



Corporate Report

NO: R033

COUNCIL DATE: March 30, 2009

REGULAR COUNCIL

TO: Mayor & Council DATE: March 19, 2009
FROM: General Manager, Engineering FILE: 4808-701
SUBJECT: Crescent Beach Climate Adaptation Strategy Addressing Drainage Concerns

RECOMMENDATION

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The Engineering Department recommends that Council receive this report as information.

INTENT

The purpose of this report is to provide information for Council regarding the Crescent Beach Climate Adaptation Study.

BACKGROUND

Crescent Beach Area Characteristics

The Crescent Beach community is situated within the Boundary Bay floodplain. The current flood control strategy within Crescent Beach consists of a system of dykes protecting the area from ocean surges and storms with the intention that flooding would only occur under extreme conditions. Although the dykes currently provide adequate flood protection, the area has relatively poor drainage.

The residents within Crescent Beach have expressed the opinion that over the last 10 years they have experienced more frequent and more significant flooding than in prior years. In response to these concerns, staff has completed a comprehensive drainage assessment of the area. This assessment serves as a first step in developing a climate adaptation strategy that will address the long-term drainage needs within Crescent Beach.

Assessment of the Existing Drainage System

The first step in the drainage study was a meeting with the Crescent Beach Ratepayers Association followed by a questionnaire being sent to all of the residents in the area. These actions were focused on developing a better understanding of the community's

concerns with drainage and expectations with regard to level of service. Of the respondents to questionnaire, 45% advised that they had either minor to no drainage issues while 55% described experiencing minor to significant drainage issues during winter months.

To better assess different drainage solutions, a detailed hydraulic model was developed for the area. The modeling recognized that winter months bring higher ocean levels and periods of prolonged precipitation, which causes the groundwater table to rise, reducing the ground's available capacity to absorb precipitation. This results in water ponding on the ground surface during winter months and flooding basements and crawlspaces in some areas due to the floor being below the winter groundwater level. These influences are schematically shown in Appendix I.

Presently less than half of the area of Crescent Beach has drainage mains. A detailed assessment of the existing drainage infrastructure in the area was also completed. This drainage infrastructure is relatively old and will require replacement within the next 20 years. The Maple Pump Station that serves part of the area was constructed in 1968 and will need replacement within 5 years.

Influence of Climate Change on the Community

A range of sources were reviewed to compile current information on climate change. The sources included the Intergovernmental Panel on Climate Change (IPCC), B.C. Ministry of Environment, University of Washington, and National Research Council of Canada. Although knowledge of climate change is still evolving, based on current best available research, sea levels near Crescent Beach are expected to rise by between 0.26 m and 0.73 m over the next 100 years. Normal land subsidence will result in the existing ground receding by 0.1 to 0.25 m over that same period. For study purposes, an average change in sea level and ground level of 0.67 m was used. Using this change in relative elevation, the internal drainage system and the ocean dyke system is not sufficient to protect the community from significant flooding. Rising sea levels will also have a significant impact on the local groundwater table. As sea levels rise over time, the groundwater table could potentially rise above the ground surface, causing flooding that would occur with the incoming tide and would subside with the receding tide. It is important to understand the potential climate change effects in order to design resilient infrastructure to better serve this community.

Influence of Development on the Community

In this floodplain, all new habitable construction is to be constructed to an elevation of 3.3 m above sea level to meet Provincial flood regulations. The City has the right to vary this requirement and has developed a policy in this regard. On most lots in Crescent Beach, the existing older houses are 2 to 3 m below the Provincial flood regulation elevation. The existing small lots within the area cannot easily be raised to the Provincial flood levels and the City has allowed some variances so as to maintain neighbourhood consistency between newer residences and older ones on neighbouring lots and to facilitate servicing, especially in relation to lot grading. The result has been some inconsistencies within the neighbourhood with respect to building elevations.

As the properties have been redeveloping in the community, new buildings are usually larger and area covered by impervious surfaces has also been increasing. The increase of impervious surface area has affected the speed at which absorption of rainfall and runoff water occurs.

DISCUSSION

Developing the Proposed Climate Adaptation Strategy

Various flood control strategies to improve drainage within the Crescent Beach area were developed and evaluated. Objectives that were considered when developing and evaluating potential strategies included:

- Reducing the impacts from increases in precipitation and rising sea and groundwater levels;
- Reducing the impacts from redevelopment (lot coverage issues);
- Community expectations, acceptance, and support for the proposed strategy; and
- Financial implications in relation to capital and operating costs.

Prior to selecting a strategy, a second resident questionnaire was distributed to determine the community's support for alternative servicing options. The servicing options included:

1. The installation of a series of open ditches throughout the community. An open ditch system would capture and drain storm water runoff and control groundwater levels by dewatering the saturated soils near the ground surface.
2. The installation of a new underground-perforated storm sewer system throughout the community. This would have the same positive effects as an open ditch system but would be less visible while more costly.
3. Raising the land. Given that the entire community is in a floodplain, raising the land will be critical in providing long-term flood protection and some filling must form part of any drainage strategy. Input from the community was necessary to assist in establishing an acceptable rate for raising the land.
4. Restricting the area of each lot that could be covered with a building or impervious surfaces to maintain pervious areas for infiltration of stormwater runoff.

Of these options, there was strong community support for Option 2. The community also responded favourably to Option 3, supporting raising the land in lifts of between 0.5 to 1.0 m.

The Proposed Climate Adaptation Strategy

After taking into account community input, a servicing strategy has been developed. It involves the installation of a perforated pipe storm sewer system combined with a new

drainage pump station and flood box. The perforated pipe storm sewer system will provide an efficient conveyance system for storm water runoff while also being able to lower groundwater levels. The perforated system would maintain a relatively constant groundwater table elevation and draw groundwater down in the developed portions of the study area. Areas closer to the shoreline will be serviced by a sealed pipe system to prevent it from drawing large quantities of ocean water. Even with this proposed drainage network in place, some areas of the community are still too low to be adequately protected against high groundwater levels and will need to be raised over time.

Land elevations needed to provide drainage servicing in the long term were studied. Two approaches were considered in relation to establishing the Minimum Building Elevation (MBE) for new homes in the study area. These are:

1. If the Provincial standards are respected, the MBE elevation of 3.35 m geodetic is required throughout the community.
2. Alternatively, MBEs could be established based on the land filling required to provide adequate drainage without fully protecting the area from major floods related to the dykes overtopping. Under this approach some community flooding could occur. The MBE resulting from this approach would be 1.9 m geodetic. Under this approach, new homes constructed in the Crescent Beach community should not be permitted to have basements or crawlspaces below the recommended MBE elevation.

With sea levels predicted to rise on average 0.67 m over the next 100 years, the existing dyke system surrounding the Crescent Beach community will need to be raised by this height to maintain the protection level. Many residents in the community were initially opposed to the dyke work fronting Boundary Bay that was done in 2000, citing concerns with accessibility and views. During the strong storm surges that breached dykes in Delta in 2006, Crescent Beach was well protected by the dyke work carried out in 2000. Since dyke improvement works will not be necessary for some time since the rate of sea level change is slow, the City has an opportunity to work with scientists to better establish actual local sea level changes and to continue consultation with the community on sea level impact on the dykes.

Capital Requirement for the Climate Adaptation Strategy

The cost to implement the proposed climate adaptation strategy, which includes a perforated-pipe storm system, pump station and floodbox and filling of City property, is estimated at approximately \$25 to \$30 million. No determination has been made as to how the City will fund these works although a combination of a Local Area Service, Drainage Utility, Development Cost Charges and Provincial funding will be explored.

Next Steps

It is very important that as the City moves forward with the strategy that the residents be apprised of the level of service that will be achieved so that resident expectations are in line with the City's ability to deliver and that the residents have a clear understanding of their involvement and expected financial contribution toward the implementation of the

strategy. Over the next few months additional public information opportunities will be rolled out to explain the proposed strategy, its features, their function and the rationale underpinning the strategy. Concurrently, further analysis will be completed to determine the timing and methodology for implementation of the strategy.

CONCLUSION

Climate change, land subsidence and redevelopment will have an impact on local drainage within the Crescent Beach community in the future. Sea level rise will translate into higher groundwater levels, which must be managed to limit impacts on the community. The City has developed a new drainage strategy for the area that involves a new perforated pipe storm sewer system, combined with a new drainage pump station and flood box. This strategy will assist in controlling the extent and frequency of high groundwater levels in the area and will mitigate significantly the extent to which flooding occurs.

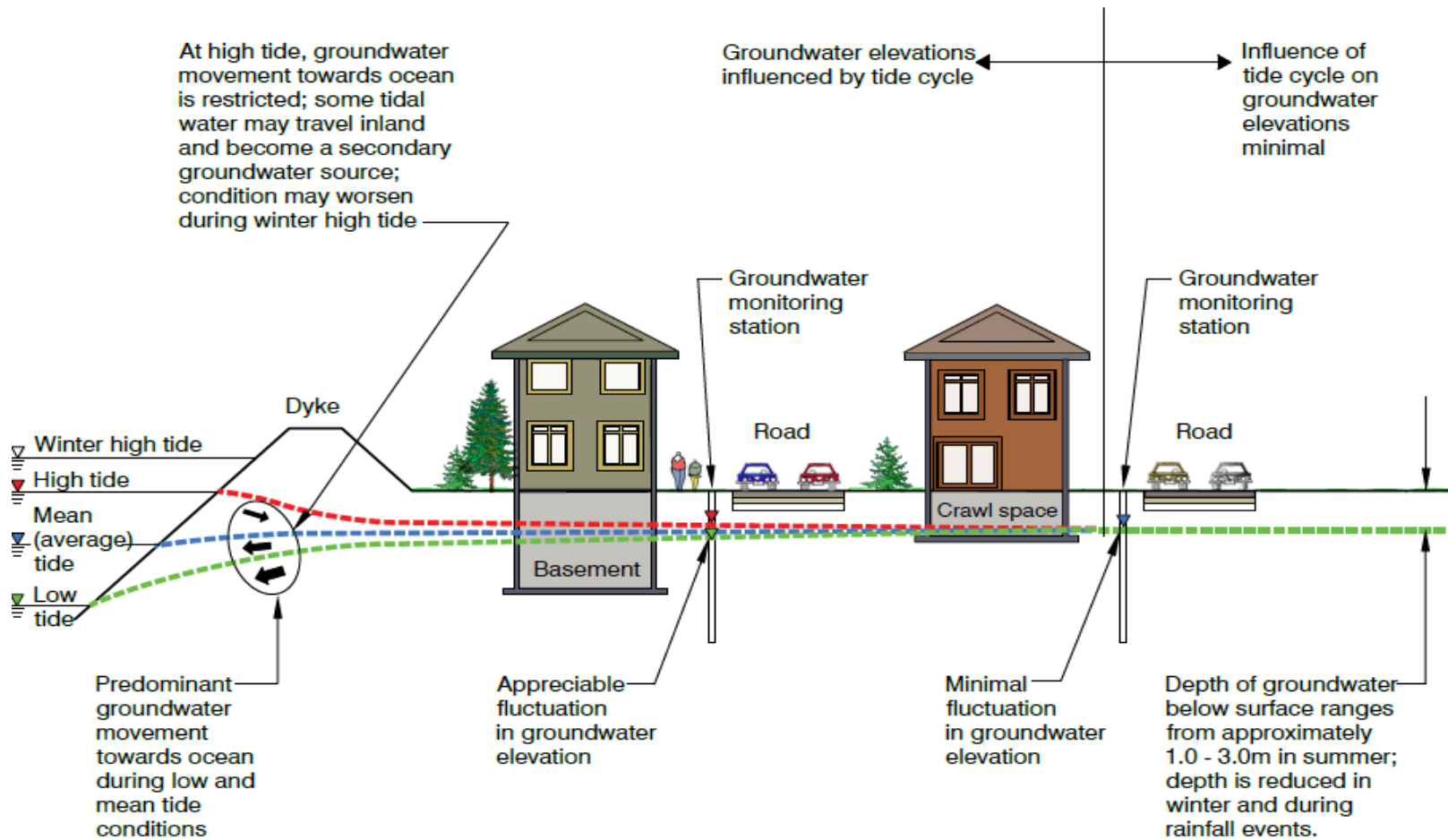
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Appendix I - Crescent Beach Functional Plan

Appendix II - Crescent Beach Map

Crescent Beach Functional Plan



Tidal Influence on Groundwater Elevations

