CITY OF BAINBRIDGE ISLAND
ENVIRONMENTAL TECHNICAL ADVISORY COMMITTEE

MEMORANDUM

TO: Planning Commission and City Council

FROM: ETAC

DATE: September 29, 2011

RE: **Technical Framework: Shoreline Stabilization**

Alleged Impact	Level of Understanding	Data Gaps
Direct loss of habitat due to burial or replacement	Effect obvious	Is loss of function proportional to loss of area?
'Beach Starvation' by blocking sediment supply	Geological interpretation is solid	Uncertain rate of degradation
Acceleration or exacerbation of beach erosion (active erosion)	Inconclusive	Effect not documented on Bainbridge. Conditions of occurrence not known
Blockage of water drainage	Effect apparent	Degree of ecological impact uncertain
Blockage of large woody debris (LWD) supply	Effect apparent	Degree of ecological impact uncertain
Loss of Vegetation due to construction	Short-term effect apparent	Long-term impacts unsubstantiated
Beach loss with sea-level rise or coastal retreat (passive erosion)	Concept appears sound.	Uncertain rates of sea level rise and coastal retreat

Summary Notes: the levels of scientific understanding of environmental effects of shoreline armoring

HABITAT-BURIAL/REPLACEMENT

Where armoring encroaches into the intertidal zone, it directly diminishes the areal extent of upper intertidal habitats.

Level of Understanding

To bury beach habitat and replace it with armoring is an obvious loss of beach habitat.

Data Gaps

We do not know whether or not the impact on upper beach ecological functions is directly proportional to the loss of area that is armored or buried.

BEACH STARVATION: BLOCKAGE OF SEDIMENT SUPPLY

Armoring blocks the dominant supply of sediment to most Bainbridge beaches: bluff erosion. WAC 173-26-231(3)(a)(ii) lists 'sediment impoundment' as distinct from 'beach starvation'; however we view that as part of the same process. As the WAC notes beaches 'down-drift' in longshore drift cell will be affected in addition to the beach adjacent to the blockage.

Level of Understanding

The science behind this assertion is based on general geologic principles; however, we believe it to be sound. It is clear that unprotected bluffs on Bainbridge Island erode and that the resulting sediment is deposited on intertidal beaches.

Other sources of beach sediment are only locally important. Small streams that empty into embayments, bring significant volumes of mostly finer grained sediment that buries historically coarser grained beaches. However that sediment is trapped at the heads of bays, and little makes it to the outer coastline. (A possible exception is Murden Cove where fine sediment transported seaward at extreme low tides may make its way into the low-tide terrace to the north.) Shell debris are generally a minor component of beach sediment, except where other sources are totally absent. Erosion of exposed bedrock can also provide a minor source of sediment.

There is no reason to question that oft-repeated assertion that bluff erosion is the dominant source of beach sediment in the Puget Sound area in general and specifically on Bainbridge Island.

Data Gaps

No estimates have been made of volumes or rates of sediment supply to Bainbridge beaches, nor of alongshore transport rates. Both erosion and transport rates are likely to vary greatly depending on beach orientation and wave energy. There is still substantive uncertainty regarding local patterns of sediment transport that can translate into specific losses and/or gains along the nearshore.

EXACERBATION OF BEACH EROSION: 'ACTIVE EROSION'. (This effect is listed twice in WAC 173-26-231(3)(a)(ii) as 'exacerbation of erosion' and as 'hydraulic impacts'.)

The presence of armoring appears to sometimes aggravate beach erosion. The more mobile finer-grained material is most vulnerable, and therefore beaches experiencing aggravated erosion rates in association with armoring are depleted of those finer materials and the substrate shifts towards coarser grain sizes.

Level of Understanding

The evidence is inconsistent. The reflection of waves off shoreline modifications sometimes causes scour at the foot of those features. However erosion is not always observed, and its presence or absence appears to depend on factors that are the subject of current research (Ruggiero, 2010).

A broad review of the literature indicated that whatever erosional effects do occur are often temporary (Dean 1987, Kraus and McDougal 1996).

Even temporary effects can impact ecological function. For example, an ill-timed erosional event could decimate a forage fish spawning cycle.

Data Gaps

Effects have not been confirmed on Bainbridge.

HYDRAULIC EFFECTS: BLOCKAGE OF NATURAL DRAINAGE ('Groundwater Impacts in WAC 173-26-231(3)(a)(ii)

Impermeable bulkheads can cause groundwater to back up behind them to a higher level, and that can increase bluff instability. Bulkheads that allow groundwater to flow through them, such as rip rap, should have no effect.

Level of Understanding

The blockage effect is obvious, and the effects of water saturation on slope stability are well established.

Data Gaps

Ecological effects of altered drainage are not substantiated.

BLOCKAGE OF LWD SUPPLY

By stopping bank erosion, armoring will also block the supply of LWD from that erosion. In addition, land use changes above the armored shoreline may reduce the supply of materials that could contribute to LWD recruitment in the nearshore.

Level of Understanding

The effect of placing a barrier between LWD and the nearshore to which it might naturally contribute is obvious, though the amount and rate of natural LWD supply to the beach is likely to be highly site-specific. In an aerial survey of King County and Vashon/Maury shorelines, Holsman and Willig (2007) found significantly lower abundance of LWD associated with armored shorelines relative to natural shorelines, and significantly lower areal coverage of LWD where the shoreline had been reinforced with vertical bulkheads.

Data Gaps

We are not aware of studies that directly quantify changes in LWD supply rates associated with armoring, evaluate the results of changes in LWD to the functioning of the shoreline, nor that evaluate the relative contributions of LWD from 'drift' and bank erosion.

LOSS OF VEGETATION DURING CONSTRUCTION (This effect is listed twice in WAC 173-26-231(3)(a)(ii) as 'habitat degradation' and as 'loss or shoreline vegetation'.)

If constructed via land access, there is typically significant damage to vegetation by heavy equipment. There is less damage if accessed by barge.

Level of Understanding

This is an obvious effect. It can be temporary if vegetation is replaced; however it appears that much lost natural vegetation appears to be replaced by less effective forms. Gabriel and Terich, 2005, found that armored banks had higher amounts of grasses and herbaceous/shrub vegetation and fewer coniferous and deciduous trees.

Data Gaps

We do not know if temporary losses could have long term effects. It is not clear whether to attribute the diminished natural vegetation associated with armored shorelines to the armoring process or to landowners' direct intent to replace natural vegetation with other forms.

CHRONIC BEACH LOSS: 'PASSIVE EROSION'

Natural shorelines would be expected to move landward over time where they are eroding or if sea level is rising. Presumably under natural conditions, intertidal habitats would move landward as well, while preserving their size and effectiveness. Armoring would prevent the landward migration, and the result would be an ever narrowing intertidal and gradual loss of habitat.

Level of Understanding

The concept appears sound.

Data Gaps

Rates of coastal erosion on Bainbridge Island have not been estimated. The rate of sea level rise is uncertain.

References

Dean, 1987, “Coastal Armoring: Effects, Principles, and Mitigation”, Proceedings, 20th International Conference on Coastal Engineering, ASCE, NY, p. 1843-1857.

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Holsman, K and J. Willig. 2007, LARGE-SCALE PATTERNS IN LARGE WOODY DEBRIS AND UPLAND VEGETATION AMONG ARMORED AND UNARMORED SHORELINES OF PUGET SOUND, WA. People For Puget Sound RPT#07-1. December 2007.

Kraus and McDougal 1996, “The Effects of Seawalls on The Beach: Part I, An Updated Literature Review”, Journal of Coastal Research, Vol 12, pp 691-701

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