



Engineering

Technical Standard

TS 0632 - Minimum Requirements of Geotechnical Investigations and Reports

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Only the current revision of this Standard should be used which is available for download from the SA Water website.

Significant/Major Changes Incorporated in This Edition




This is the first issue of this Technical Standard.

Document Controls

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Approvers

Role	Signature and Date
Responsible Discipline Lead Principal Engineer, Dams and Geotechnical Dr Moji Kan	6/07/2021 X  ----- Signer's Name Signed by: ES003424
Manager Engineering Quality and Innovation Matthew Davis	6/07/2021 X  ----- Signer's Name Signed by: DA003681
Senior Manager Engineering Richard Gray	6/07/2021 X  ----- Signer's Name Signed by: GR001964

Reviewers

Role	Name	Revision	Review Date
Geotechnical Engineer	Vivek Venkiteswaran	1.0	25/05/2021
Senior Engineer, Dams & Geotechnical	Paul Maisano	1.0	31/05/2021
Senior Engineer, Geotechnical	Jake Elphick	1.0	02/06/2021
Senior Engineer, Dams	Nick Wenzel	1.0	03/06/2021
Construction Services Manager	Tim Ingram	1.0	11/06/2021
Industry Review	Jordan Neis-Beer (Tonkin)	1.0	10/06/2021

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1 Introduction

SA Water is responsible for operation and maintenance of an extensive amount of engineering infrastructure.

This standard has been developed to assist in the design, maintenance, construction, and management of this infrastructure.

1.1 Purpose

The purpose of this standard is to detail minimum requirements of geotechnical investigations and reporting for SA Water assets and projects, to ensure that assets covered by the scope of this Standard are constructed and maintained to consistent standards and attain the required asset life.

1.2 Glossary

The following glossary items are used in this document:

Term	Description
AHD	Australian Height Datum
ATV/OTV	Acoustic and Optical Televiwer in borehole logging
CPT	Cone Penetration Test
DCP	Dynamic Cone Penetrometer
GDA	Geocentric Datum of Australia
GPS	Global Positioning System
MERIDIAN	SA Water Drawings Management System
NATA	National Association of Testing Authorities, Australia
SARIG	South Australian Resources Information Gateway
SA Water	South Australian Water Corporation
SPT	Standard Penetration Test
TG	SA Water Technical Guideline
TS	SA Water Technical Standard

1.3 References

1.3.1 Australian and International

The following table identifies Australian and International standards and other similar documents referenced in this document:

Number	Title
AS 1170.4 (2007)	Structural design actions, Part 4: Earthquake actions in Australia
AS 1289 (Multiple Documents)	Methods of testing soils for engineering purposes
AS 1726 (2017)	Geotechnical Site Investigations
AS 2159 (2009)	Piling – Design and Installation
AS 2566.1 (1998) AS 2566.2 (2002)	Buried flexible pipelines - Part 1 (Structural Design) and Part 2 (Installation)
AS 2870 (2011)	Residential slabs and footings
AS 3798 (2007)	Guidelines on Earthworks for Commercial and Residential Developments
AS 4678 (2002)	Earth Retaining Structures

1.3.2 SA Water Documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

Number	Title
Sewer Construction Manual (SCM)	Sewer Construction Manual Drawings
TG 0631 to TG 0641	SA Water Geotechnical Guidelines
TS 0100	Requirements for Technical Drawings
Water Supply Construction Manual (WSCM)	Water Supply Construction Manual Drawings

1.4 Definitions

The following definitions are applicable to this document:

Term	Description
SA Water's Representative	The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): <ul style="list-style-type: none"> • Superintendent's Representative (e.g. AS 4300 & AS 2124 etc.) • SA Water Project Manager • SA Water nominated contact person
Responsible Discipline Lead	The engineering discipline expert responsible for TS0632 defined on page 3 (via SA Water's Representative)

2 Scope

This Technical Standard covers the minimum requirements of geotechnical investigations and associated reporting of the outcomes of these investigations for SA Water projects.

3 Introduction

Geotechnical investigations for SA Water projects, in all stages of project development, design, and construction, shall comply with the minimum requirements as described in this document.

The required scope of works is to be undertaken in accordance with AS 1726-2017: Geotechnical site investigations and further requirements of the present Standard.

A site-specific risk assessment for health, safety and environmental impacts is to be developed for the project, including the geotechnical investigations aspects, to ensure adequate controls are in place to minimise the risks.

4 Aim of Investigations

The geotechnical investigations should be informed by the ultimate user of the information (e.g., designer, constructor, etc.) so that the investigations report can meet the requirements of the ultimate user.

The common geotechnical investigation aims might include all or some of the following items:

- To establish the stratigraphic subsurface ground profile (within and/or beyond the project footprint),
- To identify geologic structures, present within the area of concern,
- To determine the presence and depth of groundwater, groundwater variation and potential for perched groundwater sources,
- To develop a geotechnical ground model (suitable for concept and detailed design or as otherwise required by SA Water); and
- To determine engineering properties of the soils and/or rocks encountered.

The aims of the geotechnical investigations shall be clearly identified in the scope of works, well captured during investigations, and appropriately documented in the geotechnical investigation reports.

5 Desktop Review of Available Information

A thorough search of relevant publicly available published information and online data such as SARIG and WaterConnect, as well as information within SA Water archives shall be undertaken in all geotechnical investigations. This search needs to be undertaken to identify if there is any available geotechnical data for the site, e.g., in the historical drawings, investigation reports, or any other geotechnical information such as construction photographs that might show the ground conditions or the foundation of the assets in the area of interest.

The geotechnical engineering firms that undertake the investigations for SA Water projects are strongly recommended to be familiar with SA Water standard drawings, technical standards, and technical guidelines, including but not limited to the Water Supply Construction Manual (WSCM), Wastewater Construction Manual (SCM), and Technical Guidelines on geotechnical engineering (TG 0631 to TG 0641).

It is expected that in the case of SA Water brownfield sites, the historical drawings of the existing assets will be thoroughly reviewed as part of the desktop assessments, to understand

the geotechnical conditions of the site and to make sure that all available information at the time of original construction is captured in the updated geotechnical assessments.

Any geotechnical information that is found needs to be thoroughly reviewed as part of the desktop assessments.

The desktop assessments should be undertaken prior to undertaking the field investigation, as hitherto unknown issues could be discovered during the information review that may be able to be confirmed or discounted as part of the field works. The desktop assessments outcomes shall also be reported in the investigation reports.

6 Field Investigations and Laboratory Testing

Site investigations should be sufficient to provide information for the design of the proposed works at the site, such as but not limited to pipelines, pump stations, storages, tanks, and any associated earthworks, or to gain general understanding about the geotechnical engineering condition of the assets, and conform to the applicable standards, including, but not limited to:

- AS 1726 Geotechnical Site Investigations
- AS 1289 Methods of testing soils for engineering purposes
- AS 2159 Piling Design and Installation
- AS 2566 Buried flexible pipelines (Parts 1 and 2)
- AS 3798 Guidelines on Earthworks for Commercial and Residential Developments.
- AS 4678 Earth Retaining Structures

The field investigations shall comply with the following requirements:

- All investigation points (i.e., boreholes and test pits) need to be located in accordance with the proposed borehole/test pit location plan (subject to access constraints and service clearance as per the note below).
- Prior to commencement of borehole drilling or test pit excavation, appropriate measures should be taken to prevent striking an underground or overhead utility, including but not limited to:
 - Dial Before You Dig online submission,
 - Consultation with landowner/operator,
 - Maintaining safe clearances from overhead power lines, and
 - Non-intrusive service location using Electromagnetic Induction and/or Ground Penetrating Radar.
 - If applicable, permits regarding proximity of work to essential service assets.
- All boreholes are to be progressed using a suitably selected drilling technique to obtain required soil and rock samples to the target depth of the borehole. This may involve the use of continuous sampling methods or any other required methods (e.g., U50s) to obtain undisturbed samples, depending on the requirements of the scope of works.
- If there is a probability of early refusal prior to the target depth, this matter should be communicated with the SA Water Representative prior to mobilisation and required techniques such as hollow auger or sonic drilling should be used to advance the hole until target depth.
- Standard Penetration Tests (SPTs), if specified in the scope of works, should be undertaken at maximum 1.5 metre intervals within all boreholes in accordance with AS 1289.6.3.1.
- Pocket Penetrometer tests are to be conducted on cohesive soil samples to estimate material consistency.

- All fieldwork activities are to be supervised by a suitably experienced and qualified engineering geologist or geotechnical engineer.
- Materials encountered are to be described in accordance with AS 1726 Section 6.
- Materials retrieved from the boreholes are to be placed in core boxes, labelled clearly, and photographed, as per AS 1726 requirements. Photographic evidence should be presented in the geotechnical reports.
- Test pits should be photographed with a depth scale and a photo of the test pit and the spoil should be presented in the geotechnical reports.
- Where groundwater is encountered, the depth intersection and any change in groundwater depth are to be recorded, with time stamps.
- Material samples to be collected for laboratory testing are to be clearly labelled and logged with a unique reference number immediately after being taken. The moisture content of the samples should be retained during transportation to the laboratory.
- All investigation locations are to be surveyed to the GDA94 or GDA2020 grid and for level to the Australian Height Datum. Levels in both depth below the surface format and mAHD format should be provided on all borehole / Test Pit logs and DCP test results. A survey with 0.1m accuracy (horizontally and vertically) is the preferred approach, but a GPS survey might also be acceptable if the accuracy is proved to be suitable and accepted by the SA Water Representative.
- If specified in the scope of works, the qualifications of the drilling subcontractor who is proposed for borehole drilling (including their past experiences in similar jobs and their performance in SA Water projects) is subject to review and acceptance by SA Water prior to commencing the site investigation.
- If specified in the scope of works, the engineering geologist(s) or geotechnical engineer(s) proposed for site supervision, logging and reporting are subject to review and acceptance by SA Water prior to commencing the site investigation and reporting.
- If specified in the scope of works, SA Water should be informed of the scheduled site investigation a minimum one week prior to commencing the site investigation such that there is the opportunity for a SA Water geotechnical engineer to attend, observe the site investigation and confirm scope of works compliance.

The backfilling details of all boreholes and test pits shall be clearly recorded and described in the reports. Boreholes that are drilled in embankment dams or their footprints shall be backfilled with a cement-bentonite grout, placed in stages of no more than 5 m in height. The consistency of the grout once set should be similar to that of the material into which it is being placed. The contractor should provide a proposed mix design to the SA Water Representative for approval. It is recommended to undertake a trial mix to understand the consistency of the proposed mix after drying and to confirm its similarity with the consistency of the embankment material.

Where undisturbed sampling is required for laboratory testing (e.g., triaxial testing), appropriately sized tubes in accordance with testing standards should be made available, and the samples should be properly protected from impact damage and/or drying out.

Moreover, no drilling fluid is to be used to advance any boreholes located within earth dams and their footprint. The footprint of earth dams is defined in Clause 4.3.1 of TG 0641. In dams related projects, consistency and moisture content for each encountered material shall be identified and clearly included in the borehole and test pit logs.

7 Reporting

The minimum requirements of SA Water geotechnical reports are summarized below. These minimum requirements are applicable to factual reports but shall also be covered as a minimum in all interpretive reports.

The geotechnical report shall include all supporting calculations that have been used to prepare a geotechnical model for the site.

All available data collected during the geotechnical investigations shall be provided in a geotechnical report. At a minimum, the geotechnical report should include:

- An outline of the investigation scope,
- An index/ register of all reference resources gathered / used and or referenced and inclusion of documents used in the investigations,
- A description of the site conditions,
- A discussion of the anticipated regional soil, geology, and hydrogeology,
- A description of the investigation methodology,
- Tabulated coordinates for the surveyed investigation locations,
- Site and test location figures/plans,
- A discussion of the overall soil, rock, and groundwater conditions, with reference to the borehole and test pit logs, laboratory test results and the regional geology,
- Comments on uniformity and strength of materials and ground conditions likely to be encountered and highlight any areas where adverse ground conditions may impact design,
- Comments on the likelihood of encountering groundwater or wetter/weaker/collapsing materials,
- Engineering borehole and test pit logs and core tray photographs,
- Tabulated summary/schedule of the laboratory testing undertaken,
- Laboratory test certificates, all to be conducted and reported by NATA accredited labs,
- CPT results/certificates,
- Fence diagram(s) showing the longitudinal soil profile along the alignment if applicable,
- Tables and/or graphics presenting geotechnical information relevant to the project, such as:
 - All test results, i.e., with summarizing the test certificates in the body of the report,
 - Field test results with depth including, DCP, SPT 'N' values, and pocket penetrometer readings,
 - Laboratory classification information including the percentages of gravel, sand, clay (i.e., finer than 425 μm , 75 μm , etc.),
 - Atterberg Limits, Field Moisture Content with depth,
 - Confined compression test value with depth,
 - Shrink-swell tests with depth.
- Engineering properties for materials encountered, including unit weight, undrained shear strength, effective cohesion, effective friction angle, drained elastic modulus, undrained elastic modulus, and Poisson's Ratio,
 - Geotechnical parameters for design of the assets, such as (if applicable):

- Horizontal bearing capacity,
 - Vertical Bearing capacity,
 - Bearing capacity (longitudinal and lateral loading) of piles and pile groups,
 - Soil modulus of the native soil for design of pipelines, and
 - Any other geotechnical parameters that the civil or structural designer will require for their design, as per the approved scope of works.
- Recommendations for excavatibility and safe batter angles for excavations,
 - Recommendations for earthquake classification, as per AS 1170.4,
 - Discussions about any residual geotechnical risks that may impact the ongoing design, construction, or maintenance of the project,
 - Recommendation for site classification based on soil reactivity as per Section 2 of AS 2870.

Tabulated or graphical summaries shall consider the inferred geological unit where appropriate for clear presentation of the data.

Note that soil descriptions in the borehole logs, the laboratory test certificates, and all other occasions in the report shall be consistent and comply with AS1726 descriptions. This may require revisiting the boreholes and test pits logs after the laboratory test results are received to make sure about the consistency, plasticity, soil description and moisture contents. The need for revising the borehole and test pit logs also applies to any other post site investigations works, e.g., revisiting the borehole logs after interpretation of the ATV/OTV surveillance of the boreholes are undertaken in the office.

8 Geotechnical Drawings

The geotechnical investigations that involve any field works shall lead to preparation of geotechnical engineering drawings as per the requirements of Table 1. The level of details of the geotechnical engineering drawings depends on the total value of the project or its risk level as per SA Water advice in the scope of works. These drawings can be prepared by the designer based on the geotechnical report and be presented to SA Water as part of main drawing set for the project.

The geotechnical engineering drawings shall be prepared in SA Water templates, using relevant standards and templates, including TS0100. The drawings shall comply with requirements of TS0100 and to be prepared to be ultimately stored in SA Water Drawings Management System, MERIDIAN.

Table 1: Minimum requirements of geotechnical drawings

Project Type	Drawing Requirements
All projects	A plan view showing the location of all boreholes, test pits, and investigation points on the site, with clear references to the filename, title, and date of the corresponding geotechnical investigation report to find more details about the results of geotechnical investigations
Any project greater than \$1M, any project with Medium and higher risk level*, or if deemed required by SA Water Representative	A summary of each borehole and test pit log showing the general stratigraphy, e.g., as a table, or preferably in graphical representation
All projects greater than \$5M, any project with High risk level*, or if deemed required by SA Water Representative	A high-level geotechnical model of the site, comprised of a plan view and required cross-sections.
*: The risk level is defined in the scope of works, or nominated by SA Water Representative, based on discussions with SA Water Engineering	

9 Review of the Reports

The geotechnical report shall be provided in draft format to SA Water for review. The duration of the review should be communicated and agreed with SA Water as part of project initiation. The contractor should provide sufficient detail in the report (i.e., methods and calculations) to allow for the review to proceed.

A final report shall be submitted addressing comments that were made during the review. The review process and required time for addressing the comments should be allowed for by the contractor, in their time schedule and their pricing.