Small Sewage Treatment Plant

Strategic Environmental Compliance and Performance Review

NSW EPA

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Key terminology and acronyms used

Acronym	Meaning
BOD	biochemical oxygen demand
FC	faecal coliforms
licence	environment protection licence
NH3	ammonia
OG	oil and grease
POEO Act	*Protection of the Environment Operations Act 1997*
SSTP	small sewage treatment plant
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids

1. Introduction

The EPA has completed a strategic environmental compliance and performance review on small sewage treatment plants. The findings of the review are presented in this report.

1.1 Strategic environmental compliance and performance reviews

The NSW Environment Protection Authority (EPA) undertakes a program of strategic environmental compliance and performance reviews with the aim of improving the industry's compliance and environmental performance and the EPA's regulation. Section 78(4A) of the *Protection of the Environment Operations Act 1997 (*POEO Act) requires the EPA to audit, on an industry-wide or regional basis, compliance with environment protection licence (licence) requirements and whether such requirements reflect best practice in relation to the matters regulated by the licences. This strategic review report fulfils this requirement and informs the licence review process.

The strategic review combines a compliance audit program with a review of best environmental management practices. The individual compliance audit reports and the strategic review report are published on the EPA's website. Review findings feed into licence reviews and ongoing compliance activities.

The reviews focus on priority environmental issues. Targeted sectors and activities are chosen by:

- reviewing available licence and enforcement data
- consulting with EPA operational areas
- assessing major environmental and community concerns alongside the EPA's corporate objectives and strategies.

Consultation with external stakeholders is also undertaken during various stages of the process, including upfront feedback on priority setting.

Sewage treatment processing by small plants was selected for this review.

For more information on these strategic reviews, including previous reviews, see the EPA website.

1.2 Sewage treatment

1.2.1 Regulation of sewage treatment systems

The POEO Act allocates responsibilities for pollution prevention and control to the EPA, local councils and other public authorities. The EPA is the appropriate regulatory authority for:

- regulating activities listed in Schedule 1 of the POEO Act
- ensuring compliance with licences
- regulating activities carried out by the state or a public authority.

Sites that undertake scheduled activities and meet the licensing threshold in the POEO Act are licensed and regulated by the EPA.

Sewage treatment is defined in Schedule 1 of the POEO Act as:

the operation of sewage treatment systems (including the treatment works, pumping stations, sewage overflow structures and the reticulation system) that involve the discharge or likely discharge of wastes or by-products to land or waters.

The licensing threshold for sewage treatment is if the activity has a:

processing capacity that exceeds:

(a) 2,500 persons equivalent, or

(b) 750 kilolitres per day, whichever is the greater.

Activities that are below this threshold but that discharge to waters can also be licensed for a *miscellaneous licensed discharge to water (at any time)*.

Licences regulate the whole sewage treatment system, including the treatment plant(s) and all associated components of the reticulation system under the licensee's management or control, such as pipes, access chambers, pumping stations, overflow structures and ejection units. The licences regulate both discharges (overflows) from sewage treatment plants (also called wastewater treatment plants) and discharges from sewage reticulation systems.

The EPA developed a model licence to apply to these systems and published *Licensing Guidelines for Sewage Treatment Systems* (2003) to assist licensees in non-metropolitan areas to understand the requirements of these licences. (There was a separate process for Sydney Water and Hunter Water.)

Other agencies also administer legislation in relation to sewage treatment plants (see section 3.9).

1.2.2 What are *small* sewage treatment plants?

Sewage treatment 'processing by small plants' is listed as a fee-based activity in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009, hereafter referred to as the POEO (General) Regulation. Small plants are classified as plants with an annual processing capacity of up to 10,000ML. These plants were considered to be small sewage treatment plants (SSTPs) for this audit program along with plants that operate below the processing capacity in Schedule 1 that are licensed for a *miscellaneous licensed discharge to water (at any time).*

The EPA licenses approximately 260 SSTPs across NSW, with varying types of treatment technologies and capacities. Most SSTPs are owned and operated by local councils and water utilities as well as state government and private-sector owned and operated SSTPs.

1.2.3 Importance of managing sewage treatment plants

The main environmental risks associated with sewage treatment are water pollution, land pollution and odour emissions.

Sewage treatment plants treat the water-borne wastes from the community, which can be from residential, industrial and commercial sources. The primary purpose of sewage treatment is to protect public health and the environment by removing the pollutants found in sewage.

1.2.4 Treatment

There are many different forms of sewage treatment that can involve physical, biological and chemical treatment combined in different units to produce the quality of effluent that will meet regulatory requirements and is appropriate for the way the effluent will be managed.

Preliminary treatment is the removal of inorganic solids and other large objects from the influent. Equipment includes screens and grit arrestors (see Photos 1 and 2). Other equipment for control of the flow can also be used, such as balance tanks, and excess flow can be diverted to storage ponds.

Photo 1: Step screen

Photo 2: Enclosed grit collection

Primary sedimentation is sometimes used to reduce the amount of settleable organic solids and floatables in the wastewater, and to treat and remove the sludge. Equipment can include primary settling tanks, sludge digesters, sludge lagoons, drying beds and belt presses (see Photos 3, 5 and 6).

Photo 3: Primary sedimentation tank

Photo 4: Sludge digester

Photo 5: Fully lined sludge lagoon

Photo 6: Sludge drying beds

Biological treatment processes use micro-organisms to remove soluble and suspended organic matter and some nutrients from the wastewater. Common processes include use of trickling filters, oxidation ponds and activated sludge processes, such as intermittent decanted extended aeration (IDEA) tanks (see Photos 7, 8, 9 and 10). The growth of micro-organisms in biological processes generates solids. These are removed from the wastewater through settling or filtration. Settling can occur in separate units

or in the biological treatment tank. Proper control of solids is an essential component of the treatment process and the key operational control available to plant operators. The removed solids are known as sludge. Sludge can be processed into a material that is suitable for further use. This material is known as biosolids.

Photo 7: Oxidation pond

Photo 8: Trickling filter

Photo 9: IDEA tank in aeration with sludge lagoons and sludge drying bag in background

Photo 10: IDEA tank in settling phase

Disinfection is often used to remove harmful bacteria, commonly by chlorine or ultraviolet (UV) light and sunlight on tertiary ponds (see Photos 11 and 12). Filtration is sometimes used to remove further suspended solids, particularly where chemicals have been used to reduce phosphorus to low levels. Constructed wetlands can also be used to assist in polishing the effluent (see Photo 13).

Flow monitoring can occur at the inlet and at the discharge point. Other monitoring can occur throughout the processes and are discussed further in section 3.5.

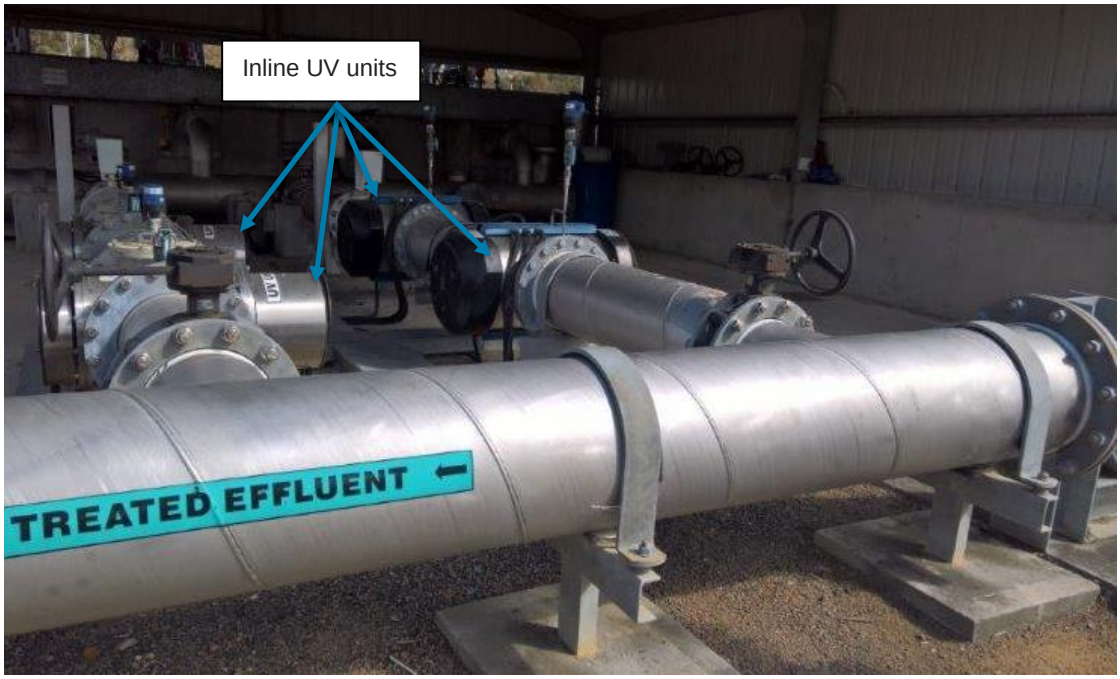


Photo 11: Inline UV units

Photo 12: Tertiary ponds

Photo 13: Discharge from tertiary pond into constructed wetlands

1.3 SSTP compliance audit program

The objectives of the SSTP audit program were to:

- assess each licensee's compliance with the audit criteria
- improve licensee's awareness and understanding of environmental and compliance issues.

1.3.1 What are compliance audits?

A compliance audit is an objective assessment of an auditee's activities to determine whether they comply with legal or regulatory requirements.

> An audit is defined in the International Standard ISO 19011:2018 as a *systematic, independent and documented process for obtaining objective evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled.*

The criteria used for EPA compliance audits are generally the legal and regulatory requirements that the EPA administers, and the audits are undertaken in accordance with the procedures and protocols outlined in the *Compliance Audit Handbook* (EPA 2017). The handbook can be accessed on the EPA website.

Audit findings are generated based on the evidence obtained, which includes information from EPA files, information supplied by site representatives and observations made during audit inspections.

When an audit is completed, the findings are presented to the licensee in an individual compliance audit report. These individual reports are publicly available on the EPA's public register, which can be accessed on the EPA website.

Each report contains an action program outlining any non-compliance, recommended actions and agreed time frames that licensees must meet. EPA officers follow up on compliance audits to ensure licensees are implementing the actions required in the report by the agreed target date. Licensees are also required to report back by a specific date on the actions taken.

The audit findings presented in this report are a collation of the findings presented in the individual compliance audit reports.

1.3.2 Scope of audits

Activities **included** in the scope of each audit were:

- treatment of wastewater (preliminary, primary, secondary and tertiary processes)
- management of influent, including variable flows and loads
- management of odour
- treatment of sludge
- monitoring and recording of data and information as per the licence conditions
- maintenance and operation of plant and equipment
- preparing, keeping, testing and implementing a pollution incident response management plan (PIRMP) in accordance with legislative requirements
- publication of pollution monitoring data in accordance with legislative requirements.

Activities **not included** in the scope:

- management of the reticulation system outside of the plant itself, including the pumping stations
- classification and re-use of biosolids
- re-use of effluent
- ambient monitoring

- load-based licensing requirements
- storage of chemicals.

The temporal scope of the audit is the day of inspection for operating conditions and at least the most recent reporting period (12 months) until the end of the audit inspection for limit, monitoring and reporting requirements.

The spatial scope of the audit is the boundaries of the sewage treatment plant and any relevant monitoring/discharge points.

1.3.3 Audit criteria

The audit criteria are the requirements against which the auditor assesses the audit evidence. The criteria were:

- conditions attached to the licence within the audit scope
- the legislative requirements for PIRMPs under Part 5.7A of the POEO Act and Chapter 7, Part 3A of the POEO (General) Regulation
- the requirements of section 66(6) of the POEO Act relating to publishing of pollution monitoring data.

1.3.4 Risk assessment

The EPA conducts a risk assessment of non-compliances as part of the audit process to identify the relative significance of any identified non-compliance. The risk assessment involved assessing each non-compliance against two criteria:

- the likelihood of environmental harm occurring considering current and past environmental performance and potential contributing factors
- the level of environmental impact because of the non-compliance, such as the quantity and toxicity of the material and the sensitivity of the receiving environment.

Each non-compliance is coded based on the risk using the matrix in Table 1: high (code red), moderate (code orange) or low (code yellow). There are also several licence conditions that do not have a direct environmental significance but are still important to the integrity of the regulatory system. These conditions relate to administrative, monitoring and reporting requirements. Non-compliance with these conditions is given a code blue risk assessment.

Table 1 Risk analysis matrix

		Likelihood of environmental harm occurring		
		Certain	Likely	Less likely
Level of environmental impact	High	Code red	Code red	Code orange
	Moderate	Code red	Code orange	Code yellow
	Low	Code orange	Code yellow	Code yellow

1.3.5 What sites were audited?

Twenty-four licensed SSTPs were audited in the EPA's SSTP compliance audit program. Although the whole plant and reticulation system is licensed, the audits included only the treatment plant in the audit scope (see section 1.3.2 for further information). The sites were selected to obtain a representative sample of the sector (e.g. in size, location and technology) and to include only those plants that discharge to waters.

Twenty-three of the sites hold a licence under Schedule 1 of the POEO for *Sewage treatment: Sewage treatment processing by small plants*. The remaining site was below the licensing threshold but holds a licence for a *miscellaneous discharge to waters (at any time)*.

Plant technology

See section 1.2.4 for information on treatment stages at sewage treatment plants.

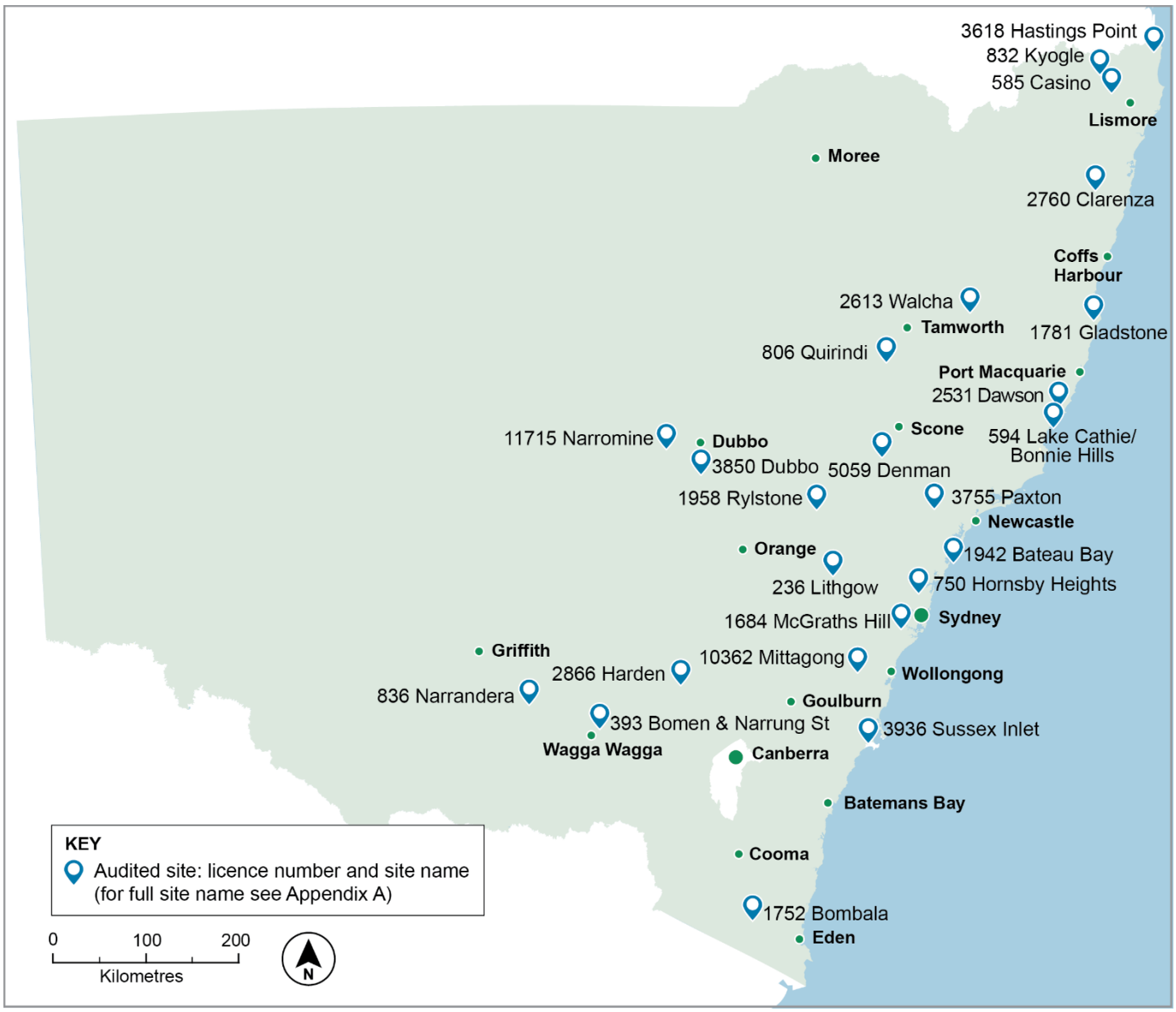
The plants audited varied in technology used; however, trickling filters and intermittent decanted extended aeration (IDEA) were the most common secondary processes, with some plants using both methods in parallel. This was commonly seen where the plant had been augmented with an IDEA plant, but the trickling filter process/equipment is still needed due to the volume of flow. One plant consisted of only four ponds in a series and one plant used a membrane bioreactor and chemical dosing.

Most plants incorporated the preliminary treatment methods of screening and grit collection. Some plants used chemical dosing during the process, such as the addition of aluminium sulphate to assist with phosphorus removal.

Tertiary treatment included tertiary ponds, UV disinfection units, chlorine disinfection and constructed wetlands. Sludge treatment included sludge digesters and sludge lagoons with drying methods of belt press, sludge drying beds and sludge drying bags.

Plant locations

The plants audited included coastal and inland plants in NSW. These are shown in Figure 1 (see



Appendix A for the list of sites). The EPA's public register of licensing contains details of all licences issued under the POEO Act. Licences are available at the EPA website.

Figure 1: Location of audited sites

Plant size

The scale of the plants audited, based on volume of annual discharge, is shown in Figure 2.

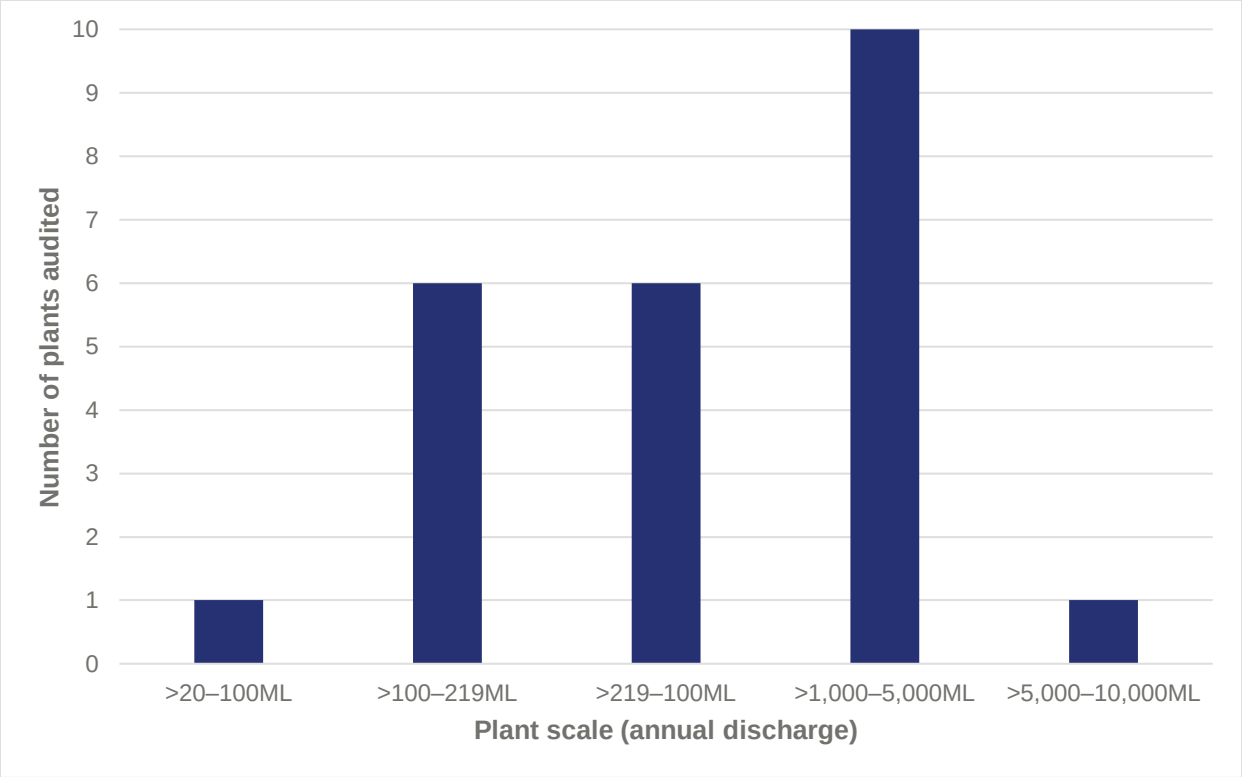


Figure 2: Scale of plants audited

2. Audit findings

2.1 Overview of audit findings

The results of the compliance assessments for the 24 audits are summarised in Table 2. Non-compliances are separated into each colour-coded category determined as part of each audit using the risk analysis matrix (see Table 2). Of the 1841 assessments, 378 (20.5%) were non-compliant. A number of assessments were classified as 'not determined' due to reasons such as insufficient information being available to the auditor.

The number of non-compliant assessments identified at individual sites ranged from five to 33. The compliance performance against summarised areas of assessment is shown in Figure 3. These findings are described in detail in the following sections.

Table 2 Summary of assessments

	Compliant	Non-compliant				Not determined	Total number of assessments
		Code red	Code orange	Code yellow	Code blue		
Number of assessments	1331	9	21	23	325*	132	**1841**

*Non-compliances consist of 110 non-compliances with the licence requirements, 105 non-compliances with pollution incident response management plan (PIRMP) requirements and 110 non-compliances with publishing pollution monitoring data (PPMD) requirements.

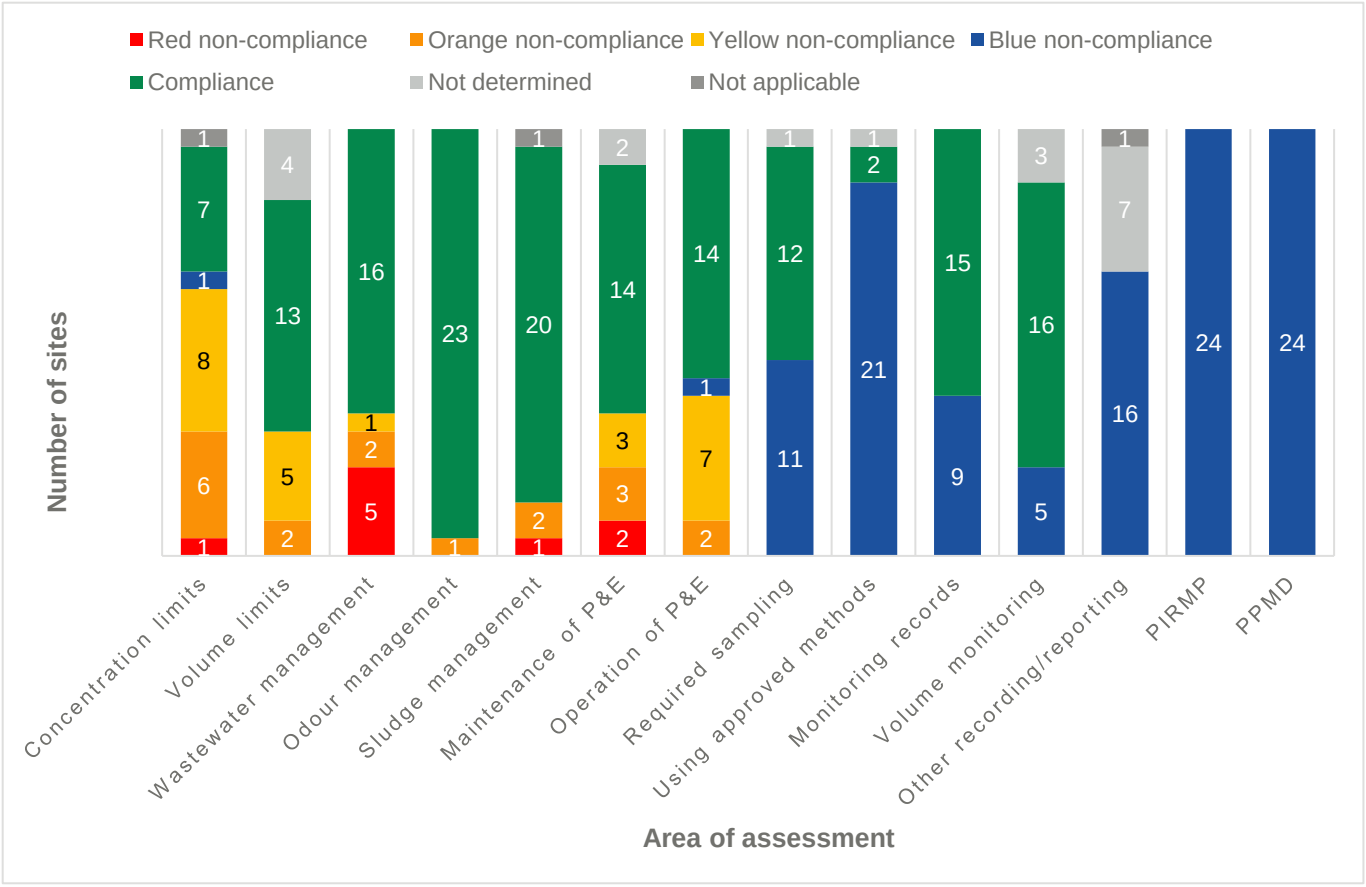


Figure 3: Summary of site assessments. This does not include all assessments but is a summary of key areas. Not applicable = the criteria did not apply to a site. P&E = plant and equipment. PIRMP = pollution incident response management plan. PPMD = publishing pollution monitoring data.

2.2 Limits

Licences can specify limits on concentration of pollutants and limits on volume of effluent discharged. These limits are determined in accordance with section 45 of the POEO Act and aim to minimise potential health risks and effects on the receiving environment. For discharges to water, the EPA regulates pollutants that pose a non-trivial risk of harm. Monitoring and sampling for pollutants is imperative to ensure discharges are within the limits.

2.2.1 Concentration limits

Maximum limits (100 percentile concentration limits) are used to ensure that an appropriate standard of treatment is provided at all times. For sewage treatment plants, the treatment performance over time can also be regulated using 90 and 50 percentile limits to reflect the inherently variable nature of biological processes. Limits vary to account for differences in the end use of the treated effluent (e.g. if it is re-used on agricultural land or discharged to a waterway) and practical matters (e.g. the plant processes that are installed).

Concentration limits were exceeded at 16 of the 23 sites audited. (One site did not have any concentration limits.)

Compliance with 100 percentile concentration limits

100 percentile limits are maximum limits that must not be exceeded.

Thirteen of the 20 sites (65%) with 100 percentile limits had non-compliances for some pollutants within the audit scope (over a period of at least 12 months).

Twenty audited licences included 100 percentile concentration limits for some pollutants. For example one site had a 100 percentile concentration limit for pH only, whereas another site had 100 percentile

concentration limits for pH, total suspended solids (TSS), biochemical oxygen demand (BOD), oil and grease (OG), faecal coliform units (FC), total nitrogen (TN), total phosphorus (TP) and ammonia (NH3).

The most non-compliances were against TSS limits. The assessments against pollutants are summarised in Table 3 and Figure 4. The required sampling frequency varied between sites, ranging from weekly to twice a year, and a pollutant exceedance has been counted once for each site. For some sites there were multiple exceedances of the same pollutant, notably for TSS, pH, TP and FC.

Table 3 Compliance with 100 percentile limits

Pollutant	Compliance	Non-compliance	Total number of assessments
TSS	11	7	**18**
BOD	14	4	**18**
OG	14	2	**16**
pH	10	3	**13**
TN	8	1	**9**
TP	5	4	**9**
FC	3	2	**5**

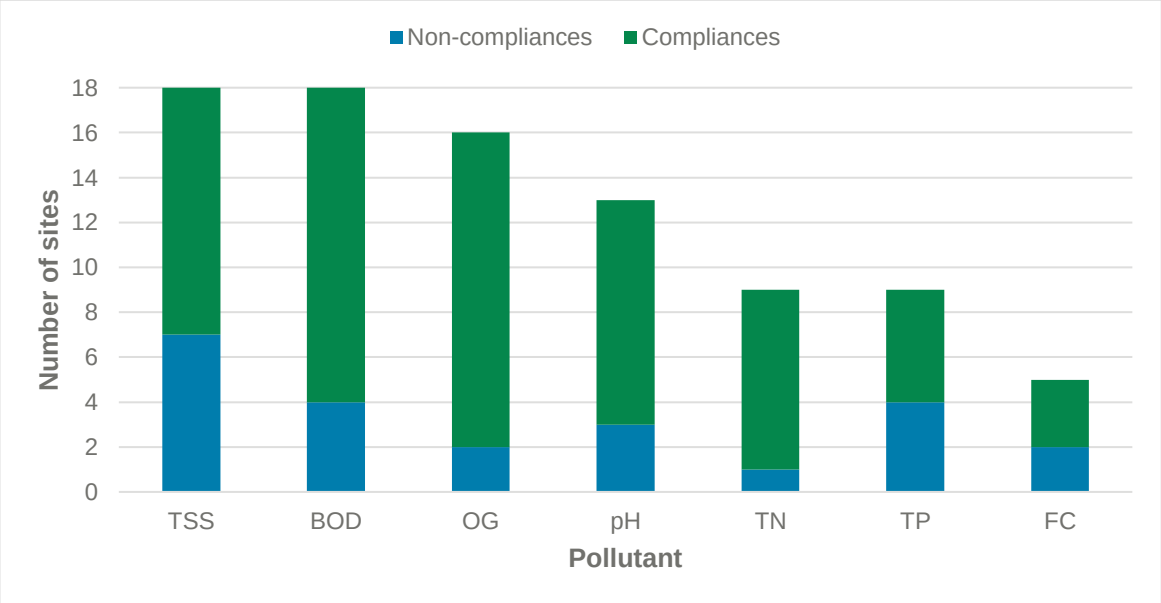


Figure 4: Compliance with 100 percentile concentration limits. Not all sites had 100 percentile concentration limits for each of these pollutants. Therefore, each column reflects the number of sites with this limit requirement.

Compliance with 90 percentile concentration limits

Ninety percentile limits mean that 90% of samples over the reporting period must not exceed this concentration limit. It can also be explained as only 10% of samples are permitted to exceed this limit.

Thirteen licences had 90 percentile concentration limits and these limits were exceeded at five of the 13 sites (38%). Exceedances of 90 percentile limits were found for the following pollutants:

- BOD – three sites
- OG – two sites
- TSS – three sites
- TN – two sites
- TP – one site.

Compliance with 50 percentile concentration limits

Fifty percentile limits mean that 50% of samples over the reporting period must not exceed this concentration limit.

Five licences had 50 percentile concentration limits, and these were complied with at all sites (excluding an emergency discharge point). See also the comments in section 2.3.1.

2.2.2 Volume limits

Licences can specify limits on the volume permitted to be discharged from particular points. All audited licences had volume limits. Seven of the 24 sites audited exceeded the volume permitted to be discharged during the reporting period. Reasons given for exceedances were mainly to heavy rain or wet weather.

2.3 Competence in carrying out activities

Condition O1 of every licence requires that all activities are carried out in a competent manner. The audits focused on three areas when assessing compliance with this condition. These were wastewater management, odour management and sludge management. The main environmental risks of not managing wastewater and sludge adequately are water pollution, land pollution and odour generation. Competency was assessed on whether:

- the licensee is aware of the environmental risks associated with carrying out the activity
- controls are in place to manage the environmental risks
- monitoring the effectiveness of the controls in place is being carried out
- staff are trained
- contingencies are in place to manage process upsets or emergencies.

2.3.1 Wastewater management

Licensees need to monitor treatment processes to ensure effective operation and that the necessary equipment is maintained and operational. If pollutants in the discharge are elevated, action needs to be taken even where the licence does not include a limit for that pollutant. Downstream users of the waterway may also need to be notified if pollutant levels are elevated.

Wastewater management was assessed as not being carried out in a competent manner at eight (33%) of the 24 sites audited. These licensees were aware of the environmental risks of managing the wastewater, but adequate controls were not always in place and maintenance and monitoring were inadequate. Some licensees had not adequately trained their staff and had no contingencies in place for emergencies. The following issues were identified.

- Emergency stormwater storage ponds were being used for receipt and temporary storage of trade waste received at the site. The waste was landfill leachate and boiler blowdown. By storing the waste in the ponds, the capacity for the emergency storage of sewage was compromised and the likelihood of trade waste discharging to surface waters increased. Further, these ponds were not lined with impermeable material, potentially posing a risk to groundwater (see Photo 14).
- Insufficient controls were in place to minimise sludge carry-over through the process and/or sludge removal from the process was inadequate as sludge was observable in the tertiary pond.
- Limited in-process sampling was being carried out to ensure processes were operating effectively.
- A maintenance program was not in place to ensure optimal operation of the plant.
- Based on the licensees' monitoring results, wastewater was not being treated to an acceptable level for discharge to the waterway. The results indicated exceedances of licence limits and/or elevated levels of other pollutants (where limits were not included on the licence) when compared to the environmental values of the receiving waters or upstream values, and not all practical measures were being used to control the levels. These pollutants included FC, NH3, TP and TN.

Photo 14: Emergency storage pond used for trade waste, posing a risk of stormwater and groundwater pollution

2.3.2 Management of activities to minimise odour

Licensees need to put measures in place to control or abate odour emissions from the plant. Measures to mitigate odour should be proactive, with necessary equipment maintained and operational. Any odour issues should be thoroughly investigated and sources identified to ensure those issues can be resolved.

Only one site was assessed as not adequately managing odour.

Complaints had been received regarding odour. The licensee did not have adequate controls in place to minimise odour emissions, particularly with a sensitive receiver located near the site. Incompetencies included:

- not adequately treating sludge
- not covering the inlet works and the bins storing grit, screenings and scum.

2.3.3 Management of sludge

Licensees need to monitor sludge processes to ensure effective treatment and to reduce odour. Weather conditions (e.g. wind direction) should be considered when disturbing sludge when it is anaerobic (e.g. when moving sludge from sludge lagoons to drying beds) to prevent odour emissions affecting neighbours. Necessary equipment must be maintained and operational and sludge must be processed/stored/ stockpiled where it will not cause water pollution.

Three of the 24 sites were assessed as not managing sludge in a competent manner, which included:

- not being aware of the risks
- not having controls in place
- not carrying out monitoring and maintenance
- not having contingencies.

These incompetencies included the following:

- Waste-activated sludge is transferred to two sludge lagoons, prior to dewatering and disposal at landfill. It was established that both lagoons were full, and sludge had not been dewatered for eight years (see Photo 15). Not maintaining the lagoons increases the risks of odour emissions, potential overflow of the lagoons and/or the reduction of effluent quality if sludge is returned through the treatment process.
- The primary sludge digester, which was essential to the sludge treatment process, was not operational and had not been for two months. Thorough mixing of sludge in the digester and factors such as control of pH, temperature and detention time are necessary to promote an environment favourable for the necessary growth of bacteria.
- The sludge drying beds, sludge stockpiles and sludge lagoon are located on a slope adjacent to the river (see Photo 16). A makeshift trench was observed dug into the slope adjacent to the stockpiles; however, this is not likely to be adequate to control runoff to the river. The sludge lagoon was not lined to prevent seepage to groundwater. These factors could increase the risk of water pollution from runoff, and seepage to the river.
- Recommendations from the Department of Primary Industries (DPI) regarding sludge management were not carried out. Despite DPI highlighting issues in 2013 that need to be addressed, the licensee had not made any changes to their practices. The issues highlighted by DPI included the
    - high suspended solids concentrations in the supernatant being returned to the plant
    - discharge from the sludge septage receival station to the sludge lagoons causing overloading of the sludge lagoons.

Photo 15: Active sludge lagoon with grass growth, indicating inadequate sludge management and lack of maintenance

Photo 16: Sludge management adjacent to river (risk of water pollution)

2.3.4 Areas for improvement

The program also identified several areas for improvement when assessing compliance with condition O1 (competency in carrying out activities). While not non-compliances they were areas where environmental performance could be improved. These included the following:

- The integrity of the lining of lagoons and/or ponds had not been checked at five sites. The lining of sludge lagoons and effluent ponds should be regularly checked for leaks to prevent soil, groundwater and surface water pollution.
- Operational and maintenance procedures or documentation, including the site Operations Manual, was not up to date or not in place at 11 sites. Operational and maintenance requirements for all plant and equipment should be included in one document and periodically updated to reflect current operations. This will provide clear and consistent guidance to operators and assist operators during any staff changes.
- Nine sites did not have a maintenance program in place, were not adequately recording inspections and maintenance or did not include all plant and equipment (e.g. ponds) in their maintenance programs. A routine and preventative maintenance program should be in place to assist in keeping plant and equipment at optimum performance. Site inspections and maintenance should be documented to ensure any operational and maintenance issues are actioned.
- In-process monitoring was not being carried out as specified in procedures or recommended in operating instructions at two sites. Adequate indicators should be measured to monitor the process, and results recorded correctly.
- The capacity or maintenance requirements of effluent bypass lagoons was not being monitored and/or the bypass storage lagoons were being used for other purposes (e.g. storage of sludge, screenings and grit) at two sites. Operators should ensure there is adequate capacity available in bypass storage lagoons should a bypass occur to avoid pollution of waters. See also the comments on the emergency stormwater storage ponds in section 2.3.1.
- Wastewater that had been bypassed at the inlet works was stagnant in the drainage discharge channel at one site. When capacity is available, bypassed effluent should be pumped back to the inlet works for treatment.
- The capacity of plant and equipment (e.g. lagoons and the belt press) was insufficient to treat the amount of sludge at two sites. If the sludge cannot be adequately treated, risks include odour, lagoon overflow and/or reduced effluent quality if excess sludge is returned through the treatment process. Licensees should ensure adequate measures are in place for sludge treatment.
- Sludge/biosolids was being stockpiled in an area where runoff may not be adequately collected at one site. Licensees should ensure that any runoff does not pollute waters.

- There was no sediment and/or grit removal at the inlet works at two sites. This material is likely to be transferred through the process, reducing the plant's capacity, and can increase requirements for maintenance of plant and equipment. Licensees should consider sediment and grit removal in any plant upgrade.
- One site had an alarm system in place for certain equipment and processes. However, after-hours alarms are responded to by an on-call employee, who is not a plant operator, and the Operations Manual had not been updated. Therefore, the person on call may not have the experience or information to respond adequately to any incidents. Alarms were not installed at all areas of risk. Licensees should ensure that control systems are reviewed continuously to ensure appropriate alarms are in place and back-up equipment and/or other contingencies are activated, and on-call employees can take appropriate action when an incident occurs.
- Operators at one site had not been trained within the last six years. At another site there were no records of staff training and the plant operating instructions had not been updated. Licensees should ensure that staff are adequately trained in environmental matters, including pollution incident response and the requirements of the licence, and records of training should be kept.
- Septic waste is occasionally received at one plant; however, there were no written procedures on waste receival. Licensees must ensure that only waste permitted by the licence is received at the site. Written procedures should be developed and communicated to operators and waste contractors.

Although these were not non-compliances, it is recommended that licensees act to address these areas for improvement to prevent environmental impacts or non-compliances occurring.

2.4 Maintenance and operation of plant and equipment

All associated plant and equipment within a sewage treatment plant must be maintained in a proper and efficient condition and operated in a proper and efficient manner to prevent pollution occurring. An effective inspection and maintenance program should be implemented, including scheduled and preventative maintenance which will assist in preventing incidents occurring. A system should be in place for recording inspections and maintenance and acting on identified issues.

2.4.1 Maintenance

Issues in relation to maintenance of plant and equipment were identified at eight (33%) of the 24 sites audited. Issues identified at individual sites were as follows:

- Grit was blocking a pipeline that conveys grit from the head of works to the grit well. Also, several nozzles on the arms of the trickling filter were blocked, thereby reducing spray distribution over the surface of the filter.
- A tree was growing in the spillway of the maturation pond and another tree had fallen across the spillway. Spillways should be maintained free of obstructions to ensure that water can overflow through this point when necessary and not endanger the integrity of the pond.
- Areas of the trickling filter plant and extended aeration tank were observed to be in poor condition, with cracks and leaks in the concrete in channels and tanks (See Photo 17). The structure on top of one trickling filter (including the central post and distributor arms) appeared to be leaning, potentially causing uneven distribution of sewage over the bed. Only one out of six valves on the sludge digester was operational for siphoning the supernatant from the sludge.
- The first digester was not operational at the time of inspection as part of the mixer (davit) needed replacing. The mixing of sludge in the digester is necessary to adequately treat the sludge. The second humus tank was also not adequately maintained. The wastewater was dark brown with some floating material.
- The two emergency stormwater ponds were observed to contain a large quantity of solids, which is likely to reduce their capacity to store effluent bypasses. The wetland and tertiary pond also needed desludging due to a build-up of solids. However, it was noted that the licensee had already budgeted in the financial year for the cleaning out of the ponds and wetlands.

- Grass was growing in both the effluent ponds and sludge lagoons, which may interfere with the process and reduce capacity. The sludge lagoons had also not been desludged for eight years (see Photo 15).
- The flow meter reader at the discharge point was flashing, indicating that it was defective, and the licensee could not provide any calibration certificates for the meter.
- The holding pin had broken on the only sludge digester, causing it to be inoperable so that sludge could not be treated. Wastewater was also leaking from the grit channel.

Operators should implement and adhere to a regular routine inspection and maintenance program. They should also address identified issues in a timely manner to ensure effective treatment and prevent pollution incidents occurring.

2.4.2 Operation

The following non-compliances in relation to operation of plant and equipment were identified at individual sites:

- The preliminary treatment process did not appear to be working effectively as material that should have been captured in the grit channel and screens was being carried over into the Imhoff tank. At the two trickling filters, the surface of the stones (media) was also observed to be dry in patches, and no slime was visible. Biological treatment through use of trickling filter beds relies on micro-organisms that become attached to the media, using the organic matter in the wastewater for growth, energy and reproduction. The micro-organisms consist mainly of bacteria that form a slime coating on the media. Dryness on the surface of the media indicates that the trickling filter beds may not be treating the wastewater effectively, as the necessary micro-organisms may not be present. This may be due to such factors as uneven effluent distribution, clogged bed material in places or significant underloading of the bed.
- Return water from the humus tank being discharged back into the inlet channel was spraying out of the channel onto the permeable ground surface. Wastewater from the trickling filter arms was also observed falling outside the trickling filter onto the ground surface.
- The subsurface wetland bypass valve had been left open so that effluent was bypassing the wetland and discharging through the discharge point.
- Effluent was pooling on the ground around a temporary discharge point from the humus tank, prior to flowing overland through a shallow concrete channel and then discharging onto land outside the site (see Photo 18). It is noted that discharges would normally occur through the maturation pond; however, due to ongoing algal blooms a pollution reduction program was in place for its upgrade.

Some plants were also required by condition of the licence to use specific treatment processes and this was not occurring.

Photo 17: Wastewater discharging from a leak in a concrete channel (lack of maintenance)

Photo 18: Effluent pooling around temporary discharge point, presenting a risk of land and water pollution

2.5 Monitoring and recording conditions

Licensees need to collect monitoring information to characterise changes in environmental discharges and to enable appropriate action when data indicates changes or ineffective treatment. The results of monitoring should be analysed and assessed against previous results and relevant criteria to identify trends and exceedances. Monitoring should be carried out at regular frequencies and with appropriate rigour to help highlight any actual or potential environmental issues.

Monitoring is an important management tool that should be used to help minimise environmental impacts associated with activities. It can be used to collect information to characterise changes in environmental emissions and to enable appropriate action to be taken when data indicates that the quantity and/or nature of emissions are changing (DECCW 2009). It is important to record monitoring and performance data to enable analysis and assessment and to make informed decisions about site operations. Monitoring of sewage treatment plants is vital because of the risk of discharging potential pollutants, including raw sewage, into waters.

Seventy-two non-compliances were identified with monitoring requirements, including requested records not being produced to the authorised officer at three sites. Other non-compliances are detailed below.

2.5.1 Concentration monitoring

- The following monitoring information was not recorded as required
  - the time that samples were collected (seven sites)
  - the location where samples were taken (three sites)
  - the name of the person who undertook the sample (five sites).
- The licensee was not sampling at the specified monitoring point and one was not monitoring the concentration of a pollutant (one site).
- The correct sampling method was not being used (two sites).
- Sampling was not carried out at the required frequency (seven sites).
- The correct units of measure were not being used (two sites).
- Representative samples were not being collected in a manner consistent with the principles of Standards Australia (1998a) AS/NZS 5667.1:1998 and the American Public Health Association (APHA) (1998) (seven sites).
- The laboratory used by the licensee to analyse samples was not using all or some of the methods in *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (DEC 2004a) for all pollutants (20 sites).

2.5.2 Volume monitoring

- Monitoring of volume had not been carried out (one site).
- The units of measure had not been included in the monitoring data (one site).
- Monitoring of the volume of discharge had not been carried out at the required frequency (two sites).
- The licensee had not submitted a proposal for volume estimation if monitoring equipment fails (11 sites).

2.5.3 Signage

- Licensees had not clearly marked the location of discharge and/or monitoring points with a sign as close as practicable to the point and indicating the point identification number (10 sites).

2.6 Recording and reporting information

Licensees need to keep accurate and detailed records of all facility operations. Keeping systematic, accurate and regular operating and maintenance records is an important part of treatment works

management and files should be well marked and readily retrievable. For records that need to be reported, it is important that the information is legible, neat, punctual and appropriate so the records can be read, understood and assessed, where required.

Licences require licensees to record and report on specific information. The following non-compliances were identified:

- not recording the required information when a bypass or overflow occurred (seven sites)
- not recording the required information regarding pollution complaints, such as the action taken by the licensee and if no action was taken, the reason why (two sites)
- not providing the written report required by a Pollution Study and Reduction Program by the due date (one site)
- not submitting the Annual System Performance Report (ASPR) or not including the required information in the ASPR, including not obtaining written approval for the format used (11 sites). Information required includes monitoring data; a summary of dry and wet weather overflows and bypasses; a breakdown of complaints received; total amount of biosolids disposed of; the amount of rainfall measured; and a diagram of the process, discharge points and monitoring points if there has been a change since the previous reporting period.

2.7 Pollution incident response management plans

All licence holders must prepare, maintain and implement a pollution incident response management plan (PIRMP). Specific requirements for PIRMPs are set out in Part 5.7A of the POEO Act and Part 3A of the POEO (General) Regulation. In summary, the requirements relating to PIRMPs are:

- All licence holders must prepare a PIRMP (section 153A, POEO Act).
- The PIRMP must include the information detailed in the POEO Act (section 153C) and be in the form required by the POEO (General) Regulation (clause 98B).
- Licence holders must keep the PIRMP at the site to which the licence relates and must publish specific parts of the PIRMP on their website (section 153D, POEO Act).
- Licence holders must test the PIRMP in accordance with the POEO (General) Regulation (clause 98E).
- If a pollution incident occurs in the course of an activity so that material harm to the environment is caused or threatened, the licence holder must immediately implement the plan (section153F, POEO Act).

The requirements are explained further in the *Environmental Guidelines: Preparation of Pollution Incident Response Management Plans* (EPA 2012). These guidelines are being reviewed and updated.

All audited licensees had developed PIRMPs, but no licensees were compliant with all PIRMP requirements.

There were 101 non-compliances, as follows:

- There was a failure to include
  - the pollution incident notification procedures for the licensed site as the PIRMP was for the whole council area (one site).
  - procedures for coordinating with the notified authorities and action taken in combatting the pollution caused by the incident (three sites).
- An incident had occurred and not all authorities were notified, nor was the likely affected community notified (one site).
- The PIRMP referred to other documents and the required information was not readily identifiable in these documents (one site).
- The current PIRMP was not available at the site (four sites).
- The PIRMP had not been tested at least once every 12 months or was not tested within one month of a pollution incident (seven sites).

- The required PIRMP information was not available on the licensee's website or was not readily accessible (two sites).
- The PIRMP did not include the following information
  - a description of the hazards (one site) and the likelihood of the hazards occurring (two sites)
  - pre-emptive actions to be taken to minimise or prevent any risk of harm (one site)
  - an inventory of all potential pollutants kept on the site or used in carrying out activities at the site and/or the maximum quantity of these pollutants (21 sites) – this should include effluent and sludge in ponds
  - a description of any safety equipment or other devices used to minimise the risks to human health or environment and to contain or control a pollution incident (two sites)
  - the names, positions and 24-hour contact details of key personnel (seven sites)
  - the contact details of all relevant authorities – this should include the EPA, local council, Ministry of Health, SafeWork, and Fire and Rescue NSW (one site)
  - the mechanisms for providing early warnings to occupiers of nearby sites (one site)
  - arrangements for minimising the risk of harm to persons on site (three sites)
  - adequate maps of the site and surrounding areas – key information (e.g. location of potential pollutants, surrounding areas most likely affected by a pollution incident, and location of stormwater drains) was not shown (19 sites)
  - a description of how any identified risk of harm to health will be reduced (two sites)
  - the nature and objectives of any staff training program (three sites)
  - the dates the plan has been tested and the names of persons who carried out the test (10 sites)
  - the dates the plan was updated (five sites)
  - the manner in which the plan is to be tested and maintained (five sites).

2.8 Publishing pollution monitoring data

Section 66(6) of the POEO Act requires all licensees who undertake monitoring as a result of a licence condition to publish or make their pollution monitoring data available to members of the public. The data must be published in accordance with the written requirements of the EPA, which are published in *Requirements for Publishing Pollution Monitoring Data* (EPA 2013). This publication is available on the EPA's website. The intention of these requirements is to improve the public's access to information and communication between licensees and neighbours.

In summary, licensees are required to do the following:

- Make the data publicly accessible in a prominent position on a website or, if the licensee does not maintain a website, the data must be provided free to any member of the public who requests it in writing.
- Provide a meaningful summary of the data and information on licence limits so that a comparison can be made with the data.
- Ensure the monitoring data that must be published is that obtained as a result of a licence condition that relates to pollutants generated, discharged or emitted from the licensed site and does not include data from ambient monitoring.
- Ensure the meaningful summary is published within 14 days of the data being obtained. (The definition of obtained includes standardising and analysing the data.)
- Publish the data in a tabular format that is easy for the public to understand.
- Publish up to four years of data, where available.
- Publish specific information with the data, such as the licence number, pollutant, monitoring frequencies, location of points, limits and relevant dates.

All audited licensees were required to undertake monitoring and all had a website which means that they are required to publish their monitoring data on their website in accordance with the requirements. All of the licensees had non-compliances with these requirements.

There were 105 non-compliances with these requirements, as follows:

- On the website, no monitoring data was published, data for all relevant points or for all pollutants was not published or the published data was unclear (seven sites).
- Volume monitoring data was not published (21 sites).
- Information regarding when and to what extent the pollutant discharge or emission limits specified in the licence were not met and why they were not met or the actual limits were not included, making it difficult for the public to know when the licensee was complying with requirements (17 sites).
- Monitoring frequencies were not published (seven sites).
- The data was not published within 14 days of the data being obtained (seven sites).
- Up to four years of data, which was available, had not been published (seven sites).
- The licence number, licensee's details and a link to the public register were not published with the data (nine sites).
- The sampling or monitoring location was not published with the data (eight sites).
- The date the data was obtained was not included with the data (12 sites).
- A correction log was not published when the licensee became aware of data being incorrect or misleading (two sites).

2.9 Other issues identified

Issues of environmental concern that did not strictly relate to the scope of the audit or assessments of compliance were also recorded as further observations. These included the following.

- One licensee had discharged from an unlicensed point prior to obtaining permission.
- Inconsistencies were noted in volume monitoring data without explanation.
- Non-compliances with limits were not reported in the Annual Return as required.

2.10 Good practices observed during the audits

The following are noted as good practices observed within the scope of the audit at some plants.

- An environmental supervisory control and data acquisition (SCADA) system is used for monitoring activities on the site. The system is equipped with alarms linked to a telemetry system that alerts operators and/or managers to issues with processes or equipment.
- A computerised maintenance management system is used for scheduling, recording and tracking maintenance.
- The inlet works, screenings and grit collection are covered and include odour control units (carbon beds), where necessary (see Photos 2, 20 and 21).
- The discharge to waters and discharge to land (irrigation onto land) for pollutants that are not required by the licence are proactively monitored.
- One licensee has a comprehensive flood management plan in place as the SSTP is located within the floodplain of a major river and lies outside the protection of the town levee system. The plan details actions to be taken in the event of different flood emergencies. The licensee has outlined specific actions to be taken dependent on the flood water level when specific areas of the site will be inaccessible or impacted by the floodwaters.
- There are fully lined sludge lagoons (high-density polyethylene or concrete) to control groundwater pollution; this also assists in sludge removal (see Photo 5).
- Adequate back-up systems are in place in cases of equipment failure, electricity outage or wet weather (e.g. availability of back-up pumps, generators and emergency storage ponds). Bypasses from head of works can be collected in storage ponds and pumped back to the head of works during low flow (see Photo 21).

- At one site, sludge digesters are heated to about 33°C to promote the growth of bacteria required for anaerobic digestion (see Photo 4). The process produces methane. This is collected, stored and used in the boilers, which heat the water used to ensure the digesters stay a consistent temperature.

Photo 19: Emergency storage pond

Photo 20: Enclosed inlet works with odour control unit

Photo 21: Inlet works with covered screening bin

2.11 After the audits

The EPA has required the licensees audited as part of this program to rectify any non-compliances identified and will continue to follow up to make sure they are complying with their licence requirements on an on-going basis.

Since the individual audit reports were finalised, follow-up by the EPA has indicated that most of the required actions have been completed by the licensees audited in this program or plans are in place for upgrades for further work to ensure that compliance is achieved.

2.11.1 Integration with licence reviews

The findings of this review will be used to guide the EPA's regular review of licences. Licences specify environmental performance requirements for activities. Appropriate conditions are generally negotiated with the licensee considering factors such as the surrounding environmental conditions, type of activity and available technology.

Section 78(1) of the POEO Act requires the EPA to review licences at least once every five years. The licence reviews aim to:

- focus on desired environmental outcomes
- enhance consistency between licences issued to an industry
- improve the effectiveness of the licensing system
- strengthen the EPA's accountability to stakeholders.

The community can contribute to the process of reviewing conditions contained in licences. The EPA publishes a list of licences to be reviewed within the next six months and this is available on our website. The community can also obtain details of any licences on the EPA's public register or by telephoning the EPA's Environment Line on 131 555.

Section 78(4A) of the POEO Act requires the EPA to audit, on an industry-wide or regional basis, compliance with licence requirements and determine whether such requirements reflect best practice in relation to the matters regulated by the licences. This strategic review report informs the licence review process in response to this legislative requirement.

3. Best environmental management practices for SSTPs

Responsible management of sewage treatment systems is important to minimise environmental and human risks. This section of the report builds on the information provided in Parts 1 and 2 to promote the use of best management practices for the operation of SSTPs to improve environmental performance and reduce these risks.

Two of the key challenges faced by SSTPs today are as follows:

- Many of the SSTPs are now old and/or poorly maintained, and require further improvement, repair or replacement to maintain their useful life and there may be financial constraints to doing so.
- Population growth and increased numbers of tourists at certain times of the year (e.g. in summer in coastal towns) creates a need for new or upgraded plants.

3.1 Environmental considerations

To minimise health and environmental risks posed by the operation of sewage treatment plants, the following general principles should be followed:

- Operate the plant according to its design parameters and, if necessary, upgrade the process.
- Ensure that peak wet weather flows can be managed without the risk of pollution incidents.
- Prepare and carry out a maintenance program to ensure equipment and works structures are kept at optimum performance, and keep maintenance records.
- Regularly monitor necessary plant control and wastewater parameters, and keep monitoring records.
- Adequately train all operational staff in the operation and maintenance of plant and equipment, responding to pollution incidents, and environmental aspects and impacts of operation, and licence conditions.
- Minimise odour emissions by applying good housekeeping practices, ensuring treatment plant processes are operating adequately and regularly maintaining plant and equipment.
- Ensure that trade waste agreements are in place and adhered to.

3.2 Environmental risk management

Licensees should consider using the framework of an environmental management system (EMS) or risk management system to manage their sites.

An EMS is a systematic approach for managing an organisation's environmental risks and opportunities. It is a framework that helps an organisation achieve its environmental goals through consistent review, evaluation and improvement of its environmental performance. It is based on a continual improvement cycle of plan, do, check and act. General guidance on establishing EMSs is available in ISO 14001:2015 *Environmental Management Systems: Requirements with Guidance for Use*. Identifying and controlling aspects and impacts are key components of an EMS. Aspects are defined as elements of an organisation's activities, products or services that can interact with the environment. Impacts are any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.

Opportunities can also be considered part of identifying aspects and are important for continuous improvement, such as keeping up to date with new technologies (e.g. improvements in treatment methods and monitoring equipment) and identifying avenues for re-use.

Guidance can also be found in *Achieving Environmental Excellence: An Environmental Management Systems (EMS) Handbook for Wastewater Utilities* (US EPA & Global Environment and Technology Foundation 2004).

The National Water Quality Management Strategy (NWQMS), *National Guidelines for Water Recycling: Managing Health and Environmental Risks* (NHMRC 2006) outlines a risk management framework to use to identify hazards, risks and preventative measures in water recycling and the use of monitoring. Other guidance can be found in *Assessing and Controlling Risk: A Guide for Business* (EPA [VIC] 2018) and ISO 31000:2009 *Risk Management: Principles and Guidelines* (Standards Australia 2009) and *Licence Assessment Guidelines: Guidelines for Using a Risk Management Approach to Assess Compliance with Licence Conditions* (EPA [VIC] 2011).

The EPA's risk-based licensing system provides for a reduction in a licensee's environmental management score for having the components of an EMS in place and this may translate into a reduction in licensing fees. To be eligible for this discount, the licensee must provide documented evidence of their EMS and its implementation to EPA auditors when being audited. See *Risk-based Licensing: Environmental Management Systems Guidelines* (EPA [NSW] 2016b).

Controls put in place to manage risks identified at any site include:

- eliminating or substituting the hazard (e.g. use of an alternative chemical)
- installing an engineering control (e.g. bunding or automatic shutdowns)
- using administrative controls (e.g. procedures, monitoring systems and training). (EPA [VIC] 2018)

These controls must subsequently be checked to ensure they are effective. This involves inspection and maintenance, including testing and calibration.

Certain activities were not included in the scope of the SSTP audits and therefore do not appear in this review. The activities not included are handling and storage of chemicals, effluent re-use, biosolids use and ambient monitoring. It is important that operators also consider those activities in their site management.

Consider using the framework of an EMS or risk management system for managing the site.

3.3 Wastewater and sludge management

3.3.1 Controls on influent to sewage treatment plants

The quality and quantity of wastes entering the sewerage system (influent) must be managed to:

- protect treatment processes (e.g. the microbes in trickling filters and activated sludge can be killed by an influx of chemicals)
- ensure adequate treatment; a plant is designed for a certain capacity so can only treat up to a maximum volume of wastewater.

Controls on influent include:

- ensuring the plant's capacity is considered when developments are planned in the STP's catchment, with additions/upgrades made as necessary
- maintaining the reticulation system to reduce infiltration and inflow of stormwater
- having controls on trade waste discharged to the system
- using measures to divert and store excess flows, which can subsequently be treated during periods of low flow.

Reliable estimation of sewage flow rates is essential for the proper design of sewers, pumping stations and treatment plants. While the reticulation system was not included in this strategic review, it is an

important part of the system that licensees must operate and maintain in a proper and efficient manner to minimise bypasses and overflows, and control influent and odour.

Liquid trade waste is defined in the Local Government (General) Regulation 2005 as 'all liquid waste other than sewage of a domestic nature'. Due to the variability of trade waste in strength and quality it places a greater demand on the sewerage system than does residential waste and increases risks to the environment and human health.

Liquid trade waste is managed either by water utilities (e.g. Sydney Water and Hunter Water) under dedicated legislation and controls or by councils under the Local Government (General) Regulation with the support of the NSW Department of Industry, which is also responsible for authorising trade waste discharges in some circumstances. The Department of Industry also administers the *Liquid Trade Waste Regulation Guidelines* (DWE 2009), which provide guidance to SSTP managers on regulation of trade waste and includes a model policy.

Plant operators must note any unusual characteristics of sewage entering the plant and communicate this to trade waste officers as this may indicate illegal trade waste discharges. Where trade waste is delivered directly to the plant but cannot be treated immediately, it must be stored in a manner that minimises risks to groundwater and surface water and odour impacts.

Ensure controls are in place to manage variable flow and load coming into the plant, including managing volumes of influent and trade waste.

3.3.2 Effluent discharges

Wastewater that is not adequately treated can pose a range of potential health and environmental risks and impacts, including:

- public health risks due to the presence of pathogens
- negative impacts on ecosystems and organisms in receiving waters due to high biological oxygen demand, low dissolved oxygen, potential ammonia toxicity, high total nitrogen and phosphorus concentrations and loads
- negative impacts on aquatic ecosystems or water users as contaminants in the sewage can be toxic to them
- groundwater and soil contamination and soil structure decline through effluent irrigation
- sediment contamination.

NSW has adopted the *National Water Quality Management Strategy* (NWQMS) and the *ANZECC Guidelines* (ANZECC and ARMCANZ 2000) as the policy and technical framework to assess and manage water quality. Where effluent is discharged to a waterway, licensees must not only consider any limits in their licence but also the environmental values of the waterway and the practical measures that can be taken to restore or maintain those values. (Further information about the NWQMS can be found on the About tab at the Water Quality Australia website.)

The POEO Act dictionary identifies the environmental values of water as those in the *ANZECC Guidelines*. Environmental values are particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and that require protection from the effects of pollution, waste discharges and deposits. These include protection of aquatic ecosystems, drinking water, primary and secondary recreation, visual amenity and agricultural water for irrigation, livestock and growing aquatic foods. The community's environmental values in NSW are the NSW Water Quality Objectives, which are consistent with the *ANZECC Guidelines*. Further information can be found in *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC 2006d) and *Considering Environmental Values of Water when Issuing Prevention Notices* (DEC 2006a).

If wastewater is not being treated adequately for the receiving environment or is not achieving limits, the system must be reviewed to identify actions to take to prevent or mitigate impacts in the short and long term. Where downstream users may be affected, notifications may be required, and this information should be included in the licensee's PIRMP.

The re-use of effluent was not included in this review. Licensees should refer to *Environmental Guidelines: Use of Effluent by Irrigation* (DEC 2004b).

The handling and management of chemicals used in the treatment process was also not included in this review. Licensees should refer to *Storing and Handling Liquids: Environmental Protection – Participant's Manual* (DECC 2007).

Ensure treatment processes are adequate to achieve compliance with licence requirements and with the end use of the water or with the receiving environment where it is discharged to not cause an environmental impact.

3.3.3 Management of solid waste

Solid waste generated from the treatment process is mainly screenings, grit and sludge. The collected screenings and grit should be disposed of at a landfill to prevent environmental impacts on land and water and odour impacts.

Sludge must be treated adequately to ensure it does not cause odour impacts. It must be stored and disposed of or re-used so that it does not impact on land and water. Weather conditions should be considered by operators when planning sludge activities (e.g. moving the sludge), particularly when it has been anaerobic, to minimise odour impacts on surrounding receptors. Sludge lagoons should include an impermeable membrane to minimise risks to groundwater. Sludge lagoons must be desludged regularly to ensure adequate residual capacity is maintained to prevent overflows.

Sludge may be re-used beneficially as biosolids when treated to an acceptable quality. Management of biosolids was not included in this review. Licensees should refer to *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA [NSW] 2000).

Ensure solid waste is being adequately treated and disposed of or re-used so that it does not cause an environmental impact.

3.3.4 Controls on odour at sewage treatment plants

An important and challenging issue of sewage treatment is controlling odours. Odour from sewage treatment works can have a detrimental impact on the quality of the local environment for those living close by. Odours are often a source of frequent complaints, from neighbours and plant workers alike.

Cause of odours

Generally, odours at treatment plants originate from anaerobic decomposition of organic compounds. Hydrogen sulfide (H_2S), a natural by-product of anaerobic digestion, gives off a strong, nauseating smell. Due to its low solubility in water, it is released into the atmosphere, producing an offensive odour.

Two other causes of odour at treatment plants are amines and mercaptans. These organic compounds contain sulfur or nitrogen, producing odours that humans can smell at extremely low concentrations.

Weather conditions such as temperature inversions, wind velocity and wind direction can intensify odours and contribute to how far odour can be perceived by humans. Odours are typically worse at higher temperatures. During the warmer months, increased activity (e.g. the influx of tourists) usually results in plant management receiving more odour complaints. The severity of odours can be affected by such factors as plant maintenance – either planned or unplanned – and/or upgrades to treatment processes.

Basic means of odour control

The four main approaches to prevent or minimise odour impacts for any odour-generating activity are:

- selecting an appropriate site and design layout (e.g. compatibility with surrounding land uses)
- managing odour at the source (e.g. control technology)
- managing odour in the pathway (e.g. buffers)

- managing odour at receptors (e.g. communication strategy with neighbours).

Further information is provided in *Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW* (DEC 2006b).

Means of odour control should be put in place proactively at SSTPs as a matter of good practice to minimise the risk of odour nuisance occurring. These include:

- where a choice in location of major sources (e.g. inlet works and sludge activities) is practicable, locating them at positions on the site where the odour impact on neighbours is likely to be minimised
- selecting process steps that present least risk of odour
- containing or covering odorous processes and equipment, where appropriate (e.g. at the inlet)
- controlling and minimising odours from wastes, particularly in sludge processes
- maintaining the effluent aeration other than in processes that are specifically anaerobic
- minimising septicity
- properly maintaining and operating plant and equipment
- using good housekeeping practices.

Plant performance, maintenance, inspection and operator training are crucial in controlling odour.

Ensure odours are prevented or minimised to not cause an impact on surrounding receptors.

3.4 Operation and maintenance of plant and equipment

Sewage treatment plants must be operated as designed to adequately protect water quality and human health. Most systems are in operation every day of the year, so providing a reliable service and avoiding equipment breakdown is essential.

All sewage treatment plants should have operational and maintenance plans for all plant and equipment in a clear and suitable form. These plans should be updated periodically to reflect current operations. This will provide clear and consistent guidance to operators, who are responsible for the day-to-day performance of the system. It will also assist operators during staff changes.

A maintenance program should be developed and implemented to assist in maintaining optimum performance of plant and equipment. This includes calibration of flow meters, sensors and other monitoring equipment and maintenance of lagoons and ponds. Critical equipment should be identified and prioritised, and back-up equipment and spare parts should be available.

Equipment must be inspected regularly. Site inspections and maintenance should be documented to ensure any operational and maintenance issues are actioned.

Maintenance orders raised in the maintenance system must be followed up, tracked and closed out within the allocated timeframe. The maintenance system should flag any uncompleted orders and have in place a robust review system that ensures all orders and notifications are closed out.

Many SSTPs use computerised maintenance programs to schedule, track and record maintenance tasks. Such programs provide the maintenance manager with information to efficiently manage plant and equipment maintenance.

Extensive guidance on operation and maintenance of sewage treatment plants is available from industry organisations, such as the NSW Water Directorate and the Water Services Association of Australia. Support for local water utilities is also available from the NSW Department of Industry.

Although the reticulation system was not assessed as part of this program, the maintenance of this system is important. Maintenance will prevent stormwater infiltration and inflow to the system, and bypasses and overflows from the system causing water pollution and odour impacts.

Ensure an effective maintenance program is in place and being implemented and records are kept. Consider using a computerised maintenance program.

3.5 Monitoring and process control

Monitoring can be broadly defined as the systematic collection, analysis and interpretation of data to effectively track, manage or alter site management activities. Monitoring is an important management tool that should be used to help minimise the environmental impacts associated with sewage treatment activities. It can be used in-process for monitoring performance and at the end of the process to verify performance and check compliance.

Effective monitoring requires the results of measurements to be analysed and assessed on an ongoing basis against previous results and relevant criteria so that trends and issues may be identified. To properly monitor any actual or potential environmental issue, taking of samples or measurements must be carried out at sufficiently regular frequencies and with appropriate rigour to provide a reliable basis for such an analysis or assessment.

Extensive process control expertise is available to SSTP operators through industry association guidance and the Department of Industry. These resources should be utilised by operators.

Critical control points or operational parameters should be identified and monitored to ensure the system is:

- performing adequately to produce effluent within concentration limits
- causing minimal impact on the receiving environment or in re-use.

Operators should carry out routine process monitoring and testing on site and by laboratory analysis to assess plant performance. Operators must be able to interpret the results and act to adjust the process, where necessary. Visual and odour inspections by experienced operators can be used to identify any issues with processes and equipment, including the quality of influent entering the plant.

Compliance or verification monitoring should be carried out on the effluent at the end of the process. In addition to samples collected to comply with the licence, the operator should carry out checks of effluent quality for at least some indicators on a more frequent basis. This will allow the operator to check the plant performance and ensure adequate water quality.

Samples collected for the licence must be representative of the condition being investigated, and collected in a manner consistent with the collection, handling and preservation principles enunciated in Standards Australia (1998a) AS/NZS 5667.1:1998 *Water Quality: Sampling Part 1 – Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples,* and section 1060 of *Standard Methods for the Examination of Water and Wastewater* (APHA 1998). Sampling procedures should be in place and the person carrying out the sampling should be trained adequately.

Licensees are also required to publish licence monitoring data on their website or to make it publicly available if they do not have a website (see section 2.8).

3.5.1 Computer control and monitoring

With advancements in technology, computer control and monitoring are used for many treatment processes, including activated sludge systems (e.g. to control and check cycles, aeration, water levels and operation of sludge pumps).

SSTP managers should consider adopting computer control and systems monitoring where appropriate. Plant control systems can include programmable logic controllers (PLCs) interfaced with a supervisory control and data acquisition (SCADA) system, which can be viewed by the operator on computer screens.

Critical alarms for the SSTP (e.g. for equipment failure or parameter exceedances) can be linked to a telemetry system. The alarm can be sent through as a text message to the mobile phone of the operator or on-call officer so that action can be taken. Written procedures should be in place for required actions in response to alarms.

3.5.2 Other monitoring

Licences may include odour conditions to monitor and manage the emission of offensive odour. Any odour sampling must be conducted in accordance with the method for odour sampling from point sources as outlined in the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (DEC 2007b). The sampling results should be compared against the odour assessment criteria in *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2007a), the *Technical framework: Assessment and Management of Odour from Stationary Sources in NSW* (DEC 2006b) and *Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW* (DEC 2006c).

Ambient monitoring was not included in this review but may be required by the licence. Licensees should carry out ambient monitoring when discharging to waterways, both upstream and downstream of the plant, to assess any impacts and inform any actions required.

Ensure the treatment processes and effluent are monitored and the results reviewed and acted on.

Consider implementing computer monitoring and control systems to monitor and control the treatment process, where appropriate, and to alert operators if there is a problem with the process or equipment.

3.6 Contingencies

Actions to be taken in response to incidents or emergencies must be documented and preventative measures and controls put in place. Pollution incident response management plans (PIRMPs) are required by the POEO Act (see section 2.7). They must be tested at least once every 12 months to ensure they are capable of being implemented in a workable and effective manner.

Licensees should have contingencies in place to prevent pollution during incidents or equipment failure. These may include:

- emergency storage of effluent during high flow or where there is an influx of low-quality influent or during other incidents
- redundant or back-up equipment for equipment failure or during maintenance
- systems to use during power outages (e.g. electricity generators and uninterrupted power supply units and battery packs) to provide power to plant control systems.

Ensure contingencies and back-up systems are in place (e.g. for equipment failure, electricity outage and high flow).

3.7 Staff competence and training

Operators must receive adequate training in all aspects of treatment plant operation and acquire a working knowledge of different units and systems. Adequate written procedures should be in place for staff and suitably documented to ensure staff can competently operate plant and equipment and minimise environmental risks.

Areas of training should include the following:

- environmental responsibilities, including environmental impacts of activities and controls that must be in place, and specific licence requirements required for their role
- maintenance and operation of plant and equipment
- incident response and reporting; testing of the PIRMP may form part of this training
- monitoring and control systems, including responding to in-process alarms/out-of-parameter indicators. Where operators are required to collect samples, training in correct sampling collection, recording and preservation should be undertaken.

Records of staff training should be kept.

Note that DPI Water offers training courses for regional NSW local water utilities in wastewater treatment and liquid trade water regulation. For further information see the Department of Industry website.

Ensure staff are trained in their roles and responsibilities and records kept of this. Ensure written procedures are in place to ensure staff can competently operate and maintain plant and equipment and minimise environmental risks.

3.8 Record keeping

Keeping systematic, accurate and regular operating and maintenance records is an important part of treatment works management (DPI 2016). From an operational and legal perspective, it is essential that plant operators keep accurate and detailed records of all facility operations. Beyond their legal and compliance purposes, the plant's records serve an even more important role for the operators. Good records are invaluable for the operators to track the plant's operating history, loading trends, process performance and effluent quality. Good data and records allow the operators to quickly recall past observations and performance at the facility, which might offer some bearing on current issues.

Records are critical for the optimal operation of the plant's maintenance program. Detailed maintenance records on every piece of equipment in the plant will allow operators to conduct a proactive preventative maintenance program. Over time, the plant's records can become a powerful tool for future maintenance planning and scheduling.

The detailed information included in records will vary with the size, type and complexity of the plant.

Records must be clear and appropriately stored so they can be used for monitoring plant and equipment performance, for planning plant upgrades and as the basis for preparing reports, such as those required by the EPA.

Ensure systematic, accurate and regular operating and maintenance records are kept.

3.9 Legislation administered by other agencies

In addition to the EPA, several other NSW government agencies have legislative responsibilities for sewage treatment plants. The primary support and oversight of matters other than environmental regulation is carried out by the Department of Industry, which administers the relevant sections of the *Local Government Act 1993*.

3.9.1 The *Local Government Act 1993*

Local councils control sewerage systems within the council region that are outside the areas of responsibility of the statutory authorities (e.g. Sydney Water or Hunter Water). The council's powers and obligations are established under the Local Government Act.

Under sections 60 and 61 of the Act, a council must obtain the approval of the Minister before constructing any sewerage scheme. It must also obey any directions of the Minister concerning operation and maintenance of the works.

In practice, the government provides advice to councils on sewerage matters. It has an obligation to ensure all schemes are designed, constructed, operated and maintained to standards acceptable to all relevant state authorities and parties concerned. All designs for sewerage schemes must be submitted to the Department of Planning and Environment for approval before construction.

Under section 68 of the Act, a person wishing to discharge trade waste to the sewerage system must obtain prior approval from the relevant council. Liquid trade waste is defined in the Local Government (General) Regulation as 'all liquid waste other than sewage of a domestic nature'.

Under section 428 of the Act, the council is required to submit an annual report on the condition of sewerage treatment works under its control, together with:

- an estimate of the amount of money required to bring the works up to a satisfactory standard
- an estimate of the annual expense of maintaining the works at that standard
- council's program of maintenance for the year in respect of the works.

3.10 Guidance material, standards and references

While reviewing best environmental management practices for SSTPs, the EPA researched current environmental management standards and guidance in Australia and overseas. These included the relevant standards and codes of practice and guidelines addressing environmental risks associated with the management of sewage treatment plants.

The following guidance material is particularly relevant to managing SSTPs:

- ANZECC & ARMCANZ 1997, *Australian Guidelines for Sewerage Systems – Effluent Management*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra
- ANZECC & ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Waters*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra
- ANZG 2018, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Governments, Canberra
- APHA 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th edn, American Public Health Association, Washington DC
- DEC 2004a, *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales*, Department of Environment and Conservation NSW, Sydney
- DEC 2004b, *Environmental Guidelines: Use of Effluent by Irrigation*, Department of Environment and Conservation NSW, Sydney
- DEC 2006a, *Considering Environmental Values of Water when Issuing Prevention Notices*, Department of Environment and Conservation NSW, Sydney
- DEC 2006b, *Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW*, Department of Environment and Conservation NSW, Sydney
- DEC 2006c, *Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW*, Department of Environment and Conservation NSW, Sydney
- DEC 2006d, *Using the ANZECC Guidelines and Water Quality Objectives in NSW,* Department of Environment and Conservation NSW, Sydney
- DEC 2007a, *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, Department of Environment and Conservation NSW, Sydney
- DEC 2007b, *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*, Department of Environment and Conservation NSW, Sydney
- DECC 2007, *Storing and Handling Liquids: Environmental Protection – Participant's Manual,* Department of Environment and Climate Change NSW, Sydney
- DECCW 2009, *Strategic Environmental Compliance and Performance Review: Industry Monitoring*, Department of Environment, Climate Change and Water NSW, Sydney.
- DEWS 2014, *Planning Guidelines for Water Supply and Sewerage,* Department of Energy and Water Supply, Queensland Government, Brisbane
- DPI 2016, *Wastewater Treatment, Operator Training Course Notes (Part 1 and Part 2),* Department of Primary Industries Water, NSW Government, Sydney

- DWE 2009, *Liquid Trade Waste Regulation Guidelines* (currently under review), NSW Department of Water and Energy, Sydney
- EPA (NSW) 2000, *Environmental Guidelines: Use and Disposal of Biosolids Products,* NSW Environment Protection Authority, Sydney
- EPA (NSW) 2003, *Licensing Guidelines for Sewage Treatment Systems*, NSW Environment Protection Authority, Sydney
- EPA (NSW) 2012, *Environmental Guidelines: Preparation of Pollution Incident Response Management Plans*, NSW Environment Protection Authority, Sydney
- EPA (NSW) 2013, *Requirements for Publishing Pollution Monitoring Data*, NSW Environment Protection Authority, Sydney
- EPA (NSW) 2016a, *Protection of the Environment Operations Risk-based Licensing: Guidance on Using the Risk Assessment Tool*, NSW Environment Protection Authority, Sydney
- EPA (NSW) 2016b, *Risk-based Licensing: Environmental Management Systems Guidelines*, NSW Environment Protection Authority, Sydney
- EPA (NSW) 2017, *Compliance Audit Handbook*, NSW Environment Protection Authority, Sydney
- EPA (VIC) 1997, *Code of Practice for Small Wastewater Treatment Plants, Publication 500,* Environment Protection Authority, Victoria
- EPA (VIC) 2011, *Licence Assessment Guidelines: Guidelines for Using a Risk Management Approach to Assess Compliance with Licence Conditions,* Environment Protection Authority, Victoria
- EPA (VIC) 2018, *Assessing and Controlling Risk: A Guide for Business,* Environment Protection Authority, Victoria
- International Organization for Standardization, 2015, ISO 14001:2015, *Environmental Management Systems: Requirements with Guidance for Use,* International Organization for Standardization, Geneva
- International Organization for Standardization, 2018, ISO 19011:2018, *Guidelines for Auditing Management Systems*, International Organization for Standardization, Geneva
- NHMRC 2006, *National Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)*, Natural Resource Management Ministerial Council, Canberra
- Standards Australia 1998a, AS/NZS 5667.1:1998, *Water Quality: Sampling Part 1 – Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples*, Standards Australia, Sydney
- Standards Australia 1998b, AS/NZS 5667.2:1998, *Water Quality: Sampling Part 2 – Guidance on Sampling Techniques*, Standards Australia, Sydney
- Standards Australia 1998c, AS/NZS 5667.3:1998, *Water Quality: Sampling Part 3 – Guidance on the Preservation and Handling of Samples*, Standards Australia, Sydney
- Standards Australia 1998d, AS/NZS 5667.6:1998*, Water Quality: Sampling Part 6 – Guidance on Sampling of Rivers and Streams*, Standards Australia, Sydney
- Standards Australia 1998e, AS/NZS 5667.11.1998, *Water Quality: Sampling Part 11 – Guidance on Sampling of Groundwater*, Standards Australia, Sydney
- Standards Australia 2009, AS/NZS ISO 31000:2009, *Risk Management: Principles and Guidelines*, Standards Australia, Sydney
- Toifi M, O'Halloran R & Diaper C. 2011 *Best Practice Performance Monitoring for Small Scale Wastewater Treatment Systems*. CSIRO: Water for a Healthy Country National Research Flagship
- US EPA & Global Environment and Technology Foundation 2004. *Achieving Environmental Excellence: An Environmental Management Systems (EMS) Handbook for Wastewater Utilities*, National Service Centre for Environmental Publications, Washington DC

Glossary

action program *see* **remedial action**

audit a *systematic, independent and documented process for obtaining objective evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled (*ISO 19011:2018)

audit criteria Defined requirements against which the auditor compares collected audit evidence. Criteria may include regulatory requirements, standards, guidelines or any other specified requirements.

audit evidence Evidence collected to assess compliance, including documentary evidence and any evidence collected during an audit inspection of the site (e.g. auditor's observations, photographs, videos and evidence provided by the licensee during interviews).

audit inspection The step in the audit process where auditors visit the licensed site to conduct meetings, interviews, observe operations and collect evidence against which compliance will be assessed.

audit scope The extent and boundaries of the audit (e.g. locations, organisational units, activities and processes to be audited) and the time period covered by the audit.

code blue A non-compliance for licence conditions that do not have a direct environmental significance but are still important to the integrity of the regulatory system. These conditions relate to administrative, monitoring and reporting requirements.

code orange A non-compliance of environmental significance but one where remedying the non-compliance can be given a lower priority than a red risk assessment.

code red A non-compliance of considerable environmental significance that therefore must be dealt with as a matter of priority.

code yellow A non-compliance that could receive a lower priority than a red or orange risk code, but the non-compliance is still important and must be addressed.

compliance There is sufficient and appropriate evidence to demonstrate the requirement has been complied with and is within the scope of the audit.

environment protection licence (EPL) A licence that authorises the carrying out of scheduled activities or controls pollution arising from non-scheduled activities, being a licence issued under Chapter 3 of the *Protection of the Environment Operations Act 1997* and in force.

environmental harm Includes any direct or indirect alteration of the environment that has the effect of degrading the environment and, without limiting the generality of the above, includes any act or omission that results in pollution.

facility Any site where a scheduled or non-scheduled activity is undertaken.

licence conditions Stipulations listed on the environmental protection licence outlining the requirements with which the licensee must comply.

licensed site Any site where a scheduled activity is undertaken for which the licensee has obtained a licence to do so.

monitoring Being aware of the state of a system. The process of monitoring involves collection, analysis and interpretation of data to determine the state of the system and how the system is changing.

monitoring data Data collected for characterising changes in an event as the result of a direct observation or experiment. The facts are usually numbers that reflect the result of a measurement determined from observations or experiments.

monitoring frequency The frequency with which a licensee is required to collect samples, as required by their licence.

non-compliance Clear evidence has been collected to demonstrate the requirement has not been complied with and is within the scope of the audit.

not applicable The requirement is not relevant to the licensee's facilities or operating conditions or the scope of the audit.

not determined Insufficient evidence is available to allow an evidence-based assessment of compliance to be made.

pollution Water pollution, air pollution, noise pollution or land pollution.

public register The public register under section 308 of the POEO Act is an online searchable database and contains:

- licences
- applications for new licences and to transfer or vary existing licences
- environment protection and noise control notices
- convictions in prosecutions under the POEO Act
- results of civil proceedings
- licence review information (submissions regarding licence review can be made at any time)
- exemptions from the provisions of the POEO Act or regulations
- approvals granted under clause 9 of the POEO (Control of Burning) Regulation
- approvals granted under clause 7A of the POEO (Clean Air) Regulation.

remedial action An action or series of actions that the licensee is required to undertake to correct an identified non-compliance. It is issued in association with an expected completion date.

risk The effect of uncertainty on objectives (AS/NZS ISO 31000:2009).

scheduled activity An activity listed in Schedule 1 of the POEO Act.

scheduled (site) A site (as defined in the POEO Act) on which an activity listed in Schedule 1 of the Act is carried out. The person or company undertaking the activity is required to hold an environment protection licence to carry out the activity. A scheduled site may be:

- a building or structure
- land or a place (whether enclosed or built on or not)
- a mobile plant, vehicle, vessel or aircraft.

Appendix A: Sites audited

Licence number	Licensee	Site name	Scale of activity (as specified in licence)
236	City of Lithgow Council	Lithgow Sewage Treatment Plant	>1,000–5,000ML discharged
393	Wagga Wagga City Council	Bomen Industrial Pre-treatment Sewage Treatment Facility and Narrung Street Sewage Treatment Plant	>1,000–5,000ML discharged
585	Richmond Valley Council	Casino Wastewater Treatment Works	>1,000–5,000ML annual maximum volume of discharge
594	Port Macquarie Hastings Council	Lake Cathie/Bonny Hills Sewage Treatment Works	>219–1,000ML discharged
750	Sydney Water Corporation	Hornsby Heights Sewage Treatment System	>1,000–5,000ML annual maximum volume of discharge
806	Liverpool Plains Shire Council	Quirindi Sewage Treatment Works	100–219ML discharged
832	Kyogle Council	Kyogle Sewage Treatment System	>219–1,000ML discharged
836	Narrandera Shire Council	Narrandera Sewage Treatment Plant	>219–1,000ML annual maximum volume of discharge
1684	Hawkesbury City Council	McGraths Hill Sewage Treatment Plant	>1,000–5,000ML discharged
1752	Snowy Monaro Regional Council	Bombala Sewage Treatment Works	100–219ML annual maximum volume of discharge
1781	Kempsey Shire Council	Gladstone Sewage Treatment System	>100–219ML discharged
1942	Wyong Shire Council	Bateau Bay Sewage Treatment System	>5,000–10,000ML discharged
1958	Mid-Western Regional Council	Rylstone Sewage Treatment Works	>20–100ML annual maximum volume of discharge authorised[1]
2531	MidCoast County Council	Dawson Wastewater Treatment Plant	>1,000–5,000ML discharged
2613	Walcha Council	Walcha Sewage Treatment Plant	>100–219ML annual maximum volume of discharge
2760	Clarence Valley Council	Clarenza Sewage Treatment Plant	>1,000–5,000ML discharged
2866	Hilltops Council	Harden Shire Council Treatment Works	>100–219ML annual maximum volume of discharge
3618	Tweed Shire Council	Hastings Point Wastewater Treatment Plant	>1,000–5,000ML discharged
3755	Hunter Water Corporation	Paxton Wastewater Treatment Works	>219–1,000ML annual maximum volume of discharge
3850	Dubbo City Council	Dubbo Sewage Treatment Plant	>1,000–5,000ML discharged
3936	Shoalhaven City Council	Sussex Inlet Sewage Treatment Plant	>219–1,000ML annual maximum volume of discharge
5059	Muswellbrook Shire Council	Denman Sewage Treatment System	>100–219ML discharged
10362	Wingecarribee Shire Council	Mittagong Sewage Treatment System	>1,000–5,000ML annual maximum volume discharged
11715	Narromine Shire Council	Narromine Sewerage Treatment Works	>219–1,000ML discharged

[1] This site was licensed for 'Miscellaneous licensed discharge to waters (at any time)'