Water Use

Supporting Guidance (WAT-SG-13)

Municipal Sewage Treatment Works (STW) Guidance

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Update Summary

Version	Description
v1.0	Draft version for internal use only.
v1.1	Interim version – for internal use only
v2.0	First issue for Water Use reference using approved content from the following documents: *DRAFT_WAT-SG-13_v10_AH.doc*
v2.1	*Two-tier Multiplier* hyperlink revised
v2.2	Figure 1 revised.
v3.0	Expired CMS links reviewed and updated.
v4.0	Revise DWF definition, insert total N stds/nutrient % reduction table (per UWWTD), clarify SEPA position on aluminium stds at STWs
v4.1	Section 5.3: Compliance with upper tier limits clarified, links updated, Table 1 Event monitor comment revised to include remote discharges
v4.2	Section 5.3 upper tier limits removed, refer to WAT-RM-40 instead
v5	Sections 5.6 & 6.3.1/6.3.2 added, various clarifications

Table of Contents

1. Key Points

This document provides recommendations and information for staff on the use of conditions in licences for Municipal Sewage Treatment Works. For the purposes of this guidance, this means STWs served by a combined sewerage system, which includes rainfall runoff and sewage. Reference should be made to WAT-TEMP-06: Municipal Sewage Treatment Works Licence Template. This is supplementary to the guidance document WAT-RM-03: Regulation of Sewage Discharges to Surface Waters, which provides guidance on septic tank discharges and for discharges from STWs serving separate sewerage systems.

Particular reference is made to -

- Flow monitoring and event recorders
- Design flows and overflow settings
- The use of instantaneous and composite standards at STWs.

2. Flow Monitoring and Event Recorders

2.1 Introduction

The flow of sewage arriving at a treatment works needs to be understood in order to confirm the hydraulic performance of the works, to trigger investment in additional capacity as growth in the catchment outstrips the existing capacity, and to provide accurate input data to sewer and quality models to determine appropriate licence conditions and to inform such investment. In addition there is an SPRI reporting requirement for works serving >15,000 population equivalent (p.e.), and a need to confirm treatment levels under UWWTD at various p.e. trigger levels, the lowest trigger level being 2000 p.e.

Flow measurements can range from a simple understanding of the population served and water consumption figures for the area, through spot gauging at appropriate times or weather conditions, to permanently installed flow monitors and data loggers.

Formula A flows
Formula A flows are discussed in section 3.

Treatment Works Flows
The various types of STW flows which SEPA requires are discussed below.

Flow recording requirements
Flow recording requirements are discussed in section 2.6.

Dry Weather Flow (DWF)
Licences for STWs on a combined sewerage system have a limit on the DWF of the influent sewage. The design of STWs is normally based on the treatment of multiples of DWF (see Section 3.2). Increases in flow, due for example to population growth or to increased trade discharges, could lead to more frequent operation of overflows and therefore the potential for an increased impact on the water environment.

Storm Overflow Settings
STW licences only allow overflows to operate when a certain flow is exceeded – e.g. >3DWF, >6DWF. To ensure this is being complied with, monitoring of pass forward flows at storm overflow weirs is required.

Final Effluent Mean Flow
Water quality modelling requires mean daily flow and standard deviation of the final effluent. Final effluent flow approximates closely to the flow to full treatment (FFT) (which will be slightly greater due to removal of sludge) and hence a dedicated final effluent flow meter is not normally required. For STWs >15,000p.e., flows are required by the operator in order to calculate SPRI submissions.

Event Recorders
It is not normally appropriate to try to measure the flow of storm sewage passing over an overflow. Instead event recorders can be used to provide a start and stop time for overflow events. Event recorders are required for CSOs discharging to designated Bathing or Shellfish Waters in order that the number

of spills can be determined. Event recorders are relatively cheap to install and can be useful in assessing increased frequency and trends of overflow events, due to increased influent flows at STW. The monitored frequency and duration of overflow events can be checked against projected data from sewer hydraulic models. An event recorder can also provide useful information when investigating an individual pollution incident in the watercourse. A limitation is that overflow events are clearly dependent on rainfall patterns, and do not necessarily reflect problems with the STW. If the actual flow of storm sewage is required, then this is best determined from flow recorders installed upstream and downstream of the overflow.

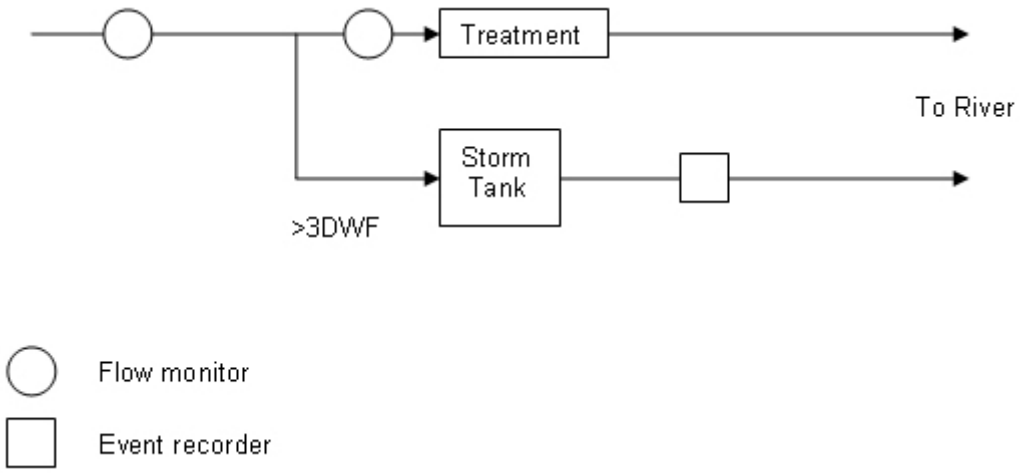
The requirement for flow measurement structures and facilities must be specified in the STW licence.

In most cases Scottish Water will install flow monitoring facilities to improve operation of the site. Although monitoring equipment is not expensive, the creation of a suitable flow measurement structure may be impractical at some works. N.B. A flow measurement structure is a structure which enables the operator to install flow monitors if continuous flow recording is required. Improvements should be agreed with the operator through the Q&S investment process.

The configuration of monitoring points will vary according to the works, and the facilities provided according to the size of the works and the risk of impact. Figure 1 is a schematic showing typical works layout and the location of monitoring equipment (if required), although it is stressed that this is for illustration only.

The event recorder should be located so as to record overflows to the water environment, rather than overflows to a storm tank (if present).

Figure 1 Schematic of Flow Monitoring and Event Recording Requirements



Flow monitoring / event recording requirements are summarised in Table 1.

Table 1 General Flow Monitoring and Event Recording Requirements[1]

Population Equivalent	Minimum Flow Monitoring Requirement	Event Recorders	Data Recording	Period that flow/event records need to be kept
>2000 pe	Flow measurement structures and permanent flow monitors 1. at inlet[2] 2. at flow to full treatment (FFT)	All overflows	Instantaneous FFT	5 years
			Annual influent DWF calculation[3]	5 years
			Effluent mean daily flow and std deviation calculation[3]	5 years
			Storm overflow events[3]	5 years
			Total annual volume discharged during overflow events[3]	5 years
500 -2000 pe	Structure at FFT only (FFT flow monitor where dilution <10:1)	Required if CSO impacts on designated Bathing, Shellfish Waters	As above, if monitors installed	As above, if monitors installed
100-500 pe	none	Required if CSO impacts on designated Bathing, Shellfish Waters[4]	As above, if monitors installed	As above, if monitors installed
<100pe	none	none	none	none
CSOs in the sewer network	Refer to WAT-RM-07			

1. These are minimum requirements for new STWs. Additional facilities may be required in certain situations. Improvements to existing STWs should be agreed with Scottish Water through the Q&S process. (Refer to CAS-G-003: Flow/Event Monitoring at Scottish Water STWs).
2. For discharges to coastal waters, inlet flow monitor not required if STW serves 2-10,000pe, unless discharge is to Bathing/Shellfish Waters. i.e. only required for UWWTD qualifying discharges unless to Bathing/Shellfish Waters.
3. Not required by licence for 2-15kpe STWs.
4. May not be required depending on risk assessment.

2.2 Facilities for STWs serving more than 2000 p.e.

Facilities for all sewage treatment works serving >2000 p.e. should include, as a minimum, flow measurement structures and flow monitors to continuously

monitor (a) inlet flows (see Table 1) and (b) the flow passing forward for full treatment along with (c) an event recorder at all storm overflow weirs.

The FFT flows should be able to be assessed without the contribution of any return liquors, recirculates etc.

Monitoring of inlet flows can allow determination of infiltration and the total volumes of sewage spilled at the storm overflows.

It is important to note that there may be more than one means of determining the required flow information depending on the layout of the STW and the configuration of the flow meters. If required flows can be derived by adding or subtracting flows from alternative flow meters, then this would be acceptable.

Furthermore it is also important to recognise that there are physical constraints at many existing STWs that limit where flow monitors may operate effectively. In many cases a compromise may be necessary and this should be taken into account in any CAS assessment.

Licences have conditions specifying minimum pass forward flows at overflow weirs at FFT and at any other overflows upstream e.g >6DWF. In many situations compliance with this condition can be demonstrated without the need for a continuous flow monitor e.g. by using fixed hydraulics in the flow channel (such as a fixed weir plate) to ensure that minimum PFFs are being complied with. In other, possibly higher risk situations, an FFT monitor may be required to determine pass forward flows.

At each storm overflow weir or bypass channel overflow there should be, as a minimum, an event recorder to record the start and finish date/time of overflow events.

2.3 Facilities for STWs serving less than 2000 p.e.

At works serving ≤2000 p.e. the facilities will depend on the p.e. of the STW and the risk of the discharge as detailed in Table 1. As a minimum, for STWs serving 500-2000p.e., this should include a structure to enable FFT to be measured.

The influent DWF (as specified and limited in the licence) can be derived from an FFT monitor since under dry weather conditions these 2 flows will be identical. FFT flows approximate to final effluent flows and so the mean daily flow and standard deviation can be derived from the FFT monitor.

2.4 Combined Sewer Overflows in the sewerage network

At new combined sewer overflows in the sewerage network the range and extent of structure/facilities will again depend on sensitivity, but would as a minimum, require a flow measurement structure. For further details refer to WAT-RM-07: Regulation of Sewer Overflows.

2.5 Inlet sewage pumping stations with storm/emergency overflows

Sewage pumping stations with storm/emergency overflows should be dealt with in the same way as CSO structures. However, in this case a measurement of pump capacities (e.g. by drop down tests) will provide the pass forward flow, and hours run meters will enable an estimation of volumes of sewage pass forward flow to treatment to be made. Event recorders and inlet flow measurement structures/monitors may be justified in sensitive locations.

2.6 Recording

Where flow monitors are permanently installed, the operator is normally required to record instantaneous flow rates to enable the following to be provided on request:

- the dry weather flow of the influent sewage (determined on an annual basis)
- the mean daily flow and standard deviation of daily flow of the effluent (determined on an annual basis)
- the rate of flow of sewage passing forward at the combined storm overflow weir and/or at the settled storm overflow weir for full treatment (FFT)
- frequency and duration of overflow events (i.e. the start and finish date and time of each overflow event)
- the total annual volume discharged during overflow events (total inlet flow – total FFT)).
- The continuous FFT record should normally be based on 15 minute readings.

The summary flow statistics (DWF and mean daily flow) should be determined from the continuous FFT and daily volume records.

2.7 Compliance Inspections

Refer to CAS-G-004: Flow Recording and Reporting at Sewage Treatment Works and on the Sewer Network for guidance on assessing recording and reporting of flows.

The licence requires keeping of flow records for 5 years which should be checked during routine inspections. In order to assess that the required flows are being treated during storm events, this should include an inspection of the records of pass forward flows to full treatment. In addition, where appropriate, influent DWFs, final effluent flows and event records should be inspected.

Should the inspection coincide with a storm event, the instantaneous pass forward flow to full treatment should be checked at that time. The operator should be aware of the FFT requirement.

For guidance on how to assess compliance with the licence condition requiring calibration of flow/event monitoring equipment, refer to CAS-G-002: Calibration of monitoring and measurement equipment at Sewage Treatment Works.

2.8 Reporting

Flow reporting conditions are normally only required in the licence for STWs serving ≥15000pe (15Kpe being the threshold for SPRI reporting). In addition, certain STWs serving <15000pe may be required to report flow data based on environmental need such as low dilution or downstream designated sites.

Rather than Scottish Water supplying flow records on an individual basis to local SEPA teams, flow reports are submitted centrally to SEPA and made available to operational teams. (Flow reports for STWs operated by PFI companies are submitted separately by the PFI operators).

The details of flow reporting requirements vary according to the licence, but may include summary statistics such as DWF, mean daily flow, the start/stop date and time of each overflow event along with total annual volume discharged during these storm events.

More detailed flow information such as the continuous FFT flow record is kept by the discharger. Portions of the continuous FFT flow record should be made available to SEPA on request e.g. during the annual inspection.

3. Population Equivalent, Dry Weather Flow and Design Flows

3.1 Population Equivalent

The licence (WAT-TEMP-06: Municipal Sewage Treatment Works Licence Template) should not contain population equivalent (p.e.) limits. However, the p.e. which was used as the basis of setting the licence must be listed in the Explanatory Notes appended to the licence.

For small developments, of less than 10 housing units, the p.e. should be determined using the number of bedrooms as referred to in the latest version of Flows and LoadsHttp://www.britishwater.co.uk/document/search.aspx (British Water Code of Practice).

For existing small wastewater treatment works, serving 10 or more houses, the population equivalent can be determined using the census figures where additional information is available to support this assessment, such as flow surveys of the existing system."

For larger developments (normally Scottish Water), it is statistically highly unlikely that there would be full occupancy of every property at any one time and determining the p.e. using the Flows and Loads document would result in an over designed STW. Therefore for these larger developments the operator can use an appropriate census figure for occupancy (Scottish Water currently uses a figure of approximately 2.1 persons per house, depending on the locality).

3.2 Dry Weather Flow

3.2.1 Design DWF

STW design is based on multiples of DWF, with DWF being calculated using the formula below.

DWF (Dry Weather Flow) = P G + I + E, where

P = Population served
G = Water consumption / head / day (typically 150 litres)
E = Trade Effluent Flow (litres)
I = Infiltration*

*Infiltration should be measured where possible using measured night time flows at the sewage works. For smaller catchments infiltration may have to be estimated. Measurement is particularly important where SEPA is aware of significant infiltration (e.g. in an ageing sewer network where river inflow or saline intrusion may be occurring), this should be measured. Where groundwater levels are high, measured infiltration flows in winter are necessary.

Further background information on infiltration and DWF can be found in User Note 33 - Modelling dry weather flow.

3.2.2 Background

Some STW licences may still define DWF in the licence Interpretation of Terms as:

> 'the average daily flow to or from the STW during a week without rain (excluding a week which includes public or local holidays), following a week during which the rainfall did not exceed 0.25mm on any one day. For sewage with a large industrial component, dry weather flow should be based on the flows during five working days if production is limited to that period'.

There are various problems with this traditional definition such as the infrequency of qualifying periods of DWF, large variability and difficulties in obtaining local reliable rainfall data.

A 2006 research project sponsored by UK Water Industry Research recommended using the Q80 DWF definition given above, rather than the traditional rainfall related definition. The Q80 definition closely matched the rainfall related definition and does not suffer from the problems outlined above.

This approach also means that Scotland is consistent with that taken by the Environment Agency.

3.2.3 Licence Compliance with DWF

f the licensed DWF is being exceeded then water quality impacts may occur, due to for example, more frequent operation of sewer overflows.

It has been determined that the 80%ile exceeded flow (or Q80) closely matches the DWF figure derived from the design equation in section 3.2.1. It is this 80%ile flow which should be used as a straightforward measure of DWF.

SEPA is moving to a position where DWF is defined in the licence as:

> 'the total daily flow value that is exceeded by 80% of the total daily flow values in a period of twelve months'.

For those STWs required to provide flow data returns (generally >15kpe STWs), this definition was changed by a licence variation undertaken centrally and came into force in December 2012.

For those STWs where no flow reporting is required, SEPA is intending to vary centrally the DWF definition to the 80%ile flow definition. In the meantime however, SEPA will accept DWF figures provided using the 80%ile definition.

3.2.4 DWF Compliance and Reporting

Compliance is assessed by comparing the 80%ile exceeded flow limit against the measured 90% exceeded flow.

This is done by calculating the total daily flow value that is exceeded by 90% of the measured total daily flows in any period of 12 months and matching this value against the permitted daily DWF limit.

The measured Q90 will always be less than the measured Q80. By assessing using the measured Q90 rather than the Q80, an allowance is made for year-on-year variability in the flow rates and also for uncertainty in the measurement of the daily flows. An assessment is made against the (lower) measured Q90 so that the discharger is not held responsible for factors out with their control such as higher flows in particularly wet years.

The UK Water Industry Research project referred to in section 3.2.2 showed that if this measured Q90 is above the discharge licence limit, we can be 95% confident that the discharge has truly exceeded the licence DWF limit.

Refer to CAS-G-004: Flow Recording and Reporting at Sewage Treatment Works and on the Sewer Network for more detailed guidance on assessing DWF compliance.

3.3 Formula A

Normally all sewage up to the Formula A flow needs to undergo at least primary treatment and all sewage up to the 3DWF flow needs to undergo full treatment (refer to Figure 1).

Formula A = DWF + 1360P + 2E

Where there is a significant proportion of the catchment drained on a separate system, a modified Formula A should be used. This is discussed in WAT-RM-07: Regulation of Sewer Overflows.

The high strength of industrial effluents discharged to the sewerage system can render the setting based on Formula A above to be inadequate for the protection of the receiving watercourse. Details of the industrial discharges will be required in determining the licence application and the multiplier 2 in 2E in the Formula A calculation should be adjusted according to the population equivalent of the industrial component relative to the domestic sewage.

4. Overflows

Guidance on sewer overflows is available in WAT-RM-07: Regulation of Sewer Overflows. This includes storm tank location and sizing, overflow settings and screening requirements.

Improvements should be agreed with Scottish Water through the Q&S investment process.

There are a number of different ways to configure and operate storm tanks and conditions should reflect the individual circumstances following the guidance in *WAT-RM-07*.

4.1 Combined Sewer Overflows (CSOs)

Where an existing CSO is satisfactory, the licence should reflect existing provisions without driving further costs. An unsatisfactory CSO (see paragraph 4, Annex H of the *Urban Wastewater Treatment Regulations Guidance Note*) should be licensed as it is - if investment is required, the CSO should be identified in the Q&S investment programme. Where a CSO fails only one of the unsatisfactory criteria, improvements should be made to a satisfactory standard for that criterion. If the unsatisfactory CSO is failing two or more criteria, improvements to achieve the full UWWTR requirements are required. Similarly, any newly constructed CSO should be designed, constructed and licensed to achieve all UWWTR requirements. See *WAT-RM-07*.

The default overflow setting is Formula A (DWF+1360P+2E expressed as litres/second). For existing satisfactory discharges, Formula A may be overly conservative in some cases and variations may be acceptable following detailed sewer modelling and impact assessment or where there are very large/small sewerage systems which warrant lower/higher settings respectively.

Where dilution is limited (for example less than 8:1), higher pass forward flows or additional storm tanks may be required to protect the receiving water. See *WAT-RM-07*.

4.2 Settled Storm Sewage Overflows

Where an existing settled storm tank discharge is satisfactory the licence should reflect the existing conditions/provisions. Where a storm tank discharge is unsatisfactory (see paragraph 4, Annex H of the UWWTR Guidance Note), due to only one of the criteria, the new licence should only tighten performance of the failing criterion. If the unsatisfactory storm tank discharge is failing two or three criteria the licence should take account of all requirements.

For existing satisfactory discharges, the settlement storage capacity currently provided should be stated. The normal requirement is for flows up to 3DWF (3PG + I + 3E) to receive full treatment and flows in excess, up to Formula A (DWF + 1360P + 2E) to receive 68 litres per head or 2 hours settlement (at 3DWF) prior to discharge. The storage capacity should be stipulated in accordance with the above standard design criteria for new or unsatisfactory

storm tank discharges. Variations may be permitted following detailed sewer modelling and impact assessment or where there are very large/small sewerage systems which warrant lower/higher settings respectively. In addition to the above storm tanks, further storage capacity may have to be provided at the STW for CSOs on the inlet sewer depending on the available dilution. Refer to WAT-RM-07 for further details.

4.3 Emergency Overflows (EOs)

EOs should only be authorised for pumping stations on the sewer network or at STWs. The emphasis of the schedule of conditions relating to EOs is to ensure that there are adequate arrangements for a quick response to an event in order to minimise pollution. What is adequate will depend on local circumstances, with telemetry being normally considered essential. The means of minimising pollution, agreed with the operator, may include standby power, storage or access for tankers.

4.3.1 Screening

12-18mm bar screening is acceptable, however the discharger may choose to put in 10mm bar screening.

4.3.2 Storage

Storage is provided to allow the operator time to take preventative measures in the event of station failure, and thereby minimise the risk of a discharge occurring. A minimum of 2 hours storage at 3DWF (3PG + I + 3E) should be provided at new pumping stations. This may be reduced to 1 hour for stations which Scottish Water or their agents can attend quickly and which have other mitigation measures in place to minimise the risk of the overflow operating, i.e. automatic standby pumps, dual power supply etc.

Where operation of the EO would result in partially treated, secondary or tertiary treated effluent being discharged, precautions such as storage tanks may not be justified.

For existing pumping stations which are problematic, the licence should be modified to include enhancements required to provide adequate protection within a specified time-scale agreed with Scottish Water through the Q&S process.

4.3.3 Telemetry

There are two types of telemetry alarm - one to advise of pump failure (e.g. due to loss of power or mechanical failure) and the other to advise of high level in the wet well and/or operation of the overflow. Typically the requirement is for notification of pumping station failure only. Notification of operation of the overflow should only be required in high risk locations, e.g. risk of impact on

shellfish or bathing waters. Requirements and installation dates should be agreed with the operator.

4.3.4 Response Time

There are a range of licence condition options relating to response time. The choice of condition should be agreed between SEPA and the operator having regard to storage capacity, remoteness of site, risk to downstream users etc. The quality of the effluent should be considered since some EOs consist of treated or partially treated effluent.

4.3.5 Power

The selection of the most appropriate alternative power supply is dependent upon the vulnerability of the receiving waters. Provision of facilities to allow a mobile generator to be installed is the least onerous requirement. A permanent stand-by generator or duplicate electricity supply (fed from two separate sub-stations) should only be required for high risk sites.

4.3.6 Pumps

Standby pumps should be provided in case of failure of the duty pump(s). The standby pump(s) capacity must normally be equivalent to the duty pump(s) capacity. However in larger pumping stations, where multiple duty pumps are provided, there is less justification for equivalent standby pumps since it is unlikely that more than one duty pump would fail at any one time. Should the duty pump(s) fail, the standby pump(s) should activate automatically. The option for activation “as soon as practicable” should only be used for existing sites, and in this case, modification of the set up to automatic activation should be considered. Pumps at new pumping stations should reactivate immediately after power is restored.

5. UWWTR (Scotland) Regulations 1994

Licences for Urban Waste Water Treatment (Scotland) Regulations 1994 (UWWTR) qualifying discharges (i.e. greater than 2000 p.e. to inland waters and estuaries and greater than 10,000 p.e. to coastal waters) require:

- a UWWTR schedule which contains UWWTR required standards and
- a CAR schedule (treated sewage effluent schedule) which contains standards required to protect the receiving water.

Refer to WAT-TEMP-06: Municipal Sewage Treatment Works Licence Template.

Licences for non-qualifying discharges (i.e. <2000 p.e. to inland waters and estuaries and <10000 p.e. to coastal waters) requiring 'appropriate treatment' under UWWTR and have a CAR schedule only which contains standards required to protect the receiving water.

Refer to section 5.5 for an explanation of how to apply discharge quality conditions under different scenarios, followed by a summary Table 3.

5.1 Appropriate Treatment

Appropriate treatment means treatment of urban waste water by any process and/or disposal system which, after discharge, allows the receiving waters to meet the relevant quality objectives and the relevant provisions of the EC UWWTD and other Community Directives. The precise form of appropriate treatment for discharges to freshwaters will depend upon the size of the discharge relative to the receiving water and uses identified downstream.

For discharges to estuarine and coastal waters, given the dilution and dispersal characteristics, a minimum requirement will normally be screening or equivalent to retain aesthetically objectionable solids.

5.2 Primary Treatment

Primary treatment means treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD of the incoming waste water is reduced by at least 20% and the total suspended solids is reduced by at least 50% before discharge.

5.3 Secondary Treatment

Secondary treatment means treatment of urban waste water by a process generally involving biological treatment either with secondary settlement or another process in which the requirements in Table 1 of the UWWTR are met. This is reproduced in Table 2.
N.B. Compliance with either the concentration or the % reduction requirements in Table 2 would mean the discharge is compliant with UWWTR. Refer to WAT-RM-40: Assessment of Numeric Discharge Quality Conditions.

Table 2 Apply Concentration Value or % Reduction

Parameter	Concentration	Minimum % reduction
BOD	25 mg/l	70%
COD	125 mg/l	75%

Refer to The Urban Waste Water Treatment (Scotland) Regulations 1994 and UWWTR Guidance Note.

In addition, analysis of discharges from lagoons shall be carried out on filtered samples, and the concentration of total suspended solids in unfiltered water samples shall not exceed 150mg/l.

5.4 Nutrient limitation conditions

Nutrient limitation conditions should be used where the receiving waters are designated as “sensitive” under the UWWTD or “polluted” under the Nitrates Directive and nutrient stripping has been identified as an investment driver for the works in question (Refer to section 6).

5.5 Discharge Quality Standard Conditions

5.5.1 Use of Instantaneous (Spot) and Composite Standards

Instantaneous or composite conditions must be included in the licence schedules as appropriate, e.g. spot standards for protecting an EQS, composite for implementing the UWWT Regulations and/or composite standards where the concern is discharge loadings, e.g. to an estuary or freshwater loch, rather than peak concentrations. Where composite conditions are used, an instantaneous upper-tier for BOD and suspended solids should be included in the licence to enable immediate enforcement of serious breaches of the licence. Where other parameters (e.g. ammonia, metals) are limited by composite conditions, an instantaneous limit set at 1.5 times the composite upper tier should be used.

The UWWTR requires composite sampling for monitoring compliance with the Directive’s standards.

Composite sampling for UWWTR compliance applies for discharges to coastal waters >10,000 PE and discharges to freshwaters and estuaries which are >2,000 PE.

The UWWTR allows for compliance with either the concentration standards or the % reduction requirements. Concentration standards should be included in all UWWTR licences but it is at the discretion of the operator to determine if they require % reduction standards to be included. The requirements should be specified in the licence.

Guidance on the type of sampling required is provided in a) to d) below, with a summary provided in Table 3 below.

a) Discharges to coastal waters and estuaries >10,000 p.e. Discharges to freshwater lochs >2,000 p.e.

Composite samples are required by UWWTR and composite samples should be included in the UWWTR schedule. Composite standards are also required for CAR as discharge loading is the main concern. However, composite standards for BOD, COD (or nutrients where required by UWWTR) should not be included in the CAR schedule unless the lower-tier standard is more stringent than that required by UWWTR (e.g. CAR BOD lower tier <25 mg/l). The upper tier standards in the CAR schedule should not be more relaxed than the UWWTR requirements (e.g. BOD upper tier should be a maximum of 50 mg/l).

Instantaneous upper-tier standards for TSS and BOD should be included for enforcement purposes, but not routinely monitored.

Routine monitoring of composite samples for BOD, COD, nutrients (if required), any other required determinands set to protect receiving water and UWWTR percentage reduction.

Enforcement instantaneous samples can be taken for BOD and TSS.

b) Discharges to rivers >10,000 p.e.

Composite samples are required by UWWTR and composite samples should be included in the UWWTR schedule. However, instantaneous standards are required for CAR as peak concentration and compliance with the EQS is the main concern for rivers.

Instantaneous two-tier standards should be calculated to protect receiving water and should be included in the CAR schedule; this will include instantaneous BOD standards as those specified in the UWWTR schedule will be for composite samples.

Instantaneous upper-tier 100 mg/l TSS should be included within the CAR schedule and included within routine monitoring and compliance assessment.

Routine monitoring of composite samples for COD, BOD and nutrients (if required) and UWWTR percentage reduction (optional).

Routine monitoring of instantaneous samples for BOD, TSS and any other required determinands set to protect receiving water.

c) Discharges to rivers and estuaries between 2,000 and 10,000 p.e.

The UWWTD requires composite sampling for monitoring compliance with the Directive's standards.

Instantaneous standards will be required for CAR

Instantaneous two-tier standards should be calculated to protect receiving water as peak concentration and compliance with the EQS is the main concern for discharges of this size to rivers and estuaries.

These standards should be included in the CAR schedule, including:

- Instantaneous BOD standards, as those specified in the UWWTR schedule will be for composite samples.
- Instantaneous upper-tier 100 mg/l TSS should be included within the CAR schedule and included within routine monitoring and compliance assessment.
- Routine monitoring of composite samples for COD and BOD and UWWTR percentage reduction (optional).
- Routine monitoring of instantaneous samples for BOD, TSS and any other required determinands set to protect receiving water.

d) Discharges to rivers and estuaries <2,000 p.e. Discharges to coastal waters <10,000 p.e.

The UWWTR does not specify the treatment standards for discharges of this size. Such discharges require appropriate treatment, therefore a UWWTR schedule in the licence is not required.

The CAR schedule should include instantaneous two-tier standards, set to protect the receiving water (e.g. BOD and ammonia).

Instantaneous upper-tier 100 mg/l TSS standard should be included in the CAR schedule for discharges subject to secondary / tertiary treatment.

Two-tier instantaneous TSS conditions should be included for sampled primary or septic tank effluent only.

Routine monitoring of instantaneous samples for any required determinands set to protect receiving water (eg BOD, Ammonia and TSS).

Table 3 Summary Table Of Discharge Quality Standard Conditions

UWWTR Qualifying Discharge	Treatment	Treated Sewage Effluent (CAR) Schedule	UWWTR Schedule
YES > 10,000 pe to coastal waters and estuaries > 2,000 pe to freshwater lochs	Secondary	1. No two-tier standards for BOD, COD, or nutrients should be included unless the lower-tier standard is more stringent than that required by UWWTR. 2. Composite 95%ile and upper-tier[1] for other standards (eg Ammonia) should be set where required to protect receiving water. 3. Instantaneous upper-tier of 100 mg/l TSS for enforcement purposes 4. Instantaneous upper-tier 75 mg/l BOD for enforcement purposes.	UWWT conditions for secondary treatment[2]: 1. Composite two-tier standards for BOD and COD 2. Composite condition for percentage reduction (optional) 3. Composite nutrient standards including percentage reduction should be included where required by UWWTR
YES > 10,000 pe to rivers	Secondary	1. Instantaneous 95%ile and upper-tier[1] set where required to protect receiving water (BOD conditions should be included as UWWTR conditions are composite). 2. Instantaneous upper-tier 100 mg/l TSS.	UWWT conditions for secondary treatment[2]: 1. Composite two-tier standards for BOD and COD 2. Composite - condition for percentage reduction (optional) 3. Composite nutrient standards including percentage reduction should be included where required by UWWTR.
YES 2,000 – 10,000 pe to rivers and estuaries	Secondary	1. Instantaneous 95%ile and upper-tier[1] set where required to protect receiving water (BOD conditions should be included as UWWTR conditions are composite). 2. Instantaneous upper-tier 100 mg/l TSS.	UWWT conditions for secondary treatment[2]: 1. Composite two-tier standards for BOD and COD 2. Composite condition for percentage reduction (optional)
NO <2,000 pe to rivers and estuaries <10,000 pe to coastal waters	Secondary	1. Instantaneous 95%ile and upper-tier[1] set to protect receiving water - for example BOD & ammonia standards. 2. Instantaneous upper-tier 100 mg/l TSS for secondary/tertiary works.	None

	Primary/ Septic tank	1. Instantaneous 95%ile and upper-tier[1] set to protect receiving water, for example TSS standards.	

1 Upper-tier: 95 percentile multipliers vary according to value of lower tier. See Two-tier Multiplier Tables for details.
2 UWWT secondary treatment conditions and nutrient conditions specified in UWWTR & licence template

5.6 Composite samples

5.6.1 Types of Composite samples

Composite samples are described as two or more samples or sub-samples, mixed together in appropriate known proportions (either discretely or continuously), from which the average result of a desired requirement may be obtained.

The proportions are usually based on time or flow measurements.

Time based composite sampling is suitable for regular flow where there are minimal fluctuations in flow. This is the default sampling method used by Scottish Water and expected by SEPA.

CAR Licences specify the start and end times of 24 hour composite samples (normally 10:00 and 09:00 respectively). These times refer to GMT (all year round) with no adjustment of autosamplers being required to take account of BST.

Flow proportional composite sampling is suitable for situations where irregular or erratic flows are experienced, i.e. batch processes or pumped inlets.

There are 3 types of composite sampling (b-d equate to figure 2 below):

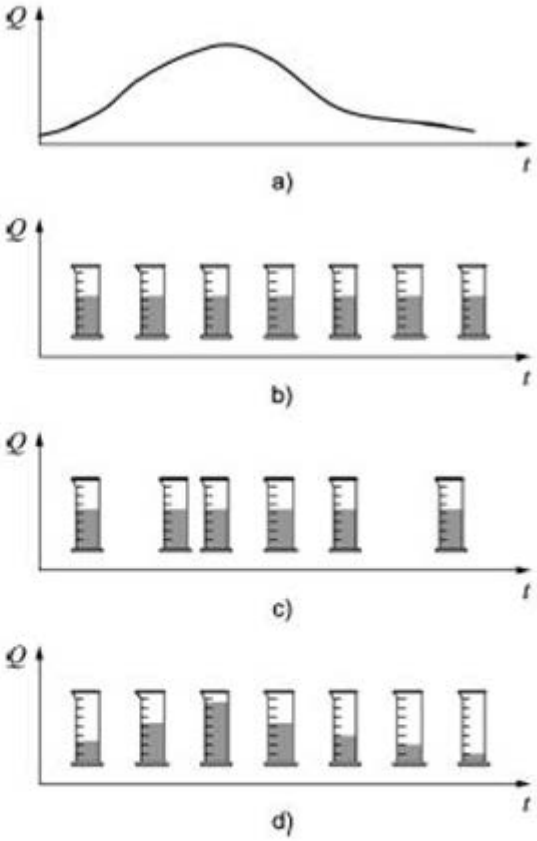
b) **Constant Time Constant Volume Sampling** (C.T.C.V.) – where equal volumes of sample or sub-sample are collected at equal increments of time

c) **Constant Volume Variable Time Sampling** (C.V.V.T.) – where the flow proportional sampling is based on collecting equal volumes of sample at frequencies proportional to flow

d) **Constant Time Variable Volume Sampling** (C.T.V.V.) – where the flow proportional sampling is based on collecting samples at fixed time intervals but where the volume of sample is varied in proportion to the flow

Further details of each are provided in Figure 2

Figure 2 Types of composite sampling



Key
Q = discharge
t = time
a) Flow rate curve
b) C.T.C.V. Time proportional sampling (Constant Time, Constant Volume)
c) C.V.V.T. Flow proportional sampling (Constant Volume, Variable Time)
d) C.T.V.V. Flow proportional sampling (Constant Time, Variable Volume)

The most appropriate composite sampling method should be used to assess the quality of the influent and final effluent, e.g. if flow proportional sampling provides a more representative sample than time-based sampling then flow proportional sampling should be used.

There may be situations where a combination of flow-proportional and time-based sampling are utilised on the same site.

The operator will need to satisfy SEPA that their proposals will ensure that representative samples are obtained.

5.6.2 Minimum sample volume

For automatic sampling equipment installed prior to 2016 there is no minimum sample volume requirement for UWWTR.

For new or replacement automatic sampling equipment a minimum sample volume of 3 litres is required for UWWTR purposes.

Refer to WAT-TEMP-06: Municipal Sewage Treatment Works Licence Template.

5.6.3 Temperature requirements

Automatic sampling equipment installed prior to 2016 should maintain a sample at a temperature above freezing but below 4oC. Where the composite sample is removed from the automatic sampling equipment it should be stored between 0oC and 4oC prior to collection.

New or replacement automatic sampling equipment should be designed and guaranteed to store a sample at 5±3°C for transportation[1], as required by the British Standard BS EN ISO 5667-3:2012. Where the composite sample is removed from the automatic sampling equipment it should be stored in compliance with BS EN ISO 5667-3:2012 prior to collection.

Refer to WAT-TEMP-06: Municipal Sewage Treatment Works Licence Template.

[1] The autosampler can be defined as having taken a sample and is subsequently storing it for transportation

6. Nutrient Standards

6.1 Soluble Reactive Phosphorus (SRP)

In 2007 modelling studies were carried out centrally by SEPA on individual water bodies to identify the Quality and Standards (Q&S) SRP standards required at individual STWs. These were modelled to meet annual mean SRP standards in the water body. The required mean effluent standards have been translated into 95%iles for licensing purposes as per Table 4.

The tightest standard in Table 4 is 0.5 mg/l SRP (annual mean) – this is what SEPA regards as BAT in terms of sewage treatment. Therefore SEPA will not required standards tighter than this.

N.B. It is the 95%ile SRP values which must be used as a licence condition.

Table 4 Required Mean Effluent Standards

Mean SRP (mg/l)	95%ile SRP (mg/l)
0.5	1
1.0	2
1.5	4
2	5
2.5	6
3	7
3.5	8

SRP standards will only be applied from 1 April – 31 October, i.e. during the period of algal growth. This aims to protect water quality while allowing energy and resource use to be minimised. Whilst this position is being reviewed any applications seeking to use this seasonal approach must be directed to the Environmental and Spatial Informatics Unit (ESIU).

6.2 Total Phosphorus (TP)

STWs serving >10,000pe discharging to freshwater river or lochs designated as Sensitive Areas subject to eutrophication under UWWTD require Total Phosphorus standards.

UWWTD phosphorus standards are fixed at 1 or 2 mg/l annual mean TP depend on the p.e. of the works. A Total Phosphorus (TP) standard of 2mg/l is applied for works < 100,000 p.e., with a TP of 1mg/l only applying to STW > 100,000 p.e.

N.B. It is the annual mean UWWTD standards which must be used in licence conditions. These TP standards should be inserted in the UWWTD schedule in the STW licence and will therefore be based upon composite sampling.

This is reproduced below in Table 5. N.B. Compliance with either the concentration or the % reduction requirements in Table 5 would mean the discharge is compliant with UWWTR.

Table 5 Apply Concentration Value or % Reduction

Parameter	Population Equivalent	Annual Mean Concentration	Minimum % Reduction
Total Phosphorus	10,000-100,000	2 mg/l	80%
	>100,000	1 mg/l	80%

N.B. For STW discharging to or impacting upon a freshwater loch, TP rather than SRP standards should be used, e.g. Loch Lomond Catchment. Refer to WAT-RM-37: Regulation of Phosphorus Discharges to Freshwater Lochs.

6.3 Summary of Phosphorus Licence conditions

Table 6 Phosphorus Licence Conditions

	UWWT	CAR	
Form of phosphorus	**Total P**	**Rivers - SRP**	**Lochs – Total P**
Statistical	Mean	95 percentile	
Sample	Composite (>10,000 p.e.)	Spot	
Seasonal	No seasonal conditions	Condition to be applied from 1 April – 31 October	No seasonal conditions
Upper tier	No upper tier condition for phosphorus		

6.3.1 Ferric Dosing

Scottish Water is likely to use ferric dosing to meet P standards. Where this is the case, a standard condition of 2mg/l annual mean, total Fe measured on the instantaneous sample should normally be included in the CAR licence schedule.

Where SW is struggling to meet 2mg/l, the Fe limit can be changed to 2 tier standards with the 95%ile limit based on site specific modelling. The procedure for doing this is described below.

The discharge iron limit should be calculated to ensure the dissolved Fe EQS of 1mg/l annual average is not exceeded, though this iron limit should be specified as total iron, not dissolved iron.

Normally the modelling would be expected to result in a dissolved iron discharge limit in order to match the EQS. The reason for specifying the discharge limit as total iron is that setting a dissolved Fe discharge limit may in theory allow the river dissolved Fe EQS to be exceeded. This is because discharge total Fe would not be limited and some of this Fe may change state into the dissolved form once it is in the river (due to for example a reduced pH).

However, in order to prevent overly high 95%ile limits being set (in cases of high dilution), a backstop maximum 95%ile limit of 4mg/l total Fe should be set.

A limit no tighter than 1mg/l total Fe as a 95%ile should be set. An upper tier spot sample limit should be 8mg/l.

6.3.2 Aluminium Dosing

SEPA discourages the use of aluminium dosing due to its toxicity. Aluminium dosing at STWs should only be used in situations where ferric dosing is impracticable. SW needs to provide full justification for the use of aluminium.

If aluminium is proposed, the EQS standards to be followed are those set out in WAT-RM-12 which will determine discharge limits. However to limit discharge levels in high dilution situations, a backstop discharge limit of 10mg/l dissolved aluminium may need to be used.

6.4 Total Nitrogen (TN)

STWs serving >10,000pe discharging to tidal waters designated as Sensitive Areas subject to eutrophication under UWWTD require Total Nitrogen standards.

UWWTD nitrogen standards are fixed at 10 or 15 mg/l annual mean TN depend on the p.e. of the works. A Total Nitrogen (TN) standard of 10mg/l is applied for works < 100,000 p.e., with a TN of 15mg/l only applying to STW > 100,000 p.e.

N.B. It is the annual mean UWWTD standards which must be used in licence conditions. These TN standards should be inserted in the UWWTD schedule in the STW licence and will therefore be based upon composite sampling.

This is reproduced below in Table 7. N.B. Compliance with either the concentration or the % reduction requirements in Table 7 would mean the discharge is compliant with UWWTR.

Table 7 Apply Concentration Value or % Reduction

Parameter	Population Equivalent	Annual Mean Concentration	Minimum % Reduction
Total Nitrogen	10,000-100,000	15 mg/l	70-80%
	>100,000	10 mg/l	70-80%

References

Water Manual Documents

WAT-RM-03: Regulation of Sewage Discharges to Surface Waters

WAT-RM-07: Regulation of Sewer Overflows

WAT-RM-12: Regulation of Discharges from Water Treatment Works

WAT-RM-37: Regulation of Phosphorus Discharges to Freshwater Lochs

WAT-RM-40: Assessment of Numeric Discharge Quality Conditions

WAT-SG-79: Priority Hazardous Substances Licence Reviews - Guidance

Two-tier Multiplier Tables SEPA Intranet

CAS Guidance Documents

CAS-G-002: Calibration of monitoring and measurement equipment at Sewage Treatment Works

CAS-G-003: Flow/Event Monitoring at Scottish Water STWs

CAS-G-004: Flow Recording and Reporting at Sewage Treatment Works and on the Sewer Network

External References

BS EN ISO 5667-3:2012 Water quality. Sampling. Preservation and handling of water samples British Standard Dec 2012 (www.bsigroup.com)

Flows and Loads British Water Code of Practice (www.britishwater.co.uk/)

Urban Waste Water Treatment (Scotland) Regulations 1994 SSI No. 2842 (www.legislation.gov.uk)

Urban Wastewater Treatment Regulations Guidance Note Feb 1998

User Note 33 - Modelling dry weather flow in Base Flows, WaPUG (www.ciwem.co.uk/)

- End of Document -