# FLOOD ELIMINATION/BELOW GRADE SCOPING GUIDELINES



## 3.1 Introduction

Below grade review and inspection is typically limited to interior observations only, as the majority of exterior elements will be concealed. Extra care must be taken to carefully document interior damage and map out on plans and elevations (interior) to attempt to discern patterns in the leaks. Common sources may be rising groundwater, excessive surface runoff, poor grading, and below-grade penetrations. Surveys of the site grade and any areaways, etc. must be included. The interior of areaways and drainage (or lack of drainage) should be directly inspected, requiring removal of grating. Discuss below grade leaks with school personnel to determine when leaks occur, specifically in relation to rainfall events (i.e., independent of? before? during? after? how long after?).

Floodproofing (wet or dry) with the intent of addressing surface water during flood events is not included in this document. Work related to floodproofing of buildings located within a FEMA Flood Zone where mitigation is required or recommended should be included under a separate SCA Additional Recommended Item for "Flood Mitigation."

The inability to make direct observations will complicate this type of scoping. Designers must rely on a combination of interior observations, reports from the school regarding leakage including when they occur if not continuous, and diagnostic water testing. When planning initial site visits, plan to visit the building during a rain event since some leaks may be active; notify the staff to watch for leaks in the reported areas over the next few days and report back if and when leaks occur as this may provide information about the nature and cause of those leaks.

- For discussion of Energy Code Compliance issues, refer to the Building Envelope Scoping Guidelines.

- See the Building Envelope Testing Scoping Guidelines for further discussion of testing strategies.

## 3.2 Project Definition

*The Flood Elimination/Below Grade Capital Category may include some or all of the following components:*

- *Foundation Walls and Slabs*
- *Areaways (including drains, gratings, slabs, stairs, and walls; typically scoped under "Flood Elimination/Below Grade")*
- *Stairs/Ramps: Exterior (including building cheek/flank walls, and railings; typically scoped under "Exterior Masonry")*
- *Vaults/Bunkers (Foundation Walls, Slab Structure, Vault/Hoist Doors)*
- *Plaza Decks*
- *Mechanical (Pumps/Sump Pump; Drain/Waste/Vent and Storm System /Sump Pumps)*

***Design Requirements:*** *Refer to DR 3.1.1 Guidelines for Foundation Design in High Water Table, DR 3.2.1 Waterproofing Systems for Foundations Subject to Hydrostatic Pressure and other relevant sections of the SCA Design Requirements for further design and technical requirements.*

### 3.3 Referred Items and Additional Items

Flood Elimination projects are normally intended to focus on water related issues identified in the basement, cellar, pipe space, or other areas below grade. These can be varied from water through the foundation wall to a need for a sump pit replacement.

It is important to look at the nodes for this project to determine the original intent of the project, which may be based on the BCAS findings.

It must be noted that there are projects that are requested for scoping through Capital Plan Management that are listed as Flood Elimination even when the infiltration is at the upper floors when the source of the water is not known and it has not been tied to the roof, masonry, parapets, or windows. When scoping the project and the infiltration is in above grade components, separate the findings and recommendations under the other appropriate capital categories and clearly indicate if the deficiencies are contributing to the below grade water infiltration issues.

### 3.4 Investigation & Documentation of Findings

Identify all water related items that may warrant a Flood Elimination project from different sources such as floor, walls, ceiling, broken pipes, and backflow of storm/sewage system or leaky equipment. Poorly graded exteriors and areas of standing water at the base of walls (both landscape and hardscape) can also contribute to below grade leakage.

Note that high groundwater levels will typically result in inches or feet of standing water in below grade spaces, whereas discrete leaks will produce localized puddles or even just damp spots that cause paint in the basement to peel.

If pipe leaks exist, include a statement in the findings of the Scope Report. Consult with the Design Project Manager (DPM) or Design Manager (DM) for direction on whether this should be included in the referred item, scoped as an additional recommended item, forwarded to DOE for repair by maintenance crews, or as a separate project. Pipe leaks will typically create large wet areas, especially if they occur in pressurized water supply lines or sprinkler pipes.

Prepare “Existing Condition” or “Damage Mapping” drawings that record the location(s) and extent of deficiencies observed on annotated plans, elevations and other drawings as appropriate. Visualizing leak locations can often provide insight into the nature and cause of leakage (e.g., focused near areaways, only around pipe penetrations, etc.). Also, note any signs of previous repairs (e.g. chemical injection). Also, prepare corresponding “Recommended Work” drawings and graphically describe the recommendations. Refer to the Building Envelope Scoping Guidelines, Section 2.5 Investigation & Documentation of Findings for additional requirements.

### 3.5 Flood Elimination/Below Grade Element Work

#### 3.5.1 Foundation Walls and Slabs

If a Flood Elimination project was recently completed at the school and the school continues to have complaints about water infiltration in the same or new areas, consult the DPM or DM. The new project is likely to be reassigned to the original designer, or Construction

Management may engage the same contractor to perform additional work or have the infiltration addressed through the warranty.

By studying original drawings, determine type and thickness of foundation walls, openings, window and louver sills, areaway walls, slabs and drains.

Determine the location of the water infiltration as it relates to the structure, i.e. at the top the wall, entire wall, junction of wall and slab, etc.

For recently completed waterproofing installations, membranes that were not properly overlapped or improperly sealed joints can create water related damage inside the building through foundation walls. In addition, lack of properly placed water stops between concrete walls and slabs can contribute to water penetration.

In some areas of Queens and Brooklyn, the water table has risen substantially after Jamaica Water Supply stopped dewatering to supply drinking water. The schools in those areas of Queens and south Brooklyn are the most likely to have water infiltration through walls and slabs compared to other areas of the city. High groundwater will produce intermittent or constant standing water in basements that is typically easily discerned from localized wall leakage.

Determination of the source(s) and frequency of water infiltration through floor slab, ceiling or wall is very important. Continuous water flow is likely due to high water table and/or deteriorated waterproofing systems. Study the borings from the original design drawings, any borings done after that period such as for addition(s), and check borings of the any other nearby school and study the different cases to identify or have a tentative idea of the depth of the water table.

Order borings if recent data cannot be found regarding water table levels and below grade leakage is reported or suspected. Consult with a geotechnical engineering firm to explore possibilities and alternatives and to study the historic data for that area.

Timing of water infiltration is also very important with respect to the location of the school building. Schools near bodies of water may experience water infiltration only at high tides. Buildings located on old stream beds may experience water infiltration at times of heavy rain. Buildings with poor site drainage often experience leaks that occur only after several hours of rain, or after rain has stopped.

Identify the location of storm and sewage water systems, drywells, detention tanks on the roof or yard and plumbing connections to the street that may be contributing to water infiltration.

Storm lines from yard drains or catch basins to the street must also be checked for blockage. This condition may create water ponding near the building and eventually can find its way inside the building through weathered/deteriorated joints.

In many older schools, storm and sewage lines are combined in the basement. This condition may cause overflow/back flow in the basement. If the school is experiencing such problems, then separating the lines and providing a detention tank in the play yard for storm water and connected to the street should be considered. DEP filing and approval is required in this case.

In some schools, toilets in the basement are sometimes found connected into the storm sewer. This condition needs to be evaluated and may require disconnection of waste lines from the storm water and connection to a dedicated sewage line.

Location and elevation of pumps, boilers, piping on the floor etc. related to HVAC work and electrical panels may be impacted when there is active water infiltration from the foundation walls or floor slab.

Verify operation and capacity of sump pumps. This may be very helpful in knowing the extent of water under the slab. If pumps are not operating, broken or under capacity, then these conditions may accelerate water related issues at the school.

Chemical and biological testing of water entering the building is important to rule out the possibility of sewage or supply water pipe breakage being the source(s) of the infiltration. Dye tests can be performed by adding dyes to adjoining storm drains to determine if there is a storm line break nearby.

If traces of oil are found in water infiltration, the project must be forwarded to the HAZMAT unit in IE&H for remedial work investigation

Grading/landscaping on outside must be inspected closely. A reverse slope towards the building of landscaping or pavement may often allow or accelerate water infiltration inside the building. This is many times the issue for brick foundation walls at planted areas.

Interior damage at the junction of slab & foundation wall many times may be due to deteriorated joints between the slab and wall, or failing joints between exterior pavement and exterior walls and/or reverse landscape slopes.

Improperly installed pipes/penetrations are often a cause of water infiltration inside foundation walls. Any penetrations made in the wall must be made watertight (i.e. new electrical upgrade or gas line for boiler replacement projects). This is often difficult in retrofit projects where exterior access is not available without excavating.

Brick walls are especially susceptible to a condition known as rising damp, where moisture comes from ground water below the slab into the brick through capillary action. This is a difficult issue to solve and may require extensive research to resolve. Excessive efflorescence or white “powder” on the surface of brick masonry is often indicative of rising damp.

Repointing of brick masonry joints or repairing of interior plaster and painting will not resolve water related issues. Water infiltration conditions must be thoroughly investigated and proper design done to stop water infiltration to the inside of the building. Interior finishes shall be repaired only after the foundation walls and slabs are made watertight. One exception is for cases of minor rising damp or efflorescence on masonry walls due to water vapor flow (not actual leakage). In this case, a parge coat of mortar can help to protect the brick by acting as a sacrificial layer on the interior (i.e., deterioration occurs at the surface of the parge coat rather than the surface of the brick).

For concrete walls, repair of deteriorated portions of concrete wall shall be performed only after the walls and slab are made watertight.

Perform a thorough investigation of the existing conditions to determine specific cause(s) of leakage. In some cases, localized crack repairs or simple flashing details can be repaired, replaced or added to address leakage as opposed to removing and replacing large areas of waterproofing.

The preferred method of below grade foundation wall waterproofing is by positive-side application, consisting of a sheet or liquid membrane waterproofing systems applied on the exterior face of foundation walls.

When excavation is being done on the outside to provide new waterproofing on the outside face of wall, installation of perforated pipes and dry wells should be considered to relieve some of the water pressure depending upon ground water conditions. Perforated drainage pipes and drainage layers over waterproofing should never be installed within the groundwater table, or in areas where they are not physically connected to a drain, sump pit, etc. to remove accumulated water.

If water infiltration is limited to cracks or localized areas only, chemical resin injection grouting of cracks and joints alone may be considered in lieu of entire wall areas. It is important to note that localized chemical resin injection grouting of cracks and joints is typically only effective on cast-in-place concrete foundation walls. Attempting to inject a masonry wall or rubble foundation wall is unlikely be effective due to the potentially large number of gaps and cracks in the masonry. It would take an impractical number of injection ports and large volume of grout to make the wall watertight, as opposed to concrete, where cracks are usually limited. Further, the high pressure of injection may be sufficient to spall or otherwise damage older or more fragile masonry walls.

Localized chemical injection at joints and cracks should be considered to stop water infiltration at isolated locations in walls and floor slabs. Conditions must be evaluated further if leaks persist after this treatment. These installations are often effective, especially where recent waterproofing was done. When waterproofing is very old and injection is performed in one area, water sometimes starts to infiltrate into the next weakest area, so the leaks continue and the leaking water is chased. Depending on the water infiltration location(s), alternatives must be considered to providing more extensive waterproofing of foundation walls and floor slabs.

If access for positive-side repairs is not possible or practical and discrete chemical injection has not been or would not be effective due to the wall construction, a continuous grout barrier or curtain should be considered. A grout barrier or curtain is a continuous barrier that protects the outside of the foundation wall. It is similar to selective grout injection methods, but usually consists of rows of vertically drilled holes through the thickness of the wall or slab through which grout is injected. When properly implemented, the grout forms a “curtain” on the exterior of the wall that acts as a waterproof barrier. The success of this approach is highly dependent on the local soil conditions, extent of leakage, construction of the walls, and the skill of the installing contractor. Another option for walls if access from the inside is limited is a grout curtain injection done from the grade by drilling into the ground and slowly grouting upward. This is not the preferred approach as injection from the inside is typically more efficient.

Although typically more effective for cast-in-place concrete Installations of below grade foundation walls, positive-side grout waterproofing barrier applications on masonry or rubble foundation walls may be considered if reviewed and approved by the SCA-approved and specified waterproofing manufacturers. Prior to specifying barrier injection for a project, the

AEOR must consult with all SCA-approved manufacturers to ensure that the installation conditions and methods of installation are acceptable for obtaining the waterproofing manufacturer's warranty.

Issues that many times influence the effectiveness of chemical injection waterproofing barrier installations (or curtains) are subsoil conditions. If there are void spaces under the slab or behind the wall, acrylate ester injection will not work without first filling the voids. During scoping, pilot holes should be performed to identify signs of voids. If it cannot be determined, include a provision in the construction contract to inject voids behind the wall or slab. It is always good to have one of the approved injection contractors to review the project early during the design phase. Do not alter the SCA specifications without discussions with the SCA Technical Standards and Support staff, as the spacing and patterns included in the standard specification are based upon input from the SCA-approved injection manufacturers and installers.

Verify the clear height in the basement, boiler pit area and in pipe spaces. It is often easier and more effective to provide waterproofing on the top of the existing slab and turn up waterproofing on the walls and provide a new slab on top of waterproofing. This approach will be limited by the nature of the leakage; if hydrostatic pressures occur below the slab, a structural engineer should be involved to determine uplift pressures and slab design to avoid causing damage to the interior elements. Termination of this type of system can be difficult especially on older walls, which may need to be parged smooth behind the waterproofing (and waterproofing carried up above the groundwater level).

In Boiler replacement projects, instead of removing the slab and lines to facilitate installation of new lines the designer should consider providing waterproofing and new lines above the existing slab and raise the slab, providing a membrane and pressure slab above. Many projects have failed and created worse problems when hydrostatic slabs have been cut to replace a drain and allowed water to flood the space.

### 3.5.2 Areaway Drains, Gratings, Slabs, Railings, Stairs and Walls

Typically, Areaways, with associated drains, gratings, slabs, railings, stairs, and walls are to be scoped under "Exterior Masonry". If areaway deficiencies contribute to below grade water infiltration into the building, areaways, these items are to be scoped under the "Flood Elimination/Below Grade" category.

The functionality of existing areaways must be evaluated. Some existing areaways may be abandoned or no longer in use. Sometimes areaways are closed improperly, which becomes the source of water infiltration. Areaways may serve to provide access for servicing of mechanical equipment or supplies and/or proper ventilation of below grade spaces. The feasibility of removing existing areaways or capping them off shall be evaluated to reduce the cost of repairs and/or future maintenance in addition to stopping the water infiltration. Areaway modifications must be evaluated by a Mechanical Engineer to determine requirements for ventilation of below grade spaces and/or other mechanical requirements. Inspect existing areaway drains, gratings, slabs, railings, stairs and walls and describe their condition. Pay close attention to any areaway locations that may have had window openings previously blocked with masonry. The transition of new to old masonry is often a source of leakage in these cases (e.g., if the masonry is not properly "toothed in", or if the infill is thinner than the surrounding walls). In addition, blocked openings may compromise the requirements for mechanical ventilation or access. Discuss the functionality of the existing areaway(s) with the School Custodian to confirm the size and other requirements for access

through the below grade space(s) or with an access hatch within the grating. Also, establish if ladder access is required below the gratings.

Inspect and verify condition of areaway drains and their piping. The drains must be functional; otherwise water ponding in the areaway where walls are not treated, as well as the sill height of window and louver being very low, can provide a path for water infiltration inside the building. It is also possible that normal rainwater exposure at the base of the areaways, even if drained, allows water to reach the base of the wall faster than in adjacent, fully-buried areas and results in leakage only at those locations. In these cases, localized waterproofing may be practical by digging out the areaway (usually only a few feet to the bottom of the wall) and installing waterproofing. If the piping is broken, the water leaking from the pipe is a likely source of water leaking at the wall below the areaway slab level.

Note the location of sill heights (windows/louvers) within areaways as these may be sources of leakage. Check code requirements for minimum height of openings above the bottom of the areaway slab. Work done to the opening must not reduce the openable area required for combustion air nor reduce the distance from the opening above the area way slab to below that required by the 2014 NYC Mechanical Code.

Identify materials, locations and any deterioration noted. Identify if deficiencies result in water infiltration into the building interior. Include recommendations for repair and refinishing of rusted/corroded elements if required.

### 3.5.3 Stairs/Ramps: Exterior

Typically, stairs/ramps and associated building cheek/flank walls and railings should be scoped under “Exterior Masonry”. If deficiencies are found to the stairs or ramps that are resulting in water infiltration into below grade spaces, the stair/ramp work is to be scoped under the “Flood Elimination/Below Grade” category.

Inspect condition of steps, landings, railings, ramps, cheek walls, etc. Note if steps or landings are over interior spaces. Exterior entrances are a major source of water penetration into the basement of older schools. Many exterior stairs are constructed of loose bluestone treads spanning between walls that permits water to enter spaces beneath and may require a complete replacement with a sandwich slab system to provide a membrane to stop the infiltration. These items need to be carefully analyzed, as replacement of exterior entrances invokes Chapter 11 requirements of the 2014 NYC Building Code, thus requiring the entrance to be made accessible. Minor work at stairs/ramps to stop the water infiltration can be included in the Flood Elimination capital category. However, extensive damage of stairs and ramps that triggers replacement of stairs and/or ramps are to be scoped as SCA Additional Recommended Items, since the replacement will trigger requirements for accessibility.

The joint at the base of the building wall and pavement shall be inspected for deteriorated caulking and filler of the joint. Deteriorated and/or open joints are surprisingly many times a reason for water infiltration inside the building, even though they may seem like such a small item. However, these joints should always be noted as maintenance items because they will likely require replacement every 1-2 years to remain effective. Grading of the site is also critical and must be noted as part of this review.

### 3.5.4 Plaza Decks

Plaza Deck work, if required, should include removal of topping, waterproofing, repair of existing slab, and removal of masonry at the perimeter walls to extend the new waterproofing up the inside of the wall prior to installing a new topping of concrete pavers.

### 3.5.5 Vaults/Bunkers

Vault areas may experience water infiltration due to damaged waterproofing below concrete walkways/sidewalks or deteriorated joints at the junction of the building and walkway. Water infiltration may cause damage of the bottom of the slab, concrete encasement of beams, hangers for piping, etc.

Condition of vault doors, coal chute covers, service elevator doors and their perimeters shall be inspected to ensure watertight conditions. These are many times corroded or completely open, permitting surface water to flood the areas.

To address water infiltration at existing vault areas, plaza decks, etc., remove the existing concrete topping and waterproofing down to the structural concrete. Perform concrete repair of the slab, apply new waterproofing and install new concrete topping or pavers above as required to restore the surface conditions. These types of repairs should only be implemented after a thorough investigation of the existing conditions and a determination of the specific cause(s) of leakage. In some cases, simple flashing details can be repaired, replaced, or added to address leakage as opposed to removing and replacing large areas of waterproofing.

### 3.5.6 Mechanical

The number, type, and condition of sump pump(s) shall be evaluated, especially when the school is experiencing water related issues in the basement area. Many times non-working or under capacity sump pumps are the reason for flooding in the basement. This condition shall be noted in the referred item. Broken water, storm or sewage pipes may sometimes be the reason for water related issues.

Frequency and timing of water infiltration and testing of water may help to determine the source of water infiltration (Refer to Building Envelope Scoping Guidelines for additional discussion). When possible, disconnect and cap existing pipes, reroute and relocate new pipes to avoid breaking through and repair of existing slabs or walls. This work shall be included in the referred item. During the scoping, engage the services of a firm that can perform video monitoring of the piping, which may reveal broken pipes or blockages that may be causing the flooding.

In case of water back flow especially after heavy storms, verify condition of storm and sewage water connection from the basement to the street.

## 3.6. Related Items

Some HVAC fans, hot water heater, gas and water lines, etc. may be sitting low on the floor that require removal, rerouting and/or relocating at a new location to facilitate work related to flood elimination, which is often an injection program, but may also include surface applications. If the solution requires installation of a new slab, the reinstallation and/or replacement of the HVAC

equipment, water heaters, pipe lines, electrical panels, ducts, etc. should be included in the referred item, not as SCA Additional Recommended Items.

Electrical panels may be located on walls that are experiencing water infiltration. Due to water infiltration through the walls and/or floor slab, the side and bottom of the panel box may be severely rusted and deteriorated. In order to perform flood elimination work, therefore, electrical supply may require disconnection, temporary supply provided, and reconnection of a new panel. This work should be included in the referred item.

### 3.7 Design Considerations

Proposed Building Envelope Modifications shall be designed to meet or exceed Energy Code Requirements, where applicable. Refer to the Building Envelope Scoping Guidelines for discussion of Energy Code Compliance.

Drawings should clearly indicate the areas that require area injection or crack injection. When doing crack and area injection, include injection of all construction joints. Add a provision for filling voids with additional expanding urethane or cement grout if required during construction.

Ensure that the areas of injection are accessible and clearly indicate items to be removed and reinstalled or relocated to facilitate the injection.

Include detailed work related to water, storm, sewage and/or gas pipes including rerouting instead of including general statements.

When storm and sewage lines are being separated, include a detention tank in the playground to restrict storm water flow. The design must be approved by DEP, so a preliminary meeting with DEP is recommended instead of meeting with DEP after completion of the project. A preliminary meeting should also shorten design filing time.

Though exterior work is typically not performed when doing chemical resin injection, improperly sloped landscape and pavement areas should also be regraded to reduce the water that could eventually infiltrate through the wall.

**End of Flood Elimination/Below Grade Scoping Guidelines**