Inspection and Troubleshooting of Onsite Wastewater Management Systems

Inspection Equipment

Testing and Monitoring

Inspection Equipment and Use

- Each item has a particular role
  - WHS - PPE
  - Access
  - Testing and monitoring
  - Tracing
  - Records

Inspection Equipment Checklist

Safety precautions should be taken when using chemicals. Read Safety Data Sheets and use PPE.

Items may include the following:

- Council authorised officer card and name badge
- Safety checklist (JSA/ Take-5)
- Inspection log sheet (paper or digital) plus inspection job list
- Council calling cards and missed inspection letters to be left on the site if no-one is home and/ or access wasn't possible and a reinspection date needs to be arranged
- Camera or mobile phone for taking photographs
- GPS for component location coordinates
- **PPE:**
- Disposable gloves
- Safety gloves for manual handling
- Safety glasses
- Protective safety shoes suitable for uneven ground
- Sun protection (sunscreen, hat, long sleeves/ pants)
- Insect protection (long sleeves/ pants, insect repellent). These also help with weed seeds
- Gumboots (wet weather and failing EAA)
- Snake bite kit and first aid kit (insect bites and cuts and scratches happen)
- Sanitiser and bleach (cleaning hands and tools)
- Water (washing hands and tools)
- Paper towel ("dry washing" tools)
- **Basic tools:**
- Screwdrivers (small and large flat-head and Phillips head for opening/ closing screws, levering small inspection openings and clearing dirt from screw heads)
- Socket set
- Battery drill with screwdriver and sockets (can save a lot of time)
- Lid lifter or multi-grips for lifting lids. Include a 20c coin for opening some poly septic tank inspection caps
- Shifters (just in case the sockets don't fit)
- Hammer (rubber/ wood to persuade stuck fittings)
- Hook for lifting floats and lids
- Wrecking bar (levering and lifting concrete lids)
- Lid lifter (suited for 'T' shaped lifting points)
- Crowbar (for moving concrete lids)
- Torch (high light output but small, floating or tethered)
- Sludge measuring device (Sludge Judge, PVC pipe with marked graduations and filled ends)
- Measuring tape and measuring wheel
- Dye for checking flow paths. More than one colour is good (e.g. Fluorescein and Rhodamine)
- Bucket(s)
- Sample bottles for water quality sampling (plastic, sterile, and preserved sterile for chlorine treated effluent)
- Permanent marker for marking samples
- Free residual chlorine test kit and pH strips
- Nessler's reagent or alternative (detects ammonia rich water)
- Turbidity tube
- Imhoff cone or equivalent (activated sludge plants)
- Dissolved Oxygen (DO) and nutrient (N and P) test kits

Inspection Equipment Checklist Example

(See Section 3.1)

Access

- Basic tools – screwdrivers, sockets, multi-grips, shifters, hammer etc.
- Battery drill or impact driver
- Crowbar, wrecking bar, hook, lid lifter, shovel

Access

Tracing Flows

- Fluorescein or other dyes for checking flow paths
- Nessler's reagent or similar tests (detects ammonia rich water) (WHS considerations)

Sludge and Scum Accumulation

Sludge Judge

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Imhoff Cone - Sludge Volume Index

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Sampling

- Sampling pole (extendable)
- Sample containers
- Esky and ice
- Field sampling record sheet/s
- Sharps container
- Disposable gloves (non-powdered)
- Field testing meters

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Sampling

- Consult individual laboratories for advice on sample bottles (type, number, volume of sample)
- Clearly label each sample bottle (location, time, date, sampled by) and complete the laboratory Chain of Custody form
- Keep laboratory samples at ~4°C (i.e. esky on ice) and deliver / analyse as soon as possible
- Only suitably trained staff should undertake field sampling following sampling protocols

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Testing and Monitoring for Compliance and Enforcement

- Where an on-site system is suspected of causing harm to human health or the environment, rigorous testing and monitoring of wastewater or environmental parameters may be necessary
- Monitoring will focus on the parameters required to provide evidence for compliance and enforcement actions (evidence of non-compliance, extent or confirmation of pollution, clean up requirements)

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Testing and Monitoring for Compliance and Enforcement

- Simple indicators may be sufficient to get compliance (tracing flows using visual indicators, faecal contamination testing, ammonia detection)
- Where further investigation is required, use of the Australian & New Zealand *Guidelines for Fresh & Marine Water Quality* website is recommended https://www.waterquality.gov.au/anz-guidelines
- Where a local jurisdiction has their own guidelines for water sampling, these should be followed

Testing and Monitoring for Compliance and Enforcement

- Testing and monitoring can provide evidence of conformance with conditions of consent, i.e. final effluent quality or quantity
- Environmental parameters will depend on the receiving environment and may require additional sampling from 'background' locations too
- A sampling program should be developed prior to sampling being undertaken, to gather comprehensive and effective data

Testing and Monitoring for Compliance and Enforcement

- Possible indicators for wastewater or effluent contamination are:
  - Physical contaminants in direct discharge (pieces of food, sanitary wastes)
  - Tracing flows with visual indicators (dye)
  - Presence of ammonia rich water
  - Tracing flows with chemical markers
  - Faecal coliforms (FC) (E. coli)
  - Viral indicators (e.g. human mastadenoviruses)

Monitoring On-site Systems

- Monitoring is essential when the performance of a system must be accurately quantified (problem identification or verification of the performance of a new / emerging technology)
- Rigorous monitoring of wastewater quality and quantity requires a significant amount of time and resources
- Programs to measure the specific treatment efficiency of a particular component must include monitoring of both influent and effluent

Sampling Programs

- Careful consideration is required when selecting sampling location, time, frequency and parameters for analysis
- Domestic wastewater is subject to significant temporal variation. Grab samples are only a snapshot of performance
- Grab samples can be useful when conducting compliance testing of multiple systems
- Composite sampling can allow assessment of average wastewater quality over a period

Sampling Programs

- Realistically, only situations with significant legal / market implications or a high risk of impact will justify greater focus
- It is important to recognise that effluent quality data does not automatically provide an accurate diagnosis of system performance

Monitoring Parameters

Hydraulic Load

- Hydraulic load should be measured at the same frequency as bio-chemical data
- Data loggers are preferred, water meter readings may be adequate (excluding external water use)

Household Behaviour

- Note the timing of wastewater generating activities (e.g. laundry, showers)
- Identify chemical inputs (products)

Monitoring Parameters

Faecal Coliforms (FC)

- FC bacteria, commonly Escherichia coli (E. coli), are used as an indicator of faecal contamination, likelihood of other pathogens and indicator of disinfection effectiveness
- FC are not a definitive proof of sewage in the environment, as they are also present in animal faeces
- FC concentrations will vary with the level of treatment

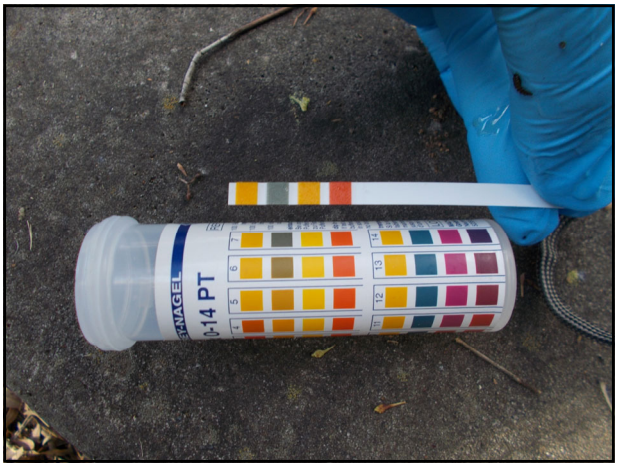
Monitoring Parameters

pH

- System pH should be kept between 6.0 and 9.0. Wide / frequent fluctuation of pH is detrimental to processes (reduced solids settleability / micro-biological activity)
- Environmental pH depends on local environment

Electrical Conductivity

- Conductivity increases as the proportion of ions in solution increase



Monitoring Parameters

Biochemical Oxygen Demand (BOD_5)

- BOD_5 is an indication of organic matter in water
- High BOD_5 is indicator of poor aerobic treatment

Total Suspended Solids (TSS)

- Includes suspended organic and inorganic material
- High TSS loads can have a detrimental effect on downstream processes (e.g. disinfection) and cause blockages in land application areas

Monitoring Parameters

Turbidity

- Is an indication of system performance that can be measured in the field
- Useful to assess if disinfection will be effective:
  - For effective disinfection by UV, turbidity should be <1 NTU
  - For effective disinfection by chlorine, turbidity should be <5 NTU, but preferably <1 NTU.

Monitoring Parameters

Phosphorus (P)

- Typically found in one of three forms in domestic wastewater: orthophosphate (e.g. PO_4^{3-}, HPO_4^{2-}); polyphosphate (e.g. $P_2O_7^{4-}$) and organic phosphate
- Orthophosphates are readily available for biological metabolism, while poly and organic phosphates must first undergo some form of conversion

Monitoring Parameters

Nitrogen (N)

- N is found in three forms – organic, ammoniacal and oxidised
- Total Kjeldahl Nitrogen (TKN) is the concentration of organic N and ammoniacal N. These forms of N are dominant in anaerobic effluent
- TKN should be <20mg/L in any clarification chamber (continuous or intermittent operation)
- If TKN is >20mg/L the aeration period is not sufficient to create conditions for nitrification / denitrification

Monitoring Parameters

Nitrogen

- Total Oxidised Nitrogen (TON) is the concentration of nitrate (NO_3) and nitrite (NO_2)
- Need to look at specific forms of N when monitoring a system to gain an understanding of treatment efficiency

Monitoring Parameters

Dissolved Oxygen (DO)

- DO can be used to assess the efficiency of most secondary treatment processes
- Secondary treated effluent should generally have a high DO (>2mg/L), but >4mg/L can be too high
- But… be careful, DO can fluctuate significantly within very short periods
- DO will not be consistently maintained in an intermittently operated AWTS and STS – measure TKN if air is off

Monitoring Parameters

Other Parameters

- Total Oil and Grease (TOG)
- Surfactants (MBAS - methylene blue active substances)
- Chemical Oxygen Demand (COD)
- Free Residual Chlorine (FRC)
- Volatile Suspended Solids (VSS)

Interpretation of Results

- It is not always advisable to assess the results of monitoring against regulatory standards in isolation
  - Consider the resolution of the data (i.e. the suitability of sampling frequency and duration)
  - Consider temporal variation (e.g. hydraulic load / peak pollutant periods)
  - Consider potential external impacts on readings (sampling errors, rainfall, higher than average pollutant inputs)

Typical Treatment Performance

Parameter	Septic Tank	Secondary[1]	Advanced Secondary[2]
BOD_5 (mg/L)	140-200 (180)	5-50 (20)	5-15 (10)
TSS (mg/L)	30-100 (80)	5-50 (30)	5-15 (10)
Faecal Coliforms (cfu/100ml)[3]	10^6-10^8	10^3-10^4	10^1-10^3
TN	40-100 (60)	15-50 (30)	10-50 (20)
TP	5-15 (10)	5-10 (8)	5-10 (8)

Source: USEPA Onsite Wastewater Treatment Systems Manual 2002.

Note 1: Traditional package plants and reed beds with no disinfection.

Note 2: Sand filters, some biofilters and textile filters.

Note 3: Secondary or advanced secondary effluent can achieve faecal coliform concentrations <100cfu/100ml with active disinfection.

STS Effluent Quality AS1546:2017

TABLE 2.2

EFFLUENT COMPLIANCE CRITERIA FOR AN STS WITH NUTRIENT REDUCTION FACILITIES

Parameter	Secondary effluent with reduced nutrients		Advanced secondary effluent with reduced nutrients	
	90% of samples	Maximum	90% of samples	Maximum
BOD_5	≤20 mg/L	30 mg/L	≤10 mg/L	20 mg/L
TSS	≤30 mg/L	45 mg/L	≤10 mg/L	20 mg/L
*E. coli**	≤10 cfu/100 mL	30 cfu/100 mL	≤10 cfu/100 mL	30 cfu/100 mL
FAC	Minimum 0.5 mg/L†	N/A	Minimum 0.5 mg/L†	N/A
Turbidity	N/A	N/A	N/A	5 NTU
Total N‡	N/A	15 mg/L	N/A	15 mg/L
Total P‡	N/A	2 mg/L	N/A	2 mg/L

* Where disinfection is required.

† Minimum level, not 90% of samples.

‡ In alignment with NZ OSET NTP 'A grade' nutrient reduction capabilities.