

Key Requirement

**Managing
risk**

Working in Excavations

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Purpose

The purpose of this Key Requirement is to set out Watercare's minimum controls to reduce the risks from working in excavations and to help managers and contractors reduce these risks.

All Watercare's managers must ensure that work is planned in accordance with these controls and ensure that the tools and resources are used by workers. All Watercare's workers must ensure that they follow the processes and controls for work in and around excavations, including using the appropriate equipment.

Background

Excavation work generally means removing soil or rock from a site to form an open face, hole or cavity, using tools, machinery or explosives. It is an important stage in the construction of most of Watercare's assets and is sometimes required for maintenance of existing assets. Excavation work includes:

- open excavations
- potholing
- pit excavations
- trenches and retaining walls
- shafts and drives

Excavation failures are particularly dangerous because they may occur quickly, limiting escape, especially if the collapse is extensive. The speed of an excavation collapse increases the risk with this type of work. The consequences are significant as the falling earth can bury or crush any person in its path, resulting in death.

Excavation work can also cause damage to services, with consequential risks of injuries to workers or people nearby. Hazards and risks associated with underground and overhead services should be addressed in the planning and design stages. In the first instance, contact the service owner for advice prior to starting any work.

WorkSafe has published good practice guidelines for working in excavations¹. This Key Requirement requires compliance with these guidelines and describes their specific application to Watercare's operations.

¹ Excavation Safety: Good Practice Guidelines (2016) <http://construction.worksafe.govt.nz/assets/guides/WSNZ-Excavation-Safety-GPG.pdf>

Responsibilities

All workers	<ul style="list-style-type: none"> Attend training courses as required by Watercare or its contractors Comply with the specified controls for working in excavations, as communicated in standard operating procedures, job safety analyses, and Toolkit meetings Use excavation protective equipment according to manufacturer's directions and risk controls imposed by Watercare
Supervisors	<ul style="list-style-type: none"> Monitor workers to ensure they understand and comply with the risk controls for working in excavations, as communicated in standard operating procedures, job safety analyses, and Toolkit meetings
Tier 4 Managers	<ul style="list-style-type: none"> Attempt to eliminate the need to work in excavations, using the hierarchy of risk controls For work in excavations that cannot be eliminated, ensure that workers are isolated from the hazard, as far as reasonably practicable For work in excavations that cannot be eliminated or isolated, ensure that workers are provided with appropriate protective equipment; that safe methods of work are planned, communicated and implemented; and that workers have been trained and understand the use of this equipment Monitor sites and projects to ensure that work is appropriately planned, that workers have adequate equipment and training and that work is being carried out in compliance with this Key Requirement
Tier 2, 3 Managers	<ul style="list-style-type: none"> Monitor sites and projects to ensure that this Key Requirement is understood by Tier 4 managers, supervisors and workers
Health and Safety Advisors	<ul style="list-style-type: none"> Assist Tier 4 managers to understand the controls in this Key Requirement Monitor sites and projects to ensure that work is appropriately planned, that workers have adequate equipment and training and that work is being carried out in compliance with this Key Requirement
Health and Safety Manager	<ul style="list-style-type: none"> Monitor the implementation and effectiveness of this Key Requirement and report to the senior management health and safety committee Recommend any further actions or changes required to ensure adequate management of the risks of working in excavations

Chief Executive
Officer

- Review reports of the implementation and effectiveness of this Key Requirement and report to the Board

Planning

Planning involves identifying the hazards, assessing risks and deciding suitable controls in consultation with everyone involved in the work, including other PCBUs, designers and workers. Planning must consider the site factors, the hazards and the unique characteristics of the site. The nature of the excavation work will affect the selection of an excavation method and a safe system of work. The ground conditions will have a significant impact on what excavation method to select and the controls to use. Other risks associated with excavation work, including any connected work such as construction, must also be controlled.

The first part of planning must consider whether excavation hazards can be eliminated, e.g. with the use of trenchless technology or low-vibration techniques.

A safe system of work must be developed before excavation starts so that the excavation happens in the right location with the right plant and equipment and with competent workers.

Careful consideration must be given to the hierarchy of controls when work is being planned. This will apply to work carried out by Watercare and work that is contracted out to other PCBUs. When contracting out work, the following steps should be carried out:

- scope the work to identify the key health and safety issues before the work is put out to tender
- ensure that the tendering contractors are competent to safely complete the required work
- negotiate health and safety requirements when the contractor is selected
- set out key risk controls used by Watercare in the contract documents
- monitor the contract to ensure that risk controls are being implemented effectively
- complete a review after the contract for any learning that can be applied to future contracted work

Planning considerations²

² Excavation Safety: Good Practice Guidelines (2016) Page 21 <http://construction.worksafe.govt.nz/assets/guides/WSNZ-Excavation-Safety-GPG.pdf>

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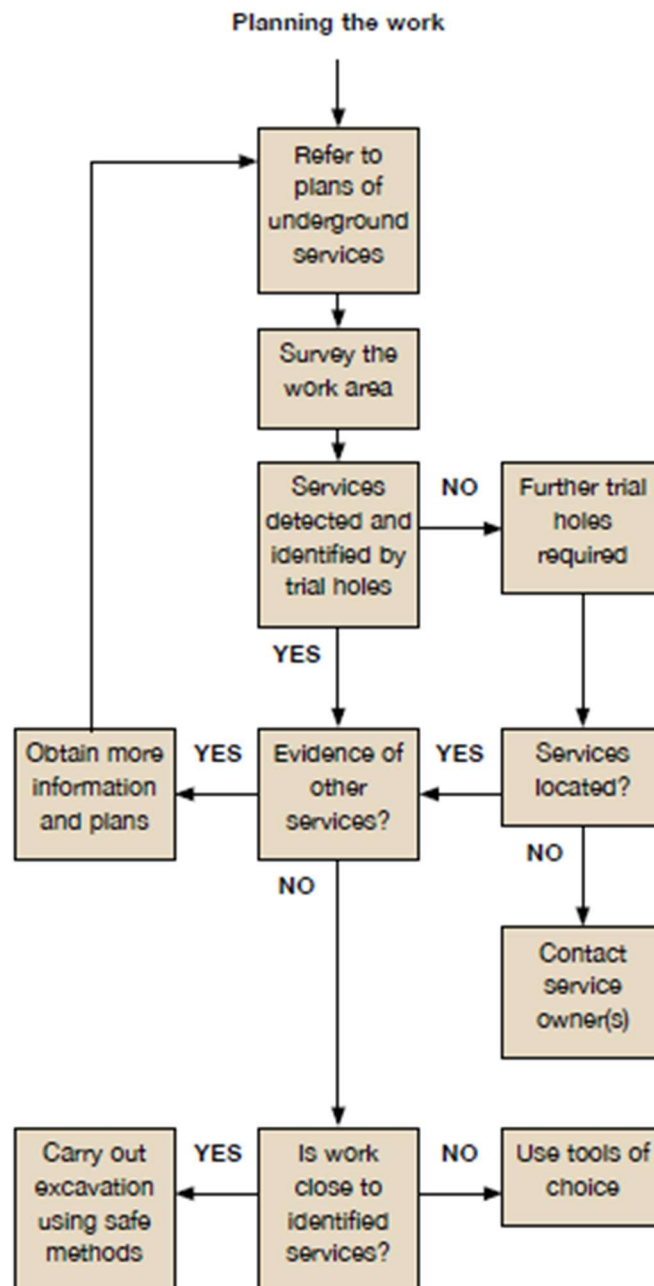
Site issues	Possible factors	Minimum considerations
Ground conditions	<ul style="list-style-type: none"> • Soil types • Stability • Ground water • Other soil and rock properties • Potential for seismic hazards (such as fault rupture, liquefaction and rock fall) 	<ul style="list-style-type: none"> • Inspecting to find out what might affect the stability of the excavation (an excavation face can appear stable for 24 hours, but may in fact be unstable) • Weather conditions • De-watering plan • Confirming whether or not it is a Hazardous Activities and Industries List (HAIL) site • Testing soil and water
Site conditions	<ul style="list-style-type: none"> • Surcharges • Underground and above-ground services • Ground slope • Adjacent buildings and structures • Water courses (including underground) • Trees • Local weather conditions • Environmental conditions • Proximity to existing trench lines 	<ul style="list-style-type: none"> • Checking if you are working on a HAIL site through local authorities • District planning and resource consent requirements • Works access permits • Consent from service owners • WorkSafe notifications
The excavation	<ul style="list-style-type: none"> • Excavation depth • Length of time the excavation will be open • Ground support • If excavation may be classified as a confined space • The planned height of the excavated face • If there will be other construction activity nearby that may cause vibration 	<ul style="list-style-type: none"> • Static and dynamic loads near the excavation • Consulting a competent person • Deciding on a support solution • Identifying all existing overhead and underground services • Managing pedestrians and traffic with a traffic management plan (TMP) <p>Securing barriers or fencing to keep members of the public and other site workers away from the excavation site</p>

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Work methods	<ul style="list-style-type: none">• Specialised plant or work methods required (e.g. ground support)• The methods of transport, haul routes and disposal• What exposures might occur, such as noise, ultraviolet rays, falls or hazardous chemicals• Workers will need to follow good practice for confined spaces safety• Number of workers involved• Possibility of unauthorised access to the work area• Safe access and egress	<ul style="list-style-type: none">• Implementing a safe system of work or safety management system• Identify hazards and assess and control risks• Build in interaction with other trades• Adequate facilities• Emergency procedures• Accident and incident procedures• Contractor management• Testing and checking for plant equipment and materials requirements• Inducting and training all workers• Exclusion zones where powered mobile plant will operate
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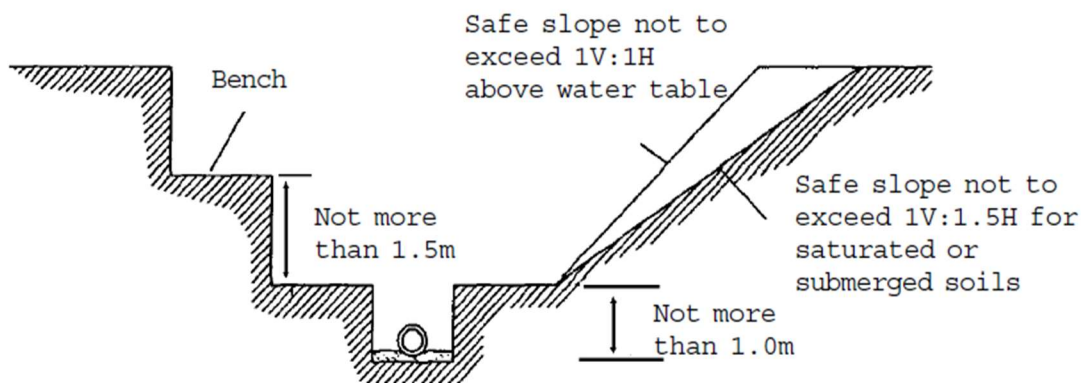
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All excavation work involving a trench greater than 1.5 metres deep will be considered a confined space.

Excavations greater than or equal to 1.5 metres deep must be shored unless:

- the face is cut back to a safe slope and the material in the face will remain stable under all anticipated conditions of work and weather
- shoring is impracticable or unreasonable and safety precautions certified by a Registered Engineer have been taken



Hazardous conditions

Planning considerations should include:

- finding out about the current use and ground history of the work site before assessing any risk
- investigating and testing if a dangerous atmosphere will be present or is likely to be present
- determining if any live services, proximate water courses or isolation failures could cause sudden flooding of the excavation
- changes in conditions during work (i.e. disturbing sediment)
- the geology

Utility services

Hazards and risks associated with underground and overhead services must be considered in the planning and design stages. Services should be considered as present until it is proven that they are not there. In the first instance, the service owner must be contacted for advice prior to starting any work.

Before any excavation takes place, workers should know what is underground and what is overhead.

Nearby buildings and structures

Excavation work may seriously affect the stability of any structure near the excavation. This may lead to structural failure or ground collapse depending on the site's condition.

The excavation's zone of influence on the stability of any nearby structure must be considered during planning.

The excavation must not remove any nearby structure's ground support.

Securing the work area

Site security should consider all risks to workers and others. The work activity's boundary should be established before securing the work area. Each work activity may be smaller than the whole workplace, so as each work activity moves, its boundary moves with it. As the work boundary moves, risk to workers and others outside the work activity must be minimised as far as reasonably practicable.

Managing traffic

Traffic must be managed while the work takes place with a temporary traffic management plan (TMP). All work on a road or work that affects the normal operating condition of a road must have an approved TMP.

If excavations are to take place on or near a road, approval must be obtained from Auckland Transport or NZTA.

The TMP should show how the excavation will be protected so work can go ahead safely for workers and others. The TMP should show how traffic (including cyclists and pedestrians) will negotiate the site, e.g. what lanes will be closed by the work and how. If the site will be unattended, a separate TMP also covering the protection of any excavations by backfilling, plating or fencing must be prepared.

Confined spaces

Hazard identification and risk assessment during planning must identify whether the excavation is a confined space under certain conditions. If the excavation meets the definition of a confined space, then this must be managed in compliance with Watercare's Key Requirement for Entering and Managing a Confined Space.

Risk controls

The following risk controls have been developed using the bow-tie method (Appendix B)

Top events	Collapse of excavation, falling into excavation, service strike	
<u>Prevention controls</u>	Engineering	<ul style="list-style-type: none">• All excavations ≥ 1.5 metre to be shored unless the face is cut back to a suitable slope not greater than 45 degrees above horizontal or benched at a rate of not greater than 1 metre high by 1 metre deep or be certified by a qualified engineer that alternative safety precautions are adequate• Installation of adequate accessways (e.g. scaffold stairs, ramps)• Installation of solid barrier > 2 metres from edge• Physically fenced off exclusion zones• Installation of shoring, shields or benching and battering• Installation of bunds• Tents or covers• Water diversion• Mechanical ventilation• Isolation of services• Adequate lighting• Installation of non-slip materials

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	Administrative	<ul style="list-style-type: none"> • Geotechnical report including site history, soil sampling • Standard operating procedures/permit to work/job safety analyses//Toolkit meetings setting out safe method of work, including weather monitoring, gas detection, mark-out of services • Project manager trained to NZQA 24918 • Signs warning of risk • Scheduled preventative maintenance and routine inspections of equipment • Annual recertification of equipment • Supervision • Inspections and monitoring • Defect reporting
	PPE	<ul style="list-style-type: none"> • Appropriate non-slip footwear
<u>Recovery controls</u>	Engineering	<ul style="list-style-type: none"> • Installation of de-watering system • Stabilise buildings • Back-up ventilation systems
	Administrative	<ul style="list-style-type: none"> • Standard operating procedures/job safety analyses//Toolkit meetings requiring the use of a spotter • Rescue/emergency response plan and training for working in excavations in compliance with WorkSafe Excavation Safety Good Practice Guidelines • All excavation works in remote areas must ensure effective means of communication
	PPE	<ul style="list-style-type: none"> • Fall arrest in compliance with AS/NZS 1891 and WorkSafe Best Practice Guidelines for Working at Height in New Zealand (page 24) • Lifeline • Soft landing system in compliance with PAS 59:2004

Prevention

Engineering controls

Weak, saturated or otherwise unfavourable ground can have a significant effect on the construction and performance of an excavation. If excavation work is planned without shoring, the continuing safety of the excavation will depend on the conditions arising during construction. If the conditions during construction are not as expected, or if conditions change during the course of the work (e.g. different soils, heavy rain) immediate action must be taken to protect workers and other people.

There are three main types of controls to prevent ground collapse. One or more of the following controls should be used to support all sides of the excavation:

- benching and battering is the horizontal stepping or sloping of the face, side or wall of an excavation
- shoring prevents collapse by maintaining positive pressure on the sides of the excavation
- shields do not ensure ground stability but protect workers from ground collapse by preventing the collapsing material falling onto them

Benches should be wide enough to stabilise the slope to prevent spoil falling into the excavation. They should also be sloped to reduce the possibility of water scouring.

Shoring should extend above ground level if practicable, or if not practicable, then at least to ground level, e.g. where covers may need to be placed over the excavation at night. If the shoring does not extend to at least ground level, the excavation should be benched and battered and the shoring must be capable of taking the surcharge load.

A combination of controls may be most effective, depending on the work environment and characteristics of the excavated material. In built-up areas or streets, the excavation may have to be sheeted or supported to prevent collapse due to vehicle movement and vibration.

Any loads near the excavation can cause collapse. Any excavated material and external actions applying a load to the ground nearby can affect the excavation's stability through the zone of influence. This zone is normally from the base of an excavated face to the surface. The zone's angle will depend on site-specific factors. Mechanical plant, vehicles, spoil, or heavy loads should not be in the zone of influence plus 1 metre from an excavation unless specific design can show it can support the surcharge load.

Safe access and egress for all workers must be provided at all times. The floor of the excavation must be clear of anything that would impede workers' escape in an emergency.

Workers and others nearby can be killed or seriously injured by striking services that are overhead or underground. Good planning and supervision should identify and anticipate all overhead and underground services, which will help decide what activities will be allowed near the excavation work.

Plans, mark-outs, locators and safe digging practices must be used when working near buried services. Mobile plant

³ See Page 51 of WorkSafe Good Practice Guidelines for Excavations. <http://construction.worksafe.govt.nz/assets/guides/WSNZ-Excavation-Safety-GPG.pdf>

operators should be informed of:

- any overhead and underground services in the vicinity
- marked-out underground services (It should be assumed that all services are live or in use unless the service owner formally advises in writing there are no risks with the service.)
- how far the mobile plant can reach
- minimum approach distances (MADs).

Techniques that should be used to minimise risk include:

- use water or air vacuum methods to expose congested services (with the service owner's permission)
- dig pilot holes progressively towards the services ahead of small-step excavations
- be aware that water under pressure around electric cables with worn sheaths or old joints may cause an electrical hazard
- use one or more spotters to spot obstacles or any signs of services in the excavation. Make sure spotters are a safe distance from any plant movement but are still able to see and warn the operator
- excavate as if expecting the unexpected
- excavate alongside the services with suitable side clearance

All engineering controls must have current inspection certificates attached to the equipment and must be erected by a competent person.

Administrative controls

Before any item of plant or equipment is put into operation, managers must:

- ensure that the work has been planned appropriately. A planned method for work in excavations should be contained in:
 - a standard operating procedure for work that is routine and of low residual risk
 - a permit to work and a job safety analysis for work that is moderate to high residual risk
- provide all workers who are to use plant and equipment with information, training, instruction or supervision to ensure compliance with the planned method of work
- ensure that all reasonably practicable steps to prevent harm from falling objects (e.g. tools, materials, lanyards, tool belts, PPE) have been taken

The condition of soil surrounding excavations can change quickly when the soil dries out, the water table changes or water saturates the soil. A competent person should frequently check the soil condition and the

Appendix A: Definitions

Terminology	Description
Angle of Repose	The angle to the horizontal at which the material in an excavation cut face is stable and does not fall away
Battering	Means to form an angled excavation face, usually less than the natural angle of repose, to prevent ground collapse
Benching	The horizontal stepping of an excavation face
Cleat	A small block of timber or other substantial material fixed across a member to provide strength and support and to prevent the movement of abutting timbers
Excavation	Any human-made cut, cavity, trench or depression in the ground that is formed by the removal of material
Excavation Exclusive Zone	A zone clearly marked with barriers or hoardings to prevent unplanned access of equipment, vehicles, materials or personnel into or close to the excavation
Face	An exposed sloping or vertical surface resulting from the excavation of material
Filling	Any ground made up of imported material
Frame	Timber or steel used in shafts in a horizontal plane to support the poling boards and resist any ground pressure from shaft walls
Laths	Short lengths of material, usually about 1.25 to 1.5 metres long, used to support the sides of walls and roofs in a tunnelling drive and supported in turn by walings, props, sets or caps
Prop	A vertical timber member used to support a higher waling or strut from the one below
Raker	An inclined strut

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Ramp	A sloping surface to give access and egress from one level to another
Safe slope	The steepest slope at which an excavated face is stable
Sheeting	Vertical timber boards or steel trench sheets placed against the face of an excavation to give it support and held in place by struts and walings
Shoring	The use of timber, steel or other structural material for the purpose of providing effective and adequate temporary support for an exposed face of an excavation
Soldier	A vertical timber or steel member taking the thrust from horizontal walings and supported by struts
Strut	A timber or steel member usually horizontal in compression, resisting thrust or pressure from the face or faces of an excavation (Steel struts are provided with end plates, with corners that are turned to form claws. They are adjustable.)
Trench	A long narrow excavation made below the surface of the ground
Trench shield	A steel-framed box with two vertical side plates permanently braced apart by cross frames or struts to provide a safe working place for employees while work in an excavation is being carried out
Unstable ground (soil)	Earth that because of its nature or the influence of related conditions cannot be depended on to remain in place without extra support, such as through shoring

Appendix B: work in excavations bowties analysis

Appendix C: References

Auckland Council (1999), Erosion and Sediment Control: Guidelines for Land Disturbing. TP90.

<http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/plansstrategies/unitaryplan/Documents/Material%20incorporated%20by%20reference/upmirbcpuncilt90erosionandsedimentcontrol.pdf>

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