

Policies for the Administration of
Ontario Regulation 177/06



Development, Interference with Wetlands and Alterations
to Shorelines and Watercourses

Appendix E

Floodproofing and Access Standards

Appendix E – NBMCA Floodproofing Guidelines

1.0 INTRODUCTION

Floodproofing is defined as “a combination of structural changes and/or adjustments incorporated into the basic design and/or construction or alteration of individual buildings, structures or properties subject to flooding so as to reduce or eliminate flood damages”. It is acknowledged that this term is somewhat misleading, since total protection from flood damage cannot always be assured. However, if applied effectively, floodproofing can play a significant role in comprehensive flood plain management.

Floodproofing is generally most appropriate in situations where moderate flooding with low velocity and short duration is experienced and where traditional structural flood management such as dams and channels are not considered to be feasible. Although measures can be applied to both existing and new developments, it is usually impractical, expensive and extremely difficult to floodproof existing buildings.

Since floodproofing is best incorporated into the initial planning and design stages, new development has the greatest potential for permanent structural adjustment. In general, floodproofing can be applied most economically and effectively in the design of new buildings in developing areas. It can also be applied to infilling situations and proposed additions in developed areas. However, as well as providing adequate flood protection, new development within developed areas will have to take into account special considerations such as the aesthetic blend with neighbouring properties.

Floodproofing, whether wet or dry should be no lower than the Regulatory flood level. The only exceptions are in cases where an addition is proposed to an existing structure or there is one remaining infilling lot in a neighbourhood. In these instances, the floodproofing level should be no lower than the first floor levels of the existing structure or the adjacent structures.

1.1 TYPES OF FLOODPROOFING

All floodproofing measures can be described as active or passive and providing wet or dry protection.

1.1.1 Active vs Passive Floodproofing

Active floodproofing requires some action, i.e. closing watertight doors or sandbagging for the measure to be effective. Advance flood warning is almost always required in order to make the flood protection operational.

Passive floodproofing measures are defined as those that are in place and do not require flood warning or any other action to put the flood protection into effect. These include construction of development at or above the flood standard, or the use of continuous berms or floodwalls.

1.1.2 Dry vs Wet Floodproofing

The object of **dry floodproofing** is to prevent the entry of floodwaters into the structure. Such can be carried out by elevating the development above the level of the flood standard or by designing walls to be watertight and installing watertight doors and seals to withstand the forces of flood waters. The benefit of floodproofing using elevation is that it is passive and advance warning of an impending flood is not required. Temporary watertight closures, on the other hand, are considered to be active floodproofing usually requiring advance warning for operation.

The object of **wet floodproofing** is to allow floodwaters to safely enter and exit the structure while minimizing damage. Its use is generally limited to certain specific nonresidential / non-habitable structures (e.g. arena, stadium, parking garage), but many wet floodproofing techniques can be used with certain dry floodproofing approaches. Wet floodproofing seeks to maintain structural integrity by avoiding external unbalanced forces from acting on buildings during and after a flood, to reduce flood damage to contents, and to reduce the cost of post flood clean up. As such, wet floodproofing requires that the interior space below the level of the flood standard remain unfinished, be non-habitable, and be free of service units and panels, thereby ensuring minimal damage. Also, this space must not be used for storage of immovable or hazardous materials that are buoyant, flammable, explosive or toxic. Furthermore, access ways into and from a wet floodproofed building must allow for safe pedestrian movement.

For new development, dry floodproofing above the level of the flood standard can generally be economically and easily achieved early in the design phase. However, dry floodproofing of structures which will have portions below the level of the flood standard will require additional special design attention so that the structure will resist all loads including hydrostatic pressures.

1.2 FLOODPROOFING REQUIREMENTS

The NBMCA in general applies the floodproofing criteria outlined in the MNR Natural Hazards Guidelines. The following sections clarify how the NBMCA applies floodproofing measures for development within its area of jurisdiction.

1.2.1 Floodproofing Requirements

In general:

- Active floodproofing is not permitted (any floodproofing that requires human action such as watertight door seals or temporary barriers),
- Safe access (i.e. ingress and egress), as defined in Section 1.3 below, must be provided,
- NBMCA does not permit the use of floodproofing based on columns, piles and piers,
- NBMCA does not permit berms (or levees) and floodwalls to be used for floodproofing.

All new development should be floodproofed to the following standards:

Habitable, Commercial, Industrial and Institutional Uses:

- Where property fabric allows, a minimum of 3 metres of fill shall be placed around the perimeter of any buildings with top of fill at or above the Regulatory Flood Elevation, and/or as specified by NBMCA's Engineer,

- Public roads and driveways must be established no lower than 0.3m below the Regulatory Flood Elevation (Regulatory Flood Elevation - 0.3m),
- Openings in structures must be established 0.3m above the Regulatory Flood Elevation (Regulatory Flood Elevation + 0.3m),
- Structures should be sealed and made watertight to the Regulatory Flood Elevation + 0.3m,
- Where basements or structures are being proposed more than 0.2m below the Regulatory Flood Elevation, the design of the floor slab must incorporate additional reinforcement to withstand hydrostatic pressures, and basements must incorporate a sump pump,
- Where basements or structures are being proposed more than 0.8m below the Regulatory Flood Elevation, the design of the walls and floor slab must be completed by a qualified structural engineer or architect to be watertight and reinforced to withstand hydrostatic pressures, and basements must incorporate a sump pump,
- All sump pumps shall have the capacity to handle total inflowing water. The sump discharge shall be established above the Regulatory Flood Elevation + 0.3m,
- Septic tank openings and tiles and trenches for effluent disposal beds should be established above the Regulatory Flood Elevation,
- Electrical panels, appliances, mechanical, heating services and other services subject to damage from flooding must be established above the Regulatory Flood Elevation + 0.3m,
- All electrical/mechanical systems and equipment must be located above the Regulatory Flood Elevation + 0.3m unless approved for use in situations where flooding may occur, and
- All storage of chemicals, toxins, pollutants must be located above the Regulatory Flood Elevation + 0.3m.

Auxiliary/Non-Habitable Uses:

- Foundation must be a concrete slab structure with standard anchoring, or designed by a qualified structural engineer to resist hydrostatic and hydrodynamic forces,
- During a flood event, water must be allowed to enter, move within, and exit a proposed accessory structure to prevent differential hydrostatic pressures. It is required that all enclosed structures have a minimum of two exterior openings, located in different walls, located no more than 0.15m above exterior grade, to allow the entry and exit of flood water,
- All storage of chemicals, toxins, pollutants must be located above the Regulatory Flood Elevation + 0.3m,
- All electrical/mechanical systems and equipment must be located above the Regulatory Flood Elevation + 0.3m unless approved for use in situations where flooding may occur, and,
- All materials used to construct below the Regulatory Flood Elevation + 0.3m must not be subject to damage or deterioration as a result of being flooded.

In general, all additions to existing development must be floodproofed to the following standards:

- Any addition will be considered as new development and subject to the same restrictions as above.

- Modifications should be made to the existing structure to bring the existing structure to the highest level of floodproofing possible.

Please note that plans will be required that indicate the following:

- 1) Survey prepared by an Ontario Land Surveyor (O.L.S.) indicating existing ground elevations in the work area as well as Regulatory Flood Elevation,
- 2) A pre and post grading plan prepared by O.L.S. or Professional Engineer (P.Eng) may be required to confirm above requirements,
- 3) In the case of cut/fill work, an as-built grading plan prepared by an O.L.S. or P.Eng may be required to confirm the balance of floodplain storage,
- 4) At the discretion of the NBMCA, the O.L.S. or P.Eng shall confirm, in writing, that the site has been constructed as per the plans submitted, and that all structures and access/egress routes have been appropriately floodproofed.
 - a) no openings have been constructed below Regulatory Flood Elevation +0.3m, and,
 - b) access to all residential or occupied buildings by driveways have been floodproofed.

1.3 NBMCA ACCESS (INGRESS/EGRESS) CRITERIA

The term “safe access/egress” refers to the ability of both pedestrians and vehicles to enter and exit a property safely during flood events. The maximum depth, velocity and depth/velocity product guideline for the NBMCA jurisdiction is based on the information provided for in Appendix 6 of the MNR’s 2002 “Technical Guide – River & Stream Systems: Flooding Hazard Limit”. Where safe access and egress is required for new development, the NBMCA assumes that both pedestrian and vehicular access/egress is required. Residents and emergency personnel must be able to have pedestrian access between vehicles and the development. Both residents’ vehicles and emergency vehicles must be able to safely pass between the development and the municipal roadways outside of the floodplain. The NBMCA applies the following criteria to determine safe access/egress:

- Maximum depth of flooding of 0.3 m for vehicular access,
- Maximum depth of flooding of 0.8 m for pedestrian access,
- Maximum velocity of flooding of 1.7 m/s,
- Combined depth velocity product of 0.4 m²/s, and
- A depth velocity product of 0.4m²/s is selected as it indicates an area of low risk to individuals and cars being overcome by flood waters.

The above criteria will apply both on the proposed development property and to the municipal right-of-way that is adjacent to the property to an area located outside of the floodplain. Where the depth criteria for safe access cannot be achieved for a site due to the municipal right-of-way being subject to unsafe conditions, the NBMCA may undertake consultation with municipal emergency services to obtain confirmation that alternative provisions for safe access will be used for the subject site; as such, the NBMCA may consider development on the property.

1.4 FLOODING RISK CRITERIA

The following sections define the different risk levels for development in lots of record with appropriate zoning in the floodplain.

1.4.1 Acceptable Risk

The NBMCA defines areas of acceptable risk as any portion of the lot for new development that meets the following:

- Flood depths less than or equal to 0.8 metres,
- Velocities less than or equal to 1.7 m/s,
- A depth-velocity product less than or equal to $0.4 \text{ m}^2/\text{s}$, and,
- That safe access/egress as defined in Section 1.1 is provided on the municipal right-of-way.

Developments within this area will need to provide:

- Floodproofing of the development as per Section 1.5,
- Access and egress to the municipal road; above the Regulatory storm flood elevation if possible, and as a minimum meet the safe access and egress criteria, and
- If the access/egress route is subject to flooding, provide permanent markings showing the location of the route.

1.4.2 Unacceptable Risk

Areas of high risk in the floodplain are defined as:

- Flood depths greater than 0.8 metres,
- Velocities greater than 1.7 m/s, or,
- A depth velocity product greater than $0.4 \text{ m}^2/\text{s}$.

These areas are considered to be areas of unacceptable risk due to the extreme risk to life if a pedestrian or a vehicle were to enter into these flood waters. The amounts of fill that would be required to floodproof such structures would have significant cumulative impacts to the storage volumes within the floodplain.

1.5 CUT/FILL BALANCE

The NBMCA may allow in certain cases fill to be placed within the floodplain, provided that a cut/fill balance of the floodplain is completed to the satisfaction of the Authority engineer. These cases require that pre-consultation is done with NBMCA prior to the first submission and is normally used to regularize the boundaries of a development to provide a better development layout. Cut/fill balances, approved in principle by NBMCA, must be completed on a 0.3 metre increment such that the cut and fill are balanced for each 0.3 meter increment. In special circumstances other criteria may be applied as approved by NBMCA engineering staff.