On-site Sewage Treatment Panel Report

| SERVICE TRADES COUNCIL

November 2022

QUEENSLAND BUILDING AND CONSTRUCTION COMMISSION

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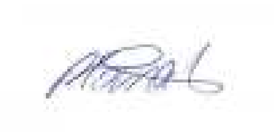
List of Abbreviations

ABCB	Australian Building Codes Board
ADWG	Australian Drinking Water Guidelines
AS/NZS	Australian Standard/New Zealand Standard
ASQA	Australian Skills Quality Authority
AWTS	Advanced Wastewater Treatment System
BOD	Biological Oxygen Demand
CCPD	Compulsory Continued Professional Development
CDC	Centre for Disease Control and Prevention
CSP	Community Sewerage Program
CWMS	Community Wastewater Management System
DEPW	Department of Energy and Public Works
DES	Department of Environment and Science
DLR	Design Loading Rate
DOJ	Department of Justice
DRDMW	Department of Regional Development, Manufacturing and Water
DSDILGP	Department of State Development, Industry, Local Government and Planning
DWMP	Domestic Wastewater Management Plan
ECO	Early Connection Option
EP	Equivalent Persons
EPA	Environmental Protection Act
EPR	Environmental Protection Regulation 2019
ERA	Environmentally Relevant Activity
FCRC	Fraser Coast Regional Council
GIS	Geographical Information System
HAB	Harmful Algal Bloom
IPIQ	Institute of Plumbing Inspectors Queensland
ISO	International Standards Organisation
IWA	International Water Association
LAA	Land Application Area
LGA	Local Government Area

LGAQ	Local Government Association Queensland
LURT	Land Use Risk Tool
NCC	National Construction Code
NorBE	Neutral or Beneficial Effect
NWI	National Water Initiative
OSF	On-site Sewage Facility
OSTP	On-site Sewage Treatment Panel
PCA	Plumbing Code of Australia
PDA	Plumbing and Drainage Act 2018
PDR	Plumbing and Drainage Regulation 2019
QAO	Queensland Audit Office
QBCC	Queensland Building and Construction Commission
QPWC	Queensland Plumbing and Wastewater Code
RTO	Registered Training Organisation
SPP	State Planning Policy
STC	Services Trades Council (The Council)
STED	Septic Tank Effluent Disposal
STEP	Septic Tank Effluent Pump
TAFE	Technical and Further Education
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
VAGO	Victorian Auditor Generals Office
VBNC	Viable but Nonculturable
VET	Vocational Education and Training
WHO	World Health Organization
WSSRA	Water Supply (Safety and Reliability) Act 2008
WTP	Water Treatment Plant
YVW	Yarra Valley Water

Document Approvals

Role	Name	Signature	Date
Service Trades Council Chair	Penny Cornah		28 November 2022
On-site Sewage Treatment Panel Chair	Dr Janet Cumming		28 November 2022

1 Executive Summary

1.1 The Panel

The On-site Sewage Treatment Panel (the Panel) was established by the Service Trades Council (the Council) on 8 August 2019 to investigate concerns relating to on-site sewage management in Queensland, including:

- Public health and safety risks
- Licensing requirements
- Training and qualifications
- Public knowledge of maintenance requirements; and
- Regulation of the industry.

The Panel's objectives were to take an evidence-based approach to the consideration of concerns raised by stakeholders and to provide recommendations to the Council for resolution of these concerns.

1.2 Work Undertaken

The Panel commenced its work by engaging with licensees and local governments in the on-site sewage industry.

A survey of local governments was conducted in November 2019. The survey asked local governments about their on-site sewage facility (OSF) compliance and auditing of OSFs, and whether they thought the training and licensing requirements for designers, installers and maintainers and the information available to owners were adequate.

An online survey of licensees was conducted in December 2019. The survey asked licensees about their experiences and observations of OSF performance. Licensees were also asked to rank the problems identified by the Panel according to most and least concern. Over 1000 licensees initially responded to the survey, but only around half completed it.

The Panel members participated in a series of workshops to discuss the results of these surveys, identify the key problems, identify the evidence of those problems and to examine potential solutions. The results of these workshops formed the basis of a series of options that were presented to the on-site sewage industry through a

Consultation Report in March 2021. The Panel categorised the problems identified into five groups: performance, location, licensing, design and households.

The Consultation Report proposed 30 options for changes or reform to the management of OSFs in Queensland, covering the five areas of concern identified by the Panel. There were just over 400 initial responses to the online survey during the consultation period, with about half completing all questions. In addition, several written responses were received from local governments, industry groups and individuals.

The Panel was unable to conduct face to face consultation sessions due to COVID-19 restrictions.

The Panel also undertook a review of the regulation of OSFs in Queensland. In addition to the national standards and codes, the Panel identified 12 pieces of legislation and six government departments that have a direct or indirect role in the management of OSFs. This legislation determines if and where OSFs can be located, and how they are managed. The roles were assessed against the requirements of Standards Australia and Standards New Zealand 2012 On-site domestic wastewater management (AS/NZS 1547:2012).

A literature review was undertaken with particular focus on studies undertaken in Queensland. A significant number of studies were undertaken in Queensland in the early 2000s. In some instances, these studies were undertaken for local governments, and the findings had informed management practices. The Panel identified other Australian and international studies that were helpful in identifying problems, health risks, failure rates and solutions in OSFs. Reports from other jurisdictions in Australia presented a range of options that could be considered for the management of OSFs in Queensland. Local governments that have implemented some of these strategies in Queensland were forthcoming with information to assist the Panel.

1.3 Key Findings

1.3.1 Wastewater Policy

The regulation of wastewater and OSFs in Queensland is complex and fragmented. Not all departments are fully across their roles or cognisant of the impacts of their decisions. There is no State policy on wastewater that would coordinate the roles. Victoria, NSW and WA have state wastewater policies that can be used to inform decisions regarding on wastewater management where Queensland often leaves these decisions to under-resourced local governments. Developments default to on-sites because no one is taking responsibility for cumulative impacts or assessing the ability of local governments to manage auditing and compliance.

1.3.2 Legacy Issues

There is a legacy of old OSFs in Queensland that is not being addressed. OSFs installed prior to 2000 were designed and installed to a standard that was not intended to ensure long-term viability, and many of these are still in use. Peri-urban areas have undergone extensive development in recent years and significantly outpaced the extension of sewerage networks. This development has occurred in many instances without regard to the ability of block sizes to cope with wastewater disposal, or to the accumulative effects of the resulting density of OSFs. In other states, particularly, but not exclusively, Victoria, this problem has been recognised and addressed for many years through a sewer backlog program. This program identifies high risk peri-urban and regional developments with failing OSFs and lagging sewerage infrastructure and seeks to identify solutions tailored to each community through the development of Domestic Wastewater Management Plans. In Queensland, management plans are required for the supply of drinking water, but not for wastewater servicing.

1.3.3 Costs

The costs of any initiatives aimed to improve OSF management and compliance in Queensland was raised by several respondents to the Consultation Report. The State Government offers grant funding to local government for water and wastewater infrastructure projects, including in the specifically targeted round 6 of Building Our Regions. The Productivity Commission, in its 2017 National Water Reform Initiative Report found that Queensland's capital grants program was poorly targeted and inconsistent with the National Water Initiative. The report suggested the capital grants program should be replaced with payments that are 'tightly targeted at unviable, high-cost, regional and remote services areas and not tied to capital expenditure". In its 2020 report, The Productivity Commission noted that many smaller urban water utilities in Queensland were not achieving full cost recovery, and that State government funding to local utilities did not meet the NWI's criteria of a transparent community service obligation payment. Grants are allocated to local governments that are able to make a significant co-contribution rather than to those with the highest need or most at risk.

1.3.4 Protection of waters

Protection of environmental waters, particularly drinking supply source water, recreational water and unconfined aquifers is not being fully addressed in the management of wastewater in Queensland. In most areas of Queensland, the approval, management and compliance of OSFs is the responsibility of the local government that is also responsible for the supply and treatment of drinking water. However, in SEQ, these functions are separate. Some SEQ local governments are responsible for the reticulation systems, but none have responsibility for the bulk water supply. Seqwater, which is responsible for the management of the bulk supply, including catchment management, has only limited influence over planning decisions that place OSFs in their catchments. Extensive development has occurred and will continue to occur in SEQ which will be reliant on OSFs for wastewater disposal, resulting in an increasing density of OSFs in SEQ's drinking water catchments. The Panel, and several respondents to the Consultation Report, expressed concern at the number and density of OSFs on areas overlaying shallow aquifers. This is particularly a concern on the Moreton Bay Islands and K'gari, where the shallow sand aquifers are used to supply drinking water.

1.3.5 Lot sizes

The Moreton Bay Islands and K'gari are a further concern because of the small lots on which are expected to disperse the wastewater. In these and other areas, lots as small as 600 square meters are approved for unsewered development. Where larger blocks are approved, the size of the building envelope for the blocks is not limited to prevent future building activity impacting the ability of the block to disperse wastewater. In other instances, planning departments in local government have approved unsewered subdivisions without consulting with the plumbing departments, who are then left to advise owners that they are unable to build as they intended and comply with the requirements for on-site wastewater management.

1.3.6 Non-domestic applications

Domestic OSFs are determined by the national standards and Queensland regulation as having a capacity of < 21 EP (where EP is Equivalent Persons, or the amount of water expected to be discharged from a domestic household by one person per day). Domestic OSFs are only designed and tested to treat typical household waste at normal and extreme high and low loadings that might be expected in a household. The minimum size domestic OSF is 8 EP. OSFs with a capacity of 21 EP or greater are regulated by the Department of Environment and Science. The Panel found that domestic OSFs are being installed to treat non-domestic wastewater provided the load on the system was calculated to be < 21 EP. Further, the methods used to determine the person equivalents for commercial and industrial premises were variable and often questionable. As a result, small domestic OSFs are being installed where the type and load of waste is outside the limits that they are designed and tested to treat. It was noted by the Panel that State Government infrastructure grants were being provided to local governments for infrastructure to new industrial developments that included water, transport and telecommunications, but not wastewater.

1.3.7 Audit and reporting

The Panel's survey of local governments found that many still relied on incomplete manual records for the management of OSFs. Some larger local governments have moved to digital records of OSFs and electronic lodgement of forms for approval and compliance activities. While these local governments often had the budgets and resources to make these changes, most reported considerable cost savings were achieved as a result of the changes. The digital database allowed maintenance technicians to lodge service records in real time. Geotagging of the OSF and the service record provided assurance that the maintenance had been carried out. Owners can access the service record of their systems. Auditing and compliance activities of the local government are enhanced by the electronic records. The electronic systems that provide for digital databases and electronic lodgement of reports are available off the shelf, and no new software development is required. If adopted across the State, these systems could provide the data for a state-wide database on the compliance and performance of OSFs. Consolidation of the data, with appropriate management and analysis, would provide rapid identification of problems areas such as unsuitable locations, under-performing systems and licensee performance.

1.3.8 Training and qualifications

Licensing requirements were included in the list of concerns that the Council required the Panel to examine, and issues with training and qualifications were part of the discussion at the Panel's workshops. Questions were included in all three surveys regarding the adequacy of qualifications and training. However, the survey results found that most survey respondents were satisfied with the training and qualifications for occupational licences. Slightly lower satisfaction was expressed for restricted licences, perhaps reflecting that most respondents held unrestricted licences.

The situation regarding contractor's licences is less clear. Information available on the QBCC's website is not easy to follow, and links to more information are circular. There are several exemptions for contractors' licences for OSF work. The Panel felt that concerns regarding training and qualifications were better addressed by a range of measures including requiring a contractor's licence for all design and install work; clarifying the definition of 'maintenance' in the regulation and code; greater accountability for designers and installers which could be implemented with the digital database and electronic reporting; Compulsory Continuing Professional Development; and better communication of roles and responsibilities for all participants in the industry.

1.3.9 Homeowners and property transfer agents

All sections of the industry were adamant that homeowners and tenants were largely responsible for the failure of OSFs, without any acknowledgement of the role and responsibility of the industry or regulator to ensure that users of OSFs have sufficient resources and information to fulfil that obligation. Tenants are subject to particular opprobrium. Both AS/NZS 1547:2012 and the *Plumbing and Drainage Act 2018* and the Plumbing and Drainage Regulation 2019 are clear on the responsibilities of both the owner (extensive) and the occupier (limited), and on the responsibility of the manufacturer and designer to provide appropriate information to the owners of the OSF. There is almost no effort expended to ensure these obligations are met. Information is available from some local government and industry websites, and from some manufacturers of household products. But this information is inconsistent and often contradictory. Users of the system need consistent advice that is readily available. While links to manufacturers websites are included for most approved systems on the Queensland Government website, links to the specifications and owner's manual should be a requirement of all approvals.

Tenants and new owners are often unaware of the type of OSF on the property and its condition or servicing requirements. AS/NZS 1547:2012 outlines the requirements at property transfer for good management of OSFs. Opportunities exist for information to be included when properties are listed for sale or lease, and details of the OSFs compliance status and service record to be provided as part of the inspection report. Similar provisions exist for the sale of a property with a swimming pool, and for the sale of motor vehicles. The introduction of digital records and electronic compliance reporting would greatly facilitate this by providing access to local government records. Efforts should be made to engage with real estate and property transfer agencies and regulate requirements if necessary.

1.4 Acknowledgement

The Panel would like to thank all the individuals and organisations that participated in the surveys and consultation processes for their valuable and thoughtful contributions. The support of the QBCC staff has sustained the Panel throughout the process and we are very grateful for all they have done. The Panel would like to thank the Council for the opportunity to address these very significant issues.

1.5 Recommendations

The Panel's recommendations below (Table 1) cover various aspects of the on-site sewage industry and may be outside the jurisdiction of the Minister for Energy, Renewables and Hydrogen and Minister for Public Works and Procurement to address. It is recommended that when the Council refers the Panel's report to the Minister it recommends that the report be provided to other relevant Ministers for consideration.

Table 1. List of Panel recommendations with relevant government departments

Recommendation	Responsible Area
1. Develop a state-wide wastewater policy (potentially as guidance material to the SPP 2017) to cover all aspects of wastewater, including OSFs, conventional wastewater treatment plants and alternatives such as small-scale or community schemes.	DEPW DES
2. Develop a sewer backlog program to sewer areas identified as at high risk of contamination.	DSDILGP
3. The relevant Queensland Government department should fund a rigorous economic investigation of the true long-term costs of OSFs and their potential alternatives (e.g. cluster-scale sewerage).	DEPW DES
4. Reduce the number of new developments that rely on OSFs by investing in sewage infrastructure or other suitable alternatives.	DSDILGP
5. When wastewater infrastructure and development are considered, make appropriate provisions for high-risk locations, including proximity to water bores, shallow aquifers and sand aquifers.	DES DSDILGP DRDMW
6. Introduce appropriate zoning for areas near critical drinking water catchments, recreational activities or areas of environmental significance, specifying maximum densities for OSFs.	DES DSDILGP DRDMW
7. Introduce a minimum lot size for OSFs to ensure adequate land application or drainage areas for the facility's expected life. Historical subdivisions (e.g., soldier settlements) that may not meet minimum lot sizes should reflect appropriate zoning in local government planning schemes such as the Limited Development Zone. This may be achieved through guidance material as part of the SPP.	DES DSDILGP
8. Sewer all high-density industrial developments.	DSDILGP

9.	Require all commercial and industrial premises with an OSF to have ERA approval, regardless of the size of the facility, to ensure the accurate design, treatment, operation and monitoring of the sewerage system.	DEPW DES
10.	Require local governments to consider conditions on compliance permits for OSFs for bushfire and flood zone properties (refer to state-wide mapping in QLD Globe). On-site wastewater systems damaged in natural disasters are not to be used until inspected by a qualified person and repaired or replaced as necessary.	DSDILGP DRDMW
11.	Encourage local governments to consider existing LAAs and reserves if a building development application is submitted, which will increase the footprint of the structure on the site. (Note: the current framework is only triggered by a change to the number of bedrooms).	DEPW DSDILGP
12.	Clarify the definition of 'wastewater' in the QPWC, and give clear direction on the application of which standards and deemed-to-satisfy provisions apply.	DEPW
13.	Encourage the use of tools such as Seqwater's LURT to assess the risk of OSFs, particularly in water supply catchments.	DEPW DSDILGP
14.	Conduct a state-wide audit of the number, location and type of OSFs in Queensland and create a central database of all facilities.	DSDILGP
15.	Local Governments be encouraged to move to electronic management systems for on-site facilities to comply with Sections 106 and 114 of the PDR, including: a. Geotagging all types of OSFs b. Recording service agents' reports into a consolidated database c. Reporting results of systems tests such as pH, turbidity and chlorine availability d. Interrogating service agents' reports to identify ongoing issues for the different types of AWTSs	DSDILGP

	e. Automated reminders to OSF owners of service requirement dates f. Adding visual inspection of effluent irrigation areas to service agents' reports (ponding, poor plant growth, disconnected piping, etc.)	
16.	Increase accountability for licensees and local governments to ensure the ongoing performance of OSFs.	DEPW DSDILGP
17.	Consider legislative amendments to provide for the monitoring and regulation of OSFs that are not currently required to hold treatment plant approval, such as septic systems with absorption trenches.	DEPW
18.	Introduce compulsory continuing professional development for persons holding an occupational licence under the PDA, where the scope of work involves on-site sewage work.	DEPW
19.	a. That the information and feedback available from reports lodged with the local government under section 106 of the PDR be used to assess and improve the training, licencing and professional development requirements of all licence classes; and b. work be undertaken to improving understanding among the industry of the roles and responsibilities of all licence classes.	DEPW DSDILGP
20.	Require licensees to obtain a manufacturer's accreditation before installing or maintaining OSFs from that manufacturer.	DEPW
21.	Develop a comprehensive education program about on-site sewage licensees' role in protecting public health, including delivering information sessions for apprentices and trainees, preparing materials for licensees, owners and occupiers and engaging with retailers.	DEPW
22.	Amend the Queensland Building and Construction Commission Regulation 2018 so that any work within the scope of an OSF licence is considered building work, and any	DEPW

	persons performing this work must hold a contractor's licence.	
23.	Review the qualification requirements for designing OSFs to ensure that all persons who may design these facilities have appropriate skills and qualifications.	DEPW
24.	Amend the Queensland Building and Construction Commission Regulation 2018 so that any work within the scope of work for a hydraulic services design licence is considered building work, and any persons performing this work must hold a contractor's licence (Note: currently, this work only requires a licence if the value of the work is over $1,100).	DEPW
25.	Review the legislative requirement for real estate agents and property transfer agents to comply with the requirements of AS 1547 (2012) Section 3.9 so that: a. Information is provided in listings and advertising of real estate offered for sale or lease. b. OSFs are required to be working and compliant at the point of sale or lease. c. A certificate or equivalent documentation of compliance is provided at the point of sale. d. All relevant information on the on-site system, including the design and installation approvals and maintenance history, is provided at the property transfer.	DEPW DOJ
26.	Develop an information kit for real estate agents to distribute to owners and tenants of properties with OSFs.	DEPW DOJ
27.	Provide consistent, appropriate and ongoing advice from a centralised, recognised source(s) on the requirements of OSFs, including the roles and responsibilities of agents, owners and occupiers.	DEPW

2 Introduction

The On-site Sewage Treatment Panel (the Panel) was established by the Service Trades Council (the Council) on 8 August 2019 to investigate concerns relating to on-site sewage management in Queensland, including:

- Public health and safety risks
- Licensing requirements
- Training and qualifications
- Public knowledge of maintenance requirements; and
- Regulation of the industry.

The Panel was established in response to anecdotal reports on failing and non-compliant on-site sewage facilities (OSFs) given to the Council by licensed plumbers and drainers across Queensland and industry representatives. The Panel includes members from both government and the private sector, including representatives from the Queensland Building and Construction Commission (QBCC), Queensland Health, the Department of Energy and Public Works (DEPW), Seqwater, local governments, the Master Plumbers' Association of Queensland, TAFE Queensland, and specialists and academics in the field of on-site sewage management and research.

The Panel's objectives were to take an evidence-based approach to the consideration of concerns raised by stakeholders and to provide recommendations to the Council for resolution of these concerns.

In March 2021, the Panel undertook a consultation process to inform this report. A discussion paper and survey were made available via the QBCC's website from 1 March to 31 March 2021 and were also emailed directly to holders of relevant trade licences (licensees), local governments, water service providers, industry organisations and other key stakeholders such as on-site sewage treatment facility manufacturers.

Approximately 460 survey respondents viewed the survey questions, and about half of that number completed the survey. The responses were reviewed by the Panel to inform the Panel's final recommendations.

2.1 Scope

The role of the Panel is to provide advice and make recommendations to the Council. The scope of the report is limited to OSFs within the regulatory framework of the *Plumbing and Drainage Act 2018* (PDA). This report does not cover on-site or community wastewater treatment plants subject to other regulations, although overlaps will be considered. The regulatory framework will be described in Section 3.3 and discussed throughout the report.

The Panel's main function is to form an evidence base and provide informed advice to the Council on issues relating to OSFs in Queensland. Issues around this matter are broad and may include, but are not limited to, advice on the following matters:

- Licensing requirements
- Training requirements
- Public knowledge of maintenance requirements
- Regulation; and
- Health risks.

In addition, the Panel will provide advice on any other matter referred by the Council to the Panel.

3 Background

3.1 What Are On-site Systems?

The definition of an OSF is implied but not specifically stated in the Plumbing Code of Australia (PCA) as a system that is designed, constructed, installed and maintained for the on-site storage, treatment and disposal or reuse of wastewater (ABCB 2020).

A full definition of what is considered an OSF is provided in the PDA (Qld):

on-site sewage facility means:

(a) a facility, other than an environmentally relevant on-site sewage facility, installed on the premises, that includes:

(i) an on-site treatment plant on the premises for treating sewage produced on the premises; and

(ii) either:

(A) a land application area (LAA) on the premises for disposal of the effluent produced by the on-site treatment plant; or

(B) a tank on the premises for storing the effluent produced by the on-site treatment plant for later disposal off the premises by collection from the tank; or

(b) a facility, other than an environmentally relevant on-site sewage facility, installed on the premises, that:

(i) includes an on-site treatment plant on the premises for treating sewage produced on the premises; and

(ii) disposes of the effluent produced by the on-site treatment plant off the premises:

(A) if the facility is installed only for testing purposes – into a sewage system; or

(B) by common effluent drainage; or

(C) in another way, stated in the permit for the installation of the facility; or

(c) a dry-vault toilet or a chemical, composting or incinerating toilet.

3.2 Types of On-site Systems

On-site wastewater systems use a two-part process to treat wastewater and dispose of or reuse the effluent (treated wastewater) on the serviced property. The treatment process may include any or all of the following processes:

- The settling of solids (sedimentation)
- Flotation of lighter materials (scum)
- Anaerobic digestion (microorganisms breaking down organic material into carbon dioxide and methane in the absence of oxygen); and
- Clarification, and sometimes also including aeration and disinfection as further treatments.

The disposal of the effluent may include:

- Absorption trenches
- Evapotranspiration absorption beds
- Subsurface irrigation and surface irrigation; and
- Sand-based mound systems.

3.2.1 Primary Systems

Primary water treatment systems are systems that do not have an external power source and do not require chemical reagents to conduct treatment. Passive systems are generally simple systems with no external aeration source. They are considered to be low cost and low maintenance. Passive systems provide only minimal treatment of wastewater. The effluent from these systems is usually of primary standard,[1] though secondary-quality effluent can sometimes be achieved.

3.2.2 Septic Systems

Septic tanks are the most common on-site system and provide primary treatment through the settling of solids and the flotation of fats and grease. A septic system consists of a septic tank and an LAA. A septic tank is a single- or multiple-chambered tank through which wastewater is allowed to flow to permit suspended matter to settle and be retained so that organic matter contained therein can be

[1] In the Queensland Plumbing and Wastewater Code, primary effluent typically has a Biochemical Oxygen Demand (BOD_5) of between 120–240 mg/L and total suspended solids of between 65–180 mg/L.

decomposed (digested) by anaerobic bacterial action in the liquid' (Standards Australia 2008). The total suspended solids (TSS) and biological oxygen demand (BOD) of the subsequent effluent are reduced by up to 40%, thereby lowering the risk of clogging in the receiving soil absorption trench or sand mound.

The effluent from the septic tank is applied to an area of natural soil for further treatment (Standards Australia 2008). It is not suitable for irrigation and must be applied to the receiving land area via a covered soil absorption trench or sand mound. Treatment plant approval is not required for a septic tank.

3.2.3 Other Passive Systems

Other passive systems that rely on biological methods to treat wastewater before discharging it through below-ground systems have been developed. Composting toilets are passive systems that turn human waste into a humus-like compost that can be used in gardens and lawns. Composting systems can either treat toilet waste only (dry composting toilets) and have a separate system for greywater or can be used in conjunction with flushing toilets (wet composting) and treat all the wastewater from a household without the need for a separate greywater system. Passive systems that treat the whole waste stream can be stand-alone or add-ons to septic systems. Fundamentally, composting is an aerobic process and works best when urine is separated from faeces.

3.2.4 Secondary Wastewater Systems

Advanced wastewater treatment systems treat water to a higher standard than septic tanks using a combination of aeration, filtration, clarification and disinfection. Other treatment processes that may be used include extended aeration-activated sludge, biofiltration, rotating biological contact, sand filtration, reed bed, trickling filtration and other technologies (Standards Australia 2017).

In secondary wastewater systems, effluent is treated to a standard that can be used for irrigation on domestic property. The treated effluent is usually disinfected to allow above-ground irrigation, subject to local government regulation, and a nutrient reduction process can also be specified. A list of approved systems is available online from Business Queensland (Queensland Government 2022). Depending on the effluent quality, these systems can be classified as secondary, advanced secondary, or advanced secondary systems with nutrient removal.

The compliance characteristics of secondary-quality effluent are as follows:

- 90% of the samples taken over the test period have a BOD_5 less than or equal to 20 g/m^3, with no sample greater than 30 g/m^3.
- 90% of the samples taken over the test period have TSS less than or equal to 30 g/m^3, with no sample greater than 45 g/m^3.
- Where disinfection is provided, 90% of the samples taken over the test period have a thermotolerant coliform count not exceeding 200 organisms per 100 ml, with no sample exceeding 1,000 organisms per 100 ml.
- Where chlorination is the disinfection process, the total chlorine concentration in the treated effluent is greater than or equal to 0.5 g/m^3 but less than 2.0 g/m^3 in four out of five samples taken.

The compliance characteristics of advanced secondary-quality effluent are as follows:

- 90% of the samples taken over the test period have a BOD_5 less than or equal to 10 g/m^3, with no sample greater than 20 g/m^3.
- 90% of the samples taken over the test period have TSS less than or equal to 10 g/m^3, with no sample greater than 20 g/m^3.
- Where disinfection is provided, 90% of the samples taken over the test period have a thermotolerant coliform count not exceeding 10 organisms per 100 ml, with no sample exceeding 200 organisms per 100 ml.
- Where chlorination is the disinfection process, the total chlorine concentration is greater than or equal to 0.5 g/m^3 but less than 2.0 g/m^3 in four out of five samples taken.

Additional compliance requirements for advanced secondary quality effluent with nutrient removal include:

- 90% of the samples, with 95% confidence limits, taken over the test period have a total nitrogen concentration less than or equal to 10 mg/l.
- 90% of the samples, with 95% confidence limits, taken over the test period have a total phosphorus concentration less than or equal to 5 mg/l.

Treated wastewater from secondary wastewater treatment systems is usually released onto the serviced property through subsurface or surface irrigation systems located in a dedicated vegetated area.

3.3 Regulation and Management of On-site Systems

The regulation of OSFs in Queensland is administered by several agencies and has resulted in a range of regulatory silos, causing complex application and approval processes, sometimes without adequate or suitable oversight. The framework for the regulation of OSFs is based on relevant Australian standards, national and state construction and plumbing codes, and requirements under Queensland legislation. Most of the processes and powers for regulating OSFs are devolved to local governments.

3.3.1 Standards Australia

Standards Australia is a non-governmental, registered charity that develops standards for consumer products and services, the environment, construction, energy and water utilities. Standards are developed, reviewed and updated by technical committees made up of representatives from industry, government, academia and the wider community. The standards are 'voluntary documents that set out specifications, procedures and guidelines that aim to ensure products, services and systems are safe, consistent and reliable'. Standards Australia is not responsible for enforcing, regulating or certifying compliance (Standards Australia 2022).

The relevant standards for OSFs in Australia are:

- AS/NZS 1546.1:2008 On-site domestic wastewater treatment units – Septic tanks
- AS/NZS 1546.2:2008 On-site domestic wastewater treatment units – Waterless composting toilets
- AS 1546.3:2017: On-site domestic wastewater treatment units – Secondary treatment systems
- AS/NZS 1547:2012 On-site domestic wastewater management

AS/ NZS1546.1 provides a set of performance requirements against which a septic tank may be assessed and 'to provide manufacturers of septic tanks and associated fittings with basic manufacturing and test specifications'. It supersedes an earlier version, AS/NZS 1546.1:1998. The 2008 revision included separate tests for septic tanks made by injection moulding and rotational moulding, as well as details for the estimation of sidewall loading. A further revision is planned to include performance criteria for TSS concentration in septic tank effluent because of its implications for premature absorption trench failure.

The 2008 edition of AS/NZS 1546.2 superseded the earlier 2001 edition with changes confined to layout and clarification of intent. The standard sets out performance requirements, performance evaluation tests and basic test requirements for manufacturers and certification bodies of composting toilets.

AS 1546.3:2017 supersedes AS/NZS 1546.3:2008, *On-site domestic wastewater treatment units*, Part 3: *Aerated wastewater treatment systems*. It provides guidance 'for the design, commissioning, performance and compliance testing of secondary treatment systems and advanced secondary treatment systems (STS) designed to treat domestic wastewater'. The scope of the standard is limited to units with treatment capacities in the range of 1,200 L/day to 5,000 L/day and must be carried out using domestic-strength sewage of a defined concentration (BOD_5 SS, TN, TP), which is applied in a sequence of different loading rates (L/day) to simulate normal and shock loads, as well as an extended period of no load. The independent testing procedure usually takes 38 to 42 weeks.

AS/NZS 1547:2012 supersedes AS/NZS 1547:2000. Versions prior to 2000 provided designers with the requirements for the design and location of disposal systems. The standard did not include guidance on the maintenance of systems, as 'no such system should be considered as suitable for long-term disposal of sullage and septic tank effluent'.

Additions were made to the 2000 edition of the standard to accommodate new technologies and included performance statements to define outcomes to cover all types of wastewater treatment units and land application systems. The new standard provided guidance on operation and maintenance, on-site evaluation, soil assessment, design, construction and installation. The standard also provided guidance on administrative and managerial responsibilities and education and training 'to ensure that on-site domestic-wastewater systems could be long-term options'.

In the 2012 version, the focus shifted to sustainable management of public health and the environment, emphasising a risk management approach that considers local climate, soils and conditions. This approach allowed for more cost-effective designs to be used where it could be demonstrated that there was no significant risk to public health, and the standard provided guidance on how local knowledge and experience should be collated. Despite the new focus of the standard, there was no substantive change to the methods outlined.

A key component of the standard involves the acceptable design loading rate (DLR) (mm/day), such that the subsurface-applied effluent does not surface on the domestic allotment. The DLR varies with soil permeability and effluent quality (primary vs secondary treated).

Australian Standards provide testing and operational protocols to help ensure the safety, performance and reliability of a range of products, services and systems. Australian Standards play a particularly important role in the plumbing industry, where they inform the key standards of the regulatory frameworks adopted by the states and territories of Australia. Reliance on these key standards facilitates the adoption of consistent plumbing standards and work practices and is an important part of keeping buildings safe for Queenslanders, provided that ongoing maintenance and monitoring occur.

3.3.2 National Construction Code

The National Construction Code (NCC) is published by the Australian Building Codes Board (ABCB), a joint initiative of the Commonwealth and State and Territory Governments in Australia. The code has three volumes, the third of which is the PCA. The NCC is given legal effect by relevant legislation in each state and territory. This legislation prescribes or 'calls up' the NCC to fulfil any technical requirements that are required to be satisfied when undertaking building work or plumbing and drainage installations.

- Each state and territory's legislation consists of an Act of Parliament and subordinate legislation that empowers the regulation of certain aspects of building work or plumbing and drainage installations and contains the administrative provisions necessary to give effect to the legislation.
- Administration provisions typically covered in the enabling or subordinate legislation include the issue of permits, licensing, and enforcement of standards.

Up until 1 May 2019, AS/NZS 1546.3 was a referenced standard of the NCC-referenced PCA in Part F1, *On-Site Wastewater Management Systems*. With a decision endorsed by the ABCB, Part F1 was deleted from the NCC, and the entire suite of Australian standards for on-site sewage, including AS1546.3, was deleted as a reference standard of the PCA. This was a decision based on the fact that most jurisdictions regulate on-site wastewater management systems through other legislation. For example, in NSW, on-site sewage is administered by NSW Health, not the plumbing regulator, while in Tasmania, it is the Department of Justice.

On commencement of the 2022 version of the NCC, on-site wastewater management will be reinstated into the PCA as Part C3, and in doing so, the relevant Australian Standards will be adopted as reference documents.

3.3.3 Plumbing Act, Regulation and Code

The DEPW (formerly the Department of Housing and Public Works) administers the PDA and the *Plumbing and Drainage Regulation 2019* (PDR). The Department's responsibilities include producing and maintaining the Queensland Plumbing and Wastewater Code (QPWC) and approving manufactured on-site systems (<21 Equivalent Persons (EP)) for use in Queensland. QBuild, which builds and maintains government-owned assets such as schools, social housing, police stations, correctional facilities and health facilities, is part of the DEPW.

The PDA is Queensland's law governing plumbing and drainage, the licensing of plumbers and drainers, on-site sewerage facilities and other matters.

The PDR contains specific laws to ensure plumbing and drainage work is compliant. It also contains the criteria for determining treatment plant approval.

S19 PDR – Criteria for decision (treatment plant approval)

- The Chief Executive may decide to approve the application if satisfied that:
  - (a) For an application relating to a greywater treatment plant of a particular type, a treatment plant of that type complies with:
    - i) AS1546.4:2016; and
    - ii) SA MP101:2017 On-site Domestic Wastewater Treatment – Conformity assessment requirements for AS 1546.3 and AS 1546.4; or
  - (b) For an application relating to a secondary on-site sewage treatment plant of a particular type, a treatment plant of that type complies with:
    - i) AS1546.3:2017; and
    - ii) SA MP101:2017 On-site Domestic Wastewater Treatment – Conformity assessment requirements for AS 1546.3 and AS 1546.4.

The QPWC (QPWC Versions1:2019) – The QPWC sets out Queensland's specific plumbing and drainage standards.

The QPWC:

- Adopts standards in relation to matters not covered by the PCA (National Construction Code, Volume 3); or
- Imposes higher standards over and above the requirements of the PCA; or
- Replaces requirements of the PCA
- Has been designed to provide performance solutions to meet the statutory requirements of the PDA.

Compliance with the QPWC is achieved by satisfying the performance requirements.

- Section F1 – On-site Wastewater Management Systems sets out the additional requirements for the design, construction, installation, replacement, repair, alteration and maintenance of any part of an on-site wastewater management system.
- Section F1.3 – LAA must take into account a site and soil evaluation report produced as a result of an on-site inspection carried out in accordance with AS 1547:2012 and the setback distances set out in Part 2 of the Appendix of the QPWC and AS 1547:2012 LAA.

In addition to the local government's approval, under the PDA, a treatment plant must also have treatment plant approval issued by the DEPW before it can be installed. Treatment plant approval is usually obtained by the manufacturer of each treatment plant model.

The following types of treatment plants currently require treatment plant approval: secondary, advanced secondary, and advanced secondary systems with nutrient removal. They are designed to treat sewage for less than 21 EP or can treat no more than 4.2 kL of sewage in a day. They must comply with AS 1546.3:2017 and the conformity assessment requirements. To receive treatment plant approval, the manufacturer must undertake testing by an independent Conformity Assessment Body and present the results to the DEPW to demonstrate that the treatment plant meets the AS1546.3:2017 and the minimum water quality specified under the QPWC. There are only two testing locations in Australia at Jimboomba (QLD) and Hahndorf (SA), and the performance report must be legally endorsed by a JAS-ANZ certification authority.

A list of currently approved systems is found on the DEPW's website: (https://www.business.qld.gov.au/industries/building-property-development/building-construction/plumbing-drainage/on-site-sewerage).

3.3.4 Local Government

Where an on-site sewerage facility is to be installed, a plumbing application must be made to the local government. The requirements for an on-site sewerage facility are provided under the PDA, the QPWC and its referenced Australian Standards.

An application for an on-site sewerage facility must be assessed by the local government in accordance with the QPWC (Parts F1 and F1.3), which includes the siting of the facility on the allotment and layout of the LAA.

> Section F1 – On-site Wastewater Management Systems sets out the additional requirements for the design, construction, installation, replacement, repair, alteration and maintenance of any part of an on-site wastewater management system.
>
> Section F1.3 – LAA must take into account a site and soil evaluation report produced as a result of an on-site inspection carried out in accordance with AS1547:2012 and the setback distances set out in Part 2 of the Appendix of the QPWC and AS1547:2012 LAA.

In assessing a plumbing application for an on-site sewerage facility, the local government may also attach conditions to its approval. For example, these could include:

- The method of disposal for the treated effluent (above or below ground)
- The design of the LAA on the property where the wastewater is to be disposed of based on the relevant soil type and its potential impact on surface and groundwater; and
- The proximity to neighbouring properties and any sensitive environmental area.

3.4 Other Queensland Government Roles

3.4.1 Queensland Building and Construction Commission

The QBCC is Queensland's construction industry regulator and supports the growing Queensland community by providing information, advice and regulation to ensure the maintenance of proper building standards and remedies for defective building work, promoting confidence in the building and construction industry. Led by the Commissioner and governed by the QBCC, consisting of a skilled and expert team of staff that work hard to meet the needs of industry participants and the wider community.

With more than 5.2 million people living in Queensland and more than 10% of those residents working in the construction sector, the QBCC has an important task in serving and regulating the industry, contributing to the growth of the Queensland economy.

The QBCC administers several pieces of legislation, including the:

- *Queensland Building and Construction Commission Act 1991* (QBCC Act)
- *Queensland Building and Construction Commission Regulation 2018*
- PDA
- PDR

The QBCC plays a role in regulating the OSF industry through licensing and compliance activities and engaging with local government authorities on matters of concern.

3.4.2 Department of Environment and Science

The Department of Environment and Science (DES) regulates sewage and wastewater treatment under the *Environmental Protection Act 1994* (EPA) and the Environmental Protection Regulation 2019 (EPR). Under Schedule 2 of the EPR, a site operating one or more sewage treatment works over 21 EP is a prescribed environmentally relevant activity (ERA). The Department regulates based on the principle of 'regulation proportionate to risk'. This means that the proposed size of the sewage treatment plant, as well as the impact on the environment (e.g., a release to land or a release to waters), is considered when the activity is assessed, and if approved, how the activity is regulated is also considered, including the frequency of ongoing monitoring requirements. Only sites operating up to 100 EP can apply for standard approval for ERA 63.

3.4.3 Department of Regional Development, Manufacturing and Water

The Department of Regional Development, Manufacturing and Water administers the *Water Supply (Safety and Reliability) Act 2008* (WSSRA), which provides the framework for regulating drinking water, recycled water and wastewater service providers. It does not have a role in regulating on-site systems. It is the custodian of the document published in April 2010 (Chapter 6 amended March 2014) by the former Department of Energy and Water Supply *Planning Guidelines for Water Supply and Sewerage*. The guidelines list the legislation applicable to on-site wastewater systems at the time of publishing (table 5.1) and indicate when the use of on-site systems might be appropriate as part of planning a sewerage system (generally, the role of the service provider, which is usually a local government).

3.4.4 Department of State Development Infrastructure Local Government and Planning

The Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) administers both the *Planning Act 2016* (the Planning Act) and *Planning Regulation 2017* and the *Local Government Act 2009* (the Local Government Act) and *Local Government Regulation 2012*.

The State Planning Policy (SPP) is a statutory instrument established under the *Planning Act 2016* and *Planning Regulation 2017* and provides guiding principles to ensure that schemes and plans are 'outcome focused, integrated, efficient, positive and accountable'.

The SPP State Interest for Water Quality sets benchmarks for development in a drinking water catchment, which goes hand in hand with the state interest for energy and water supply (the timely, safe, affordable and reliable provision and operation of electricity and water supply infrastructure is supported (State of Queensland 2017)). In considering development occurring in a drinking water catchment and the impacts on source water quality, the following are a sample of policy statements that apply:

- Water quality – Development in water resource catchments and water supply buffer areas avoids potential adverse impacts on surface waters and groundwaters to protect drinking water supply environmental values.
- Energy and water supply – The timely, safe, affordable and reliable provision and operation of electricity and water supply infrastructure are supported, and renewable energy development is enabled.

Some instruments provide binding instructions to ensure consistency across the state. These are:

- The Minister's Guidelines and Rules outline the processes and timeframes for making or amending local planning instruments.
- The Development Assessment rules set out the rules for how development applications are assessed in Queensland.
- The State Development Assessment Provisions include the state's assessment requirements, used by the state in assessing development applications.

Local planning schemes guide land use and development in a local government area, which sets out both the overall plan for managing long-term development and specifics such as what, where and how development can occur and what assessment process is required.

The *Local Government Act 2019* and *Local Government Regulation 2012* define what a local government is and what it can do. They limit the making of local laws to matters that are not similar to and do not duplicate processes under the Planning Act. The Local Government Act allows local governments to levy charges for services, regardless of whether the local government provides the services. The Local Government Act can impose cost-recovery fees for the performance of responsibility under the *Building Act 1975* or the PDA.

3.4.5 Seqwater

The Queensland Bulk Water Authority (trading as Seqwater) is a statutory authority of the Queensland Government with a legislative obligation to provide safe, secure, resilient and reliable bulk drinking water for South East Queensland (SEQ). Seqwater also provides essential flood mitigation services and water for irrigation, and it offers community recreation facilities.

Seqwater relies on catchments as its major water supply source. Unlike many other water authorities in Australia, many of SEQ's catchments are open and contain a variety of land uses, including for rural and urban development. Protecting catchments from the impacts of development is essential for delivering a safe and affordable drinking water supply.

Seqwater relies on the SPP State Interest for Water Quality, energy, water supply and the SEQ Regional Plan (ShapingSEQ) through plan-making provisions to ensure state interests are reflected in local government planning schemes.

Seqwater provides third-party advice to local and state governments on assessing development applications triggered within drinking water catchments, including on-site wastewater systems and plumbing advice for on-site systems located in drinking water catchments. While Seqwater has legislative obligations relating to the drinking water supply, it has no statutory role in the development assessment process.

3.4.6 Department of Employment, Small Business and Training

The Department of Employment, Small Business and Training administers the *Further Education and Training Act 2014*. The Department administers the provision of government-subsidised Vocational Education and Training (VET) in Queensland, including funding priority qualifications, contracting and funding pre-approved registered training organisations and administering the apprenticeship and traineeship system. The Australian Skills Quality Authority is responsible for the quality of Australia's VET scheme by oversight of accredited training products and RTOs under the provisions of the *National Vocational Education and Training Regulator Act 2011*. This is achieved through a network of departments and agencies, including the Department of Education, Skills and Employment, the National Skills Commission, the National Centre for Vocational Education Research, the Skills Minister Skills Council, the Australian Industry and Skills Committee, as well as various industry and employer groups and state and territory training authorities.

3.4.7 Queensland Health

Queensland Health administers the *Public Health Act 2005* and the *Public Health Regulation 2018*. Chapter 2 of the *Public Health Act 2005* sets out the public health risks administered by state or local governments. The state is responsible for public health risks associated with drinking water provided by a drinking water service provider and recycled water schemes defined in the WSSRA. It leaves ‘other water’ to the local government, which includes drinking water supplies not covered by the WSSRA and recreational water. The regulatory tools provided in the PDA are considered the most relevant and effective in addressing shortcomings associated with failing OSFs, such as ponding or saturation in LAAs.

4 Issues and Impacts

Domestic OSFs are generally the only available means for the treatment of household wastewater in areas not serviced by centralised collection and treatment systems, such as a municipal reticulated sewer system connected to a sewage treatment plant. It is estimated that more than 100,000 OSFs are currently installed in Queensland, with modelling and spatial analysis undertaken by Seqwater in 2019 indicating that there are more than 127,000 in SEQ (Beale, Gardner et al. 2005). The exact number of OSFs in Queensland is unknown, given that the Panel's survey of local governments indicated that many (40% of respondents) do not know the exact number of facilities in their areas.

It is predicted that the number of OSFs installed in Queensland will increase considerably over the next few years, given interstate and international net migration trends to Queensland. A significant proportion of the net migration to Queensland is represented by an increasing trend in 'sea changers', 'tree changers' and recently retired baby boomers, leading to an increased demand for land development at the urban fringes and in previously rural areas. Considering the increase in housing lots needed to meet this demand, combined with retirement patterns and land cost and availability, there is a significant decrease in lot sizes in peri-urban areas. A lack of willingness by water utilities to extend sewerage networks due to prohibitive costs and a lack of regulation to support the need to extend sewer networks will result in an increasing reliance on OSFs to manage wastewater in many areas across Queensland. The predicted result is that the number of OSFs will significantly increase over the next few years.

Domestic wastewater can contain a variety of hazards, including hydrocarbons, synthetic organic compounds, pesticides, metals, nutrients, micropollutants and waterborne pathogens. Some OSFs can effectively treat household wastewater to a state whereby constituents of concern to public health and the environment are effectively removed or inactivated. However, the key to effective treatment is a properly functioning, appropriately located and well-maintained OSF. In addition, given that OSFs discharge treated effluent into the land, appropriate lot sizes and suitable densities of OSFs (the numbers of OSFs per area) are critical to minimise risk to public health and the environment.

Published reports and peer-reviewed literature from studies undertaken by researchers in Queensland point to significant issues with the siting, functioning, maintenance and density of OSFs, as indicated by the anecdotal evidence presented to the Council. These issues, combined with a lack of clarity and/or consistency in the application of key components of the codes and standards regarding OSFs, present a risk to public health, water quality and environmental condition in the state. The primary hazards and their impact on important aspects of public health, water quality and environmental conditions are discussed below. Given that the failure of OSFs, rather than the OSFs themselves, are the drivers of these impacts, evidence of failure is discussed in Section 5. Responses to failure are discussed in Section 6.

4.1 Primary Hazards

4.1.1 Pathogens

There are five main groups of pathogens: viruses, bacteria, protozoa, helminths and fungi. All but the last are waterborne. Pathogens can also be classified as enteric or non-enteric. Enteric pathogens require a host species for their life cycle. They are excreted in faecal matter, contaminate the environment and then gain access to new hosts through ingestion (usually the faecal–oral route). Non-enteric (opportunistic) pathogens such as *naegleria fowleri and legionella spp*. are present in natural waters and are not dependent on an animal or human host for the completion of their life cycle. Non-enteric pathogens can cause disease when they opportunistically find a suitable environment in a host. Some opportunistic pathogens have been detected in wastewater. The focus of concern is on faecal-excreted pathogens that are not adequately attenuated by OSFs and associated land disposal activities or where the cumulative pathogen load from OSFs can impact raw drinking water supplies or recreational waters.

An environment where a pathogen can survive or grow is known as a reservoir. Some pathogens can survive only in the host species, and when the reservoir is human, direct human-to-human contact is required for transmission. Other pathogens can survive in multiple animal species and are known as zoonotic pathogens. About 60% of human pathogens are zoonotic (Bitton 2010). Many pathogens can survive and be transported in non-living environments, including water, food and soil (Bitton, 2010). The ability to survive in non-living environments is important for the transmission of waterborne pathogens. Some pathogens will survive only a few hours outside the host, but others employ various strategies to survive. Many can survive and even reproduce in the environment if conditions are conducive. Where conditions are not conducive to survival, some pathogens can enter a state where they maintain metabolic activity but do not multiply. Bacteria in this state are known as 'viable but nonculturable' and cannot be detected by routine plating methods (Percival and Williams, 2014, p213).

The transmission of waterborne pathogens to a new host can occur through a variety of contact scenarios, including drinking contaminated water, swimming, bathing or playing in contaminated water, poor hand-washing after contact with impacted areas (effluent disposal soils, lands and irrigated effluent), eating food crops irrigated or washed with contaminated water, or eating seafood or freshwater fish and shellfish caught or grown in contaminated water. For infection to occur, the uptake of a pathogen from the source needs to be of sufficient quantity. The smallest number of pathogens required to produce infection in the host, the virulence, is the minimum infective dose and can range from millions to fewer than 10 (Bitton 2010). To cause disease, the pathogen must overcome the host's immune response, which can vary with the age and health status of the host. The very young, the elderly, people with comorbidities and people who are immunocompromised are more vulnerable to infection than the general population and may become ill following a lower infective dose. The process by which pathogens return to the environment from the host is known as 'shedding'.

Viruses are potentially the most hazardous pathogens in wastewater in Western countries as they are more resistant to disinfection than bacteria and require a much smaller dose to cause infection and disease. Viruses in wastewater include enteroviruses, adenoviruses, rotaviruses, reoviruses, astroviruses and caliciviruses. Viruses occur at concentrations of 10^3 – 10^4 pfu/L in effluent and cause a range of diseases, including gastroenteritis, respiratory infection, conjunctivitis, cystitis, acute hepatitis, skin rashes, encephalitis, meningitis, paralysis and heart disease (Rusinol and Girones 2017).

Bacteria are the most common pathogens in wastewater, with enteropathogenic (causing disease in the intestinal tract) *E. coli*, *Salmonella spp*., *Campylobactor spp*., Helicobacter and Arcobacter commonly found. Waterborne enteric bacteria primarily cause gastrointestinal illness in humans, with symptoms including nausea, diarrhoea, vomiting and stomach cramps. Non-enteric bacteria include *Legionella spp*., *Leptospira*, and *Burkholderia pseudomallei* and cause disease via inhalation of contaminated aerosols or by contact with skin. Infection with waterborne pathogens can lead to post-viral or bacterial diseases such as Guillain–Barré syndrome.

The most common pathogenic protozoans in water are *Entamoeba histolytica*, *Giardia intestinalis* and *Cryptosporidium parvum*. *E. histolytica* infections usually occur among residents and returning travellers from regions of high endemicity (for example, India, South East Asia), but the parasite is also endemic in areas of northern Australia. *Giardia intestinalis, Giardia duodenalis* and *Giardia lamblia* are found in soil, food or water that have been contaminated with faeces from infected animals or humans. Drinking water and recreational water are the most common mode of transmission. There are several species of cryptosporidium that affect a range of animals, and not all are host-specific. *Cryptosporidium parvaum and Cryptosporidium hominis* are of greatest concern to public health in Queensland. They are highly resistant to chlorine at levels used in municipal drinking water and in most chlorinated pools and can survive for long periods outside a host. As with *Giardia*, drinking water and recreational water are the main mode of transmission. *Giardia* is the second leading cause of waterborne infection in the United States after norovirus (CDC 2020).

4.1.2 Nutrients

Nutrients are substances that provide essential nourishment for the maintenance of life and growth. Major nutrients needed for plant growth are nitrogen, phosphorus and potassium, with calcium, magnesium, and sulphur needed in much smaller quantities (g/kg biomass). The availability of nutrients in both soil and water is essential for a healthy ecosystem.

Anthropogenic sources of nutrients include artificial fertilizers, wastewater, agricultural waste from animals and automobile exhaust. These sources far exceed natural sources in areas of human habitation. Studies of Sydney's catchments (Charles, Roser et al. 2003) found that unsewered catchments had nutrient export loads almost 10 times greater than those in equivalent bushland catchments (Table 2).

Table 2. Nutrient export loads in areas of Sydney's drinking water catchment (Charles, Roser et al. 2003)

Land Use	Nitrogen (kg $ha^{-1}yr^{-1}$)	Phosphorus (kg $ha^{-1}yr^{-1}$)
Bushland	1.3	0.1
Unimproved grazing	5.3	1.5
Sewered catchments	7.5	1.2
Unsewered catchments	12.5	1.8

The presence and density of OSFs can significantly impact both surface water and groundwater. The impact of the nitrogen and phosphorus production of sewered and unsewered areas is reduced by the relatively small areas of these land use types in the drinking water catchment. The estimated nitrogen input per person per year is in the range of 7 to 15 kg (Ursin and Roeder 2013). Some of the excreted nitrogen settles with solids in the septic tank, but most nitrogen treatment occurs in the LAA, which can remove between 10% and 40% of total nitrogen (Diaz-Elsayed, Xu et al. 2017).

The importance of the density of OSFs was demonstrated using isotopic analysis, which showed that in areas with a high density of septic tanks (>1 per hectare), wastewater was the most likely source of nitrogen, while nitrogen fertiliser and soil organic matter were the dominant sources in low-density, sewered or forested areas (Iverson, Humphrey et al. 2018). However, even when septic systems were a dominant source in localised areas, this isotopic signature could have been lost at the watershed scale. In high-density OSF areas, total nitrogen and total phosphorus loadings were double those in low-density areas (<1 per hectare). At OSF densities of around 0.4 per hectare, the total nitrogen and total phosphorus were indistinguishable from forested areas (Iverson, Humphrey *et al.* 2018). In Florida, where OSFs are installed in medium-density developments at 5–12 per hectare, nitrogen concentrations in the soil pore water were found to exceed 10 mg NO_3-N/L to a depth of 3 to 4.5 m. The highest nitrogen concentrations were found in areas with older (pre-1978) septic systems (Lapointe, Herron et al. 2017).

Nutrient pollution can affect both ground and surface water. Soil water draining below the crop root zones (deep drainage) picks up nitrogen (especially NO_3-N) and phosphorus (as phosphate PO_4) and transports them to the water table, where they move laterally with the groundwater flow. Surface runoff carries excess nutrients to rivers and lakes that provide drinking water supply and recreation and to coastal areas where people enjoy recreation. There are photosynthetic species that adapt well to high concentrations of nutrients and respond with opportunistic, excessive growth. Typically, in aquatic environments, the organisms that respond in this manner are algae, and excessive growth is known as an algal bloom or harmful algal bloom (HAB). HABs can lead to a loss of other aquatic plants, as crowding by the algae leads to increased turbidity and decreasing light and visibility. When blooms inevitably collapse, the decomposing algae consume oxygen in the water (causing a reduced dissolved oxygen concentration), resulting in the death of other aquatic species, especially fish. This process is known as 'eutrophication'.

Nutrients in drinking water reservoirs can result in blooms of cyanobacteria (algae) that often produce cyanotoxins which, if not removed, can result in chronic and acute health implications. Cyanotoxins can produce metabolites that make the water taste and smell unpleasant when certain concentrations are exceeded. The removal of toxins and taste and odour components requires additional treatment processes and chemicals at potable water treatment facilities (for example, Mt Crosby), thereby increasing the cost of water production. Excessive nitrates in drinking water (>10 mg NO_3-N/L) are a concern for some remote indigenous communities that rely on groundwater supplies, but excessive nitrates have not been observed at levels of concern in Queensland's municipal drinking water supplies. Eutrified waters caused by excessive nutrients can adversely affect municipal urban and private water supply provision, stock and domestic rural water supply provision, commercial and recreational fishing and other activities. The tourism industry also relies on waterways for the livelihoods of its workers.

In Queensland, *Raphidiopsis raciborskii*, which produces the cyanotoxin *Cylindrospermopsin*, is the most common tropical and sub-tropical cyanobacteria of concern. Accidentally swallowing water containing cyanotoxins while swimming can cause stomach or liver illness, respiratory problems and neurological effects.

4.1.3 Micropollutants

Micropollutants are chemical contaminants that can come from a range of sources. Except for a few, they are generally not regulated due to a lack of information on health impacts. A smaller subset of micropollutants is often called 'emerging chemicals of concern' as they can be found in ground and surface water in very low concentrations (at or below the microgram per litre level) as a result of human activity. These emerging chemicals of concern are an evolving part of the research and regulatory environment.

Micropollutants include chemicals that occur in their original (manufactured) form as well as their metabolites (chemicals changed when excreted by humans) and degradation products (chemicals changed after release to the environment). Micropollutants include:

- Pharmaceuticals and personal care products
- Endocrine-disrupting chemicals
- Food additives such as artificial sweeteners
- Agricultural chemicals used in domestic gardens and veterinary medicines prescribed for pets
- Industrial chemicals, including fragrances, dyes, plasticisers, tyre wear products and flame retardants
- Per- and poly-fluoroalkyl substances (PFAS)

OSFs are generally designed to reduce carbonaceous compounds and pathogen loads, not to remove micropollutants. Efficiencies of removal mechanisms of chemicals in OSFs can range from less than 1% to greater than 99% depending on the treatment type and physicochemical properties of the chemicals (Conn, Barber et al. 2006). Current regulations to protect domestic bores from pathogens may not prevent organic contaminants from reaching drinking water bores due to both the mobility and environmental persistence of contaminants (Schaider, Ackerman et al. 2016). Elliot and Erickson (2018) illustrated how *large on-site* wastewater systems (larger than 21 EP systems discussed in this paper) that discharge to permeable soil or shallow groundwater also deliver pharmaceuticals and other micropollutants to aquifers and could contribute micropollutants to drinking water via water supply bores.

Factors that influence the number of chemicals that may be released into groundwater from OSFs include:

- Areas with dense residential developments where septic systems are common
- Highly permeable sand and gravel aquifers with shallow water tables
- Where nutrient contamination is known to affect surface water quality.

(Schaider, Rodgers et al. 2017)

Chemicals that are good indicators of wastewater contamination are those that are not well removed during treatment and remain stable and persistent after release. Acesulfame (an artificial sweetener) is considered a good indicator. It was reported at a concentration of 8–18 µg/L in a groundwater septic plume 200 m downstream of a 20-year-old septic system. The corresponding travel time was estimated to be 15 years (Robertson, van Stempvoort et al. 2012). The gradient of acesulfame and DEET (an insect repellent), along with bacterial indicators, in a groundwater plume in a shallow aquifer in Eromanga, Queensland, was used to help identify a leaking septic tank (Queensland Health, unpublished data). The body of literature in this area of study generally reports on large-scale facilities (>40 kL/day) with a greater amount of total waste received. However, given the environmental persistence characteristics of the chemicals discussed and the similarity of disposal methods and soil transformation characterisations, large-scale studies can still be used to flag this as an area of concern, especially in areas where clusters of OSFs are located. Other chemicals that have been associated with wastewater plumes include sulfamethoxazole (an antibiotic), carbamazepine (an anticonvulsant) and fluconazole (an antifungal) (Elliot, Erickson et al. 2018).

Microplastics and nanoparticles are currently an emerging concern in wastewater; however, very limited studies are available on these in OSFs.

4.1.4 Secondary Impacts

There are several ways in which humans can be exposed to the primary hazards described above. Contact can occur directly with contaminated soil or water, via other organisms such as flies and mosquitoes or by the consumption of produce grown in contaminated soil or irrigated with contaminated water. These routes of exposure are illustrated in Error! Reference source not found..

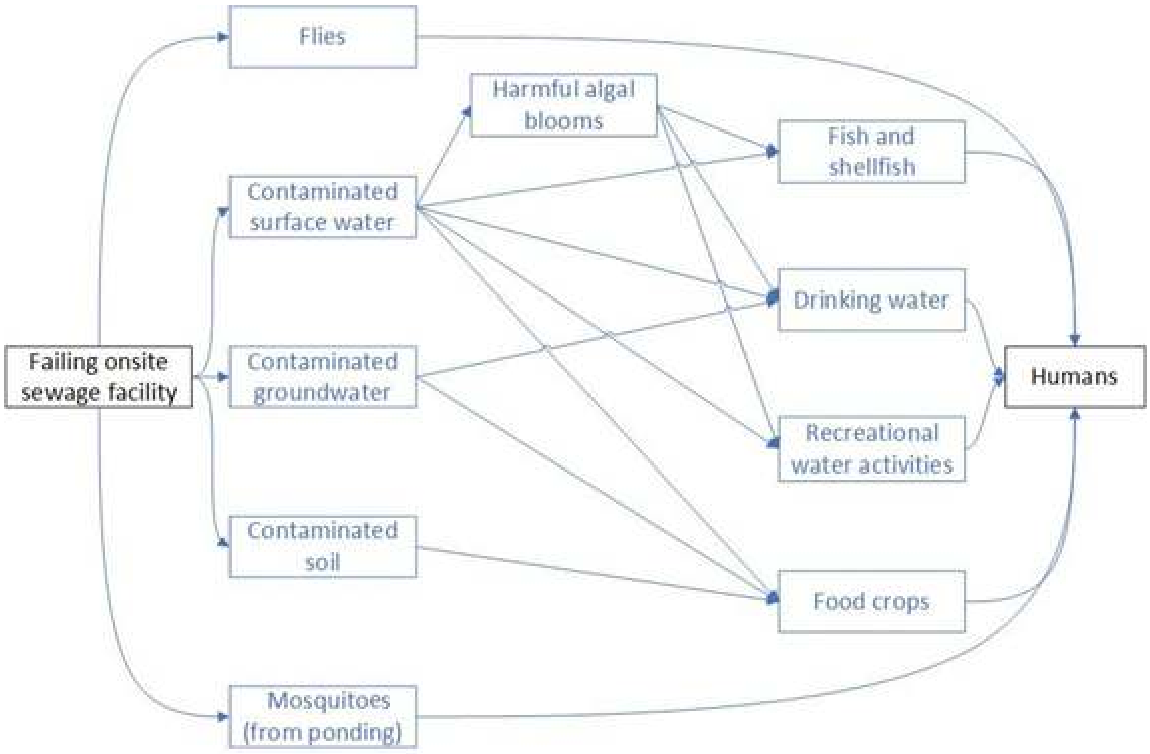


Figure 1. Routes of human exposure to hazards from OSF

4.1.5 Drinking Water – Public Supplies

A drinking water supply system comprises source water catchments (including aquifers), storage reservoirs (lakes and dams), water treatment facilities, service reservoirs and distribution networks. As these components are directly interrelated, the quality of drinking water supplied to consumers can be affected by hazards occurring at any of these points in the drinking water supply chain from catchment to tap. Accordingly, the most effective means of assuring drinking water quality and the protection of public health is through the adoption of a preventative management approach that encompasses all steps in water production from catchment to the consumer. This is known as the multi-barrier approach.

Under the multi-barrier approach, the failure of one barrier to mitigate a contamination event should be compensated by the effective operation of the remaining barriers within the entire treatment system. Although in the traditional sense, multiple barriers were more likely to be viewed as various steps at water treatment facilities (for example, filtration is one barrier, disinfection via chlorination another), it is firmly recognised within the international best practice (for example, the World Health Organization (WHO) Water Safety Plan approach (WHO and IWA, 2017) and Element 3 of the Australian Drinking Water Guidelines (NHMRC 2011) that source water catchments are the first and most fundamental barrier in the multi-barrier approach.

Wastewater contains many water quality hazards, including human pathogenic bacteria, protozoa and viruses. As such, an OSF's failure or underperformance can lead to serious environmental and public health impacts from local surface ponding, direct discharge to surface water bodies supplying reservoirs, and groundwater contamination. Many OSFs are not designed for a specific pathogen reduction, and the reduction function is achieved through time-based detention in a biologically active media such as soil or a sand filter. Outbreaks of disease caused by the contamination of drinking water by pathogenic microorganisms have occurred quite frequently over recent years, even in notionally sophisticated and well-operated water supply systems (Hrudey and Hrudey 2006). Failing, underperforming or poorly sited OSFs have been identified as factors contributing to disease outbreaks caused by contaminated drinking water, including in the developed world (Borchardt, Chyou et al. 2003).

The provision of safe drinking water is most effectively managed through a preventative management approach with multiple barriers against contamination, as covered in the Australian Drinking Water Guidelines (ADWG) Framework for Management of Drinking Water Quality (NHMRC 2011). Under the ADWG, the catchment where the water lands and is stored, in many cases, provides the first and most fundamental barrier for protecting drinking water quality. Ideally, the catchment would have little to no anthropogenic sources of contamination. However, for much of Queensland, the raw water supply is stored and generated from open catchments with a range of point and diffuse chemical and microbial inputs. In many cases, there is a degree of attenuation and dilution in the catchment before water treatment. However, the overwhelming burden of risk reduction is borne by the water utility company or local government authority to manage this public health risk. Conventional water treatment processes, which involve a flocculation and settling process, followed by filtration and disinfection (most often chlorination), have the ability to reduce the pathogen levels found in open catchments but not always to a level that is defined as 'unequivocally safe' (1 µDALY). In many cases, there is a gap between the desired or required level of pathogen removal and what is possible by the water treatment process with the current treatment steps. The reduction of catchment pathogen input through the correct function, use, placement and type of OSF is critical to holistic risk management. In cases where this does not happen, health outcomes can be very severe.

4.1.6 Drinking Water – Private Supplies

In instances where domestic properties and community and commercial premises are unable to connect to a drinking water service, they will almost always be reliant on private drinking water supplies. Most private water supplies rely on roof-harvested rainwater; however, some are reliant on surface and/or groundwater sources.

For several reasons, private drinking water supplies that rely on surface and shallow groundwater sources are susceptible to impacts from failing on-site wastewater treatment systems. First, homeowners and managers of commercial and community premises may only employ very basic treatment processes as part of their private drinking water supplies under the mistaken belief that the water they source from the environment is 'natural' and, therefore, safe to drink. However, even when there is an acknowledgement that treatment is required and a suitable treatment system is installed, it is unlikely that the system will be capable of removing or inactivating all of the hazards that a failing OSF might introduce into the environment (e.g. viruses and, through secondary impacts, algal toxins).

Potable water is not just for drinking. It is also required for cooking, food preparation, bathing, showering, hand-washing and toothbrushing. Water outlets in kitchens and bathrooms (excluding toilets) must be connected to a potable supply. Consequently, potable drinking water service is not easily replaced with alternatives such as bottled water.

As indicated above, private supplies are not limited to domestic households. Commercial, tourism and community premises that may have private drinking water supplies include:

- Food premises such as cafes, restaurants and mobile caterers
- Accommodation premises such as hotels, motels, guest houses, bed and breakfasts, farm stays and backpacker accommodation
- Caravan parks and camping grounds, including school and church camps
- Childcare centres
- Private residential aged care facilities

- Health clinics
- Schools
- Recreation and sporting facilities
- Community halls and showgrounds
- Petrol stations and roadhouses
- Mining camps and other worksites.

An incorrectly located or failing OSF can impact the water supply of the same household, but where shallow aquifers are the main source of drinking water, the water supply of a whole community can be affected. An example of this occurred in Eromanga in 2014, where one failing septic tank contaminated a shallow aquifer and affected the drinking water of most of the community, leading to significant illness in that community. There are other communities in Queensland where multiple OSFs have been installed over shallow aquifers that are used as sources of drinking water, including K'gari (Fraser Island) and the sand islands of Moreton Bay. Shallow sand aquifers are particularly susceptible to contamination, so failing OSFs pose a particular risk to private supplies that draw their water from these sand aquifers.

4.1.7 Recreational Water

Many water bodies in Queensland are used for recreational purposes, providing significant health, social and economic benefits to locals and tourists alike. The safe use of recreational water bodies is a valued aspect of Queensland's lifestyle.

From a public health perspective, uses of recreational water bodies are categorised into either primary, secondary or non-contact uses. Primary uses of the water involve immersion in the water, such as swimming, whereas secondary uses involve limited contact with the water, such as boating and fishing. Non-contract uses involve taking recreation near a water body (e.g. having a picnic on the shoreline of a lake).

Recreational water bodies are susceptible to both direct and indirect impacts of failing OSFs. A failing or incorrectly located OSF, or several failing or incorrectly located OSFs, can lead to the contamination of these water bodies with disease-causing microorganisms present in sewage (e.g. norovirus, *Salmonella spp.*, *Cryptosporidium hominis*), leading to an increased risk of diarrhoeal illness in the users of these recreational waters. Additionally, failing or incorrectly located OSFs can lead to an increased concentration of nutrients in the water (such as nitrogen and phosphorus), which, in turn, can increase the likelihood, extent and duration of HABs. HABs pose a risk to users in several ways, depending on how a user is exposed to the bloom. Through contact with water, these algal cells can lead to harmful skin irritation. These HABs can also produce algal toxins and, depending on the toxin produced by the bloom, incidental ingestion of water containing it can result in various illnesses, affecting the gastrointestinal tract, the liver, the kidneys and even the nervous system. Inhalation of aerosols containing these toxins can also cause illness. Some studies have demonstrated that failing OSFs can threaten the safety of recreational waters, thereby jeopardising the benefits they can provide.

Epidemiological literature established a relationship between wastewater contamination, recreational activity and illness in early studies of inland waters (Stevenson, 1953) and coastal waters (the Committee on Bathing Beach Contamination 1959). Further studies by the United States Environmental Protection Agency (USEPA) on the relationship between faecal indicators and adverse health outcomes (Cabelli, Dufour et al. 1983) led to the development of standards for enterococci and *E. coli* for fresh waters and enterococci for marine waters. However, several factors make the establishment of a direct relationship between water quality, particularly pathogens, and illness problematic.

4.1.8 Impact on Aquatic Environments

The focus of the Panel is on human health impacts. However, human health impacts often occur in tandem with environmental impacts. Domestic wastewater can contain synthetic organic compounds, metals, nutrients and micropollutants. When OSFs are not operating as required, contaminants can make their way into the aquatic environment at even greater levels, impacting water quality and resulting in undesirable ecosystem changes. In addition to the human health impacts described above, these environmental impacts can lead to increases in pest species such as mosquitoes. Loss of fish habitat can result in the reduction of available suitable species for recreational fishing and consumption. Some fish and shellfish species can accumulate algal toxins and other toxic chemicals, resulting in species loss in the food chain and making the fish unsuitable for human consumption.

4.1.9 Amenity

Failing or poorly sighted OSFs can lead to issues of site malodours and reduced visual amenity. Issues can be grouped into three main classes: inputs, performance and disposal.

System inputs and design are key to the functional performance of these systems. If systems are volumetrically overloaded or if the chemical addition of bleaches or similar chemicals exceeds system assimilation capacity or mode of operation (e.g., frequent absences of residents), this can lead to increased odour and poorer quality effluent composition.

System performance is pivotal to the successful application of OSFs. Modification or failure to maintain system operability can result in blower air ratios not being optimal or blowers being turned off, reducing the efficacy of aerobic treatment stages. This applies to aerobic wastewater treatment systems that use the activated sludge process for sewage treatment.

Disposal design and operation are also key to the functional performance of OSFs with overloaded or uneven transpiration trenches, leading to waterlogging and ineffective soil-based remediation. Keeping the area clear of tree roots and other pipe-blocking vegetation is also important to avoid blockages and surface-based expression of pungent pathogen-loaded effluent. Mowing and exclusion barricades also significantly assist in reducing the chances of direct interaction with effluent in the receiving area.

4.1.10 Economic Impacts

The choice of on-site systems usually hinges on the ease and perceived cheapness of the systems without proper thought to the longer-term impacts. This is especially true at locations with small lot sizes and mains drinking water but no reticulated sewerage. In many cases, developers of subdivisions save significant money to offer the property with mains water and no sewage service, requiring OSFs to be installed at the homeowner's expense. This cost saving is attractive to the developer and can appear to be a saving to the local government, which does not need to upgrade wastewater infrastructure. For the homeowner, the saving from not paying a sewage rate is offset by quarterly servicing costs if an AWTS is installed.

The hidden costs in this model can be high, with the homeowner (often not aware of requirements in the operation of these systems) then requiring quarterly servicing and inspecting, as well as periodic pump-outs. The area of land and, ideally, the reserve disposal field cannot be used for anything other than the planned disposal area, limiting further building on the property. If these systems fail, there are downstream impacts to neighbours and the community at large and generate overland flow to neighbouring properties or waterways.

The local government authority is required to meet the ongoing costs of compliance and auditing of the OSFs. If the systems fail or the cumulative impacts are too great, the local government authority (or the distributor retailers in SEQ) may have to meet the costs of retrospective installation of the sewer network and the costs of upgrading their drinking water treatment.

5 Evidence of Failing Systems

In most cases, OSFs should be able to effectively treat household wastewater to a quality where concerning elements, such as disease-causing microorganisms, are effectively removed or inactivated. However, the key to effective treatment is having a properly functioning, appropriately located and well-maintained OSF. Studies undertaken in Australia, specifically in SEQ, suggest that domestic OSFs are often not correctly functioning and are, therefore, 'failing' to a lesser or greater extent.

5.1 Defining Failure

Using consistent, well-defined terms is essential in characterising the success of the regulatory intervention in preventing OSF failures and thereby reducing the risk to public health. In the many reports and scientific papers on OSFs, various definitions of failure have been used. In some publications, failure is defined simply as non-compliance with effluent quality guidelines (Levett, Vanderzalm, . 2010). Other definitions require the presence of pooling, odour or similar visible, physical evidence of failure (Gardner, Vieritz et al. 2006). Other terms that are used in assessing failure include:

- Catastrophic, irreversible, episodic, periodic (Beal, Gardner et al. 2005)
- Poorly performing, underperforming, failing (Gunady, Shishkana et al. 2015); and
- Suboptimal (Withers, Jordan et al. 2014).

The differences in failure rates reported in different studies are partly explained by the failure definition used. Another critical factor is the timeframe in which the failure is considered. For example, did the failure occur at the time of the survey, or was it estimated over the life of the system or a defined period of years?

One of the Panel's first tasks was to agree on a workable definition of 'failure'. After reviewing the literature and being informed, particularly by the work undertaken by the Seqwater Source Protection Planning team, on regional source water risk reduction planning, a tiered definition of failure was adopted.

Broadly, failure categories are:

- *Compliance failure* includes a facility that has not been designed, installed or maintained in accordance with applicable codes or standards.
- *Design failure* includes failures in design, including non-compliance with standards, regulations or codes or is based on an incorrect assessment of location or household parameters.
- *Hydraulic failure* is visible failure indicated by above- or below-ground seepage, resulting in pooling, ponding or flowing effluent or unusually vigorous vegetation growth.
- *Operational or maintenance failure* is any condition of a facility that could lead to hydraulic failure, including faulty installation, mechanical breakdown or a lack of adequate maintenance.
- *Technical failure* describes a facility or a component of a facility that was compliant at the time of installation but does not meet the requirements of current codes and standards.

See Appendix A for a full description of each category of failure.

Under a codified risk management framework, such as ISO 31000:2018 (Risk Management), risk can be estimated by identifying the likelihood of occurrence of a hazardous event and evaluating the severity of consequences if the hazardous event were to occur, where a hazard is an agent that has the potential to cause harm and a hazardous event is an incident or situation that can lead to the presence of a hazard. Risk is then calculated as the product of likelihood and consequence via a risk matrix (Figure 2).

	Consequence					
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Almost Certain	Medium	High	High	Extreme	Extreme
	Likely	Medium	Medium	High	Extreme	Extreme
	Possible	Low	Medium	Medium	High	Extreme
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Figure 2. Risk Matrix. An example of a risk matrix aligned with ISO 31000:2018 (Risk Management). Risk is calculated as the product of likelihood and consequence).

In line with ISO 31000:2018 and informed by the risk assessment method developed by Baker, Ferguson et al. (2016), for the purposes of this report, where the hazard is wastewater pollution, and the hazardous event leading to the presence of the hazard is the failure mode, the likelihood of occurrence of a hazardous event and consideration is being given to the severity of consequence to human and/or environmental health. Thus:

- An OSF that is in hydraulic failure is considered to have a likelihood of 'likely' (a wastewater pollution hazard is likely to occur in the event of hydraulic failure), and the consequence rating is 'major' (a wastewater pollution hazard will have a major consequence in terms of human and/or environmental health). Thus, by applying the risk matrix as per Figure 2, the risk posed to human and/or environmental health from a hydraulically failing OSF is estimated as 'Extreme'.
- A compliance failure, design failure, operational/maintenance failure or technical failure is considered to have a likelihood of 'possible' (the presence of the wastewater pollution hazard is 'possible' in the event of these failure modes), and the consequence rating is 'major' (a wastewater pollution hazard will have a major consequence in terms of human and/or environmental health). Thus, by applying the risk matrix as per Figure 2, the risk posed to human and/or environmental health from an OSF that is in either compliance, design, operational/maintenance or technical failure is estimated as 'High'.

5.2 Estimating Failure Rates in Queensland

It is estimated that there are more than 100,000 OSFs installed in Queensland, with more than 43,000 in Seqwater's Source Water Catchment in SEQ alone. Anecdotal data had been reported to members of the Council on high failure rates of OSF, but no supporting data was available. To at least partially compensate for the lack of data, the Panel undertook surveys of local government and licensees to try to gauge broader estimates of OSF compliance.

Of the 34 local government responses to the Panel's survey of local governments (see Section 5.1), only one was able to give numbers for primary, secondary, pump-outs and total on-sites systems in their jurisdiction. Another local government authority indicated that it would need to manually count the records. The remaining 21 gave qualified answers, either 'around' or 'between' or only for secondary/advanced systems or only those installed after a certain date. Almost half of the 34 local governments did not know how many OSFs were in their jurisdiction.

Eleven respondents could not estimate the percentage of compliant OSFs in their local government area, and only seven thought that greater than 80% were compliant. The results are consistent with other estimates that somewhere around half of OSFs are not compliant.

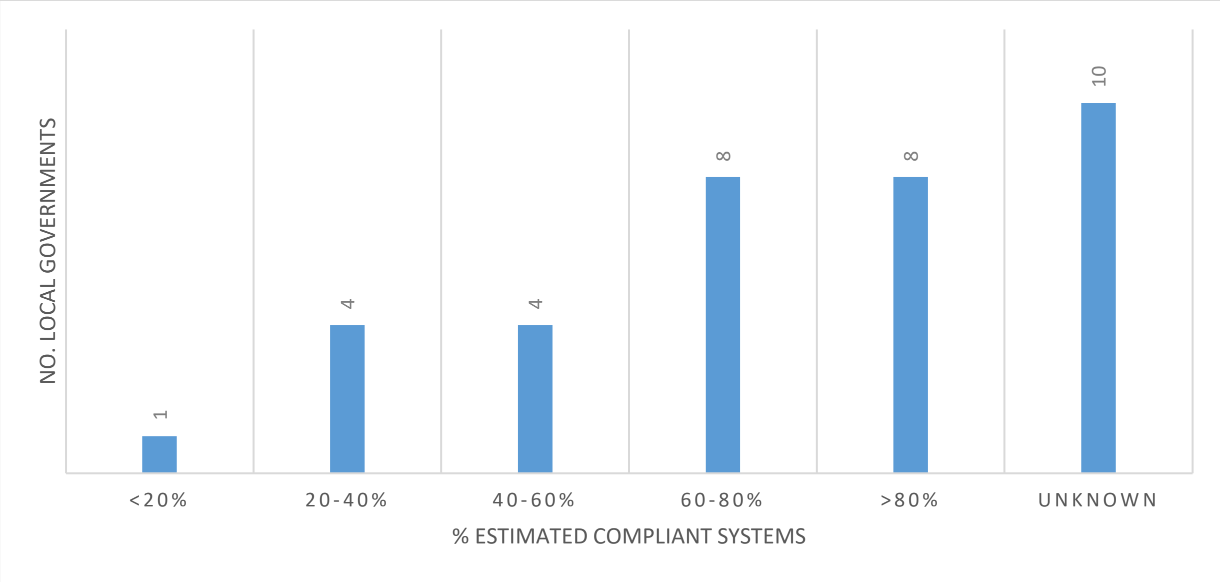


Figure 3. Responses to the local government survey estimating the percentage of compliant OSFs in their area.

In the survey of licensees (Section 6.2), only half said they seldom or never come across OSFs that are not maintained, failing or have significant compliance issues. Two-thirds of licensees indicated that they sometimes, often or daily come across OSFs with minor compliance issues (Table 3).

In your work, how frequently do you come across the following situations?

A: An on-site sewage facility that is generally well maintained but has minor compliance issues.

B: An on-site sewage facility that has not been well maintained and has no obvious compliance issues.

C: An on-site sewage facility that has not been well maintained and is failing or has significant compliance issues.

Response	A: Minor issues	B: Not maintained	C: Non-compliant
Never	108	151	167
Seldom	155	216	215
Sometimes	339	267	245
Often	139	122	127
Daily	22	7	9
Total	763	763	763

Table 3. Licensee survey.

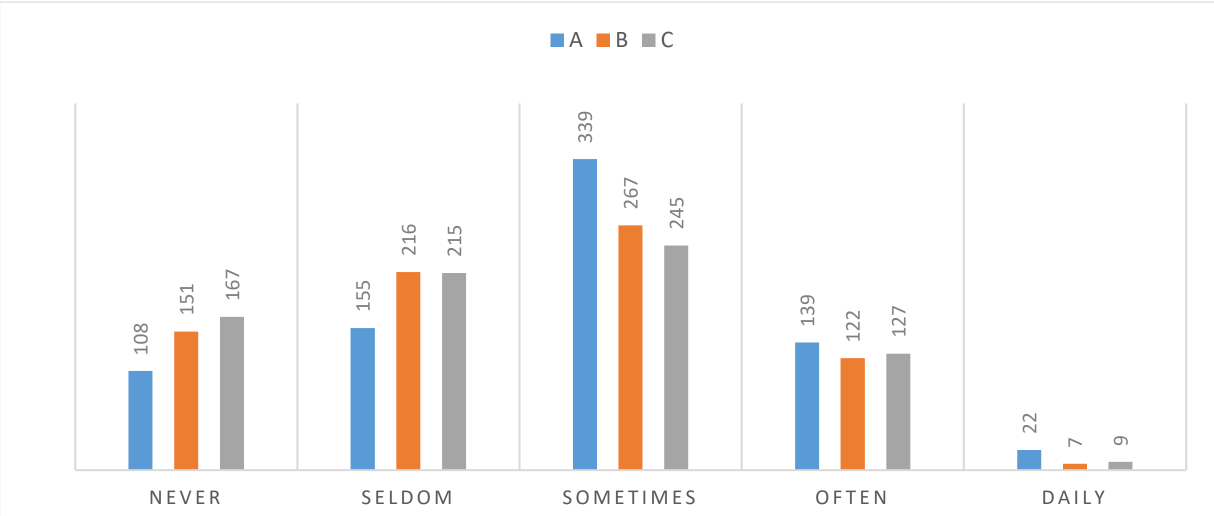


Figure 4. Responses in the survey of licensees.

'In your work, how frequently do you come across the following situations? – A: An on-site sewage facility that is generally well maintained but has minor compliance issues; B: An on-site sewage facility that has not been well maintained and has no obvious compliance issues; C: An on-site sewage facility that has not been well maintained and is failing or has significant compliance issues.'

5.3 Previous Studies in Queensland

Several studies on on-site systems were undertaken in Queensland from 1998 by researchers from The University of Queensland and Queensland University of Technology with the participation of various local governments, including Logan, Gold Coast, Noosa, Caboolture and Brisbane and government departments and agencies, including the (then) Department of Natural Resources and Mines and the (then) Moreton Bay Catchment Authority. These studies variously examined system performance, ground and surface water contamination, microbial source tracking and soil capacity. The studies resulted in progress in some local governments, and at least two townships, Jacobs Well (Gold Coast) and Malanda (Atherton Tableland), were sewered following studies in these areas. Despite efforts by some local governments, there has been little follow-up research since 2006, apart from one Noosa study published in 2016 (Noosa Council 2016).

A review of on-site wastewater practices in SEQ (Beal, Gardner et al. 2005) reported an audit of non-sewered areas in SEQ for Moreton Bay and Catchments Water Management Partnership (now Healthy Land and Water). Non-sewered lot sizes across Queensland averaged 5,100 m^2, ranging from 800 m^2 in Noosa to 20,000 m^2 in Nanango, based on estimates from planning officers and/or plumbing inspectors. Almost all local governments had no accurate records of septic systems installed prior to 2000. Record-keeping was not a requirement prior to the introduction of the Queensland interim code of practice for OSFs in 1999 and the introduction of the PDA in 2002. The study reported that the local government was not monitoring most septic systems as part of a structured program but rather on a complaints basis only. The systems that were being monitored were part of audit programs of just two local governments (Logan and Caboolture). In contrast, around 80% of aerobic systems were being monitored. Most local governments thought there were inadequate resources for managing OSFs. As expected with complaints-based reporting, most failures (59%) were absorption trench surcharges, the causes of which included broken baffles/outlet filters and infrequent septic tank desludging, both of which allow solids carry-over into trenches. Other faults reported included tank disrepair (21%), odour (10%) and off-site risk (10%). The LGAs reported higher failure in combined (black and greywater) systems than in older blackwater-only systems, possibly due to the larger volumes of water that enter the combined trench.

The Gold Coast City Council commissioned a study to inform a risk-based approach for identifying parameters that can lead to environmental contamination from OSFs and identifying areas that are unsuitable for on-site development (Carroll, Goonetilleke et al. 2005). One area studied was Jacobs Well, a small community on the southern tip of Moreton Bay by the mouth of the Pimpama River. In the early 2000s, the area underwent significant development without the inclusion of sewerage trunk infrastructure, resulting in a reliance on on-site systems. The average block size was 400 m^2, and the resulting density of on-sites systems was 2.9 per hectare. A study of nutrient and pathogen concentrations in surface water and groundwater indicated that impacts were occurring in the shallow aquifers and the hydraulically connected surface waters. Although there was some dilution across the area via groundwater flow, numerical modelling indicated that further development could result in contamination above guideline limits (Carroll, Goonetilleke et al. 2005). The township of Jacobs Well has since been sewered, allowing further development to occur in the area.

Neither the study by Beal, Gardner et al. (2005) nor Carroll, Goonetilleke et al. (2004) undertook any auditing of individual systems. In a study of on-site system performance in the Brisbane local government area, Goonetilleke, Dawes et al. (2000) inspected 16 OSF sites. The sites included eight septics, two greywater systems and six AWTSs. Monitoring bores or piezometers were installed 1m and 3m downstream of the edge of the system's disposal area. Only four sites (three septics and one AWTS) were found to be operating satisfactorily. The remaining 12 sites had evidence of ponding, seepage or saturation.

An audit of 100 OSFs in the Noosa shire found that 41 systems were not compliant (Noosa Council 2016). The failures identified included:

- Nine plants had TSS levels greater than the permitted range.
- Four plants had pH levels out of the recommended range.
- Eight plants required pump-outs due to high sludge levels.
- Six plants had insufficient chlorine levels.
- Seven mechanical faults were found (broken air blowers, pumps and alarm systems).
- 16 LAAs were defective; the issues were overgrown vegetation and inappropriate ground coverage, signs not being in place and faulty sprinklers.
- One sand filter had completely failed and had to be replaced.

A study of the catchment area around the unsewered community of Eudlo in the Sunshine Coast hinterland used a novel but complex biochemical fingerprinting technique to match human sources of faecal coliforms bacteria in 39 septic tanks and the adjacent Eudlo creek (Ahmed, Neller et al. 2005). Creek water samples were collected upstream and downstream from the community and from 39 septic tanks to 'fingerprint' enterococci and *E. coli*. A high match was found between indicator bacteria in defective septic tanks (defined below) and downstream water samples, indicating water contamination from the septic systems. From the survey of the septic tanks, the authors reported:

'Of the 48 septic systems surveyed in the study area (for example, Eudlo township), 32 (67%) tanks needed cleaning out, and 23 (72%) of these systems had soggy absorption fields. Four (8%) tanks had structural problems such as broken baffles or lids. Two (4%) systems had technical faults such as the absorption field being located close to a water bore or the tanks were installed below the flood level. Three (6%) tanks had insufficient capacity for the household wastes. Only seven (15%) systems were found well-maintained.'

Several other studies have been undertaken using various methods to trace the source of microbial contamination in water. Sewage pollution from septic tanks has been consistently found to be a source (Ahmed, Toze et al. 2010) (Table 4).

Rising population growth, decreasing lot sizes in peri-urban areas and an unwillingness for water utilities to extend sewerage networks before a critical allotment number is developed are predicted to result in the number of OSFs increasing significantly over the next few years. Although many of these will be AWTSs rather than septics, standard septic systems are still being installed in many areas, and older septics will continue to be used.

Table 4. Faecal source-tracking case studies undertaken in SEQ, Australia (source: Ahmed, Toze et al. 2010).

Location	Aquatic environment type	Tools used	Likely sources of faecal pollution	Reference
Eudlo Creek, Maroochydore	Freshwater creeks	Biochemical fingerprinting	Sewage pollution via septic tanks, animals such	Ahmed, Neller et al. 2005

			as chickens and ducks	
Bonogin Valley and Tallebudgera Creek, Gold Coast	Freshwater creeks	Antibiotic resistance analysis	Sewage pollution via septic tanks, wild animals	Carroll, Goonetilleke et al. 2005
Bergin Creek, Four Mile Creek and River Oaks Drive in Pine Rivers Shire	Stormwater runoff	Biochemical fingerprinting sewage-associated HF183b and HF134b PCR	Sewage pollution via septic tanks, wild animals	Ahmed, Stewart et al. 2007
Tooway Lake, Caloundra	Coastal lake	Biochemical fingerprinting and antibiotic resistance analysis	Sewage pollution via STP, waterfowl	Ahmed, Hargreaves et al. 2008
Ningi Creek, Caboolture	Brackish waters	Sewage-associated HF183b, HF134b, *esp*b, ruminant-associated CF128, dog-associated BacCanbPCR	Sewage pollution via septic tanks, cattle and dog faecal pollution	Ahmed, Powell et al. 2008
Ningi Creek, Caboolture	Brackish waters	Sewage-associated *esp*a PCR	Sewage pollution via septic tanks	Ahmed, Stewart et al. 2008a
Bergin, Four Mile and River Oaks Drive	Stormwater runoff	Sewage-associated *Bacteroides*	Sewage pollution via septic tanks	Ahmed, Stewart et al. 2008b

Creek in Pine Rivers Shire		HF183b and HF134b PCR		
Maroochy River, Maroochydore	Estuarine water	Sewage-associated JCV and BKV polyomaviruse sbPCR	Sewage pollution via STP and stormwater drains	Ahmed, Wan et al. 2010
Maroochy River, Maroochydore	Estuarine water	Sewageb - and bovineb wastewater-associated adenoviruses	Sewage pollution via STP and stormwater drains and bovine faecal faeces	Ahmed, Goonetilleke et al. 2010
North Maroochy River, Maroochydore	Freshwater creeks	Faecal sterols	Sewage pollution via septic tanks, wild animals	Sullivan et al. 2010

6 Responses to Failing Systems

A range of responses to the problems of OSFs has been implemented in Australia and Queensland. Some states have wastewater policies and guidelines to sewer communities with OSFs at high density or in sensitive areas. The digital age is providing better options for the management of OSFs, including auditing and compliance activities. Technologies that challenge the binary choice between large reticulated sewerage schemes and domestic on-site schemes are being developed.

6.1 Sewer Backlog Programs

Sewer backlog programs identify high-risk unsewered catchments for upgrades to a sewer system or alternative system. NSW and Victoria have run sewer backlog programs since the 1990s, and both schemes have undergone reviews and updates in recent years.

In NSW, the Country Towns Water Supply and Sewerage Program (now part of Restart NSW) invested $1.2 billion in state government funding and $3 billion from local governments between 1996 and 2016, delivering 600 projects (including dam storage). Sewerage projects include Stuarts Point–Grassy Heads in Kempsey Shire Council (a coastal shire), where houses are around 40 years old. The scheme will enable households to avoid significant costs to bring individual OSFs up to compliance standards while improving property values and providing social benefits (NSW Government 2022). The Three Village Sewerage Scheme in the Port Macquarie–Hastings Council area will install a fully reticulated system to replace OSFs, provide a more efficient disposal method and protect the environment and health of the communities of Telegraph Point, Comboyne and Long Flat in the Port Macquarie–Hastings region (PMHC 2021).

Under the Victorian Government's Environment Protection Policy (Waters of Victoria) (SEPP(WOV)), local governments are required to develop a domestic wastewater management plan (DWMP) for unsewered townships. The towns were initially selected because of the large number of unsewered properties or the inability of the properties to contain wastewater on-site. The plan identified strategies to manage them and to refer high-risk unsewered townships to water authorities to either sewer them or connect them to an alternative service (e.g., a small-bore pressure sewer). The water authority is required to find the most cost-effective, fit-for-purpose wastewater treatment option (Victorian Government 2018).

The Yarra Valley Water (YVW) Community Sewerage Program (CSP) commenced the traditional backlog program in 2008. The CSP offered sewer connections to 3,863 properties in the first 10 years of the backlog program, with a take-up rate of 76% by 2018. This represents 19% of all properties on the CSP across all municipalities served by YVW. The remoteness of townships, pushback from the community, and difficult terrain were all identified as factors contributing to difficulties in implementing the traditional backlog program. YVW found that in some high-risk unsewered townships, upgrading or improving the management of OSFs was quicker and less costly than providing sewers for the same environmental and human health benefits (VAGO 2018).

South East Water (SEW) Peninsular Early Connection Option (ECO) is a backlog program costing $357 million to provide sewerage for 16,900 unsewered lots in four townships on the southern Mornington Peninsula. The scheme was able to save $100 million through innovative technology (on-site grinder pump chambers connected to small-bore sewers) and competitive procurement compared to the traditional program. The ECO program has connected over 5,000 of the 6,401 sewered properties by 2018, including 32% of the high-risk properties across the Mornington Peninsular (VAGO 2018). Although a sewer was the most cost-effective option for the majority of townships in its program, one township was estimated to need costs of about $50,000 per dwelling compared with SEW's benchmark cost of $10,000 per allotment. A more cost-effective alternative was found for this township (VAGO 2018).

The sewer backlog programs in Victoria and NSW have been underway for many years and have undergone reviews and restructuring over that time. These are long-term programs. In Victoria, the sewering of high-risk unsewered townships can take up to 30 years from when this need is first identified.

6.2 On-site Co-funding Program

There are more than 40,000 OSFs that service households across Seqwater's source water catchments. Given that inappropriately sited and/or poorly functioning OSFs can pose risks to the safety and security of drinking water, the management of OSFs across the region is of keen interest to Seqwater. However, Seqwater does not have regulatory powers over OSFs, nor does it have a clearly defined role, presence or reputation to independently engage with the local community on the issue.

In line with the approach taken for its broader catchment-based Source Water Protection Partnership Program, Seqwater has sought a solution to this problem by initiating a collaborative program with a number of LGAs. Under the program *On-site wastewater risk mitigation for priority areas*, LGAs and Seqwater work together on a desktop/mapping analysis to identify areas that are 'of concern' to source water quality, and subsequently:

1. Undertake community awareness activities, such as information sessions at libraries or shopping centres, regarding householders' roles and responsibilities regarding OSFs;

2. LGAs make targeted letterbox drops to households in close proximity to waterways within the 'area of concern', providing information regarding the proper operation and maintenance of OSFs and with an offer to have a council plumbing inspector examine the household wastewater system.

Based on the outcomes of the community awareness sessions and particularly the on-ground inspections of OSFs by local government plumbing inspectors, the LGAs and Seqwater assess the risk to source water quality posed by OSFs within the area 'of concern'. Should it be determined that the risk to source water quality is unacceptable and certain key criteria are met regarding the nature of regulatory compliance in the target area, the LGA and Seqwater collaborate on the development of a program to establish a pool of funds whereby eligible householders can access a subsidy to pay for a professional site design and the purchase and installation of an OSF that fully complies with the QPWC, AS/NZS 1547:2012, relevant LGA regulations and the Seqwater development guidelines.

This approach to actively address OSFs assessed as posing a risk to water quality is based on models that have been successfully employed both in Australia and overseas. For example, numerous jurisdictions in North America provide funding assistance for households and communities to rectify or upgrade OSFs (see, for example, http://cwconline.org/septic-programs-overview/). In the Australian context, the Mount Lofty Ranges Waste Control Project is one example of where a program offering householders incentives to upgrade failing OSFs has successfully been in operation for 10 years.

To date, more than 100 OSFs considered high risk to source water quality have been replaced with a lower risk system under the collaborative *On-site wastewater risk mitigation for priority areas* program. Other benefits of the program include improved data regarding the level of risk posed to source water quality across the region, improvements in OSF records within LGAs, building cross-institutional relationships and an understanding of perspectives regarding the management of OSFs.

6.3 Digital Management

A range of digital technologies is available to assist local governments with managing, monitoring and auditing OSFs. These programs enable the use of geographical information system (GIS) technology to locate OSFs and electronic form submissions to maintain an accurate and up-to-date database of OSFs, including their maintenance and compliance history.

Electronic lodgement of forms with geolocation of systems is an alternative method being pursued by some local governments. For example, Gympie, Logan Toowoomba, Sunshine Coast and Gold Coast plan to implement new automated electronic systems to reduce the number of human resources needed to process the large volume of service reports submitted by the various service agents of AWTSs.

Typically, these digital systems consist of:

- An application that can be run on a mobile phone or tablet
- A unique electronic tag (QR code) on each system that can be scanned by the person servicing the system
- A central database maintained by the Council with the details of the type of system, the installation date, QR codes, geolocation data and service history

Digital systems provide easy access to information on OSFs to all stakeholders:

- The person servicing the system scans the QR code and enters geolocation data from their mobile device.
- The person has access to the entire service history of the system and can follow up on previously reported problems.
- The details of the service, including measurements, observations and actions, are entered into the app while the person is still on-site.

- The data from the app is uploaded to the local government website either immediately or subsequently if the device is out of range.
- Any inconsistencies or issues identified can be flagged by the system, and automatic notifications can be sent to the submitter.
- The local government database can identify systems where service is late or missing and send reminder notices to system owners.
- The local government is able to generate reports on the status of all registered systems in their area.
- System owners can also be provided access to the history and service schedule of their system..

An electronic lodgement system is less resource-intensive than the manual systems currently used by many local governments and provides an opportunity for cost savings for all parties. It is simple, improves the visibility of workflow and can be integrated into larger databases. Applications that provide for electronic management of OSFs are available for purchase off the shelf. These systems can also be used for other local government regulatory functions, such as a backflow device register. There are benefits for local government, contractors and owners in using electronic management systems.

For servicing and maintenance contractors, the electronic lodgement systems provide information to support their business planning and operations, such as scheduling work and planning routes. The system provides detailed information on the system immediately and on-site and a verifiable and defensible record of the work being completed. Unethical practices mean higher risk, so a fair and level playing field for contractors is encouraged. Owners will be discouraged from changing service providers to avoid undertaking repairs and maintenance.

System owners will have access to the full history of their system, including design, installation and service records. Owners can receive a copy of service reports by email when they are lodged and will be assured that their system is functioning in accordance with inspection protocols. Faults can be rectified before they become major problems or result in risks to the health of the user.

Current legislative requirements focus on the property owner’s responsibility to have their OSF serviced and regularly maintained. Unfortunately, this does not address service agents who are not following correct servicing standards or are dishonest about the work they have done (or have not done) on the installed facility.

To address this issue, consideration should be given to introducing licensing requirements for service agents and their employees, which could include fines and penalties should they fail to service the facility correctly or dishonestly claim they have visited the property to conduct the required service.

6.3.1 Information Provided by Fraser Coast Regional Council

The Fraser Coast Regional Council (FCRC) engaged (a consultant) to develop an On-site Sewerage Facility Guide and co-ordinate a GIS risk assessment mapping tool for the assessment of site and soil evaluations in the concept/development phase of a wastewater design. The guide is to ensure prospects and constraints are identified as early as possible in the design stage and to allow the OSF to comply with the appropriate codes, regulations and standards. Risks associated with wastewater management can be minimised through appropriate selection, design, application and management.

A GIS module was generated by FCRC based on the outcome of the guide to assist with and identify risks with the assessment and design of future OSFs in the Fraser Coast region. The GIS portal will provide Council inspectors, site and soil classifiers and geotechnical and hydraulic design consultants with a comprehensive tool for minimising the environmental, health and economic risks associated with the design and installation of wastewater treatment systems while complying with all codes, standards and regulations. Appropriate assessments of applications will ensure that risks are minimised within mandated timeframes.

The mapping tool has been designed for use by consultants in the planning stages to ensure that the wastewater design presented to the Council is the most effective system that complies with the codes, standards and regulations in any Fraser Coast area. Council plumbing inspectors utilise the tool to assess submitted designs for compliance with the legislation and standards. Furthermore, the town planning section can utilise the portal to assess the risk of any particular lot within a proposed subdivision application, analyse and establish the constraints and specify the minimum LAA required for each lot to ensure appropriate wastewater management.

6.3.2 Information Provided by the City of Gold Coast

The City of Gold Coast has pristine sub-tropical rainforests on the western border of the Gold Coast hinterland. The Hinze Dam, which is the main drinking water supply for the Gold Coast region, is located in the hinterland. With the Gold Coast waterways and natural environment being the primary draw card for the growing population and tourists, we must protect these natural resources and our drinking water quality.

To support the growing population and expanding residential footprint, there has been an increase in rural-residential developments. As a result, the city now has close to 20,000 on-site sewerage treatment facilities servicing allotments in unsewered areas. Many of these properties are in the hinterland and within the water supply catchment buffer or near streams, creeks and rivers feeding into the tidal and coastal waterways of the Gold Coast.

Water quality monitoring programs were established over 25 years ago by the City of Gold Coast, and there are now over 50 monitoring sites across it. In support of this program, the plumbing and drainage team introduced an on-site sewerage auditing program approximately 17 years ago. The program includes registering on-site sewerage facilities, archiving and auditing service reports and auditing treatment plants and LAAs to ensure correct operation and compliant effluent quality.

The program is supported by an administration officer, three technical audit officers and one senior technical officer who register and save over 40,000 service reports and audit over 6,000 plants each year. The team have fully equipped vehicles with a full complement of sampling and testing equipment and have access to the Gold Coast's water laboratory services at the Griffith University Smart Water Research Centre.

The auditing program identified that approximately 60% of the treatment plants and/or LAAs had defects. Approximately 50% of these are dealt with promptly by the owner, with no further action required. We issue approximately 240 show-cause notices each month for failure to service (90) and failure to comply with the defect notice (150). About 80 enforcement notices are issued each month. Considering that nearly 60% of 20,000 on-site sewerage facilities have defects with either the plant operation or the LAA, the work of this team is vital for protecting the environment, the waterways and drinking water quality.

6.4 Scalable Technologies

Large-scale municipal sewers and small domestic OSFs are not the only options for managing domestic wastewater. Decentralised systems at cluster or development scale can provide an alternative stand-alone system or be integrated within a centralised system. Decentralised systems are also known as small-scale sanitation or distributed sanitation. These systems can be viable alternatives to mains sewers and OSFs for large residential buildings, compounds, peri-urban areas and small rural settlements (Reymond Chandragiri et al. 2020).

Traditionally associated with wastewater provision in developing countries, small-scale systems are now being installed in Australia. Yarra Valley Water's Community Sewage System and South Australia's Community Wastewater Management System (CWMS) are examples. Western Australia has also installed septic tank effluent disposal (STED) schemes at Hyden (130 lots) and Bruce Rock (250 lots). In these schemes, a septic tank effluent pump (STEP) is installed on each property. The septic tank provides primary treatment of the effluent. Solids are retained in the tank for periodic pump-out, which is organised by the service provider. Effluent-only sewage is pumped from each allotment to a reticulated sewerage network or to a sewage treatment plant. The removal of solids reduces the diameter of the polyethylene sewerage pipes to less than 75mm, which are installed at a shallow depth (<=1.5m), following the natural land contours. No manholes are required. The network can connect to conventional wastewater treatment plants, rising main sewers or other treatments, such as treatment lagoons that are connected to a dedicated irrigation area. In South Australia (SA), the capacity of a CWMS cannot exceed 2,000 EP (SALGA 2019).

In Queensland, the DES regulates small- to medium-sized wastewater treatment plants. Small- to medium-sized treatment plants service between 21 and 1,500 EP in resorts, caravan parks and other tourist facilities. The assessment guidelines (State of Queensland 2017) provide no specific assessment framework for STED or small-bore sewerage schemes. While it would be possible for STED schemes to be enacted in Queensland, there is no policy framework to encourage this or specific development pathway to facilitate such schemes. This is a legislative shortcoming that warrants investigation, as the current on-site system favours the developer's interests over the allotment purchaser's.

7 Consultation

As part of their deliberations, the Panel undertook an online survey of licensees in the industries working in on-site design, installation, maintenance and compliance as well as another survey of local governments. The surveys were hosted on the QBCC website, and invitations to participate were sent by email from the QBCC and in included in the Council's newsletter. Following these surveys, the consultation paper (QBCC 2021a) mentioned above was released on the QBCC website, and industry stakeholders were invited to respond. Face-to-face consultation was not undertaken due to the COVID-19 pandemic.

The Panel appreciates the contributions made by the individuals and organisations that responded to the surveys. Respondents provided new insights that the Panel had overlooked and provided fresh perspectives on others. In some instances, it was clear that the Panel had not provided adequate information in the consultation paper not only on individual options but also on the role of this report in the policy development process. Some respondents expressed concern that options could be implemented without further consultation. In reality, considerable discussion, refinement and consultation still remain between the draft consultation paper and any changes to policy or regulation in Queensland.

7.1 Local Government Survey

The Panel surveyed Queensland local governments to identify issues and concerns relating to on-site sewage management.

A survey was distributed to Queensland's 77 local governments in November 2019. Initially, 53 responses to the online survey were received from 34 of the 77 local governments in Queensland. Five local governments completed the survey twice, and one did so three times. In most instances, multiple responses were submitted from different departments within the local government – for example, plumbing, building or environment. For many of the questions, the responses from a local government making multiple entries were not consistent, suggesting a lack of communication between council departments (silo culture). A total of 41 responses from 34 local governments were included in the analysis.

In response to the question 'Does your local government maintain an electronic or hard copy register of on-site sewage facilities installed in your local government area?', 29 respondents said they had an electronic database of OSFs, and three had hard copy records. Nine selected 'other' with follow-up text answers indicating that systems were under development, contained data on AWTSs only, or the data was included in a general database. Asked what information the database contained, 25 said it included the current compliance status of the OSF, and 16 included a history of non-compliance. Twenty-three almost always inspect new installations, and 10 both inspect and accept Form 8 – an on-site sewage work declaration. According to the 15 respondents, no proactive compliance checks were undertaken by their council. Only 12 councils undertook site inspections, while seven did audits. Three stated in comments that compliance was complaints-based only.

When asked if there were known instances of failed OSFs impacting water sources in their area, eight respondents said there were confirmed cases, but 17 said they did not know whether there were or not. In response to questions about water quality, drinking water treatment and recreational activities, only 12 indicated that their council undertook water quality testing, although 33 said that both primary and secondary water activities occurred in their area (three said secondary only, but one of these was probably incorrect). Nine respondents indicated that their council had undertaken upgrades to water treatment plans to manage contaminated or degraded source water.

In questions about whether training and information were adequate, most thought that training for design, installation and maintenance was somewhat or very adequate, but in contrast, almost all (87%) thought that owners/occupiers were insufficiently educated on how to maintain their OSFs.

7.2 Licensee Survey

The Panel surveyed QBCC licensees to identify their perspectives on on-site sewage industry issues.

A survey was distributed to both occupational and contractor licensees who hold a licence that enables the performance of on-site sewage work.

There were 1,061 responses to the online licensee survey. The distribution of licence classes in the responses (Table 5) was reflective of the distribution of licence classes in Queensland. Among the respondents, 328 have an endorsement on their licence for on-site maintenance, 591 have a contractor's licence, and 209 have both.

Table 5. Distribution of licence classes in respondents to the online licensee survey

What occupational licence do you hold?	Drainer	Plumber and Drainer	Provisional Plumber and Drainer*	Provisional Drainer	Restricted Drainer (maintain only)**	Restricted Drainer (install and maintain)	Total
Number	37	896	52	4	50	22	1061
% of respondents	3.5	84.4	4.9	0.4	4.7	2.1	100.0

Only 763 respondents answered the following question on the frequency of on-site work. Of the 'other' category of work, 'inspect' was the most frequently cited response, followed by 'compliance and assess' (seven each) and 'retired' (five). There were 126 respondents who selected 'never' for all categories of work.

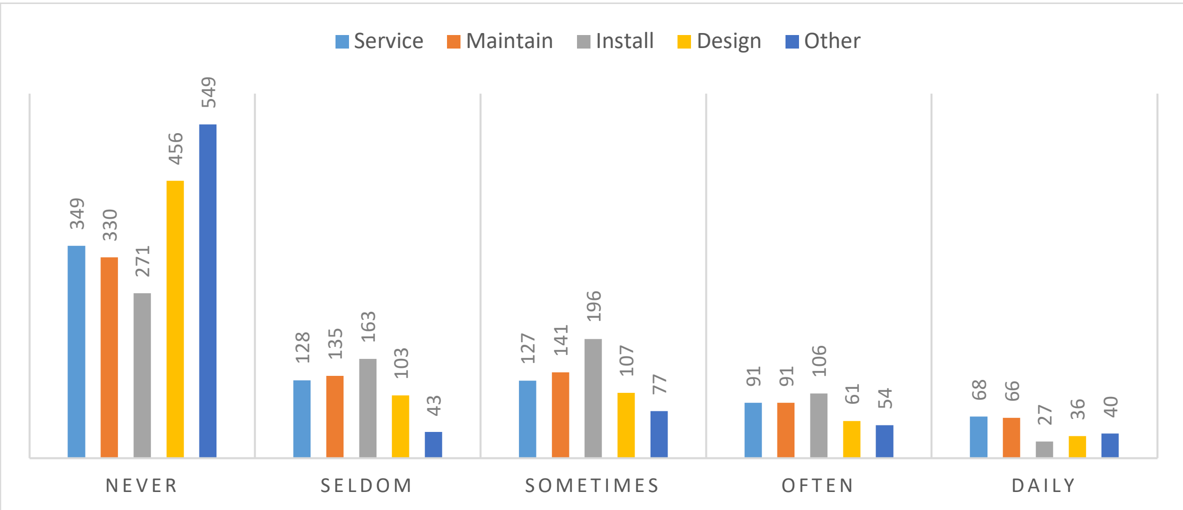


Figure 5. Frequency of responses in licensee survey

'How frequently do you perform the following types of on-site sewage work? Servicing on-site sewage facilities (service); Maintaining on-site sewage facilities (maintain); Installing on-site sewage facilities (install); Design and siting of on-site sewage facilities (design); other'.

'Sometimes' was the most frequent response to Question 6: 'In your work, how frequently do you come across the following situations?

a. An on-site sewage facility that is generally well maintained but has minor compliance issues

b. An on-site sewage facility that has not been well maintained and has no obvious compliance issues

c. An on-site sewage facility that has not been maintained and is failing or has significant compliance issues.'

Eighty responded 'never' to all Question 6 options. Fifty-two of these had also responded 'never' to Question 5. Only nine of those who responded 'never' to both Questions 5 and 6 answered any subsequent questions, and their most frequent response to Questions 12 through 17 was neutral/unsure.

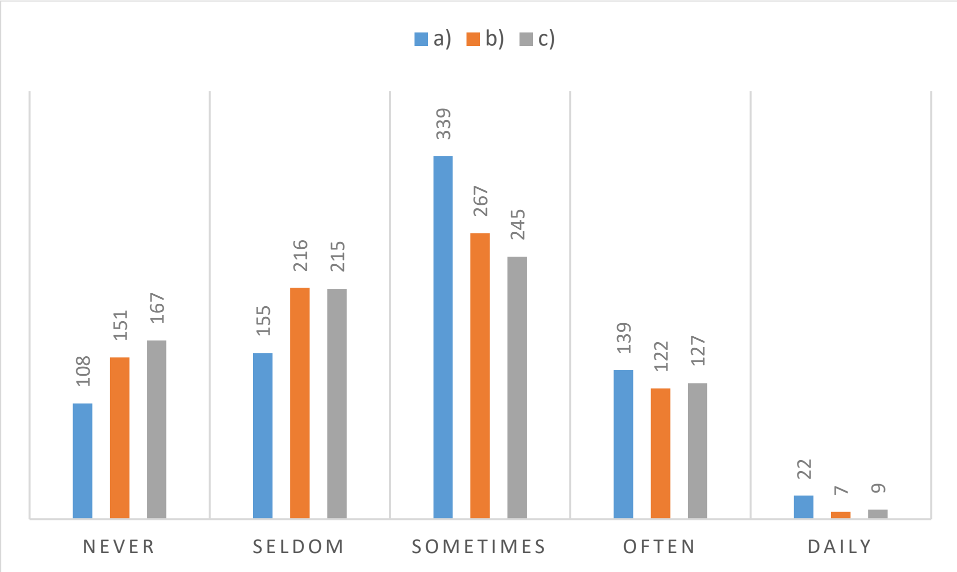


Figure 6. Response by licensees

'In your work, how frequently do you come across the following situations? a. An on-site sewage facility that is generally well maintained but has minor compliance issues; b. An on-site sewage facility that has not been well maintained and has no obvious compliance issues; c. An on-site sewage facility that has not been maintained and is failing or has significant compliance issues.'

Respondents were asked to rank in order of importance the main problems with compliance of OSFs as identified by the Panel:

- Non-compliant installation of facilities (not in accord with manufacturers' requirements or the wastewater design report)
- Non-compliant design or inappropriate sizing of the facility
- Non-compliant location of the facility (system and/or LAA)
- Licensees failing to maintain systems to the required standard
- Residents failing to arrange servicing as required
- Other

Each option was ranked between 113 and 227 times. Only 16 respondents ranked all six options.

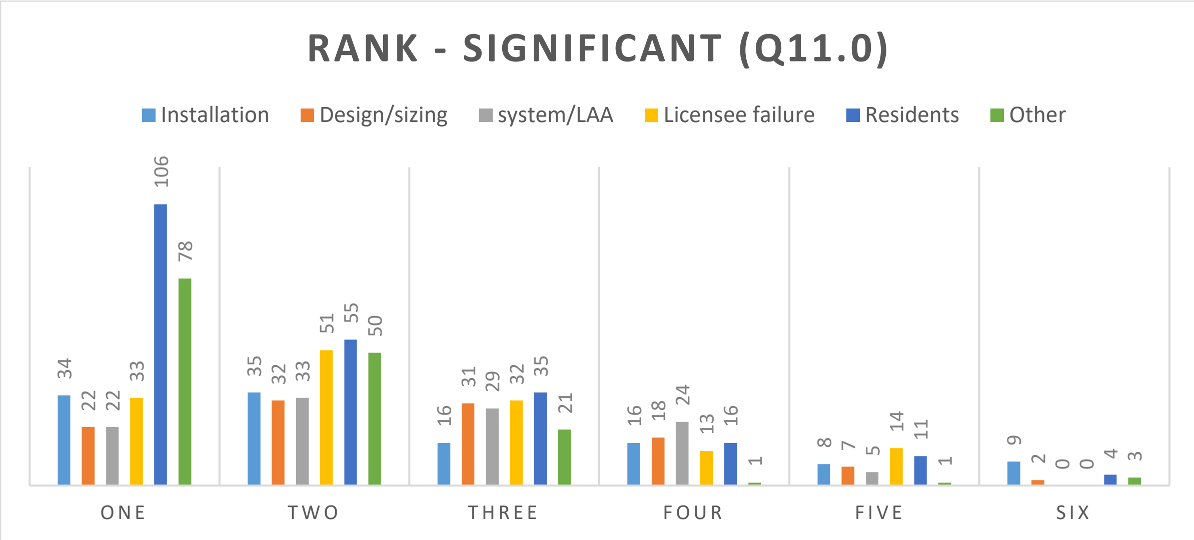


Figure 7. Ranking of problems

Non-compliant installation of facilities (not in accord with manufacturers' requirements or the wastewater design report) (installation); Non-compliant design or inappropriate sizing of the facility (design/sizing); Non-compliant location of the facility (system and/or LAA)(system/LAA); Licensees failing to maintain systems to the required standard (licensee failure); Residents failing to arrange servicing as required (residents); other.

In response to the question 'Do you believe that owners and occupiers have enough education about how to correctly maintain an on-site sewage facility?', 304 respondents (71%) selected 'no'. This is similar to the LG response (87%). Respondents were also asked whether they believed that the current training and qualifications were adequate for the servicing, maintaining, installing or designing OSF work. These questions were answered by 203–295 respondents, with most believing that training and qualifications were adequate (Error! Reference source not found.). When asked whether they believed that the experience requirements for OSF licences for Drainer, Restricted Drainer – Install and Maintain, Restricted Drainer – Maintain only, or On-site Sewage Endorsement were adequate, respondents were more inclined to believe that experience requirements for the restricted licence classes were not adequate (Error! Reference source not found.).

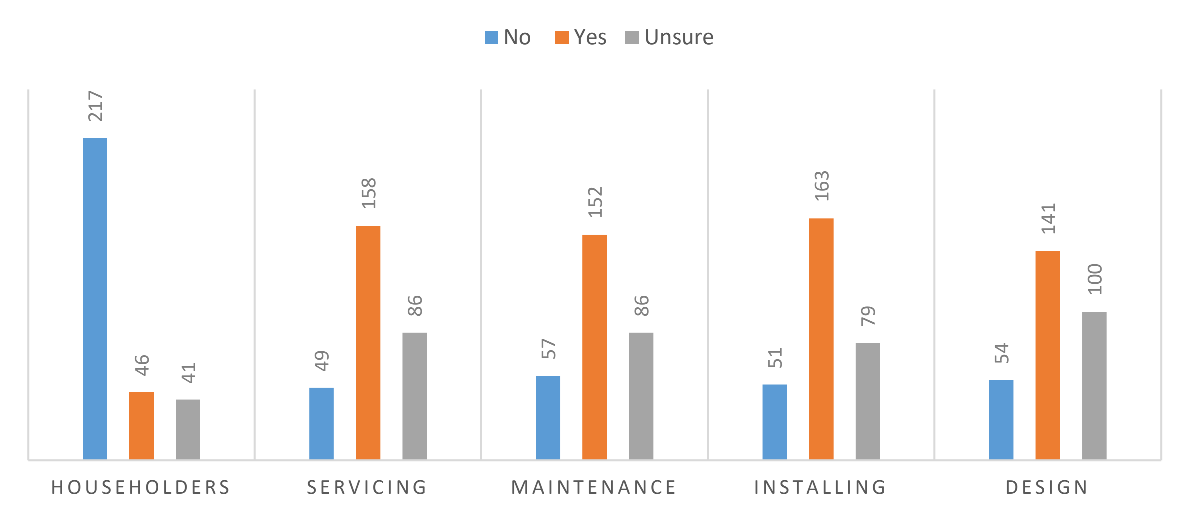


Figure 8. Responses to the questions

'Do you believe that owners and occupiers have enough education about how to correctly maintain an on-site sewage facility' (Households) and 'Do you believe that the current training and qualifications for the following types of on-site sewage facility work are adequate? – Servicing on-site sewage facilities (Servicing); Maintaining on-site sewage facilities (Maintenance); Installing on-site sewage facilities (Installing); Designing on-site sewage facilities (Design).'

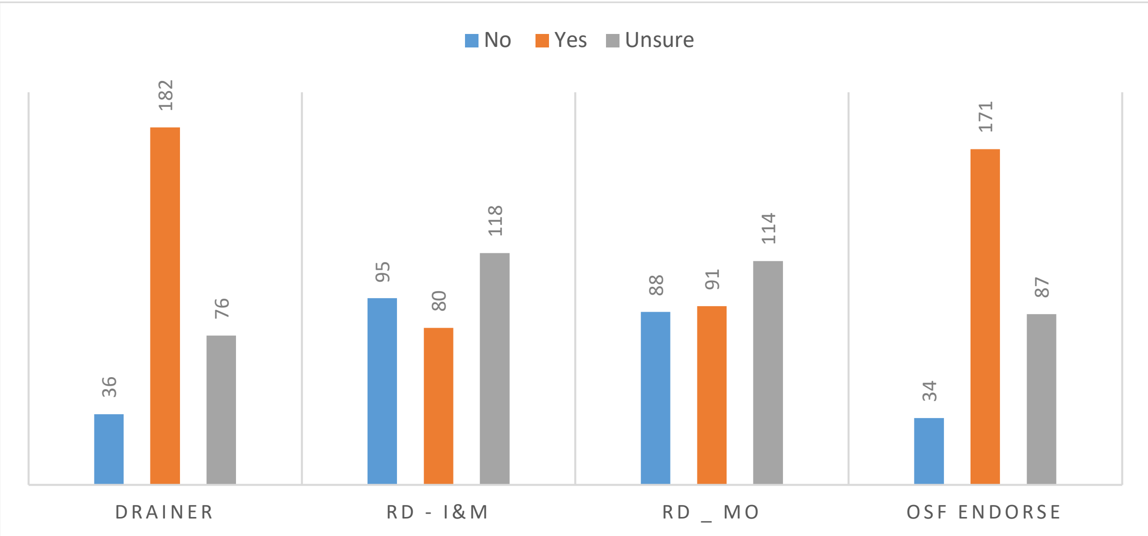


Figure 9. Responses to the question

'Do you believe that the experience requirements for the following types of on-site sewage facility licences are adequate? Drainer; Restricted Drainer – Install and Maintain (RD -I&M); Restricted Drainer – Maintain only (RD_MO) or On-site sewage endorsement (OSF Endorse)?'

Most respondents were confident that the Australian standards (73%) and the QPWC (67%) for OSFs were adequate.

7.3 The Consultation Paper

The Panel identified a range of issues that were classified broadly into five categories: location, performance, licensees and licencing, design and households. Across these categories, the Panel formulated 30 options that were included in the consultation paper for public comment (ref the paper).

The consultation period ran from 1 March 2021 to 31 March 2021. Stakeholders, including licensees, local governments, state government departments and industry associations, were invited by email to respond to the consultation paper. The paper and an online survey to collate responses were also made available on the QBCC's website.

The Panel received 464 responses to the online survey, of which 205 (44%) answered all questions, and 117 (25%) answered no questions after logging in. Approximately half (264, 57%) answered half the questions. In considering the responses, the Panel assessed the favourable responses expressed as a percentage of the total logins and a percentage of those responding to the particular question. Written responses were provided by the Local Government Association Queensland , the Planning Institute of Australia, the Urban Development Institute of Australia , the Central Highlands Regional Council , the Lockyer Valley Regional Council, the State Planner DSDILGP, and Seqwater.

Respondents were asked to identify which section of the industry they worked in, with multiple answers permitted (Most respondents identified a single category (333), with the remainder nominating several sectors. In the text response for 'other' sector, 26 responses included the word 'builder', and 15 included 'owner' or 'user'.

Table 6. Industry sector that respondents were identified as working in.

Industry Sector	All responses		Selected as sole category	
	N	%*	n	%*
Design	95	20	35	8
Industry or member Organisation	50	11	34	7
Installation	178	38	65	14
Local government	79	17	71	15

Manufacturing	28	6	8	2
Servicing and maintenance	138	30	34	7
State government department or entity	13	3	9	2
Other (please describe)	91	20	82	18

Most respondents identified a single category (333), with the remainder nominating several sectors.

* % calculated as a fraction of 464 replies

Respondents were asked to indicate whether they 'support' or 'do not support' each option presented in the consultation paper. The responses to specific options are presented in this report as recommendations and will be discussed in the next section. Provision was also made for an additional text response to each question. The average number of comments for each question was 48 (min 23, max 85).

There were some issues that were raised frequently across many questions by multiple respondents, as well as very specific responses to individual options. These will be addressed in the following section. Despite the highly favourable response to most options, similar comments were raised both in support and in opposition to some options. Often, the comments appeared contradictory, but this largely reflects the complexity of the issues and the different perspectives of stakeholders.

There were two major contradictory positions in many of the comments. The need for consistency across local government areas versus the need for local governments to be able to respond to local conditions, and the need for balance – conditions that are encountered everywhere – and specific things that only some local governments (LG) may have to respond to (e.g., shallow aquifers, sand aquifers, low or high surface water flows, flood plains).

There was a certain lack of introspection in the responses, with various industry segments pointing a virtual finger at other sections. It is apparent that industry participants, including regulators, are keen to place the responsibility on householders/owners without considering how the users will gain the information needed to comply with the operational and regulatory requirements of their OSFs.

As expected, the written submissions contained support for some but not all options. The respondents argued that more information was needed before they could decide to support or not support some options, and they emphasised that much more consultation was needed before any of the options presented could be implemented. These responses came from organisations with a significant role as government lobbyists, and they should be aware of the policy development processes in government. The Panel was careful in the consultation paper to label the ideas being expressed as ‘options’, not recommendations. The non-binding nature of the options presented should have been obvious to such seasoned players.

Finally, some options from the consultation paper have not been included in the recommendations in this final report, while others have been refined. These will be discussed in the next section: ‘Discussion and Recommendations’.

8 Discussion and Recommendations

All Panel members had some stake in the industry, had first-hand knowledge and experience of OSFs and contributed their opinions in good faith. The Panel acknowledges the advisory role in the development of government policy. This report is prepared for the consideration of the Council choosing to take all or some of the ideas presented here to the QBCC Commissioner and/or the Minister for Energy, Renewables and Hydrogen, and the Minister for Public Works and Procurement. The Panel is seeking to address a range of real and/or perceived issues associated with OSFs and recognises that there are a wide range of issues to be addressed. The Panel has drawn on its collective experience and its research to present these recommendations for consideration.

The ideas considered by the Panel fall into several categories:

1. Some are so simple they require no further development – for example, updating the information on a website, and members of the panel were able to implement them in their workplaces.
2. Proposals concerning the preparation of public and industry awareness and education were presented directly to the STC for consideration.
3. Some of the proposals are relatively simple changes that can be implemented in the normal rounds of regulatory amendments, such as making definitions consistent across various pieces of legislation.
4. Some ideas may already reflect existing policy and implementation practices, but the visible representation of this on the ground may be lacking.
5. Some ideas may reflect the intention of existing policy whose objectives may not be achieved in the implantation program.
6. Finally, other ideas may require significant policy changes that would require the full range of development, consultation, Cabinet approval and regulatory impact assessment were they to be considered further.

The Panel accepts that further work and testing of ideas is required and that some ideas, when tested and examined in greater detail and through consultation with stakeholders, may not proceed to the implementation stage.

8.1 Planning

The Panel could not identify a state-wide policy on wastewater that could be used to assess the health and/or environmental implications of not providing a mains sewerage system in new developments. In Western Australia, the Government Sewerage Policy (State Government of Western Australia 2019) sets the state government's position on how sewerage services are to be provided in Western Australia through the planning and development of land. The state interests for Queensland are contained in the SPP, managed by DSDLGIP under the *Planning Act 2016*. In responding to option 1 in the consultation paper, the Department stated:

> 'It is unclear what is meant by a state-wide policy and how this would be implemented. The state already has a position on managing water quality impacts through the SPP July 2017. The state also provides additional guidance material to support the state interest policies. The DES is the custodian of water quality and environmental protection. The DES's policies are given effect through the planning framework.'

While the SPP does set out water quality objectives for Queensland, the policy has five themes, three of which are relevant to the provision of wastewater services (Table 7).

Table 7. Relevant themes, statements and benchmarks from the SPP (our emphasis) (State of Queensland 2017).

Theme	State Interest Statement	Policies and Assessment Benchmarks
Liveable communities and housing	Liveable, well-designed and serviced communities are delivered to support wellbeing and enhance the quality of life.	Land for housing development and redevelopment in areas that are accessible and **well-connected to services.** Employment and a diverse, affordable and comprehensive range of housing options in accessible and **well-serviced locations** are facilitated by considering

		incentives to promote affordable and social housing outcomes, particularly in areas in close proximity to services and amenities.
Environment and heritage	The environmental values and quality of Queensland waters are protected and enhanced.	Development is located, designed, constructed and operated to avoid or minimise adverse impacts on the environmental values of receiving waters arising from wastewater (other than contaminated stormwater and sewage).
Infrastructure	The timely, safe, affordable and reliable provision and operation of electricity and water supply infrastructure are supported, and renewable energy development is enabled. The benefits of past and ongoing investment in infrastructure and facilities are maximised through integrated land use planning.	Development occurs: (a) in areas currently serviced by state and/or local infrastructure and associated services; or (b) in a logical and orderly location, form and sequence to enable the cost-effective delivery of state and local infrastructure to service development.

According to the SPP, water quality benchmarks are applied for developments for urban purposes that involve a change of use or reconfiguration of premises 2,500 m^2 or greater in size that will result in six or more dwellings or an impervious area greater than 25% of the net developable area. The focus of this policy for the water quality state interest is on stormwater runoff.

For water supply buffer areas and water resource catchment areas, Seqwater relies on its development guidelines for water quality management in a drinking water catchment. State interests are reflected through the SPP until they are implemented in local government planning schemes. There are water quality benchmarks that are applied to a material change in use for intensive and hazardous industries, including utility installation of reticulated sewerage services and reconfiguring a lot into five or more additional lots if any resulting lot is fewer than 16 hectares and any of the lots will rely on on-site wastewater treatment. The applicable benchmarks also state that such developments must be located, designed and operated to avoid or minimise adverse impacts on environmental values resulting from wastewater. In water supply buffer areas, developments must avoid adverse impacts on drinking water supply environmental values.

Spatial analysis undertaken by Seqwater in 2019 indicated more than 43,000 OSFs in drinking water catchments in SEQ. Reliance on the water quality benchmarks as the endpoint for the planning of wastewater services acknowledges the potential hazards of wastewater but does not address either the infrastructure or service aspects of wastewater management. This is considered an area that could improve environmental performance and provide a point source consideration of potential contaminants in drinking water catchments. The DES leads the development of the guidance material for the water quality state interest with input from Seqwater.

Non-sewered areas continue to be approved for domestic, commercial or industrial development where the responsibility of wastewater disposal relies on property owners, and the regulation lies with the local government. In a meeting with the Panel chair, representatives of the DES expressed the view that the DES had no role in regulating any individual or cumulative impacts from excessive allotment density or poorly performing or failing OSFs.

In Queensland, the DES issues approval of OSFs above 21 EP. Local government approval is required to install all on-site facilities under the PDA and comply with the QPWC (Queensland Government, 2019) and AS1547:2012. The DEPW is not involved in the process of reconfiguring a lot, which creates the resulting densities in new subdivisions. However, DEPW legislation governs how the resulting lots are developed and maintained (with the Queensland Development Code [building] and the QPWC [plumbing]). Under the PD Act, owners of an OSF must take all reasonable steps to ensure that their facility is kept in good condition and operates properly. They must also ensure that it is operated and maintained in compliance with the conditions of the permit. There is no specification on the frequency that a local government must monitor greywater/OSF, no specification for the frequency of servicing of systems and no requirement that obliges the local government to undertake compliance activities as a result of either of these matters. Guidance on these matters will assist the local government.

The State Infrastructure Plan (State of Queensland 2022) identifies water infrastructure as dams, weirs, water and wastewater treatment plants and pipelines. Local water supply, sewerage and stormwater management are identified as local government responsibilities. State interests in water are limited to bulk water supply, water allocations and trading, and water security and efficiency. The infrastructure plan states:

> ‘Ensuring all Queenslanders have access to safe and secure drinking water is a critical priority. The Queensland Government works in partnership with local governments to ensure that communities have water and wastewater systems in place and that these assets are sustainably managed through good planning, proactive maintenance and an appropriately skilled workforce.’

The plan has only three further references to sewerage and wastewater. Under *Key Initiatives*, $70 million has been allocated over three years for councils to improve their water supply and sewerage systems as a key initiative as part of round 6 of ‘Building Our Regions’). *Priority actions* include improving wastewater (and stormwater) quality to improve the overall water ecosystems and supporting public and private investment in higher-value use of existing wastewater resources in Queensland.

Particular local government infrastructure plans reviewed by Panel members demonstrate a clear gap between the provision of water supply and the non-provision of reticulated wastewater infrastructure. These areas usually comprise extended urban or peri-urban areas and urban development approvals on urban-sized blocks. This discussion paper includes a range of options and ideas for reducing the number of new developments in unsewered localities.

The Panel considered that there was a need for greater evaluation of the cumulative environmental and public health impacts prior to the approval of unsewered developments and that appropriate funding structures should be put in place to ensure that future costs of local government oversight of the OSFs can be met. This could be achieved by including appropriate benchmarks in the SPP guidance materials to encourage more development to occur within existing or extended sewerage trunk infrastructure and ensuring benchmarks provide for the adequate assessment of the effects of OSF on the development at full build-out.

This recommendation was supported by 58% of all respondents to the survey (79% of those who responded to this recommendation).

Recommendation 1

Develop a state-wide wastewater policy (potentially as guidance material to the SPP 2017) to cover all aspects of wastewater, including OSFs, conventional wastewater treatment plants and alternatives such as small-scale or community schemes.

8.2 Legacy Issues

A range of Queensland locations lacks the provision of sewerage infrastructure, which has led to developments that have outpaced sewerage connections, leading to areas on the urban fringe relying on OSFs. In some of these areas, there are concerns that the environmental impacts of OSFs are leading to a decline in ground and stormwater quality. In other jurisdictions, programs to address the issue of legacy OSFs are in place. These programs focus on the backlog of sewerage infrastructure and on other options to mitigate the impacts of OSFs. As noted in Section 2.1, versions of AS/NZS 1547 prior to 2000 did not provide guidance on the maintenance of OSFs as 'no such system should be considered as suitable for long-term disposal of sullage and septic tank effluent.' All systems installed prior to 2000 were designed and installed to a standard that was not intended to ensure long-term viability. The current version of the standard's guidance on administrative and managerial responsibilities Section 7.1 includes 'liais[ing] with any local or regional sewerage authority on matters such as providing sewerage where OSFs can no longer meet performance objectives.'

The study at Jacobs Well and subsequent action by the City of Gold Coast is a local example of a backlog sewer project. The programs have been more thoroughly pursued in both Victoria and NSW. The Victorian program, which commenced in 2003–2004, was audited in 2006 and 2018 by the Victorian Auditor General's Office (VAGO), and their audit reports provide valuable insight into the advantages and difficulties of such programs. The key objectives of Victoria's backlog programs were to minimise the adverse impacts on the environment and human health from poorly performing OSFs and ensure that all (sewerage) servicing options are evaluated for towns that are deemed to have a detrimental impact on the environment or human health (VAGO 2018 p71).

Victoria's backlog programs do not aim to connect all properties to sewerage networks. The decision to include an area on a backlog program is based on the assessment of environmental and human health risks, which can occur either due to the number of unsewered properties or properties unable to contain their wastewater on-site (VAGO 2018). Specialist consulting companies usually carry out this exercise. Once an area has been identified, the local government must develop a DWMP that assesses risks and identifies strategies to manage unsewered properties that are unable to contain wastewater on-site. Where the local government is not the provider of sewerage services, the area/properties can be referred to the appropriate water utility (VAGO 2018). In Victoria and NSW, each council develops its own criteria for assessing risks, taking into account factors including local ponding or evidence of off-site discharge, the type and age of the system, property size and use, and proximity to water sources, environmentally sensitive areas, boundaries or other structures. An example of a risk classification system used by the Federation Council in the Riverina region of NSW (2018) is given in Table 8.

Table 8. Criteria used to assess the risk of OSFs and determine the duration of approval and frequency of inspection by the Federation Council of NSW (Federation Council 2018).

Criteria	Low Risk	Medium Risk	High Risk
Distance from:			
·Environmentally sensitive areas (habitat, wetlands, aquatic reserves, declared wilderness areas)	>100 m	40–100 m	<40 m
·Permanent water (river, stream, creek, dams)	>300 m	100–300 m	<100 m
·Temporary waterway (intermittent gully or creek)	>100 m	40–100 m	<40 m
·Well or bore used for domestic purposes	Nil or >500 m	250–500 m	<250 m
·Closest boundary of neighbouring property to effluent disposal area	>50 m	15–50 m	<15 m
·Closest dwelling (on property or neighbouring property)	>15 m	6–15 m	<6 m
Land area	>10 ha	2,000 m^2–10 ha	<2,000 m^2
Flood liable	NO	NO	YES
Meets performance standards / no history of ongoing problems	YES	YES	NO

Effluent ponding on ground surface / wet soggy disposal area	NO	NO	YES
Grazing and other activities restricted in effluent disposal area	YES	YES	NO
Condition of tank and infrastructure	GOOD	GOOD	POOR

For prioritised areas, a range of options can be considered to mitigate the risks. These options include connecting to an existing sewerage network or a new wastewater treatment plant, local scale alternatives such as pressure sewers with on-site grinder chambers or STEPs (a septic tank with effluent pumping to a shared sewer and local treatment plant), upgrading existing OSFs to more modern and reliable systems or implementing a pump-out system. The preferred solution to service a backlog area would consider terrain and ground conditions, community impact from construction, proximity to sewer networks and capital and operating costs.

The backlog option was supported by 59% of all respondents and 84% of those completing this section of the consultation survey. Respondents to the consultation report identified the locations where this was an issue, including Jacobs Well, Donnybrook and the Moreton Bay islands. Jacobs Well has already been discussed in Section 4.2 as an example of a small community sewered in response to adverse impacts from high-density OSFs.

Recommendation 2

Develop a sewer backlog program for sewer areas identified as at high risk of contamination.

8.3 Costs and Funding

In response to the consultation paper, costs were raised as a concern for many of the options presented, with responders commenting that the cost of some proposals for rural and remote local governments would be prohibitive. This may have resulted from the consultation paper not being clear enough that many recommendations were specifically directed at peri-urban and in-fill development.

The costs of OSFs need to be examined in conjunction with the costs of alternatives – particularly reticulated sewerage networks but also alternative systems such as community sewerage (for example, STEDs or small-bore pressure sewers). OSFs become the default when local governments, utilities or developers baulk at the cost of reticulated sewerage services. OSF costs are borne by the resident, not the developer. All subsequent negative externalities are borne by the community, the local government and the householder. Externalised costs, including local government administrative and compliance costs, site decommissioning and rehabilitation and environmental and public health impacts, must be included in assessing the appropriate wastewater management strategy for new and existing developments.

Information on individual local governments can be found on the Queensland Audit Office (QAO) website (Queensland Audit Office 2022). QAO groups local governments into six categories: Indigenous, Rural/Remote, Rural/Regional, Resource Councils, Coastal, and SEQ. While some local governments have the resources to implement the reforms suggested in this report, and some are already doing so, many others do not. In the planning guidelines for water and sewerage supply, the Department of Energy and Water Supply estimated that the per-person cost of providing water and wastewater infrastructure for 500 people is nearly five times that of servicing 10,000 (State of Queensland 2010). There is no data on the costs of monitoring and enforcement of OSFs and registered service providers. Some larger local government authorities can operate their water and wastewater services as a profit-making business while others cannot recover costs. Four local government areas within Queensland have no wastewater services.

The state provides support for local governments to provide service infrastructure, including wastewater, through the 'Building Our Regions' fund, administered by DSDILGP. In rounds one to five of the program, 32 of 269 grants were for wastewater, with a further two for both drinking water and wastewater. Only two mentioned network extension, although providing for future growth and development was a common theme in the description of projects.

For grants under round six – the ‘Building Our Regions’ fund – which has $70 million for water and sewerage projects, local government authorities are grouped by their number of connections into very small (<1,000), small (>1,000 to 10,000), medium (>10,000 to 25,000), large (>25,000 to 100,000) and very large (>100,000). Grant eligibility criteria are dependent on size (very small and small; medium; large). Very small and small local government authorities are expected to make a voluntary contribution to approved contributions, but the state limits its contribution to 50% for medium-sized local governments and 40% for large local governments. The total program budget is allocated according to the size categories, with $48 million, $10 million and $12 million allocated for small and very small, medium, and large local governments, respectively.

In 2017, the National Water Reform Initiative Report (Productivity Commission 2018) found that Queensland’s capital grants program was poorly targeted and inconsistent with the National Water Initiative (NWI). The report suggested that the capital grants program should be replaced with payments that are ‘tightly targeted at unviable, high-cost, regional and remote services areas and not tied to capital expenditure’. In its 2020 report, the Productivity Commission noted that many smaller (urban water) utilities in Queensland were not achieving full cost recovery and that state government funding to local utilities did not meet the NWI’s criteria of a transparent community service obligation payment.

The extent to which perceived ‘savings’ in development costs are shifted or externalised is not always straightforward or clear. What appears to be savings often comes at the expense of a different entity at a later time. The cost of reticulated sewage compared to OSFs, and passive OSFs compared to AWTSs is complex but not impossible. Cost factors include initial installation, connection, operation, compliance monitoring and enforcement and can be assigned to the householder, a utility or service provider, or local and state government regulators. Externalised costs arise from unintended consequences and can include health impacts in the community, increased water treatment costs, environmental harm and loss of amenities. In many areas of Queensland, local government authorities are the service provider for both wastewater and drinking water, as well as the regulators for OSFs, with the responsibilities spread across different departments of councils. In SEQ, the provision of drinking water is split between the state-owned bulk water provider and distributor/retailers, while the distributor/retailers provide wastewater services. Reticulated sewers and larger OSFs (>21 EP) are regulated by the state (DES). The local government regulates OSFs below 21 EP.

A comprehensive review of all associated costs would assist the state and local governments in making informed decisions on the appropriate servicing of all development in Queensland. The review would facilitate the implementation of a state-wide policy of state interest in the SPP (Recommendation 1) and the backlog sewer program (Recommendation 2).

The option to have the Queensland Government investigate the cost of OSFs was supported by 52% of all respondents and 74% of those who completed this question in the survey.

<u>Recommendation 3</u>

The relevant Queensland Government department should fund a rigorous economic investigation of the true long-term costs of OSFs and their potential alternatives (e.g., cluster-scale sewerage).

8.4 New Developments

The provision of reticulated drinking water services in many Queensland communities covers a greater area than the provision of reticulated wastewater services. Local governments and water utilities have been much more receptive to extending the provision of drinking water services, primarily as a basic human need, but also because the cost and logistics of water reticulation are considerably less demanding than the cost and logistics of providing reticulated wastewater systems. The result is the installation of on-site wastewater systems in urban developments where there is no effective constraint on domestic water use. Appropriate support and incentives to match wastewater rollout with reticulated water supplies should be considered. Targeting grants, as discussed in section 7.3, would be one means of achieving this objective.

In the consultation report, several options were put forward for reducing the development of new sites without sewerage infrastructure. Some of these options overlap with others presented in the report. The feedback from the consultation process has been considered by the Panel, and the recommendation has been amended. Implementing a strategy to reduce the number of new unsewered developments would mitigate the risk of harm to public health and the environment and relieve the pressure on a future backlog program.

This option was supported by 31% of all respondents to the online survey and opposed by 28%. The option was supported by 52% of respondents who completed this section of the survey. Among the concerns expressed in the survey comments was that local governments were 'approving subdivisions without any regard for the proper infrastructure being in place before the development is approved'. It was becoming more difficult for plumbing inspectors to approve OSFs on urban developments that Council planning departments had approved. Consideration of alternatives to both reticulated sewerage and OSFs, such as small-scale commercial systems and common effluent drainage systems, could result in better adherence to servicing and compliance requirements.

The objective to reduce the number of unsewered developments should be part of the focus of planning recommendations in section 7.1.

Requirements under AS/NZS1547:2012 Section 3.2 for planners, surveyors and land developers:

a. Undertake in the initial planning stage an assessment to determine the sustainable wastewater management practice for the site.

b. Evaluate the sustainability and environmental implications for public health, land use and the continuing use of energy, material and finances.

c. Have suitably qualified and experienced personnel assess the risks to public health and the environment and the costs and benefits of on-site versus reticulated wastewater.

d. Ensure that key personnel from within their organisations are accredited through an appropriate training program.

e. Take account of site-and-soil checks prior to deciding the layout of a subdivision.

f. Reserve adequate areas of suitable soil for on-site land application systems.

g. Evaluate potential cumulative environmental and public health effects from on-site systems' long-term use.

h. Ensure that the on-site systems can achieve the performance requirements of this standard.

i. Provide design reports and plans to local authorities, property owners and property purchasers.

j. Protect potential LAAs during subdivision construction, trafficking with heavy equipment and removal of topsoil.

k. Provide details of the on-site operation, maintenance and monitoring of the applications and plan for a subdivision.

The Panel suggested in the consultation report that planning schemes and regional plans should be required to evaluate on-site facilities' environmental and public health impacts (including cumulative impacts) before approving any zoning changes that facilitate unsewered lots, as required by 3.8 a and b of AS/NZS1547:2012. One way to facilitate this would be for each local government authority to have a DWMP, as required in Victoria and discussed in 7.2 above. A better understanding of all the costs involved in the management of OSFs, as recommended in 7.3, would enable local governments to make more informed decisions on wastewater options for new developments.

Recommendation 4

Reduce the number of new developments that rely on OSFs by investing in sewage infrastructure or other suitable alternatives.

8.5 Protection of Drinking Water

A catchment is an area where stormwater runoff is collected by the natural landscape and flows by gravity from the highest point at the outer edge of the catchment to dams, rivers, lakes, groundwater recharge areas or the ocean. Water falling outside the highest point in one catchment is therefore falling inside another catchment. There are 23 major water catchment areas covering Queensland, each with a number of sub-catchments. Water plans are administered under the *Water Act 2000* for the sustainable management and harvesting of water for each basin.

Water is further protected under the EPA and the subordinate *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*. The policy establishes management goals for water by identifying environmental values for waters and wetlands and setting water quality objectives to protect and enhance those values. The environmental values that are protected under the policy include drinking water (raw water supply) and recreational use, aquaculture, agricultural and industrial uses and cultural and spiritual values. Importantly, the water quality objectives apply to the environmental waters and not to point source contributions to the water quality. While an individual failing OSF can be a point source for a nearby waterway or wetland, an unsewered community is a diffuse pollution source for a catchment.

The ADWG Framework for Management of Drinking Water Quality (the Framework) (NHMRC 2011) states that catchment management is the first barrier to the provision of safe drinking water. The Framework recommends developing a catchment management plan to protect both surface and groundwater source water. To achieve this, catchment management plans should ensure that planning regulations include the protection of water resources from potentially polluting activities and that they are enforced. Planning and environmental regulations under the SPP, and to ensure good water quality, should protect water resources from potentially polluting developments, including urban development. This includes the regulation of community and on-site wastewater treatment and disposal systems.

In Queensland, there are two different structures in place in the water industry. In SEQ, the state-owned Seqwater is responsible for the bulk water supply and management of the source water catchment but has no regulatory role in planning and development within the catchment and no role in the provision of wastewater services. The distribution of drinking water and the operation of community wastewater systems are the functions of separate water utilities, which either state or local government operates. In the rest of Queensland, local governments provide both drinking water and wastewater services. They manage their own bulk water storages and catchments or purchase water from the state-owned Sunwater or Seqwater. While they have some capacity to approve development within the catchment where it is included in their boundaries, they have limited ability to control or regulate other sources of pollution or areas of their water catchments that may be in neighbouring local government areas.

The Framework recommended measures to protect surface water catchments, including the:

- Exclusion or limitations of uses (restrictions on human access and agriculture)
- Protection of waterways (fencing out livestock, management of riparian zones)
- Use of planning regulations to limit activities such as urban development, agriculture, industry, mining and forestry; and
- Use of industry codes of practice and best practice management.

Groundwater from shallow or unconfined aquifers can be subject to contamination from discharges or seepages associated with agricultural practices, septic tank discharges and industrial wastes.

Most surface water catchments for drinking water supply in Queensland are open catchments, with the drinking water supplier owning only a small percentage of the total land area and with limited restrictions on development or other activities. For example, of a total drinking water source catchment area of approximately 1.8 million hectares, Seqwater owns around 69,000 hectares, and much of this land is used for recreation or livestock grazing purposes. Approximately 30% of the 1.8 million-hectare drinking water source catchment area is classified as conservation and natural environments or as forestry. Nonetheless, much of this area is open to recreational uses or forest harvesting. By contrast, in Victoria and NSW, large areas of the drinking water catchments that supply the capital cities are closed to public use and protected. To illustrate, in NSW, approximately 364,000 hectares of bushland around the water storages in the Illawarra, Blue Mountains, Southern Highlands and Shoalhaven regions, which are the source of water supply for the Sydney metropolitan area and areas nearby, are designated as 'protected' and ‘special areas’. All development in the catchment area is required to have a neutral or beneficial effect (NorBE) on water quality. Part of the NorBE assessment is a wastewater effluent model to determine the contaminant movement from an OSF for 25 years (WaterNSW 2019). The parameters modelled are faecal coliforms, nitrogen and phosphorus. Similarly, in Victoria, land use in Melbourne’s drinking water catchment is devoted to state forests and national parks, with only a small amount of private land. In open potable water catchments, dwelling density is limited to one dwelling per 40 hectares unless a range of conditions is met, including the development of a DWMP by the local government.

Western Australia has mapped sewage-sensitive areas. Public Drinking Water Source Areas apply to all or part of the recharge area for unconfined groundwater sources and the area immediately surrounding each production bore in a confined groundwater source and the catchment of surface water sources. (https://water.wa.gov.au/__data/assets/pdf_file/0014/1733/12441.pdf). Areas are assigned a priority based on land use: P1 for state-owned land or forests; P2 for agricultural and rural-residential; and P3 for land-zoned urban, commercial or light industrial. The aim of the policy is to avoid introducing risks in P1 areas, minimising risks in P2 areas and managing risks in P3 areas. Activities are assessed as compatible, compatible with conditions, or incompatible with the protection of the drinking water in each zone. For example, rural-residential lots of fewer than four hectares are incompatible within all priority areas, whereas lot sizes of greater than four hectares are compatible with P3 areas, compatible with conditions in P2 and incompatible with P1 areas.

Queensland has many public and private water supplies that are dependent on shallow unconfined aquifers. These include K’gari (Fraser Island) and the sand islands of Moreton Bay – for example, Stradbroke and Moreton Islands. Incidences of contamination of drinking water supplies sourced from shallow unconfined aquifers have already occurred in Queensland – for example, at Eromanga, Tangalooma and Clifton (see Table 9). There are also incidents of contamination of drinking water supply systems by microbial pathogens that are not able to be attributable to a particular source. One such example is the outbreak of Cryptosporidiosis in Torres Shire in 2018.

Table 9. Incidents in Queensland of contamination of drinking water sourced from shallow aquifers (information provided by Queensland Health and Seqwater).

Community	Year	Water Supply	Contamination Source
Eromanga	2014	Private bores	Septic tank
Tangalooma	2019	Private bores	Sewer pipe to privately operated on-site WWTP
Clifton	2019	Public drinking water supply	Municipal sewage pond most likely source
Dunwich (Minjerribah)[2]	2016	Raw water source (prior to treatment) for a public drinking water supply	A poorly functioning and inappropriately sited on-site wastewater system

The proposal to make appropriate provisions for high-risk locations such as drinking water catchments was supported by 248 respondents to the consultation survey (53% of all respondents and 89% of respondents that completed this section of the survey). Only 30 respondents did not support the option. Among the comments was the suggestion that developers should have to pay extra if they want to develop sensitive areas. One respondent commented, 'Better subdivision/developer studies are required. What comes out for an estate has lots of pages but is mainly outdated once the dozers get in.' K'gari was singled out again for mention: 'Most important but for example what a dogs breakfast is Fraser Island on site disposal!!' (sic) However, some respondents commented that adequate protection was already provided in the QPWC and local laws.

Many respondents commented that appropriate setbacks are already covered in the QPWC and local laws. Peri-urban and rural developments with OSFs are required to have specific setbacks from surface water and groundwater tables. The setbacks outlined in the QPWC do not consider a site's location within a drinking water

[2] NB. This event refers to the detection of faecal indicator bacteria in a raw water production bore prior to treatment only. Drinking water supplied to the community continues to meet Australian drinking water guidelines.

catchment. The distances in Table T5 of the QPWC do not match those in Table R1 of the AS/NZS 1547:2012 (Table 10). Although the QPWC calls up the standard, there is no reference to the significant notes in Table R1 nor to the site constraints in Table R2, which are meant to be read in conjunction with the setback distances in R1.

Table 10. Comparison of setback distances between AS/NZS 1547:2012 and the QPWC.

Site feature	AS/NZS 1547:2012	QPWC		
		Advanced Secondary	Secondary	Primary
Surface water	15–100 m	10	30	50
Bore (horizontal)	15–50 m	10	30	50
Groundwater	0.6 - > 1.5 m	0.3	0.6	1.2

The extensive notes and caveats in the standard include references to:

- Obtaining further advice from the water supply authority on appropriate setbacks to surface waters when a site is within a water supply catchment
- Having setbacks commensurate with the level of risk to public health and the environment
- Adopting maximum setback distances when site/system features are at the high end of the constraint scale
- Seeking advice from a hydrogeologist regarding setback distances for highly permeable aquifers.

Other states have taken additional steps to protect drinking water catchments to lower the risks to public health and the costs of water treatment. The provisions that exist currently in Queensland do not match the basic requirements set out in AS/NZS 1547 2012.

Seqwater has developed the Land Use Risk Tool (LURT), which is used to assess the risk of domestic on-site wastewater treatment systems proposed in the water resource catchments. The LURT operates in an online platform hosted on Seqwater's website and is an interactive tool that designers and local government authorities can use to assess the risk of a proposal and generate draft conditions.

Seqwater relies on the SPP – state interest guidance material for water quality, which cites the outcomes related to the LURT.

Very few planning schemes in Queensland regulate drainage work as its own aspect of development. To apply the LURT to development assessment within the existing planning framework, drainage work (within certain trigger areas) needs to become assessable development under the regulation. The framework in which the LURT warrants further discussion (i.e., is it better suited under the PDA framework or the Planning Act 2016 framework where all other types of development are captured?)

Although the setback or exclusion option in the consultation paper received overwhelming support (82%) from respondents who completed this section of the survey, it was apparent from the comments that 'catchment' is not a well-understood concept. One respondent stated, 'In the past these requirements where an ever day event for subdivisions or a single buildings any where near drinking water catchments. One subdivision several KM away from a drinking water catchment area each block had to be assessed for impact on the dam. The original set back was 400M above the fullest extent of the dam at full capacity.'(sic) Several respondents thought there was already sufficient provision to ensure drinking water was protected. One respondent pointed out that many local governments had already approved residential blocks within sensitive catchment areas and that these would be difficult to resume. However, alternatives to resumption exist and could be pursued.

Recommendation 5

When wastewater infrastructure and development are considered, make appropriate provisions for high-risk locations, including proximity to water bores, shallow aquifers and sand aquifers.

Recommendation 6

Introduce appropriate zoning for areas near critical drinking water catchments, recreational activities or areas of environmental significance, specifying maximum densities for OSFs.

8.6 Minimum Lot Sizes

In addition to soil type, slope, proximity to surface water, groundwater and recharge areas, lot size and system density have been demonstrated to be important in determining contaminant loadings and pathways (Oosting and Joy 2011). Higher densities of OSFs have been associated with higher concentrations of nutrients in watersheds (Iverson, Humphrey et al. 2018) and a higher risk of drinking water wells being contaminated with septic leachate, particularly for contaminants released at high concentration, contaminants with limited attenuation or contaminants that are harmful even at low concentrations (for example, pathogens) (Bremer and Harter 2012).

Guidance on suitable lot sizes is provided in other jurisdictions. In Victoria, the on-site wastewater management code of practice suggests that lots smaller than 10,000 m^2 should be considered for connection to reticulated sewerage systems. It further suggests that lot sizes <4,000 m^2 must minimise the amount of wastewater generated if they are to contain all waste on-site (EPA 2016). In Queensland, lots smaller than 4,000 m^2 are regularly connected to a drinking water service but not a reticulated sewerage system, which disincentivises water saving.

Respondents to the consultation survey suggested acceptable minimum lot sizes were between 2,000 m^2 and 4,000 m^2. Generally, lot sizes of <2,000 m^2 do not have sufficient capacity to fit a contemporary home while meeting necessary setbacks adequately. In these cases, reticulated, cluster or authority-managed systems are more appropriate (DWC 2020). Properties >4,000 m^2 are appropriately sized for owner-managed OSFs, subject to site-specific land capability constraints.

A minimum lot size should be based on the general requirements for on-site wastewater management and sustainability but need not necessarily be universally applied across the whole state. Different minimum lot sizes could be applied in drinking water catchments and recreational waters, above shallow aquifers, proximity to the tideline, urban areas, and most notably, to Moreton Bay and Wide Bay islands.

To ensure that local governments and developers adequately consider the sustainability of an area for on-site wastewater disposal, the state government, through its SPP guidance material, should set a minimum lot size that protects the environment and public health from the potential impacts of OSF leachate leaving the property. Making adequate provisions is also needed to protect particularly sensitive areas such as drinking water catchments, shallow aquifers, groundwater recharge areas, recreational areas and sensitive environmental areas. The minimum lot size for a given area should have a sound scientific justification and not be based on economic considerations associated with a proposed development.

The option to introduce minimum lot sizes was supported by 49% of all respondents (83% of those completing this section of the survey). Only 10% of all respondents were opposed. Respondents suggested in their comments that local governments were allowing the development of smaller blocks driven by state government policy, population growth and pressure from developers. Respondents particularly mentioned the Moreton Bay islands and parts of the Gold Coast as areas where block sizes were inadequate for sustainable on-site wastewater treatment. One reason identified for the development of unsustainable block sizes was the failure of planning departments to consult with plumbing departments within their councils. One respondent to the consultation survey commented, 'There is pressure to chop it up as tight as possible so an unrealistic proposal for development is approved.

'Southern Moreton Bay Islands is a perfect example. Most blocks are under 500 sqm, which makes it almost impossible to change the sizes of these blocks, not to mention installing a compliant OSF system plus a house on 500 sqm.'

In addition to having a sound scientific basis, an important part of determining appropriate lot sizes for developments should be consultation across multiple departments within councils, particularly plumbing and environmental health. Plumbing departments within councils are often left with the unenviable task of informing owners that their planned house build cannot be accommodated on the lot due to the requirements for on-site wastewater disposal. The frustration of many in the industry with this catch-22 was reflected in their comments.

'[The] biggest issue the industry faces is compromised designs. New subdivisions are often inadequate in size as the plumbing department is not consulted when the town planners approve. Also, the subdivision reports need to clearly state the developer should not dig off all the soil and reshape everything after the report.

'This process needs to happen at the town planning stage by the developer long before subdivision approval is granted. It's too late for a homeowner applying for a compliance permit to perform onsite sewerage work to find out the block is too small to fit the buildings and the onsite sewerage facility.'

Recommendation 7

Introduce a minimum lot size for OSFs to ensure adequate land application or drainage areas for the facility's expected life. Historical subdivisions (e.g., soldier settlements) that may not meet minimum lot sizes should reflect appropriate zoning in local government planning schemes such as the Limited Development Zone. This may be achieved through guidance material as part of the SPP.

8.7 Industrial Developments

The development impacts can result in the reduction of water quality in catchments that supply water to drinking water treatment plants (WTPs). This water quality reduction can compromise the treatment process, increase treatment costs and threaten public health. In the longer term, a reduction in catchment water quality can require infrastructure upgrades to provide effective treatment and lead to higher ongoing operational costs associated with increased levels of treatment (e.g., chemical usage and waste disposal). Therefore, development occurring within drinking water catchments must be appropriately sited, designed and managed to prevent adverse impacts to catchment water quality.

Of particular concern on Minjerribah are the risks posed by on-site wastewater treatment systems. Shallow or unconfined aquifers can be subject to contamination from microbiological and/or chemical pollutants. One of the primary pathways for groundwater contamination is the infiltration of contaminants from the land surface through the unsaturated zone and to the unconfined aquifer below. This is the case for the drinking water service WTPs (Amity Point, Point Lookout and Dunwich WTPs) on Minjerribah, which are drawing water from the shallow peripheral aquifer near the coastal fridge of the island. Shallow unconfined aquifers are particularly vulnerable to contamination, especially where the associated land use includes hazardous activities with uncontrolled contamination sources. The porosity and permeability of the unsaturated zone contribute significantly to the travel time of contaminants between the source and the groundwater. A highly porous or permeable unsaturated zone, such as sand aquifers, can result in the relatively quick transfer of contaminants from the surface to groundwater.

Concerns have been provided to the DSDILGP for a proposed Waterfront Marine Industry Zone, which is to be in close proximity to the Dunwich WTP. Concerns focus on the potential localised contamination of the aquifer proximal to the Dunwich WTP from water contaminated with a range of metals, organics and microplastics that are associated with industrial use. The connection of industrial development areas to the sewer network removes some of the risks of groundwater contamination. However, it then relies on wastewater treatment plants to be able to treat these contaminants, which is not always possible.

There are other examples of industrial areas in Queensland that are proposed in areas that are not sewered. The draft Lockyer Valley Planning Scheme is expected to include an Industry Investigation Area (Gatton North Enterprise Area) within the Water Supply Buffer Area and Water Resource Catchment directly adjoining Lockyer Creek in some areas. Under the current Gatton Shire Planning Scheme, this area is generally identified to be in the rural agriculture and rural general zones. This presents significant risks to water quality, both drinking water and for irrigation purposes, and adverse impacts on irrigation infrastructure. There are also areas zoned in Gatton township for industrial development that is not connected to sewer.

Recommendation 8

Sewer all high-density industrial developments.

8.8 Commercial Premises

The QPWC deemed to satisfy requirements for on-site wastewater systems requires compliance with AS/NZS 1546.1: 2008 for septic tanks or AS 1546.3: 2017 for secondary treatment systems, standards specifically developed for domestic systems. The definition of domestic wastewater in these standards states that:

'Wastewater originating from household fixtures such as toilets, urinals, kitchens, bathrooms (including shower, washbasins, baths, spa baths, but excluding spa pools) and laundries; and wastewater flows from facilities serving staff, employees and residents in institutional, commercial, and industrial establishments, but excluding commercial and industrial wastewaters, large-scale laundry activities, and stormwater flows.' (Section 1.8.7 AS/NZS:1546.3)

Commercial premises, such as food service businesses, manufacturing, trade or industrial premises, typically produce liquid waste in addition to sewage. This waterborne waste, known as trade waste, may have a concentration of organic compounds many times that of domestic sewage. Trade waste may also contain a variety of other substances, such as high levels of fats and grease, heavy metals, inorganic compounds and solvents (USEPA 2002; Redland City Council 2020). Further, commercial premises often produce large volumes of liquid waste via a combination of their sewage and trade waste streams.

A domestic on-site wastewater treatment system of 21 EP or less is not designed to process trade waste or cope with large volumes of influent generated by commercial premises. Constituents of trade waste can degrade and damage the infrastructure of domestic treatment systems, cause blockages resulting in surcharging, inhibit biological processes within the treatment plant, pass through the system untreated, resulting in environmental contamination, and put the health and safety of personnel working around or servicing the system at risk.

Estimating the volume of flow generated by commercial or industrial premises can be difficult, particularly if the wastewater production is irregular over time (large weekly or seasonal variations) – for example, a tourism venture may have a short peak season and a long off-season, while a function facility (such as a wedding venue) may produce most of its wastewater flow over the weekend. There are no clear guidelines on how the flow for such premises should be estimated that are local and current. The USEPA has issued some guidance for estimating flow from various hospitality, entertainment and recreational facilities (USEPA 2002). There is little information available for industrial, horticultural, aquacultural or livestock activities. One respondent to the consultation survey commented, ‘It is difficult to determine an accurate daily flow rate of effluent from a remote service station. The flow rates of these systems need to be monitored.’

Large episodic volumes of influent to a domestic onsite wastewater treatment system of 21 EP or less can result in hydraulic overloading or high carbon loading, which in turn will result in effluent surfacing and/or passing through the system untreated.

Systems installed to treat non-domestic wastewater less than 21 EP would have to demonstrate that they can meet the performance requirements under section F1.1. of the QPWC. The decision to approve the systems is made by the plumbing compliance departments in the local government. Not all local governments have the expertise internally to make these assessments or are uncomfortable making them. There was some concern expressed with the number of applications for systems with calculated flows of 19 or 20 EP, often for difficult-to-assess enterprises such as wineries and service stations.

The Panel recommendation that all commercial and industrial premises with an OSF be required to obtain ERA approval, regardless of the size of the facility, and to ensure an appropriate wastewater management system is in place, was supported by two-thirds of respondents who completed this section of the consultation survey; 39% of total respondents supported this option, while 20% did not support. One respondent to the consultation survey commented, ‘This is a problem I have encountered on several occasions. The DES should be more proactive with this’ while another suggested this objective ‘may also be achieved through development permits associated with development regulated under the *Planning Act 2016* or *Building Work Act 1975*.’ The Panel acknowledges that there may be other solutions to the problems outlined here, including an amendment of the QPWC to provide a regulatory framework guidance material for designing and managing small commercial OSFs. The Panel maintains the recommendation as originally proposed in the consultation survey, which would use the existing framework, knowledge and experience already contained within the DES.

Recommendation 9

Require all commercial and industrial premises with an OSF to have ERA approval, regardless of the size of the facility, to ensure the accurate design, treatment, operation and monitoring of the sewerage system.

8.9 Bushfires and Floods

Disasters can impact the functioning of OSFs. In Queensland, disasters generally mean floods, cyclones and storms but increasingly include fires.

Cyclones, storms and flooding can damage both above-ground structures of secondary facilities and underground septic tanks. The Queensland Flood Commission of Inquiry (2012) reported instances of damage to OSFs, including the release of effluent to floodwater and a septic tank floating out of the ground. Other damage that can occur to OSFs during floods includes tank filling with floodwater or collapsing (CDC 2021). A high water table can affect the capacity of the LAA to absorb effluent (Commonwealth of Australia 2020).

Heat, smoke and ash can all contribute to OSF damage during fires. Plastic or fibreglass components above ground or shallow can burn, and electrical components can be damaged. Heavy firefighting equipment and vehicles can also cause damage (NEHA 2019).

Measures to protect public health and the environment from hazards resulting from failing OSFs during natural disasters can include:

1. Designing protections when the property is first built or retrofitting a property that does not have current best-practice protection.
2. Providing advice on preparing property when a disaster is imminent.
3. Providing advice on returning home after the disaster.

The Queensland Floods Commission of Inquiry (2012) received evidence that floodwater may have been contaminated with sewage leaking from OSFs. The Commission noted that flood resilience was not a specific performance criterion in the QPWC. The commission made the recommendation that 'The Queensland Government should consider including in the criteria in the QPWC a requirement that the risk of leakage from private on-site sewerage systems during floods be minimised.'

Well-constructed and maintained OSFs should withstand heavy rains or flooding, 'provided proper function is maintained by regular inspection and maintenance' (CDC 2021). The CDC provides the following advice on preparing an OSF before a flood event:

- Seal the manhole and/or inspection ports to keep excess water out of the septic tank.
- Be sure your septic tank is at least half full to prevent it from collapsing or floating.
- If your septic system requires electricity,
  - Turn off the pump at the circuit box before the area floods.
  - Waterproof all electrical connections to avoid electrical shock or damage to wiring, pumps and the electrical system.

Steps for preparing for a bushfire (NEHA 2019) could include:

- Marking system components with a fire-resistant marker such as a rock
- Turning off electricity to the system at the circuit breaker
- Turning off your pump at the circuit box if you have a pressure distribution or mound system
- Turning off electricity to the system at the circuit breaker
- After the power is off, wrapping control panels, plastic risers and lids with durable flame-resistant sheeting.

The Queensland Government website advises returning to buildings after flooding but does not mention OSFs. The QBCC's advice is to 'contact your local council for water and sewage services.' The Disaster and Emergency Management for Environmental Health Practitioners guidance suggests that where significant damage has occurred to OSFs, 'securing or decommissioning may be required to protect public health' (CoA 2020). NSW Health advises that OSFs damaged in natural disasters should not be used until they have been repaired or replaced.

Queensland's regulations and advice currently do not reflect best practices in designing for, preparing for and recovering after natural disasters. Both the regulatory framework and the advice to the public need to be improved.

This option was supported by 196 (42% of all respondents, 71% of those completing this section of the survey) respondents to the consultation survey and not supported by 79. Many respondents thought this was already addressed or only needed for areas at risk of flooding, while others suggested the problem is that developments are still being approved on flood plains.

Recommendation 10

Require local governments to consider conditions on compliance permits for OSFs for bushfire and flood zone properties (refer to state-wide mapping in QLD Globe). On-site wastewater systems damaged in natural disasters are not to be used until inspected by a qualified person and repaired or replaced as necessary.

8.10 Protection of LAAs

The LAA is the area in which effluent from an on-site sewage treatment plant or greywater diversion device is disposed of by subsurface or surface irrigation (QPWC 2019). The LAA is an important component of the OSF, and its successful functioning ensures that effluent remains within the property boundary. The QPWC requires that the LAA will continue to function, that is, fulfil the requirements of the code, for the duration of its design life. The design life of an OSF is generally around 20–30 years. If the LAA ceases to function, a new LAA must be established within the property boundary, or the existing LAA must be remediated (restored to a state in which it can function). Remediation can be expensive and can be avoided by ensuring that there is a reserve LAA available on the property.

A review of the LAA can be triggered by a building application that includes additional bedrooms to a property to ensure that the capacity of the OSF, including the LAA, can meet the additional number of occupants. A review of the LAA is rarely undertaken for any other building application where the occupancy of the building is not to be changed. But there are other ways additional buildings can interfere with the functioning of an OSF. Building structures or paths over the LAA or shading an LAA will impact the function of the LAA. These factors are not always checked when building applications are lodged. Setback distances to paths, footings, retaining walls, recreational areas, inground swimming pools and potable water tanks applied when an OSF is installed may not be checked when these structures are added after the OSF. Landscaping work that adversely affects the operation of an LAA usually does not trigger the need for a building appraisal.

This option was supported by 181 respondents (39% of total, 66% of responses; 94 did not support; 189 did not answer) to the consultation survey. In comments, respondents tended to place the responsibility for these failures on building certifiers. Respondents offered the following comments:

‘Private certifiers do not even look for land application areas when approving extension, pools or outbuildings.’

‘Reserves are totally ignored, if known about at all, on most lots. Pools, sheds and hard stands often make the existing LAA non-compliant and, if still on septic, make changeovers almost impossible sometimes. Private certifiers need a tune-up on pools and sheds LAAs!’ (sic)

'Subsequent building applications to an existing residence, say for a pool or shed, go via a private certifier, and typically the location and performance of the existing on-site effluent system is never considered.'

<u>Recommendation 11</u>

Encourage local governments to consider existing LAAs and reserves if a building development application is submitted that will increase the footprint of the structure on the site. (Note: the current framework is only triggered by a change to the number of bedrooms.)

8.11 Definition of Wastewater

Definitions of wastewater are not consistent across different Australian standards or Queensland legislation and codes. AS 1546.3:2017 defines 'Wastewater' (section 1.8.53) as 'domestic wastewater, and 'Domestic wastewater' (section 1.8.7) as:

> Wastewater originating from household fixtures such as toilets, urinals, kitchens, bathrooms (including shower, washbasins, baths, spa baths, but excluding spa pools) and laundries; and wastewater flows from facilities serving staff, employees and residents in institutional, commercial and industrial establishments, but excluding commercial and industrial wastewaters, large-scale laundry activities and stormwater flows.

Commercial wastewater is defined (section 1.8.4 of the standard) as 'Wastewater generated by shops, restaurants, cafés, hotels, motels, bed and breakfast accommodation, medical centres and similar premises, but excluding industrial wastewater'. Industrial wastewater is not defined but presumably is all wastewater that is not 'domestic' or commercial'. AS/NZS 1547:2012 defines wastewater as 'The discharge from sanitary fixtures and sanitary appliances'. There is no definition of wastewater in AS/NZS 3500.2:2018, but the scope of the standard includes 'sanitary plumbing and drainage from fixtures to a sewer, common effluent system or an on-site wastewater management system, as appropriate'.

The NPC does not have a definition of wastewater but states: 'On-site wastewater management systems must collect, contain, treat and assimilate and process domestic wastewater, human excreta or both.' The PDA and its subordinate regulations do not have a definition of wastewater, but the definition of sewage defers to the WSSRA, which defines sewage as 'household and commercial wastewater that contains, or may contain, faecal, urinary or other human waste'. The schedule also has a definition of wastewater as 'the spent or used water generated on premises from industrial, commercial or manufacturing activities, or animal husbandry activities, other than spent or used water generated from' a list of exclusions relating to agricultural and resource activities.

The differences in definition have ramifications for the approval and compliance of OSFs. For example, the deemed-to-satisfy provisions of the plumbing code require the on-site system to satisfy the provisions of the relevant Australian standards. Otherwise, the system's design must demonstrate that it can meet the performance requirements of Section F1.1 of the code, the first criterion of which should be that the wastewater intended to be treated is within the scope of the relevant standard. When it is unclear whether the wastewater to be treated is within the scope of the relevant standard and, therefore, the deemed-to-satisfy provision of the code, on-site facilities may be installed where they cannot demonstrate satisfactory performance.

This recommendation had clear support in the consultation survey, with 53% of all respondents (88% of respondents answering this question) supporting and only 33 (7%) not supporting. Some respondents thought the definitions provided by the Australian standards were adequate, but one respondent commented, 'Aligning and strengthening policy and policy objectives in planning and development, building and plumbing, providing local government with the tools to better manage compliance is a must, this one example in achieving that goal.'

There is a disconnect between the QPWC and requirements through the SPP water quality state interest for areas mapped within the water supply buffer area and the water resource catchment areas, which is challenging for local government. Local government authorities are obliged to reflect the SPP in their planning schemes, but this can be undermined in some instances by QPWC requirements that do not identify setbacks specific to drinking water catchments.

Recommendation 12

Clarify the definition of 'wastewater' in the QPWC, and give clear direction on the application of which standards and deemed-to-satisfy provisions apply.

8.12 Risk Assessment Tools

This should occur in all drinking water catchments, especially where councils do not have their own land use risk registers for all environmentally sensitive areas.

Design, installation and operational considerations for OSF include a complex array of factors, such as wastewater characteristics, system owner preferences for siting, operation and maintenance costs, regulatory requirements and receiving site capability to treat or otherwise assimilate the effluent (USEPA 2002). While the QPWC guidelines and the relevant AS/NZ standards provide guidance on requirements for the design, installation and performance of OSF, parts of the material can be complex and sometimes inconsistent. Further, although many workers in the industry have decades of knowledge and experience, there are multiple roles (and entities) responsible for the different steps in the design, installation and regulation of OSF.

In response, several LGAs and other entities interested in OSF have developed digital tools encompassing the requirements of the relevant regulations, codes and standards to provide householders, designers, installers and regulators with a standardised, robust, repeatable process to ensure OSFs meet the requirements. For example, the LURT uses risk management principles to assess the design, siting and installation options at the property level to confirm the relevant regulations have been met and to determine the level of risk that the sewage treatment options pose to water quality in drinking water catchments. The tool is freely available on the Seqwater website and can be utilised for sites anywhere in Queensland.

The use of digital tools, particularly risk assessment tools, enables a cooperative, transparent and coordinated approach to protect health and water resources and can achieve results that are greater than the sum of the individual efforts of each partnering entity.

Recommendation 13

Encourage the use of tools such as Seqwater's LURT to assess the risk of OSFs, particularly in water supply catchments.

8.13 Audits and Reporting Requirements (Including Geotagging and Notifications)

According to AS 1547:2012, the regulatory authority should maintain records of OSFs' subsequent modifications, performance and failures. In Queensland, this requirement is called up in the PDR in Section 106, which requires the local government to keep a record of service reports submitted by a person servicing an on-site system under Section 106 of the PDR. Reports must be submitted within 10 business days, and records are to be maintained and available to the public until the system is demolished or removed. There are penalties for failure to comply. The requirement only applies to systems that require treatment plant approval (AWTSs but not septic systems). Local government is able to apply conditions to any approvals for OSFs, and some local government authorities have applied registration and servicing conditions to septic systems.

In the survey of local governments (see Section 6.1), 29 of 34 local governments had electronic records, and three had manual records. Most recorded only AWTSs. Some local governments had systems under development. Proactive auditing, compliance checking and inspections were undertaken by only half the local governments responding.

The current system of manual lodgement and filing is resource-intensive. Forms need to be checked manually, and issues must be identified and followed up for missing data or late lodgement. For many local governments, at least one full-time administrative position is allocated to this task. Even if there were no issues, allowing 10 minutes per a report, with four reports per system per year, over 600 hours would be required for 1,000 systems. Many local governments have over 10,000 systems. Considerable time may be required to follow up on missing data, poorly identified systems and other issues with lodgement. It can be 10 days before a report identifying a poorly performing or failing system is identified. It is difficult for local governments to establish that the servicing took place as described.

There are many benefits to local governments using electronic management systems of OSFs. Reports are received immediately following the inspections, and the QR-coded and geotagged reports confirm that the inspection took place as reported. The data can be incorporated into larger databases within local government. Overdue notices can be automatically generated if reports are not lodged on time, and alerts can be generated if the system detects data outside specification. Local governments will have information to help inform their audit and compliance programs.

The cost savings of not having to handle manually submitted hard-copy documents are significant. The lower cost of the electronic system can be recovered in lodgement fees. Higher hard-copy lodge fees can incentivise the industry to move to the electronic management system. Some local governments have advised that savings can exceed $100,000 per year in administrative costs linked to processing received test forms up to four times per year against each system.

Local governments will be better able to identify patterns of problems associated with particular types of systems or geographic areas where adverse impacts may be occurring. The value of this function would be greatly enhanced if relevant data on systems were compiled into a state-wide database. This would identify problems that might not be evident to individual local governments but may be detected with the improved statistical power of a much larger database. For example, a state-wide database would provide evidence if a specifically approved plant failed to meet its approval conditions.

A state-wide audit of existing on-site facilities could be a first step in encouraging local governments to move to electronic management systems. Systems not currently included in many local government records could be added during an audit. Alternatively, other incentives could be applied to encourage local governments to move to electronic management systems and the state database established as a result. The state database would not shift the regulatory responsibility of approval and compliance from local government but could have significant benefits for both local and state governments. The database would provide information on the location and density of existing systems and guide planning and policy decisions. Areas not suited to non-sewered development could be identified from the compilation of data from the service reports. The data could also provide feedback for regulatory review processes.

Options in the consultation paper for the establishment of a state-wide database, electronic lodgement and audit requirements received support from two-thirds of respondents who answered questions on these topics. The Panel has reviewed the wording and format of the options and refined the recommendations.

Recommendation 14

Conduct a state-wide audit of the number, location and type of OSFs in Queensland and create a central database of all facilities.

Recommendation 15

Local governments be encouraged to move to electronic management systems for on-site facilities to comply with Sections 106 and 114 of the PDR, including:

a. Geotagging all types of OSFs

b. Recording service agents' reports into a consolidated database

c. Reporting results of systems tests such as pH, turbidity and chlorine availability

d. Interrogating service agents' reports to identify ongoing issues for the different types of AWTSs

e. Automated reminders to OSF owners of service requirement dates

f. Adding visual inspection of effluent irrigation areas to service agents' reports (ponding, poor plant growth, disconnected piping, etc.)

Recommendation 16

Increase accountability for licensees and local governments to ensure the ongoing performance of OSFs.

Recommendation 17

Consider legislative amendments to provide for the monitoring and regulation of OSFs that are not currently required to hold treatment plant approval, such as septic systems with absorption trenches.

8.14 Training and Licensing

The Panel identified the complexity of the licensing arrangements and the training requirements for each category of licence as contributing factors in the failure of OSFs. In the survey of local governments, most respondents thought that training requirements for licence classes were 'somewhat adequate'. Feedback from one industry group suggested that local government plumbing inspectors needed more training.

Finding a 'plain English' guide to the licence requirements for the various roles for designing, installing and maintaining an on-site system is not easy. Information that should be available to the general public seeking to engage a tradesperson or contractor to do work or a person seeking a career in the industry is lost in technical descriptions and explanations that many in the industry struggle to understand or interpret.

Licence requirements for on-site sewage work are administered under both the PDA and the QBCC Act.

Any person who carries out any work on an on-site facility must have an occupational licence for the category of work being performed. Classes of occupational licences issued under the Plumbing and Drainage (Act 2018), Section 12 include a plumber's licence, a drainers licence or a restricted licence. A provisional licence can be granted in each class. Provisional licences are issued to applicants in their first year after completing an apprenticeship or to a person who the Commissioner believes does not have enough experience for a full licence. The commissioner determines the qualifications and experience for each class of licence. An endorsement is a qualification in addition to the requirements of the licence class to carry out certain work specified in the regulation. Examples of endorsements include backflow prevention, on-site sewerage work and fire protection.

In addition to a licence under the PDA, a person who enters into a contract with a client to perform plumbing and drainage work must also hold a contractor's licence under Section 30 of the *Queensland Building and Construction Industry Act* (1991). Employees are not required to hold this licence. Work can be exempt from the requirement for a contractor's licence if it is below a certain value, depending on the type of work. The Commissioner can also issue licences for hydraulic services design and a site classifier. These latter licences can be issued with restrictions to exclude on-site domestic wastewater management if the applicant does not hold the appropriate qualifications.

8.14.1 Occupational Licences

The QBCC issues occupational licences under the PDA. The classes of licences relevant to work performed on an on-site facility are listed in Table 11. The Commissioner determines the qualifications and experience needed to obtain a licence (QBCC 2021b). This document provides full lists of the required qualifications for occupational and contractor licences in Appendix B (PD Act licences) and Appendix C (QBCC Act licences).

Table 11. Occupational licences that are issued under the PDA.

Type of Licence	Type of Work	
	Installation	Maintenance
Restricted Drainer – On-site Sewage Facility (maintaining OSFs)	[illegible]	[illegible]
Restricted Drainer – On-site Sewage Facility (carrying out OSTP[3] installation work and maintaining OSFs)	[illegible]	[illegible]
Drainer or Provisional Drainer	[illegible]	[illegible]
Drainer or Provisional Drainer with Endorsement for Maintaining OSFs	[illegible]	[illegible]

In the survey of licensees, around two-thirds of respondents thought that the training and qualifications for drainers were adequate, but this dropped to around half for the restricted licence classes (see Section 6.2). In the local government survey, just over half the respondents thought the training and qualifications for maintaining and installing OSFs were adequate or somewhat adequate, while one-quarter thought they were inadequate (15% selected neither adequate nor inadequate). Note that some local government respondents would have been plumbing inspectors who would hold a plumbing licence. The QBCC also issues contractor licences under the QBCC Act for on-site sewage work.

The requirements for installation contractors in section 3.5 of AS/NZS 1547 are:

3.5 Installation Contractors

a. Attend an appropriate accredited training program that should include training in the theory of current and contemporary design approaches and installing on-site systems.

b. Consult with the designer on the intention of the design and the installation/construction methods and procedures essential to achieving design integrity.

c. Liaise with the designer during installation/construction so that a certificate of compliance with design can be completed, particularly when unusual or innovative design approaches are being used that are beyond their current experience.

d. Certify with the designer that all equipment incorporated as part of the on-site system has been installed in accordance with the manufacturer's or supplier's instructions and in accordance with any other conditions established by the regulatory authority.

For maintenance and desludging/pump-out contractors, the requirements in section 3.7 of AS/NZS 1547 are that:

a. All field personnel have undertaken an appropriate training program.

b. A service report covering all maintenance carried out is completed by the servicing contractor.

c. Full records are kept for at least 10 years of maintenance operations (desludging/pump-out operations of wastewater treatment units), and they notify in writing the owner or occupier and the regulatory authority of unusual circumstances and wastewater treatment unit defects discovered during servicing.

d. Scum/sludge and all septage material taken from the site during desludging/pump-out are disposed of or used by an approved facility or agency in accordance with the regulatory authority requirements.

e. Appropriate measures are in place during desludging/pump-out operations to protect staff and any other individuals who could be exposed to health risks during the activity.

One of the options considered by the Panel was the removal of the restricted licence class that would require a licenced drainer with an on-site endorsement to carry out all work on OSFs. The risk of this strategy would be the reduction in the available workforce. There is little available evidence that one category of licence has more responsibility for problems with OSFs than any other. One aspect of the survey results was for respondents to implicate worker categories other than their own in attributing responsibility for on-site problems. Implementing the strategies outlined in Section 7.13 above for a centralised electronic database and electronic lodgement of reports would provide insight into any weaknesses in licences and training that may be contributing to OSF failure.

Adopting Compulsory Continuing Professional Development (CCPD), which will soon be introduced to the industry, will also contribute to lifting the skill levels of all licence classes. The option put in the consultation paper is not presented as a recommendation. The following recommendation, which is premised on the adoption of recommendations in Section 7.14.5, is presented as recommendations 19 (a) and (b).

8.14.2 Contractor's Licences

In addition to the appropriate occupational licence, a QBCC contractor's licence may be required if a person enters into a contract to 'carry out work for the construction, erection, renovation, alteration, extension, improvement, repair, installation, commissioning, maintenance and testing of on-site domestic wastewater management systems if the value of the work is greater than $3,300.' This requirement does not apply to employees and subcontractors or to the 'construction, extension, repair or replacement of a sewerage system other than works connecting a particular building to a mains sewerage system”. There is an extensive list of exemptions (QBCC 2021b).

Contractor licences that include on-site sewage within their scope of work are:

- Plumbing and Drainage
- Drainage
- Drainage – On-site Sewage Facility (maintenance only)
- Drainage – On-site Sewage Facility (maintenance and installation)

In addition to the appropriate occupational licence, a QBCC contractor’s licence may be required if a person enters into a contract to carry out work for the installation, alteration, extension, improvement, repair, commissioning, maintenance and testing of an OSF. The requirement for a contractor’s licence does not apply to employees or sub-trade contractors.

Contractor licences that include on-site sewage work within their scope of work are:

- Plumbing and Drainage (Part 18, Schedule 2 – QBCC Regulation 2018)
- Drainage (Part 19, Schedule 2 – QBCC Regulation 2018)
- Drainage – On-site Sewage Facility (maintenance only) (Part 20, Schedule 2 – QBCC Regulation 2018)
- Drainage – On-site Sewage Facility (maintenance and installation) (Part 20, Schedule 2 – QBCC Regulation 2018)

Schedule 1, Section 2 of the Queensland Building and Construction Commission Regulation 2018 prescribes that where the value of the work is $3,300 or less, the work is not classified as building work unless the work is within the scope of work of a licence provided for in Parts 11–14, 18, 19, 36, 51 or 56. The effect of this regulation is that a person is required to hold a contractor’s licence for plumbing and drainage work regardless of the value of the work itself. Note, however, that Part 20 is not included, meaning that unless the work within the scope of Part 20 is greater than $3,300, a contractor’s licence may not be required. Work associated with an OSF corresponds with the scope of work within Parts 18, 19 and 20; however, there is an inconsistency between these parts in the exclusion provisions of Schedule 1 of the QBCC Regulation.

8.14.3 Licences for Designers

Licences are also required to undertake work in the design OSFs. Design means preparing the plans, specifications and documents that are required to install an OSF on a site. The QBCC issues these licences under the *Building and Construction Commission Act 1991).* To undertake this work, a person must hold either a site classifiers' licence or a hydraulic design licence.

A site classifiers' licence requires a Certificate III in laboratory skills or equivalent and a unit of competency in designing OSFs. The scope of work for a site classifier includes:

- A site survey, including the use of dumpy and laser levelling equipment
- A sample, test and assessment of materials on building sites, including moisture testing, particle distribution testing and field strength testing
- Classifying building sites through the interpretation of site and laboratory data
- Preparing plans, specifications and documents for on-site domestic wastewater management

The requirements for site evaluators and soil assessors under section 3.3. of AS/NZS 1547:2012 are:

a. To have attended an appropriate accredited training program
b. To be familiar with any regulatory requirements for site evaluation
c. To be responsible for all work to evaluate the capacity of a site and its soil for accepting treated wastewater
d. To certify that evaluation procedures have been undertaken in accordance with this standard and any requirements of the relevant regulatory authority
e. To identify cultural concerns or constraints

Hydraulic services design requires a diploma of hydraulic services design and a unit of competency in designing OSFs. The scope of work includes preparing plans, specifications and documents associated with the following building services:

- Sanitary drainage, soil waste and venting

- Trade waste drainage, plumbing and venting
- Cold and hot water
- Rainwater and stormwater drainage
- Gas services
- Fire hydrant and hose reel services, with or without pumps
- Domestic fire sprinkler systems
- On-site domestic wastewater management

Both site classifiers and hydraulic services designers can apply for a contractor's licence. A contractor's licence is not required if the value of design work is less than $1,100.

Both can design OSFs, but only a site classifier can undertake soil assessment to assess the capacity of the site to contain and treat the wastewater. Drainers with an on-site endorsement can undertake design work only for their own clients on a 'design and install' basis. The unit of competency for drainers is *design and size domestic treatment plant disposal systems* CPCPDR4013B. For hydraulic services designers and site classifiers, the unit of competency is *design onsite sewerage facilities* QLD334WEP02A.

The requirements of designers under section 3.4 of AS/NZS 1547:2012 are:

a. To have attended an appropriate accredited training program
b. To have completed and certified a design report (including a loading certificate) to accompany any application for installing or operating on-site systems (as set out in 7.4.2)
c. To be familiar with the information on current installation trade practices, the range of materials and methods employed, the types of machinery available to the installer and the level of operator competence required for their use
d. To be familiar with any community and environmental constraints
e. To have certified on completion of the installation that the on-site system has been constructed, installed and commissioned in accordance with its design, including any additional requirements of the relevant regulatory authority

f. To lodge a set of 'as-built' plans and details, as set out in 6.2.5.4, with the owner or occupier of the facility being serviced by the on-site system and with the relevant regulatory authority if required

g. To prepare a set of operation and maintenance guidelines (see 6.3) specific to the on-site system as designed and installed or constructed. The guidelines should be lodged with the property owner or occupier and, if required, with the regulatory authority or their agent

Both site classifiers and hydraulic design licences can be issued, excluding on-site wastewater in the scope of work. Holders of such licences cannot undertake design work for OSFs and are limited to other work within the scope of work for the licence.

S&SA can be undertaken at various stages in the planning and development process, including:

- At the regional planning stage to determine which areas are suited to development and the suitability of areas for on-site wastewater management
- At the rezoning or subdivision stage to determine the appropriate lot sizes
- At the development stage to design the treatment system for an individual lot

Only the latter is covered in the QPWC, which defines the site and soil evaluation report as an assessment of the legal constraints, financial consequences and risks to public health and the environment of an OSF. The assessments are required to be in accordance with AS/NZS 1547:2012.

8.14.4 Licensee Accreditation

The option to require licensees to obtain a manufacturer's certification to install or maintain OSFs was one of the most misunderstood and least supported of the options in the consultation paper. It was supported by 144 respondents (31% of total, 56% of those completing the question) and opposed by 114. Concerns were expressed about the need for further TAFE training, the number of different systems, and the time and cost imposition on already qualified licensees. Some respondents commented that the provision of the installation manual and operation and maintenance manual under Schedule 5 of the PDR, Section 4 and 6, respectively, was sufficient to ensure licensees could work with any approved system.

There are currently 64 AWTSs approved for use in Queensland: 31 secondary treatment systems, 28 advanced secondary treatment systems and five advanced systems with nutrient removal. The 64 approvals are held by 23 different companies. Not all licensees undertaking installation or maintenance would encounter all of these. Many will work with one exclusively, and most with a small number of them.

It was not the Panel's intent to suggest that accreditation be an arduous or expensive burden on licensees. Some respondents pointed out that some manufacturers already require accreditation for licensees to work with their products. It is intended for the certification to be an online process consisting of a video presentation followed by questions that need to be answered for a certificate to be produced. Similar training is required or offered in many workplaces and occupations. This method of teaching is the basis of many Open University courses. With software packages available, setting up is not difficult or expensive.

The accreditation package could be a requirement of the approval process for the system under the PDR, just as the manual is, and should be free for the licensee. Accreditation would provide manufacturers, licensees and their clients with confidence in the integrity of the installation and maintenance of their systems.

8.14.5 Compulsory Continuous Professional Development

CCPD is the process of undertaking and recording professional education and training after initial registration or licensing to maintain and/or improve professional skills and knowledge. CCPD is a process undertaken throughout one's career as a condition for maintaining authorisation to practise in a given industry. In the on-site wastewater industry, changing regulations within the industry, in public and in environmental health, as well as updated national standards and changing consumer expectations, can impact the way the industry operates and the skills and knowledge needed to undertake the work.

Two-thirds of respondents to the consultation survey supported the option for CCPD. The usual concerns about costs and administration were raised. Some respondents expressed the sentiment that current training and on-the-job skills were sufficient. A survey conducted for the Plumbing Industry Commission in Victoria produced a similar result. 'Over two-thirds of Victorian plumbers "strongly agree" that plumbers have to keep up to date because of their licensed trade status. However, only 29% felt that "experience" in the trade was sufficient in keeping up to date, suggesting that other forms of learning are necessary to maintain currency' (Walker and Powers 2010).

The main challenges for participation in CCPD for industry participants are time and cost. For professionals who have never previously had to participate in CCPD, the benefits can be hard to see. In addition to protecting human health, most plumbers in the Victorian survey believed that CCPD would have an important impact on the industry's reputation, the ability of plumbers to move into different areas of plumbing and their careers (Walker and Powers 2010).

Some sections of the industry already offer CPD opportunities for their members. The Master Plumbers and Mechanical Services Association of Australia offers a voluntary CPD program for their members, with a points system for the completion of courses offered or self-directed learning. The Master Plumbers Association Queensland offers a range of non-accredited and accredited courses, but these are not part of a structured CPD program. The Institute of Plumbing Inspectors Queensland (IPIQ) has a voluntary CPD program with points allocated for participation in conferences, seminars and training courses, academic courses, individual studies, involvement with professional and technical activities and attendance at IPIQ annual general meetings. The ABCB is developing a range of courses for practitioners in the building sector, including compliance practitioners. The QBCC has begun a trial of CCPD for industries that it licenses. The DEPW is currently preparing a regulatory impact statement for the introduction of CCPD, and the QBCC has recently trialled a compulsory continuing professional development scheme in the building industry (QBCC 2021c).

8.14.6 Plumbers as Health Workers

Improvements in water and sanitation accounted for a significant proportion of the decline in death rates and increased life expectancy in many countries during the 20th century (Cutler and Miller et al. 2005; Bartam and Cairncross 2010; Harris and Helgertz 2019). Most of the improvements result from declines in infectious diseases, many of which are waterborne. Improvements in sanitation lead to lower infant mortality and child death rates, linked to better outcomes in health, education and sustainable growth (Alemu 2017). Cutler and Miller (2004) estimated clean water was responsible for nearly half of the total mortality reduction in major cities, three-quarters of the infant mortality reduction and nearly two-thirds of the child mortality reduction in the USA during the 20th century. The importance of these improvements can be illustrated by the outcomes (disease burden, mortality, life expectancy) in regions where poor water quality and sanitation continue (Prüss-Üstün, A. and World Health Organization, 2008)et al. In Queensland and other parts of Australia, water and sanitation issues continue to contribute to adverse health outcomes in First Nations communities (Hall 2018, Beal, Jackson et al. 2019).

Only 50% of the world population has access to piped drinking water within their properties, and 31% have piped sanitation facilities connected to a public sewer system. A focus on health and plumbing is justifiable in regions where these services are most lacking (WHO 2006). However, even in Australia, access to reticulated drinking water service and wastewater services is not universal. While there is some regulation of wastewater disposal in areas not covered by reticulated sewerage services, there is very little regulation of non-reticulated (private) drinking water supplies. As mentioned in Section 7.5 contamination of private drinking water supplies by accidental sewage releases has occurred in Queensland.

Monitoring and compliance activity to protect public health is important and has been discussed extensively in this document. An important component of compliance activity is the dedication and vigilance of those working directly with these systems. The Panel formed the view that the industry's role in protecting the public and environmental health needed to be better acknowledged. The Panel identified the need for continuing and updating skills in the industry and improving accountability as actions that should reduce the failure of OSFs.

Recommendation 18

Introduce compulsory continuing professional development for persons holding an occupational licence under the PDA, where the scope of work involves on-site sewage work.

Recommendation 19

a. That the information and feedback available from reports lodged with the local government under section 106 of the PDR be used to assess and improve the training, licencing and professional development requirements of all licence classes; and

b. work be undertaken to improving understanding among the industry of the roles and responsibilities of all licence classes.

Recommendation 20

Require licensees to obtain a manufacturer's accreditation before installing or maintaining OSFs from that manufacturer.

Recommendation 21

Develop a comprehensive education program about on-site sewage licensees' role in protecting public health, including delivering information sessions for apprentices and trainees, preparing materials for licensees and owners and occupiers, and engaging with retailers.

Recommendation 22

Amend the Queensland Building and Construction Commission Regulation 2018 so that any work within the scope of an OSF licence is considered building work, and any persons performing this work must hold a contractor's licence.

Recommendation 23

Review the qualification requirements for designing OSFs to ensure that all persons who may design these facilities have appropriate skills and qualifications.

Recommendation 24

Amend the Queensland Building and Construction Commission Regulation 2018 so that any work within the scope of work for a hydraulic services design licence is considered building work, and any persons performing this work must hold a contractor's licence. (Note: currently, this work only requires a licence if the value of the work is over $1,100).

8.15 Information for Real Estate Agents and Property Transfer Agents

A series of projects undertaken by the Queensland University of Technology in the early 2000s found that:

i. There is a very limited appreciation among householders in the Gold Coast region for the need for regular maintenance of septic tanks.

ii. None of the septic tank owners surveyed in the Brisbane region was aware of the need for sludge removal at regular intervals, and most householders in this region with aerobic (aerated) wastewater treatment systems do not undertake adequate maintenance (Goonetilleke et al*.* 2000; Goonetilleke et al*.* 2002).

More recent anecdotal evidence suggests that the ongoing 'tree change' phenomenon, as well as the current surge in interstate migration into Queensland, has seen a problematic increase in the number of people taking up residence in houses serviced by OSFs who are unaware of how their system functions or its limitations, not to mention a homeowner's responsibilities regarding servicing. Anecdotal reports have also suggested that there have been cases where tenants have moved in and been completely oblivious to the fact that their particular dwelling is serviced by an OSF, assuming that they were connected to the municipal reticulated sewer system.

Real estate agents are the key interface with prospective owners and tenants who may be looking to move into a dwelling that is serviced by an OSF. As such, real estate agents are an important resource in providing overarching information to these householders regarding the operation of an OSF and the roles and responsibilities of householders with an OSF.

Accordingly, it is recommended that the DEPW should review the requirements for estate agents and property transfer agents under section 3.9 of AS/NZS 1547:2012 to be appropriately encoded in the act, regulations or code. These responsibilities for estate agents and property transfer agents handling the sale, purchase or letting of properties and facilities serviced by OSFs include:

a. Being aware of the type and location of the wastewater management system for each property and facility

b. Arranging for an operation, maintenance and performance monitoring check to be undertaken prior to finalising a sale, organising the completion of any maintenance and remedial actions identified by the check and ensuring that a maintenance certificate (see 6.3.5.6) is provided to the purchaser

c. Making prospective purchasers and occupiers aware of the details of the wastewater management system, including operation and maintenance requirements

d. Supplying each purchaser and occupier with a copy of the current operation, maintenance and monitoring guidelines and the loading certificate for the particular system

e. Transferring any consent to the purchaser's name

f. Having purchasers and occupiers certify that they have received information on the working details of the system and are aware of its type, maintenance requirements and location, as well as any consent, approval or permit requirements (where applicable)

g. Making prospective purchasers of land in a new subdivision development aware of the requirements of this standard

h. Entering appropriate site and effluent management requirements and constraints into individual property titles (for example, exclusion areas such as building platforms, rocky outcrops, poor soil areas, LAAs and reserve areas)

The provisions to meet these requirements should begin at the listing stage, with the information that the property is not connected to a sewer and the type of on-site system (passive or AWTS) indicated and included in real estate listings and advertising. This should also include information on reticulated drinking water service and alternative source water.

All OSFs should be working and compliant at the point of sale or on occupancy for rental properties. Evidence of compliance should be required during a sale, just as a pool safety certificate is required for pool fencing or a roadworthy certificate is required for a vehicle.

Many of the requirements for the provision of information to owners would be facilitated if the recommendations in Section 7.13 were implemented, as the new owner would have access to all the information on their system via the online portal, including the service history. Of particular importance is the requirement in 3.9 that prospective purchasers are aware of the land requirements of the on-site system, as discussed in Section 7.10, and the limits these requirements place on the addition of buildings, sheds, pools and vegetation on the land.

Recommendation 25

Review the legislative requirement for real estate agents and property transfer agents to comply with the requirements of AS 1547 (2012) Section 3.9 so that:

a. Information is provided in listings and advertising of real estate offered for sale or lease.

b. On-site systems are required to be working and compliant at the point of sale or lease.

c. A certificate or equivalent compliance documentation is provided at the point of sale.

d. All relevant information on the on-site system, including the design and installation approvals and maintenance history, is provided at the property transfer.

Recommendation 26

Develop an information kit for real estate agents to distribute to owners and tenants of properties with OSFs.

8.16 Households

The Panel identified incorrect use by householders – for example, biology-killing chemicals and failure by owners to ensure that scheduled maintenance is carried out as contributing to OSF failure. In both the licensee and local government surveys, responsibility for on-site failures was largely attributed to owners and occupiers. Tenants, in particular, were singled out in comments.

> 'Our perception is that despite adequate information available to owners/occupiers, many show no interest in learning about this – particularly occupiers/renters.'

> 'Most people that rent are not interested unless there is a problem that affects them.'

Asked to rank the main problems with non-compliance of OSFs in order of importance, residents failing to arrange service as required was ranked highest by most respondents, significantly ahead of problems with design, installation, system performance or failures by licensees.

Responding to the question, 'Do you believe that owners and occupiers have enough education about how to correctly maintain an on-site sewage facility?', 70% of respondents said 'no'. In free-text answers to the follow-up question, 'If "no," what additional information do you think is important for owners and occupiers to know?', most comments focused on how the system works, its maintenance requirements and what products were suitable for use with the system. In the survey of local governments, 35 respondents thought owners and occupiers did not have enough education about how to correctly maintain an OSF, compared to only five who thought they did.

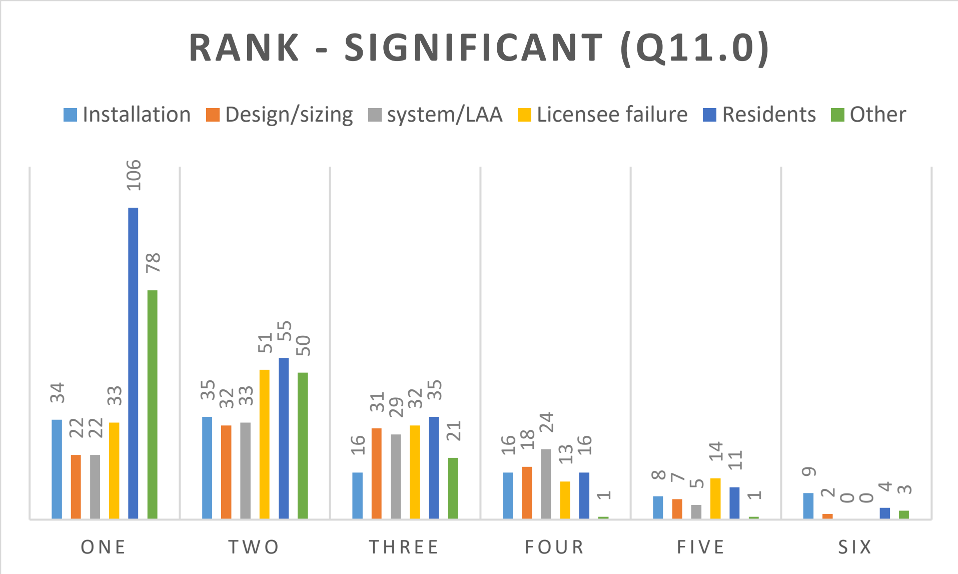


Figure 10. Responses to question to ranks in significant issues.

Installations – Non-compliant installation of facilities (not in line with manufacturers' requirements or wastewater design report); Design/sizing – Non-compliant design or inappropriate sizing of the facility; system/LAA – Non-compliant location of facilities (system and/or LAAs); Licensee failure – Licensees failing to maintain systems to the required standard; Residents – Residents failing to arrange servicing as required.

Under Section 70 of the PDA, the premises owner must take all reasonable steps to ensure that plumbing and drainage on their property, including an OSF, are kept in good condition and operate properly. It is also recommended that owners ensure that other occupants, including tenants, know operational and maintenance requirements. Schedule 5, Part 5 of the PDR states that the manufacturer must provide an operating manual for the treatment plant that includes the responsibility of the owner for operating and maintaining the treatment plant and the types of substances that may adversely affect the plant or the environment. System manuals approved before 2019 may not comply with all the schedule requirements.

The responsibilities of the property owner as outlined in Section 3.8 of AS 1547 are:

a. Property owners should fully inform themselves about the on-site wastewater management system on their property and its operation and maintenance. They should have available a copy of the operation, maintenance and monitoring guidelines and the load certification of the system.

b. The property owner should ensure that maintenance carried out on the system is certified by the contractor. The maintenance should be in accordance with the schedules in the operation, maintenance and monitoring guidelines prepared for the system by the designer and with the regulatory authority requirements. Property owners should keep records of the maintenance carried out over the last 10 years.

c. Property owners should also ensure that details and requirements for operation, maintenance and monitoring (including plans, design reports, loading certificates, equipment brochures and so on) are retained on the property and are readily accessible to the occupier.

The Queensland Government website, with its list of approved OSFs (State of Queensland 2022), provides links to manufacturers' websites where the owner's manual should be accessible (but isn't always). The quality of the manuals varies in the information offered, particularly for systems approved before 2019. Occupiers can seek information on some aspects from other sources – for example, the suitability of chemicals for use with certain types of systems from the product manufacturer.

Many websites and fact sheets provided by state and local governments, industry organisations, and other interested parties contain lists of don'ts for occupiers but little information on appropriate alternatives. For example, the Easy Septic Guide (NSW Department of Local Government, 2000) advises against the use of chemical cleaners and suggests the use of traditional products such as bicarbonates of soda and vinegar. Other websites use generic terms such as 'harsh chemicals' and 'bleaches'. Unilever's website advises that all its products are 'septic safe', including a disinfectant, a fabric conditioner, several laundry powders and all its personal care products. It recommends that antibacterial solutions, caustic solutions (such as oven cleaners and drain cleaners) and disinfectant and ammonia-based cleaners should be avoided with Envirocycle and Biocycle systems only (Unilever, 2020). Local government can provide information on minimum service requirements for septics and advanced wastewater systems, but these might not include all the servicing requirements for a particular system. Access to a comprehensive owner's manual is essential for all responsible parties to ensure the safe operation of OSFs.

Confusion over the respective responsibilities of owners, agents and tenants is a further complication that can lead to the failure of OSFs. Both AS/NZS 1547:2012 and the PDA and PDR are clear on the lines of responsibility:

1. The manufacturer must provide an owner's manual detailing the name, model and size of the treatment plant, the limitations of the treatment plant

– for example, capacity, clear instructions on how the plant should be operated, the type of wastewater that can be treated and how it is treated, the types of substances that can be discharged into the treatment plant without adversely affecting the plant or the environments, the responsibilities of the owner of the plant for operating and maintaining the plant, actions to be taken if the plant is used intermittently and instructions for identifying and solving problems.

2. The owner of the treatment plant is required to be fully informed about the operation and maintenance requirements of the system to ensure that maintenance carried out on the system is certified, maintain records for at least 10 years and to ensure that all information is retained on the property and available to the occupier.

3. The occupier, where this is not the owner, must be aware of the operating and maintenance requirements and ensure that the system is kept in good condition and operates properly.

The tenant's responsibilities would extend to not flushing unsuitable material down the toilet, only using chemicals as recommended by the manufacturer, not causing physical damage to the plant, not deliberately interrupting the power supply to the plant and not interfering with the LAA or trenches. The owners would be required to maintain the system in accordance with state and local laws. This is similar to the arrangements that would occur if the property was connected to the sewer and to responsibilities for electrical safety switches and smoke alarms.

The recommendation, as presented in the consultation paper, advised that consistent and appropriate advice be provided from a centralised, technically competent, recognised source on the requirements for on-site facilities. It is recognised here that the implementation of the recommendations in 7.13 and 7.15 would substantially meet these requirements. The recommendation is retained here, slightly modified, in support of those items.

<u>Recommendation 27</u>

Provide consistent, appropriate and ongoing advice from a centralised, recognised source(s) on the requirements of OSFs, including the roles and responsibilities of agents, owners and occupiers.

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10 Glossary of Terms

Absorption	The uptake of effluent into the soil by infiltration and capillary action.[1]
Advanced Secondary Treatment	The treatment of wastewater to meet the criteria in AS 1546.3:2017 viz ≤10 mg/L BOD5, ≤10 mg/L TSS, ≤10 cfu/mL E. Coli.[2]
Advanced Wastewater Systems	A wastewater treatment system that produces treated effluent of advanced secondary standard, as per AS/1546.3:2017.
Aeration	A process in which air is circulated through water to remove hydrogen sulphide, volatile organic compounds and other dissolved gases and oxidise dissolved metals, including iron.
BOD_5	The amount of dissolved oxygen consumed by microbiological action and chemical processes when a sample of liquid is incubated over five days at 20°C. The result is expressed in milligrams per litre (mg/L).[2]
Chlorination	The disinfection of water using chlorine.
Commissioner	The person appointed as Commissioner of the QBCC under s20D of the QBCC Act 1991.
Decentralised	Systems that collect and treat wastewater at a spatial scale smaller than the municipal reticulated sewerage system – for example, clusters of homes, communities, industries or other built environments.
Design Loading Rate	The loading rate that applies to the distribution of effluent to the design area of an absorption trench, bed or mound land application system, expressed in $L/m^2/day$ or mm/day.[1]
Desludging	The removal of accumulated sludge and scum from a treatment unit or holding tank.[1]

Disinfection	The wastewater treatment method kills or inactivates microbial pathogens to an acceptable level and is satisfactory for the intended use. Its effectiveness is typically measured by the reduction in the faecal indicator bacteria *E. coli*.[1]
Drainage	An apparatus, fitting or pipe, either above or below ground level carrying sewage to a sewerage system; or sewage to, within or from an OSF; greywater from a greywater treatment plant or greywater diversion device; or an OSF.[3]
Drainage Work	Work that includes installing, changing, extending, disconnecting, taking away and maintaining drainage; or a greywater use facility; or an OSF.[3]
Drinking Water	Water for human consumption, intended primarily as water for drinking, whether or not the water is used for other purposes, but does not include water that is defined under *Food Act 2006* or water taken or supplied for domestic purposes under the *Water Act*.[4]
Drinking Water Service	Water service for the treatment, transmission or reticulation of water for supply as drinking water.[4]
E. Coli (*Escherichia coli*)	A member of the faecal coliform group of bacteria and indicative of faecal contamination.[1]
Effluent	The liquid discharged from a wastewater treatment plant.[1]
Endorsement	An addition to a licence applicable to a specific scope of work granted under Section 25 (1) of the PDA.[3]
Environment	Surroundings, including natural and physical resources, ecosystems, community and neighbourhood.[1]
Filtration	A process that removes chemical and biological contaminants by passing the water through a medium that blocks particles but not water.
Flocculation	A process that removes solids from water by adding a chemical agent that causes them to form larger clusters, which can then be removed by sedimentation.

Greywater	Wastewater from a bath, basin, laundry or shower, whether or not the wastewater is contaminated with human waste.[3]
Groundwater	The body of water in the soil, all the pores of which are saturated with water. If the body of water is present at all times, it represents permanent or true groundwater.[1]
Harmful Algal Bloom	Colonies of algae growing out of control and with the ability to produce toxic or harmful effects on people and the environment.
Infiltration	The passage of water or effluent into the soil.[1]
Influent	Wastewater that flows into a chamber, tank or vessel of a wastewater treatment system before treatment.[2]
Inspector	A person who holds an appointment as an inspector under Sec 139 of the PDA.
Irrigation	The distribution of effluent into the topsoil by a shallow subsurface or covered surface drip irrigation system, a shallow subsurface LPED irrigation system or an above-ground spray irrigation system.[1]
Land Application Area	An area where greywater or effluent from an on-site sewage treatment plant is disposed of by subsurface or surface irrigation.[3]
Land Application System	The system used to apply effluent from a wastewater treatment unit into or onto the soil for further in-soil treatment and absorption or evaporation.[1]
Licensee	A person who holds a licence under the PDA.[3]
Local Government	In relation to work, a facility or premises, this relates to the local government area in which the work is carried out, is to be carried out or where the facility or premises are located.[3]
Manufacturer	Any person, firm or nominated representative of the company or firm that manufactures or assembles a sewage treatment system.[2]

Monitor	Check, supervise, observe critically or measure the progress of an activity, action or system on a regular basis to identify change from the performance level required or expected.[1]
Occupier	The person who is acting with the authority of a person who apparently occupies the place, or if no one apparently occupies the place, the person who is the owner of the place.[3]
On-site Sewage Facility	A facility other than an environmentally relevant OSF installed on premises that includes an on-site treatment plant on the premises for treating sewage produced on the premises; and either an LAA on the premises for disposal of the effluent produced by the on-site treatment plant; or a tank for storing on the premises the effluent produced by the on-site treatment plant for later disposal off the premises by collection from the tank; or a facility, other than an environmentally relevant OSF, installed on premises, that includes an on-site treatment plant on the premises for treating sewage produced on the premises and disposes of the effluent produced by the on-site treatment plant off the premises if the facility is installed only for testing purposes—into a sewage system; or by common effluent drainage; or in another way, stated in the permit for the installation of the facility; or a dry-vault toilet or a chemical, composting or incinerating toilet.[3]
On-site Sewage Treatment Plant	A sewage treatment plant that is, or is designed to be, part of an OSF installed on premises.[3]
Owner	The owner of the building or structure within the meaning of the Building Act 1975.3.
Passive Systems	Water treatment systems that do not have an external power source, have no perceptible operation and do not require chemical reagents to conduct treatment.

Pathogen	A microorganism capable of causing or likely to cause disease.
Performance Criteria	The qualitative or quantitative measures or limits that indicate attainment of the performance requirement.[1]
Performance Requirements	The functions that a system has to perform in order to operate as defined.[2]
Piezometer	A sensor that measures pore water pressure in the ground.
Ponding	Excessive accumulation of water at low-lying areas.
Population Equivalent	The ratio of the total quantity of waste produced to that defined as being from one person in a dwelling.[1]
Premises	An allotment of land, including any buildings on it.[2]
Primary Contact	Any activity in water where there is direct contact with water that could result in swallowing water, including swimming, surfing, water skiing or diving.
Primary Effluent	Effluent from a treatment system that provides minimal (primary) treatment.
Primary Treatment	The separation of suspended material from wastewater by settlement and/or floatation in septic tanks, primary settling chambers or other structures. In addition to physical separation of solids from liquid, the solids may be decomposed by aerobic or anaerobic microbial processes and digestion.[2]
Provisional Licence	A licence that may be granted under Section 19(1)(b) of the PDA to a person who the Commissioner believes does not have enough experience for a full licence.
Provisional Licensee	A person who holds a provisional licence.
Recreational Water	Any open water in rivers, lakes, dams and coastal waters used for recreation, including swimming, surfing, white water sports, diving, boating or fishing, but not including treated waters such as swimming pools.

Reserve Area	An area set aside for future use as an LAA to replace or extend the original land application.
Reservoir	(1) With reference to a pathogen, a reservoir of an infectious agent is the habitat in which the agent normally lives, grows and multiplies. Reservoirs include humans, animals and the environment. (2) A storage of water that is either part of the water catchment (lakes and dams) or the water distribution system (ground level, elevated or buried tanks). In Queensland, a reservoir is usually used to refer to stored water in a distribution system.
Sanitary Drainage	An apparatus, fitting or pipe for collecting and carrying discharges from sanitary plumbing or from a fixture directly connected to a sanitary drain, to a sewerage system, OSF or greywater use facility, including disconnector gullies; bends at the base of stacks or below ground level; and for connection to an OSF, a pipe, other than a soil or waste pipe, used to carry sewage to or from the facility; and pipes, above ground level, installed using drainage principles.[3]
Sanitary Plumbing	An apparatus, fitting, fixture or pipe, above ground level, for carrying sewage to a sanitary drain.[3]
Saturation	Soil water content at which all pore space is filled with water, and the ground has no further capacity to absorb water.
Scum	The floating mass of wastewater solids buoyed up by the entrained gas, grease or other substances that form an accumulating layer on the liquid surface inside the treatment tank.[1]
Secondary Contact	Any contact with recreational water in which the opportunity to ingest water is limited – for example, paddling, wading, boating or fishing.

Secondary Treatment	Aerobic biological processing and settling or filtering of effluent received from a primary treatment unit.[1]
Septic Tank	A single- or multiple-chambered tank through which wastewater is allowed to flow slowly to permit suspended matter to settle and be retained so that organic matter contained therein can be decomposed (digested) by anaerobic bacterial action in the liquid.[1]
Sewage	Household and commercial wastewater that contains, or may contain, faecal, urinary or other human waste.[4]
Sewage Treatment Plant	A plant for the biological, physical or chemical treatment of sewage.
Sewerage System	Infrastructure used to receive, transport and treat sewage or effluent, including, for example, access chambers, engines, machinery, outfalls, pumps, sewers, structures and vents.[3]
Sewered Area	A service area for a sewerage service under the WSSRA or a connection area for a wastewater service under the *South East Queensland Water (Distribution and Retail Restructuring) Act 2009*.[3]
Shallow Aquifer	An aquifer that lies immediately below a permeable layer of soil.
Sludge	The semi-liquid solids settled from wastewater.[1]
Source Water Catchments	Catchments (including aquifer recharge areas) that supply water for human consumption, intended primarily for drinking, whether or not the water is used for other purposes.
Total Suspended Solids	The concentration of solids suspended in water, expressed in mg/L.[2]
Trade Waste	Industrial wastewater, including commercial-scale laundries.
Transpiration	The process in a land disposal system where water is removed by vegetation planted in the area.

Treatment Plant	A greywater treatment plant or an on-site sewage treatment plant.[3]
Treatment Plant approval	A treatment plant testing approval or a treatment plant use approval.[3]
Viable but Nonculturable	Bacteria that are in a state of very low metabolic activity but do not divide and may not be detected by standard plating methods. The bacteria are alive and have the ability to become culturable and cause disease once conditions become favourable.
Wastewater	The spent or used water generated on premises from industrial, commercial or manufacturing activities, or animal husbandry activities, other than spent or used water generated from an agricultural or resource activity.[4]
Water Table	The upper surface of groundwater below which the soil is permanently saturated with water.[1]

Sources: [1] AS/NZS 1547:2012; [2] AS 1546.3:2017; [3] Plumbing and Drainage Act 2018; [4] Water Supply (Safety and Reliability) Act 2008.

11 Appendix A – Definitions

Compliance failure includes a facility that has not been designed, installed or maintained according to applicable codes or standards.

Design failure includes:

a) a facility that has not been designed in accordance with applicable codes and standards; or

b) a design with an improperly chosen, designed, sized or located LAA or disposal method; or

c) a design that has not considered and applied setbacks appropriate for a drinking water catchment (i.e. to watercourses and urban water supply storages); or

d) a design based on erroneous information, including but not limited to incorrect soil classification or system loading; or

e) the design not taking into proper consideration soil over the proposed location of the LAA; or

f) no provision for a reserve LAA or a reserve LAA improperly located concerning setbacks in a drinking water catchment; or

g) inadequate treatment capacity (i.e. EP number) of the wastewater treatment system or any holding tanks.

Hydraulic failure is a visible failure of a facility, resulting in:

a) surface ponding, boggy areas or evidence of subsurface seepage of effluent (treated or untreated) from pipework or vessels; or

b) overland flow or the emergence of untreated or treated effluent; or

c) pooling or ponding of influent or effluent; or

d) boggy soils in the vicinity of effluent disposal areas; or

e) unusually vigorous vegetation or bright green grass over or around any effluent disposal, transfer or holding area.

Operational or maintenance failure is any condition of a facility that could lead to hydraulic failure, including:

a) installation or maintenance of the facility that does not comply with the design or manufacturer's requirements; or

b) installation of any part of the wastewater treatment, storage and disposal facilities by an unqualified person or organisation; or

c) mechanical breakdown, damage to or age-related disintegration of components; or

d) a lack of adequate maintenance of the facility, as recommended by the manufacturer.

Note: An operational or maintenance failure may result from an error on the part of the installer or service agent or from an occupier failing to arrange the required servicing of the facility.

A technical failure describes a facility or a component of a facility that was compliant at the time of installation but does not meet the requirements of current codes and standards.

Note: A facility with a technical failure may not necessarily have operational or hydraulic failures.

12 Appendix B – Qualifications and experience requirements for licences under the PDA.

Plumbers Licence

Qualifications

(a) A plumbing apprenticeship completed in an Australian jurisdiction, and a Certificate III in Plumbing (CPC32420) with the competencies provided in Appendix A of the technical qualifications document.

(b) A plumbing apprenticeship completed in an Australian jurisdiction, and one of the following qualifications:

   (i) Certificate III in Plumbing (CPC32413)

   (ii) Certificate III in Plumbing (CPC32412)

   (iii) Certificate III in Plumbing (CPC32411)

   (iv) Certificate III in Plumbing (CPC32408)

(c) A plumbing apprenticeship completed in an Australian jurisdiction, and a qualification which has been assessed and verified by a registered training organisation as at least equivalent to a Certificate III in Plumbing (CPC32420)

(d) A plumbing apprenticeship completed outside an Australian jurisdiction, and a qualification which has been assessed and verified by a registered training organisation as at least equivalent to a Certificate III in Plumbing (CPC32420)

(e) A plumbing apprenticeship completed outside an Australian jurisdiction, and a qualification which has been assessed and verified by a registered training organisation as at least equivalent to a Certificate III in Plumbing (CPC32420) because the applicant has also successfully completed relevant gap training competencies recognised in the National Register on Vocational Education and Training (VET) in Australia

(f) A Certificate III in Plumbing (CPC32420) or a qualification which has been assessed and verified by a registered training organisation as at least equivalent to a Certificate III in Plumbing (CPC32420), that was not completed through an apprenticeship, provided the certificate or qualification excludes reliance on recognition of prior learning for any period where unlawful work (including work without the required licence) was carried out

(g) A plumbing apprenticeship completed in an Australian jurisdiction, and a qualification in plumbing completed prior to 1 January 2011 if the applicant has also completed the following units of competency from the Certificate III in Plumbing (CPC32420):

(i) CPCPCM2043 – Carry out WHS requirements

(ii) CPCCWHS2001 – Apply OHS requirements, policies and procedures in the construction industry; and

(iii) CPCPFS3038 – Test and maintain fire hydrant and hose reel installations.

Practical experience

(a) Where the required qualification is obtained pursuant to paragraphs (a), (b), (c), (d) or (e) above, at least one (1) year's practical plumbing experience after successful completion of the required qualification.

(b) Where the required qualification is obtained pursuant to paragraph (f) above, four (4) years practical plumbing experience after successful completion of the required qualification.

(c) Where the required qualification is obtained pursuant to paragraph (g) above, at least one (1) year's practical plumbing experience after successful completion of the applicant's apprenticeship.

Drainers Licence

Drainage qualifications

(a) A Certificate II in Drainage (CPC20720) completed other than through a recognition of prior learning process

(b) A Certificate II in Drainage (CPC20720) completed through a recognition of prior learning process provided the qualification (in whole or part) was not obtained through a recognition of prior learning process that relied on the applicant performing unlawful work (including work without the required licence)

(c) A qualification, other than a qualification completed through a recognition of prior learning process, which has been assessed and verified by a registered training organisation as at least equivalent to a Certificate II in Drainage (CPC20720)

(d) A qualification completed in another country, completed other than through a recognition of prior learning or like process, which has been assessed and verified as at least equivalent to a Certificate II in Drainage (CPC20720) because the applicant has also successfully completed relevant gap training competencies recognised in the National Register on Vocational Education and Training (VET) in Australia

(e) A qualification listed above which has been completed through a recognition of prior learning process provided that the qualification was not obtained through a recognition of prior learning process that relied on the applicant performing unlawful work (including work without the required licence).

Plumbing and drainage qualifications

(f) A qualification for a plumber's licence as provided in Part 1, subsection (a) to (f) of the technical qualifications document (as described above)

(g) A plumbing apprenticeship completed in Australian jurisdiction, and a plumbing and drainage qualification completed prior to 1 January 2011 if the applicant has also completed the following units of competency from the Certificate III in Plumbing (CPC32420):

  (iv) CPCPCM2043 – Carry out WHS requirements

  (v) CPCCWHS2001– Apply OHS requirements, policies and procedures in the construction industry

Practical experience

At least one (1) year's practical drainage experience.

Restricted Drainer – On-site Sewage Facility (maintaining on-site sewage facilities)

1. QLD334WEP01A – Maintain and service domestic treatment plants and OSFs; and
2. CPCPDR4013B – Design and size domestic treatment plant disposal systems.

Practical experience: At least six (6) months of practical experience within the scope of work for which the licence is issued.

Restricted Drainer – On-site Sewage Facility (carrying out OSTP installation work and maintaining OSFs)

1. QLD334WEP01A – Maintain and service domestic treatment plants and OSFs; and
2. CPCPDR4013B – Design and size domestic treatment plant disposal systems; and
3. CPCPCM2043A – Carry out work health and safety requirements; and
4. CPCPDR2022A – Install domestic treatment plants; and
5. CPCPDR3023A – Install on-site disposal systems; and
6. BSBSMB401A – Establish legal and risk management requirements of small businesses.

Practical experience: At least six (6) months of practical experience within the scope of work for which the licence is issued.

Endorsement for on-site sewage facility maintenance

1. CPCPDR4013B – Design and size domestic treatment plant disposal systems; and
2. QLD334WEP01A – Maintain and service domestic treatment plants and OSFs.

Practical experience: No practical experience.

13 Appendix C – Qualifications and experience requirements for licences under the QBCC Act.

Part 4 – Builder – Low-rise Licence

Contractor and nominee supervisor licences

Any one of the following:

1. Successful completion of Certificate IV in Building and Construction (Building) CPC40110;
2. Successful completion of a course the commission considers is at least equivalent to the course mentioned in paragraph (a);
3. A recognition certificate as a builder qualified to carry out the scope of work for the licence class;
4. A qualification or statement of attainment of required competency for the class of licence.

Site supervisor licence

Any one of the following:

1. The technical qualifications stated for Builder – Low Rise;
2. Successful completion of the following units of competency:
    1. Apply building codes and standards to the construction process for low-rise building projects CPCCBC4001A;
    2. Manage occupational health and safety in the building and construction workplace CPCCBC4002A;
    3. Plan building or construction work CPCCBC4007A;
    4. Conduct on-site supervision of building and construction projects CPCCBC4008B;
    5. Apply legal requirements to building and construction projects CPCCBC4009B;

6. Apply structural principles to residential low-rise constructions CPCCBC4010B;
7. Apply structural principles to commercial low-rise constructions CPCCBC4011B;
8. Read and interpret plans and specifications CPCCBC4012B;
9. Apply site surveys and set out procedures to building and construction projects CPCCBC4018A;
10. Lead team effectiveness BSBLDR403;

3. Successful completion of a course or units of competency of a course the commission considers is at least equivalent to the units of competency mentioned in paragraph (b).

Part 5 – Builder – Medium-rise Licence

Contractor and nominee supervisor licences

Any one of the following:

1. Successful completion of Diploma of Building and Construction (Building) CPC50210;
2. Successful completion of a course the commission considers is at least equivalent to the course mentioned in paragraph (a);
3. A recognition certificate as a builder qualified to carry out the scope of work for the class;
4. A qualification or statement of attainment of required competency for the class of licence.

Site supervisor licence

Any one of the following:

1. The technical qualifications stated for Builder – Medium Rise;
2. Successful completion of the following units of competency:
    1. Apply building codes and standards to the construction process for medium-rise building projects CPCCBC5001B;
    2. Supervise and apply quality standards to the selection of building and construction materials CPCCBC5004A;

3. Select and manage building and construction contractors CPCCBC5005A;
4. Apply site surveys and set out procedures for medium-rise building projects CPCCBC5006B;
5. Apply structural principles to the construction of medium-rise buildings CPCCBC5018A;
6. Identify services layout and connection methods to medium-rise construction projects CPCCBC5009A;
7. Manage construction work CPCCBC5010B;

3. Successful completion of a course or units of competency of a course the commission considers is at least equivalent to the units of competency mentioned in paragraph (b).

Part 6 – Builder – Open Licence

Builder – open contractor and nominee supervisor licences

Any one of the following:

1. Successful completion of Advanced Diploma of Building and Construction (Management) CPC60212;
2. Successful completion of a course the commission considers is at least equivalent to the course mentioned in paragraph (a);
3. A recognition certificate as a qualified builder to carry out the scope of work for the licence class;
4. A qualification or statement of attainment of required competency for the class of licence.

Builder – project management services contractor and nominee supervisor licences

1. Any one of the qualifications mentioned for Builder – Open; or
2. Successful completion of a degree in architecture, construction management, engineering, quantity surveying; or
3. Successful completion of a course the commission considers is at least equivalent to the course mentioned in paragraph (b).

Part 11 – Building Design – Low-rise Licence

Any one of the following:

1. Successful completion of the following units from the CPP50911 Diploma of Building Design:
    1. Apply OHS requirements, policies and procedures in the construction industry CPCCOHS2001A;
    2. Research construction materials and methods for small-scale residential building design projects CPPBDN5001A;
    3. Research compliance requirements for small-scale residential building design projects CPPBDN5003A;
    4. Recommend sustainability solutions for small-scale building design projects CPPBDN5005A;
    5. Consult with clients to produce approved small-scale building project design briefs CPPBDN5006A;
    6. Produce compliant client-approved working drawings for small-scale residential buildings CPPBDN5011A;
    7. Assess timber-framed designs for one- and two-storey buildings CPCCSV5012A;
2. Successful completion of a course or modules of a course the commission considers is at least equivalent to a course mentioned in paragraph (a);
3. A recognition certificate as a building designer qualified to carry out the scope of work for the class;
4. A qualification or statement of attainment of required competency for the class of licence.

Part 12 – Building Design – Medium-rise Licence

Any one of the following:

1. Successful completion of any of the following courses:
    1. Associate Degree of Building Design CC01 (CQU);
    2. Diploma of Building Design CPP50911;

3. Successful completion of a course or modules of a course the commission considers is at least equivalent to a course mentioned in paragraph (a);
4. A recognition certificate as a building designer qualified to carry out the scope of work for the class;
5. A qualification or statement of attainment of required competency for the class of licence.

Part 13 – Building Design – Open Licence

Any one of the following:

1. Successful completion of any of the following courses:
    1. Bachelor of Design (Architectural Studies) DE42 (QUT);
    2. Bachelor of Building Design CU65 (CQU);
2. Successful completion of a course or modules of a course the commission considers is at least equivalent to a course mentioned in paragraph (a);
3. A recognition certificate as a building designer qualified to carry out the scope of work for the class;
4. A qualification or statement of attainment of required competency for the class of licence.

Part 18 – Plumbing and Drainage Licence

1. Either:
    1. The successful completion of the following units of competency from Certificate IV in Plumbing and Services CPC40912:
        1. Carry out work-based risk control processes CPCPCM4011A;
        2. Estimate and cost work CPCPCM4012A;
        3. Design and size sanitary drainage systems CPCPDR4011B;
        4. Design and size stormwater drainage systems CPCPDR4012B;
        5. Design and size domestic treatment plant disposal systems CPCPDR4013B;
        6. Design and size sanitary plumbing systems CPCPSN4011B;

7. Design and size heated and cold water services and systems CPCPWT4011B;
8. Establish legal and risk management requirements of small business BSBSMB401; or

2. The successful completion of a course and units of competency of a course the commission considers is at least equivalent to the course and units of competency mentioned in paragraph (a)(i); and
    1. Possession of a plumbers' and drainers' licence issued by the commissioner under the PDA, other than a provisional licence.

Part 19 – Drainage Licence

1. Either:
    1. Successful completion of the following units of competency from the Certificate IV in Plumbing and Services CPC40912:
        1. Carry out work-based risk control processes CPCPCM4011A;
        2. Estimate and cost work CPCPCM4012A;
        3. Design and size sanitary drainage systems CPCPDR4011B;
        4. Design and size stormwater drainage systems CPCPDR4012B;
        5. Design and size domestic treatment plant disposal systems CPCPDR4013B;
        6. Establish legal and risk management requirements of small business BSBSMB401; or
2. Successful completion of a course and units of competency of a course the commission considers is at least equivalent to the course and units of competency mentioned in paragraph (a)(i); and
    1. Possession of a drainers' licence issued by the commissioner under the PDA, other than a provisional licence.

Part 20 – Drainage – On-site Sewerage Facility Licence

Maintenance

1. Either:
    1. Successful completion of the following units of competency:

        1. Maintain and service domestic treatment plants and on-site sewerage facilities QLD334WEP01A;
        2. Design and size domestic treatment plant disposal systems CPCPDR4013B; or
2. Successful completion of a course the commission considers is at least equivalent to the units of competency mentioned in paragraph (a)(i); and
    1. Possession of a restricted drainer – on-site sewerage facility licence issued by the commissioner under the PDA for maintaining on-site sewerage facilities.

Maintenance and installation

1. Either:
    1. Successful completion of the following units of competency:
        1. Maintain and service domestic treatment plants and on-site sewerage facilities QLD334WEP01A;
        2. Design and size domestic treatment plant disposal systems CPCPDR4013B;
        3. Carry out WHS requirements CPCPCM2043A;
        4. Install domestic treatment plants CPCPDR2022A;
        5. Install on-site disposal systems CPCPDR3023A;
        6. Establish legal and risk management requirements of small business BSBSMB401; or
    2. Successful completion of a course the commission considers is at least equivalent to the units of competency mentioned in paragraph (a); and
        1. Possession of a restricted drainer – on-site sewerage facility licence issued by the commissioner under the PDA for maintaining on-site sewerage facilities and OSTP installation work.

Part 38 – Hydraulic Services Design Licences

Hydraulic services design

1. Successful completion of a Diploma of Hydraulic Services Design CPC50612 or a qualification the commission considers is at least equivalent to the diploma; and
2. Successful completion of the unit of competency design on-site sewerage facilities QLD334WEP02A or a unit of competency the commission considers is at least equivalent to QLD334WEP02A unit of competency.

Part 51 – Site Classifier Licences

Site classifier

Any one of the following:

1. Successful completion of:
    1. Certificate III in Construction Material Testing 10544NAT, including the unit of competency, classify sites CMTGEO406A;
    2. A course the commission considers is at least equivalent to the qualification mentioned in subparagraph (i);
    3. A qualification or statement of attainment of required competency for the class of licence; and
2. Successful completion of the unit of competency design on-site sewerage facilities WEP02A or competency the commission considers is at least equivalent to the WEP02A unit of competency.