is assumed for the purposes of planning that the existing WWTP cannot handle the increased ammonia load associated with dewatering of THP treated digested sludge. The recommended option for Limerick is to treat return liquors with a dedicated side stream liquor treatment process (LTP) using annamox bacteria. This SBR type process will remove 85% of the ammonia load from the liquors prior to returning flow to the head of the works.

Treated liquor from the side stream liquor treatment plant would be returned to the head of the works or directly to the ASP process in the form of Nitrate, NO_3. This Nitrate is removed from the wastewater through denitrification, whereby an oxygen depleted environment is required which provides a chemical oxygen demand (COD). The oxygen depleted environment is produced by the anoxic zone of the ASP which causes COD to develop, allowing denitrifying bacteria (using naturally occurring inorganic and organic compounds as a carbon source) in the wastewater to strip oxygen from the NO_3 Nitrate, leaving N_2 (Nitrogen gas) and CO_2. depicts the proposed liquor treatment process tanks.

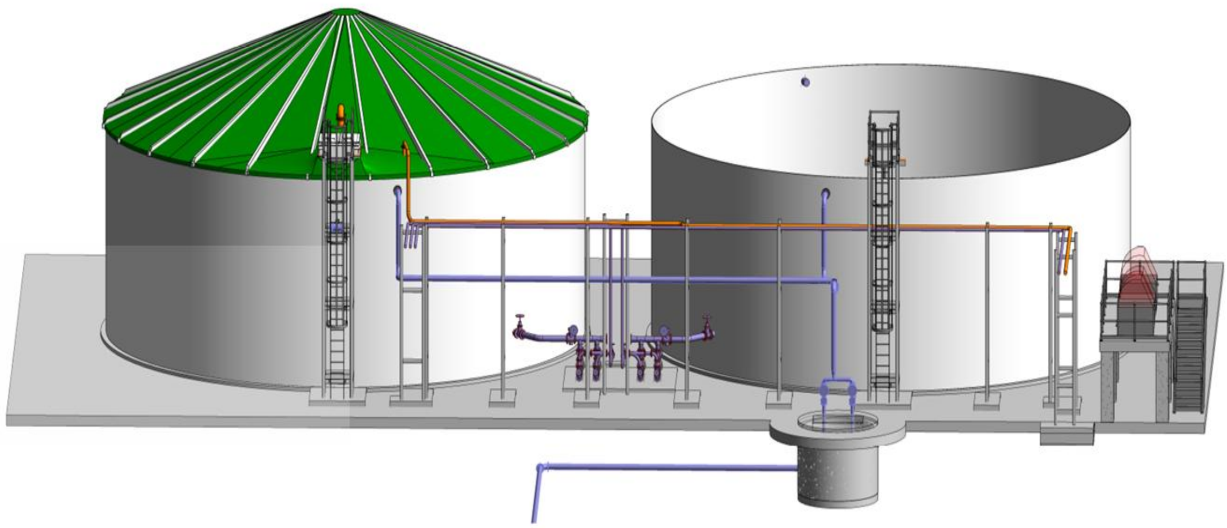

FIGURE 6-12: PROPOSED LPT TANKS

6.4.7 Odour Control

Active odour control will be required for all covered sludge and liquor storage tanks, sludge silos, and for sludge thickening and dewatering equipment. The existing biofilter does not have sufficient capacity to accommodate the sludge storage infrastructure and there is no plan in place to bring the regenerative thermal oxidiser (RTO) back into operation. Figure 6-13 shows an existing RTO.

A new odour control unit has been proposed in the location of the old RTO. The existing Regenerative Thermal Oxidiser (RTO) will be demolished as part of the proposed upgrade works. To minimise planning risk and maintain continuity with the established site profile, the associated exhaust stack will be replaced with a new structure of equivalent height. This approach ensures that visual impact remains consistent with current conditions while providing the necessary infrastructure for the upgraded odour control system.

FIGURE 6-13: EXISTING RTO TO BE DEMOLISHED

The RBC incorporates multiple process elements with high potential for odour nuisance. The odour control design aims to reduce potential for an odour nuisance to a minimum to mitigate against any impact of offence odours on the surrounding environment.

Table 6-16 outlines a breakdown of the identified odour sources and the recommended air change rate. To planning, boundary limits are based on an assigned level of offensiveness of the odour. This design aims to achieve a worst case of 3 OUE. It may also be beneficial to include routinely odorous neighbours in any odour modelling carried out for the proposed Regional Bioresource Centre and WwTP upgrade.

TABLE 6-16 IDENTIFIED ODOUR SOURCES

Existing Sludge Tank Sizes (Working Volume)	Working Volume (m3)	Days Storage at Future Loading	Current Contents	OCU Connection Present	OCU Connection Future	Air Changes per hour
Import Primary Balancing Tank No.1 (*Future Import Only)	1,257	5 to 10 days	Imports & Primary Sludge	Covered, Mushroom vent only	Covered & OCU	1 to 2
Import Primary Balancing Tank No.2 (*Future Primary Only)	1,257	Approx 2 days	Imports & Primary Sludge	Covered, Mushroom vent only	Covered & OCU	1 to 2
WAS Balancing Tank	1,693	Approx 1 day	Thin WAS	Covered, Mushroom Vent only	Covered & OCU	1 to 2
Digested Sludge Tank No.1 (Formerly Sludge Thickener No.1)	309	Approx 0.8 days	Digested Sludge	Uncovered	Covered & Poss. Connection to Biogas Headspace	1 to 2
Digested Sludge Tank No.2 (Formerly Sludge Thickener No.2)	309	Approx 0.8 days	Digested Sludge	Uncovered	Covered & Poss. Connection to Biogas Headspace	1 to 2
Digester Feed Tank No.1 (Formerly Mixed Sludge Tank No.1)	521	Approx 0.6 days	Thickened WAS, Primary & Imports	Covered, Mushroom vent only	Covered & OCU	1 to 2
Digester Feed Tank No.2 (Formerly Mixed Sludge Tank No.2)	521	Approx 0.6 days	Thickened WAS, Primary & Imports	Covered, Mushroom vent only	Covered & OCU	1 to 2

The following process equipment are also required to be connected to OCUs which would also require 8 to 10 air changes per hour:

- Gravity Belt Thickeners (WAS) x 2
- Pre-THP Dewatering Units
- Digested Sludge Dewatering Units x 2
- Sludge Storage Silo
- Imported Sludge reception pump station

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