6 Rock Revetment

6.1 General

The remediation and extension of the Kingston Pier Rock Revetment west of and adjacent to the pier in accordance with the Drawings. The particulars are:

- remediation of approximately 70m of existing rock revetment;
- extension of approximately 20m of rock revetment to the west into the scalloped area of the foreshore; and
- extension of approximately 25m of rock revetment to the east to conceal the exposed sheet piling leading up the Pier.

The specific requirements associated with the rock revetment are contained in this section.

6.2 Supply of Rock

6.2.1 General

It is proposed to carry out the Works using igneous rock.

All rock shall be naturally occurring, dense, sound material quarried from an approved source. It shall be free from weathering, mechanical weakness and chemical decomposition, and of such character that will resist disintegration and erosion by the action of air, water (fresh or seawater), wetting and drying, extremes of temperature and impact due to wave action or any other natural or climatic factors. It shall be free from dirt, soil, peat, loam, clay or any organic matter and all holes drilled for blasting purposes. It shall be capable of being handled and placed without fracture or damage. Quarried rock shall not contain visually observable or chemically detectable impurities or foreign matters in such quantities that are damaging for the constructive application of the quarried rock or for the environment in which the quarried rock is to be placed.

Information on the type, structure and quality of the rock in any new source of rock proposed by the Contractor, shall be supplied to the Superintendent in writing, and shall include all data as set out in **Section 6.2.2**. The Superintendent shall require a minimum period of four (4) weeks, from the date of receipt of the abovementioned data from the Contractor, to give conditional approval (or rejection) in terms of the aforementioned criteria for the proposed new source of supply.

6.2.2 Data to be Supplied

Prior to the agreement to use a proposed source, the Contractor shall provide evidence of rock selection quality control procedures in operation at the quarry. This evidence shall include, but not be restricted to:

a) Details of the quarry from which the rock is to be supplied, including the quarry's operation licence, and identification of the sections of the quarry where rock complies with the requirements of this specification; and,

b) A test report from a NATA registered independent testing authority on the physical and chemical properties of the rock to be supplied. The report shall include the results of laboratory testing of the rock.

Should the Contractor wish to vary the source of rock supplied either within the quarry or by changing quarries, the Contractor shall submit additional documentation (as listed above) to demonstrate that the rock from the new source complies with the requirements of this Specification.

6.2.3 Data to be Submitted by the Supplier at Delivery

For every consignment of quarried rock delivered, the Contractor must obtain, for each load, a certificate of origin submitted by the organisation which operates the production of rock materials from the quarry. The following data must be included on the certificate:

a) the delivery date;

b) the designated number of the road transport unit;

c) the name of the producer;

d) the designation of the grading;

e) the name and location of the quarry or other source where the grading has been produced; and,

f) the weight of the load.

6.2.4 Acceptance of Rock

Acceptance of rock on satisfying all of the following criteria:

(i) individual rocks shall be hard, durable and clean and should be free from cracks, cleavage planes, joints, seams, chemical alteration or weathering and other defects which would result in the breakdown of the rock in the marine environment;

(ii) rock shall be igneous and have a minimum dry density of 2,600 kg/m^3;

(iii) rock shall be rough and angular;

(iv) the ratio of the maximum dimension of any rock to the minimum dimension, measured at right angles to the maximum dimension, shall not exceed 2.5;

(v) rock shall have no more than 10% *(by volume)* olivine material and shall exhibit no zones of secondary alteration such as chloritisation;

(vi) rock shall have a saturated point load strength index *(Is_{50})* no less than 5.0 MPa;

(vii) rock shall exhibit a maximum Los Angeles abrasion value of 25%;

(viii) rock shall exhibit a maximum sodium sulfate weight loss (AS 1141.24) of 5%; and

(ix) rock shall exhibit no signs of stress relief.

Acceptance of the above criteria shall be as follows:

- the average of all laboratory test results shall satisfy the specified criteria; and
- no more than 20% of the results to not satisfy the criteria.

6.2.5 Rock Sizing and Grading

The armour and underlayer rock shall satisfy all of the size and grading criteria summarised the table below. Rocks that are delivered to site and do not meet the size and grading requirements in the opinion of the Superintendent shall be rejected and removed from site at the Contractors expense.

Armour Rock Sizes and Grading

Type	MEDIAN MASS M50 (tonnes)	MASS GRADING (tonnes)	APPROX DIAMETER(a) (m)
Primary Armour	1.49	1.11 to 1.90	0.86 to 1.03
Secondary Armour	0.15	0.11 to 0.19	0.39 to 0.48
Core	-	-	0.1 to 0.39

Note:
(a) The approximate diameter is based on size by sieve, grizzly or visual inspection

6.3 Design Profiles

The Works shall be constructed in the location shown and to the levels, widths and side slopes indicated on the Drawings.

Where transitions or variations in slope, level or geometry are shown on the Drawings, they shall be smooth and linear over the length of the transition with no abrupt changes in the outer surface of the Rock Revetment.

The Primary Armour Layer is defined as the outer most rock armour layer/s (may be multiple layers of an equal rock size). The Secondary Armour Layer is used as an underlayer to the primary layer.

6.4 Preparation and Placement of Rock

The Contractor shall prepare the bed profile along the alignment of the revetment in accordance with the levels and side slopes shown on the Drawings.

Placing of revetment armour rock shall comply with the following requirements.

a) Armour rock shall be placed to achieve a dense, fully interlocked armoured slope so that each rock is held securely in place by its neighbours. Placing shall commence at the toe and proceed upwards towards the crest and diagonally toward the equipment operator. Rock shall

be placed carefully to avoid damage to the surface below or to the geotextile. Height drop shall not be more than 500mm. Rocks shall be placed so that they obtain their stability from frictional resistance on at least three planes

b) Rock shall be placed to achieve an even distribution of rock sizes without concentrations of smaller rock sizes and with the minimum practicable percentage of voids. Hand placing or rearranging of individual rocks by mechanical equipment maybe required to the extent necessary to secure the results specified.

c) Armour rocks shall be individually placed using a grab attachment on an excavator. Tipping rock from vehicles into final position shall not be permitted without the prior approval of the Superintendent.

d) Rock shall be placed to its full course thickness in such a manner as to avoid displacing the underlying material. Placement of rocks in multiple layers, or by dumping into chutes, or by similar methods likely to cause segregation, shall not be permitted.

e) Rock armour shall be placed to be stable to the profiles and levels shown on the drawings. The surface of the armoured slope shall present an angular uneven face to the sea. Rocks shall generally be placed with their long axes normal to the slope. The finished rock armour shall be at least two rocks thick. Smaller pieces of rock shall not be used to fill interstices, or to prop larger rocks in order to achieve the required profile.

f) Continuous joints will not be permitted between adjoining rock.

g) Rocks shall be placed by feeling with the handling equipment to achieve contact when vision is obscured by turbidity. Line and grade shall be maintained through approved quality control methods.

h) Armour rock broken during handling or placing shall be removed immediately at the Contractor's expense. Subject to the Superintendent's approval, broken armour rock may be included in smaller rock grades.

i) The specified gradation shall be consistently maintained throughout the structure.

j) Armour rocks shall not protrude excessively from the structure face (in relation to rock size).

6.5 Rock Quantity Estimate

The Works propose to reuse as much existing rock as practicable. This would involve selectively relocating rock suitable for the primary and secondary armour.

Based on the design sections provided in the Drawings and the design dimensions, the estimated quantity of rock required is as follows:

- Primary Armour Rock –approximately 3,300 t;
- Secondary Armour Rock (top-up of existing) –approximately 700 t; and
- Core Rock – approximately 300 t.

6.6 Construction Tolerances

The vertical construction tolerances for the placement of rock shall be + 0.25m/-0.00m.