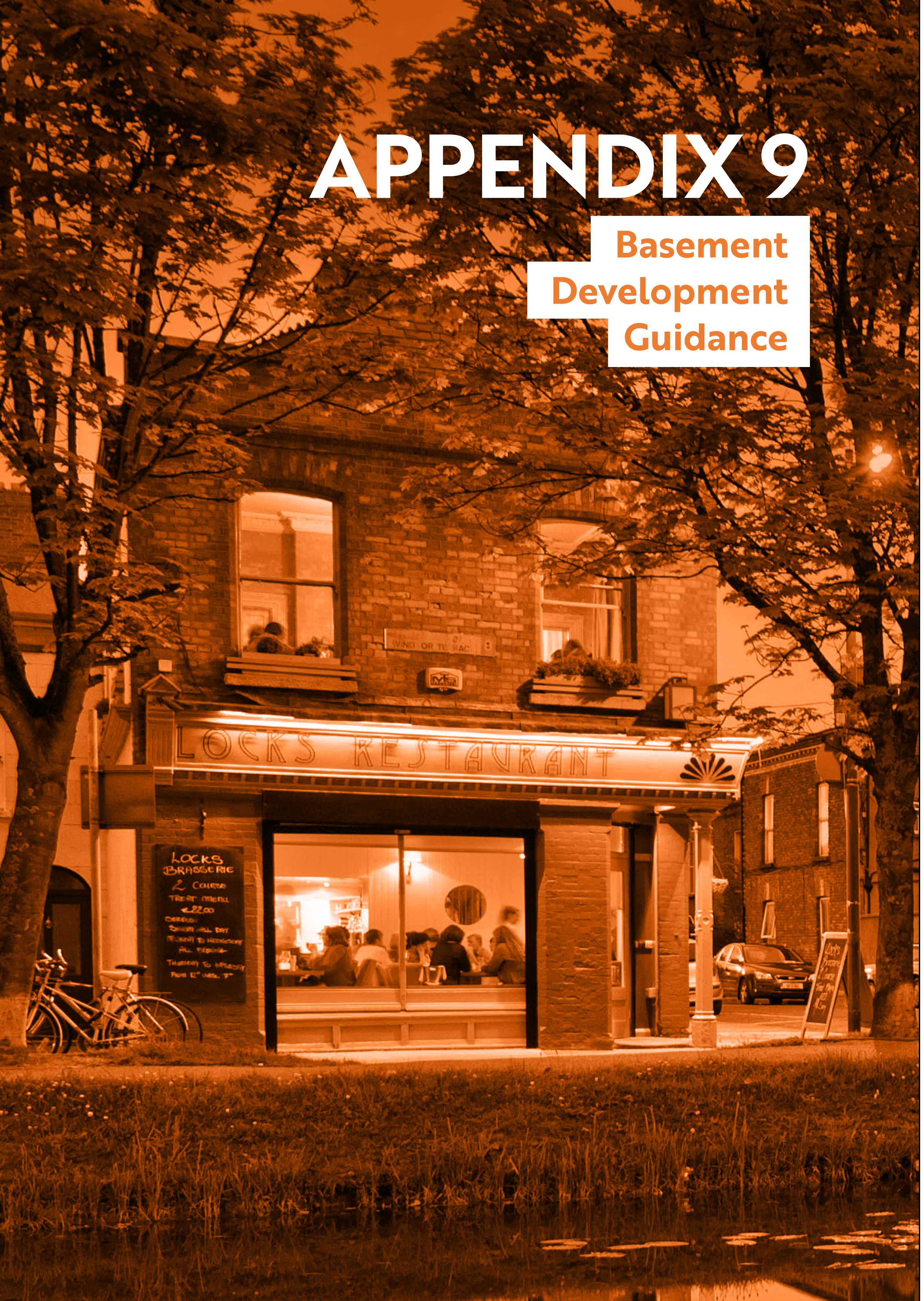


APPENDIX 9
Basement Development Guidance

1.0 Introduction

There is an increasing number of basement developments in the city. Whilst basement accommodation can be a useful means to increase the floor space of a development, it can also have significant geological, hydrological and hydrogeological impacts which have an additional significance in the context of climate change.

A basement or underground development is considered as being an accessible area which may comprise one or more levels positioned below the existing street level or ground level and would include any works that will remain permanently in the ground, such as embedded wall construction below the base of the accessible area. It is the policy of the City Council that a Basement Impact Assessment (BIA) shall accompany all planning applications that include a basement.

This document sets out general guidance regarding basement developments, and in particular, an outline of the information to be contained in a Basement Impact Assessment. The extent of information to be contained within such studies will vary depending on site specific circumstances. This guidance document is intended, therefore, not to be prescriptive, but rather to provide general guidance on the typical scope of information to be included in such assessments. It is advised that applicants engage with the Environment and Transportation Department prior to lodgement of the application to agree the scope and detail of the Basement Impact Assessment.

2.0 Basement Development – Potential Negative Impacts

The potential impacts to arise from basement development are typically:

- There is potential to alter groundwater levels or flow. An impermeable subsurface structure may impede water movement underground and the water table can rise or fall as a result of a new basement. Seasonal changes in groundwater levels can also influence potential impacts. Such impacts can have adverse consequences for adjacent properties including a risk of flooding and increased filtration onto sewers. A decline in groundwater levels may affect wells, streams and ponds and can cause subsidence.

- Basement construction can induce ground movements in the surrounding area and impact negatively on adjacent properties and infrastructure. Adjacent land stability can also be compromised, particularly where there is a proposal to dewater a site during construction or excavate close to or below the level of existing foundations. Structural damage to existing properties and infrastructure may arise due to specific geotechnical conditions and the works being undertaken.
- Ground anchors that extend outside the property boundaries, unless of a particular type can impact on the possible long term development options of adjacent areas and need to be licensed accordingly by the Roads Authority and relevant utility agencies.
- Surface water flow and flooding can be impacted on.
- The construction of basements including piling, deep excavation as well as associated impacts such as noise, dust, traffic management and discharge of groundwater can have an adverse effect on existing communities. Installation of temporary works can also have adverse impacts.
- Excavated material may require analyses for potential contamination.
- Basement excavation may have archaeological implications.
- Basements can have negative impacts on underground services and infrastructure which may need to be addressed.
- Cumulative impacts from all of the above factors can arise from the incremental development of basements in close proximity, and can create significant impacts on hydrological and hydrogeological conditions.

3.0 Purpose of a Basement Impact Assessment

The purpose of the Basement Impact Assessment is to identify potential impacts, short and long term; to inform whether a proposed basement is acceptable; and to identify whether appropriate mitigating measures can be incorporated. It must also demonstrate:

- That the construction of the basement will not unduly impact on groundwater conditions and that groundwater quality, quantity and classification will be protected.
- That groundwater or surface water flows will be not be impacted on to the extent that there is likely to be an increase in the risk of flooding.
- That the basement development will not increase groundwater infiltration into existing sewers and drains beyond permitted levels.
- That the basement development will not have an adverse effect on existing patterns of surface water drainage, including infiltration into groundwater and is consistent with best practice in SuDS.
- That the structural stability/integrity of adjoining and neighbouring buildings will not be compromised.
- That the design of the basement relates to the characteristics/ proportions of the site. Domestic basements, save for exceptional circumstances, should not exceed the footprint of the original building and be no deeper than one storey below ground level. They should generally not extend to more than 50% of the amenity/garden area.
- That the basement has been designed to an appropriate standard and will be constructed in accordance with a detailed Construction Management Plan during the excavation and construction stages and that an appropriate suite of mitigation measures are proposed to address potential adverse impacts.
- That the construction of the basement will not cause undue nuisance to the residential amenities of existing communities and will not adversely impact on the built and natural environment.
- That the design of the basement considered impacts on future planting including trees and where possible, enhances the biodiversity value of the site.

- That the basement development will not adversely impact on existing protected structures, heritage sites, conservation areas or sites of archaeological interest. The City Council in general does not support the construction of basements in close proximity to protected structures. However, in instances where this is proposed, the applicant must demonstrate that the basement construction will have no adverse impact on the structural stability of this structure, including at excavation/construction stage e.g. vibration, settlement.
- That the design of the basement provides for adequate ventilation; a suitable means of escape to a place of safety at the external ground level and that depending on the intended use of the basement accommodation, adequate sunlight/daylight penetration is provided. The design should be compliant with all relevant building regulations.

4.0 Content of Basement Impact Assessment

The BIA will be specific to the site and the proposed development and should be undertaken by a person(s) with the appropriate qualifications and experience (Chartered Structural and/or Geotechnical Engineer or equivalent). The level of detail to be contained within a BIA will depend on the location of the proposed basement, its size and complexity, setting and relationship to existing development on and adjacent to the site. The content of the BIA shall also reflect the scale of the potential impacts identified during the scoping and site investigation stages. Any other information relevant to BIA should be included in appendices and reports. Set out below is a guide to the format and information typically to be contained in a BIA.

4.1 Baseline Characteristics of the Project

This will include details such as:

- Development extent and description. The BIA should provide details of the retaining wall and basement design for the basement excavation. Details should be provided regarding all temporary and permanent works including where piles and ground anchors or similar are proposed to be used.
- A plan showing the site location and boundary of the development including land required temporarily during construction.
- Maps and photographs showing the location of the project relative to surrounding buildings and structures, topography, protected structures and man-made features.
- An assessment and description of the ground conditions, surface water and groundwater regime including groundwater levels and history of any previously built infrastructure on the site of the proposed excavation including the potential for contamination.
- Schematic and details of the water table level and groundwater flow direction (conceptual site model during construction phase and in the longer, post-construction phase).
- A work programme for construction, operation and commissioning phases and restoration and after use where appropriate.
- Construction methods including any temporary/permanent works.
- Details of any other permits required.

4.2 Site Investigation and Geotechnical Analysis

An appropriate level of site investigation including groundwater studies, monitoring and geotechnical analysis should be demonstrated having regard to the location of the basement and its relationship to adjacent properties. The preparation of the BIA will be an iterative process and the scope and content of the assessment may evolve due to ongoing site investigations and analysis. The applicant should account for potential impacts outside of the site boundary when planning for suitable site investigations to ensure all relevant information is included in the BIA.

It is envisaged that the BIA will include:

- Desktop study and site inspection.
- Field investigation, including intrusive investigations, pumping tests, water chemistry and bacteriology sampling. Details of the ground conditions, drill logs, geology and groundwater conditions should be provided.
- Monitoring of seasonal and as appropriate, tidal groundwater levels at different levels below and around the site.
- Pre-condition external survey of adjacent properties and structures and internal survey where feasible.
- Identification of existing basements in the vicinity of proposed

development with an analysis of potential cumulative impact.

The scope of testing on the site will depend on the nature of the proposed development. The following general guidance should be noted:

- Boreholes or trial pits should extend to a depth of at least 3 metres below that of the proposed basement and foundation excavations and typically further into the ground if possible.
- Construction design and methods for boreholes and trial pits should be specified in accordance with site investigation best practice.
- The location of site investigation boreholes adopted for groundwater monitoring, groundwater dewatering boreholes and groundwater recharge boreholes should be such that monitoring can continue both during and after construction works have taken place. It is recommended that the location of piezometers utilised on the site should be digitally recorded and coordinates provided. Piezometers should where feasible, be positioned in areas accessible post construction and be maintained for future monitoring and reference.
- A sufficient number of boreholes or trial pits will be required in order to determine the groundwater flow direction.
- All data should be referenced to a common geographic coordinate system and the reference given to an appropriate level of resolution.
- Elevation data (including water levels, the observed increased inflows of water during drilling and soil and lithological changes in boreholes and trial pits) should be quoted with reference to Malin Head Ordnance Datum. This allows sub surface data to be correlated with topographic data which is related to OD.
- A consistent approach to borehole numbering should be provided.
- It may be necessary to perform calculations on the data collected during intrusive investigation and monitoring phases of site investigation in order to derive parameters, for example hydraulic conductivity, or to estimate ground responses to certain effects, for example groundwater level response to dewatering. Standard calculation methods should be used where possible.
- The data and information collected in the site investigation will be analysed and interpreted by the developer to provide baseline data which can be used in order to make an assessment of the potential impacts.

- As appropriate, and depending on the location, extent and nature of the development, to account for seasonal variations, the applicant may need to monitor ground water levels and movement over a hydrological year. Such data will be required to inform the final design phase of the basement.

4.3 Impact Assessment

General

The report should set out the potential direct and indirect impacts of the proposed basement construction, during and post construction.

Identifying potential impacts may be facilitated by the preparation of a conceptual ground model developed for the proposed site. A conceptual ground model includes the flow of groundwater through the site and the known and suspected features on, below and adjacent to a proposed site, including geotechnical details. Consideration should be given to the preparation of a 3D dimensional block model showing adjacent buildings, trees, gardens and buried infrastructure. The use of appropriate groundwater/seepage/slope/ground stability and other structural modelling tools should also be considered.

Potential impacts beyond the site boundary are of particular importance. Where work, including any temporary works are proposed external to the applicant's site to assess existing groundwater conditions or monitor the impact of dewatering during basement construction, the applicant is required to demonstrate that they have the necessary permissions from the relevant land owner and/or authority. Where permission is not given by adjacent landowners for structural surveys or subsurface investigations to be carried out, the undetermined structural conditions and ground conditions beyond the site boundary should be identified as a significant risk and should be assessed and mitigated against accordingly.

Groundwater Flow

Potential impacts to groundwater conditions must be assessed in the BIA. The BIA shall demonstrate insofar as practical, that the proposed width between the boundary and any permanent structure is adequate to account for the anticipated flow, levels and quality of groundwater through and within the site. Account should be taken of proposed groundwater velocities and any impact that may have on adjoining structures.

Each basement development shall implement measures to ensure that the volume of groundwater, within and passing through the site pre development shall be maintained during construction and post development and there should be no impact upon groundwater quality or levels upstream or downstream of the groundwater gradient. In this regard, a hydrogeological assessment of the site pre development, during construction stage and post development will be required and accounted for in the BIA. Boreholes should be retained for the monitoring of ground water levels and quality during and post construction.

It is recommended that all basement development provide at least 0.5m wide of clear space between the site/property boundary and the outer extent of the basement development of 0.5m is retained. Such a space shall extend over the full height and around the perimeter of the basement and shall be accounted for in the hydrological, geotechnical and structural assessments within the BIA. The intention in maintaining the 0.5m space is to reduce the potential for cumulative effects if further basements are to be constructed nearby. Consideration will be given to a reduction in the 0.5m width where the applicant can provide an innovative design solution and/or compensating measures and where it can be demonstrated that the design and construction methods will protect against any potential adverse impacts to adjoining structures and/or groundwater levels and flows within or adjacent to the site.

Groundwater outside the boundary of the site can be affected by dewatering during construction. It is recommended that appropriate modelling techniques with site specific parameters are utilised to assess potential impacts. An analysis shall be undertaken to identify impacts during and post construction of a change in groundwater levels i.e. for example, an increase may impact upon existing neighbouring basements, whereas a decrease in groundwater levels may impact upon the stability of adjoining structures. Limit values should be determined so they can be incorporated into the construction phase and construction management plan with an analysis of the levels in the longer, post-construction phase. Any breaches of these limits should be reported to DCC E&T.

It should be demonstrated how dewatering of the site during construction is to be undertaken over the entire duration of the construction period. Consideration of suitable locations for groundwater re-charging within the site area or discharge off site should be accounted and provided for. The location of a groundwater recharge point should be accounted for at the basement design stage, if appropriate and the location should be included as part of the construction methodology. Calculations should be provided as part of the BIA demonstrating the expected level of groundwater discharge and expected recharge capacity back to the groundwater. A discharge licence shall be required from the relevant owners of any pipeline into which the discharge is proposed. If there is an intention to continue to dewater the basement post construction, this should be highlighted and the discharge accounted for. Dewatering volumes and quality of discharge along with groundwater level variations on the site in question during the construction phase are to be recorded and made available to the City Council.

Land Stability and Ground Movement

It should be demonstrated that the structural stability of adjoining or neighbouring buildings and structures will not be compromised. Calculations of predicted ground movements and structural impacts should be provided. Potential land stability impacts from dewatering should also be considered. A structural/geotechnical design report should be included e.g. as per guidance in IS EN 1997.

Such an assessment will be particularly pertinent where there are protected structures/old buildings adjacent to the proposed basement. It is the developer's responsibility to ensure adverse ground movements and/or instability is guarded against through proper investigation and design of mitigation measures at planning stage. Pre and post condition surveys may be required. Basement pumps in adjacent buildings should also be identified.

Surface Flow and Flooding

An evidence based approach must be provided that the development will not significantly impact on groundwater or surface water flows to the extent that there would be an increased risk of flooding. A Site Specific Flood Risk Assessment should be undertaken in accordance with The Planning System and Flood Risk Management – Guidelines for Planning Authorities 2009. There is a general restriction against the development of basements below the estimated flood levels for flood zones A or B.

The impact of the development on proposed or existing SuDS measures must also be considered as the construction of a basement typically removes the permeable shallow ground that previously occupied the site footprint thus reducing the capacity of the ground to allow rainfall to be stored. It is recommended that a thickness of at least 1m of soil on the roof of a basement is required to minimise surface water runoff.

Cumulative Effects

The cumulative impacts of the incremental development of basements (existing and planned) in close proximity to each other should be assessed.

The cumulative effect - if any - of several underground developments in a given street could potentially differ from the impact of the initial single basement. It is, therefore, appropriate for the Planning Authority to consider the layout and proximity of existing basements and/or where multiple basements are proposed. It should again be noted that this guidance provides a schematic that assumes a homogeneous aquifer with isotropic hydrogeological properties.

The shape of the structure in relation to the groundwater flow direction and soil strata should be considered to assess whether any damming effect could potentially arise. If the basement is to be constructed perpendicular to the flow of groundwater it shall have the greatest impact.

Scenarios B1, B2 and B3 of Figure 1 illustrate the principle of groundwater flow around a single basement structure. The diversion of flow paths around the basement structure leads to an increase in groundwater levels upstream, and a similar reduction in groundwater levels downstream.

Scenarios C1, C2 and C3 of Figure 1 demonstrate the effect of several basements acting cumulatively. Scenario C provides a notional example where a one house width gap is always present between adjacent basements. Groundwater flows through the gaps between basement structures and is prevented from passing beneath the houses with new basements. The effect is an increase in groundwater levels upstream of the structures, and a decrease downstream.

For hydraulic cut-off structures such as sheet piles, the purpose of which is to form a barrier to groundwater flow. In the notional case shown in Scenarios C1, C2 and C3, the space remaining open between buildings, as a proportion of the original flow channel, is approximately 40%. The flow velocity through the narrowed channel will be higher than before, which might conceivably result in piping and subsurface erosion of loose sandy material if this is present, but the greater impact will be to the groundwater levels. The higher flow velocity is due to the increased hydraulic gradient resulting from the rise in water levels upstream, and lowering downstream of the row of basements.

The change in water levels could be assumed to be in proportion to the increase in the length of the flow path. In the case of a site measuring 10m in the direction of groundwater flow, the natural difference in groundwater level might be one or two centimetres. Introducing a basement of dimension 10m by 10m will increase the flow path from 10m before to approximately 20m.

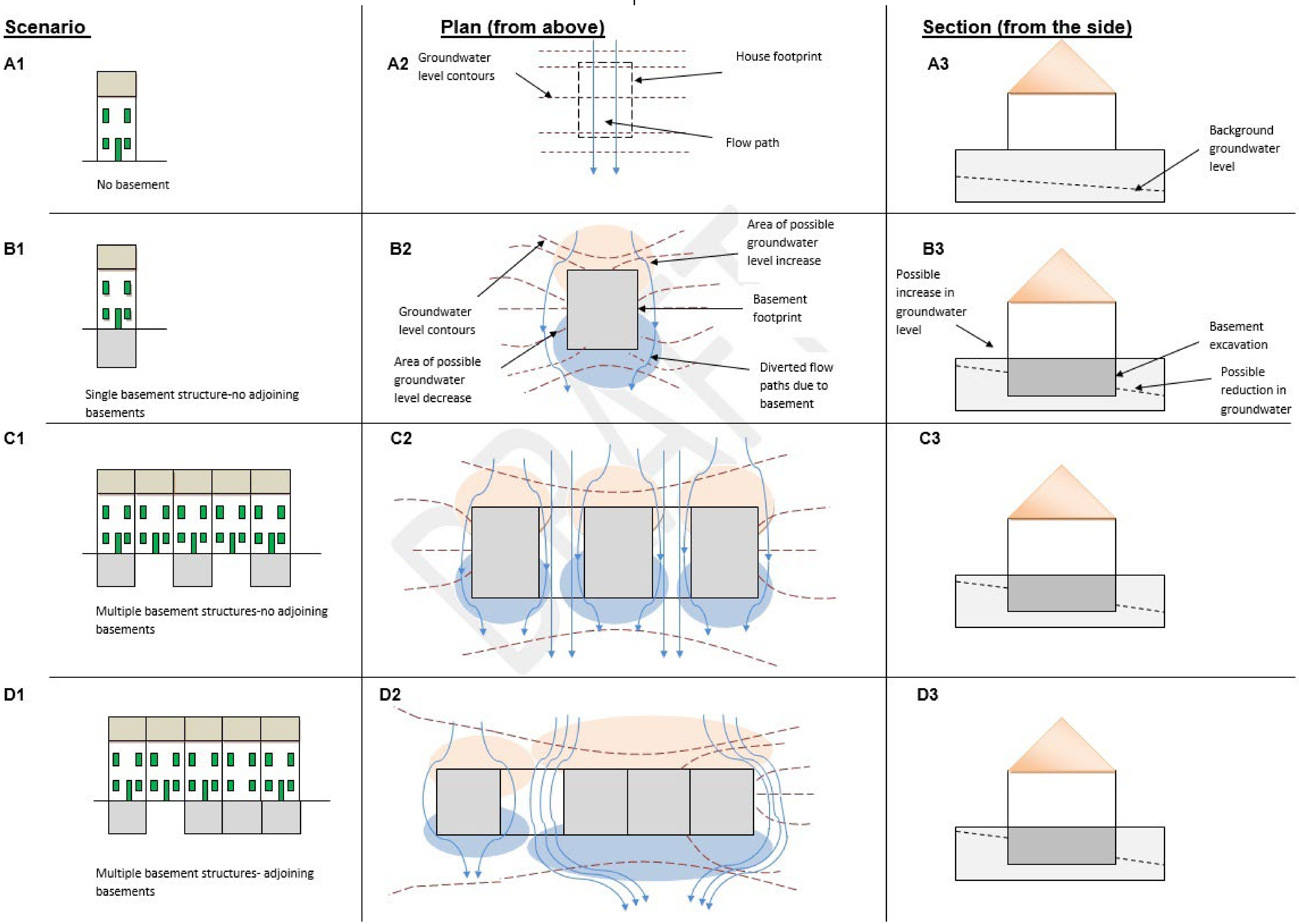
Where several basements effectively act as a single barrier to groundwater flow such as in Scenario D1, D2 and D3 of Figure 1, the impact will be larger. In this case, the water will be forced to follow a longer flow path, with greater energy loss as a consequence, and, therefore, the changes in groundwater levels upstream and downstream will be greater.

The extent to which the cumulative effects of basements may impact groundwater flow and levels is likely to depend on the properties of the aquifer materials. In highly permeable formations groundwater flow can easily be diverted around basements, and will not ultimately lead to a groundwater level rise upstream of the basement.

Therefore, a single basement in extensive sand and gravel deposits is unlikely to have a significant impact, whereas a single basement blocking a narrow linear gravel deposit with clay in either side, will have a very significant impact.

Detail of groundwater flows due to cumulative effects shall need to be accounted for in the basement design. In order to make basement construction fair and equitable for all parties, the Planning Authority shall require a Hydrogeological Assessment of the site to determine the extent of existing groundwater passing through the site pre-development (relative to depths etc.). Each development shall then be required to account for the groundwater flows and volumes of groundwater below and through their own site ensuring that there shall be minimal change to the groundwater flows, levels and volumes post-completion of the works when compared to the pre-development scenario. These proposals should be described in detail within the BIA.

Figure 1: Scenarios A-D



Construction Related Impacts

Basement construction has the potential to cause significant nuisance. Potential impacts during the construction phase include piling, excavation, noise, air quality, vibration and traffic movements. Dewatering, groundwater discharge and potential for hazardous/ contaminated ground should be considered and assessed.

Temporary Works

No works should take place on or below private land without the owner's written permission. If temporary works are required to facilitate the construction of the proposed basement, these are not permitted within public lands without a Ground Anchor Installation Licence (GAIL). The application, if required, should form part of the BIA and should be completed in conjunction with the GAIL guidance document. The relevant application form and guidance can be found at the following link –https://www.dublincity.ie/residential/transportation/apply-licence-or-permit/ground-anchor-installation-licence

All ground anchors shall be temporary in nature, decommissioned upon completion of the development and shall not inhibit future infrastructure schemes. They should be "cuttable" in design to allow for the installation of future infrastructure. A detailed survey of existing utilities and infrastructure is required to establish locations and depths as part of the GAIL.

Heritage and Biodiversity Impacts

Work beneath a protected structure or historic building may require underpinning specialists and appropriate detail and information should be provided. It must be demonstrated that there will be no adverse impacts during the demolition and construction phase to protected structures. Impacts to archaeology should also be considered. All works should stop on site if any archaeological or heritage material is found and the National Museum of Ireland and the City Archaeologist contacted. It should be noted that there is a general presumption against the development of basements in Zones of Archaeological Interest except in exceptional circumstances.

The BIA should consider impact to existing green infrastructure and in particular, the impact on the future planting including mature trees on the site.

Land Use

The impact of the proposal in land use terms should also be considered and it should be demonstrated that the intended use of the basement is appropriate and in the interests of the proper planning and sustainable development of the area. The environmental sustainability of the proposal should also be considered.

4.4 Construction Management Plan

A Construction Management Plan should be incorporated into the BIA. The level of content of the CMP should be proportional to the scale and complexity of the proposed development.

The CMP should contain as a minimum:

- Detailed information regarding the structural and geotechnical design of the basement and how the design and construction of the basement has been prepared in order to minimise the impacts on neighbouring properties, public lands and the water environment.
- Details demonstrating that the basement has been designed using evidence of local factors including ground conditions, the local water environment and structural condition of neighbouring properties in order to minimise the impact on them.
- Method statement detailing the proposed method of ensuring the safety and stability of neighbouring properties/structures and land throughout the construction phase. It should be clearly identified as to how potential for ground movements are to be mitigated and how monitoring of movement of buildings/structures and land will be addressed. A search for existing private basements and possible monitoring of these may also be required.
- Provision to monitor groundwater levels during and post construction. Appropriate limits of groundwater fluctuation to be accounted for and detailed. Critical groundwater threshold levels to be identified such that alarm set points can be established and constantly monitored. Appropriate mitigation measures to be detailed if these limits are reached or exceeded with provision for reporting breaches to DCC.
- Proposed site working hours and provision for site management, safety and supervision. Provision for phasing of works should be considered.
- Management of noise, vibration and dust.

- Construction and Demolition Waste Management Plan including provisions for the removal of hazardous waste.
- Management of construction traffic including traffic movements/ routes to and from the site.
- The location(s) of a groundwater recharge point(s) should be accounted for (if appropriate), taking into account and with reference to the local site geology, hydrogeology, ground conditions and development extent and site boundary.
- If discharge is proposed to a local sewer, details related to the anticipated pumped volumes and discharge quality are to be detailed and the relevant licence approved/granted and enclosed in the BIA.
- Details of temporary or permanent works within the site boundary with an additional explanation if they are to extend outside the site boundary.
  - Boreholes required to monitor groundwater.
  - Ground anchors/soil nails for which a GAIL shall be required.
  - Sheet piles, contiguous bored piles details, retaining walls.
  - Depths of proposed walls and piles with reference to water table levels, groundwater flow direction, geology, hydrogeology etc.
- Appropriate monitoring measures including risk assessment thresholds and contingency measures for ground movement, groundwater levels, surface water flooding and pre condition surveys. The frequency and duration of monitoring must be chosen with reference to the specific effect which is being investigated.
- The locations of an appropriate number of groundwater monitoring points facilitating monitoring during the pre-planning, pre-construction phase.
- Provision to retain where necessary at the property throughout the construction phase of a suitably qualified engineer supported as required by a hydrogeologist from a recognised relevant professional body to monitor impacts, adjust pumping rates, inspect dewatering arrangements, review and apply the threshold groundwater levels (pumping controls) and approve the permanent and temporary basement construction works.
- Cumulative construction impacts of adjacent development should also be considered.

4.5 Impact Assessment and Mitigation

The impact assessment should describe, quantify and aggregate the effect of the development (for both construction and post-construction phase) as identified in the report. Where it is identified that the construction of the basement will have negative consequences and impacts, mitigation measures should be set out and where appropriate, incorporated onto the scheme design. A comparison of the assessed impacts with the baseline studies should be included.

Mitigation measures which may be included in basement development proposals comprise (but are not limited to):

- Controlled or adequate drainage;
- Grout injection to prevent vertical flow from lower groundwater flow systems;
- Underpinning of neighbouring structures and
- Setting the basement in from property boundaries.

4.6 Non-technical summary

A non-technical summary of the report is to be incorporated outlining the conclusions at each stage of the report.

5.0 Basement Impact Assessment – Submission Checklist

Note this check list is not exhaustive and the scope of information required is dependent on the scale and location of the basement construction proposed. The scope of the BIA should be agreed in advance with the Environment and Transport Department of Dublin City Council (as per details provided on the DCC website). The BIA must be completed by a suitably qualified professional with the necessary expertise to complete such an assessment (Chartered Structural/ Geotechnical Engineer or equivalent).

Table 1: Basement Impact Assessment Submission Checklist

	Item	Yes/ No
1	Description of proposed development.	
2	Plan showing boundary of development including any land required temporarily during construction.	
3	Plan, maps and photographs to show the location of basement relative to surrounding structures.	
4	Plans, maps and or photographs to show topography of surrounding area with any nearby watercourses/ waterbodies including consideration of the relevant maps on the SFRA (Vol 7).	
5	Plans and sections to show foundation details of adjacent structures (reference to pre-condition reports).	
6	Plans and sections to show layout and dimensions of proposed basement and all proposed foundation details.	
7	Modelling evaluation of baseline groundwater levels and flows.	
8	Modelling and evaluation of groundwater levels and flows during construction and following construction of basement.	
9	Programme of enabling works and construction and restoration.	
10	Identification of potential risks to land stability (including surrounding structures and infrastructure and groundwater flooding.	
11	Assessment of potential risks on neighbouring properties and surface groundwater.	
12	Identification of significant adverse impacts.	
13	Ground Investigation Report and Conceptual Site Model including: · Desktop study · Exploratory hole record · Results from monitoring the local groundwater regime · Confirmation of baseline conditions · Factual site investigation report	
14	Ground Movement Assessment.	
15	Plans, drawings, reports to show extent of affected area.	
16	Construction Sequence Methodology (CSM) referring to site investigation and containing basement, floor and roof plan, sections, sequence of construction and temporary works.	
17	Proposals for monitoring during and post construction (groundwater movement and levels, ground movement, vibration with comparisons to baseline) – limits to be advised in BIA and monitored. Any breaches should be reported to DCC E&T.	
18	Consideration of potential impacts to protected structures, conservation areas and archaeology where relevant.	
19	Consideration of potential impacts to biodiversity and amenity.	
20	Construction Management Plan.	
21	Impact assessment and specific mitigation measures to reduce or offset significant adverse impacts with comparisons to baseline study.	
22	Provision for monitoring post construction (post-condition surveys, groundwater levels/flows etc.).	
23	Non-technical summary of full report.	