VISION 2016 – 2020
Conservation Ontario will be the leader in engaging Conservation Authorities in matters of common interest and in shaping effective policy related to Conservation Authorities

Conservation Ontario Council Report

From: Jo-Anne Rzadki, Conservation Ontario

Date: November 28, 2017

Subject: CO Comments: Preventing Disaster Before It Strikes: Developing a Canadian Standard for New Flood-Resilient Residential Communities, 20 Critical Best Practices

Summary

The Intact Centre for Climate Adaptation and Standards Council of Canada (SCC) released Preventing *Disaster Before it Strikes: Developing a Canadian Standard for New Flood-Resilient Communities, 20 Critical Best Practices in* September of this year. Toronto Region CA, Credit Valley Conservation and Conservation Halton provided comments on earlier versions and the final document was circulated to CAs for comment in advance of SCC commencing work on a Canadian Standard. The strengths and expertise of the CA collective, including the benefits of the flood management program in Ontario is demonstrated and promoted and recognized by others when input is provided towards the development of national standards like the one to be developed for new flood resilient communities. CAs will be notified of further opportunities for CA engagement.

Recommendation

THAT Conservation Ontario Council endorse CO comments on Preventing Disaster Before it Strikes: Developing a Canadian Standard for New Flood-Resilient Communities, 20 Critical Best Practices

---

Background

The Intact Centre for Climate Adaptation and Standards Council of Canada (SCC) released Preventing *Disaster Before it Strikes: Developing a Canadian Standard for New Flood-Resilient Communities, 20 Critical Best Practices in* September of this year (See weblink below).

Some conservation authorities commented on earlier drafts of this report, including Conservation Halton, Credit Valley Conservation and Toronto Region Conservation Authority represented by Sameer Dhalla at a March 2017 working session on this subject. On the release of the Final report in September, The Intact Centre broadly circulated an invitation to provide comments on this Report in advance of commencing work on a Canadian Standard.

Current Status

Given the time sensitive nature of this request, CH, TRCA and CVC staff previously engaged in the process contributed to the development of a draft letter which was circulated for comment to CA Provincial Flood Forecast and Warning contacts, Flood Business Case Working Group and Subcommittee members, CAOs and CO staff. It is important to demonstrate the strengths of the CA collective and the benefits of the flood management program and partnership in Ontario.

Comments on the draft letter were provided by Cataraqui, Grand River and St. Clair Region CA staff with additional input of TRCA, CVC and Conservation Halton and submitted to the Intact Centre for Climate Adaptation on November 6, 2017.

Natalia Moudrak, Director at the Intact Centre and Christie Moore, Sector Specialist, Strategy and Stakeholder Engagement at the Standards Council of Canada responded by e-mail that the CO comments were valued and will serve to inform the upcoming National Standard of Canada (NSC) based on the "Best Practices" Report. The upcoming NSC will be developed by an accredited standards development organization (SDO). The accredited process for an NSC serves to ensure the resulting standard will be consensus-based and developed by a technical committee that consists of a balanced matrix of stakeholders. This will include expertise in the area of Low Impact Development and conservation.

Regarding specific standards for LID, the SCC welcomes additional ideas as to where standards might help improve the uptake / application of LID. CO comments on the Ministry of Environment and Climate Change Low Impact Development Guidelines currently under development will be provided to SCC for information.

In terms of current ongoing work at SCC, CAs may also be interested in the pending update of *PLUS 4013 (2nd ed. pub. 2012) - Technical guide: Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners*. SCC is supporting an update of this technical guide with involvement/support from Environment and Climate Change Canada. This will also require a balanced matrix of stakeholders on the committee, and will most likely include conservation expertise around the table.

Conclusion

The strengths and expertise of the CA collective, including the benefits of the flood management program in Ontario is demonstrated and promoted when input is provided towards the development of national standards like the one to be developed for new flood resilient communities. Standards Council of Canada recognizes the important work that the Conservation Authorities do and is interested in exploring any opportunities for further collaboration, including participation in the standardization process.

Additional Resources (for information only, not required for printing)
Standards for Flood Resilience in New Communities: Preventing Disaster Before it Strikes

November 6, 2017

Ms. Natalia Moudrak
Director, Infrastructure Adaptation Program
Intact Centre on Climate Adaptation
Faculty of Environment, University of Waterloo
EV3 4334 -200 University Avenue West
Waterloo, ON, N2L 3G1

RE: Stakeholder Consultation - *Preventing Disaster Before It Strikes: Developing a Canadian Standard for New Flood-Resilient Residential Communities, 20 Critical Best Practices*

Dear Ms. Moudrak:

Thank you for sharing *Preventing Disaster Before It Strikes: Developing a Canadian Standard for New Flood-Resilient Residential Communities - 20 Critical Best Practices*, prepared by the Intact Centre on Climate Adaptation, dated September, 2017. Conservation Ontario is the network of 36 Conservation Authorities (CAs), watershed based organizations with a provincial mandate under the Conservation Authorities Act to play a key role in managing and reducing flood risk. CAs implement a range of services and programs with municipal and other partners to adapt and mitigate climate change impacts and build watershed resilience. Conservation Ontario is pleased to note that some conservation authorities contributed to earlier drafts of this report, including Conservation Halton, Credit Valley Conservation and Toronto Region Conservation Authority represented by Sameer Dhalla at your March 2017 working session.

Conservation Ontario strongly supports the goal of flood risk reduction and would welcome an opportunity to participate and support the development of a National Flood-Resilient Community Design Standard. The following is a response to your invitation to provide comments on this Report in advance of the Intact Centre on Climate Adaptation and the Standards Council of Canada commencing work on a Canadian Standard.

First, Conservation Ontario is pleased to note that many of the best practices identified within the report are already commonly implemented within Ontario, with some recommended best practices being less restrictive than Ontario's existing regulatory framework. The challenges associated with achieving consensus on effective and implementable recommendations that can be broadly supported across the country appears to have led to the elimination of several recommendations which merit further consideration, particularly with respect to greenfield development. As both of the following recommendations provide remedial benefits of addressing some of the root causes of flooding it is recommended that the following best practices be further considered:

- As is the case in Ontario, the adoption of a one-zone floodplain planning policy as the approach, excluding new greenfield residential development from the entire regulatory floodplain (including the flood fringe) and wetland areas; and

- While the report focuses on site scale options to support flood mitigation at the watershed scale, the adoption of a suite of complementary Integrated Watershed Management approaches is recommended. This includes protection of riparian corridors, wetlands, and natural features, ensuring development and stormwater management practices are guided by current watershed and subwatershed management studies, application of Low Impact Development practices to reduce runoff generation, implementation of source controls related to water re-use, infiltration and evapotranspiration, etc.

Additional discussion supporting the above recommendations has been incorporated into responses to Feedback sought associated with recommendations DR1 - New homes should not be built in the floodway, DR3 – New development should not increase the risk of flooding for existing communities, PNF1 – Development should not encroach on riparian buffers, and PNF 2 – New development should aim to minimize runoff from impervious areas. While the above measures do not represent complete solutions to address flooding, they are complementary, no-regrets management approaches that, through widespread application throughout Ontario, have been shown to successfully reduce the severity of flood damage.

1. **DR1. New homes should not be built in the floodway. New homes should also not be built in the flood fringe, unless flood-proofing addresses flood risk in the flood fringe.**

Feedback Sought: Should new community development be permitted in the flood fringe? If yes, what are the most pertinent design considerations for new community development in the flood fringe?

Given the identified best practice relates solely to new, greenfield residential development, (i.e. development of areas previously used for agricultural or other non-population intensive uses), development within the flood fringe places additional people and property at undue risk. Permitting new greenfield residential development in the flood fringe (even when flood proofed) increases risk to life and property. Failure to protect the full extent of the floodplain allows for incremental loss of floodplain storage which, when considered cumulatively, has the potential to impact the extent and duration of flooding experienced by existing floodplain development. Should flood fringe development also result in loss of conveyance, the new floodplain development may increase flood elevations or increase flow velocities, accelerating erosion. Other considerations which support restricting new flood-proofed residential development within the flood fringe include:

- the challenges and limitations associated with accurately estimating the extent of the floodplain;
- uncertainties related to hydrologic changes associated with climate change impacts and future development within the watershed;
- uncertainties related to the estimation of cumulative impact from all future floodplain intrusions compounded by the loss of riparian functions, as well as the increase of impervious surfaces from new and existing development over time;
- difficulty in assessing and designing flood-proofing to protect against cumulative future flood fringe development (should it be permitted);
- difficulties in ensuring achievement of construction standards and on-going private maintenance of flood-proofing measures;
- the need to communicate potential risk and presence of specific passive flood-proofing measures to subsequent property owners;

- limitations of standard construction techniques to withstand flood depths of over 0.8 m;
- ability to safely access and evacuate residents living in the flood-fringe should it become necessary; and
- Loss of natural mitigating benefits associated with protection of the riparian corridor (please refer to comments associated with PNF1).

Development within the floodplain is subject to hydrostatic, hydrodynamic, and impact loadings, all of which may cause extensive damages to structures and contents if flood proofing measures do not adequately account for these forces. Flood proofing is further complicated by challenges in accurately predicting these forces, due to the dynamic nature of river systems and floods, and the inability of standard construction measures to withstand flood forces.

High flows associated with flooding have the potential to cause significant erosion, the effects of which may be difficult to predict. Erosion may cause loss of soils around a building foundation, shift the channel thalweg, the location where the highest flow velocities occur, dislodge large trees from a riverbank, increasing potential for impact loading, and debris jamming and flow blockages at culverts, etc. This may result in increases to the actual flood elevation relative to the modelled elevation, changes in the anticipated flow route or velocities associated with flood flows, and the weakening of structures in the floodplain.

Per the MNR's 2002 Technical Guide, River and Stream Systems Flooding Hazard Limit "…0.8 m (2.5 ft.) would appear to be the upper limit of effective flood depth (static plus equivalent hydrodynamic head) which can be resisted by conventionally designed structures without affecting structural integrity." It is important to note that the effective head only corresponds to a flooding depth of 0.8 m in still water, and the permissible depth of flooding that would not endanger structural integrity would be further decreased in proportion to velocity and impact potential. There are additional structural concerns related to hydrostatic uplift pressures. The 2002 MNR Guide also indicates "…hydrostatic head in excess of 0.2 m (0.7 ft.) may result in damage to basement floors (i.e. the upward force of groundwater on the basement floor)." It further indicates that bungalows may be subject to structural integrity issues and/or buoyancy where flood depths or groundwater levels are 1.2 to 1.5 m above the level of the basement floor.

Should a national standard advance a recommendation supporting flood-proofed development within the flood fringe, it will be important to recognize the provincial variability in the regulatory floodplain definition, and to establish an appropriate and consistent minimum standard of care, relative to the definition of the regulatory floodplain from which new development should be excluded. As documented, the range in regulatory flood standards, from the 1:500 year return flood in Saskatchewan, the 1:200 year return period flood in British Columbia, flood associated with specific rainfall events (Hurricane Hazel and Timmins in parts of Ontario), or the 1:100 year event, as well as variations in the definition of the flood fringe, results in a 'patchwork' approach to risk management across the country. It is recommended that at a minimum, new, greenfield development be built outside of the 1:100 year floodplain.

2. **DR2: "Safety Factors" should be used in new community design to account for potentially more frequent and severe rainfalls and stormwater system failures. (e.g. locating buildings further distance away from the edge of the floodplain)**

Feedback Sought: What safety factors/approaches should be used to account for severe weather and operational uncertainty in new community design? What are the best available tools to account for future climate change impacts from the standpoint of flood risk management?

Floodplain Safety Factors: Conservation Ontario has recommended to the province of Ontario that through broad consultation the establishment of updated provincial standards should consider climate change implications, with appropriate factors of safety to account for challenges in modelling and local variability.

In Ontario, the extent of the regulatory floodplain is determined based on application of a number of conservative assumptions, including near uniform rainfall distribution across the entire watershed, and no permitted attenuation associated with any man-made structure in the floodplain. Presuming other jurisdictions apply similar conservative approaches in floodplain delineation, it is recommended that the return interval associated with the regulatory flood or design flood be set with a sufficient degree of conservativeness to eliminate near and mid-term climate change assumptions as a key factor impacting the success of the flood mitigation strategy. (i.e. in Southern Ontario, regulating on the basis of Hurricane Hazel). Recognizing construction tolerances, modeling limitations, data gaps, projected climactic conditions etc., it is recommended that a factor of safety be applied to all regulatory floodplains.

Setbacks may be a simple and effective measure to provide a factor of safety, where setbacks consider both minimum horizontal and vertical tolerances or a proportional flow increase. A reasonable safety factor should be established through broad consultation , but consideration should be given to containing/protecting for a 15% increase in regulatory flood flow or a 0.3 m freeboard.

Major Drainage System Factors of Safety: Protecting conveyance to the limit of the regulatory floodplain should be maintained throughout the riparian valley system with consideration for an additional degree of freeboard, as described above. For the road network and 'built' features forming part of the major system, it is recommended that IDF prediction tools be applied to confirm anticipated future condition flows do not result in flooding extending beyond the road right of way, and ensuring safe access and egress may be maintained. Large scale stormwater management control facilities should be designed to capture and safely convey excess peak flows and runoff volumes associated with potential future conditions without failure. A minimum 0.1 m of freeboard between the design high water level and emergency spillway elevation is recommended, in conjunction with other measures (such as consideration of back-to-back storms) as required by the approval agencies.

3. DR3. New Development should be designed so that it does not increase the risk of flooding for existing communities.

Feedback Sought: What are the critical considerations for analyzing flood impacts of new development on downstream and existing communities?

As discussed briefly under comments associated with recommendation DR1, allowing new development within the flood fringe reduces floodplain storage and has the potential to impact conveyance, which consequently impacts the extent and duration of flooding experienced by existing communities located within the floodplain. The cumulative impact of all future floodplain intrusions compounded by the loss of riparian functions may be difficult to assess.

Increased peak flows and runoff volume associated with urban development necessitate stormwater management solutions that often shift when peak flows reach the downstream watercourse. Changes in timing must be assessed at an appropriate scale (which may be on a watershed, subwatershed or reach basis, depending on the size of the system) as this may result in increased peak flows downstream, even when developments control the release of stormflows to less than or equal to pre-development peak flows. When establishing stormwater management targets to ensure the protection of existing downstream development, anticipated controls associated with all potential future development (extending even beyond the current urban boundary) should be considered. The need for development controls up to and including the regulatory storm should be evaluated in conjunction with application of a suite of integrated watershed management approaches to limit changes in stormflow peaks and volumes. Potential failure risks associated with stormwater management systems should also be carefully assessed.

4. **DR4. New development should be designed to minimize the risk of basement flooding from groundwater infiltration.**

Feedback Sought: What are the critical considerations for assessing and minimizing groundwater seepage risk for new developments?

Under extreme storm events, ponding for extended durations may cause significant hydrostatic pressures on structures within or adjacent to the floodplain, with foundations or basements extending below the ponded elevation. Per the MNR's 2002 Technical Guideline:

> Based on normal (conventional) construction methods, any hydrostatic head in excess of 0.2 m (0.7 ft.) may result in damage to basement floors (i.e. the upward force of groundwater on the basement floor). Even where the basement of a single story brick or masonry structure has been structurally reinforced and/or made watertight, structural integrity or buoyancy may pose problems when groundwater (saturated soil) levels are 1.2 - 1.5 m (4 - 5 ft.) above the level of the basement floor. Much depends on the duration of the flooding, type of soil and the presence/effectiveness of the drainage system.

The effect of potential hydrodynamic pressures and soil saturation resulting from floods should be considered as part of the structural design where basements and or foundations extend below elevations anticipated to be subject to extended ponding.

Nevertheless it is strongly recommended there should be a focus on keeping the floor level above potential high groundwater conditions so that extensive dewatering/discharge is not required, and to prevent damages arising from power disruption during extreme events. Further consider that basement flooding from *groundwater sources* is not necessarily, or not even typically, related to specific at-surface flood events such as a design storm. It may be more closely tied to seasonal fluctuations in the groundwater table and is perhaps exacerbated by wetter-than-normal "seasons". It is recommended that hydrogeologic studies be undertaken to define seasonally high groundwater tables to the extent possible, perhaps apply a factor of safety to account for potentially wetter seasons, then either keep basements out of the groundwater table or incorporate design elements to minimize potential impact.

5. STO3. Inlet control devices (ICDs) should be used to restrict the flow of stormwater from the street into storm sewers

The examples cited as successful application of ICDs for reducing flood damages likely involved the retrofitting of existing sewer systems, not the design of new, greenfield development as is being discussed within the current document. For new developments, designing for surcharge capacity and appropriate connectivity and backflow prevention should suffice. If ICDs are deemed to be required in a new design, the associated pipes are likely being unnecessarily oversized.

6. SD3. Roads should be designed so that the maximum depth of water during the extreme design condition does not exceed 30 cm at the curb.

Feedback Sought: What is the maximum depth of ponding on the right of way that should be permitted?

It is recommended that the maximum depth of ponding permitted be based on vehicular buoyancy and that the criteria be expanded to consider flow velocity and impacts on vehicular stability. As available guidelines on vehicle stability and buoyancy when exposed to flowing water are dated, and may not be reflective of current vehicular form, it is also recommended that newer supporting information be sought to confirm the relative depths associated with loss of vehicular stability, and loss of vehicular propulsion for modern vehicles.

7. WP1. Wastewater pumping stations should be located in areas where they will remain operational and fully-accessible during extreme rain events.

Feedback Sought: What is the appropriate level of service for wastewater pumping stations? Should there be a freeboard requirement for wastewater pumping stations, consistent with a major system freeboard?

In Ontario, per Section 3.15c of the Provincial Policy Statement 2014, "development shall not be permitted to locate in hazardous lands and hazardous sites where the use is: …uses associated with the disposal, manufacture, treatment or storage of hazardous substances." New pumping stations should be fully accessible under the regulatory storm. Additional freeboard requirements consistent with any recommended freeboard applied to the regulatory floodplain may be considered; particularly should the 1:100 year floodplain standard be maintained as the national standard.

8. PNF1. Development should not encroach on riparian buffers (land and natural vegetation adjacent to waterbodies), and sufficient setbacks should be maintained along the water bodies to reduce the risk of flooding due to stream movement and bank erosion.

Feedback Sought: What are key considerations for determining minimum setbacks along water bodies and minimum vegetated buffer zones?

Conservation Ontario supports establishment of the riparian buffer on the basis of the combined future flood and erosion hazard, which would account for natural riparian processes that have the potential to place development at increased risk. The Intact Centre and Standards Council of Canada are reminded of the July 2017 report: *When the Big Storm Hits- The role of Wetlands to limit rural and urban storm damage* which details the impact of upstream wetland conservation on downstream flood damage, conservatively estimated at 29-38% reduction in flood damage costs.

Protection of riparian corridors and wetlands offer a suite of complementary benefits to reduce potential flooding impacts, in conjunction with a host of other environmental benefits. Maintaining well vegetated riparian corridors and wetlands allow for significant storage, interception of rainfall, evapotranspiration and enhanced infiltration, as well as the potential for carbon sequestration, and reduction in heat island effect. This aids in mitigating a portion of the increased runoff generated by urban uses, and provides complementary benefits such as drought attenuation, habitat protection, water and air quality improvement, etc. Maintaining the floodplain within the natural riparian corridor allows for passive flow conveyance and poses a decreased potential for flooding related to blocked inlet structures, should the alternative be conveyance of flows through an underground pipe network.

9. PNF2. New development should aim to minimize runoff from impervious areas.

Feedback Sought: What are key considerations for determining impervious surface area limits?

With respect to the recommendation PNF2:

Broad scale adoption of integrated watershed management including Low Impact Development measures and source controls focused on water re-use, infiltration and evapotranspiration are among the few tools available to deal with increased runoff generation resulting from urbanization, a root cause of flooding. While it may not be possible to limit impervious surface areas, adoption of a stormwater management approaches that focus on mimicking the pre-development water balance may be an effective measure in mitigating a portion of the flood risk. Current monitoring by the Sustainable Technologies Evaluation Program has demonstrated that Low Impact Development can be effective at providing flood control for storms up to and including the 10 year storm. This can be further improved with the incorporation of additional subsurface storage. There are numerous papers that discuss how Low Impact Development can provide flood quantity benefits, including examples found here:
https://www.witpress.com/Secure/elibrary/papers/SC12/SC12039FU1.pdf
https://www.estormwater.com/sites/estormwater.com/files/20_5.6.12-Flood%20Control%20LID.pdf

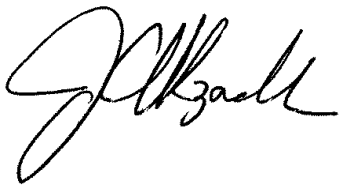
With respect to the question above :

Copious literature indicates that hydrologic changes occur whenever impervious coverage exceeds roughly 10-15%. As noted previously, the reduction in evapotranspiration has to be compensated by either increases in runoff, infiltration, or both. What is typically referred to as a "water balance" is most often not. Rather the intention is to focus on balancing post-to-pre infiltration volumes only.

Finally, Conservation Ontario is supportive of identifying initiatives that would further complement the standard and support flood risk reduction in Canada as noted in Section 3 *National Standard for Flood-Resilient Residential Community Design: Enabling Environment,* and specifically, the completion of up-to-date, forward-looking floodplain maps, as having updated maps wil underpin any flood management effort. The report points to new national guidance being developed, however it should be noted that conservation authorities, municipalities and their provincial partners including the Ministry of Natural Resources and Forestry have developed guidance, policies and innovations that the rest of Canada can benefit from. Funding should be made available to update floodplain maps to reflect current land use and technologies on a 10 year cycle.

We hope the above comments and feedback on the Report: *Preventing Disaster Before It Strikes: Developing a Canadian Standard for Flood Resilient Residential Communities, 20 Critical Best Practices* will be helpful in commencing the development of the Canadian standards based on the framework presented in this document. We welcome the opportunity to develop an ongoing partnership with the Intact Centre for Climate Adaptation, and to continue to participate on the forthcoming standards development. Should you have any questions, or wish to discuss any of the above further, please contact me at ext. 224 e-mail: jrzadki@conservationontario.ca.

Sincerely,



Jo-Anne Rzadki, MSc.
Business Development and Partnerships

cc: Christie Moore, Sector Specialist, Strategy and Stakeholder Engagement, Standards Council of Canada
Kim Gavine, General Manager, Conservation Ontario
Conservation Authorities of Ontario