UNDERTAKING # 4

To describe the worst case scenario of settling ponds outflow, channel flow rates, and effects on downstream vegetated channel.

Drawing down the retention ponds prior to an anticipated storm event is considered a worst case scenario and not a part of the regular quarry operation. It is an unlikely event potentially associated with a storm event that may occur within a 100 year time frame (100yr-storm event).

The proposed wetland will be designed as a channel with variable dimensions with respect to channel width and slope in the embankments. This will provide for increased habitat diversity. To increase the effectiveness of the wetland, the channel will be built with a series of check dams. Armor stone (rip rap) will be used in combination with plant material to protect the channel against erosion. The plant species used will be native species typical for local wetland habitats and will include grass, herbaceous and shrub species.

The stabilization of the wetland channel will be developed during detailed design stage with the objective to withstand 100yr-storm events and associated draw downs. Should any such event cause erosion or damage to the wetland vegetation, this is expected to be of short duration and very localized. Any erosion damage would be immediately repaired. If required, new armor stone would be placed. Vegetation is expected to quickly re-establish itself through seeds dormant in the wetland soils and root systems below and between the armor stone. If required, new stabilizing vegetation will be planted and/or seeded.

The proposed wetland provides supplementary polishing functions but is not a requirement for retaining water or trapping sediment. Any short term failure of the wetland therefore is not compromising the effectiveness of the Quarry's storm and process water management system. The drainage channel for conveying water from the retention ponds to the Bay of Fundy has been proposed as an open wetland type channel for habitat purposes only. The alternative would have been an enclosed discharge pipe without habitat value.

In addition to the above, Bilcon has reviewed the total pond storage volume requirements and worst case draw down requirements for emergency flood storage. This review concludes that neither under the 100-yr/24-hr rainfall nor the 100-yr/5-day rainfall sceneraio would be required (see attached text from Conestoga Rovers).

Whites Point Quarry Project – Panel Hearings
Undertaking Information

The following information is provided to Bilcon NS in response to the Undertaking request from the Panel during the June 16, 2007 Panel Hearing Day. The information summarizes pond storage volume requirements and worst case scenario drawdown requirements for emergency flood storage.

The 5 sediment storage ponds proposed to handle site runoff to the north of Whites Cove Rd. are considered in this summary. The ponds are proposed by Bilcon to provide storage for treatment (i.e. sediment settling), supply and flood purposes.

Table 1 summarizes the pond volumes required, assuming all runoff from the 143 ha drainage area to the north of Whites Cove Rd. is directed to the ponds. Based on the water balance completed by CRA, maximum supply storage would range from 0.9 m under average conditions to 2.4 m for drought conditions. This represents the maximum amount of storage required to provide enough supply over the course of the summer dry period.

Flood storage requirements were calculated based on information for the combined climate stations at Yarmouth, NS (ID's 8206500 and 8206490) with a period of record from 1871 – 2006. The data indicated a 100-yr/24-hr rainfall amount of 149.7 mm and a 100-yr/5-day rainfall amount of 191.2 mm (note that previous analyses used a 100-yr/24-hr rainfall of 124.6 mm, which was based on outdated IDF data provided by MSC from only one of the Yarmouth stations for the period 1971 – 1996). This translates to a flood storage requirement of 2.2 m for the 100-yr/24-hr storm and 2.9 m for the 100-yr/5-day storm, averaged over the 5 sediment ponds. Note that these are conservative estimates of flood volume assuming all precipitation runs off to the ponds. In reality, this is not the case as losses due to infiltration, interception, depression storage and other abstractions will occur. Note that storage volume requirements for sediment storage are not reflected in Table 1. It is assumed that the bulk of sediment will be removed in the sediment forebay Bilcon is proposing for Pond 5, and the conservative estimates of flood volume should also more than compensate for sediment storage requirements.

Based on the storage requirements in Table 1, potential drawdown depths required to ensure sufficient flood storage is available are calculated, assuming a 4 m deep sediment pond and minimum of 0.3 m of freeboard is required. The data indicate a worst case condition of 1.6 m of drawdown required or approximately 149,000 m^3, for the case of storage maximized for drought conditions and the 100-yr/5-day storm occurring. Assuming a 24 hour drawdown period, the average drawdown flowrate required would be 1.7 m^3/s.

It is noted that the analysis indicated that the dry period extends from July through October under average conditions and from May through November under drought conditions. For the remaining months, there is a surplus of water so that the amount of water in storage during these months can be reduced providing more room for potential flood storage requirements. In other words, the risk period for worst case conditions runs from May through November when drought storage would be in effect. Pond operating principles could be designed to reflect this, thereby reducing the risk period. Furthermore, the amount of water held in storage could be incrementally reduced as the summer progresses, should drought conditions not be realized for

a particular month. For example, if storage is maximized in May at 2.4 m but May and June prove to be surplus months (i.e. as for average conditions), then storage could be reduced from July onward. Again, this reduces the risk period for worst case conditions of ponds at maximum storage and a 100-yr storm occurring, using operational planning measures.

Also, holding times for particle settling will typically be less than 5 days, thus the requirement to hold the entire 5-day flood volume is likely excessive as treated water will be released over the course of the 5-day period and allow for additional runoff volume storage. As such, the 1.6 m of maximum drawdown referred to above should be considered a conservative, absolute maximum.

In order to reduce the required drawdown amounts calculated above, an additional calculation of drawdown requirements was completed based on the fact that some of the runoff during a flood could be diverted away from the ponds. The analysis described above considered flood runoff from the entire 143 ha catchment above the ponds. It is noted that 64 ha of this area is the undisturbed watershed above the property boundary. Thus runoff from this area will not necessarily require treatment and does not need to pass through the sediment ponds in a flood situation. As such, this runoff could potentially be diverted prior to entering Pond 5, directly into the Bay of Fundy. A diversion structure at the inlet to Pond 5 could be designed to allow normal flows to pass into the ponds for supply collection, but would divert larger flood flows around the pond.

Table 2 shows the results of storage requirements and drawdown assuming flood runoff from the property area only (79 ha). The data indicates that flood storage requirements drop to 1.2 m and 1.6 m for the 100-yr/24-hr and 100-yr/5-day floods, respectively. The worst case drawdown condition then falls to 0.3 m or approximately 26,000 m^3. A 24-hr drawdown flowrate of 0.3 m^3/s would be required. Again, these are highly conservative estimates assuming no abstraction losses. If one assumes a conservative runoff coefficient for the property area of 0.85 (i.e. that 85% of precipitation during a storm runs off), the drawdown requirements become negligible, and the 4 m ponds have sufficient capacity to handle the 100-yr/5-day storm event combined with maximum drought supply storage of 2.4 m.

The above information provides data for preliminary planning purposes and represents worst case conditions. Detailed runoff volume calculations would be completed for final pond sizing during industrial approval, using a detailed hydrologic model developed for the site. Residence time requirements and outflow rates for treated water would also be calculated to ensure adequate treatment and outlet design.

Table 1 - Pond Depths
Total Catchment Area[1] Contributing

Scenario	Storage Requirements[2] (m)			Drawdown Requirement[3]		
	Supply[4]	Flood[5]	Total[6]	Depth (m)	Volume (m^3)	Flowrate[7] (m^3/s)
100-yr/24-hr Storm / Average Supply Conditions	0.9	2.2	3.1	-	-	-
100-yr/24-hr Storm / Drought Supply Conditions	2.4	2.2	4.6	0.9	89,870	1.0
100-yr/5-day Storm / Average Supply Conditions	0.9	2.9	3.8	0.1	5,094	0.1
100-yr/5-day Storm / Drought Supply Conditions	2.4	2.9	5.3	1.6	149,094	1.7

Notes: 1. Total contributing catchment area of 143 ha, consisting of quarry property to the north of Whites Cove Rd. and upslope watershed drainage.
2. Averaged over 5 ponds with total plan area of 9.6 ha.
3. Amount of drawdown required to provide at least 0.3 m of freeboard at maximum containment for 4 m deep ponds.
4. Maximum cumulative depth of storage required to satisfy demand during summer dry period.
5. Depth required to fully contain runoff volume from 149.7 mm 100-yr/24-hr storm or 191.2 mm 100-yr/5-day storm. Assumes no abstraction losses (conservative).
6. Does not consider sediment depth - additional depth required for sediment storage depending on removal efficiency of sediment forebay, sediment load and cleanout frequency.
7. Average flow rate assuming a 24 hour drawdown period.

Table 2 - Pond Depths
Property Area Only[1] Contributing

Scenario	Storage Requirements[2] (m)			Drawdown Requirement[3]		
	Supply[4]	Flood[5]	Total[6]	Depth (m)	Volume (m^3)	Flowrate[7] (m^3/s)
100-yr/24-hr Storm / Average Supply Conditions	0.9	1.2	2.1	-	-	-
100-yr/24-hr Storm / Drought Supply Conditions	2.4	1.2	3.6	-	-	-
100-yr/5-day Storm / Average Supply Conditions	0.9	1.6	2.5	-	-	-
100-yr/5-day Storm / Drought Supply Conditions	2.4	1.6	4.0	0.3	26,472	0.3

Notes: 1. Total contributing catchment area of 79 ha - runoff from 64 ha natural watershed area above property assumed diverted.
2. Averaged over 5 ponds with total plan area of 9.6 ha.
3. Amount of drawdown required to provide at least 0.3 m of freeboard at maximum containment for 4 m deep ponds.
4. Maximum cumulative depth of storage required to satisfy demand during summer dry period.
5. Depth required to fully contain runoff volume from 149.7 mm 100-yr/24-hr storm or 191.2 mm 100-yr/5-day storm. Assumes no abstraction losses (conservative).
6. Does not consider sediment depth - additional depth required for sediment storage depending on removal efficiency of sediment forebay, sediment load and cleanout frequency.
7. Average flow rate assuming a 24 hour drawdown period.