Welcome to 'Monitor and Control Maintenance of Wastewater Collection and Transfer Assets’, a unit in the course Certificate III in Water Industry Operations (Civil).

- Each screen has an activity.
- Each activity is supported with three tabs, called Instructions, Mentor Advice and Resources.
- Click each of these tabs to learn more.

Over the next 60 minutes you will work through a series of screens.

Click the mentor advice tab at any time to get advice on what you need to learn to complete an activity.

Our thanks to Tyco for sponsoring these E-Learning materials.
In this topic you will learn how to:

- Analyse asset condition and determine action
- Plan and prepare for asset repair
- Control and monitor work activities

Please note that some of the references to legislation in this course are Queensland specific.

In this topic you will:

- Complete various on-screen activities
- Receive advice from a mentor
- Watch videos and listen to audio
- Read procedures and other documents.
At the end of this topic, you will sit a review. This is for learning purposes only and does not count towards your formal assessment.

This training is based on the competency unit called "Monitor and Control Maintenance of Wastewater Collection and Transfer Assets (NWP335B)". This unit is part of the qualification called Certificate III in Water Industry Operations. Check out the list of Certificate III units in the Resources section. (Note: after 2011 the unit NWP335B will be replaced by NWP303A)
Instructions
Mentor Advice

It’s important to report all asset failures so that future asset failures can be predicted and appropriate measures put in place.

Resources

Maintenance Schedules and prediction of faults are based on historical data.

If an asset fails, it is not necessary to analyse associated data to look for a pattern of asset performance.

Data should be collected through original construction and maintenance reports on fault attendance.

Date of construction, type of asset, location, load on system, associated fittings and corrosion are all primary criteria for predicting asset failure.

Resources

Index  Glossary  Help

© Commonwealth of Australia 2011

National Water Training
Collect and analyse data

Mentor Advice

Asset inspections should reveal whether;
- the network is operating normally
- maintenance is being conducted at regular intervals or there are reoccurring items
- indicators of repair and maintenance show that repair or maintenance is required
- there are obvious leaks, corrosion or physical damage

Question: Would you determine the asset to be in good condition?

- Yes, if there are no reported faults and it is properly functioning, the asset is in good condition.
- No, although there are no reported faults and the asset is functioning, the physical damage and corrosion may indicate possible leaks or further deterioration leading to malfunction.

© Commonwealth of Australia 2011

National Water Training
Asset Condition Question 1

Scenario: You arrive at an asset (a wastewater pipeline), and can see that it is functioning properly. There is obvious corrosion and physical damage. However, there have been no reported faults and it is easily accessible.
**Asset Condition Question 2**

**Scenario:** You have arrived at a site to assess the condition of another wastewater asset.

**Question:** What are the two main aspects of asset condition you need to take into consideration?

- [ ] Visual and structural
- [ ] Operational and structural
- [ ] Operational and flow
- [ ] Design and flow

**Mentor Advice**

Check out the Mentor Advice and Resources tabs. When you are done, click Next to continue with another question about asset condition.

**Asset Condition Question 3**

**Scenario:** You conduct a visual inspection of the asset (wastewater pipeline) to assess its condition.

**Question:** Which of the following could be some of the primary signs of failure? (you can select more than one)

- [ ] Exfiltration around valves, pipes and manholes
- [ ] Reduction in flow rate
- [ ] Deterioration of chamber walls
- [ ] Sinkage along the line of the main

**Mentor Advice**

Check out the Mentor Advice and Resources tabs. When you are done, click Next to continue.
Scenario: You have determined an asset requires repair and will need to consider the priority of that repair.

Priority of repair is a combination of importance and urgency.

Urgent items do not pose any health or safety threats, threaten integrity of the asset or cause serious quality defects.

Important repairs will improve long term or short term effectiveness and reliability or prevent further deterioration of the asset or are required by regulatory or similar bodies.

Repairs that are both urgent and important are not a high priority.

You have been asked to prepare for a repair of a wastewater asset that requires a pipe section replacement. Review the table on maintenance and repair costs and consider what costs you will need to take into account.

### Costing Maintenance & Repair

<table>
<thead>
<tr>
<th>Assets</th>
<th>Labour (L)</th>
<th>Time (t)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fittings &amp; Pipes (F)</td>
<td>Cost of F + L</td>
<td>t hours</td>
<td>Multiply L x t + F</td>
</tr>
<tr>
<td>Construction (C)</td>
<td>Cost of C + L</td>
<td>t hours</td>
<td>Multiply L x t + C</td>
</tr>
<tr>
<td>Repair (R)</td>
<td>Cost of R + L</td>
<td>t hours</td>
<td>Multiply L x t + R</td>
</tr>
<tr>
<td>Plant + Operator (P)</td>
<td>Cost of P</td>
<td>t hours</td>
<td>Multiply P x t</td>
</tr>
<tr>
<td>Truck &amp; Disposal (T &amp; D)</td>
<td>Cost of T + D</td>
<td>t hours</td>
<td>Multiply T x t + D</td>
</tr>
<tr>
<td>Restoration (S)</td>
<td>Cost of S + L</td>
<td>t hours</td>
<td>Multiply L x t + S</td>
</tr>
<tr>
<td>Traffic Control (TC)</td>
<td>Cost of TC</td>
<td>t hours</td>
<td>Multiply TC x t</td>
</tr>
<tr>
<td>Report/Evaluation (E)</td>
<td>Wastewater Operator</td>
<td>t hours</td>
<td>Multiply P x t</td>
</tr>
</tbody>
</table>

Sub-total (ST) = 10% Multiply ST x 10%

TOTAL (ST + G)
Scenario: There are different approaches to scheduling asset repair. Have a go at matching the types to the definitions.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive maintenance</td>
<td>A maintenance approach that uses maintenance intervals to plan taking the item off line for maintenance at a specific time. It is useful when the cost of failure or having the item off line is high, the cost of maintenance is low or the item is a critical item, with no standby, but time can be found when it is convenient to have it off line.</td>
</tr>
<tr>
<td>Programmed/preventative maintenance</td>
<td>A modern approach that seeks to gather and analyse relevant data to make a prediction as to when an item needs maintenance. It is useful for lowering the cost of maintenance and improving plant availability.</td>
</tr>
<tr>
<td>Proactive maintenance</td>
<td>A type of maintenance undertaken whenever the equipment breaks down, or otherwise ceases to fulfill its function. It is useful when the cost of failure is not high, the item is not a critical plant item or there is standby equipment which can be readily brought on line to replace the broken-down item.</td>
</tr>
</tbody>
</table>

For low cost repairs to non-critical equipment, developing repair plans is usually quite simple. For critical assets or asset items which would interfere with the normal running of the collection or transfer system if they were offline, planning needs to be more detailed.

The first step is determining the importance and urgency of the job. The next step is to find people who can do the job in the timeframe and work out how long the job will take.
**Scenario:** After a thorough inspection of several wastewater assets, you determine that there are the following defects requiring action: pump fault, blockage, pipe section replacement.

**Question:** Which are you more likely to be able to respond to immediately? (may select multiple)

- Pump faults
- Blockages
- None of them
- Pipe section replacement

**Scenario:** You have determined that a defect needs to be addressed at a later date.

**Question:** Which of the following factors should you consider in determining when to undertake follow up action?

- The likelihood of the defect affecting recorded quality data
- The possibility of the defect endangering the public, environment or other assets
- When the next scheduled inspection is
- All of the above
The use of a jet rodder is the preferred method. Ensure that you have detailed plans, maps and instructions for the job at hand.
Check the area against the detailed plan and identify/locate relevant manholes and inspection outlets and determine flow directions and identify issues.

Can be used for noting all defects. Measurements are recorded accurately and data collected to enable future rehabilitation of the pipe and to locate any immediate defects.
An effective method of detecting illegal connections, defects and other sources of infiltration.

---

Used to assess the following to determine any follow up maintenance or repair:
- physical condition of manhole cover
- rim for adequate sealing
- condition of manhole walls
- condition of base
- seals
- benches condition
- condition of inlet and outlet etc.
Wastewater Maintenance Jobs

Instructions
- Sewer Cleaning
- Sewer Blockages
- CCTV Survey of Sewers
- Smoke Testing of Sewers
- Manhole Inspections
- Overflow Cleanup

Assess environmental, health and safety impacts and follow relevant organisational procedures for containment.

Resources

Typical Wastewater Asset Repairs

Instructions
- Sewer Patching
- Pipe Section Replacement
- Sewer Junction and Jump up Replacement

Suitable for most repairs of cracked, broken or dislocated sewer pipelines. Can be an inexpensive 'no-dig' solution.
Gibault joints with an insert of PVC pipe may be used for sewer risers or gravity PVC mains. Stepped rubber adapters are used for vitreous clay sewer gravity mains.

Replacement PVC pipe is used, the pipe ends are primed with RED primer and glued with BLUE adhesive or other suitable joining method (depending on the pipe type).
Inspect Materials and Equipment

**Scenario:** A wastewater operator has monitored the utilisation of hand tools, vehicles and PPE required to complete the job. He has found a non-conforming piece of equipment, he has taken it out of service and placed it back in the truck and obtained a replacement calibrated item.

**Question:** What crucial task has the wastewater operator failed to complete?

- [ ] Nothing
- [ ] Tell the nearest worker
- [ ] Tag the item ‘unserviceable’
- [ ] Attempt to fix the item himself

---

Monitor Repairs to ensure compliance

Certain performance standards have been established to ensure that the water authority’s provision of water and wastewater services deliver value for money and are tailored to meet the needs of customers, community and government. Your organisation’s standards will contain compliance criteria for:

- standards of service
- operating standards
- repair standards
- reporting standards

---

It is recommended that you access your organisation’s Standards to learn more about compliance criteria and how they apply to maintenance and repair works.
Complete maintenance and repair records

It is not enough to just monitor the quality of the repair and maintenance work being done, it is important to also monitor the progress according to the plan. Keeping an accurate record of progress to plan and overall time to do a job helps with planning for the next time that particular job needs to be done.

So not only should maintenance repairs be monitored, but the result of that monitoring should be recorded in a useful way. The recording should be done in the manner required by your organisation.

Great work, you have completed Unit NWP355B - Monitor and Repair Maintenance of Wastewater Collection and Transfer Assets. Now it's time to review your learning. When you click Next you will be presented with a series of questions to check your knowledge.

If you are totally confident, start your quiz now. But if you are unsure of anything, use the Back and Next buttons to review your learning first. Oh, and good luck!
Question 1 of 8

Routine asset inspections describe a coordinated schedule often based on historical performance information used to systematically plan maintenance of wastewater collection and transfer assets.

True  False

Submit ▸

Question 2 of 8

Question: Which of the following are primary criteria for predicting asset failure?

- Date of construction
- Load on System
- Associated fittings
- All of the above

Submit ▸
Question: Which of the following would be items requiring urgent attention?

- Something that poses a health or safety threat
- Something that threatens the integrity of the asset
- Something that can cause serious quality defects
- All of the above

When reviewing asset condition, only the operational condition needs to be considered, not the structural.
Reactive maintenance is used when an item breaks down or ceases to fulfill its function.

True False

Question: When recording the details of defects what should you include? (there may be more than one correct answer)

- The nature of the defect
- The cause of the defect (if known)
- The expected consequence of not rectifying the fault
- All of the above

Submit
It is not important to consider environmental impact by putting in place measures for controlling spills, sediment etc.
Your Score: 32%

Great work, you have completed: Unit NWP355B - Monitor and Repair Maintenance of Wastewater Collection and Transfer Assets.

You can now select EXIT to end the program or use the Back button to review the course.
Resources

**Wastewater Collection and Transfer Assets - Refresher**

Effective design, installation and operation and maintenance of wastewater infrastructure and the investigation and monitoring practices of water industry workers are critical to safeguarding public health, community well-being and protection of the environment.

**Wastewater systems:**
Three (3) main areas:

1. Property connections
2. Collection systems
3. Wastewater treatment plants

**Property Connections:**
- Comprise all the house-drains or pipes that transport wastewater from each house, shop, building or factory to the reticulated sewer mains.

**Wastewater collection systems:**
- These comprise the network of underground pipes and manholes (sewers) and pumping stations that transport the wastewater to the treatment plants
- Pipes can be made of:
  - Brick, vitreous clay;
  - Concrete, asbestos cement;
  - Cast iron, steel, ductile iron (cement lined);
  - Polyvinyl chloride, polyethylene, GRP
- A hydraulic gradient allows wastewater to drain naturally through pipes and manholes by gravity but with a minimum critical velocity to ensure organic solids and silt do not settling out.

**Pumping stations:**
- Are needed to lift wastewater to a higher level. They pump the wastewater through a rising main to a discharge manhole, gravity then transports it to the next pump station or a treatment plant.

**Flow in a wastewater reticulation system**

Three (3) factors that govern the flow of reticulated wastewater are:

1. Gravity flow (Hydraulic Gradient)
2. Pump stations (pump and pipe size)
3. Vacuum stations (pump and pipe size)

- Wastewater that flows from a property is transported in pipes on a downhill grade by means of gravity (hydraulic Gradient)
- While the wastewater flow depends largely on gravity, in most cases the wastewater cannot be transported for the entire distance by gravity to the treatment plant.
- The system is designed so that the flow drains into either a pumping station or a vacuum station.

**Wastewater Treatment Plant**
- The wastewater is delivered to a treatment plant where it is treated to a licence standards to enable it to be either discharged or re-used without causing environment harm
- The main options for discharge of treated wastewater (effluent) are the ocean, watercourse or recycled for beneficial use (irrigation).
Collect and Analyse Asset Data

System Information

It is important to conduct a visual inspection of the area in which the wastewater main is located and confirm information on ‘as constructed’ plans and service diagrams.

Any departures from the recorded details should be noted and checked with Network Services information management personnel.

In particular, the distances to valves, between manholes, structures and other features should be measured during a physical inspection to verify their correct location.

Visually inspect all wastewater mains and their component markers to confirm the pipeline assembly and the type and location of markers are as specified in the water authority’s Standards and Specifications.

In accordance with the organisation’s quality management system, the line manager responsible for the inspection will:

- use a checklist to ensure that nothing is missed or forgotten
- review the performance records
- review quality documentation for operational performance standards.

Schedule and Conduct Routine Inspections

The requirements for routine inspections and monitoring will be specified in organisational documents such as SOPs. These will provide the methodology and chronological order for the completion of all routine inspections. SOPs are developed in response to various state and federal legislative requirements.

Routine Asset Inspections

A coordinated schedule based on historical performance information is the most effective method of systematically planning to maintain wastewater collection and transfer assets.

This information is generated through a database and entered into an asset management program to produce work orders, job numbers, job cards or work dockets.

These series of work orders are the prompt for maintenance to be scheduled and resources to be allocated. These are filed by asset number and compile all information on fault frequency, repair undertaken and year commissioned.

The asset management system allows any impact from other assets to be identified. This, together with fault reporting presents a complete picture of trouble spots (i.e. locations with features at risk of failure or areas with a history of successful asset management).

By monitoring, fault reporting and scheduling regular maintenance checks, the optimum lifetime of the asset can be achieved.

As work dockets are completed, data from them is entered into the database to form a record of all the information necessary to plan and schedule repairs.
Based on historical information entered into the database, the original construction information and maintenance information, the database can be analysed to look for possibilities of failure. For example, we may deduce that, statistically, there is a significant probability that a certain section of the main in a particular area is likely to fail; this may be because it is subject to greater stresses, because of environmental impacts, or because of original construction materials.

**Identify and assess potential hazards**

A competent person must conduct a risk assessment to identify all hazards, assess the risk, develop and implement control measures relating to a particular job (this may also include forming a contingency plan). All works must be completed in accordance with organisational safe work method statements and standard operating procedures.

**Other Utilities**

Notify ‘Dial Before You Dig’ and obtain plans of other utility services in the area of works. Do a visual inspection for surface fittings and overhead conductors. Remember to protect all underground services, for example:

- de-energise power if possible
- use tiger tails for sight awareness
- use a spotter if digging in the vicinity of fibre optic cables.
**Asset Condition**

Because maintenance schedules and the prediction of faults are based on historical data, it is important to collect and analyse data accurately. Data is collected through original construction and maintenance reports and fault attendance.

If an asset fails, we analyse its associated data looking for a pattern of asset performance. Details about its material, date of construction, fittings and manufacturer, as well as the point of failure are all recorded. If you were able to dissect a failed asset, you would be able to determine how and why it failed. It is difficult to predict asset failures, however, when there are no reported failures.

Wastewater operators are now better educated and are aware of the importance of reporting faults and analysing causes; these are things that may not have been performed very well in years gone by.

Age may not be the primary reason for failure, and therefore, we should not regard age alone as an indicator of high maintenance requirements in the absence of supporting data. For example, there are sections of wastewater mains that were constructed many years ago where no faults have occurred but other sections laid in the last forty years have had to be replaced.

The primary criteria for predicting failure are:

- date of construction
- type of asset
- location
- associated fittings
- corrosion
- load on the system
- Material type

**Asset Condition**

The asset is said to be in good condition if there have been no reported faults; if the asset is also easily accessible and functioning normally. This broad description can be illustrated by inspection of valves, manholes and pipework by the use of CCTV.

When selecting construction materials for these types of assets, it is important to recognise the practical application of the device, the potential frequency of operation, and the potential environmental impact on the device.

Failures, such as blockages and burst pipes can have great impact in terms of asset and property damage, environmental harm. Better predicting these failures can result in significant savings for the network budget and minimise environmental and customer impact.

**Signs of potential failure**

The primary signs of potential failure are:

- exfiltration around valves, pipes and manholes
- reduction in flow rate
- deterioration of chamber walls (corrosion)
• sinkage along the line of the main
• Odour

Looking for indicators such as those above, the maintenance crew in the area will conduct some physical and visual tests, including lifting of manhole lids, visually inspecting the general area and responding to customer concerns.

The following table lists some assets that can be accessed, the tests that can be performed and the indicators of potential failures.

**Analysing data on asset condition**

There are two main aspects to asset condition:

• operational condition
• structural or other condition.

Inspections should reveal whether:

• network is operating normally
• maintenance is being conducted at normal intervals or there are recurring items
• indicators of repair and maintenance (as noted in operating procedures, service manuals or manufacturer’s specifications) show that repair or maintenance is required
• there are obvious leaks, corrosion or physical damage.

Collecting and recording all this data is important so that it can be analysed for trends and patterns, including excessive repetition of items.
Determining Priority of Repairs

Analysis should also give an indication of the priority of the repair. Priority is a combination of importance and urgency.

**Urgent** items are those which:

- pose a health or safety threat
- pose an environmental or licence to operate threat
- will cause serious quality defects
- threaten the integrity of the asset or process
- Pose a major customer impact.

**Important** items are those which:

- will improve the long- or short-term effectiveness of collection of transfer assets
- will improve the reliability of the asset or process
- are required by regulatory or similar bodies
- will prevent further deterioration of the asset or process.

Using this approach, we can rationally distinguish what must be done now (urgent AND important) from what needs to be done, but can wait for a more convenient time (important only). Things which are neither urgent nor important can be deferred even longer. Things which are urgent but not important (will not improve the fault) should be queried as to their benefit and possible alternative options.

If your experience to date does not allow you to make urgency and importance judgements which will be accepted by others, then the best approach is to discuss these with a range of relevant stakeholders to get a consensus view.
Approaches to Scheduling Maintenance and Repair

There are several schools of thought as to the correct way to schedule maintenance. The choice between them usually comes down to risk management: 'the one that minimises the risks and costs is the one we use'. The maintenance schedules can be summarised as:

- breakdown/reactive maintenance
- programmed or preventative maintenance
- proactive maintenance.

Breakdown Maintenance

As the name implies, breakdown maintenance is done whenever the equipment breaks down, or otherwise ceases to fulfil its function.

We all use breakdown maintenance for some things. For example, at home we usually only change light bulbs when they no longer work.

Breakdown maintenance is good when:

- the cost of failure is not high
- the item is not a critical plant item
- there is standby equipment which can be readily brought on line to replace the broken-down item.

Keeping in mind that failure of wastewater systems can lead to both customer and environmental impacts and may lead to a failure to meet environmental or legislation obligations it is important to consider breakdown maintenance as a last option.

Breakdown maintenance is often practised for some plant items.

Scheduling breakdown maintenance is easy: do nothing until it breaks down and then get it done ASAP.

Programmed or Preventative Maintenance

Programmed or preventative maintenance takes a different approach. Programmed maintenance says that it is not acceptable for an item to fail, and it is better to take the item off line for maintenance at a known time. Programmed maintenance estimates the service interval and then undertakes the planned maintenance at that time whether the item needs it or not. This is similar to servicing your car every 10,000 km. Lubrication is often done to a programmed maintenance schedule.

Programmed maintenance is good when:

- the cost of failure or having the item off line is high
- the cost of maintenance is low
- the item is a critical item, with no standby, but time can be found when it is convenient to have it off line.

Maintenance intervals for programmed maintenance are often determined from the manufacturer’s recommendations or from an analysis of past failures or CCTV assessments.
Programmed maintenance is common for some maintenance items.

Scheduling programmed maintenance is a matter of determining the required maintenance frequency (for instance, from the maintenance manual), getting an estimate of how long it will take (maintenance manual again, or records from last time it was done) and then working out the most convenient time to schedule this near when it is required. Scheduling is best done in liaison with production personnel and with knowledge of the times when the plant is most likely to be operating below capacity.

**Proactive Maintenance**

Proactive maintenance is a modern approach and covers a range of specific maintenance methods which will be covered in more detail below.

The general concept of proactive maintenance accepts that neither breakdown nor preventative maintenance is ideal. For instance, a major disadvantage of the programmed maintenance approach is that plant is made not available by being shut down for maintenance when it could have continued functioning perfectly well for a while. So proactive maintenance seeks to gather relevant data to make a prediction as to when an item needs maintenance. This can have the effect of lowering the cost of maintenance while improving plant availability. However, proactive maintenance does require greater effort in collecting and analysing data to make the decisions. This monitoring and collecting of data may be done automatically. Some of the concepts and approaches are summarised here.