FUTURE MAINTENANCE

The marine river wall works at Howard Kent predominantly comprise exposed Steel Sheet Piles (SSP's), a Reinforced Concrete (RC) capping beam, balustrade and emergency escape ladders. It should be noted that the steel and concrete structures are designed for a 100 year design life, with only minor maintenance before 50 years.

It is anticipated that the following maintenance strategy, or similar, will be adopted by the Estates Management Team following construction and handover of the site:

- Vehicle access behind the river wall is provided to enable inspection and maintenance to be completed (allowable surcharge load limited to 10 kN/m² only).

- Close access to the sheet pile wall face can be obtained by use of articulated Mobile Elevated Working Platform (MEWP) from the quayside. Eastern foreshore access is possible by foot (except for heavy plant). The western foreshore is considered unsafe for access by foot and where further access is required this should be undertaken using a suitable boat/ barge.

- Following construction; periodic monitoring of the cathodic protection anodes should be undertaken to assess whether flotsam, jetsam or vandalism is evident. If so, appropriate measures should be taken to remove debris and further limit access to the units.

- Cathodic protection anodes at "wall 1" (Eastern) are estimated to require replacement at 20 year intervals, subject to specialist inspection and monitoring. Replacement is likely to require lifting of anodes from the landside using a small hi-ab or spider crane and fixing (welding) by diver (boat access). Cathodic protection will help extend the residual life of the new steel sheet piles and minimise the effect of Accelerated Low Water Corrosion.

- Bed levels and sediment erosion / accretion to be monitored periodically. Continued scour of the material in front of the river wall in excess of 0.5m could indicate potential future stability issues and should be discussed with a suitably qualified Engineer.

- The Steel Sheet Piles are specified with additional sacrificial steel in order to meet the 100 year design life required and to allow for the loss of section due to corrosion.

- The reinforced concrete elements have circa 70mm of cover to the steel reinforcement (see drawings) in order to provide the 100 year design life required and to allow for the chloride and carbonation ingress and loss of alkalinity of the concrete.

- Ladders, lifebuoys, balustrades and emergency escape ladders etc are proprietary items and will require monitoring, inspection and occasional replacement as required.

- Back-of-wall drainage, flap valves and weep holes will require periodic general maintenance; rodding, cleaning, checking and replacing damaged items etc.

- Steel tie-bars and anchorages are provided with 100 years of sacrificial buried corrosion allowance. Tie-bars are also wrapped in Denso tape to provide additional protection.

The purpose of the maintenance strategy outlined is to safeguard the structural integrity of the river wall. Additional safety inspections regarding paving trip hazards, emergency life saving equipment and the like, will also be required.

FUTURE INSPECTION

PIANC (The World Association for Waterborne Transport Infrastructure) are an internationally recognised professional body who bring together experts (in the form of working groups) to issue technical reports on a wide range of waterborne transport and infrastructure issues.

Report 119 (Inventory of Inspection and repair techniques of navigation structures (steel, concrete, masonry and timber) both underwater and in the dry) sets out best practice guidance for Inspection, including frequency and scope of works.

The following tables are extracts from PIANC 119 and set out recommendations for Inspection Frequencies:

Inspection Type	Purpose	Frequency
Continuous Supervision	Means the continuous (at least each ¼ of a year) supervision by a technical employee, not necessarily an engineer, to notify obvious major damages in terms of usability of the structure.	Every 3 Month
Regular Supervision	Is performed and documented yearly by an educated technician who is familiar with the structure to ensure that no major defects affecting capacity and/or usability occur.	Yearly
Main/Routine Inspection	Is performed every 3 years by an engineer. It is stated as an intense visual inspection, but regularly without additional technical equipment.	Every 3 Years (alternative to Major inspection)
Major Inspection	Is performed every 6 years. In addition to the Main Inspection technical equipment should be applied. Each part of the structure must be inspected, even those not visible in regular operation. Capacity and usability of the structure must be inspected and documented.	Every 6 Years
Special Inspection	Is performed in case of damage, after building or renewing the structure or on special behalf. The depth of the inspection depends on the damage, so it might be as intensive as a Major Inspection.	Not scheduled

Table 4-2: Alternative approach to supervision and inspection types

Objective	Inspection Type	Included in Standard Scope of Work	Addition to the Standard Scope of Work
1. Ensure quality control during new construction	New Construction	✓	
2. Verify installed quantities for contractor payment	New Construction	✓	
3. Respond to field questions and problems during new construction	New Construction	✓	
4. Verify that structure is built in general compliance with the design drawings, if available	Baseline	✓	
5. Ensure that new structure has no significant defects prior to owner acceptance	Baseline	✓	
6. Generate design drawings where no drawings exist	Baseline		✓
7. Assess and rate the overall condition of an existing structure	Routine	✓	
8. Determine what future maintenance activities are necessary on a structure	Routine	✓	
9. Quantitatively evaluate the local loss of structural capacity of typical components as a result of damage or deterioration	Routine	✓	
10. Quantitatively evaluate the global structural integrity relative to actual loads on the structure, considering observed damage or deterioration	Routine		✓(2)
11. Estimate the remaining useful life of the structure	Routine		✓(3)
12. Develop order-of-magnitude estimates of probable costs for rehabilitation work	Routine		✓
13. Document details of defects and components to be repaired	Repair Design	✓	
14. Develop detailed quantity estimates for rehabilitation work	Repair Design	✓	
15. Develop detailed repair plans (bid documents) including drawings and specifications	Repair Design		✓
16. Determine the cause of observed deterioration in order to fix or prevent in the future, where such cause is not readily apparent	Special (1)		✓
17. Quantify the extent of observed deterioration	Special (1)		✓
18. Determine the structural significance of observed damage	Special (1)		✓
19. Determine the significance of observed damage on future durability	Special (1)		✓
20. Ensure quality control of repairs during construction	Repair Construction	✓	
21. Respond to field questions and problems during construction of repairs	Repair Construction	✓	
22. Ensure impartial documentation of repair quantities during construction of repairs	Repair Construction	✓	
23. Assess and rate structural integrity following a significant loading or environmental event	Post-Event	✓	
24. Determine if additional remedial attention is necessary on a structure as a result of a significant loading or environmental event	Post-Event	✓	
(1) Note that Special Inspections have no "standard" scope of work. Each Special Inspection should be conducted for a pre-defined purpose and such purposes may vary considerably. (2) Engineering Evaluation (3) May require Special Inspection			

Table 4-3: Matching inspection objectives with the Seven inspection types

SUMMARY OF INSPECTION LEVELS FOR UNDERWATER INSPECTION					
Level	**Purpose**	**Detectable Defects**			
		Steel	**Concrete**	**Timber**	**Composite**
I	General visual/tactile inspection to confirm as-built condition and detect severe damage	Extensive corrosion, holes Severe mechanical damage	Major spalling and cracking Severe reinforcement corrosion Broken piles	Major loss of section Broken piles and bracings Severe abrasion or marine borer attack	Permanent deformation Broken piles Major cracking or mechanical damage
II	To detect surface defects normally obscured by marine growth	Moderate mechanical damage Corrosion pitting and loss of section	Surface cracking, spalling, erosion Rust staining Exposed reinforcing steel and/or prestressing strands	External pile damage due to marine borers Splintered piles Loss of bolts and fasteners Rot or insect infestation	Cracking Delamination Material degradation
III	To detect hidden or interior damage, evaluate loss of cross-sectional area, or evaluate material homogeneity	Thickness of material Electrical potentials for cathodic protection	Location of reinforcing steel Beginning of corrosion of reinforcing steel Internal voids Change in material strength	Internal damage due to marine borers (internal voids) Decrease in material strength	N/A

Table 5-1: A summary of the information typically collected for each of these levels of effort