

Uisce Éireann

Wastewater Treatment Functional Specification

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1 INTRODUCTION

This Uisce Éireann technical standard specifies functional requirements and gives guidance for Wastewater Treatment Plant Process (WwTP) Design. It includes:

- The overarching design principles
- Guidance on the selection of treatment processes.
- Key design criteria for core wastewater treatment works assets
- The key commissioning, operation and maintenance requirements for new wastewater treatment works assets.

This specification is specifically concerned with assets on WwTPs; as a separate specification is being developed with regards to Wastewater (Ww) network design and operation. Any user of this document must also familiarise themselves with this specification, as certain aspects of network design and operation can have significant impact on the performance and operation of receiving WwTPs (e.g. network Combined Sewer Overflow (CSO) operation, network storm storage, gravity sewers leading to increased Ww septicity etc.)

2 PURPOSE

The Uisce Éireann Standards and Specifications suite of documents describes the minimum standards to be achieved by those engaged in the Design, Construction Installation and Refurbishment of Uisce Éireann assets.

The Uisce Éireann Standards and Specifications apply to all new assets and to all existing assets that are undergoing refurbishment, replacement, or expansion.

Three types of standards are being produced (see Figure 1).

- Functional Specifications for the four main classes of asset (Water Treatment Works, Water Networks, Wastewater Networks and Wastewater Treatment Works).
- General Standards Specifications and Guidance that are common for each type of asset (Mechanical and Electrical, Civil, Instrumentation and SCADA/Telemetry).
- Detailed Asset standards for systems and each type of component.

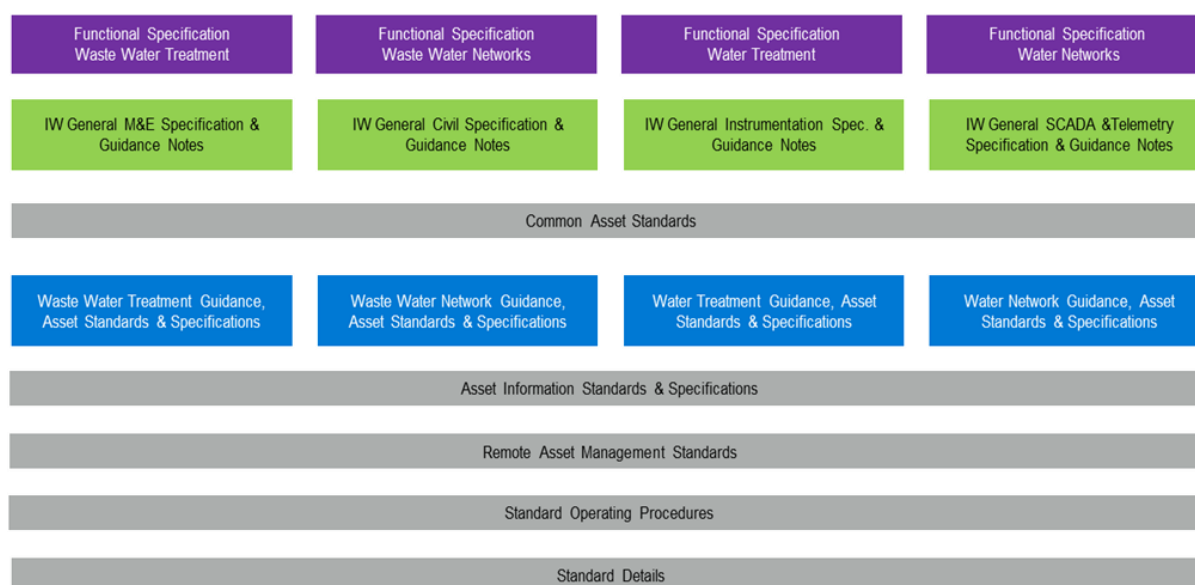


Figure 2.1 Structure of standards proposed by Uisce Éireann current draft strategy

3 SCOPE

3.1 General

All Uisce Éireann, asset specific design standards specifications, guidance, policies etc. for the approaches and assets discussed in this document are available on the Uisce Éireann Standard Portal (<https://www.water.ie/iwstandards/home>). This document does not look to supersede any of these existing documents, rather the purpose is to specify the overall approach to new asset design and integration, whilst highlighting the key design requirements and consideration for individual process types.

In order to facilitate the roll out of Uisce Éireann standards to the supply chain (including Local Authorities) there is a need to support them through a system of Derogations / Queries / Change requests. There is also a need to harness the information being gathered from the various users to facilitate continuous improvement of the standards documents. In the event that an ESP wishes to request a change to an UÉ standard or specification they are required to provide details by way of a Derogation Application Form AD-EDS-SOP-005.

This document is one of a group of standards and specifications which forms Uisce Éireann Technical Standards System. The requirements of this document are mandatory for those engaged in the design and construction of Uisce Éireann assets.

If a Supplier/Designer considers that adhering to any part of this document will result in an asset which is not fit for purpose for a particular project or situation, or a Supplier has any other issue with this document, they are obliged to seek permission to modify the requirements of this document from Uisce Éireann through the derogations process.”)

3.2 Derogations from the Specification

Whilst the minimum requirements of this standard / specification shall be met (where applicable) this document is not intended to stifle innovation by the Contractor/Designer, or delay progress. Should the Contractor/Designer wish to apply for a derogation from any aspect of the document, they shall submit a derogation application to the Employer's Representative in accordance with AD-EDS-SOP-005, in advance of any proposed departure from the requirements of the specification (the required form for the derogation application will be provided to the Contractor/Designer by the Employer's Representative). Submission of the derogation application does not confer permission to proceed, and the application should be submitted allowing sufficient time for the Employer and the Employer's Representative to evaluate. Works can only proceed on the basis of the derogation, after the Contractor/Designer has received written confirmation from the Employer's Representative. The written confirmation of the derogation shall be treated as a change order/variation under the contract and its consequences shall be decided pursuant to the change/order variation mechanism of the contract.

The submission of a derogation application shall not impact on the programme of works for the specified project and shall be made at the risk and expense of the Contractor/Designer. Uisce Éireann or the Employer's Representative shall retain the right to reject the derogation application in favour of compliance with this document.

For the avoidance of doubt, the derogation, where approved, shall only pertain to the specific circumstance for which the derogation is approved. An approved derogation shall not carry any precedent to another project/contract and shall not be used or applied on other similar

projects/contracts or circumstances thereafter. The subject of a derogation can only be applied on another contract/project if it has been directly incorporated into the standards/specifications for the relevant contract/project.

4 DEFINITIONS

4.1 Terms and definitions

For the purposes of this standard, the following definitions apply:

Term	Definition
A2O	A specific configuration implemented on ASP treatment processes to promote EBPR. It involves providing dedicated sequential zones within an ASP in the order of anaerobic, anoxic, then aerated (A, A, Oxygenated)
Actual Oxygen Requirement	A calculated value to estimate the full oxygen supply a biological system will require allowing for transfer inefficiencies between oxygen supply system (blowers) and the actual biomass.
Agglomeration	A defined area within the Uisce Éireann region that is connected to wastewater network, and will eventually arrive at a given WwTP
Alkalinity	A measurable wastewater parameter, typically expressed as mg/l of CaCO ₃ , but in reality, is made up of a number of compounds. This parameter is consumed as an intermediary step in the nitrification process, and the consumption can impact the pH of the wastewater. It can be produced in anoxic zones, supplemented through chemical design (e.g. caustic or lime dosing) and is also consumed as a result of metal coagulant dosing.
ATEX	Abbreviated name given to a set of two European Regulations covering the minimum safety requirements for workplaces and equipment used in explosive atmospheres.
Biofilm	A layer on top of fixed film media that contains active biological organisms that provide biological treatment in secondary or tertiary treatment stages.
Biological Oxygen Demand	A measurable wastewater parameter that quantifies the potential for biological oxygen consumption within a given volume of sampled wastewater (usually described in mg/l)

Term	Definition
Blind Tank	A storm tank within a set of two or more, that is configured to fill first during a storm event, with the remaining tanks only filling once the blind tank has reached capacity. This configuration allows the initial "first flush" wastewater to be captured within the blind tank.
Carbonaceous	Biological treatment that is targeted to remove BOD and COD only.
Caustic	Common name for the chemical with the active ingredient sodium hydroxide, commonly used in wastewater treatment to provide supplementary alkalinity
Chemical Oxygen Demand	A measurable wastewater parameter that quantifies the potential for chemical oxygen consumption within a given volume of sampled wastewater (usually described in mg/l)
CORMIX	A specific type of software modelling used for flood modelling scenarios
Data Manual	The data that Uisce Éireann may (but is not obliged) to provide to the Designer at the commencement of a given project
Designer	The person(s)/organisation undertaking activities to propose/size/install/commission new or refurbishment of existing assets on any given Uisce Éireann owned site and/or asset.
Double Filtration	A configuration in biological treatment stages, where the influent is treated by the same biological stage twice (i.e. a portion of the effluent is recycled, and/or passed through a subsequent set of the same filter media type) in order to achieve greater parameter (typically BOD, COD, Ammonia, Total Nitrogen) Removal
Drainage Asset Planning	The process by which Uisce Éireann manages the
Dry Weather Flow	A measured parameter of crude flows to a given WwTP that quantifies the typical amount of flow the WwTP receives on a dry day (i.e. with no rainfall).
Emission Limit Values	The concentration limits in the final effluent that a given WwTP is required to achieve, either stated within its specific WWDL, or by agreement with Uisce Éireann

Term	Definition
Ferric	Common name for iron (III) based chemical compounds, typically used in wastewater treatment for targeting phosphorus coagulation for removal by settlement and/or filtration. These chemicals are also occasionally used to aide poor solids settlement. The most common of these compounds are ferric sulphate, and ferric chloride.
Fine Bubble Diffused Aeration	A configuration of aeration in biological treatment where fine bubbles are passed through a biological reactor via a diffuser grid located on the reactor floor.
First Flush	The scenario where a treatment works experiences a significant increase in crude flow and loads following an extended period of low flows. This most commonly occurs when there is significant rainfall within the connected WwTP agglomeration following an extended period of dry weather. This scenario often represents a high risk to final effluent compliance, as this is most likely when the WwTP experiences its highest flow and loads and most rapid change in flow and load.
Flood Modeller	A specific type of software modelling used for flood modelling scenarios
Flow to Full Treatment	A measured parameter of crude flows through a given WwTP representing the maximum crude flows the WwTP is required to treat, above which crude flows are permitted to spill to storm tanks or direct to the environment (depending on the specific permit conditions).
Flow to Works	A measured parameter of crude flows received at a given WwTP, which represents the maximum flow the WwTP is expected to receive. Depending on the specific conditions for the WwTP, this may represent either the maximum crude flow the WwTP is expected to treat, or may represent the total flow received, where the amount discharged to the storm tanks, or direct to the environment (depending on the specific permits conditions) can be estimated by subtracting the Flow to Full Treatment value
Food to Biomass Ratio	A calculated ratio that quantifies the amount of Biological Oxygen Demand load (kg/d) feed to a given biological stage per mass of biological organisms within the treatment stage available to consume it.

Term	Definition
Formula A	A calculated parameter of crude flows to a given WwTP, which estimates the theoretical maximum flow expected at the WwTP given the connected Population Equivalent.
GeoDirectory database	A specific national Irish database that provides information on the number and type of businesses within a specific agglomeration. May be used to inform estimated trade effluent calculations/assumptions
HEC-RAS	A specific type of software modelling used for flood modelling scenarios
High-Density Polyethylene	A specific type of plastic material commonly used for construction (e.g. commonly used for chemical storage tank construction)
INFOWORKS (ICM)	A specific type of software modelling used for flood modelling scenarios
Invest to Outcome	Uisce Éireann Capital Investment Process
Kallic	Short form/common name for stabilised liquid lime chemical typically used for alkalinity correction in Ww
Lower Tier Limit	A type of Emissions Limit Value for a WwTP, where the final effluent concentration may only exceed a certain number of times in a given time period. Most typically, these are also known as 95%ile limits, as the number of exceedances is based on 95% of the regulatory samples taken in a given time period being below the limit.
MCERT	A framework of standards and specifications owned by the UK environment agency governing Monitoring Certification. It is primarily used in this document to refer to flow monitoring installations, where MCERT is used to indicate the installations must be compliant with the wide range of specifications which governs the Monitoring Certification.
MIKE11	A specific type of software modelling used for flood modelling scenarios
National Park and Wildlife Service	An Irish Government agency concerned with national parks and other wildlife services
Nitrification	Biological treatment that is specifically targeted to remove Ammonia and potentially also Total Nitrogen. Depending on whether the treatment stage is providing full secondary treatment, or is only providing tertiary treatment following dedicated carbonaceous secondary treatment, the nitrification process may also provide BOD and COD removal in addition to ammonia and total nitrogen removal.

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Term	Definition
Office of Public Works	A major Irish government agency that manages the majority of the state's property portfolio
Orthophosphate	A measurable wastewater parameter that represents the measured concentration of PO_4^{3-} compounds. It is often used to estimate the total concentration of soluble phosphorus in wastewater
PID	A type of automated controller that includes Proportional, Iterative, and Derivative control.
P-k-C*	A method for calculating estimated sizing requirements for constructed wetlands
Polypropylene copolymer	A specific type of plastic material in used in construction
Population Equivalent	An estimated/calculated value to represent to total connected loading to a given WwTP, and/or within a defined agglomeration. It is used as the primary sizing metric for WwTPs
Project Manager	A designated Uisce Éireann representative that has overall authority/responsibility for a given project within Uisce Éireann capital programme and/or asset planning
RAG	The waste material captured by inlet screens on WwTPs/network screened overflows. It primarily consists of solid material, most notably toilet paper.
Readily biodegradable Chemical Oxygen Demand	A measure of the fraction of the total COD within a given Ww sample that is easily consumed by typical biological treatment organisms.
Return Activated Sludge	A recycled flow stream that is returned to the inlet of a given ASP reactor, that contains a high concentration of the ASP biomass.
Single Filtration	A configuration in biological treatment stages, where the influent is treated a biological stage only once (i.e. as opposed to double filtration)
Specific Stirred Volume Index	A measurable parameter for Mixed Liquor Suspended Solids that in essence measure the settleability of the biomass fraction of the MLSS. It is an important parameter for FST sizing, and in troubleshooting operational ASPs.
Specific surface area	A property of filter media that quantifies the total biological contact surface area that is contained within a given volume of filter media.

Term	Definition
Standard Oxygen Requirement	A calculated value that estimates the theoretical oxygen requirement of a given biological treatment stage based on the estimated influent loads, removals required, size of the available biomass, and target oxygen residual in the reactor.
Supervisory Control and Data Acquisition	A system that uses software and hardware to control, monitor, and analyse the processes on a given WwTPs
Surplus Activated Sludge	The waste stream taken off a given ASP installation
Total Kjeldhal Nitrogen	A measurable wastewater parameter, which measures the total amount of nitrogen in a sample, including both organic and inorganic nitrogen.
Grit	A primarily inert solid waste stream produced in WwTP grit removal systems (e.g. Detritors or bendy channels). It primarily consists of the solid waste produced as a result of road wash off (i.e. when heavy rainfall washes away part of the tarmac layer on roads and pavements)
Upper Tier Limit	A type of Emissions Limit Value for a WwTP, where the final effluent concentration is not permitted to exceed the stated limit. If a WwTP experiences even one sample exceedance above the limit, it becomes classed as a failing works
Waste Assimilation Capacity	The limit of a given water course/receiving aquatic environment to absorb certain pollutants without it being of detriment above stated limits. The total capacity for a given water course/aquatic environment for stated wastewater parameters is defined by the Designer using calculation methods and templates provided by Uisce Éireann technical standards team

4.2 Abbreviations and acronyms

Term	Definition
AOR	Actual Oxygen Requirement
BAFF	Biological Aerated Flooded Filter
BOD	Biological Oxygen Demand
BS	British Standard
COD	Chemical Oxygen Demand
COUF	Continuously Operated Upflow Filter
CSO	Combined Sewer Overflow
CW	Constructed Wetland
DO	Dissolved Oxygen

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Term	Definition
DWF	Dry Weather Flow
EBPR	Enhanced Biological Phosphorus Removal
ELV	Emission Limited Value
EN	European Standard
EQS	Environmental Quality Standard
FBDA	Fine Bubble Dissolved Aeration
FFT	Flow to Full Treatment
FOG	Fats, Oils and Grease
FST	Final Settlement Tank
FTW	Flow To Works
GSI	Geological Survey Index
HDPE	High Density Polypropylene
HSE	Health and Safety Executive
I ₂ O	Invest to Outcome
ISO	International Standard
LA	Local Authority
LRV	Log Reduction Value
MBBR	Moving Membrane Biofilm Reactor
MLSS	Mixed Liquor Suspended Solids
NB	Nominal Bore
NbS	Nature Based Solutions
NOMC	National Operations Monitoring Centre
NPWS	National Park and Wildlife Services
nSAF	Nitrifying Sand Filter
NTF	Nitrifying Trickling Filter
O&M	Operation and Maintenance
OP	Ortho-phosphate
Ops	Operations (UE site operatives)
OPW	Office of Public Works
PCMF	Pile Cloth Media Filters
PE	Population Equivalent
PMS	Performance Management System
PP	Polypropylene
RAS	Return Activated Sludge
RBC	Rotating Biological Contactor
rbCOD	Readily biodegradable Chemical Oxygen Demand
RGF	Rapid Gravity Filter
SAF	Submerged Aerated Filter
SAS	Surplus Activated Sludge
SBR	Sequencing Biological Reactor
SCADA	Supervisory Control and Data Acquisition
SDRB	Sludge Drainage Reed Bed
SOR	Standard Oxygen Requirements
tDS	Tonnes of Dry Solids
TN	Total Nitrogen
TP	Total Phosphorus
TSR	Tertiary Solids Removal

Term	Definition
TSS	Total Suspended Solids
UCT	University of Cape Town
UÉ	Uisce Éireann
UTL	Upper Tier Limit
UVDGM	Ultraviolet Design Guidance Manual
UVT	Ultraviolet Transmissivity
UWWTD	Urban Wastewater Treatment Directive
WAC	Waste Assimilation Capacity
WFD	Water Framework Directive
WLC	Whole Life Cost
WSCL	Uisce Éireann's Wastewater Source Control and Licensing Team
WSTG	Uisce Éireann's Water Services Training Group
Ww	Wastewater
WwTP	Wastewater Treatment Plant
LTL	Lower Tier Limit
WWDL	Wastewater Discharge License
COA	Certificate of Authorisation
WIMES	Water Industry Mechanical and Electrical Specifications

4.3 Symbols

Term	Definition
%DS	Percentage Dry Solids
24/7	Continuous operation (i.e. 24 hours per day, 7 days per week)
Al ₂ O ₃	Aluminium Oxide
CFU/100ml	Coliform units per 100 millilitres
d	Days
Fe ²⁺	Ferrous ion
Fe ³⁺	Ferric ion
hd	Head
hrs	Hours
kg/year	Kilograms per years
l	Litres
l/m ² /h	Litres per metres squared per hour
m/hr	Metres per hour
m/s	Metres per second
m ²	Metres squared
m ² /m ³	Metres squared per metres cubed (surface area per volume)
%DS	Percentage Dry Solids
24/7	Continuous operation (i.e. 24 hours per day, 7 days per week)
Al ₂ O ₃	Aluminium Oxide

Term	Definition
CFU/100ml	Coliform units per 100 millilitres
d	Days
Fe ²⁺	Ferrous ion
Fe ³⁺	Ferric ion
hd	Head
hrs	Hours
kg/year	Kilograms per years
l	Litres
l/m ² /h	Litres per metres squared per hour
m/hr	Metres per hour
m/s	Metres per second
m ²	Metres squared
m ² /m ³	Metres squared per metres cubed (surface area per volume)
m ³	Metres cubed
mg/l	Milligrams per litre
ml/g	Millilitres per gram
Mm	Millimetres
°	Degrees
°C	Degrees Centigrade
rev/hour	Revolutions per hour
Sk	Flushing Intensity
w/w%	Weight by weight content as a percentage
Al ³⁺	Aluminium ion
CaCO ₃	Calcium Carbonate
F:M	Food to Biomass ratio
log ₁₀	Log base 10 (mathematical function)
SSV _I _{3.5}	Specific Stirred Volume Index, corrected for 3,500mg/l MLSS
yrs	Years

5 ROLES AND RESPONSIBILITIES

The responsibility for ensuring compliance with the Uisce Éireann Standards and Specifications lies with the Designer. Uisce Éireann reserves the right to inspect all design work and delivered assets at any time to ensure that compliance with the Standards and Specifications is being achieved. The term Designer is defined in section 4.1.

6 SPECIFICATION

6.1 Requirements

6.1.1 General

The design of a WwTP is complex and the overall design and implementation of WwTP solutions is achieved by ensuring successful consideration of a number of factors. This document aims to describe the overall approach in a logical order.

The overall key design principles that must be satisfied to realise optimum design are discussed in section 6.1.4. The specifics of the minimum data requirements to facilitate the design of a WwTP are discussed in section 6.1.5. Guidance as to what process assets should be selected for given criteria for successful WwTP design is provided in the process selection tool within section 6.1.5 with the supporting logic behind the tool shown for clarity in the appendix. Section 6.1.7 then provides specific design requirements for the different types of possible process asset where these types of asset are required. Finally, section 6.2 describes the general requirements for successful commissioning, operation and maintenance of a given WwTP, with required process asset performance criteria where relevant.

To fully understand and appreciate the requirements for WwTP design, it is recommended that the document is read in this order.

6.1.2 Discharge Licenses

Typically in place for larger WwTPs (above 500 PE) discharge licenses between Uisce Éireann and the EPA that specify required final effluent ELVs and required flow performance for a given WwTP.

Flow measurement at these WwTPs are typically required to maintain regulatory compliance with permitted flow parameters. The main regulatory flow monitoring points required are:

- Flow to Plant (FTP)
- Flow to Full Treatment (FFT)
- Storm/Emergency Overflow discharge monitoring

Further details on the requirements for these monitoring points can be found in Flow Measurement Standard (Wastewater) (TEC-700-99-01) and Inlet Works Stormwater Treatment (Wastewater) (TEC-700-99-02)

Specific requirements for confirming compliance with final effluent ELVs are set out in the

relevant discharge document. Below shows an example of a live discharge license in place that specifies the required final effluent ELVs and required sampling method for compliance :

Environmental Protection Agency

Licence Reg. No. D0034-02

SCHEDULE A: DISCHARGES & DISCHARGE MONITORING

A.1: Primary Waste Water Discharge and Monitoring

A.1.1 Primary Waste Water Discharge(s)					
EDEN Code	Licence Code	Discharge Location	Monitoring Location	Receiving Water Name	WFD Code Receiving Water
TPEFF0700D0034SW001	SW001	E 321073 N 233814	E 320335 N 233396	Lower Liffey Estuary	IE_EA_090_0300

Discharge Emission Limit Values and Monitoring					
Parameter	Units	ELV	Monitoring Frequency	Sampling Method	Analysis Method / Technique
Flow rate	m ³ /24 hours	–	Continuous	Online	Online flow probe meter with recorder
pH	pH units	6-9	Daily	Continuous	pH meter and recorder
BOD, 5 days with Inhibition (Carbonaceous BOD)	mg/l	25	Weekly	Composite	Standard method
COD	mg/l	125	Weekly	Composite	Standard method
Suspended Solids	mg/l	35	Weekly	Composite	Standard method
Total Nitrogen (as N) ^{Note 1}	mg/l	10	Weekly	Composite	Standard method
	kg/year	2,239,056			
Total Phosphorus (as P)	mg/l	1	Weekly	Composite	Standard method
	kg/year	223,906			
Toxicity	T.U.	5	Annually	Composite	Microtox & Rotifer LC50 Calculation Programme ^{Note 3}
Specific pollutants & priority substances	-	-	Annually	Composite	Standard Method
Escherichia coli ^{Note 2}	CFU/100ml	21,500	Weekly	Grab	Standard method
Enterococci (Intestinal) ^{Note 2}	CFU/100ml	7,400	Weekly	Grab	Standard method

Note 1 The requirements for nitrogen may be checked using daily averages when it is proved, in accordance with Annex I, Paragraph D.1 of the Urban Waste Water Treatment Directive Amendment 1998, that the same level of protection is obtained. In this case, the daily average must not exceed 20 mg/l of total nitrogen for all the samples when the temperature from the effluent in the biological reactor is superior or equal to 12°C.

Note 2 ELV shall apply during the bathing season 1st June to 15th September (as per S.I. No. 79/2008 - Bathing Water Quality Regulations 2008), unless otherwise agreed by the Agency.

Note 3 Or any other method to be agreed with by the Agency.

Figure 6.1 – Example ELV Condition From Site Discharge License Document

6.1.3 Online/Continuous monitoring

All equipment used to undertake the monitoring must be in compliance with the wider suite of Uisce Éireann standards technical guidance, and records of all equipment maintenance carried out in accordance with manufacturer Operation and Maintenance (O&M) requirements must be kept as required by the permit conditions. Further details of the Uisce Éireann specific requirements, particularly with regard to flow monitoring and Ww sampling is available in technical standards “Flow Measurement Standard (Wastewater)” (TEC-700-99-01) and “Sampling at WwTPs – Interim standard” (TEC-700-99-08).

6.1.4 Design Principles

UÉ is a publicly owned and funded organisation, and as a result has key responsibilities in delivering value on any public investment. The following sections set out UÉ’s key design principles when implementing any new project or intervention on a Ww UÉ owned asset. There is extensive guidance already available within the UÉ suite of standards and specifications that sets out the requirements and guidance for the Designer in the approach to any given intervention on the UÉ asset base. Specifically, there are detailed governance structures that are in place which are described in the suite of guidance and specifications within the I₂O process, and within AD-EDS-MAN-001 “Asset Delivery Quality Manual”. This specification does not look to replace any of this guidance, but rather highlight core elements that require key consideration within any Ww project within the asset base, aligning with existing standards, as well as introducing further guidance where appropriate. The principles discussed should be considered in combination with each other when approaching any given project. The ideal solution will result in optimum outcomes being achieved in project delivery with regards to:

- **Outcome**
- **Maximising Value From Existing Asset Base**
- **Financial assessment**
- **Safe design**
- **Water Services Strategic Plan**
- **Sustainability**
- **Innovation**

In reality, it is unlikely that on any given project/work that the optimum outcome with regards

to each design principle will be achieved. It is up to the Designer to agree with the UÉ project manager, asset planning and engineering technical teams, which proposals best achieve the overall design. This is a case by case assessment and must be based on the principles discussed in the subsequent sections and in-line with the existing guidance around delivering optimum outcomes for any UÉ investment (i.e. the I₂O process and in line with the Asset Delivery Quality Manual).

6.1.4.1 Outcome

It is a critical measure of any project, that any proposed investment is tied directly to an explicit outcome. As a result, “Outcome” is one of the key “6 dial” metrics that must be defined as part of any capital project within UÉ. Further information on defining the “outcome” for any proposed UÉ project is available in the suite of guidance and training material available under the governance of the I₂O process. In short, the purpose of any given intervention on the UÉ Ww asset base must be clearly defined and proposals put forward as part of the I₂O process must demonstrate clear capability of meeting the defined outcome(s).

6.1.4.2 Maximising Value From Existing Asset Base

When approaching any given project, regardless of scale or cost, UÉ is keen to promote opportunities to realise maximum value from the existing wastewater asset base. This is not only likely to provide cost benefit, but also time and carbon reductions in line with the wider sustainability principles around circular economy and the PAS2080 approach (see section 6.1.4.6 for further details). On every project, it is the Designers’ responsibility to consider and present alternatives which maximise reuse of existing assets rather than full scale asset replacement where this can achieve the required project outcomes. This approach is actively encouraged, and may range from maintenance/refurbishment of existing assets to extend asset life, to appropriate relaxation of certain design criteria to avoid the need for new asset construction (on condition of derogations against the required standard(s) being approved). Further detail around how these options should be presented and considered through the existing I₂O process is included in section 6.1.6.1. The I₂O guidance/processes which are in place actively support this approach where it minimises cost/time/carbon but still ultimately meets the outcomes requirements.

6.1.4.3 Financial Assessment

The Designers must ensure that any new proposed intervention(s) on the UÉ asset base incorporates new assets that are efficient, reliable, easy to maintain, meet all the process requirements and are procured in line with UÉ guidance, all with the overall aim of achieving optimised costs. This requires that all the costs associated with the operation and maintenance of the plant during its lifetime are well understood, alongside any initial capital costs. It is important that the data used in life cycle cost assessments is based on actual Uisce Éireann Operational and Maintenance working practices and experience, wherever possible.

As part of any proposed intervention on the UÉ asset base, the Designer will ensure that all financial costing exercises are conducted in accordance with the approaches and templates set out in the current version of the I₂O process. Alongside quantifying the “Cost Estimate” (CAPEX) and “Delta OPEX” of any proposed intervention, the designer is required to produce Net Present Value (NPV) estimates so that the overall financial impact of any intervention is understood.

6.1.4.4 Safe Design

Any project within UE that involves the installation of any new assets, the modification or repurposing of any new assets are required to be implemented with safety in mind. It is the Designer's responsibility that any project undertaken within the UÉ asset base does not result in unsafe asset design and/or unsafe working conditions for UÉ operational staff, or pose a threat to the wider public. All UÉ projects must adhere to the requirements and follow the guidance of the latest version of AD-EDS-GL-07, “Irish Water Safe Design Guidance Document” and apply the principles therein to all design work from the start of concept phase of any project and throughout the entire project life cycle.

6.1.4.5 Water Services Strategic Plan

UÉ is currently in the process of developing their new Water Services Strategic Plan (WSSP) covering the years 2025 – 2050, which will, when enacted, supersede the existing WSSP 2015 – 2040. Figure 6.2 below, taken from the draft SEA for the WSSP 2050 illustrates the hierarchy of plans within the organisation.



Figure 6.2 - Hierarchy and interaction of plans and projects

This framework of strategies and plans creates a clear line of sight through UÉ, demonstrating how the WSSP 2050 will influence all tiers and strategies within the organisation. A coherent and consistent sustainability framework also integrates within all plans and strategies at each tier of the organisation.

The Draft WSSP 2050 includes four Strategic Objectives, strategic aims and key actions to address the identified challenges from now to 2050. In accordance with Section 33(4) of the Water Services (No. 2) Act, 2013, UÉ has set out the means by which they propose to achieve these Strategic Objectives. These are presented as 35 key actions which outline the direction of travel and steps that UÉ will take over the next 5-10 years to deliver on the long-term objectives.



Figure 6.3 - Uisce Éireann Strategic Objectives (draft) WSSP 2050

6.1.4.6 Sustainability

The sustainable delivery of any given intervention within the UÉ asset base is critical to the ongoing successful operation of the UÉ business. There are number of documents within the UE suite of standards and specifications that provide guidance around the UE approach to sustainability. Additional supporting resources are currently under development. The following sections summarise the key requirements and guidance relating to sustainable delivery of interventions on the UÉ asset base. It is the Designer's responsibility to ensure that the sustainable design principles discussed below are incorporated into the design of any proposed intervention throughout the project lifecycle.

6.1.4.6.1 Context

Effective water services, including the delivery of a sustainable and reliable clean water supply and safe disposal of wastewater, are essential for a modern country. Considering the challenges posed by the twin climate and biodiversity crises, there is an ever-increasing need for the delivery of water services to be low carbon and sustainable in nature.

This section of the FDS is focused on summarising the key points of the relevant guidance within UÉ, to ensure key sustainability principles are integrated in the design of any intervention within the UÉ Ww asset base.

6.1.4.6.2 Sustainability Framework

UÉ's sustainability ambitions are set out in its [Sustainability Framework](#). The Framework has three key pillars at its core, underpinned by a governance approach, ensuring sustainable practises are implemented and followed at each of the key stages of the project lifecycle. To support delivery and to demonstrate commitment to achieving success within these three pillars, UÉ have six public-facing ambitions relating to environment, social, and collaboration.

Uisce Éireann has developed six public-facing ambitions under its Sustainability Pillars

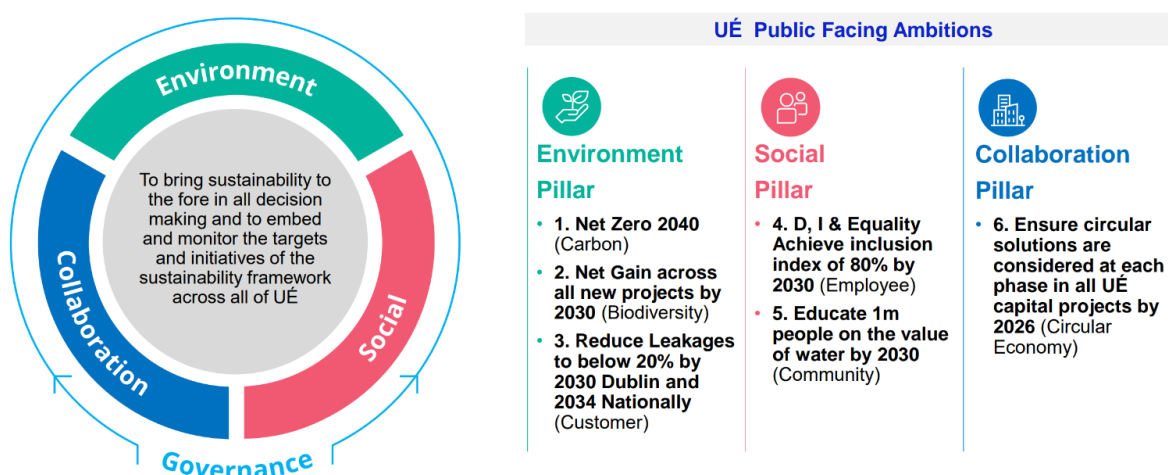


Figure 6.4 – UE Sustainability Framework Pillars

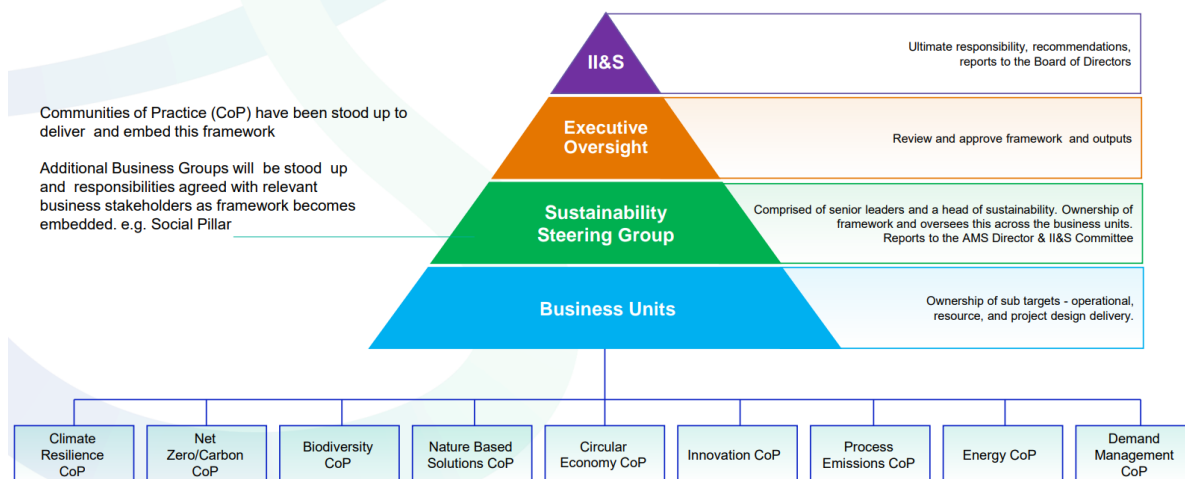
Further information on specific companywide targets and commitments aimed at achieving these six ambitions are detailed within the Sustainability Framework document. It is the Designer's responsibility to ensure that during the design process of any proposed intervention on the UÉ asset base, opportunities to support and contribute to achieving the specific UÉ sustainability ambitions are highlighted to UÉ. In particular, Designers implementing interventions on the UÉ Ww asset base should be aware of the following specific UÉ ambitions:

1. Net Zero 2040
 - i. Reduce the Carbon Intensity of capital investment
 - ii. 40% energy demand met from installed Renewables and PPAs by 2035
 - iii. Half Energy Intensity by 2030
 - iv. WwTP (>10,000 PE) Energy Neutrality by 2040

- v. Supply Chain Support & Engagement – Scope 3
- vi. 51% reduction in energy -related GHG emissions by 2030 (SEAI) including 51% reduction in Fossil Fuel Consumption related to thermal heating & transport
- 2. Biodiversity Net Gain by 2030
 - i. Biodiversity net gain across all new projects by 2030
 - ii. Champion nature-based solutions in the delivery of water services and adopt for in excess of 30 projects by 2030
 - iii. Biodiversity enhancement measures implemented across all UE sites by 2030
- 3. Ensure circular solutions are considered at each phase in all UE capital projects by 2026
 - i. Reduce, Reuse, Recycle existing waste:
 - a. Zero recoverable waste to landfill by 2030
 - b. Circular economy outlets for sludge by 2026
 - c. Reuse of decommissioned materials in upgrade projects
 - ii. Design for circular economy: Use of more sustainable materials and switching to circular business model approach

It is Designer's responsibility to engage with the relevant UÉ stakeholder, in particular representatives of the relevant Communities of Practice (CoPs), shown in Figure 6.5, to ensure the impact and potential opportunities of any proposed interventions are explored fully throughout the project lifecycle. In addition, there is explicit guidance available within the suite of I2O documents that covers requirements for Designers to be aligned to the I2O process. These should be followed for Climate Resilience, Circular Economy, Energy Efficiency and Renewable Energy. There is also a draft questionnaire for supply chain partners that UÉ have developed to be completed as part of any capital and/or maintenance project, which is aligned to the sustainability pillars within the Sustainability Framework. It is the responsibility of the Designer to ensure that the answers to these questions, where applicable, are provided as part of any proposed intervention on the UÉ Ww asset base.

Governance: Business-Wide Approach



4

CoP – Community of Practice

Figure 6.5 – UÉ Sustainability Governance approach (with individual workstream CoPs)

6.1.4.6.3 Energy Efficient Design

As a potential key impact on both overall cost and carbon impact of a project, particularly on the Ww asset base, understanding the energy requirements of any proposed intervention is key to design. UÉ requires that monitoring of the energy usage of new assets is provided using Energy Performance Indicators (EnPIs) and energy monitoring of particular elements of the plant. All energy monitoring and efficiency drives shall be in line with the current version of the TEC-600-004 Energy Efficient Design Standard (EED). It is the Designer's responsibility to consider the impact of design decisions on operational energy usage. Opportunities to minimise future energy consumption by optimising design should be undertaken using the EED Principles Energy Hierarchy as illustrated in Figure 6.6 for all UÉ projects, including capital delivery programmes and capital maintenance replacement and refurbishment programmes. Energyefficientdesign@water.ie should be consulted where guidance on the EED process is required.

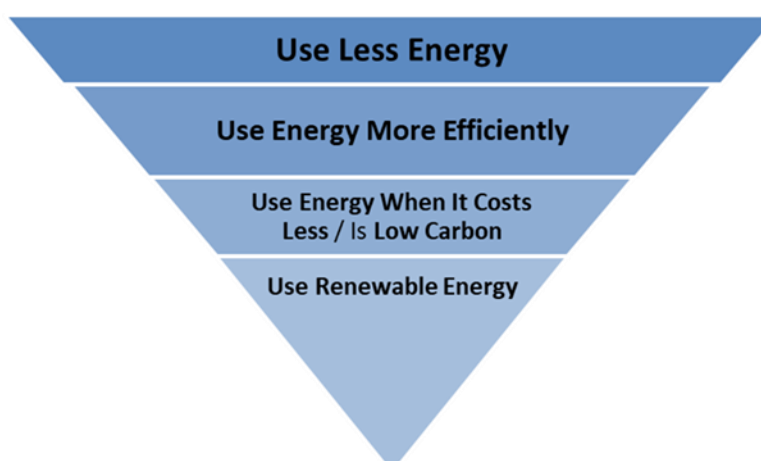


Figure 6.6 – Energy Efficiency Design Hierarchy

6.1.4.6.4 Climate Resilience

Climate change is expected to increase the frequency and severity of extreme events, as well as altering seasonal weather characteristics and temperatures. The most significant risks to UÉ from a changing climate are:

- More intense rainfall leading to flooding (pluvial or fluvial) of assets and overloading of wastewater networks.
- Coastal flooding from sea level rise and increased storm surge.
- More intense storms leading to flooding and power interruptions.
- Less rainfall and higher temperatures leading to more frequent and severe droughts.

All of these factors have the potential to impact upon the project durability, as well as financial aspects such as repair and recovery costs. Designers should work closely with representatives from the UÉ Climate Resilience CoP to ensure that, where possible, any proposed intervention on the UÉ Ww asset base has carefully considered climate resilience impacts and opportunities. This includes reviewing any previously conducted climate resilience studies.

6.1.4.6.5 Biodiversity

Impact on the local Biodiversity is a key element of the overall Sustainability Framework within UÉ. As stated in section 6.1.4.6.2, a number of the key pledges UE have made related specifically to Biodiversity enhancements within the UE asset base, offsetting the impact of proposed improvements to the UÉ asset base, or both. It is the designer's responsibility to ensure that any elements of proposed intervention on the UÉ Ww asset base fully consider

the potential impact on the local and wider biodiversity; that any required interventions to offset/achieve net gain against any impacts are brought to the attention of the UE project team, and that any opportunities to provide biodiversity enhancements beyond traditional solutions (e.g. providing Nature Based Solutions alternatives) are fully explored. Further guidance on the specific Biodiversity implications on an individual project/site basis can be obtained from members of the UE Biodiversity CoP within the wider Sustainability Governance structure.

6.1.4.6.6 Carbon Assessment, measurement and reduction

When looking at integrating carbon reduction in UÉ projects, it is the Designer's responsibility to ensure that at each stage, the project team explores the potential embodied, operational and whole life carbon impacts associated with proposed interventions. The figure below provides a summary of UÉ current Operational carbon emissions, in order to provide context for determining the key areas to include in operational carbon estimates.

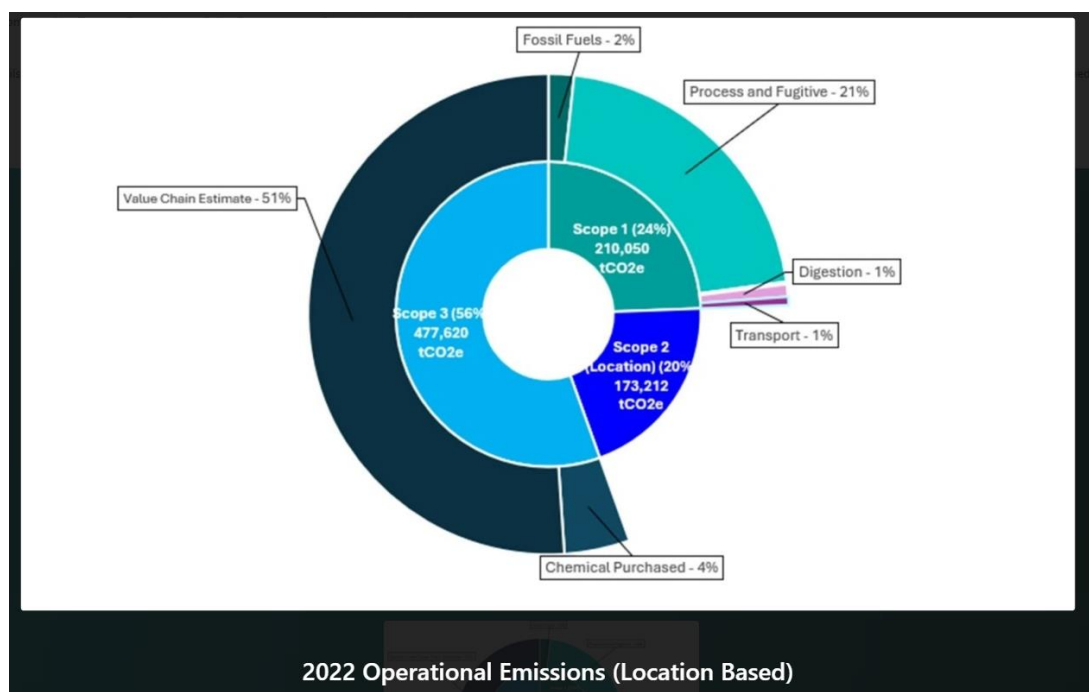
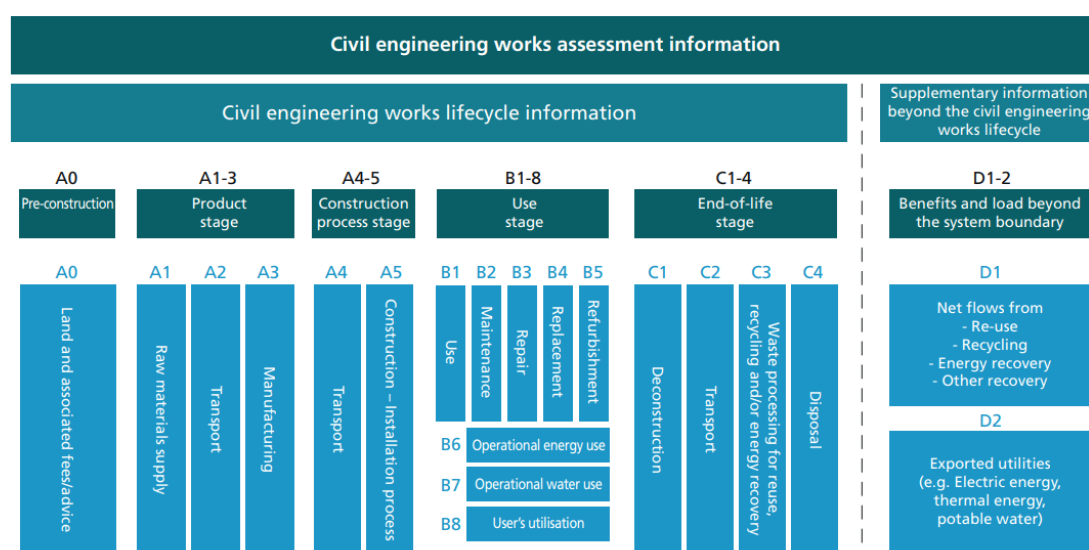


Figure 6.7 – UÉ Operational Carbon Emissions for 2022 (Location Based)

At present, there is no prescribed methodology within the UE standards and specifications to quantify embodied, operational and whole life carbon impacts associated with proposed interventions, although a Carbon Management Guidance document is currently in

development that will include guidance on carrying out Carbon Life Cycle Analysis within UÉ. Until this guidance is published, it is the Designer's responsibility to ensure that appropriate estimates of embodied, operational and whole life carbon impact estimates are provided for any proposed interventions using appropriate methodologies.

There are various methodologies and data sources available for carrying out whole life carbon assessment. Until the UÉ Carbon Management guidance document is published, it is recommended that Designers' follow the methodology and take emissions factors from sources listed in the latest version of the published [PAS2080 guidance document](#). It should be noted that this guidance document was produced for the UK construction environment, and Irish specific data sources (e.g. SEAI grid electricity emission factors) are likely to provide more appropriate emission factor estimates than some of the sources listed in table 4.13 of the PAS2080 guidance document.



Source: BS EN 17472:2022

Figure 6.8 – PAS2080 Whole Life Carbon Assessment Life Cycle Stages

6.1.4.6.7 Circular Economy and Waste Management

As set out in the overall UE Sustainability Framework, prioritising opportunities to maximise circular economy potential is a key design principle for project sustainability going forward. It is the Designer's responsibility to highlight any opportunities to realise advancement of circular economy within the UE asset base. The Sustainability Framework, and UE representatives from the Circular Economy COP should be consulted on specific details on a project-by-project

basis, but key principles specifically in relation to delivery on the UE Ww asset base are highlight below:

- **Materials Optimisation** – *e.g. selection of lower carbon impact materials where appropriate*
- **Design for Reuse and Recycling** – *e.g. prioritising incorporation of existing assets rather than construction of new assets where appropriate in any design*
- **Design for Flexibility and Adaptability** – *e.g. Allowing space in design for future installation of additional assets to account for future population growth or selecting units that are modular in design and can easily accommodate additional units in future if required*
- **Design for Longevity** – *e.g. prioritising selecting of harder wearing materials for pump impellers etc.*
- **Design for Disassembly and Deconstruction** – *e.g. prioritising materials of construction/design that is easily recyclable and reusable and end of asset life of is straightforward to dispose of i.e. non-hazardous waste.*
- **Design to Enhance Natural Systems** – *e.g. prioritising selection of NbS solutions (wetlands, reed beds etc.) where appropriate*

Figure 5.9 below details circular economy principles within the built environment and how they can influence an asset design and lifecycle and the opportunities to take a more resource efficient and circular approach.

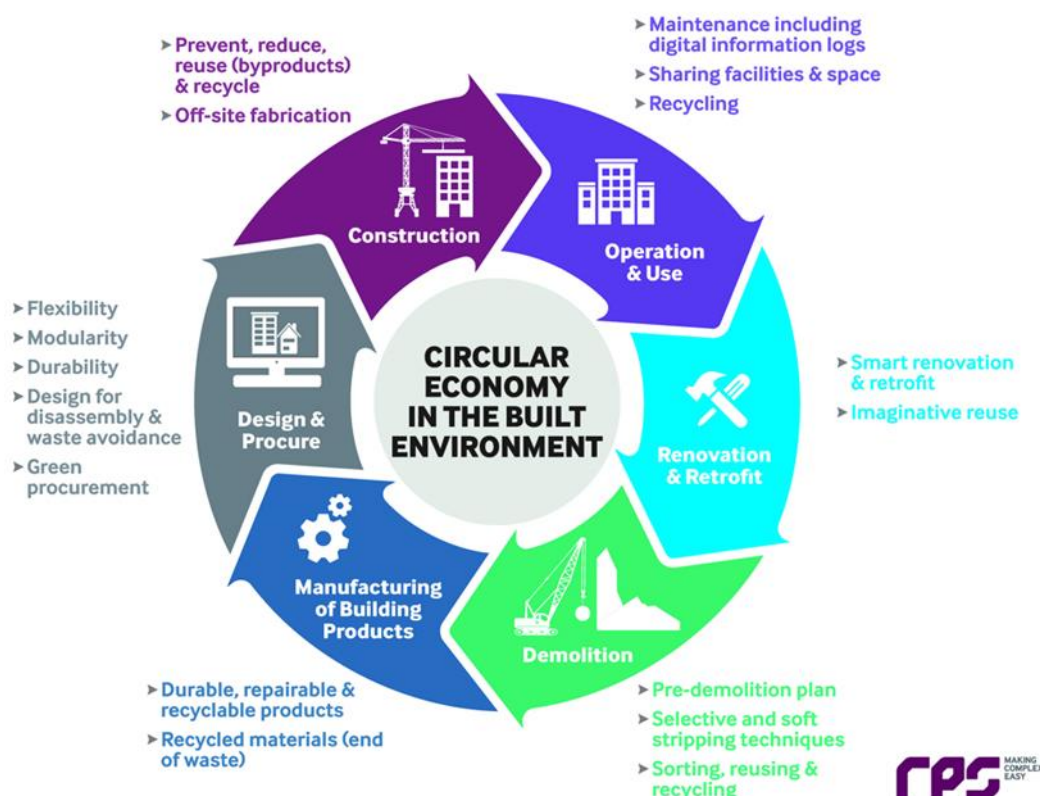


Figure 6.9 - Circular economy in the built environment.

It is the Designer's responsibility to ensure that any proposed intervention on the UÉ Ww asset base seeks to minimise waste production and maximise the use of circular economy principles. The UÉ Sustainability Framework includes an ambition to "ensure circular solutions are considered in all UÉ capital projects by 2026", and UE are in the process of developing a Circular Economy Design Standard with associated circular economy guidance. Table 6.1 below shows example challenge questions that can be used as initial guidance for identifying and maximising circular economy opportunities:

Project Design	Project Delivery
Have existing assets been assessed as part of an Asset Condition Survey or Pre-Redevelopment Assessment to determine their suitability for reuse or incorporation into new designs?	What is the total material consumption per m/km of infrastructure development? What is the waste associated with that?
Has the project design embedded circular economy principles at design stage? Has consideration been given to minimising quantities of new raw materials required?	Can materials and/or wastes generated be reused within this site/ other (local) UÉ sites? What percentage of materials and /or waste are being reused?
Has an assessment of material availability (soil, crushed concrete, recycled asphalt planings etc) arising from site clearance informed project design? Have mechanisms such as Article 27 or Article 28 been considered to facilitate any potential re-use?	Is all waste movement recorded on UÉ's Waste Management Tracker (IDD-FM-06)?
Has project design ensured that the material performance is maximised, and waste is minimised in particular avoiding having to send recoverable waste to landfill where possible?	Has unavoidable waste arisings been managed carefully to maximise its potential for off-site reuse or recycling and to avoid sending recoverable waste to landfill where possible?
Has asset durability, longevity, adaptability and flexibility during its lifecycle informed project design?	Have value engineering opportunities which support innovative design or material reuse been captured?
Has asset decommissioning and deconstruction at the end of its life been considered in project design to facilitate reuse or repurposing?	Have you set up return loops with packaging from suppliers?

Table 6.1 – Circular Economy and Waste Management Challenge Questions for Sustainable Project Design and Delivery

6.1.4.6.8 Project Design Principles

It is the Designer's responsibility to ensure that any proposed intervention on the UÉ asset base not only follows the UE guidance provided in the preceding sections (6.1.4.6.1 through 6.1.4.6.7) but adheres to these general design principles. Further guidance on a project-by-project basis should be sought from the relevant UE technical teams and representatives from the UE Sustainability CoPs. Although the PAS2080 methodology specifically considers whole

life carbon impact, the same principles can be applied to the other elements of the UÉ Sustainability Framework (e.g. designing for climate resilience, circular economy, biodiversity).

The figures below are taken from the latest published [PAS2080 guidance documentation](#) produced by the Institute of Civil Engineers. In essence, the key principles they describe are:

- The ability to reduce the whole life impact of any proposed intervention decreases dramatically throughout the project life cycle. The most impactful way to reduce any proposed interventions whole life impact is to ensure the whole life impact and opportunities to reduce this are understood as fully as possible, as early in the project life cycle as possible.
- There are three main approaches/methods to reducing the whole life impact of any given intervention. In decreasing order of impact, they are:
 - **Avoid** – can the need for the intervention be removed/de-scoped and therefore the impact be completely avoided (e.g. removing the need for a new pumping station by optimising hydraulic design)
 - **Switch** – can the proposed solution be substituted for a less impactful alternative (e.g. substituting a standard pump asset for an equivalent high efficiency model)
 - **Improve** – can the proposed solution be optimised as far as possible to ensure the whole life impact is minimised (e.g. optimising wet well design and pump start/stop level set points so that the proposed pumps operate within its most efficient pump curve range for the majority of the asset life)

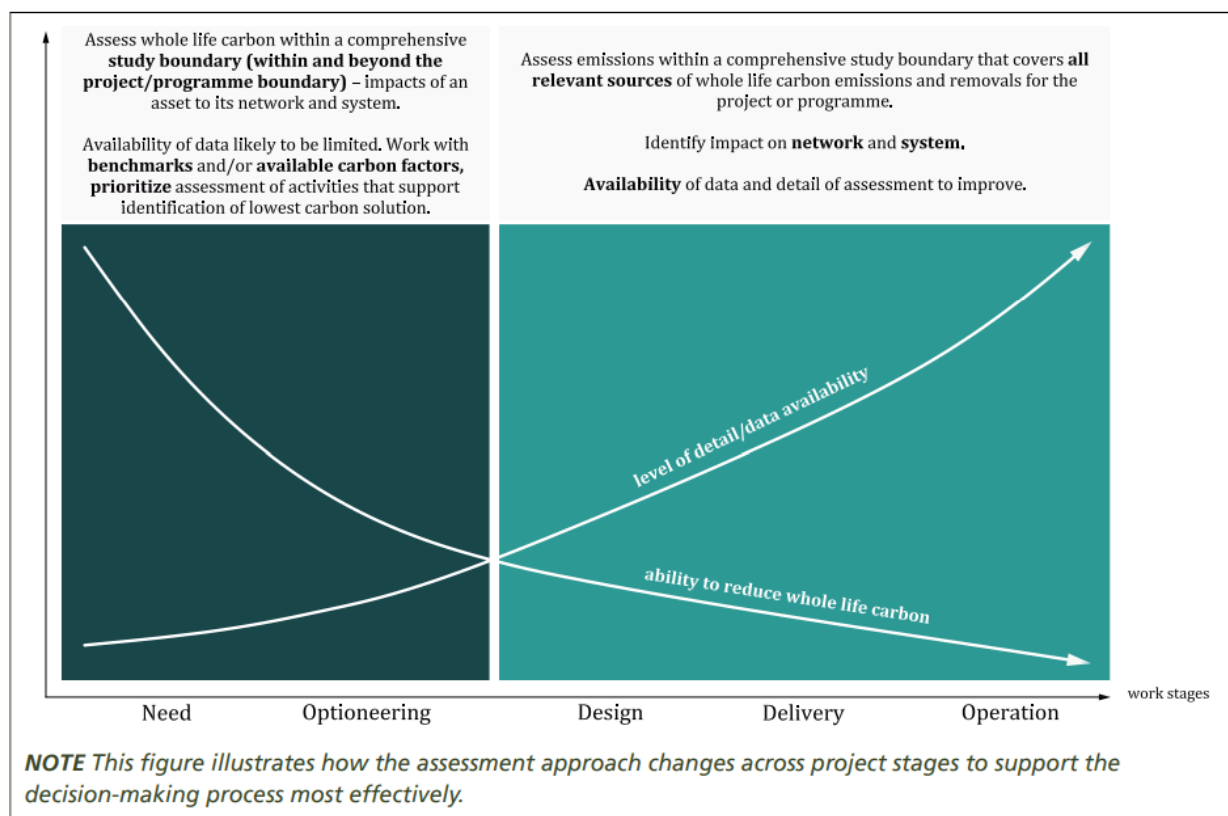


Figure 6.10 – PAS2080 Whole Life Carbon Influence throughout the Project Life Cycle.

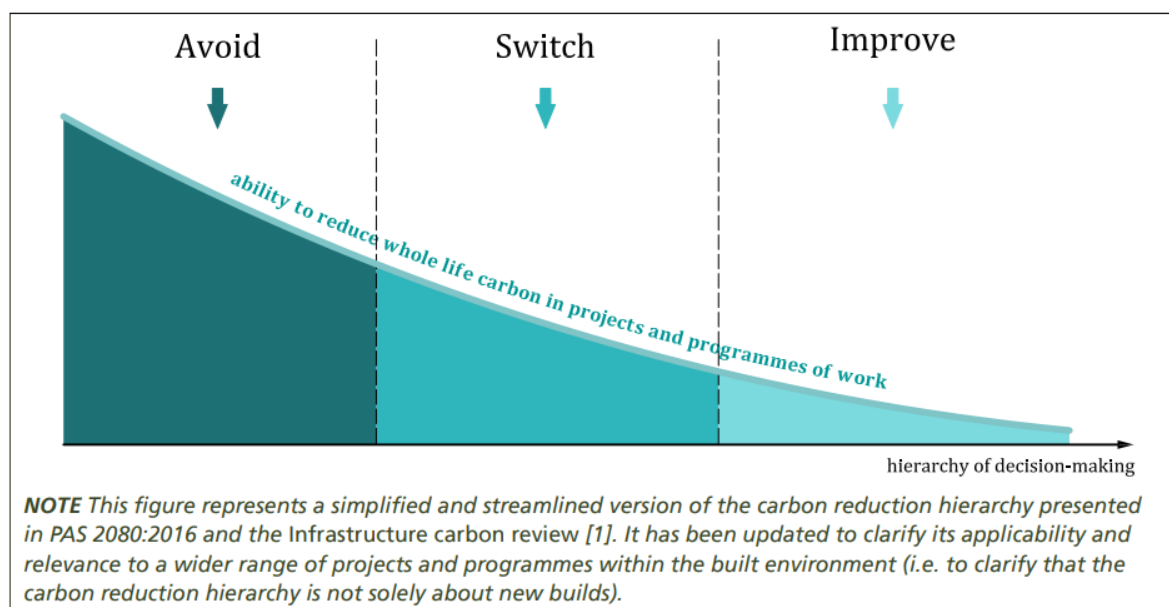


Figure 6.11 – PAS2080 Carbon Reduction Hierarchy

6.1.4.7 Innovation

Project Managers from both the Designer teams and internal UÉ teams shall be responsible for driving innovative engineering solutions and demonstrating the value created through design. Innovative solutions are actively encouraged for UÉ sites where it is appropriate and there is a relative level of confidence it will be successful. In particular, where an innovative approach has the potential to deliver significant benefits against the key design principles outlined in the previous sections, the Designer has a responsibility to bring any proposal to the attention of UÉ. Indeed in some cases of particularly stretching ELVs or permitting requirements that have not traditionally been in place (e.g. specific substances outlined in the UWWTD (recast)), innovative approaches/technology may provide the only viable options to meet the drivers when time/cost/carbon implications are taken into account.

Support from the UÉ innovation representatives (From AM&S or IDD, whichever is most appropriate) can be provided where requested, to help the Designers develop value case proposals, alongside any risk mitigations where innovative approaches and/or technologies are proposed.

All innovative proposals submitted shall be subject to the usual I₂O process and will ultimately be subject to the standard UÉ derogation approval process, but agreement to submit any innovative proposal for review shall be agreed with the UÉ project manager and technical team well in advance so the potential benefits of any proposal can be fully scrutinised. Any solution shall be considered innovative if it meets one or more of the follow criteria:

- The technology is not explicitly referenced in any UÉ standards or specifications (including this document)
- The technology has not been successfully implemented at an equivalent scale (within +/-25% PE) within the existing UÉ asset base
- The technology has not been successfully implemented within the existing UÉ asset base for the same purpose as is being proposed
- The technology being proposed has not been implemented within the existing UÉ asset base, meeting equivalent standards as is being proposed.

6.1.5 Design Criteria

6.1.5.1 Determining Emission Limit Values

WwTP performance in Uisce Éireann is governed by regulatory agreements between Uisce Éireann and the Irish Environmental Protection Agency (EPA). There are two types of agreements that cover the required performance of WwTPs:

- Certificate of Authorisation (CoA)
- Waste Water Discharge License (WWDL)

These agreements are subject to periodic reviews (typically every 5 years) at which point the requirements are subject to change. It is the Designer's responsibility to ensure any new project achieves compliance with all relevant Environmental Quality Standards (EQS) for the receiving waters. The main legislation for any Designer to be aware of as a minimum are:

- Waste Water Discharge (Authorisation) Regulations (As Amended) (S.I No.684/2007)
- European Union Environmental Objectives (Surface Water) (Amendment) Regulations 2019 (S.I No. 77/2019, hereafter Surface Waters Directive)
- The Urban Wastewater Treatment Directive (Directive 91/271/EEC)
- Bathing Water Directive (Directive 2006/7/EC)
- Shellfish Waters Directive (Directive 2006/7/EC)
- Freshwater Fish Directive (directive 2006/44/EC)
- Habitats Directive (92/43/EEC)

For further information on requirements for given water body discharges, the following internal Uisce Éireann documents should be consulted:

- Discharge to freshwater - AMT-GL-028 Uisce Éireann Interim Technical Guidance for Water Quality Impact Assessment (Freshwaters)
- Discharge to coastal waters - TEC-100-015 Technical Standards - Marine Modelling
- Discharges to ground – Standard not developed yet. Request requirements from Asset Planning

Currently, the EPA determines ELVs on licencing stage. Given the fact that EPA accept discharge licence application only when planning approval is granted, and the fact that on

average it takes 2+ years for the EPA to process the licence applications, the licence ELVs are usually only known when assets are already being build. Uisce Éireann proactively engages with EPA to change that approach and allow agreement of ELVs and much earlier stage. In meantime the requirements outlined below shall be adhered to.

The process for determining these ELVs are to be recorded in the Waste Assimilation Capacity (WAC) documentation templates, provided by Uisce Éireann Asset Planning. The main goal of these processes is to ensure that the receiving water bodies that WwTP effluent is discharged to does not result in an exceedance of the WAC of the water body.

As there is some degree of uncertainty over the exact emission limit values until a final decision has been reached by the EPA and communicated to Uisce Éireann, it is of critical important that confirmation of the ELV concentration design values are agreed with Uisce Éireann Asset Planning through the Drainage Asset Planning (DAP) process before required upgrades of any given WwTPs are assessed in full.

As a general guide, the example ranges of target design final effluent ELVs for the most common parameters that are to be expected at WwTPs in the Uisce Éireann region due to the different regulatory drivers are shown in Table 6.2 below. This table is provided as reference to the typical range of permits only, and all design ELVs must be determined using the methodologies and guidance from the reference documents described above.

Parameter	Urban Waste Water Treatment Directive (UWWTD)	Water Framework Directive (WFD)
BOD	Lower Tier Limit (LTL): 25mg/l Upper Tier Limit (UTL): 50mg/l or minimum 70% removal	LTL: 8-60mg/l UTL: 30-60mg/l
COD	LTL: 125mg/l UTL: 250mg/l or minimum 80% removal	
TSS		LTL: 20-60mg/l
Ammonia		LTL: 1-20mg/l UTL: 12-65mg/l
Total Nitrogen	Annual average: 10-30mg/l and specified total mass removal in kg/yr	
TP	Annual average: 1-2mg/l and specified total mass removal in kg/yr	Annual average: 0.25-6mg/l

Parameter	Urban Waste Water Treatment Directive (UWWTD)	Water Framework Directive (WFD)
Orthophosphate	Annual average: 1-2mg/l	Annual average: 0.25-6mg/l
Total Iron		LTL: 2-6mg/l UTL: 4-10mg/l
Total Aluminium		LTL: 2-6mg/l UTL: 4-10mg/l

Table 6.2 – Typical ELV Conditions for WwTPs

6.1.5.2 Certificate of Authorisation

Certification of Authorisation are typically in place at smaller WwTPs (design Population Equivalent (PE) less than 500), and they typically do not include specific final effluent concentration ELVs or required flow monitoring. It should be noted that all sites under this type of permit are required to provide primary treatment, and monthly final effluent sampling of the works discharge is required. In addition, the authorisation certification will typically stipulate the following as part of the regulatory requirements:

- Plant design PE
- Whether secondary (biological) treatment is required
- Whether UV treatment is required

For works under this type of agreement, the standard minimum performance targets are required:

Treatment type	Minimum performance requirements	
	BOD	TSS
Primary treatment only	20% removal	50% removal
Secondary (biological) treatment)	40mg/l final effluent	60mg/l final effluent

Table 6.3 – Minimum Performance Requirements for Certificate of Authorisation WwTPs

In addition to these minimum requirements, a WAC assessment will be carried out by Designer and confirmed with Uisce Éireann Asset Planning to determine the required final effluent ELV design targets based on maintaining the required status of the receiving water body. It is critical that confirmation on all final effluent concentration target conditions is received from Uisce Éireann Asset Planning when assessing the required upgrades for a given WwTP.

6.1.5.3 Design Horizons

For the design of a new or upgrade to a given WwTP, the required target year design horizon is 20 year for Mechanical and Electrical Assets, and 50 years for Civil assets, starting from the date of project completion, unless otherwise advised by Uisce Éireann. The date of project completion should be clearly defined at the beginning of the design process.

6.1.5.4 Design Agglomeration Loading

The design agglomeration assessment evaluates the current agglomeration loading based on the existing connected and unconnected wastewater sources. This includes domestic, commercial, institutional and industrial sources. Further definitions and guidance for determining these loads is provided within Sections 6.1.5.4.1 and 0. The purpose of the assessment is to benchmark the current loading to derive the future agglomeration loading and the resulting basis of design and aligning with the future projected wastewater characteristics, improving design accuracy and reliability from an early stage.

The current and future agglomeration loading derivation shall be undertaken in the following stages:

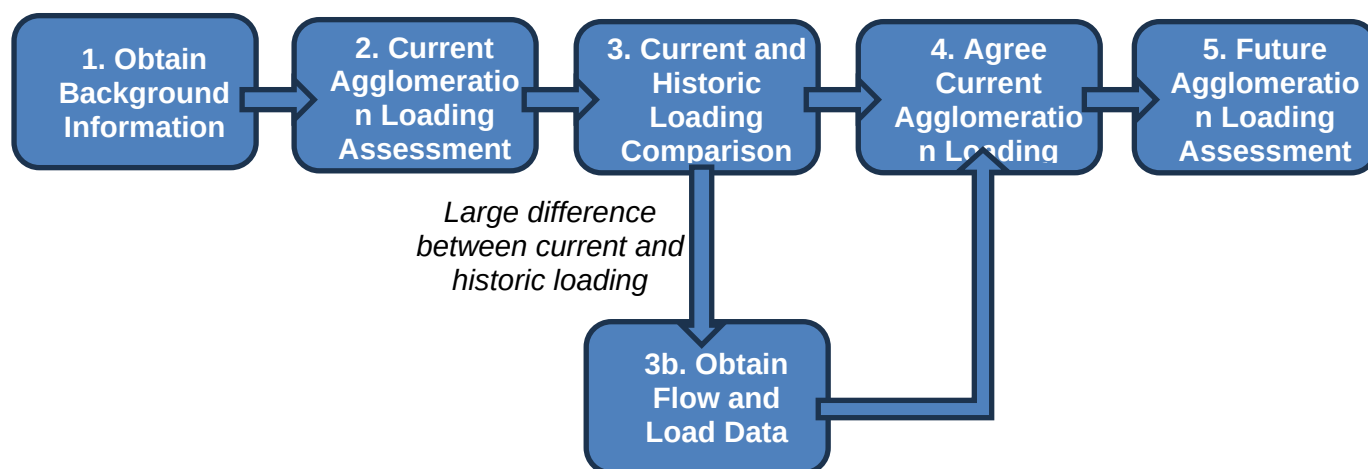


Figure 6.12 Design Agglomeration Loading Step Process

Further information and recommendations on how to complete the stages listed in Figure 6.12 above is provided in the following sections.

A UÉ Design Horizon Loadings Calculation Sheet shall be used for the purpose of loading calculation.

6.1.5.4.1 Background Information and Data sources

Stage 1 of the Design Agglomeration Loading step process recommends collection of all data and information pertaining to the project agglomeration. Collecting this data at the earliest stage will improve assessment accuracy and current loading understanding and characterisation.

The following recommended, but not limited to, data sources shall be used for the purpose of determining the current and future design agglomeration loading:

Description	Assessment	Data Holder/ Location
Current WwTP Connected Networks GIS Data	Current Agglomeration Loading	Uisce Éireann (UÉ) Asset Information <i>Note, the data shall be verified with local UÉ Operations to confirm validity of connections.</i>
Latest Agglomeration Census (Central Statistics Office) Data	Current Agglomeration Loading	Central Statistics Office (www.cso.ie)
Drainage Area Plan (DAP) or Integrated Catchment Model (if available)	Current Agglomeration Loading	Uisce Éireann (UÉ) Asset Planning
Commercial and Domestic/Residential Loading Information	Current Agglomeration Loading	GeoDirectory. To be obtained from Uisce Éireann Asset Intelligence
OS Mapping Data	Current Agglomeration Loading	Uisce Éireann (UÉ) Asset Intelligence
Educational Institute Search	Current Agglomeration Loading	TUSLA: Register of Early Years Services. To be obtained from www.tusla.ie . TUSLA: Creche Inspection Reports. To be obtained from www.tusla.ie . Government of Ireland: Find-a-School. To be obtained from gov.ie - Schools
Prison Location Search	Current Agglomeration Loading	www.irishprisons.ie
Existing Commercial/Industrial Licences <i>UÉ Section 16 or Integrated Pollution Prevention and Control (IPPC)/ Industrial Emissions Directive (IED)</i>	Current/Future Agglomeration Loading	Uisce Éireann (UÉ) Wastewater Source Control and Licencing Team
Projected Population Growth Rates	Future Agglomeration Loading	Uisce Éireann (UÉ) Forward Planning Specialists Team (FPS)
DPI (Developer Provided Infrastructure) data (if applicable)	Current/Future Agglomeration Loading	Uisce Éireann (UÉ) Asset Planning

Table 6.4 – Background information and data sources for determining design agglomeration loads

6.1.5.4.2 Determining Current Agglomeration Loading

Stage 2 of the Design Agglomeration Loading step process requires determination of the current agglomeration loading using a theoretical approach to determine the total Agglomeration Load which is based on the following constituent components:

- **Domestic** – Population permanently resident within the catchments, outside of the defined tourist season. Further details on determining Domestic loading are provided in Section 6.1.5.4.2.2.
- **Tourism** – Residential and day visitors, a proportion of whom will contribute to the commercial sector via hotels etc. Further details on determining Tourism loading are provided in Section 6.1.5.4.2.2.
- **Institutional** – Occupants of non-commercial premises who are not included in the above “Domestic” population. Institutional should be split into Education and Non-Educational facilities.
 - **Educational Institutional** loads are derived from occupants of all educational establishments (e.g. pre-schools, primary and secondary school and tertiary education facilities).
 - **Non-Educational Institutional** loads are derived from occupants of health care facilities (e.g. nursing homes and hospitals), public service facilities (including prisons and Government offices).
- **Commercial** – Loading from commercial premises whether measured or unmeasured, which have not been included under the ‘domestic’ heading. These may include a proportion of the tourism component plus flows from agricultural activities such as livestock markets within the urban area. Further details on determining Commercial loading is provided in Section 6.1.5.4.2.5.
- **Industrial** – All industrial waste loading whether measured or not that discharge directly into the public sewer. Further details on determining Industrial loading is provided in Section 6.1.5.4.2.6.

The following sections provide further detailed guidance on determining the specific loading sources within each catchment/agglomeration.

6.1.5.4.2.1 Agglomeration Boundary

The current agglomeration load assessment shall be based on the connected load.

Agglomeration boundary shall be based on the extent of collection network and may vary from administrative agglomeration boundary (i.e. collection network extending outside of administrative boundary serving nearby houses or even entire additional administrative agglomeration). An available Geographic Information System (GIS) data of the collection network shall be used to determine agglomeration boundary to be used for purposes of calculation of current and future agglomeration loadings.

Where the DAP and/or ICM is available for an agglomeration, it shall be analysed to identify any proposed modifications to the collection network that may affect agglomeration boundary. In some projects, the future growth horizon may account for requested or envisaged Developer Provided Water Services Infrastructure (DPI) load. This should be discussed with Asset Planning in advance of the Agglomeration Loading assessment.

6.1.5.4.2.2 Domestic Loads

Domestic Load accounts for the total permanent residential load within the catchment and does not include loads derived from tourism dwellings.

There are two approaches to determining the agglomeration domestic loading:

1. Using latest Agglomeration Boundary Census (CSO) Data which provides the total residential population of the catchment.
2. Residential Property – Population Assessment: By using the GeoDirectory the total number of residential properties can be determined. A national, county or local average long term occupancy rate (%) and the average dwelling occupancy rate can be applied to determine the total residential population as per the equation below:

$$\text{Total Domestic Population} = \text{Total Number of Properties} \times \text{Occupancy Status} \times \text{Occupancy Rate}$$

Equation 1 – Total Domestic Population For WwTP Load Estimation

Where latest CSO data or GeoDirectory information is unavailable. The Uisce Éireann (UÉ) Forward Planning Specialists Team (FPS) should be consulted for further direction.

The domestic load determined within this exercise shall be used as the baseline for all subsequent assessments. Further details on future agglomeration determination is provided in Section 6.1.5.4.3.

6.1.5.4.2.3 Leisure/Tourism loads

Leisure and tourism load accounts for day visitors and guests that will contribute wastewater loads to the wastewater network and/or WwTP. The leisure/tourism load can be derived using the following method:

- The GeoDirectory and GIS statistics data provided by the Department of Transport, Tourism & Sport shall be used to determine the following for the defined agglomeration boundary:
 - The total number of hotel beds
 - The total number of bed & breakfasts (B&Bs)
 - The total number of guest houses
 - The total number of Activity Holiday Units
- The total tourism population = Number of hotel beds + 2 x (Number of B&Bs + Number of Guest Houses + Number of Activity Holiday Units)

6.1.5.4.2.4 Institutional Loads

As previously discussed, Institutional Loads account for Educational and Non-Education sources. Educational Institutional loads are derived from occupants of all educational establishments (e.g. pre-schools, primary and secondary school and tertiary education facilities). Non-Educational Institutional loads are derived from occupants of health care facilities (e.g. nursing homes and hospitals), public service facilities (including prisons and Government offices).

Educational Institutional Loads

Educational institutional loads only consider additional load from the school/facility derived by pupils and staff members attending from outside of the agglomeration. This prevents doubling counting contributions from permanent residents within the agglomeration.

The Government websites reference in Section 6.1.5.4.1 shall be used to derive pupil and staff member numbers. On some occasions the schools do not show up on TUSLA or Gov website therefore web search is required to supplement same.

Thus, the census population data should be used to determine the population numbers per age within the agglomeration. This data is subsequently used to derive the number of pupils attending the school/facility from outside the agglomeration. The percentage of school population attendees from outside the agglomeration is determined and applied to the number of staff members to derive a total school/facility load. Where staff member data is unavailable,

an assumed student to staff ratio of 28.1:1 should be applied.

The school/facility load is converted into an Educational PE Load by applying a 20gBOD/PE/d load factor.

Note, where school attendance numbers are lower than the CSO data, it should not be assumed that permanent residents attend school outside of the catchment boundary i.e. educational school/facility loads should not be less than zero.

Non-Educational Institutional Loads

The following data sources and information is required to complete the current agglomeration loading:

- Hospital Loads: HSE Hospital Directory search to locate any hospital facilities within the agglomeration and derive the number of patient places
- Nursing Homes and Healthcare Facilities Loads: HIQA Inspection Report search to locate any nursing homes/healthcare facilities within the agglomeration and derive the number of patient places.
- Prison Loads: Irish Prison Service Annual Report search to locate any prison facilities within the agglomeration and derive the number of current prisoners.
- National Organisations Loads:

A factor of 1.1465 shall be applied to the total number of patient places with the hospital and nursing home and healthcare facility assessment whilst a factor of 1.41 shall be applied to the number of prisoner places.

6.1.5.4.2.5 Commercial loads

Commercial loads represent loads from shops, retail, restaurants, pubs etc. Typically, the discharge from these facilities closely resembles domestic waste characteristics. Two possible options can be considered for determining the Commercial load of the agglomeration:

1. GeoDirectory Search Approach:

- Business and Commercial listed premises from the GeoDirectory database provided by UÉ Asset Intelligence shall be taken as the total non-domestic/commercial wastewater delivery points.

- The Leakage Management Data team can provide the metered and non-metered consumption for agglomeration commercial delivery points.
- Commercial PE is then determined using the total metered and total unmetered flows (in m³/d) and applying the Dry Weather Flow (DWF) Per Capita Contribution (PCC) of 0.225 m³/PE/d.

2. Domestic/Residential % Loading:

- A commercial loading factor of 16% can be applied to the total calculated domestic/residential load (See Section 6.1.5.4.2.2).

The Option 2 Commercial loading factor was derived in the National Urban Wastewater Study (NUWWS) which established that commercial sector wastewater flow and load was generally equivalent to 16% of the total domestic/residential load. This relationship has been used extensively in the estimation of flow and load for design purposes and is widely accepted at a local and national level in Ireland.

6.1.5.4.2.6 Industrial Loads

Industrial Loads account for both total licences and unlicensed industrial discharges to the Uisce Éireann wastewater network.

Industrial facilities within the agglomeration with a contributing wastewater load shall be identified by examining existing commercial discharge licences (UÉ Section 16 or IPPC/IED) discharging to sewer, liaison with the local authority, liaison with UÉ Operations and/or web search.

For design purposes, the aggregate peak week industrial load for the agglomeration is to be determined. The following section defines the requirements for determining these loads from industrial sources within a given agglomeration:

- Existing commercial discharge licenses shall be reviewed and must be validated by the designer by consulting with the relevant local authorities and UÉ Operations.
 - For each confirmed licence, the maximum licenced BOD discharge (in kgBOD/d) is used to determine the PE loading using a BOD PCC of 60gBOD/PE/d.
 - For each confirmed licence, the maximum allowable daily effluent discharge (in m³/d) is also used to determine the PE loading using a flow PCC of 0.225 m³/PE/d.

- The maximum of the two loads is then used within the assessment. The final Industrial Load to be used within the assessment is taken as 50% of this maximum PE load.
- For non-licensed loads, the following estimate shall be used
 - Non-license industrial loads = Total Annual Averaged Meter Readings within an agglomeration less licenced industrial loads, less commercial loads, less institutional loads
 - Where this results in the estimate for non-licensed loads being less than 0, it can be assumed that the contribution from non-licensed sources is negligible (i.e. these loads are capture elsewhere, from domestic, institutional sources etc.)

6.1.5.4.2.7 Other

The following shall be taken into account when determining existing agglomeration loading

1. Waste/sludge imported from other UÉ WwTPs and WTPs
2. Waste/sludge imported from third parties (e.g. private septic tanks, etc.)
3. Leachate/supernatant from nearby UÉ facilities such as sludge hubs and satellite dewatering centres.

6.1.5.4.2.8 Use of Historic Data

Step 3 of the Design Agglomeration Loading step process requires analysis and assessment of historic measured data, where available, to confirm alignment with theoretical estimations to ensure accuracy and reliability of the current agglomeration loading assessment. Where available, a minimum of 3 years-worth of recorded daily flow measurements, and a minimum of 36 individual crude concentration sample results over the same time period should be used as the measured data. The data used must be as recent as possible, but at a minimum be from within 5 years of the initial design date. Results for the following determinants are required for the use of historic crude sample data in design:

All permit conditions	Ammonia permit conditions	Total Nitrogen permit conditions	Total Phosphorus or Ortho-Phosphate Permit conditions
BOD	BOD	BOD	BOD
TSS	TSS	TSS	TSS

pH	pH	pH	pH
	Ammonia	Ammonia	Total Phosphorus
	Alkalinity	Alkalinity	Ortho-Phosphate
		Total Nitrogen	Alkalinity

Table 6.5 – Minimum crude sample data collection requirements for different final effluent permit conditions

Where historic measured data indicates alignment with theoretical current loading assessment, the assessment Agglomeration Load PE can be agreed and used within subsequent assessments, Where historic measured data shows a significant deviation for any of the crude flow and load design parameters, this must be raised with the Uisce Éireann Asset Planning team through the DAP process.

6.1.5.4.2.9 Collection of New Data to Inform Design

Where the estimated current theoretical agglomeration loading cannot be reconciled with historic data, and only when instructed by Uisce Éireann, more in-depth data collection, including detailed flow and load surveys, may be required to determine specific design criteria and values on a site-by-site basis. This is particularly likely to be required where one or more of the following is known to occur within the agglomeration:

- Unusual variations in the catchment population profile (e.g. high tourist area)
- Non-statutory surface water connections
- Tidal and/or watercourse inflow
- Groundwater infiltration (which may be saline)
- High levels of industrial discharges
 - Commercial licenses are in place for a significant number of suppliers in the connected agglomeration
 - The GeoDirectory database lists a significant number of non-domestic properties in the connected agglomeration
- High levels of imported waste/sludge
- Prolonged periods of low flow leading to septic conditions in the network
- Unusual ambient temperatures (prolonged conditions where effluent temperature is less than 10°C)

Where any of the above criteria are identified as being a particular cause for concern for a given WwTP, it must be agreed with the Uisce Éireann Asset Planning team through the DAP process how this will inform/impact the design of any new assets. Additional capacity may be required to be factored into any new design, including potentially unconventional approaches (e.g. providing inlet balance tank, or additional assets that are only in use seasonally). The potential impact of any of the above must be considered carefully on a case-by-case basis with agreement with Uisce Éireann Asset Planning Team.

At works with significant seasonal variations, it may be necessary to determine tourist loading rates with tourist seasons defined. This will be agreed with the relevant Uisce Éireann Asset Planning team through the DAP process, but is likely to be the case if:

- There is measured data that confirms total crude loads fluctuate by more than +/-20% in given months
- The network that feeds the WwTP in question is known to have significant tourist influx from population data at certain times of the year
- There is density of tourist accommodation (hotels, hostels etc.) that exceeds 30% of the residential population
- There are known one off annual events. If this is the case, the designer should consider designing the works so that they it be operated in a different manner in each season.

6.1.5.4.3 Determining Future Agglomeration Loading

Step 5 of the Design Agglomeration Loading step process is the Future Agglomeration Loading assessment which is used in all subsequent project design deliverables. The assessment uses the agreed current agglomeration loading data, information and findings to derive the 10-year and 25-year design horizon loading.

The following sections outline the Future Agglomeration Loading considerations, assumptions and guidelines.

6.1.5.4.3.1 Future Growth

The future agglomeration population is determined by applying projected agglomeration population growth rates obtained from Uisce Éireann FPS Team.

Within the future agglomeration loading assessment, the future population growth rates are applied only to the following agglomeration loading constituents:

- Domestic/Residential Population Loading
- Commercial Loading
- Leisure/Tourism Loading
- Institutional (Education and Non-Educational) Loading

The future population growth rates are not applied to the determined current industrial loadings.

6.1.5.4.4 Headroom allowance

Within the future agglomeration loading assessment, a headroom allowance shall be applied. The headroom allowance is specific to the catchment area and/or size and shall apply to the design of new or upgrades WwTPs. These allowances must be applied on top of the estimated design horizon Population Equivalents for all sources defined in section 6.1.5.4.2, with the exception of industrial loads. The following headroom allowances and associated definitions are detailed below:

- Large Urban Settlements – 20%
- Regional gateways and hub towns – 15%
- Other Towns - 10%

A large urban settlement is defined as an agglomeration within one of the main cities in Ireland (Dublin, Cork, Limerick, Galway and Waterford)

Regional gateways are defined as agglomerations within one of the remaining gateways referenced in the Uisce Éireann National Spatial Strategy (Shannon, Dundalk, Sligo, Letterkenny and a linked Midland Gateway involving Athlone, Tullamor and Mullingar)

Hub Towns are defined as agglomerations within one of the Castlebar/Ballina, Cavan, Ennis, Kilkenny, Mallow, Monaghan, Tralee/Killarney, Tuam and Wexford regions, as defined in the Uisce Éireann National Spatial Strategy.

Where a proposed WwTP will combine more than one defined agglomeration, the highest headroom allowance associated with the individually defined agglomerations must be used

6.1.5.5 Design Hydraulic and Organic Load

To formulate the basis of design, the hydraulic and organic loads must be derived using the agree future design horizon agglomeration loading outputs as outlined in Section 6.1.5.4.3.

This section shall outline the approach to be used to determine and quantify design flows and nutrient loading.

6.1.5.5.1 Design Flows

6.1.5.5.1.1 Measured Data Analysis

Where raw influent flow data is available, a data analysis shall be completed and assessed. The data accuracy and reliability shall be assessed and recommendations on its use within the basis of design should be made. Where available, a minimum of 3 years-worth of recorded daily flow measurements should be used. The data must be as recent as possible, but as a minimum be from within 5 years of the initial design date.

The flow data shall be analysed to provide the following historic flow profiles for use within appropriate WwTP design elements. Guidance on the recommended analysis type is provided in Table 6.6.

Parameter	Analysis	Unit
Domestic Dry Weather Flow (DWF)	5%ile	m ³ /d
Average Daily Flow (ADF)	Average	m ³ /d
Flow to Full Treatment (FFT)	95%ile	m ³ /d

Table 6.6 Measured Data Flow Analysis Parameters

6.1.5.5.1.2 Theoretical Data Analysis

Where raw influent flow data is unavailable, a theoretical flow analysis shall be completed using the agreed agglomeration loading design population equivalents and UÉ standard flow Per Capita Contribution (PCC) factors. The design flow PCCs are provided in Table 6.7 below.

Parameter	Value	Unit
Domestic wastewater discharge / head /day (G)	175	L/PE/d
Infiltration (I)	50	L/PE/d
Industrial and commercial flow (E)	17.5	l/hd/d

Table 6.7 Design Flow Per Capita Contributions (PCCs)

The design factors and PCC values presented in Table 6.7 are for use within WwTP design only and should not be used for wastewater network system design. If the flows to WwTP are pumped that should be taken into consideration, e.g. design for pump rate, assume that future pumped flow will be 3DWF based on future population, etc.

In all instances, understanding of the wastewater network is crucial to determine design flows. Further details on assessing catchment specific Infiltration and Peak flows are provided in the following sections. The theoretical flow design equations and usage guidance is also outlined in Section 6.1.5.5.1.2.3.

6.1.5.5.1.2.1 Infiltration

Infiltration may be seasonal (variable baseflow), rainfall induced (slow response) or due to high tidal/river levels. For initial calculations (Stage 1 – Strategic Assessment) where flow data does not exist, an assumed infiltration rate of 50 L/PE/d may be assumed. However, this cannot be relied upon for specimen, preliminary and detailed design (Stage 2 PBC and Stage 3 FBC).

An engineering judgement is required based on individual catchment characteristics when determining infiltration, and methods used for their determination.

Where the flow monitoring data on the inlet to WwTP or at terminal PS is available, infiltration flowrates shall be assessed using night-time flows over an extended period, including winter, by deducting calculated theoretical DWF (excluding infiltration) from observed flows and considering rainfall events.

Where a verified network model exists, the rate of infiltration used in the model shall be used for current loading. For verified models, infiltration rates are normally estimated from the short-term flow and rainfall survey data and, where data exists, compared against inflow calculated from long term flow monitoring at the WWTP. Any proposed or expected network upgrades or changes should be established and taken into consider for future design infiltration flow determination.

Where a network model or permanent flow monitoring does not exist, a short-term flow and rainfall survey shall be undertaken based on hydraulic load of 225l/PE/d as min. (175 usage + 50 infiltration) to determine DWF and infiltration. The detailed requirements for short term flow and rainfall surveys are set out in TEC-800-08. The survey period shall be a minimum of 5-weeks and may need to be extended or repeated to ensure dry weather events are captured and any seasonal infiltration is identified. This survey shall be undertaken in winter months (i.e. Oct – Mar)

Where infiltration exceeds 450l/PE/day (based on current population) an agglomeration shall be identified for Infiltration Reduction Programme. Implication of same shall be discussed with UÉ and approach agreed (e.g. design inlet works for lower infiltration assuming that network

infiltration will be reduced in future).

6.1.5.5.1.2.2 Peak Flows to WWTP

Design shall prevent internal flooding from an event with a 1 in 30-year return period. Where a network model is available, the peak future flow for 1 in 30 years event to be used.

For WWTPs where no network model is available the following methodology shall be used for gravity sewer collection systems:

1. assume existing WWTP inlet gravity sewers serving significant sub-catchments* will be upsized by 2 pipe sizes at some stage in the future to accommodate growth and address any existing hydraulic constraints.
2. assume the network will be operating under pressure. Calculate static head using ground level at the nearest upstream manhole. Assume 1m static head if ground level at the nearest upstream manhole is not available.

* - e.g. where, apart from main sewer, there are smaller sewers coming to plant connecting smaller areas with no potential for growth (e.g. no areas zoned for future development), it should be assumed that these will not be upsized

If the flows to WwTPs are pumped the pumping regime and the site-specific details shall be taken into consideration by the designer, e.g. design for pump rate, assuming that future pumped flow will be 3DWF based on future population, decide whether rising main to be upsized, etc.

6.1.5.5.1.2.3 Flow Equations

Where the infiltration is used for calculating any flows refer to section 6.1.5.5.1.2.1.

Formula A equations - refer to TEC-800-03 Storm Water Overflows

Dry Weather Flow (DWF) - refer to TEC-800-03 Storm Water Overflows

Flow to Full Treatment (FFT) = $3PG + I + 3E$

where:

- P – total population
- G – domestic wastewater discharge / head /day (refer to Table 6.6)
- I – Infiltration (refer to section 6.1.5.5.1.2.1)
- E – industrial flow

6.1.5.5.2 Design Load

6.1.5.5.2.1 Measured Data Analysis

Where raw influent sample data is available, a data analysis shall be completed and assessed. The data accuracy and reliability shall be assessed and recommendations on its use within the basis of design should be made. Where available, a minimum of 3 years-worth of recorded daily flow measurements should be used. The data must be as recent as possible, but as a minimum be from within 5 years of the initial design date.

The sample data shall be analysed to determine the mean and 95%ile influent concentrations for the following parameters, where data is available:

- BOD
- TSS
- Total Ammonia
- Total Kjeldahl Nitrogen
- Total Phosphorus
- Orthophosphate
- Alkalinity

Average influent loads (in kg/d) shall be determined by multiplying the mean influent concentrations by the average daily flow (ADF) for the future design horizon. Average influent loads shall be used within appropriate WwTP design elements. Instructions on determination of the ADF are outlined in Section 0.

6.1.5.5.2.2 Theoretical Data Analysis

Where raw influent sample data is unavailable, a theoretical load analysis shall be completed using the agreed agglomeration loading design population equivalents and UÉ standard nutrient loading Per Capita Contribution (PCC) factors. The design nutrient loading PCCs are provided in Table 6.7 below.

Biological Oxygen Demand (BOD)	60	g/hd/d
Suspended Solids (TSS)	75	g/hd/d
Total Ammonia	8	g/hd/d
Total Kjeldahl Nitrogen	11	g/hd/d
Phosphorous	2.2	g/hd/d

Orthophosphate	1.5	g/hd/d
Alkalinity	50	g/hd/d

Table 6.8 Design Nutrient Loading Per Capita Contributions (PCCs)

The design factors and PCC values presented in Table 6.7 are for use within WwTP design only and should not be used for wastewater network system design.

6.1.6 Process Asset Selection

6.1.6.1 Long List of Options and Shortlisting

It is the Designer's responsibility to ensure that they refer to Invest to Outcome (I₂O) for the detailed requirements in relation to shortlisting Financial and Economical Assessment, etc. for any project, and that the requirements of the I₂O process are met in full. As a summary, any new Ww project and therefore the selection of new Ww process assets should follow the key I₂O stages:

- **Stage 1 – Strategic Assessment** – the standardised long list of options is considered and options are shortlisted to proceed to Stage 2. In accordance with I₂O a minimum of 2 no. options are required to be brought to Stage 2 in addition to counterfactual (do nothing) option. The basis of the decisions making throughout the I₂O process in terms of options carried forward is done using the “6 Dials” individual project metrics. These are; Outcome, Output, Cost Estimate, Schedule, Priority and Delta Opex. More detail on definitions and estimation of these metrics is available in the I₂O suite of standards and guidance documents available on UE standards and specifications web page.
- **Stage 2 – Preliminary Business Case** – the concept design for shortlisted options is developed and the preferred option is selected by comparing shortlisted options to each other and counterfactual.
- **At Stage 3 – Final Business Case** – a preliminary and detailed design, planning, L&W are being completed for preferred option are being completed.

As stated, as part of the Stage 1 process, the Designer shall produce a long list and short list of options for solutions for agreement with the core project team. The standardised long list of options for wastewater treatment is as follows:

1. **Do Nothing** (Counterfactual) – This is a theoretical option used for financial and economic assessment at Stage 2 (Preliminary Business Case). In this option the current arrangement (existing WwTP, existing untreated discharge, etc.) is left as it is (i.e. not upgraded) and is subject to same design horizon same population growth, etc. as all alternative options.
2. **Capital Maintenance** – The desired outcome can be achieved via capital maintenance (i.e. like for like replacement) and/or optimisation of an existing process e.g. available site capacity is constrained by one of duty RBC stream being out of service and available capacity can be restored by like-for-like replacement of broken RBC stream.
3. **Reuse Existing Discharge Location** – Upgrade existing or provide new WwTP to achieve the desired outcome without changing existing discharge location (i.e. discharge location should be considered in context of assimilative capacity – if the physical relocation of discharge point is required for some reason but design ELVs are same as in existing physical discharge location that this is not considered discharge relocation). The sub-options for this option can be selected using process shortlisting tool provided in section 6.1.6.2
4. **Relocate Discharge Location** - Effluent pump out to new discharge location where design ELVs are less stringent (i.e. discharge location should be considered in context of assimilative capacity – if the physical relocation of discharge point is required for some reason but design ELVs are same as in existing physical discharge location than this is not considered discharge relocation). It is key that the guidance and processes described in section 6.1.5.1 is used to confirm new design ELVs for any proposed change in outfall location.
5. **Pump-away to Another WWTP** – Influent pump out to other WwTP for treatment e.g. entire WwTP is being converted to WwPS and influent is pumped out to another WwTP for treatment. If the receiving WwTP does not have already sufficient capacity these option shall include the required upgrade.

In accordance with I₂O a minimum of 2 no. feasible options are required to be taken through concept design, with financial and economical (if required) assessment in addition to counterfactual.

6.1.6.2 Process Asset Selection Tool

Provided alongside this specification document in a separate excel file (TEC-700-015-FM-01) which provides guidance on process asset selection for WwTP design. The outcomes from this sheet can be used to generate options for potential solutions for any WwTPs works/project that meets the input design criteria as specified, and be used to inform the (I₂O) shortlisting process. Specifically, the tool can be used once the key input design criteria (requested in the tool) are known to guide the user towards acceptable plant configurations for the design WwTP to support the designer in developing different options for shortlisting within the “Reuse Existing Discharge Location” and “Relocated Discharge Location” from the standardised list. The flow charts which describe the logic of the decision sheet embedded in this section are also provided in the Appendix A (Section 9) of this functional specification. Although the sheet and flow chart does give recommended assets as a result of the inputs, the sheet can be used to develop numerous options that are acceptable to Uisce Éireann based on the input design criteria. This guidance does not look to replace or shortcut the wider optioneering process as part of the I₂O process, but instead provide high-level guidance as to the likely solutions for the input design criteria. Nor does this guidance look to stifle innovation on the part of the Designer. Where the Designer believes an alternative approach, not listed in the guidance, that meets the design criteria and delivers a more beneficial outcome (e.g. improved whole cost, lower whole life carbon etc.) it is the Designer’s responsibility to present this option to Uisce Éireann Project Manager as part of the I₂O process.

6.1.7 High Level Process Requirements

The following sections provide information below is for the core treatment processes and must be read in conjunction with the applicable Uisce Éireann process design specifications and standards referenced in the relevant sections. Designers must ensure that any guidance derived from this documents is used in conjunction with the wider suite of Uisce Éireann standards and design specifications, as only the asset specific information is summarised in these sections (e.g. for there are no requirements listed with regards to Data Standards, ICA Specification, Physical Site Security Specification, etc). For the sake of simplicity, only the key information is summarised in these sections.

When upgrading existing WwTPs or designing entirely new WwTPs, treatment processes shall be selected based on a systematic review assessing the following:

- The size (PE) of the agglomeration(s) being treated
- The required Final Effluent ELVs
- Evaluation of the useful life of the existing infrastructure
- Optimisation of the existing treatment processes to maximise both their hydraulic and organic capacity
- Evaluation of the limiting elements in existing infrastructure, both organic and hydraulic
- Any selected upgrade process must reflect the existing process and shall consider hydraulic split and additional organic load

The selection of the proposed treatment processes is carried out after the future design flow and loads have been determined and the treatment levels are defined (as discussed in section 6.1.5). The decision to replace rather than refurbish assets must be done following a Whole Life Cost (WLC) assessment.

All proposed solutions and design for assets at UE WwTPs are subject to commissioning and performance testing requirements in addition to the requirements set out in the following sections (section 6.1.7.1 to 6.1.7.12). The exact details of asset performance testing shall be agreed prior to the commencement of any performance testing with the UE project manage and design technical teams. This is discussed in further detail in section 6.2.1.2.

6.1.7.1 Inlet pipework

If any sections of the inlet gravity sewer are being re-laid, as part of the WwTP upgrade, in general, these shall be upsized by the 2 No. pipe diameters to cater for future network upgrade works, however, the designer shall take in account all site-specific aspect and confirm same.

6.1.7.2 Preliminary Treatment

Preliminary treatment (inlet screening and dedicated grit removal) is generally required on all WwTPs regardless of size and final effluent emission limit values. The only exceptions to this are where septic tank or Imhoff primary treatment is provided. For full guidance of where certain types of preliminary treatment are required, the decision tool from section 6.1.4.7 should be utilised, or flow chart from section 11.2 should be consulted.

Further information on the specific design requirements for preliminary treatment works is available in the design specification "Inlet Works and Stormwater Treatment (Wastewater)" (TEC-700-99-02).

6.1.7.3 Storm Treatment

Storm storage is generally only required on WwTPs where a flow to full treatment permit is in place but the works flow to works, or Formula A flow is higher than this. For treat all flow works/Formula A sites, storm tanks are not required. Storm tanks are commonly required on larger WwTPs (above 500 PE), and a required amount of storm volume may even be stated in the agreement covering the WwTP's WWDL or COA. The requirements for storm storage on any given WwTP must be confirmed with Uisce Éireann Asset Planning, as the requirement for storm storage must be confirmed on a site-specific basis, often with the support of network modelling. In some cases, storm storage may be installed on a given WwTP to reduce spills further up in the network, despite there being no specific requirement for storm storage capacity at the site under the WwTP permit conditions. Where storm storage is provided to support Ww network design, even if the physical location of these assets is at the receiving WwTP, the guidance contained within the Ww network storm guidance (TEC-800-04) must be consulted. For full guidance regarding storm storage provided as part of WwTP design the design specification "Inlet Works and Stormwater Treatment (Wastewater)" (TEC-700-99-02) must be consulted.

6.1.7.4 Primary Treatment

Primary treatment is generally required in most cases for WwTPs. Generally, the only exceptions to requiring primary treatment are:

- Sites where only direct biological treatment is required for compliance with a descriptive permit
- Sites designed for Enhanced Biological Phosphorus Removal (EBPR) where primary treatment is deliberately omitted to ensure sufficiently high content of readily biodegradable COD (rbCOD) content in the biological treatment feed

For full guidance of where certain types of primary treatment are required, and further information regarding asset design a requirements, the design specification "Primary Treatment Wastewater" (TEC-700-02) must be consulted.

6.1.7.5 Biological Treatment

6.1.7.5.1 Application

Typically, some form of biological treatment is required at most WwTPs and is always required where a final effluent BOD limit is in place. The main exception to this is very small WwTPs which are covered by a COA agreement and no biological treatment is specified. All biological treatment stages can be categorised into one of two categories, fixed film processes and suspended growth processes.

6.1.7.5.2 Trickling filters & Rotating Biological Contactors

Given the demographic of Uisce Éireann's WwTP asset base (i.e. a large number of smaller sites <2,000 PE) fixed film processes are much more common than suspended growth. For full guidance of where certain types of biological treatment are required, the decision tool from section 6.1.4.7 should be utilised, or the flow charts from section 9.4 and 9.5 should be consulted.

Further information is available in the design specifications "Rotating Biological Contactor Specification (Wastewater)" (TEC-700-99-07), "Rotating Biological Contactors Standard (Wastewater)" (TEC-700-99-05) and "Certificate of Authorisation Wastewater Treatment Plants" (TEC-700-99-04).

6.1.7.5.3 Activated Sludge Plant

There are relatively few ASP installations within UÉ, as the technology is most commonly employed on larger WwTPs. However, the technology is a very common across the wider industry as a form of secondary treatment. Currently, there is no published UÉ standard for ASP assets, although there is one in draft that is aimed to be published soon. Prior to this standard being published, the following information should be used to inform ASP design.

6.1.7.5.3.1 General Requirements

- Unless otherwise agreed with Uisce Éireann, all Activated Sludge Plant (ASP) design must assume a minimum temperature of 8°C
- Oxidation ditches may only be considered for sites <10,000 PE.
- Tapered aeration is not a required design feature for oxidation ditches
- Plug flow design is the preferred configuration for new ASP installations.

- All new Final Settlement Tanks (FSTs) must be circular
- Control systems must be capable of achieving $\pm 0.5\text{mg/l}$ of the targeted DO set point. This is with the exception of when the minimum air for mixing is exceeded
- For smaller works, where it is likely that the minimum air for mixing will be exceeded on a regular basis, the use of mechanical mixing and start/stop aeration control should be considered if it shows significant whole life cost benefit and doesn't compromise final effluent compliance.
- All new blowers must be high efficiency models

6.1.7.5.3.2 Design Requirements

- The secondary sludge design must achieve a Return Activated Sludge (RAS) flow rate of at least 2XDWF, which will be achievable even with one FST out of service.
- All aeration lanes must have a minimum depth of 6m unless otherwise agreed with Uisce Éireann
- For all nitrifying aeration lane installations, an assumed anoxic volume equal to at least 10% of the overall reactor volume must be provided. For sites greater than 40,000 PE, the exact size required must be confirmed via process modelling.
- A minimum length to width ratio of 10:1 must be allowed for in aeration lanes design.
- Design must allow for the ability to take one lane out without comprising final effluent compliance.
- The maximum capacity of any individual lane must not exceed 8,000m³.
- Default assumed design Mixed Liquor Suspended Solids (MLSS) for carbonaceous treatment should be 2,000mg/l
- Default assumed design MLSS for nitrifying treatment should be 3,000mg/l
- The following tables (Table 6.9 and Table 6.10) must be used for aeration lane reactor sizing:

	Minimum LTL ammonia permit limit (mg/l)	Design sludge age (d)	Maximum Food to Biomass ratio (F:M) (kgBOD/kgMLSS d)	Minimum HRT (h)
Primary effluent feed	1	16	0.070	5
	2	15	0.080	5
	3	14	0.090	4.5
	5	12	0.100	4
	7	12	0.110	4
	10	12	0.125	3.5
	n/a (carbonaceous treatment only)	6	0.300	2.5

Table 6.9 – ASP Key Sizing Design Criteria (Primary Effluent Feed)

	Minimum LTL ammonia permit limit (mg/l)	Maximum F:M (kgBOD/kgMLSS d)	Minimum HRT (h)
Crude sewage feed	1	0.050	5.0
	3	0.060	4.5
	5	0.070	4.0
	10	0.100	3.5
	n/a (carbonaceous treatment only)		2.5

Table 6.10 – ASP Key Design Sizing Criteria (Crude Sewage Feed)

- All aeration pipework must be designed assuming a maximum air velocity of 15m/s
- Standard Fine Bubble Diffused Aeration (FBDA) systems are the preferred method of aeration for new ASPs.

- Aeration blowers must be sized to supply the maximum air demand based on the WRc calculations (assuming FBDA configuration) for Standard Oxygen Requirement (SOR) and Actual Oxygen Requirement (AOR) and the following assumptions:
 - Peaking factor of 1.4
 - Minimum air for mixing = 30% of calculated AOR
 - Dissolved Oxygen (DO) residual of 1.0mg/l for carbonaceous treatment
 - DO residual of 2.0mg/l for nitrifying treatment
 - Maximum water temperature of 20°C
 - Alpha factor of 0.7 for nitrifying treatment
 - Alpha factor of 0.6 for carbonaceous treatment
 - Beta factor of 0.95 for all treatment
- Required FST surface area must be calculated using the WRc Mass Flux calculations, assuming a Specific Stirred Volume Index (SSVI_{3.5}) of 120ml/g
- Individual FST must have a maximum diameter of 35m
- Individual FSTs must have a maximum side wall depth of 2.5m
- FST sizing must allow for 20% of the surface area of an individual tank to be taken up by the diffuser drum
- A minimum floor slope of 7° must be assumed for tank floor design
- ASP RAS flows must have a flow range of 0.3 – 2.0 DWF. All RAS pumping stations must have at least on standby pump. The preference is for variable speed RAS pumps.
- Surplus Activated Sludge (SAS) pumps must be sized on the basis of calculated maximum SAS production using the following SAS yield assumptions:
 - Nitrifying treatment: SAS yield (kgSS/d) = 0.75 x kgBOD influent/d
 - Carbonaceous treatment: SAS yield (kgSS/d) = 1.0 x kgBOD influent /d
 - Assumed concentration (mg/l) = 2 x design MLSS

6.1.7.5.3.3 Specific Requirements

- All new aeration installations must be designed with a common air manifold (i.e. all blowers feeding into a common manifold)
- For systems that use surface aeration, a minimum of two speed aerators must be provided. Where feasible and whole life cost efficient. Variable speed aerators must be used

6.1.7.5.3.4 Operational Requirements

- Sludge blanket detectors must be provided for all new FSTs, located on the scraper bridge.
- Scum removal systems must be provided for all new FSTs. The preferred method is to achieve removal via the secondary sludge system, directly into the SAS stream.
- All new FSTs require scraper bridges, moving secondary sludge into a central hopper within a minimum of 2 hours sludge retention.
- The preferred method for secondary sludge removal from FSTs is via automatic bellmouth operation.
- The bellmouth must be capable of being raised to at least 100mm above the top water level within the individual tanks, to prevent unintentional discharge during tank maintenance when the tank has been isolated and drained.
- For oxidation ditches, continuous mixing to avoid MLSS settlement must be provided
- For oxidation ditches one DO probe per ditch will be provided
- A separate isolation valve must be provided downstream of each individual blower unit
- All blower installations must comply with relevant noise regulations
- Each blower must have individual power monitoring with data logged and visible on the local site SCADA
- The design of new FST capacity must allow for one unit out of service and still provide sufficient surface area.
- ASP surface aeration control must be achieved through start/stop/variable speed aerators linked to in-lane DO probes. Where variable speed aerators are in place, the run speed must be controlled via PID controller.
- ASP FBDA blower control must be achieved through common manifold header pressure control linked to blower run speeds via a PID controller.
- ASP FBDA aeration control must be managed by in lane zone control valves linked to in lane zone DO probes via a PID controller.
- RAS control must be either flow proportional (to measured FFT) or fixed flow
- SAS control must be achieved either on timer control, or continuous operation to achieve an operator input daily SAS volume.

6.1.7.5.3.5 Enhanced Biological Phosphorus Removal

- EBPR with no other additional phosphorous removal is only acceptable for total phosphorous limits of 1mg/l or higher
- EBPR with the addition of downstream Tertiary Solids Removal (TSR), but no coagulant dosing, is only acceptable for TP ELVs of 0.7mg/l or higher.
- EBPR with downstream TSR and post precipitation coagulant dosing can achieve TP ELVs of 0.25mg/l
- For any EBPR solution to be acceptable, a BOD:TP ratio in excess of 20:1 in the feed to EBPR stage must be achieved
- For any EBPR solution to be acceptable, a COD:TP ratio in excess of 45:1 in the feed to EBPR stage must be achieved
- Co-settling of EBPR SAS must not be accepted.
- It is recommended that sites with EBPR employ separate primary sludge and SAS thickening, rather than storing raw sludge with decant returns.
- The following types of conventional EBPR ASP configuration are deemed acceptable:
 - A₂O
 - UCT
 - Modified UCT (with aerobic/anoxic swing zone up-front of the aeration zone)
 - Johannesburg
- For any sites proposing EBPR installation, the minimum sampling requirements include 12 months' worth of composite samples and at least two diurnal profiles for the following parameters on all influent streams (i.e. crude and any internal site returns and sludge liquors)
 - BOD
 - COD
 - rbCOD
 - Volatile Fatty Acids (VFAs)
 - TSS
 - Ammonia
 - TN
 - TP
 - OP

- The anaerobic zone must have a retention time at maximum design flow of between 1-2 hours. The anaerobic volume must be equal to at least 10% of the total EBPR reactor volume
- Mechanical mixing is required within the anaerobic zone to avoid settlement of the MLSS
- There must be a free-flowing discharge from the anaerobic zone into the aerobic zone to prevent any backflow of aerated biomass into the anaerobic zone
- EBPRs should target RAS flows of 0.6:1. DWF.
- All other aspects of ASP design must be as conventional ASP.

6.1.7.5.4 Tertiary Biological Treatment

In some cases, tertiary biological treatment may be required at WwTPs, most commonly where strict final effluent ELVs are in place for ammonia or TN. The specific, detailed design requirements for the chosen technology must be confirmed with the relevant technology provider, based on design influent flow and loads and target effluent concentrations to be agreed with the Uisce Éireann Project Manager.

6.1.7.5.4.1 General Requirements

The following types of tertiary ammonia and TN removal processes are accepted within Uisce Éireann:

- Submerged Aerated Filters (SAFs)
- Biological Aerated Flooded Filters (BAFFs)
- Nitrifying Trickling Filters (NTFs)
- Nitrifying Sand Filters (nSAFs)
- Moving Membrane Biofilm Reactor (MBBR)

Where a tertiary biological stage is required for ammonia or TN removal, the following minimum requirements apply

- Influent TP concentration must be in excess of 1mg/l, regardless of final effluent ELV for TP or OP

- There must be sufficient alkalinity in the influent to achieve the target ammonia and TN removal, in line with the requirements set out in section 6.7 of this standard
- The design of the tertiary treatment stage must be sufficient so that all target final effluent ELVs are satisfied for the full range of design flows. Where tertiary treatment stage units are required to be out of service for extended periods for maintenance and/or periodic cleaning, this must be factored into the overall design of the tertiary treatment stage.
- Any generated backwash return streams must be returned up front of the primary settlement stage.
- Where there is a significant risk of sloughing from the tertiary biological treatment stage during seasonal periods, appropriately sized downstream TSR must be provided

6.1.7.6 Nature Based Solutions

6.1.7.6.1 Application

The implementation of Nature Based Solutions (NbS) is actively encouraged within Uisce Éireann. The Uisce Éireann asset base is well suited to this type of technology, as it is most typically employed on smaller sites (<500 PE). Nature Based technologies should be particularly considered for implementation where a site less than <500 PE has a new ammonia/TN driver greater than or equal to 10/15mg/l, and TP/OP driver greater than or equal to 3mg/l/4mg/l, or there is a requirement for additional storm capacity.

To support the active encouragement of pursuing nature-based solutions within Uisce Éireann, under certain conditions Nature Based Solutions are listed as the preferred solution under given conditions in the process selection tool from section 6.1.4.7, and this logic can be seen in the flow charts contained within sections 9.4, 9.5 and 9.6.

There is currently an integrated constructed wetland standard in draft form with UÉ. The information in the following sections is summarised from that draft standard and should be used to inform nature-based solution design until that standard is published. Once that standard has been published, that standard should be referred to for further information regarding nature-based solution design.

6.1.7.6.2 General Requirements

The following section describes the key general design requirements for different types of nature-based solutions at WwTPs within Uisce Éireann. Given the Uisce Éireann asset base

and ELV conditions, nature-based solutions are relatively common. The most common of these installations are Integrated Constructed Wetlands (CW). These types of asset are typically in place on smaller WwTPs (<500PE) with relatively relaxed final effluent limits.

- Where CW is proposed as part of the solution preliminary treatment is required.
- Where CW is proposed as part of the solution, primary treatment is required. Where possible, and cost effective, this should take the form of sludge ponds.
- CW treatment will not be an acceptable solution where any of the following conditions are met or apply:
 - The target WwTP is within the inner protection zone of a public groundwater supply and the vulnerability rating is classed as extreme
 - The target WwTP is within 300m up-gradient of a public supply, supplying more than 10m³/d (50 persons) where an inner protection zone has not been identified

Sites within 60m up-gradient of any well or spring used for potable supply

- Sites where the possibility of collapse/soil subsidence cannot be ruled out(e.g. where swallow holes are observed near the surface)
- Where a site has a high-water table, a CW must not be constructed within or below the existing water table
- For soil only lined CWs, the top groundwater level must be at least 1m below the bottom of the wetland
- For geo-membrane lined CWs, the top groundwater level must be at least 0.5m between the base of the liner.
- The overall land required for CW treatment construction and ancillary requirements will assume 30-35% uplift to the estimated surface area required for the CW.
- Where sludge ponds are proposed for the primary treatment stage, this uplift will increase further to 60% of the estimated surface area required for CW treatment
- Proposed CWs should be located outside of flood zones and outside of riparian corridors
- Propose CWs are required to achieve a biodiversity net gain, and therefore, should avoid the removal of existing valuable habitat (e.g. woodland, Category A&B mature trees and vegetation).

- A No net loss assessment is required for any proposed CW installation, and should be carried out in accordance with “Biodiversity Guidance for Uisce Éireann Developments (AMS-AMT-GL-021)
- Proposed sludge ponds should maintain a minimum distance of 50m from any sensitive off-site odour receptors
- Propose secondary and tertiary ponds should maintain a minimum distance of 25m from any sensitive off-site odour receptors.
- CWs should be planted with native wetland species known to establish and grow well in the region targeted. Recommended plant species can be found in Appendix D of the soon to be published “Integrated Constructed Wetland” design guidance.
- All planting should be carried out manually to avoid plant and ground damage
- Planting should be carried out in the spring or early summer
- Planting should be carried out immediately after the completion of each individual treatment cell

6.1.7.6.3 Design Requirements

- Primary sludge ponds must be sized to provide a minimum of 18 hours HRT at maximum design flow
- The following are considered the achievable limits for ELV conditions where ICW treatment, and no additional downstream asset, is in place:
 - LTL TSS: 15-20mg/l
 - LTL BOD: 15-20mg/l
 - Annual average TP: 0.7-1.0mg/l
 - Soluble reactive phosphorus: 1.0mg/l
 - Annual average TN: 10-15mg/l
 - LTL ammonia: 3-5mg/l
- CW sizing is a progressive process through the following steps:
 - Rule of thumb design
 - Mass loading rate
 - P-k-C* model
- The Table 6.11 summarises the rule of thumb design loading assumptions:

Effluent Target (s)	Sizing rate (m ² /Pe (hd))	
	Combined network crude	Separate (foul only) network supply
Standard UWWTD targets (BOD = 25:50mg/l)	20	15
LTL BOD: 10-15mg/l LTL ammonia: <=10mg/l	30	25
LTL BOD: <= 5mg/l LTL ammonia: <=5mg/l	35	30

Table 6.11 – General Sizing Guidance for ICWs

- The Table 6.12 summarises the assumed values for mass loading rate ICW sizing:

Type of CW	Parameter	Influent loading rate (kg/ha/d)	Target 75th%ile effluent concentration (mg/l)
Secondary	TSS	117	20
	BOD	70	28
	TKN	2	8
	TP	17	4
Tertiary	TSS	38	10
	BOD	10	10
	TKN	3	2
	TP	1	3

Table 6.12 – P-k-C* Sizing Guidance for ICWs

- For details on the P-k-C* design method, see section 5.1.3 of XXX-TEC-XXX asset standard
- A soil or geo-membrane barrier liner is required to prevent contamination of groundwater.
- Proposed CWs with soil liners should be underlain by at least 1.0m of moderate or low permeable sub-soil. The upper 0.5m should have a permeability of less than $1 \times 10^{-8} \text{ms}^{-1}$.¹ Where a regionally important aquifer is present the total thickness should be at least 1.0m with the upper 0.75m having a permeability of less than $1 \times 10^{-8} \text{ms}^{-1}$

- Where a geo-membrane liner is used due to insufficient sub-soil depth, at least 150mm of subsoil is required with an upper 50mm layer of fine sand. Liners should be overlain by sub-soil with a minimum thickness of 200mm with low to moderate permeability for vegetation planting.

6.1.7.6.4 Specific Requirements

- Where CW is proposed, the following surveys and assessments must be completed as part of the detailed assessment phase:
 - Topographical survey: encompassing all natural and built features and detailed grid of spot levels across the sites.
 - Ecological assessment: including surveys of all trees, hedgerows, vegetation, access tracks, drainage routes and compound areas, addressing all requirements of “Biodiversity Guidance for Uisce Eireann Developments” (UE-IMT-GL-021)
 - Flood risk assessment: As a minimum, a stage 1 flood risk assessment/screening is required. Where a target WwTP has been identified as a particularly high flood risk, Flood Risk Assessments should be completed in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009), the County Development Plan and accompanying Strategic Flood Risk Assessment and/or Local Area Plans where relevant.
 - Geotechnical surveys: all require assessments to establish the highest groundwater level, the soil permeability and ground conditions within the proposed construction area should be undertaken.
- Target sites should have no greater than a 6% topographical incline

6.1.7.6.5 Operational Requirements

- The optimum CW and sludge pond design to avoid short-circuiting is to achieve a length: width ratio of 2.2:1 or less. Where this is unachievable due to site constraints, open water channels can be incorporated through the CW cell.
- Open water channels should be provided at the inlet and outlet of each CW cell. These channels should take up approximately 25% of the total CW and should be between 0.7 – 1.0m deep

- Mustow marshes should comprise approximately 75-80% of the total ICW coverage area.
- The water level within CWs should be allowed to fluctuate between 0.1-0.3m to facilitate hydraulic flow throughout the CW
- CWs typically should be sized to accommodate formula A flows
The start-up/acclimation phase typically last for a minimum of 12 months to ensure full biological adjustment

6.1.7.7 Tertiary Solids Removal

6.1.7.7.1 Application

Typically, TSR is required on WwTPs where either a low final effluent TSS, BOD or TP limit is in place. It may also be recommended where a fixed film secondary or tertiary biological treatment process is installed that is particularly prone to sloughing is in place. For full guidance of where certain types of TSR treatment are required, the decision tool from section 6.1.4.7 should be utilised, or the flow chart from section 9.7 should be consulted.

The following technologies are accepted form of TSR. Any other TSR technologies are considered innovative, and will require separate approval by the Uisce Éireann Design Standards Team:

- Pile Cloth Media Filters (PCMFs)
- Continuously Operated Upflow Filers (COUFs)
- Disc Filters
- Rapid Gravity Filters (RGFs) /Deep Bed Sand Filters

All solids loading rates quoted in the following sections are assumed to be inclusive of chemically generated solids where coagulant dosing is employed directly upfront of the TSR stage.

6.1.7.7.2 General Requirements

- All flows to TSR stages must be screened to at least 6mm in 2 directions.
- All dirty backwash returns must be returned up-stream of the primary settlement stage.

- Where backwash return is not continuous, dirty backwash buffer volume must be provided, sized to store at least x2 individual filter unit backwashes. This buffer storage can take the form of a separate buffer tank or be incorporated into proposed return pump wet well volume.
- All TSR stages must be installed with a bypass arrangement. The use of the bypass must be restricted to contingency use only, and must raise an associated alarm
- Where multiple filter units are installed, an equal influent flow and load split between filters must be achieved, including when an individual filter is out of service.
- At least one standby feed pump must be provided

6.1.7.7.3 Design Requirements

- Where coagulant dosing is employed directly up front of the tertiary removal stage (post precipitation) a flocculation tank must be provided, sized to provide a minimum of 10 minutes retention at average design flows, and 5 minutes retention time at maximum flows.
- Where actual backwash requirements are unknown, at least 10% of average design flow must be allowed for to account for backwash returns from the TSR stage.
- For the following ELV limit conditions, at least one standby filter unit must be provided:
 - LTL: BOD <10mg/l
 - LTL: TSS < 20mg/l
 - Annual average: TP/OP <0.5mg/l
 - LTL: iron/aluminium <3mg/l
- Feed flows to TSR stage must be managed to minimise filter start/stops. An absolute maximum of 12 filter start/stops an hour must be allowed.
- No more than one individual units must be allowed to backwash at any given time (with the exception of continuously washed filters)
- The exact specification and grade of filter media for the technology type selected must be confirmed with the technology supplier based on design influent flow and load rates and target effluent requirements agreed between the Designer and Uisce Éireann design team.

6.1.7.7.4 Specific and Operational Requirements

The following section details specific and operational requirements, based on the TSR

technology selected in addition to the requirements stated in sections 6.1.7.7.1 to 6.1.7.7.3.

6.1.7.7.4.1 COUFs

- Minimum bed depth of 2m
- An additional 10% uplift must be applied to the design maximum flow to allow for backwash returns from the COUF units
- The following solids loading rates should be used for target final effluent LTLTSS concentrations
 - 0-10mg/l: 0.3kgSS/m²/hr
 - 10-15mg/l: 0.4kgSS/m²/hr
 - 15-20mg/l: 0.5kgSS/m²/hr
 - 20-25mg/l: 0.8kgSS/m²/hr
- Design should assume media loss rate of 1% per year
- A minimum of a one standby feed pump must be provided
- A minimum of one standby air compressor must be provided
- All compressors must be fitted with pressure relief valves
- Compressor pipework must be fitted with condensate pots
- Individual filters must be fitted with pressure headloss monitoring.

6.1.7.7.4.2 Rapid Gravity Filters (Deep Sand Bed)

- A minimum media depth of 2m must be achieved
- Filters installations with no direct upfront coagulant dosing must be sized based on the following hydraulic loading rates:
 - Maximum loading rate: 10m/hr
 - Average loading rate: 8m/hr
 - Maximum loading rate with one unit out of service
- Filters installations with direct upfront coagulant dosing must be sized based on the following hydraulic loading rates:
 - Maximum loading rate: 10m/hr
 - Average loading rate: 8m/hr
 - Maximum loading rate with one unit out of service
- Filter backwashes must be triggered if any of the following conditions are met:

- Filter run duration between backwashes exceeds set point
 - Measured filter head loss exceeds set point
- Filter backwash cycle must consist of both air and wash cycles
- Filter backwash flow rates must be maintained at a fixed speed for the duration of the wash, and must achieve a minimum upward flow velocity of at least 15m/hr
- At least on standby air compressor must be provided
- Media loss of 1% per year must be assumed for design/maintenance purposes

6.1.7.7.4.3 Disc Filters

- Coagulant dosing directly upstream of disc filters must not be accepted
- Disc filters must primarily be sized based on the hydraulic loading rates from Table 6.13 being achieved at maximum design flow to the filters (inclusive of all backwash returns):

Minimum achievable LTL TSS effluent concentration (mg/l)	Maximum allowable hydraulic loading rate (m/h)
20	9.2
25	8.5
30	7.9
35	7.2
40	6.6
45	6.1

Table 6.13 – Disc Filter Design Hydraulic Loading Rates

- The design must allow for at least one filter to be out of service at any given time
- Facilities must be provided to facilitate the regular chemical cleaning of all individual filters. Typically chemical cleaning of filters is required at 6-12 months intervals. Exact requirements must be confirmed with the manufacturer.

6.1.7.7.4.4 Pile Cloth Media Filters

- For small sites (up to 5,000 PE) a single unit may be provided to treat the maximum design flow and loads
- For larger sites (Greater than 5,000 PE) at least two units must be provided

- Where the target LTL BOD or TSS final effluent concentration is 10mg/l or less, or the TP target is 0.5mg/l or less, at least on standby unit must be provided
- All influent flows to PCMF must have been screened to at least 6mm in 2 directions
- Initial design must account for a minimum of 10% of average design flows to allow for PCMF backwash return flows. Actual required backwash flows must be confirmed with the chosen manufacturer during detailed design
- The following design assumptions must be used for sizing filters with standard fibre cloth media:
 - Hydraulic loading rate – 10m/hr
 - TSS loading rate – 300g/m²/hr
- The following design assumptions must be used for sizing filters with micro fibre cloth media:
 - Hydraulic loading rate – 8m/hr
 - TSS loading rate – 400g/m²/hr
- Target LTL TSS effluent concentrations for PCMFS are assumed as follows:
 - Standard fibre treating settled fixed film media effluent: 20mg/l
 - Standard fibre treating settled suspended growth effluent: 10mg/l
 - Standard fibre treating settled fixed film media effluent: 10mg/l
 - Standard fibre treating settled suspended growth effluent: 5mg/l
- For very low final effluent ELVs, a series configuration of standard fibre cloth followed by microfibre cloth may be required. For this type of configuration, the first (standard) filter stage loading rate may be reduced to 300g/m²/hr, and the second (micro) filter stage may be solids loading rate may be reduced to 120g/m²/hr.
- Where a chemical coagulant is dosed immediately upfront of the PCMF stage, a flocculation tank must be provided. This tank must have a residence time of at least 10 minutes at average design flow, and 5 minutes at maximum design flow (inclusive of all backwash returns).
- Design must allow for at least one standby PCMF feed pump
- A dirty backwash buffer tank must be provided to manage instantaneous backwash return flows. The buffer tank must have capacity to store at least 2 individual filter backwashes, and 4 individual filter de-sludges.
- The following conditions must trigger an individual filter to backwash:
 - Filter run duration between backwashes exceeds set point

- Measured filter head loss exceeds set point

6.1.7.8 Chemical Dosing for Phosphorus Removal

6.1.7.8.1 Application

Typically, coagulant chemical dosing is only required where a WwTP has a TP or OP permit and there is no dedicated biological phosphorus removal in place. Within the Uisce Éireann region, it is far more common for OP permits to be in place at WwTPs rather than TP limits. In addition, strict metal ELVs are not as prevalent as they are within other regions (e.g. the UK). For full guidance of where certain types of chemical dosing for targeted phosphorus removal are required, the decision tool from section 6.1.4.7 should be utilised, or the flow chart from section 9.6 should be consulted. For further information regarding asset design and operation, the design specifications “Chemical Phosphorus Removal Asset Standard” (TEC-700-05) and “Chemical Phosphorus Removal Specification” (TEC-700-06) must be consulted.

6.1.7.9 Alkalinity Correction

6.1.7.9.1 Application

Alkalinity on WwTPs is measured in mgCaCO₃/l and typically alkalinity correction is only required in the case of high metal coagulant dose rates to achieve a low TP or ortho phosphate permit, or in the case of high levels of nitrification to achieve a low ammonia or TN permit. Alkalinity correction chemicals are high cost, and high carbon, and their use should be designed out where possible. The use of alkalinity correction must be confirmed on a case-by-case basis using the guidance from section 6.1.7.9.3 below.

6.1.7.9.2 General Requirements

The following section describes the key general design requirements where alkalinity correction is required.

- The following chemicals are accepted methods of providing alkalinity correction on WwTPs:
 - Sodium Bicarbonate
 - Liquid lime (Kalic)
 - Bulk Lime powder (made up to liquid on site)

- Sodium hydroxide (caustic)
 - Sodium Aluminate
 - Magnesium hydroxide
- The most commonly accepted chemical for alkalinity correction is caustic. The bulk supply of caustic typically comes in either 25%w/w or 45%w/w concentration. A whole life cost analysis must be carried out on a site-by-site basis to determine the appropriate chemical selection.
- Where 45%w/w bulk caustic is selected, bulk tank heating and dosing line trace heating must be required to prevent chemical freezing
- Liquid lime (Kalic) must only be used as a last resort where site specific conditions indicate the use of other acceptable chemicals will result in significantly higher whole life cost, or poor performance. Where liquid lime is selected, special consideration must be given to the design of the bulk tank(s) and dosing systems to avoid blockages within the tank and dosing pipework.

6.1.7.9.3 Design Requirements

- A minimum alkalinity residual of 50mg/l must be achieved in the final effluent under all flow and load conditions at any given WwTP
- The following alkalinity consumption rates must be applied to estimate alkalinity demand requirements:
 - 7.14kgCaCO₃ consumed per kg ammonia removed
 - 2.5 kgCaCO₃ consumed per kg ferric sulphate dosed (Fe³⁺)
 - 2.9 kgCaCO₃ consumed per kg ferric chloride dosed (Fe³⁺)
 - 3.3 kgCaCO₃ consumed per kg Poly Aluminium Chloride dosed (Al³⁺)
 - 3.57kgCaCO₃ produced per kg of nitrate reduced in anoxic zone
- Allowance for alkalinity generation will only be accepted where a permanent and dedicated anoxic zone is included as part of the design. Where this is the case, a maximum of 50% removal of nitrate in the denitrification zone must be assumed.
- Where the ELV limit is 5mg/l or less, full nitrification will be assumed for the alkalinity demand estimate (i.e. 100% ammonia removal)
- Where the ELV limit is 0.5mg/l or less, full TP removal must be assumed for the alkalinity demand estimate (i.e. 100% TP removal)
- Bulk storage tanks must provide a minimum of 14 days chemical retention time

6.1.7.9.4 Operational Requirements

- All bulk storage tanks must have appropriate bunded areas and health and safety facilities (e.g. chemical safety showers and eye baths) in line with Uisce Éireann standard TEC-600-06-01
- Duty/standby dosing rigs must be provided.
- All chemical storage tanks (including bulk and day tanks) must be provided with level indicators and associated monitoring with accompanying alarms indicating high and low levels.
- Control of chemical dose must be linked to real time ferric dose rates and influent ammonia concentration readings to estimate the required alkalinity correction required in real time.
- A final effluent pH instrument must be provided where alkalinity correction is provided. If the final effluent pH exceeds 8.5, the alkalinity correction chemical dose must be stopped automatically.
- Alkalinity correction chemical dosing control via pH readings alone is not an acceptable method of dose control.
- Chemical day tank overflows should not be connected to any recycled system of pipework unless solely back to that chemical tank of bund

6.1.7.10 Sludge Storage, Handling and Treatment

6.1.7.10.1 Application

Sludge storage of some form is typically required on all WwTPs regardless of size or final effluent emission value limits. The only exception to this, is where only septic tank treatment is provided, but in some ways this in itself can be considered a sludge storage solution. Where it is deemed cost effective, thickening and or dewatering technologies may be employed to minimise the transportation requirements of the exported sludge. The proposal for any sludge thickening and dewatering assets must be discussed with the relevant Uisce Éireann Design Standards Team, and a whole life costing exercise to prove its suitability on a site-by-site basis must be conducted. It is likely that sludge processing assets in addition to raw sludge storage will only be cost effective on larger WwTPs. The details and design criteria for any proposal requiring new sludge digestion must be confirmed with the relevant Uisce Éireann Design

Standards Team. There is currently a sludge management and processing standard in draft form within UÉ. The information in the following sections is summarised from that draft standard and should be used to inform sludge management and processing design until that standard is published. Once that standard has been published, that standard should be referred to for further information regarding sludge management and processing solution design.

The following sections describes the key requirements for raw sludge storage and processing at WwTPs. These sections do not cover sludge digestion assets.

6.1.7.10.2 General Requirements

- One duty raw sludge storage tank is acceptable
- New sludge storage tanks should be constructed completely above ground level.
- For sites larger than 10,000 PE, sludge thickening prior to dewatering for cake export must be provided (alongside required interstage and final export storage)
- For sites between 1,000 to 10,000 PE, sludge thickening for thickened liquid sludge export must be provided (alongside required interstage and final export storage)
- For sites less than 1,000 PE, raw sludge storage with no dedicated thickening and dewatering processing is accepted.
- For all other instances, the following figures shall be used for sludge management design guidance:

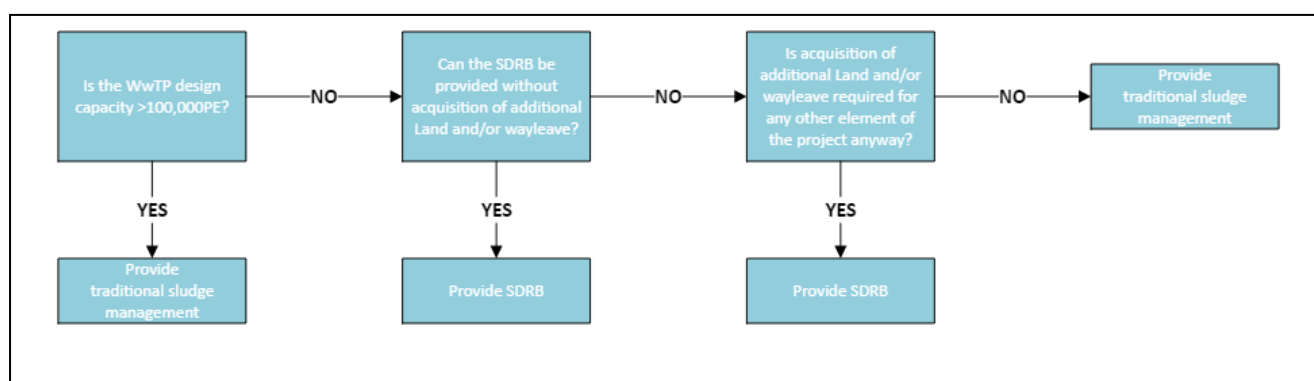


Figure 6.13 – Sludge Management Provision Decision Flow Chart

6.1.7.10.3 Design Requirements

- Any new assets installed as part of a new project at a given WwTP must pass the performance tests as listed in Table 6.15. See section 6.2.1.2 for further details.
- A minimum raw sludge production rate of 70g/PE/d must be used for design
- Raw sludge dry solids concentration of 3%DS must be assumed for sizing raw sludge storage volumes
- For sites producing less than 250tDS/yrs, the minimum required retention time in the raw sludge storage tanks is 10days
- For sites producing in excess of 250tDS/yr, the minimum required retention time in the raw sludge storage is 7 days
- The raw sludge storage volume must be at least equal to the minimum tanker volume that can access the site (usually either 10m³, or 27m³).
- Raws sludge export tanks ancillaries and pipework, should be capable of handling sludge up to 6%DS
- Where whole life costing indicates that on site raw sludge thickening for export will prove beneficial, one of the following technologies may be used:
 - Gravity Belt Thickening
 - Belt Press thickening
 - Picket Fence thickeners
- Sludge dewatering must be achieved through sludge decant bowl centrifuge technology
- Guidance from the specific equipment and polymer manufactures must be sought to provide design detail confirmation of the following assumed design values for both thickening and dewatered processing:
 - Assumed solids capture: 95%
 - Assumed polymer dose rate: 5kg active poly/tDS feed
 - Washwater requirements: equal to liquid sludge feed
 - A minimum of 1 standby processing unit is required
 - Duty/standby polymer dosing is required
 - All units require an upfront buffer tank with a minimum of 1 day retention time

6.1.7.10.4 Specific Requirements

- A minimum benched floor slope of 5° must be provided.
- Decant pipework must be limited to a maximum of 1000mm NB to prevent line blockages.

6.1.7.10.5 Operational Requirements

- All new sludge storage tanks must be equipped with decant facilities with a minimum of 3 different levels of decant valving.
- Automatic decant valving must be provided unless whole life costing indicates that this will not provide overall benefit.
- All tanks must be equipped with ultrasonic level monitoring and level switches linked to raw sludge storage feed
- Tank mixing must be provided on all new raw sludge storage tanks. The preference is for recirculation pump mixing, although coarse bubble air mixing will also be accepted.
- Tank mixing must be capable of achieve full suspension of the full tank volume at a 6%DS
- Standby mixing arrangements are not required
- Where whole life costing indicates on site raw sludge dewatering for export will prove beneficial, this Disinfection

6.1.7.11 UV disinfection

6.1.7.11.1 Application

UV disinfection is not usually required on a typical WwTP. This technology is only required where it is specifically required by the WwTP discharge agreement as a result of maintaining or improving water quality within the WwTP receiving waters. The requirement for UV technology must be determined on a case-by-case and must be confirmed with the relevant Uisce Éireann Design Standards Team and Project Manager before project commencement. The requirement and for and design of UV disinfection treatment is very specific and must always be determined on an individual project basis with the regulator and the technology manufacturer.

There is currently a Ww UV disinfection standard in draft form within UÉ. The information in

the following sections is summarised from that draft standard and should be used to inform Ww UV disinfection design until that standard is published. Once that standard has been published, that standard should be referred to for further information regarding Ww UV disinfection solution design.

6.1.7.11.2 General Requirements

The following section describes the general requirements where disinfection is required at a given WwTP. The only accepted form of disinfection treatment within Uisce Éireann is via Ultraviolet radiation. The following are just general requirements, and it is critical that specifics of all UV design are discussed with the Uisce Éireann Design Standards Team, and the selected UV manufacturer before being finalised and implemented.

- Only UV irradiation systems that have undergone performance validation based on the United States Environmental Protection Agency's Ultraviolet Disinfection Guidance Manual (UVDGM) (US EPA,2006) must be considered.
- All influent flows to the UV stage must have been screened to at least 6mm in 2 directions and have received grit removal treatment. Where there is a known risk of RAG and/or grit carry over at the target site, dedicated screening upfront of the UV stage should be considered.
- Inlet design to the UV installation must ensure that turbulent flows leading to entrained air is avoided.
- Iron based coagulant dosing upfront of a UV system will not be accepted without express approval from Uisce Éireann.
- Where lime dosing upstream of a UV system is in place, additional allowance must be made for more frequent lamp cleaning due to the additional fouling.
- All installations must achieve a minimum of a 20-year design life
- A holistic approach must be taken to ensure UV systems achieve the required levels of disinfection at efficient power consumption rates. Whole life costing for UV installations must balance the full implications of site refurbishment and/or new asset installation to improve influent UVT and reduce on-going UV power consumption.

6.1.7.11.3 Design Requirements

- The typical target organism concentrations for UV effluent are shown in Table 6.14:

Criticality of discharge to receiving water compliance	Licence condition (95%ile)		Post disinfection target	
	<i>E. coli</i> cfu/100ml	Intestinal enterococci cfu/100ml	<i>E. coli</i> cfu/100ml	Intestinal enterococci cfu/100ml
Low	> 1,000	> 400	90% of license condition	
Medium	< 1,000	< 400	80% of license condition	
High	< 500	<200	50% of license condition	

Table 6.14 – Typical Design Requirements for UV Disinfection Treatment (N.B for example, for a limit of *E. coli* 20,000 cfu/100ml would require a design target of 18,000 cfu/100ml)

- Target UV dose must be determined for site specific conditions via collimated beam testing
- Collimated beam testing must be carried out on samples of wastewater covering the expected design range of flows, Ultraviolet Transmissivity (UVT) and the concentration of parameters detailed in the sampling recommendations below
- A minimum of 10 Collimated beam test, producing 10 dose-response curves for each target organism, must be conducted
- The determined target UV dose, the sensitivity for each indicator organism, and the results of any sampling carried out in line with the recommendations below, must be used in conjunction with manufacturer validation reports to size proposed UV systems to achieve the disinfection requirements agreed with Uisce Éireann Design Standards team and Project Manager.
- UVT data collection is highly recommended to inform UV design. This can either be:
 - via continuous online data monitoring over the course of a year
 - Weekly samples spot samples over the course of a year
 - 4 sets of week-long intensive hourly diurnal spot samples over the course of a year, with one week collected during each season over the course of the year.
- Where UVT data is not collected, the Designer may make an assumption for design purposes. The basis of this assumption must be agreed with Uisce Éireann Design Standards team and Project Manager, and is at the Designer's risk.
- Sampling for the following parameters is also recommended to inform UV design. Either a minimum of 50 weekly spot samples collected over a calendar year or four

separate 2 or 3 day periods of intensive sampling (with one set in each of the four meteorological seasons), where a minimum of 6 spot samples are taken per day can be carried out.

- TSS
 - Iron
 - Magnesium
 - Manganese
 - Alkalinity
 - Water hardness
 - Salinity
 - Calcium
- UV systems must be designed to provided sufficient treatment at maximum design flows and minimum measured UVT
- The target UV dose must be delivered for a minimum of 99% of data points, on a rolling annual basis, based on continuous monitoring of 15-minute data as a combination of either:
 - Delivery a validated dose at or in excess of the target
 - Providing a non-validated “pass”
- For every new UV installation provided, an accompanying design report must be completed. As a minimum this must include:
 - details of the most important design parameters: UV reactor inlet conditions (indicator organisms, UVT, sanitary determinants), how they vary in relation to each other and how the design flowrate and UVT were established.
 - agreed effluent targets for indicator organisms and Log Reduction Value (LRV) required to achieve performance requirements.
 - identification and selection of the design UV dose for each target indicator organism.
 - identification and selection of the sensitivity of the target organisms and virus surrogate to be used in the validation equations to establish the reactor design.
 - lamp and sleeve aging and fouling factors used to size the UV irradiation system.

- an evaluation demonstrating that the selected reactor design will meet the targets through outcome of detailed design assessment against the supplier's validation report.
- an evaluation of redundancy (response to lamp / ballast / critical instrument failure) of the options considered.
- summary of the assessment of the selection of the final design / configuration including comparison of risk to compliance .
- outcome / results of completion testing of the installed UV irradiation system.

6.1.7.11.4 Operational Requirements

- A minimum of at least one standby bank must be provided
- Low pressure lamps are preferred due to lower operation costs, but a whole life cost assessment must be undertaken to confirm the most economical choice that still achieves the required target disinfection rates
- Total power consumption from the UV system must be recorded and displayed on the site SCADA
- UV banks in channels must be covered with GRP covering or equivalent to minimise potential lamp damage.
- It must be possible to isolate and remove individual banks of UV lamps to facilitate maintenance without the need to turn off more than the individual bank for removal.
- An automatic cleaning system must be provided for the lamps and critical UVT instrumentation
- All installations must include appropriately sized lifting davits and lay down areas to facilitate lamp maintenance
- Accurate water level within the lamp channel is required via downstream penstock/weir control
- Where multiple installations are provided, the flow split between installations must be accurately controlled to ensure that flows are equal to the lamp intensity installed.
- All UV installations require the following instantaneous online monitoring points as a minimum:
 - Instantaneous flow (l/s) measured by MCERT equivalent calibrated flowmeter(s) (+/-8%)
 - Calculated instantaneous UV dose (mJ/cm²)

- Number of operational lamp banks
- UVT
- UV intensity measured per bank
- Calculated retention time in the UV reactor
- Level in the UV channel(s)
- Number of operational banks
- Instantaneous percentage power consumption for each bank
- Lamp hours run
- Number of starts per nak
- Power drawn by UV system
- In addition to data being logged and by the on-site SCADA a separate data logger must be provided for the UV system with a capacity of holding 6 months' worth of the required data
- Easily accessible sample points are required immediately pre and post UV disinfection
- UV systems must be programmed to auto-reset once power has been restored following a power interruption, as long as the control deems it safe to do so. Manual resets should only be required in exceptional circumstances, where repeated automatic power resets fail.

6.1.7.12 Odour Control

6.1.7.12.1 Application

Odour Control is not normally required on a typical WwTP. This technology is only required where it has been determined, usually by odour dispersion modelling and accompanying impact assessment that the ongoing operation or installation of new assets will cause unacceptable off-site odour impact. The requirement for any odour abatement technologies and approaches must be determined on a case-by-case and must be confirmed with the relevant Uisce Éireann Design Standards Team before project commencement. The requirement and for and design of odour abatement technology is very specific and must almost always be determined on an individual project basis with the technical odour Subject Matter Experts (SMEs) and the technology manufacturer.

6.1.7.12.2 General Requirements

The following section describes the key general design requirements for odour abatement at

Uisce Éireann WwTPs. Further detail on the specific and operational requirements for required odour abatement technology must be discussed with the relevant technology providers.

- All reasonable measures in any WwTP asset design must be taken to minimise potential for odorous release where possible
- All new assets provide must conduct an odour risk assessment with potential attention paid to the following types of asset:
 - Primary settlement tanks
 - Raw sludge storage tanks
 - Raw sludge thickening/dewatering assets
- Where 1 or more of the above types of new assets are proposed within 25m of the nearest sensitive off-site odour receptor, a full odour dispersion model must be undertaken
- Where 2 or more of the above types of new assets are proposed within 50m of the nearest sensitive off-site odour receptor, a full odour dispersion model must be undertaken.
- Where dispersion modelling results indicate additional odour abatement is required, guidance must be sought from the relevant Uisce Éireann Design Standards Team and odour control technology manufacturer to determine detailed design requirements of any assets provided

6.2 Commissioning Operation and Maintenance

6.2.1 Commissioning

All new asset provided as part of WwTP refurbishment and/or upgrade are required to produce a commission plan in line with the template provide by Uisce Éireann in TEC-600-05-FM-02 in line with the requirement of TEC-600-05.

6.2.1.1 Asset Integration

All new assets installed on Uisce Éireann WwTPs must be subject to required asset integration, performance testing and final handover before project acceptance. Particular care needs to be taken where new assets introduce new chemical dosing streams, new biological processes or significant increases in internally returned flows. Where any of these types of processes are being introduced to a given WwTP as part of a site upgrade, an adjustment

period of a minimum of 8 weeks is required, during which new assets are brought online and gradually ramped up to full design flow and loads. All commissioning/asset integration plans must be submitted to the relevant Uisce Éireann Project Manager and Site Operations Management Team for approval. Any plans that are deemed to pose a significant risk to existing treatment compliance with final effluent or flow permit conditions will not be accepted. All plans must also be consistent with manufacturer recommendations.

Following successful completion of required performance testing, a handover period to Uisce Éireann site operatives must be carried out. This period will consist of a minimum of 2 weeks and must include:

- Delivery of all new asset/equipment O&Ms and as-built documentation
- Delivery of onsite training for select Uisce Éireann operatives covering all new asset operation and maintenance tasks that are required at a frequency of 2 months or less.
- Where required for operation and maintenance of new assets, the Designer will provide external training to upskill select Uisce Éireann operatives
- Template checklists for all routine operations and maintenance task required as per the O&Ms for all new assets. As a minimum these must include:
 - Task frequencies (up to a maximum of 12 monthly intervals)
 - Expected task durations (hrs)
 - Notes on required consumables, including estimated costs
 - Details on required equipment to carry out task (e.g. lifting equipment)
 - Expected number of operatives required to successfully and safely carry out tasks

6.2.1.2 Performance Testing

The following section details the minimum recommended process performance testing requirements for new assets installed on Uisce Éireann WwTPs. This is done with reference to an example Process Flow Diagram (PFD), Figure 6.14, showing the different configurations and sample locations depending on the different asset stages that are installed on site. Figure 6.14 and tables Table 6.15 to Table 6.20 are to be used as a guide to inform draft project performance testing requirements, with full performance testing schedule to be agreed with the Uisce Éireann Project Manager and Site Operations Management Team following final design acceptance. For the guidance provide in Table 6.15 to Table 6.20:

- Testing detailed in Core Tests (CT) 1-3 are required for all types of projects, regardless of scope
- The requirement to carry out tests Optional Tests (OTs) 1-16 must be agreed/confirmed with the Uisce Éireann Project Manager and Site Operations Management Team. Tests are only required where the project design has introduced new, or significantly changed the process operation of an existing asset (e.g. by increasing treated flow, or introducing new chemical dosing immediately up-stream)
- The details of the testing are colour coded as follows
 - Required in all cases
 - Required where final effluent ammonia limit is in place
 - Required where final effluent ammonia or TN limits is in place
 - Required where final effluent TP or OP limit is in place
 - Required where UV system for disinfection is installed
 - Required where any of the above final effluent limits are in place (ammonia, TN, TP or OP)

In addition to the performance testing outlined in this section, any asset specific performance requirements contained within the relevant asset standard from the wider Uisce Éireann Standard Asset library must be achieved before performance testing is considered to be completed.

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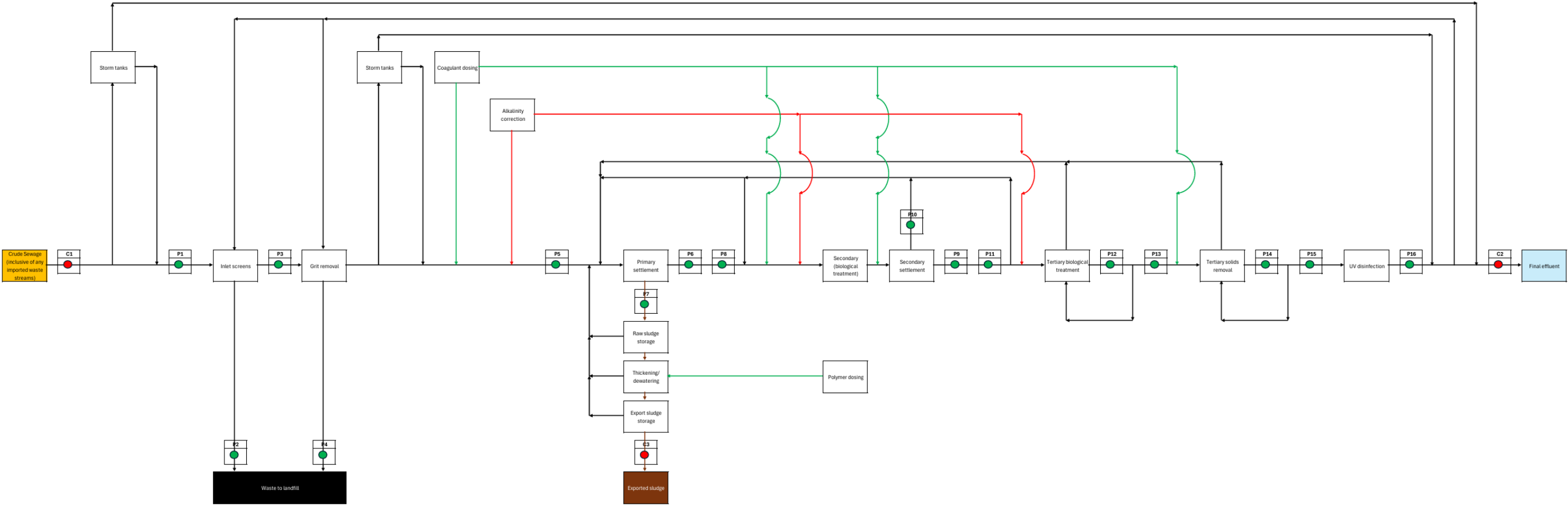


Figure 6.14 – Example PFD Showing Theoretical Process Performance Testing Locations

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Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
CT1	Crude Sewage (inclusive of any imported waste streams or non-internal returns streams)	Must be located upstream of all internal sites returns and any imported. Same location point may be used for CT1 and OT1, OT5 or OT8 if this is appropriate	<i>Instantaneous flow</i> <i>Daily average flow</i> BOD COD TSS Ammonia pH Alkalinity	All proposed final effluent emission value limits and % removals as per relevant site permit document or design brief agreed with Uisce Éireann Project Manager and Site Operations Management Team has been achieved	Flow data must be recorded via suitably calibrated flowmeter (where required, MCERT certified flow meter must be used). A minimum of max, minimum and daily average flow data recorded in m3/d must be collected for a period of at least 28 consecutive days. Where already installed or required by new permit conditions, on site composite sampler must be used to collect determinands data. A daily composite sample must be collected and analysis for the required determinands for a minimum of 14 consecutive days. All values must be reported in mg/l unless specified.
CT2	Final effluent	Must be located downstream of all internal site recycle take offs with the exception of preliminary Washwater take off. Same location point may be used for CT2 and OT6, OT9, OT12, OT14 or OT16 if it is agreed with Uisce Éireann Project Manager and Site Operations Management Team that this is appropriate	TP OP Total Iron Total Aluminium TN Nitrate E.coli Intestinal enterococci Targeted viruses and pathogens		To be collected as required based on ELV conditions in line with permit conditions requirements (i.e. where permit compliance is based on composite samples, composite samples must be collected, where permit compliance is based on spot samples, spot samples must be collected). Samples must be collected and analysed for the required parameters for a minimum of 14 consecutive days, to coincide with the same dates the corresponding C1 samples are collected. All values must be reported in mg/l unless specified.

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Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
CT3	Exported sludge	Sample location must be located in export tanker discharge line or taken directly from cake wagon	Average export flow (m ³ /d) %DS	Minimum of 3%DS achieved for all results	Exported flow may be recorded either by flowmeter on discharge line, or by recorded export tanker volumes. %DS must be recorded either by calibrated in line solids instrument, via on-site lab testing or off-site lab sample testing. At least 5 different spot samples from different export tanker/wagons must be collected over a period of 14 calendar days.

Table 6.15 – Core Process Performance Testing Requirements

Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT1	Inlet Screen influent	Must be located up-front of inlet screen units ,upstream of any internal site returns (e.g. Washwater returns)	Instantaneous flow (l/s) RAG content (mg/l)	Inlet works can pass maximum design flow Minimum recorded moisture content of 30% Minimum calculated RAG removal of 70%	Where online flow monitoring is not required, separate verified hydraulic modelling must be provided to confirm that maximum design flow can be passed through process units. Analysed RAG content must be used to confirm manufacture specified RAG removal %s (where 70% is the minimum acceptable)
OT2	Inlet waste stream	Samples and weight recorded directly from waste skip/bins	RAG collected for landfill (kg/d) Moisture content (%)		
OT3	Grit removal influent	Must be located up-front of grit removal stage	Instantaneous flow (l/s) Grit content (mg/l)	Minimum recorded moisture content of 30%	Where online flow monitoring is not required, separate verified hydraulic modelling must be provided to confirm

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT4	Grit removal waste stream	Samples and weight recorded directly from waste skip/bins	Grit collected for landfill (kg/d) Moisture content (%)	Minimum calculated RAG removal of 70%	that maximum design flow can be passed through process units. Analysed grit content must be used to confirm manufacture specified grit removal %s (where 70% is the minimum acceptable)

Table 6.16 – Preliminary Treatment Process Performance Testing Requirements

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT5	Primary settlement influent	Must be located up-front of primary settlement stage but downstream of any internal recycle streams and any chemical dosing	BOD COD TSS Ammonia pH Alkalinity TP OP Total Iron Total Aluminium	For all cases: Minimum %DS of sludge stream = 2.5%DS	14 samples for all locations must be taken on consecutive days. Final agreement on whether spot or composite samples must be taken will be subject to final agreement with the Uisce Éireann Project Manager and Site Operations Management Team. As a guide, for sites greater than 10,000PE, composite sampling is required, sites smaller than this spot samples will be accepted. For sludge samples, spot samples must be accepted.
OT6	Primary settlement effluent	Must be located downstream of primary settlement stage but upfront of any chemical dosing post primary settlement		Where no coagulant dosing in place Average estimated BOD % removal = 25% Average estimated TSS % removal = 50%	
OT7	Primary settlement waste stream	Taken off de-sludge line between primary settlement stage and raw sludge holding tanks.	Average flow to holding tank (m3/d) %DS	Where coagulant dosing in place = 25%	

Table 6.17 – Primary Treatment Process Performance Testing Requirements

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT8	Secondary (biological) treatment influent	Must be located upfront of secondary (biological) treatment stage, and upfront of any internal recycles and chemical dosing immediately upfront of the secondary treatment stage	BOD COD TSS Ammonia pH Alkalinity TP OP Total Iron Total Aluminium TN Nitrate	Where no downstream tertiary treatment in place: All ELV conditions achieved as per CT2 testing. Testing must be used to confirm target design average % load removals for BOD, Ammonia, TSS, TN where applicable have been achieved.	14 samples for all locations must be taken on consecutive days. Final agreement on whether spot or composite samples must be taken will be subject to final agreement with the Uisce Éireann Project Manager and Site Operations Management Team. As a guide, for sites greater than 10,000PE, composite sampling is required, sites smaller than this spot samples will be accepted.
OT9	Secondary settlement effluent	Must be located downstream of secondary settlement stage, but upstream of any internal recycles and chemical dosing immediately downstream of the secondary settlement stage		Testing must be used to confirm target MLSS concentrations with suspended growth bioreactors have been	For sludge samples, spot samples must be accepted.

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT10	Secondary settlement waste stream	Taken off de-sludge line between secondary settlement stage and return locations	For fixed film processes: %DS average flow returned (m3/d) For suspended growth processes; TSS (mg/l) Instantaneous flow returned (l/s) for RAS stream Daily average flow returned (m3/d) for SAS stream	achieved where applicable. Testing must be used to confirm secondary sludge concentrations have been achieved where applicable	

Table 6.18 – Secondary Treatment Process Performance Testing Requirements

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT11	Tertiary biological treatment influent	Must be located upfront of tertiary biological treatment stage and any chemical dosing and internal recycle returns immediately upstream of tertiary biological treatment stage	BOD COD TSS Ammonia pH Alkalinity	Where no downstream tertiary treatment in place: All ELV conditions achieved as per CT2 testing.	14 samples for all locations must be taken on consecutive days. Final agreement on whether spot or composite samples must be taken will be subject to final agreement with the Uisce Éireann Project Manager and Site Operations Management Team.
OT12	Tertiary biological treatment effluent	Must be located downstream of tertiary biological treatment stage but upfront of any chemical dosing or internal recycle returns immediately downstream of tertiary biological treatment stage	TP OP TN Nitrate	Testing must be used to confirm target design average % load removals for BOD, Ammonia, TSS, TN where applicable have been achieved.	As a guide, for sites greater than 10,000PE, composite sampling is required, sites smaller than this spot samples will be accepted.
OT13	TSR influent	Must be located upfront of TSR stage and any chemical dosing and internal recycle returns immediately upstream of TSR stage	TSS pH Alkalinity TP OP	Where no downstream tertiary treatment in place: All ELV conditions achieved as per CT2	14 samples for all locations must be taken on consecutive days. Final agreement on whether spot or composite samples must be taken will be subject to final agreement with the

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
OT14	TSR effluent	Must be located downstream of TSR stage but upfront of any chemical dosing or internal recycle returns immediately downstream of TSR stage	Total Iron Total Aluminium	testing. Testing must be used to confirm target design average % load removals for BOD, TSS, TP and OP where applicable have been achieved.	Uisce Éireann Project Manager and Site Operations Management Team. As a guide, for sites greater than 10,000PE, composite sampling is required, sites smaller than this spot samples will be accepted.

Table 6.19 – Tertiary Treatment (biological and solids removal) Process Performance Testing Requirements

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Test Ref	Location	Location notes	Required test parameters	Test success criteria	Notes/testing requirements
P15	UV disinfection influent	Must be located immediately upfront of inlet to bank channels.	<i>Instantaneous flow</i> <i>Daily average flow</i> TSS All agreed target organisms (e.g. E.coli, Intestinal enterococci, Targeted viruses and pathogens) UVT	All target organism effluent concentration and log ₁₀ reductions as per agreed manufacture design and project brief achieved	Specific testing conditions to be agreed separately with the Uisce Éireann Project Manager and Site Operations Management Teams, equipment manufacture and EPA
P16	UV disinfection effluent	Must be located immediately downstream of outlet of banks channel			

Table 6.20 – UV Disinfection Process Performance Testing Requirements

6.2.2 Operation and Maintenance

The operation and maintenance of all WwTPs assets must be carried out in accordance with the manufacturers O&Ms, Uisce Éireann's standard operating procedures, process maps and guidelines as included in Uisce Éireann's Standard document and in accordance with Uisce Éireann's Asset Management System. Where Uisce Éireann standard procedures and guidelines have not been developed for a particular Works element or area then the Performance Management System (PMS) as published by Uisce Éireann's Water Services Training Group (WSTG) must be used.

In order to ensure that the Works can meet Uisce Éireann's requirements on a continuous basis under all operating conditions the Designer must ensure that adequate process reliability and flexibility is developed for key plant and process elements.

Details on asset specific operation and maintenance requirements can be found in the relevant standards, but the following general items/requirements should be noted:

- Unless specified, the following asset design life's (based on 2,000 hours per year run time) must be achieved:
 - 50 years for constructed concrete assets
 - 20 years for all non-wearing/non-consumable components
 - 3 years for non-metallic wearing components (e.g. brushes, seals, strips etc.)
 - 5 years for metallic wearing components (e.g. chains, rollers, guides, etc.)
- All assets must be of industry standard design so that existing supply chain agreements can be used to procure necessary component replacements and facilitate required off-site disposal of waste products etc.
- Plant controls must be such that a single instrument or control element does not instantly or in a cascade fashion:
 - Cause the plant to shut down for non-critical reasons.
 - Result in failure to achieve regulatory or Uisce Éireann targets for water quality.
 - Result in a shutdown of greater duration than the maximum permissible single outage period as advised by Uisce Éireann for the particular treatment works.
- All assets will be compliant with all aspects of the Irish Safety Health and Welfare at Work Act. From this act, the key umbrella regulations require specific attention to ensure compliance:
 - ATEX Directive 1999/92/ECC

- Confined Space
 - Working at Height
 - Work Safety
 - Manual Handling
- All ATEX zoning designations must comply with the requirements of the Uisce Éireann ATEX Standards.
- All assets components that require regular maintenance (frequency of one calendar month or less) must be easily accessible with requirements for associated lifting equipment and specialised tools minimised
- Designers must work with Uisce Éireann Project Manager and Design Standards Team to ensure that new assets do not contain any non-standard/bespoke components that are unfamiliar to the existing asset operational and maintenance team
- Where a brand-new type of asset is included as part of any new project/installation at an individual WwTP, the Designer must provide a summary of key O&M activities to the site manager and where requested, provide on-site training to key operatives
- Key consumables/frequently replaced parts and instrument reagents must be identified and where applicable a 2-month supply stored on site.
- Where assets are required to be removed from service to facilitate required maintenance activities, the design must account for this and deterioration in plant performance will not be acceptable (with regard to either final effluent emission value limit concentrations, or flow permitting requirements)
- All regular maintenance should be achievable without requiring access below coping levels.
- No elements that require greasing must be below the water line.
- Minimum clearance should be provided such that parts can be removed in a safe & reliable way without interference to operation
- Wearable brushes (where used) should be replaceable by a single operator
- Routine maintenance and repair of wearable parts and bearings must be easily achieved with assets in-situ.
- Wherever possible, final effluent rather than potable water should be utilised for screen wash-water and launder transfer water. Where final effluent is used then covers must be provided to eliminate the aerosol effect.

- Where asset covers are required (e.g. for odour control reasons) all covers must be easily removable for the purposes of routine maintenance. This will also include viewing ports to allow visual inspection of moving parts without the need for cover removal
- Where duty only assets are provided, a full set of critical spares (including long lead delivery items) must be provided.
- Lubrication intervals on all relevant mechanical components must be a minimum of 12 months (shorter where the manufacturer specifies this in the O&M)
- Automated screen washing must be provided.
- All fixtures and control must be located so as to provide convenient and safe access for operation and maintenance, particularly for assets that require frequent maintenance and/or inspections such as blowers, mixers, gearboxes, scum removal mechanism, baffles, weirs and effluent channels.
- All aeration pipework must have insulation lagging provide to minimise noise and to provide insulation from high temperatures.
- All chemical dosing systems require a formal calibration with issue certificate every 6 months by the pump manufacturer. Additional on-site calibration by the operations staff should be carried out on a monthly basis

7 REFERENCED DOCUMENTS

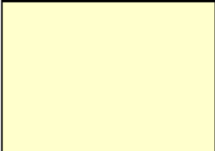
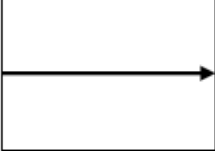
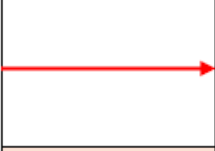
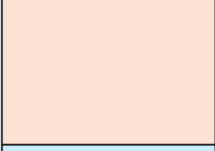
Document Name	Document Number	Location
Primary Treatment Wastewater	TEC-700-02	UÉ Standards Portal
Chemical Phosphorous Removal Standard	TEC-700-05	UÉ Standards Portal
Chemical Phosphorus Removal Specification	TEC-700-06	UÉ Standards Portal
Flow Measurement	TEC-700-99-01	UÉ Standards Portal
Inlet Works and Stormwater Treatment	TEC-700-99-02	UÉ Standards Portal
Engineering Specification Wash Water Waste Water	TEC-700-99-03	UÉ Standards Portal
Engineering Specification – Certificate of Authorisation Wastewater Treatment Plants	TEC-700-99-04	UÉ Standards Portal
Rotating Biological Contactors Standard	TEC-700-99-05	UÉ Standards Portal
Waste Import Facilities	TEC-700-99-06	UÉ Standards Portal
Rotating Biological Contactors Specification	TEC-700-99-07	UÉ Standards Portal
Sampling at WwTPs	TEC-700-99-08	UÉ Standards Portal

8 GENERATED DOCUMENTS

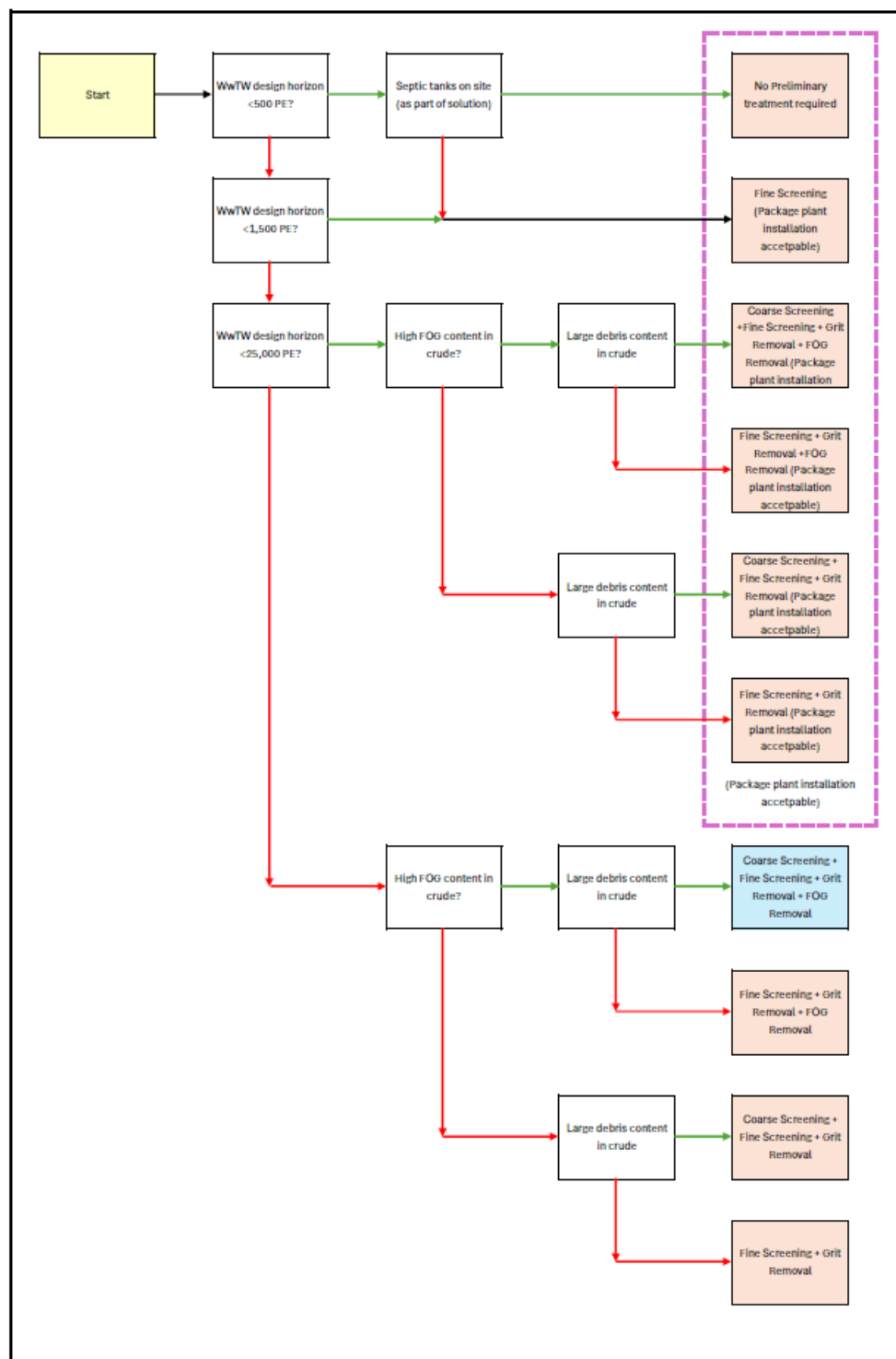
Document Name	Document Number	Location
Process Selection Guidance Tool	TEC 700-15-FM-01	UÉ Standards Portal

9 APPENDIX A – PROCESS ASSET SELECTION FLOW SHEETS

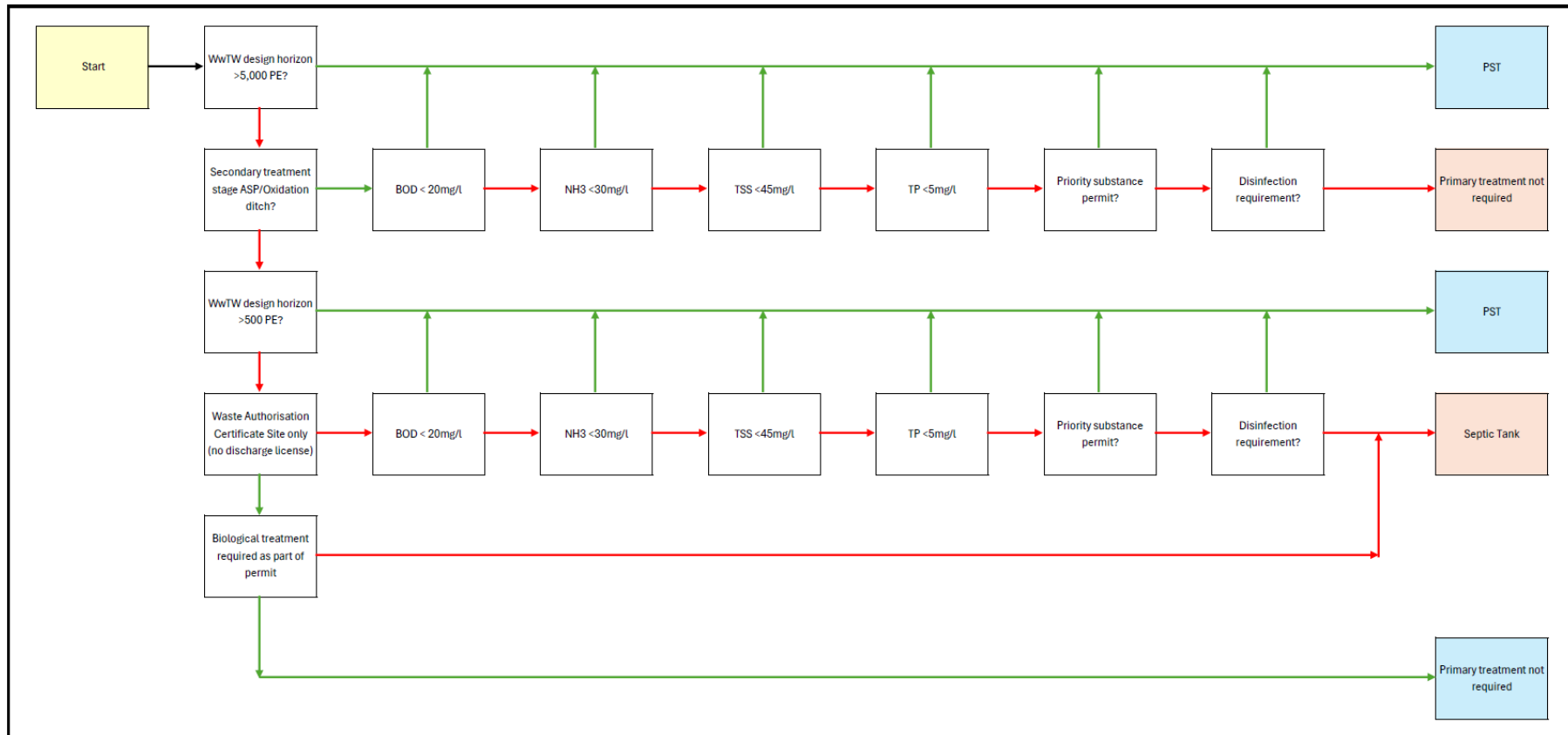
9.1 Key

Symbol	Meaning
	Start point
	Challenge question
	Non-descript route
	"Yes" route
	"No" route
	Recommend solution (alternative outcomes acceptable)
	Recommend solution (only acceptable outcome)
	Grouping type - <i>specified in footnotes</i>

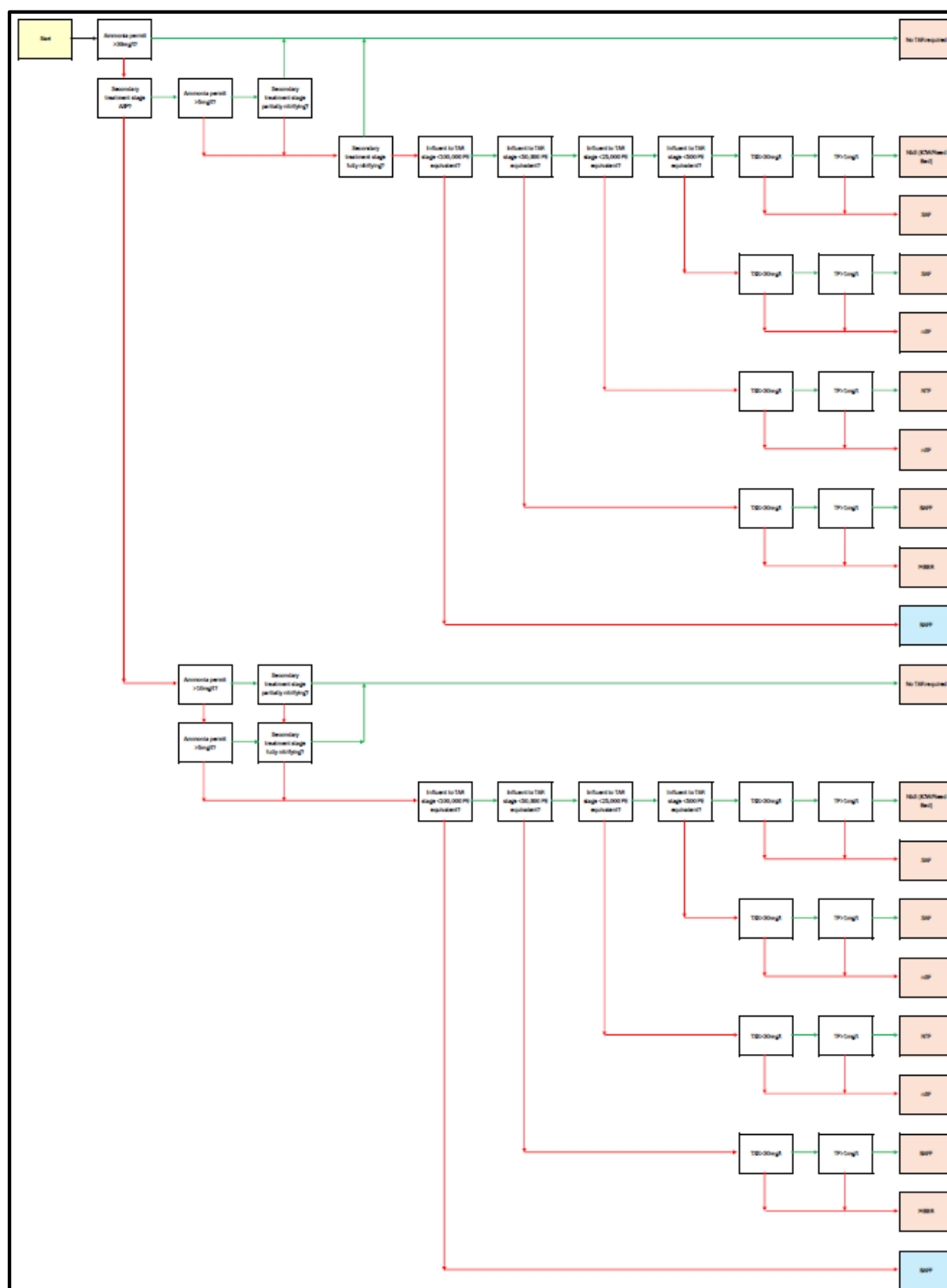
9.2 Preliminary Treatment



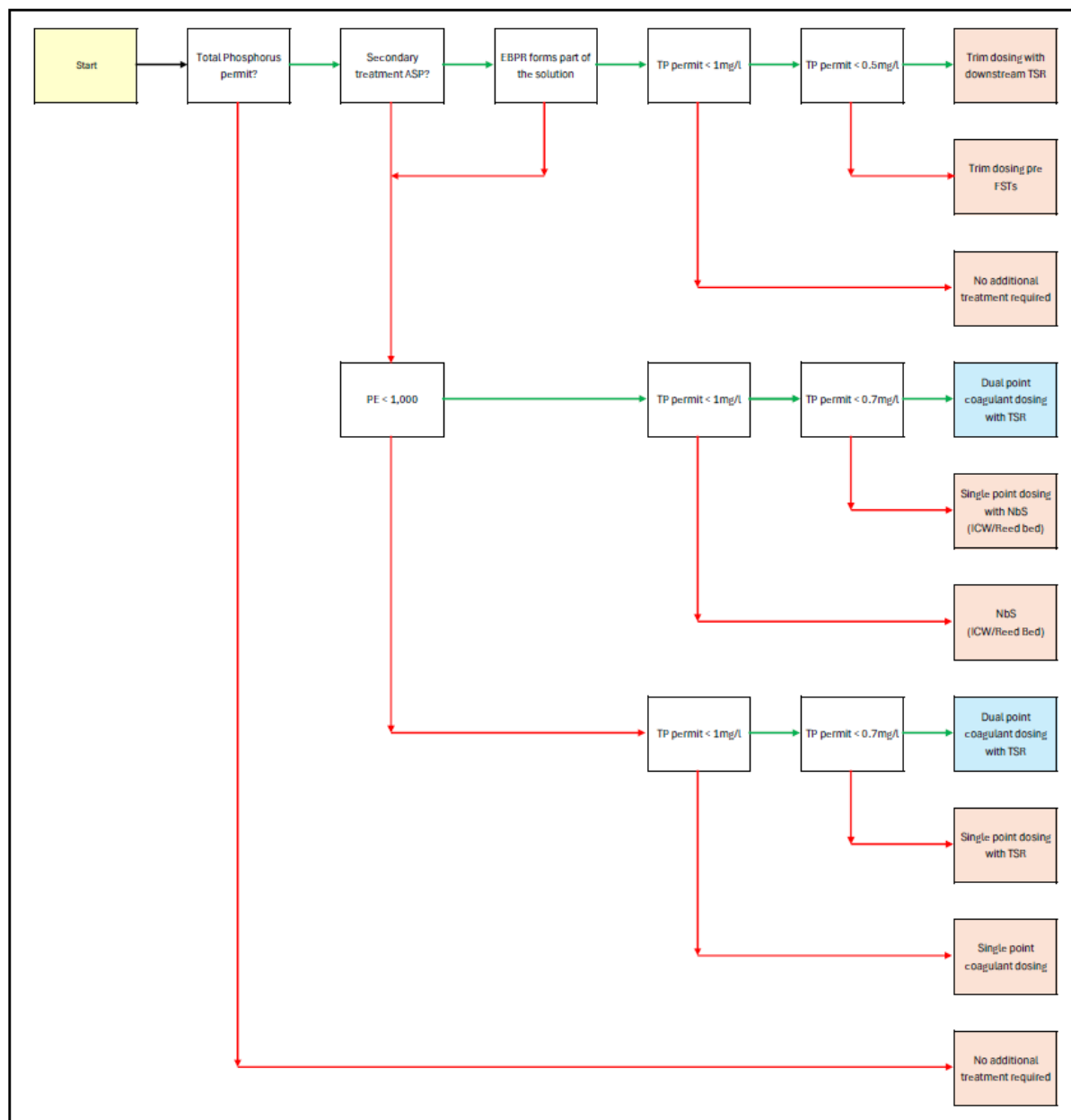
9.3 Primary Treatment



9.5 Tertiary Treatment (Biological)



9.6 Phosphorus Removal



9.7 Tertiary Solids Removal

