HOP
CONSULTING CIVIL AND STRUCTURAL ENGINEERS

SUSSEX YACHT CLUB

RIVER MORPHOLOGY TECHNICAL NOTE

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1.0 SCOPE

1.1 General

The proposed works involve the construction of a new retaining wall and infill of the upper reaches of the existing slipway at Sussex Yacht Club. This results in a loss of habitat on the slipway as noted in The Ecology Consultancy Preliminary Ecological Appraisal Report V2 (dated 05/11/2018).

On construction of the proposed wall, the lower reaches of the slipway will be abandoned and will be relieved of regular access and maintenance operations, including clearance of accumulated silt and service as a slip. It is considered that the abandonment of the lower reaches of the slipway and areas adjacent will allow it to return to a state of naturally occurring mudflat and naturally recolonise, resulting in a net gain in habitat over the site.

This Technical Advice note is provided as an addendum to the Water Framework Directive assessment report (HOP 16/11/2018), and in conjunction with The Ecology Consultancy Preliminary Ecological Appraisal Report V2 (dated 05/11/2018).

Section 2 considers the likely river morphology following abandonment of the lower reaches of the slipway and is informed by commonly held principles on civil engineering hydraulics and sediment transport.

Section 3 considers the option to mechanically break up the existing concrete and whether this is preferable.

Section 4 considers likely silt mobility in the permeant condition.

2.0 TECHNICAL APPRAISAL

2.1 Desk study

This desk study assesses tidal range, wave climate, flow velocity, channel bathymetry and anecdotal site specific observations.

2.1.1 Tidal Range

The tidal range at Sussex Yacht Club varies between approx. +0.0m Chart Datum (CD) and +5.7m Chart Datum (CD). Table below shows the intermediate tidal range at.

Table 1 - Tide levels taken from Admiralty Tide Tables 2017 for Shoreham Port and referenced to Admiralty Chart no. 2044 for conditions local to the footbridge

	'Footbridge'		'Shoreham Port'	
	Meters above Chart Datum (mCD)	Meters above Ordnance Datum (mOD)	Meters above Chart Datum (mCD)	Meters above Ordnance Datum (mOD)
Highest Astronomical Tide (HAT)	5.7*	3.5*	6.9	3.63
Mean High Water Springs (MHWS)	5.1	2.9	6.3	3.03
Mean High Water Neaps (MHWN)	3.8	1.6	4.8	1.53
Mean Sea Level (MSL)	2.2	0	3.4	0.13
Mean Low Water Neaps (MLWN)	0.8	-1.4	1.9	-1.37
Mean Low Water Springs (MLWS)	0.3	-1.9	0.6	-2.67
Chart Datum	0	-2.2	0	-3.27

The tidal range is such that the base of the proposed wall is approximately 360mm below Mean High Water Neaps (MHWN).

2.1.2 Wave Climate

The Sussex Yacht Club site is sheltered from offshore wave action by the breakwater defences. River alignment limits the fetch (maximum distance the wave generating wind can act). Strong westerly winds may cause ‘choppy’ conditions at or around high water but significant wave height is expected to be in the region of 0.5 to 1m maximum.

2.1.3 Flow Velocity

The flow velocity taken at the pedestrian bridge (directly adjacent to the Sussex Yacht Club site) in a 2014 study measured 0.6m/s (mid channel). With reference to the velocity distribution diagram presented by Chadwick and Morfett in Hydraulics in Civil and Environmental Engineering, velocity at the edges of a channel is reasonably expected to be approximately 40% of mid channel flow. The expected maximum velocity at the site of closure is estimated as 0.4 x 0.6m/s = 0.24m/s.

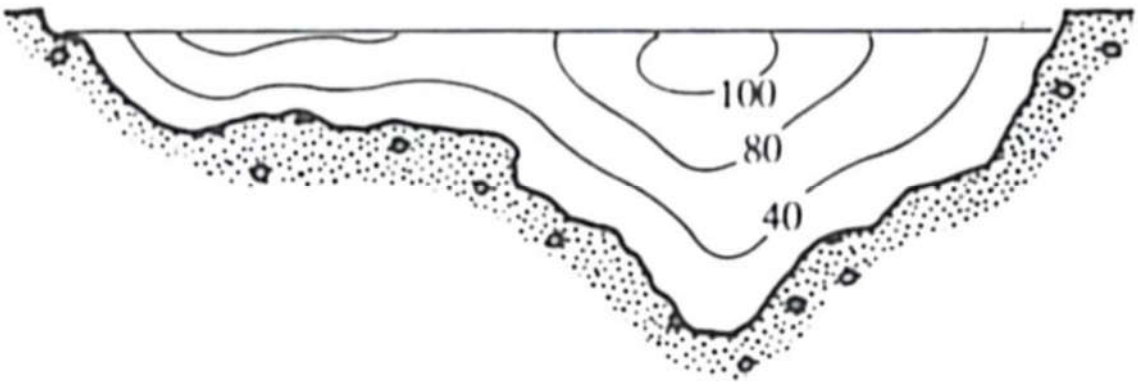

Figure 1 - Velocity distribution in a channel from Chadwick and Morfett, Hydraulics in Civil and Environmental Engineering

Advice presented by PIANC on water velocity potential for scour suggests the following velocity limits for various materials.

Table 2 - Maximum permitted water velocity before scour is likely to occur

River Bed Material	Maximum water velocity for which scour is not anticipated
Fine loosely packed sand	>0.5 m/s
Fairly compacted clay (void ratio .5)	>0.8 m/s
Firm Clay	>1.2 m/s
Stiff clay (void ratio .25)	>1.5 m/s

The silt bed material is considered comparable to the fine loosely packed sand presented in table 2. The following conclusions can be drawn:

a) Flow velocity is minimal and well below that which scour is expected.
b) This low flow velocity will encourage deposition of silts and sands.

2.1.4 Morphology

The site is situated on the inner reaches of a bend on the River Adur. Dominant flow in a channel tends towards deposition of sediments on the embankment of interest (reference figure 2 below).

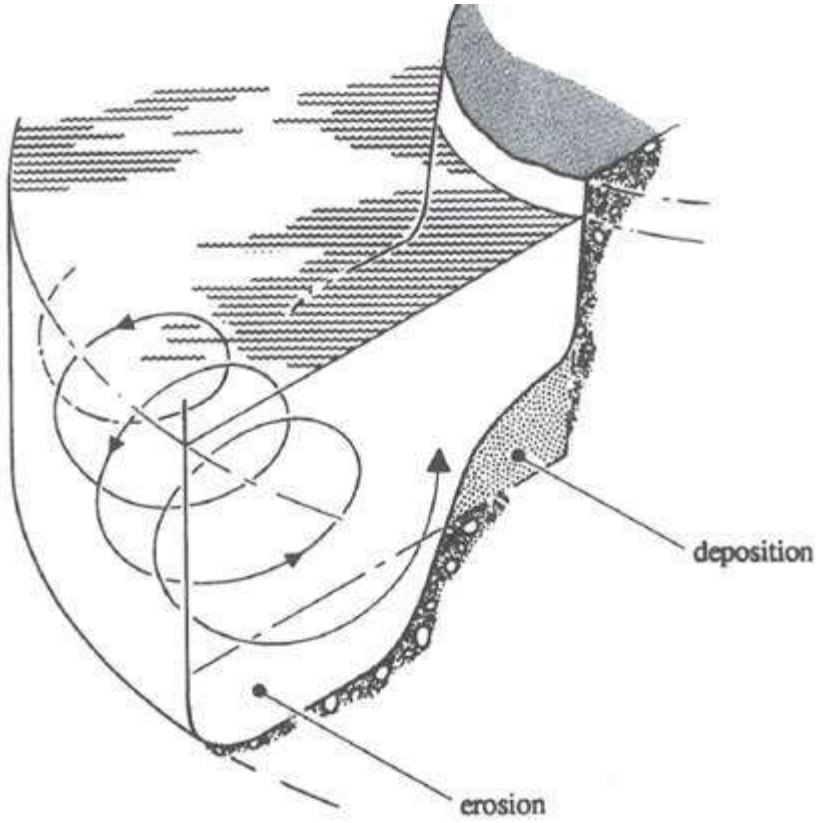

Figure 2 - Section showing secondary currents, erosion and disposition of a channel on a river bend (taken from Hydraulics in Civil and Environmental Engineering, Chadwick and Morfett)

2.1.5 Anecdotal Site Specific Observations

Site observations note a considerable build-up of sediment either side of the existing slipway (and throughout the wider reaches of the area). Areas immediately upstream and downstream from the existing slipway was observed and typically found to be battered back from the central slip (adjacent to the tracks). The depth of silt was observed to be in excess of 1m depth at approx. 3m from the slip. Following closure of the slip and abandonment, it seems reasonable that the existing slip will naturally silt-up to a similar depth of that observed immediately up and down stream.

The slipway operator has advised of the need to clear the accumulated silt build up approximately every 2 weeks to maintain a serviceable slipway. This anecdotal evidence provides further comfort that the area will reaccumulate silt post abandonment. Site observations are presented in photographs 1 and 2.



Photograph 1 - Typical silt accumulation over a 6-day period since slipway opperator advised of most recent silt clearance campain.



Photograph 2 - Probing of silt immediately upstream of the slipway at the lower reaches noting approximate 1:3 slope.

3.0 CONCRETE DEMOLITION CONSIDERATIONS

3.1 General

It is understood that the Environment Agency consultation response has suggested that the benefits of breaking up areas of existing concrete hardstanding be considered. It is understood the suggestion is in the context of considering if this would likely provide any significant enhancement to the habitat quality generated by the proposals.

The thickness and construction form of existing buried concrete is unknown. However, in places this supports launch rails and it therefore seems likely concrete elements locally could be fairly substantial and founded at significant depth.

The applicant has advised that the slipway was used during WW2 for launch and recovery of motor torpedo boats and air sea rescue craft. This anecdotal evidence might further support the conclusion of substantial construction.

Operations to break up the existing concrete elements would likely require the tracking of excavators with concrete breaker intertidally. If concrete foundations were to be physically grubbed out then this would likely require significant battering of excavation side slopes to achieve an appropriate and safe temporary working environment. Stability of the ground locally could be negatively impacted. For example, it can't be ruled out that removal of deep buried concrete elements could have the potential to undermine existing shallow founded adjacent river walls.

Noise of concrete breaker action, tracking on the existing foreshore, temporary excavation slopes in adjacent silt are considered to negatively impact on the local ecology in the temporary condition e.g. noise is adverse to nesting birds and excessive foreshore disturbance is considered best avoided.

In the permanent case it is anticipated that the slipway will become recolonised with substantial silt deposits in excess of 1m.

Under the circumstances little benefit seems to be gained from breaking or grubbing out existing concrete.

4.0 SILT MOBILITY IN THE PERMENENT CONDITION.

4.1 General

Environment Agency consultation queried the sensitivity of silt to mobility on the abandoned slipway in the permeant condition.

The existing slip has gradient of approximately 1:9.1 or 6.3 degrees. The proposals plan to abandon the slip. Silt is known to accumulate on the slip forming alluvium / mud flat deposits, refer to photograph 1.

Soil Mechanics theory uses the parameter ‘angle of repose’ to describe the expected field behaviour of a soil. The angle of repose indicates the maximum slope or gradient of a soil that might be expected for it to remain stable.

The angle of repose for a loose wet clay/silt is in the range of 20-25 degrees. This order of stable gradient is significantly larger than the existing slip gradient and hence silt is reasonably expected to build up.

Photograph 2 above provides further supportive anecdotal evidence that a gradient of the order of 20-25 degrees remains stable in the alluvium material on site. Note the side slope to the flank of the lower reaches of the slip.

5.0 SUMMARY

5.1 Morphological Technical Note

Tidal range, wave climate, flow velocity, channel bathymetry and anecdotal site specific observations have been reviewed. Natural siltation of the lower reaches of the slipway is expected with the bed returning locally to a profile similar to the adjacent areas up and down stream. Silt mobility in the permeant condition seems unlikely.

5.2 Concrete Demolition Works

Proposal to break up or grub out existing buried concrete is considered not preferred as the process brings with it unnecessary foreshore disturbance, noise and risk to adjacent shallow founded river walls. In the permanent case it is not expected to enhance the habitat significantly and the construction phase impact on habitat is considered undesirable.