City of KINGSTON

Basements and Deep Building Construction

Guidelines 2014

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Contents

1. Purpose of the Guidelines

The purpose of the Underground Structure Guidelines (2014) is to describe the processes which the City of Kingston utilizes to manage construction of underground structures within the municipality.

The Underground Structure Policy states the approach, tools, principles and procedures that Council will follow in order to manage underground structures to ensure consistent, equitable and transparent outcomes are achieved.

2. Scope

The Guidelines apply to all properties in the City of Kingston. This includes all Private, Council and Government owned properties that have basements, underground car parking or other below ground structures.

3. Background

In recent years, the prevalence of underground basement structures as part of new building developments has increased in Kingston.

4. Related Documents

a) Basement and Deep Building Construction Policy (2014)

b) Local Government Act 1989 – Section 200

c) Water Act 1989 – Section 7

d) AS/NZS 2890.1 – Off Street Car Parking

e) Kingston One Vision, Council Plan 2013-2017

f) Kingston Council Civil Design Requirements for Developers : Part A

g) Kingston Flood Mitigation Strategy

h) Kingston Integrated Water Cycle Strategy

i) Kingston Construction Management Plan Guidelines 2014

5. Definitions

a. ***Acid Sulfate Soils*** – means naturally occurring soils, sediments or organic substrates that are formed under water logged conditions which contain iron sulphide minerals or related oxides. These soils commonly occur within Kingston.

b. ***Aquifer*** – means a geological structure or formation or an artificial land fill permeated or capable of being permeated permanently or intermittently with water.

c. ***Stormwater*** – refers to water that runs off all urban surfaces such as roofs, foot paths, car parks, roads, gardens and vegetated open spaces and is captured in constructed storages and drainage systems. This excludes roof water captured directly by rainwater tanks, water captured in natural rivers, creeks, streams and lakes, and water sourced from private dams for primary production purposes.

d. ***Groundwater*** – refers to any water occurring in or obtained from an aquifer and includes any matter dissolved or suspended in any such water.

6. Technical Issues

There are many technical issues associated with the construction of underground structures.

6.1. Groundwater Management

Background

Groundwater is an important part of the water cycle, contributing to the replenishment of downstream water bodies. Consideration needs to be given for groundwater before, during and after construction.

Soil profile

Before construction it is necessary to consider the chemical composition of the groundwater on site. This will aid in choosing an appropriate material for construction. It is recommended that a geotechnical investigation be undertaken prior to any design or construction work commencing. This investigation should determine the soil structure at the site and the level and flow regime of groundwater beneath the site. A minimum of 3 locations on site should be investigated to allow triangulation of results to determine flow direction and hydraulic gradient.

Construction Phase

During construction, it is common practice to pump groundwater to drawdown the water table below the level of construction. This is typically not an issue with regard to groundwater equilibrium, as it is not sustained for long periods. However, it may cause problems in areas containing acid sulfate soils. Exposure to oxygen can lead to a change in chemical composition in the soil, creating sulphuric acid. After construction has been completed, pumping ceases and the water table rises to its previous level, where it then becomes contaminated by the acidic soil. Coastal Acid Sulfate Soils are prevalent in Kingston.

Design

The design of the structure is particularly important when considering the long-term performance requirements. Wet basement designs require ongoing pumping to remove water from the structure, leading to high costs and energy requirements. These designs are typically considered unsustainable. Tanked designs eliminate the need for pumping, but require more detailed design to take into account hydrostatic forces that will act on the structure. They can also lead to long-term changes in the groundwater equilibrium position.

Siting

The location of the development is also an important factor. Sites close to the coast may be susceptible to saline intrusion of groundwater if there is long-term pumping. This contaminates the groundwater over time, leading to environmental problems. Local flora may not be able to survive with the increased levels of salinity. It may also lead to other problems, such as increased rates of corrosion in structures, due to the higher concentration of salts.

Extraction

Consideration should be given for the disposal of any groundwater that is extracted. As mentioned previously, exposure to oxygen can cause changes in chemical composition that may be detrimental to the natural ecosystem. This should be investigated prior to reuse or reinjection of groundwater. Possible sources of local site contamination, such as greywater used for garden watering, should also be investigated. All sources, including those likely to occur in the future, should be given consideration.

Under relevant legislation, Council is not required to accept groundwater discharge to the stormwater system. Discharging groundwater to the stormwater drain reduces the capacity of the drain to handle rainfall events, and can lead to excessive flooding. Groundwater may be discharged to a wastewater drain under a relevant trade waste agreement with the local sewer authority.

6.2. Soil Properties

Groundwater management is closely linked to soil structure. Changes in the water table can lead to changes in soil properties, particularly soil strength or bearing capacity, and consolidation, whereby the soil compacts due to removal of pore water.

Consolidation is a key issue that may lead to severe structural damage. Depending on the soil properties, it is possible for different areas to consolidate by different amounts. This can lead to damage due to excessive shear forces. The effect may also extend to neighbouring properties, depending on the amount of groundwater being removed. Investigation of soil properties should be undertaken prior to any pumping.

Coastal Acid Sulphate Soils are widely spread in Kingston. Removal of groundwater from this type of soil profile, under certain conditions can cause contamination of the vicinity. For this reason a comprehensive analysis of the soil properties may be required as part of a GMP.

6.3. Underground Construction Techniques

There are several different methods of basement construction; however most will fall into the category of wet or dry (tanked).

6.3.1 Wet basement

Wet basements typically have a slotted subsurface drainage collection system on the outside of the wall to collect groundwater and relieve hydrostatic pressures. This is usually collected into pits that are pumped out. Since the water in this type of system is groundwater, Council has no obligation to accept this to the legal point of stormwater discharge.

Risks associated with this type of construction include the potential for large amounts of groundwater being collected in the drainage system. . If discharged to the street network, this will overload the system. This water is not stormwater and must be disposed of on site or via a trade waste agreement reached with the local sewer authority. Other risks are those associated with changes to the local water table level. This may cause subsidence in adjacent properties.

Closed systems to re-inject the groundwater back into the water table are acceptable however Kingston has many areas of ground water with high levels of organic fines which may not make this method practical.

6.3.2 Dry (Tanked) Basement

A tanked basement is considered waterproof and is designed to withstand the hydrostatic pressures of a saturated soil. Waterproofing agents are applied to the concrete during construction to prevent ingress of water. Concrete is often sprayed onto the walls, similar to a swimming pool construction. This type of design requires no groundwater collection and is the preferred method of construction by Council.

6.3.3 Retaining Walls

Retaining walls are an engineered method of holding soil at unstable angles to create or protect usable spaces. Most retaining walls rely on the soil behind the wall being drained in a similar way to a wet basement.

Kingston allows the drainage retaining walls to be connected to the Legal Point of discharge if all of the following requirements are met:

- the retaining wall is less than 1.0m high or
- has a small upstream catchment (less than 200m^2)
- does not intercept a groundwater table
- is not within 2m of an existing dwelling

Alternatively retaining walls should be designed to withstand hydrostatic pressures and constructed using appropriate materials.

6.3.4 Soil Management

Stockpiling of excavated materials must be conducted to best practice guidelines, especially in areas of Coastal Acid Sulphate Soils. Leachates must be prevented from contaminating the environment.

For further guidelines relating to this issue, refer EPA Victoria Publication 655.1:2009.

6.3.5 Dewatering

Dewatering is considered to be when groundwater or surface water is removed from a construction site. Dewatering has the potential to cause a range of issues with local groundwater regimes and must be treated the same as a wet basement.

If dewatering is required during the construction process only, a temporary Trade Waste Agreement will be required to discharge to the sewer network. South East Water have information about how this can be arranged.

7. Groundwater Requirements

All proposed works in Kingston that involve dewatering or excavation for any form of underground structure requiring a Building Permit will need to prepare a Groundwater Assessment Report. The Senior Development Engineer at the City of Kingston is responsible for deciding if a Groundwater Management Plan is required.

7.1. Groundwater Assessment Report

The Groundwater Assessment Report contains the findings of an initial site investigation. The Groundwater Assessment Report must be produced by a suitably qualified Hydro-geologist. This helps determine if detailed investigation is required to develop a Groundwater Management Plan.

The following must be reported as a minimum:

- Depth to water table

- Recharge characteristics of water table
- Presence of contaminated soils
- Presence of contaminated surface water
- Presence of contaminated groundwater
- Salinity level of groundwater
- Potential for underground structure to interact with the groundwater flow regime
- Proximity to nearby structures and how they may be affected by the proposed works.

7.2. Groundwater Management Plan

Properties where the GAR indicates there may be issues with groundwater are required to submit a GMP prior to approval of a building permit. The Groundwater Management Plan must be produced by a suitable qualified Hydro-geologist.

The GMP must include the following:

- Summary of findings of GAR
- More detailed information on local hydrogeology, including flow rates
- Chemical composition of groundwater, including–
    - presence of ions
    - pH level
    - electrical conductivity
    - presence of organic/inorganic compounds
    - presence of nutrients
    - presence of microbiological organisms
- Proximity to nearby structures
- Soil properties
- In the case of contamination, remediation measures to be undertaken prior to any construction
- Potential for consolidation due to extraction of groundwater
- Measures to be employed to manage interference to groundwater

  Sufficient detail should be provided as to the measures to manage groundwater interference to demonstrate that such measures will provide acceptable performance.

- Options for the disposal or recycling of any groundwater to be extracted
- How the existing groundwater regime will be maintained
- An ongoing monitoring program to determine any impacts the structure will have on the groundwater regime
- Contingency plans for substandard performance of groundwater management measures

7.3. Construction Management Plan

Development issues that are affected as part of the Basements and Deep Building Policy will be required to be listed in the approved Construction Management Plan for the particular site. Any non-conformance will be subject to the enforcement provisions of the Construction Management Policy.

8. Traffic and Safety

Underground car parking requires consideration for vehicle access. Sufficient length should be provided to allow a comfortable grade on the access ramp. Sightlines,

grades, clearances and dimensions should also comply with relevant standards (AS/NZS 2890.1 – Off Street Car Parking). Sightlines are particularly important to ensure the safety of pedestrians that may cross the driveway.

The design of the vehicle crossing into the property is also important for flooding protection. Developers may be tempted to lower the level of the crossing to allow for gentler ramp grades. This is not a recommended practice, as it can lead to flooding problems during rainfall events. A lowered vehicle crossing allows stormwater to flow from the gutter into the driveway and basement. A raised vehicle crossing acts as a levee, preventing this.

Kingston City Council reserves the right to nominate an apex height for the highest point of the basement access ramp to prevent stormwater inundation of the property from adjacent land. The reduced level provided by Kingston may affect the floor levels of the proposed structures and should be considered early in the design process.

8.1. Key Design Standards

The following design standards are excerpts from AS/NZS 2890.1 Off Street Car Parking. They are provided here as a guide to the minimum design requirements that should be addressed. The complete AS/NZS 2890.1 document should be referenced for the full design requirements.

Table 3.1 – Selection of Access Facility Category

Class of parking facility (see Table 1.1)	Frontage road type	Access facility category				
		Number of parking spaces (Note 1)				
		<25	25 to 100	101 to 300	301 to 600	>600
1, 1A	Arterial	1	2	3	4	5
	Local	1	1	2	3	4
2	Arterial	2	2	3	4	5
	Local	1	2	3	4	4
3, 3A	Arterial	2	3	4	4	5
	Local	1	2	3	4	4

NOTES:

1 When a car park has multiple access points, each access should be designed for the number of parking spaces effectively served by that access.

2 This Table does not imply that certain types of development are necessarily suitable for location on any particular frontage road type. In particular, access to arterial roads should be limited as far as practicable, and in some circumstances, it may be preferable to allow left-turn-only movements into and out of the access driveway.

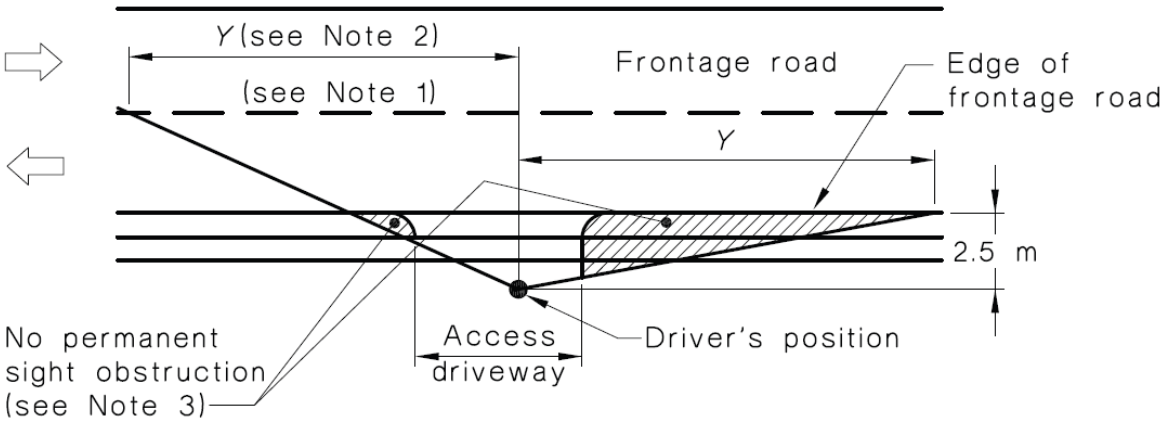
Table 3.2 – Access Driveway Widths

Metres

Category	Entry width	Exit width	Separation of driveways
1	3.0 to 5.5	(Combined) (see Note)	N/A

2	6.0 to 9.0	(Combined) (see Note)	N/A
3	6.0	4.0 to 6.0	1 to 3
4	6.0 to 8.0	6.0 to 8.0	1 to 3
5	To be provided as an intersection, not an access driveway, see Clause 3.1.1		

NOTE: Driveways are normally combined, but if separate, both entry and exit widths should be 3.0m min



Frontage road speed (Note 4) Km/h	Distance (Y) along frontage road M		
	Access driveways other than domestic (Note 5)		Domestic property access (Note 6)
	Desirable 5s gap	Minimum SSD	
40	55	35	30
50	69	45	40
60	83	65	55
70	97	85	70
80	111	105	95
90	125	130	Use values from 2nd and 3rd columns
100	139	160	
110	153	190	

Figure 3.2 – Sight Distance Requirements at Access Driveways

NOTES:

1 Centre-line or centre of road (undivided road), or right hand edge of right hand through lane (divided road).

2 A check to the left is not required at a divided road where the median is wide enough to shelter a vehicle leaving the driveway.

3 Parking on this side of the frontage road may need to be restricted on either side of the driveway so that the sight distance required by the above table to an approaching vehicle is not obstructed.

4 This is the posted or general speed limit unless the 85th percentile speed is more than 5km/h above the limit in which case the tabulated speed nearest the 85th percentile shall be adopted.

5 The values in the table apply only to left turn and right turn manoeuvres into two-way roads up to four lanes wide and one-way streets regardless of width, either for a 5s gap, desirable at lower frontage road speeds, or minimum stopping sight distance based on 2s reaction time.

Crossing manoeuvres (e.g. from an access opposite the steam of a T-junction) over four lanes or more, and turning manoeuvres into a six lane two-way road would require longer gaps unless there was a median wide enough to store a vehicle and allow a two stage manoeuvre.

6 These distances are based on stopping sight distances with reaction time of 1.5s for traffic approaching along the frontage road and are applicable to a frontage road speed of up to 80km/h only. Wherever practicable sight distance provided at domestic property accesses should meet the values given in the second or third columns of the Table.

7 When checking sight distance the driver's eye height and the height of the object (approaching vehicle) are to be taken as 1.15m above the road surface.

3.3 Gradients of Access Driveways

At entry and exit points, the access driveway should be graded to minimise problems associated with crossing the footpath and entering the traffic in the frontage road.

Maximum gradients on or near access driveways, other than at domestic properties (see Clause 2.6), shall be as follows:

(a) *Property line/building alignment/pedestrian path* – max. 1 in 20 (5%) between edge of frontage road and the property line, building alignment or pedestrian path (except as provided in Item (d)), and for at least the first 6m into the car park (except as provided below).

The grade of the first 6m into the car park may be increased to 1 in 8 (12.5%) provided all three of the following conditions are met:

(i) The grade is a downgrade for traffic leaving the property and entering the frontage road.

(ii) The user class is 1, 1A or 2 only.

(iii) The maximum car park size is-

(1) For entry into an arterial road – 25 car spaces, or

(2) For entry onto a local road – 100 spaces

The maximum grade across the property line shall remain at 1 in 20 (5%).

(b) *Vehicular control points* – max. 1 in 20 (5%) for at least 6m prior to the control point.

(c) *Queuing area* – max. 1 in 10 (10%) for not less than o.8 of the queue length determined in Table 3.3

(d) *Across footpaths* – where the driveway crosses a footpath, the driveway grade shall be 1 in 40 (2.5%) or less across the footpath over a lateral distance of at least 1.0m.

NOTE: The advice of the relevant regulatory authority should be sought to obtain grade requirements for footpaths.

9. Standard Clauses

These clauses are to be placed in the documents listed below

9.1. Legal Point of Discharge

Council does not accept sub-surface water (groundwater) into the stormwater system. This is the responsibility of the property owner to dispose on site or reach an agreement with local sewer authority. This is particularly relevant for basements and sub-surface structures.

9.2. Planning Permit

Should the condition be located within the body of the permit only:

3. Prior to the commencement of works, a Groundwater Assessment Report (GAR), to the satisfaction of the Responsible Authority, must be submitted. The GAR must be prepared by a qualified hydro-geologist and assess any possible impact of the proposed development upon existing ground water table and surrounding land and buildings to the satisfaction of the Council.

   Should the results of the GAR indicate that the site is likely to experience issues associated with groundwater management the following documentation must be submitted and approved by the Responsible Authority prior to the commencement of works:

   a) a Groundwater Management Plan (GMP); and

   b) development plans that demonstrate a fully-tanked dry basement with no AG drain collection or disposal and an allowance made for any hydrostatic pressures.

   Once approved the plans will be endorsed and form part of the planning permit.

   NOTE TO BE PLACED ON THE PLANNING PERMIT

   Council does not accept any groundwater (including AG drain) into the stormwater system. Sub-surface water (groundwater) is the responsibility of the property owner to dispose of on site or reach an agreement with the local sewer authority.

Should the condition be both within Condition 1 and the body of the permit:

   c) a Groundwater Assessment Report (GAR) prepared by a qualified hydrogeologist that assesses any possible impact of the proposed development upon existing ground water table and surrounding land and buildings;

   d) the provision of a fully-tanked dry basement with no AG drain collection or disposal and an allowance made for any hydrostatic pressures, should the findings of the report under condition 1c) demonstrate that the site is likely to experience issues surrounding ground water management

4. Prior to the commencement of works, a Groundwater Management Plan (GMP) must be submitted and approved by the Responsible Authority. The GMP must consider……

   NOTE TO BE PLACED ON THE PLANNING PERMIT

   Council does not accept any groundwater (including AG drain) into the stormwater system. Sub-surface water (groundwater) is the responsibility of the property owner to dispose of on site or reach an agreement with the local sewer authority.

Other conditions for inclusion:

A flood proof apex (ie ridge level) of minimum XXXmm higher than the existing driveway at the boundary of Site Address, Suburb must be provided to protect the basement from flooding. This apex is to fully surround the proposed development to ensure that no water can enter the underground portions of the property via other routes such as doors, windows, vents and openings to the basement carpark. This apex is to continue through any driveways or pathways that may cross it. The apex is to be a permanent structure (e.g. rise in concrete driveway/pathway, sleeper retaining wall, solid brick fence/wall). Low mounded soil on its own is unlikely to be acceptable due to the likelihood of future disturbance.