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Technical Note

Date: 31/3/2020

Client: Kingston District Council

Subject: Wyomi Beach seawall – immediate term adaptation options assessment

1 Introduction

Over the last two decades, storm erosion at Wyomi Beach, located approximately 2.5km south-west of the Kingston township, has resulted in the loss of approximately 10 to 15m of dune width, damaging paths and threatening Marine Parade (ABC News, 2016). In recent years, Kingston District Council (KDC) has constructed several seawall structures to protect these assets, including Geotextile Sand Container (GSC) and rock seawalls.

KDC has recently obtained grant funding from the Regional Coast Protection funds, to extend the GSC seawall to the north and south of the existing seawalls with the intent to provide temporary protection to dunes and infrastructure that are currently not protected by the existing structures. It is understood that after a recent site visit by the Coast Protection Board (CPB), recommendation was made to KDC to consider using the funding to place approx. 20,000 m^3 of sand nourishment in front of the seawall and dunes instead of extending the GSC seawall.

Wavelength, at the request of KDC, has been engaged to investigate immediate adaptation options at Wyomi seawall, this technical note outlines these investigations.

1.1. Study area

The Wyomi shoreline can be separated into 3 distinct compartments outlined below and as shown in Figure 1:

- South (pink area)
- Central (brown area)
- North (blue area)

These three areas will be referred to throughout this technical note. The study area extends approximately 100m north and south of the existing GSC seawalls and the existing coastal protection structures have a range of foundation and crest levels, as summarised in Table 1 and presented in Figure 1.

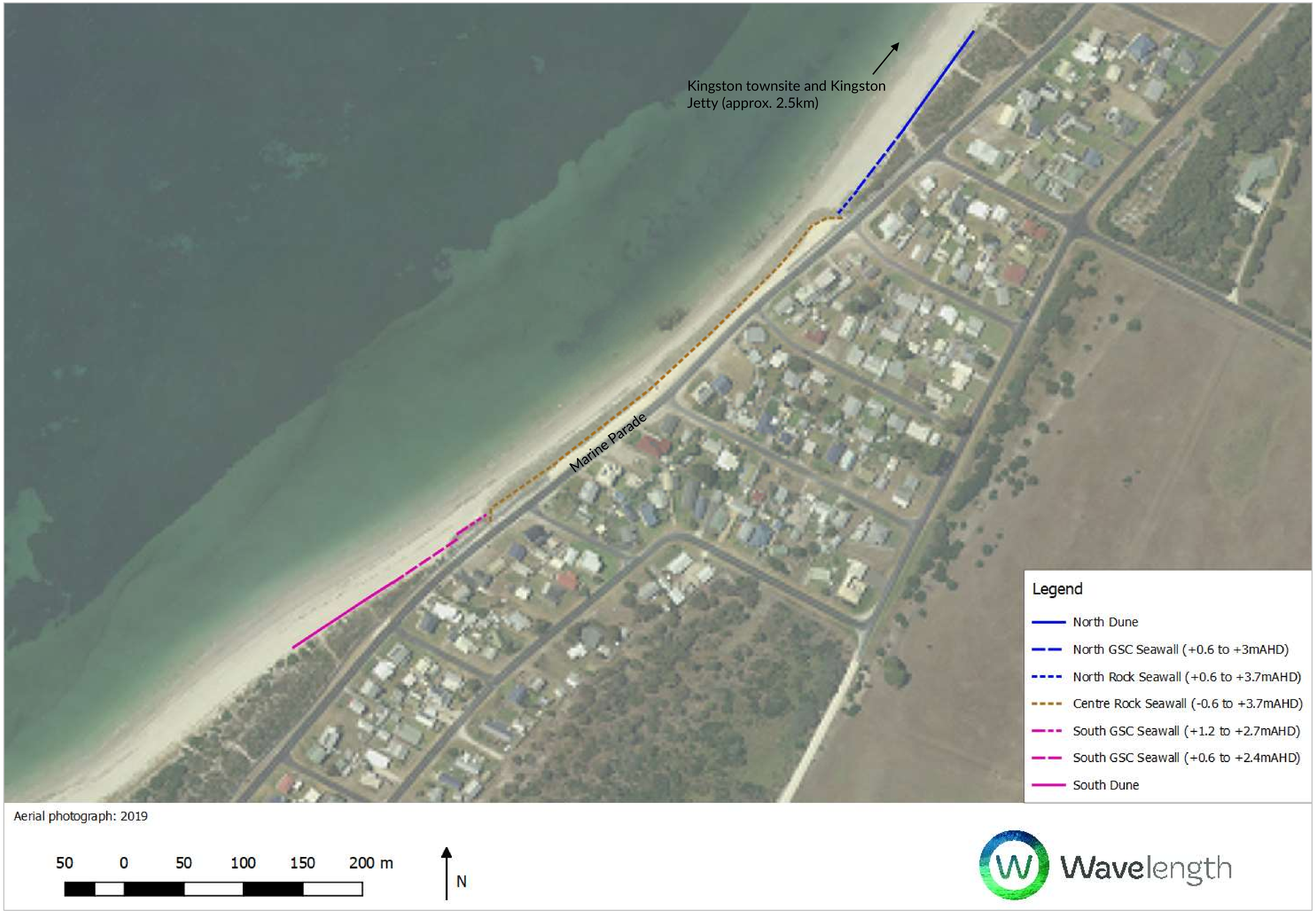

Figure 1: Wyomi Beach study area & existing structures

Table 1: Existing coastal protection structure details

Compartment	Structure Description	Date constructed	Current Exposure[1]	Approximate Length (m)	Indicative Foundation Level (m AHD)	Indicative Crest Level (m AHD)
North	North 2.5m^3 GSC seawall	April 2019	Top 2 GSCs currently exposed	72	+0.6	+3.0
	North ad hoc rock seawall	Mid 2018	Exposed	22	+0.6	+3.7
Centre	Centre rock seawall	April – May 2018	Exposed to top portion of toe rock	395	-0.6	+3.7
South	South 0.75m^3 GSC seawall	April 2019[2]	Top 2 GSCs currently exposed	28	+1.2	+2.7
	South 2.5m^3 GSC seawall	April 2019	Buried	72	+0.6	+2.4

Notes: 1. Based on Wavelength Senior Engineer site visit 21/2/2020.
2. Original 0.75m^3 GSC seawall constructed post July-2016 and upgraded with a top row of 2.5m^3 GSCs in April 2019.

Key design drawings for the various structures are presented in Appendix A.

2 Storm erosion & overtopping hazards

2.1. Approach

The Coastal Adaptation Strategy (CAS) currently being undertaken by Wavelength will investigate the longer term erosion and inundation risks and potential adaptation pathways at Wyomi Beach, in line with the *LGA SA Climate change decision support framework* (Balston, J.M. et al, 2012). The CAS will investigate longer term shoreline movements, as well as potential shoreline recession due to sea level rise.

The aim of this immediate term study at Wyomi is to determine the present day erosion and wave overtopping risk to assets, including existing seawall structures, to guide immediate adaptation option selection for prioritising funding allocation.

Australian Standards (AS) *4997-2005: Guidelines for the Design of Maritime Structures* presents recommended design lives and return period events for a range of structure categories (Table 2).

Table 2: Annual probability of exceedance of design wave events

Function category	Category description	Design working life (years)			
		5 or less (temporary works)	25 (small craft facilities)	50 (normal maritime structures)	100 or more (special structures/ residential developments)
1	Structures presenting a low degree of hazard to life or property	1/20	1/50	1/200	1/500
2	Normal structures	1/50	1/200	1/500	1/1000
3	High property value or high risk to people	1/100	1/500	1/1000	1/2000

Given a potential implementation timeframe of short term CAS adaptation options in the order of 5 years, a design working life of **5 years** is considered appropriate for the immediate works at Wyomi Beach. This corresponds to a design event of **20 to 50 years Annual Recurrence Interval (ARI)**, as shown in red in Table 2. This design working life and design event will be used in the immediate adaptation assessment at Wyomi Beach.

The immediate adaptation assessment will focus on the following coastal hazards:

- Erosion and wave overtopping at all sections of the existing seawall structures (Table 1) in the design event. Beach erosion can lead to undercutting of seawall foundations, potentially causing the seawall to fail. Wave overtopping occurs when wave runup exceeds the seawall crest level, potentially leading to crest damage and/or scour behind the seawall crest and may also cause the seawall to fail.

- Erosion hazard exposure of coastal assets behind existing seawalls, should the existing seawalls structures fail in the design event.

- Erosion hazard exposure of coastal assets on unprotected shoreline sections in the design event.

This assessment will not include review of the suitability of the rock or GSC seawall armour size, placement or filter layers (rock and/or geotextile) filters at withstanding the design event conditions.

2.2. Storm erosion modelling inputs

2.2.1. Software

SBEACH (Storm-induced BEAch CHange) software was used to predict and analyse present day storm-induced erosion at the site. The SBEACH model is the most commonly used model within the industry for evaluating beach response to storms, and has been successfully calibrated and verified for a number of Australian beaches (WRL, 2013).

SBEACH simulates cross-shore beach, berm, and dune erosion produced by storm waves and water levels. The software uses varying input water levels (from combined storm surge and tide), varying wave heights and periods, and an effective grain size (D_{50}) for the beach sand.

2.2.2. Input profiles

A total of five SBEACH profiles were created across the three compartments at critical dune and seawall locations. The following information was used to create these profiles:

- Site measurements of beach levels (relative to existing structure levels) by senior coastal engineer's site visit on the 21/2/2020.
- Beach and nearshore profiles 715008 and 715009 collected by Department of Environment and Water (DEW). These extend from the rear of Marine Parade to approximately -5mAHD contour, as shown in Figure 2 on the following page. The latest survey from April 2018 was used for the present day beach profiles and were found to match well with site observations of beach slope and height.
- LiDAR Digital Elevation Model (DEM) data from October 2018 was used to fill in the beach and onshore topography between the DEW profiles. The LiDAR and DEW profiles were found to match well, as shown in Figure 3.
- Offshore regional bathymetry data from nautical charts available from http://spatialwebapps.environment.sa.gov.au/naturemaps/?viewer=naturemaps.
- Regional bathymetry (250m grid) available online from https://data.gov.au/data/dataset/australian-bathymetry-and-topography-grid-june-2009. These profiles were extended to the -80 mAHD contour, which was the input location for the offshore wave conditions.

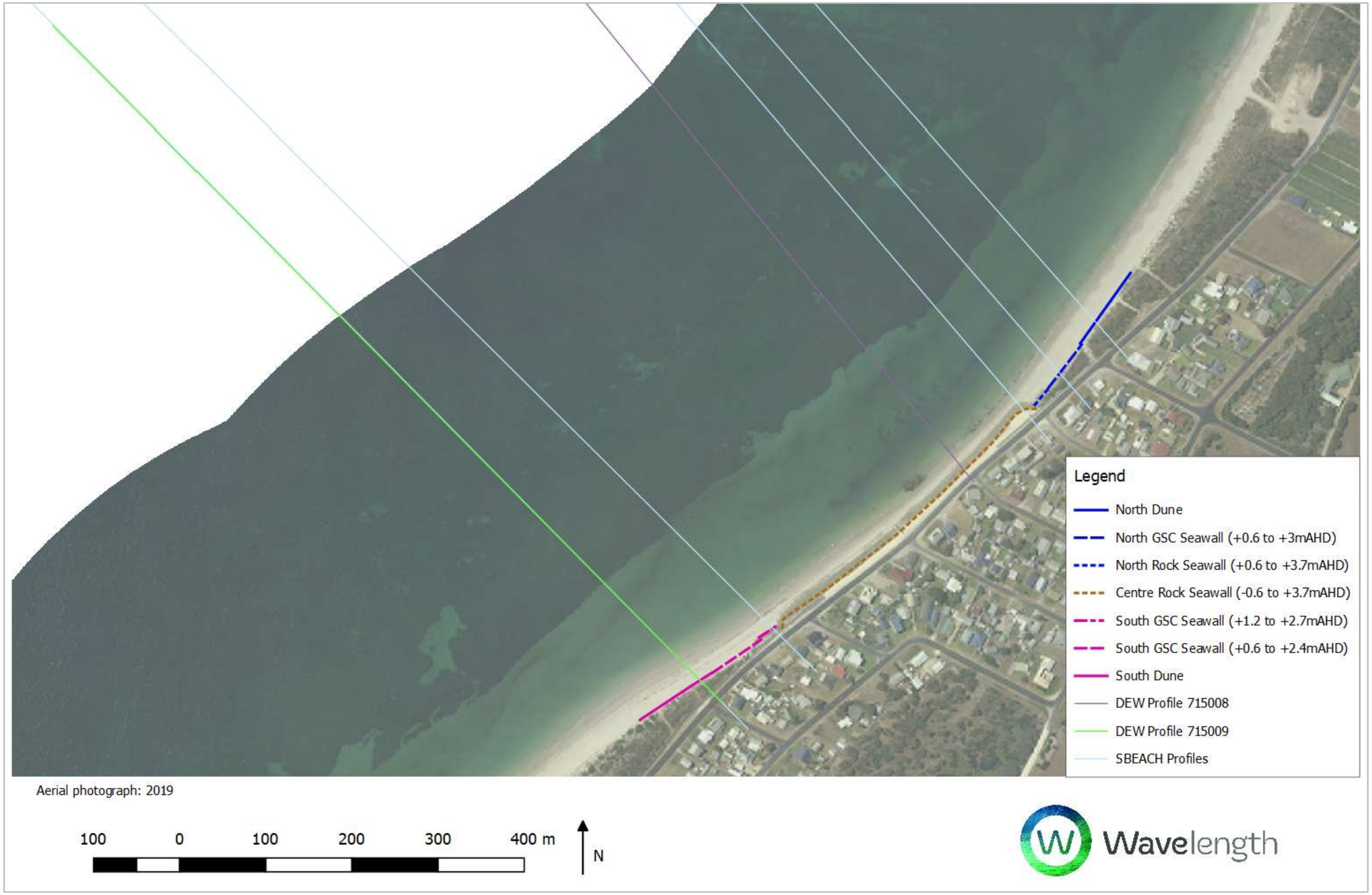

Figure 2: DEW profile locations

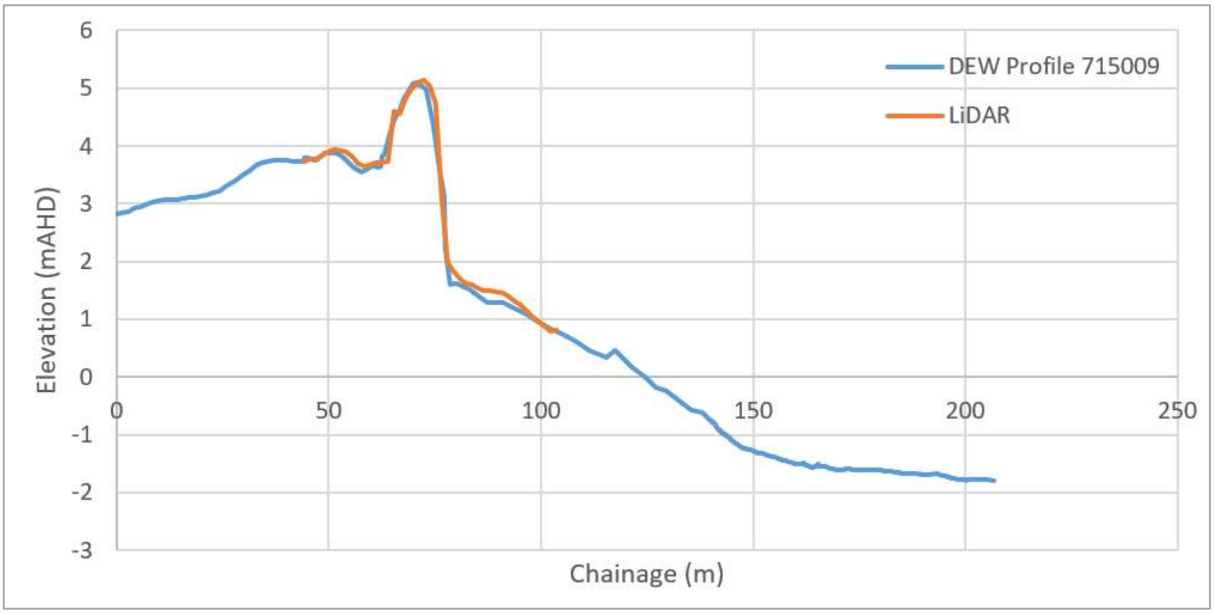

Figure 3: Comparison of LiDAR and DEW profile 715009

2.2.3. Horizontal Setback Datum

The Horizontal Setback Datum (HSD), which is typically defined as the base of the erosion scarp on an eroding shoreline, varied from +1.7 mAHD in the south to approximately +2.1 mAHD in the north. Dune erosion widths are measured landward from the HSD.

2.2.4. Sediment grain size

Particle Size Distribution (PSD) analysis was carried out on beach sand samples collected by Wavelength as part of the CAS. The effective grain size (D_{50}) was calculated at Wyomi Beach, with a D_{50} of 0.23 mm. This value was used in the SBEACH modelling.

2.2.5. Design storm inputs

As noted in Section 2.1, the design storm for assessment of immediate adaptation options is in the order of 20 to 50 years ARI. DEW have been monitoring the shoreline at Wyomi at approximately 1 to 3 year intervals since 2003, as shown in Figure 4

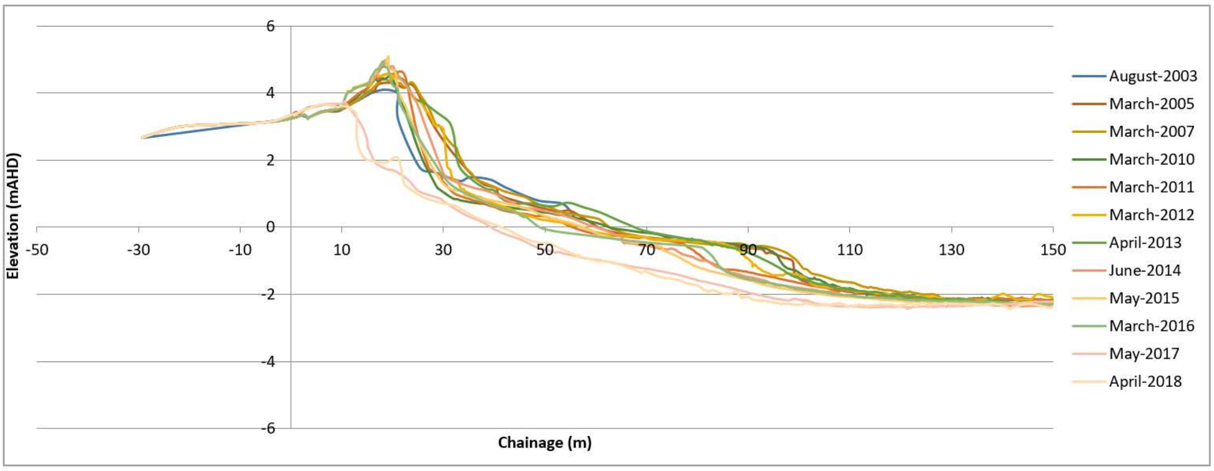

Figure 4: DEW profile 715008 since 2003

The largest erosion recorded during this approximate 20 year period was between March-2016 and May-2017, with approximately 10 to 15m of dune width lost. Most of this erosion is likely to have occurred during a large storm event between 10th and 13th July 2016. This storm was reported to have damaged the Kingston jetty and Maria Creek breakwaters (Pers. Comm. David Worthley, 21 February 2020), as well as causing significant beach erosion at Wyomi, as shown in Figure 5 (ABC News, 2016).

Figure 5: 15th July 2016 storm erosion photograph (ABC News, 2016)

Water levels during the storm event were recorded at Victor Harbour, located approximately 170km north of the study site, presented in Figure 6.

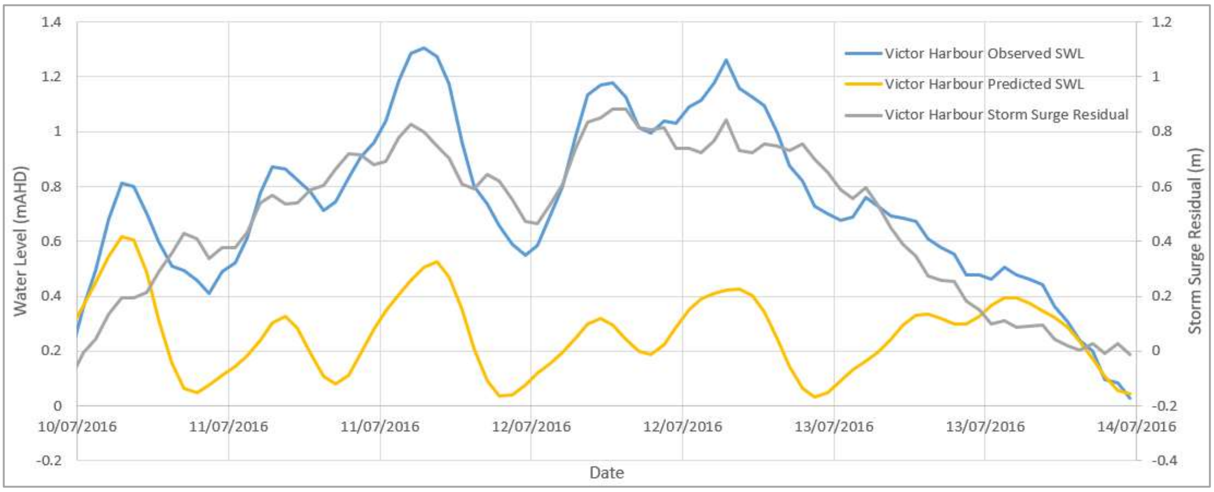

Figure 6: Victor Harbour water level observations

Figure 6 shows the July 2016 storms had two water level peaks due to the passage of two winter cold fronts in close succession. This event had elevated water levels for a 72-hour period, coinciding with a period of spring high tides (Mean High Water Springs at Victor Harbour is approx. +0.6mAHD). The water level peaked at an approximate 5 year ARI water level for the Victor Harbour tide gauge (Pattiaratchi, C. et al 2018).

The waves recorded offshore at Cape du Couedic wave rider buoy (south-west of Kangaroo Island) in approximately 80m water depth are presented in Figure 7.

Figure 7: Cape du Couedic wave observations

The July 2016 storms had a peak wave height of approximately 8.2m, which corresponds to an approximately 10 year ARI offshore wave height (WRL, 2013).

Given the July 2016 storm event resulted in the largest erosion recorded at the site over the last 20 years, it is anticipated that this event estimates a storm erosion event in the order of 20 to 50 years ARI. The July 2016 storm event was tested in SBEACH to ensure that the modelled erosion matched on-site profile measurements at Wyomi Beach.

The input water levels from Victor Harbour (Figure 6) and wave heights from Cape du Couedic (Figure 7) were input to the SBEACH model with the pre-storm profile taken from the March-2016 DEW profiles 715008 and 715009. The missing wave data from the Cape du Couedic was synthesised to peak at a wave height of 7m with the passage of the first storm front, given that this was less severe than the second storm front based on the recorded storm surge residuals.

The results of the model testing are shown in Figure 8 and Figure 9.

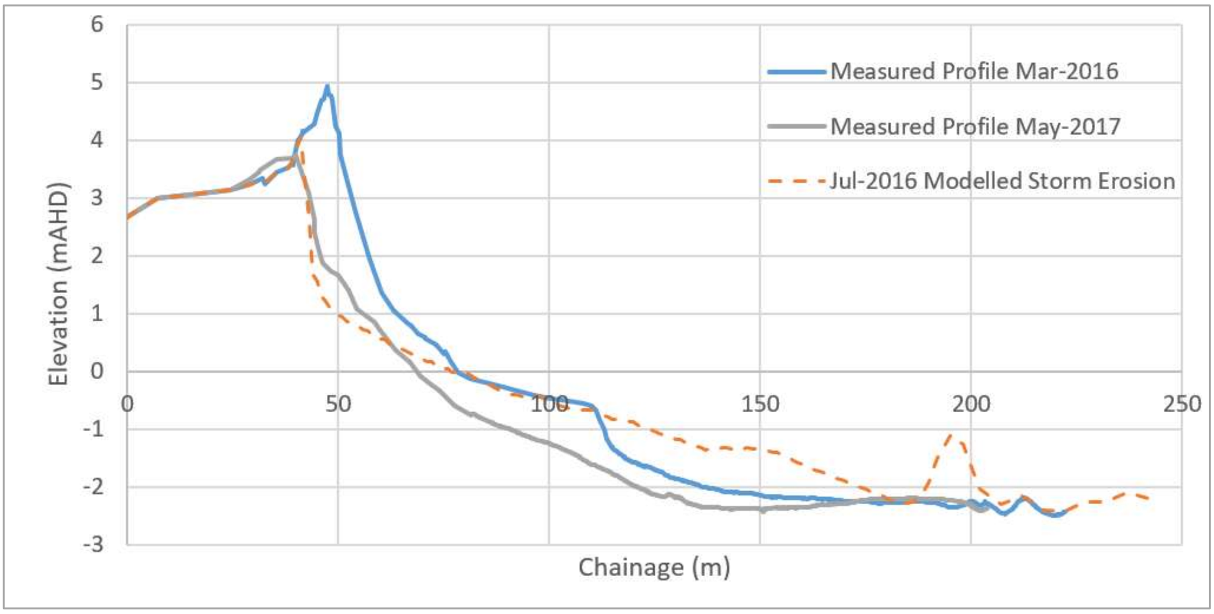

Figure 8: DEW Profile 715008 model testing results

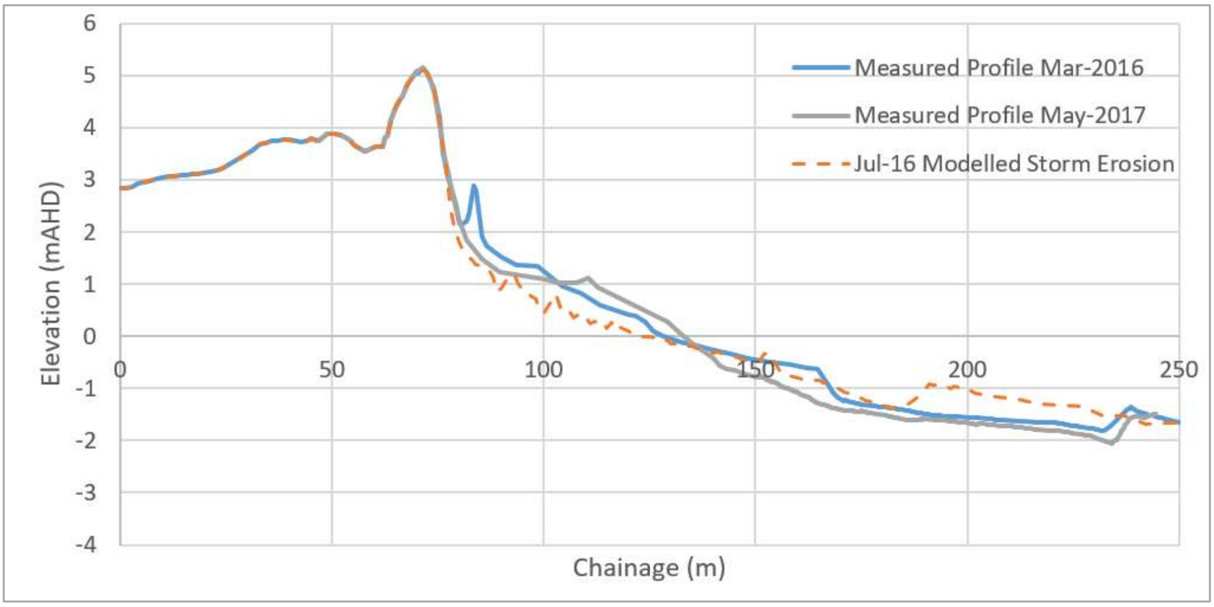

Figure 9: DEW Profile 715009 model testing results

The modelled dune erosion widths match the measured post-storm (May-2017) profiles well. There has been some loss of material at depth (>-1mAHD) but this is likely due to longshore transport losses that occur naturally through coastal processes, including during severe storm events. These results provide confidence in the model inputs for testing various erosion scenarios at Wyomi Beach. As such, the July 2016 storm was input as the design storm event in the SBEACH modelling.

2.3. Storm erosion results

The design storm event was applied to the dune and seawall locations previously presented in Figure 1. An example plot of the modelled erosion for the north dune profile is presented in Figure 10.

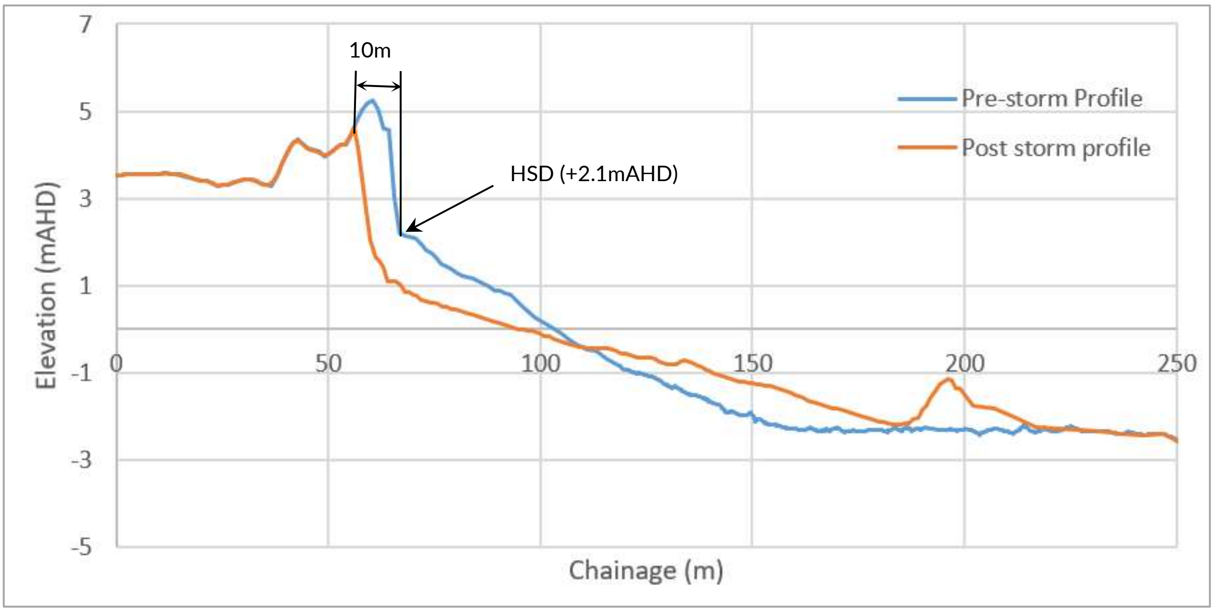

Figure 10: Example SBEACH results (north dune)

Where seawalls exist on the profile, a hard bottom profile was added in SBEACH to model potential scour depth at the seawall toe. Scour calculations, using the methodology of Xie (1981), were also completed to cross-check erosion depths. Wave runup was also output from SBEACH for comparison to crest levels and width for determination of overtopping risk. These results are summarised in Table 3 on the following page. Erosion hazard lines are presented in the following Section 3.

Table 3: SBEACH modelling results

Compartment	Location	Erosion Width (m behind HSD)	Foundation Level (mAHD)	Indicative Erosion Depth (mAHD)	Indicative Crest Level (mAHD) & Crest Width (m)	Indicative Wave Runup Level (mAHD)
North	North dune	10	n/a	n/a	n/a	n/a
	North 2.5m^3 GSC seawall	n/a	+0.6	+0.2 to +0.4	+3.0 1.6	+5.0
	North ad hoc rock seawall	n/a	+0.6	+0.2 to +0.4	+3.7 2.0	+5.5
Centre	Centre rock seawall	n/a	-0.6	-0.5 to -1[2]	+3.7 5.0 to 7	+5.5
South	South 0.75m^3 GSC seawall	10[1]	+1.2	+0.7 to +0.8	+2.7 1.6	+5.0
	South 2.5m^3 GSC seawall	10[1]	+0.6	+0.7 to +0.8	+2.4 1.6	+5.0
	South dune	10	n/a	n/a	n/a	n/a

Notes: 1. SBEACH modelling suggests seawall is likely to fail in design storm event due to erosion and/or overtopping. A 10m erosion width behind the failed seawall has been applied at this location.
2. Centre rock seawall has a 3.5m wide toe berm, which is expected to provide protection below -1mAHD.

3 Asset & infrastructure risk profiling

Analysis has been carried out to identify the coastal protection structures and assets that may currently be at risk from coastal erosion or overtopping (for seawalls only) during the design storm event. The developed risk profiles have subsequently been used to identify priority areas to inform the immediate adaptation option assessment (Section 4).

3.1. Approach

An asset and infrastructure database was developed using a feature survey of the site to identify the assets and infrastructure at immediate risk to coastal erosion and wave overtopping. The northern assets are presented in Figure 11, with the southern assets presented in Figure 12. All assets are summarised in Table 4.

Table 4: Asset summary

Asset Type	Compartment	Asset Description	Potential Hazard
Protection Structure	North	North 2.5m^3 GSC seawall	Erosion & overtopping
	North	North ad hoc rock seawall	Erosion & overtopping
	Centre	Centre rock seawall	Erosion & overtopping
	South	South 0.75m^3 GSC seawall	Erosion & overtopping
	South	South 2.5m^3 GSC seawall	Erosion & overtopping
Recreational/Social	All	Path	Erosion
Environmental	North	North dune vegetation	Erosion
	South	South dune vegetation	Erosion
Infrastructure	All	Telstra cable	Erosion
	All	Marine Parade	Erosion

Figure 11: North assets & erosion hazard line

Figure 12: South assets & erosion hazard line

A qualitative approach was developed to assess the magnitude of the risks associated with both erosion and wave overtopping. The risk assessment was undertaken in line with the recommendations of the *LGA SA Climate change decision support framework* (Balston, J.M. et al, 2012), which notes:

> *The risk rating method involves considering the two components of risk: likelihood of hazard; and magnitude of consequence (impact). The likelihood assessment relates to the probability of the hazard occurring over the lifetime of the particular asset or service in question. The magnitude is based on a qualitative assessment of the consequence of the hazard, by considering four categories of consequence: health, social, economic, environment.*

The likelihood of occurrence of the design event (20 to 50 year ARI) occurring over the design life of the adaptation options (5 years) is between 10% and 23%. Using the likelihood descriptors developed by the Australian Geomechanics Society (AGS) in 2007, presented in Table 5, a likelihood between Possible and Likely is calculated. For the purposes of this study, a conservative likelihood of **Likely** will be used in this assessment.

Table 5: Likelihood descriptors (AGS, 2007)

Descriptor	Designated cumulative probability of event occurring over design life
Almost Certain	95.4%
Likely	26%
Possible	3%
Unlikely	0.3%
Rare	0.03%
Barely Credible	<0.03%

The assessment of consequences for both erosion and overtopping was based on a "Do Nothing" scenario and adopting the local government framework for coastal risk assessments in Australia developed for damage to infrastructure and services, and the environment (AGS, 2007), presented in Table 6. The subsequent likelihood versus consequence risk matrix is presented in Table 7.

Table 6: Consequence descriptors (based on AGS, 2007)

Descriptor	Approximate quantum of damage (cost)	Asset, Infrastructure and Recreational- Description	Environment - Description
Catastrophic	>100%	Significant permanent damage and/or complete loss of the infrastructure and the infrastructure service or recreational value. Loss of infrastructure support and translocation of services to other sites	Very significant loss to the environment. May include localised loss of species, habitats or ecosystems Extensive remedial action essential to prevent further degradation Restoration likely to be required
Major	40 to 100%	Extensive infrastructure damage requiring major repair. Major loss of infrastructure service/ amenity value	Significant effect on the environment and local ecosystems. Remedial action likely to be required
Medium	10% to 40%	Limited infrastructure damage and loss of service / amenity value. Damage recoverable by maintenance and minor repair	Some damage to the environment, including local ecosystems. Some remedial action may be required
Minor	1% to 10%	Localised infrastructure service disruption or loss of amenity value. No permanent damage Some minor restoration work required	Minimal effects on the natural environment
Insignificant	<1%	No infrastructure damage, little change to service or amenity value	No adverse effects on natural environment

Table 7: Risk (Likelihood/Consequence) Matrix (AGS, 2007)

Likelihood	Consequence				
	Catastrophic	**Major**	**Medium**	**Minor**	**Insignificant**
Almost Certain	Very High	Very High	Very High	High	Medium
Likely	Very High	Very High	High	Medium	Low
Possible	Very High	High	Medium	Medium	Very Low
Unlikely	High	Medium	Low	Low	Very Low
Rare	Medium	Low	Low	Very Low	Very Low
Barely Credible	Low	Very Low	Very Low	Very Low	Very Low

A High or Very High risk is considered unacceptable, requiring adaption responses to be implemented.

3.2. Consequence & risk ratings

The consequence rating for the coastal protection structures exposed to the design storm was determined using the SBEACH modelling results (Table 3). The following should be noted regarding these consequence and risk ratings:

- The risk assessment aims to identify relative erosion and overtopping risk for the existing structures only. This is not intended to be a detailed design review of existing structures.
- The central rock seawall has a 3.5m wide toe berm at -0.6mAHD. This berm is likely to provide scour protection to at least -1mAHD.
- The 2.5m^3 GSC seawalls were installed with scour flaps on the bottom row. These containers are likely to provide some additional scour protection to a level approximately 0 to +0.2 mAHD.
- GSC seawalls are less resilient to wave overtopping than rock seawalls, with design guidance suggesting wave overtopping should be minimal to prevent crest damage and wall failure.

The resultant consequence and risk ratings are presented in Table 8 for the coastal protection structures and Table 9 for the other coastal assets.

The following important results are noted from this risk assessment:

- The southern GSC seawalls have a higher risk of failure than the northern structures. Failure of the southern GSC seawalls means the Telstra Cable and the path are also at Very High risk of erosion in the coming 5 years.
- The northern seawalls are at High risk from erosion and overtopping in the coming 5 years, with significant damage of these structures expected in the design event. These seawalls are not expected to completely fail in the design event under present day conditions but would require significant repairs to remain functional.
- The unprotected coastal assets, including dune vegetation, on either side of the existing seawalls are considered Low to Medium risk of coastal erosion. As such, extension of the existing seawalls should be considered a lower priority than improving protection in the already protected sections of shoreline in the north and south compartments.

Table 8: Consequence and risk ratings – coast protection structures

Compartment	Asset Description	Hazard	Consequence Description / Description of potential damage	Consequence Rating	Risk Rating
North	North 2.5m^3 GSC seawall (72m length)	Erosion	Wall unlikely to completely fail but could slump due to undercutting of scour flap Erosion at seawall return possible. May require restoration works to backfill wall.	Medium	High
		Overtopping	Crest bags likely to be damaged	Medium	High
	North ad hoc rock seawall (22m length)	Erosion	Wall unlikely to fail completely but could slump due to undercutting, exposing filter layers	Medium	High
		Overtopping	Crest likely to be damaged	Medium	High
Centre	Centre rock seawall (395m length)	Erosion	Some restoration work may be required following severe storm	Minor	Medium
		Overtopping	Some restoration work may be required following severe storm	Minor	Medium
South	South 0.75m^3 GSC seawall (28m length)	Erosion	Wall likely to fail due to undercutting and overtopping	Major	Very High
		Overtopping		Major	Very High
	South 2.5m^3 GSC seawall (72m length)	Erosion	Erosion at seawall return possible. May require restoration works to backfill wall	Minor	Medium
		Overtopping	Likely major crest damage, which is likely to cause wall to fail	Major	Very High

Table 9: Consequence and risk ratings – other assets

Compartment	Asset Type	Asset Description	Consequence Description / Description of potential damage	Consequence Rating	Risk Rating
North	Recreational/Social	Path	No damage - protected by seawalls	Insignificant	Low
	Infrastructure	Telstra cable	No damage - protected by seawalls	Insignificant	Low
	Environmental	Dune vegetation	Loss of 10m dune vegetation in localised area. Large extents of dune vegetation remain in adjacent coastline	Minor	Medium
Centre	Recreational/Social	Path	No damage - protected by seawalls	Insignificant	Low
	Infrastructure	Telstra cable	No damage - protected by seawalls	Insignificant	Low
South	Recreational/Social	Path – behind GSC seawalls	Path eroded due to erosion scarp, as GSC seawalls likely to fail	Major	Very High
		Path – behind dunes	No damage. Erosion extent does not extend to path behind dunes	Insignificant	Low
	Infrastructure	Telstra cable– behind GSC seawalls	Cable exposed due to erosion scarp, as GSC seawalls likely to fail	Major	Very High
		Telstra cable- behind dunes	No damage. Erosion extent does not extend to cable behind dunes	Insignificant	Low
	Environmental	Dune vegetation	Loss of 10m dune vegetation in localised area. Large extents of dune vegetation remain in adjacent coastline	Minor	Medium
All	Infrastructure	Marine Parade	Erosion extent does not extend to asset	Insignificant	Low

4 Adaptation options assessment

4.1. Approach

The immediate adaptation options assessment contained in this report will focus on options to manage the present day erosion and overtopping risk to the existing structures and assets in close proximity to the coast. The adaptation options must take into account the relatively limited budget (approx. $200,000) and timeframe (2-3 months implementation) constraints of the Coast Protection funding.

As such, the following adaptation options have been investigated:

- Accommodate – upgrade existing seawalls to accommodate higher levels of wave overtopping.
- Defend – replace existing seawalls with new seawalls at a deeper foundation level and increased crest height.
- Defend – Place sand nourishment to provide erosion buffer in front of existing seawalls.
- Do Nothing

The above adaptation options have been investigated for those assets and coastal protection structures that have a High or Very High risk of coastal erosion and/or wave overtopping. The following factors have been considered and discussed for each option in Sections 4.2 to 4.5:

- Capital cost (refer Section 4.6 for more details)
- Recurrent costs (refer Section 4.6 for more details)
- Environmental impact
- Community acceptability (social impact)
- Flexibility - can the option be readily adapted in the future?
- Effectiveness -does the option provide a long term solution for mitigating coastal hazards?

4.2. Accommodate –upgrade seawalls

The crests of existing seawalls can be raised to increase their resilience to wave overtopping events. This can be done by placing additional GSC containers on top of GSC seawalls or adding additional crest rocks to an existing rock seawall.

Existing seawalls can not be easily upgraded to accommodate an erosion depth greater than the seawall foundation level without significant cost or potential structural damage during construction. As such, it has been assumed that new seawalls (Section 4.3) would be constructed in locations where the existing rock or GSC seawall has a High or Very High risk of erosion.

Given the above, the only seawall section that is suitable for a crest upgrade is the southern 2.5m^3 GSC seawall. Based on the wave runup levels during the design storm event (Table 3), a minimum crest level of +4.2mAHD has been assumed to upgrade this GSC seawall, requiring placement of up to 3 layers of additional containers. This option would require detailed design to finalise crest levels should it be a preferred option.

The following should be considered for the upgraded seawall section:

- Relatively low capital and on-going costs (refer Section 4.6 for details).
- Crest works would negatively impact on the recently established dune vegetation.
- Community acceptability is likely to be higher compared to replacing seawalls, placing sand nourishment or a Do Nothing option.
- The upgraded seawalls would continue to have a reasonable degree of flexibility in terms of overtopping, with crest levels able to be increased in the future. Generally however, a seawall is considered an inflexible option compared to sand nourishment as it is difficult to reverse should an option other than a seawall be identified in the CAS.

- The long term effectiveness of the upgraded seawalls is limited, as the foundations can not be easily deepened without replacing the wall. The upgraded seawalls may come under threat from erosion in the future with on-going sediment loss from longshore transport and sea level rise and may need to be replaced in the future with a seawall founded to at least -0.6mAHD.

4.3. Defend – construct new seawall

As noted above, existing seawalls can not be easily upgraded to accommodate an erosion depth greater than the seawall foundation level. Therefore, it has been assumed that in locations where the existing rock or GSC seawall has an unacceptable risk of erosion, the existing seawall would be pulled apart and new seawalls would be constructed in their place. Existing, undamaged GSC bags would be reused in the new seawall.

Based on the design erosion depths and wave runup levels (Table 3), a toe depth of -0.6mAHD and a crest level of +4.2mAHD has been assumed for new GSC seawalls and would require placement of an 8 container high wall. For replacement with a rock seawall, the existing cross-section in the central compartment (built in 2018) is considered suitable as a longer term seawall solution. These options would require detailed design to finalise crest levels and toe depths should either be the preferred option.

The following should be considered for new seawall sections:

- Highest capital costs but relatively low recurrent costs (refer to Section 4.6 for details).
- Construction of a new seawall would negatively impact on the recently established dune vegetation and over time.
- This is likely to have a higher community acceptability than sand nourishment or a Do Nothing option, however replacement of recently constructed seawalls with new seawalls could be seen by community members.
- As listed above, whilst crest levels are able to be increased in the future seawalls are considered a reasonably inflexible option.

As noted previously, extension of the existing seawalls to the north and south should be considered a lower priority than defending existing seawall sections with more robust options.

4.4. Defend – sand nourishment

Sand nourishment can be placed in front of the existing seawalls, providing an erosion buffer during severe storm events. A number of options were considered for sourcing the fill sand for the nourishment. In collaboration with KDC, it was decided that sand would be sourced from the southern side of the Kingston Jetty due to the following reasons:

- the prevailing longshore transport is to the north-east, so sourcing sand from the south-west such as at Pinks Beach is likely to starve the longshore transport feed into the Wyomi Beach area, potentially increasing longshore erosion rates at Wyomi Beach.
- there is a surplus of sand at Kingston jetty, which is currently creating a sand management issue.

An approximate 10m increase in beach and berm width is required to protect the existing structures during the design storm event. Using the methods presented in the Coastal Engineering Manual Section V-4 (USACE, 2006), a nourishment volume of approximately 60 m^3 per m would need to be placed to provide this design beach width.

A nourished berm 20m wide at +3mAHD, with a front slope of 1V:5H would provide the necessary volume and could be placed above 0mAHD. The nourished berm was input with the July 2016 design storm in SBEACH. The erosion modelling results for the southern compartment are presented in Figure 13.

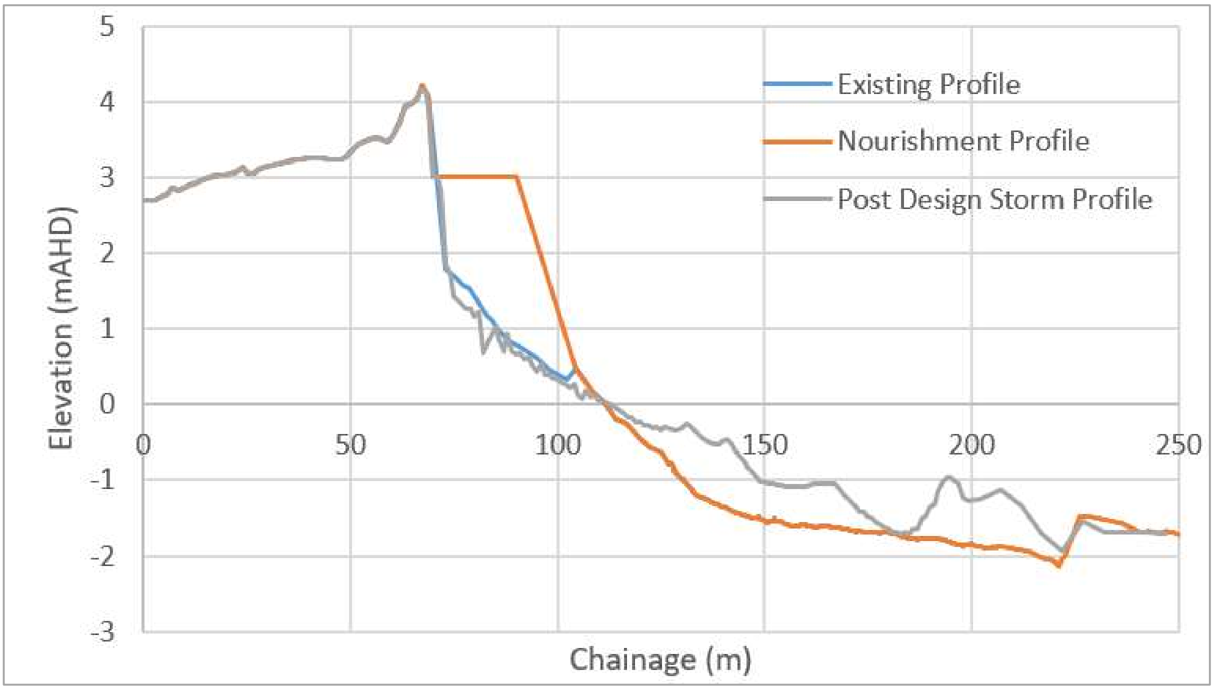

Figure 13: South compartment nourished profile & post storm profile

Figure 13 shows that erosion during the design storm event does not expose the existing GSC seawall, with similar results obtained in the northern compartment.

The longevity of the sand nourishment is dependent on the longshore sediment transport loss in the area. Longshore transport is believed to be strongly related to storm events within Lacepede Bay, with increased storm activity increasing longshore sediment transport losses at Wyomi Beach. The DEW profiles were reviewed to determine the longer term (since 2005) and shorter term (since 2016) sediment loss at Wyomi Beach (profile 715008).

Sand nourishment is estimated to be lost at a rate of approximately 15 m^3/m in a year with relatively few storms and up to 45 m^3/m in a year such as 2016 with several large storms. Therefore, the proposed nourishment could be expected to last between **1 to 4 years** depending on the severity of storm events experienced following placement.

The following should be considered for placement of sand nourishment:

- Moderate capital costs, with the highest recurrent costs to maintain protection (Section 4.6).
- Nourishment is the only option available to maintain beach widths and amenity in front of the seawalls.
- Nourishment is likely to have a higher community acceptability than the Do Nothing option however it is understood the community generally do not consider nourishment a cost effective protection strategy (Pers. Comm. David Worthley, 21/2/2020).
- Nourishment is the most flexible option should in the future a different adaptation option be identified (other than a seawall) in the CAS.
- The effectiveness of a nourishment strategy is dependent on the ongoing monitoring, planning and proactive management to ensure sand is replenished in a timely manner to maintain the required buffer width.

Nourishment may also require the following additional management:

- Potentially dangerous erosion scarps can form following storm and high water level events, which may need to be managed by KDC to minimize public safety risks.

- Sand nourishment may increase the amount of wind blown sand, which was noted as being a problem at Wyomi Beach by local residents (Pers. Comm. David Worthley, 21/2/2020).

4.5. Do nothing

Under this scenario KDC would continue to repair and maintain only the infrastructure that they are responsible for, such as coastal protection structures, paths and roads. The Do Nothing option is likely to have the following implications:

- Low capital and recurrent costs.
- Moderate environmental impact.
- Lowest community acceptability, as the Coast Protection funding is available and not taking the opportunity to spend the money could be seen as wasteful.
- High flexibility.
- Lowest effectiveness in the long term.

4.6. Preliminary cost estimates

Preliminary capital and recurrent annual (maintenance) cost estimates for each of the options have been prepared (Table 10 and Table 11). The cost estimates presented are to be used as a guide only, more detailed costings should be developed prior to any of the adaptation pathways being pursued. Cost estimates were developed under the following assumptions and limitations:

- The construction and maintenance costs for the seawall options have been estimated based on meterage or bag costs provided by KDC below. Lengths of each structure have been dictated by the required length to protect the asset or structure being assessed.
    - Rock seawall capital costs estimated at $4,000 per m based on feedback of construction costs from KDC (Pers. Comm. David Worthley, 21/2/2020). Recurring maintenance costs $20 per m per year.
    - GSC seawall upgrades and new seawall capital costs estimated at $700 per bag, based on feedback of recent GSC seawall construction costs from KDC (Pers. Comm. Chelsea Burns, 2/3/2020). Recurring maintenance costs $20 per m per year.
    - For the construct new seawall option (Section 4.3), it's assumed that half of the 2.5m^3 containers would be damaged when removing an existing GSC seawall and replacing it with a new GSC seawall. The remaining, undamaged containers could be re-used in the new seawall.
- Beach nourishment costs have been calculated on the basis of $17 per m^3 assuming sand would be sourced from the southern side of the Kingston Jetty. An excavator supported by three dump trucks would be required to efficiently excavate and haul beach sand from Kingston Jetty to Wyomi Beach. A dozer or loader would be required at Wyomi to shape the final nourishment to the design levels and slopes. This equates to a lineal rate of approximately $1,000 per m.
- It was assumed an additional 30m length would be added to the updrift (southern) side of any nourishment to provide longshore feed at the edge of the nourishment. Costs in Table 10 and Table 11 include this 30m for each shoreline section. Should two or more adjacent sections be protected by nourishment, the 30m overlap would be reduced, increasing the cost effectiveness of nourishment for longer stretches of shoreline.
- The proposed nourishment could be expected to last between 1 to 4 years depending on the severity of storm events experienced following placement. For the purposes of this study, it is assumed that half the sand nourishment volume would need to be replaced every year (i.e. nourishment lasts for 2 years before being lost). This is slightly conservative, as it less than the average of 1 to 4 years equal to 2.5 years.

- Costs presented for defend and accommodate options do not include costs associated with pre works such as detailed design, approvals and environmental impacts assessments.

The capital and recurring cost estimates for the adaptation options for the north and south coastal compartments are presented in Table 10 and Table 11 on the following page.

No assets are at High risk of erosion or overtopping in the central compartment.

Table 10: Preliminary Cost Estimates – North compartment

Asset Type	Asset Information			Option Type	Option	Capital Cost	Recurrent costs (per annum)
	Asset at risk	Overtopping Risk	Erosion Risk				
Coastal Protection Structures	North ad-hoc rock seawall (22m length)	-	High	Defend	Build new rock seawall to same standard as centre compartment	$96,000	<$5,000
				Defend	Nourishment (3,000m^3 - 50m length)	$50,000	$25,000
				Do Nothing	Do Nothing	$0	<$5,000
	North 2.5m^3 GSC Seawall (72m length)	High	High	Defend	Build new 8 bag GSC Seawall (-0.6 to +4.2mAHD)	$105,000	<$5,000
				Defend	Build new rock seawall to same standard as centre compartment	$288,000	<$5,000
				Defend	Nourishment (6,000m^3 - 100m length)	$100,000	$50,000
				Do Nothing	Do Nothing	$0	<$5,000

Table 11: Preliminary Cost Estimates – South compartment

Asset Type	Asset Information			Option Type	Option	Capital Cost	Recurrent costs (per annum)
	Asset at risk	Overtopping Risk	Erosion Risk				
Coastal Protection Structures & Protected Infrastructure (Path & Telstra Cable)	South 2.5m^3 GSC Seawall (72m length)	Very High	-	Accommodate	Upgrade GSC Seawall - Add 3 layers to crest	$63,000	<$5,000
				Defend	Build new 8 bag GSC Seawall (-0.6 to +4.2mAHD)	$136,500	<$5,000
				Defend	Build new rock seawall to same standard as centre compartment	$288,000	<$5,000
				Defend	Nourishment (6,000m^3 - 100m length)	$100,000	$50,000
				Do Nothing	Do Nothing	$0	<$5,000
	South 0.75m^3 GSC Seawall (28m length)	Very High	Very High	Defend	Build new 8 bag GSC Seawall (-0.6 to +4.2mAHD)	$66,000	<$5,000
				Defend	Build new rock seawall to same standard as centre compartment	$120,000	<$5,000
				Defend	Nourishment (3,000m^3 - 50m length)	$50,000	$25,000
				Do Nothing	Do Nothing	$0	<$5,000

5 Recommendations

The key results of the study are outlined below:

- The Kingston CAS is currently being undertaken by Wavelength, which will guide future coastal adaptation planning over the coming century at Wyomi Beach. Therefore, immediate adaptation options that are flexible and reduce risks over the greatest length of shoreline should be favored over expensive and inflexible options that may not align with potential findings of the long term CAS.
- Existing assets behind unprotected sections of shoreline (in the north and south compartments) were assessed as having lower risk of coastal erosion than assets behind some sections of protected shoreline in the southern compartment. This is due to potential failure of the southern GSC seawalls from erosion and/or overtopping in the design (20 to 50 year ARI) event. As such, extension of the existing seawalls to the north and south should be considered a lower priority than defending existing seawall sections.
- In the north and south compartments, Do Nothing is not a recommended adaptation option given the Very High and High risks of erosion and overtopping and the immediate availability of funding.
- The $200,000 available funding is unlikely to protect all sections of High and Very High risk shoreline over the 5 year timeframe. As such, it's recommended that immediate term adaptation options focus on managing Very High risk areas in the southern compartment first, with any remaining funds or future funding focused on reducing risks in the northern compartment.
- Nourishment is the recommended option to manage risks in the two compartments, as it is the most flexible option, providing protection to the longest portion of shoreline whilst the longer term CAS and it's adaptation pathways are finalised. That is, nourishment is the most flexible solution should in the future a different adaptation option be identified (other than a seawall) in the CAS.
- In the southern compartment, placement of approximately 7,200m^3 (in situ volume) sand at an estimated cost of $120,000 would be required to protect the 90m long Very High risk shoreline. The recommended nourishment has a total length of 120m and includes an additional 30m allowance on the southern (downdrift) side of the GSC seawalls. The recommended extent of nourishment is shown in Figure 13.
- The initial 7,200m^3 nourishment volume should be placed as a trial in the southern compartment and monitored to determine how successful it is at maintaining beach widths in ambient and extreme conditions. Should it be required, future Coast Protection Funding could be sought to maintain the protective buffer, whilst the longer term adaptation options from the CAS are considered and implemented. On-going sand nourishment costs are likely to be in the order of $30,000 to $60,000 per year depending on the severity of storm events experienced following placement.
- The remaining $80,000 of Coast Protection funds should be spent on placing an additional 4,500m^3 of sand nourishment in the northern compartment, as shown in Figure 13. This would equate to an approximate 120m long nourished berm with a cross-sectional area of approximately 40m^3 per m. Whilst this would have a slightly reduced width compared to the design nourishment profile, it is expected to provide a suitable buffer to reduce erosion and overtopping risks in the northern compartment.

Figure 14: Recommended Nourishment Extent

6 References

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U.S. Army Corps of Engineers, 2006. Coastal Engineering Manual. Washington, D.C.

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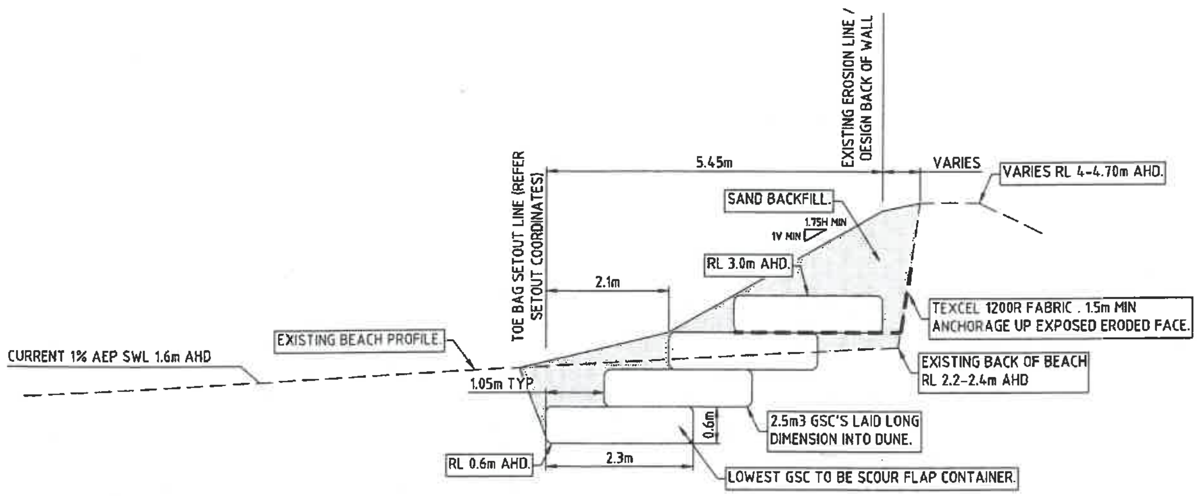
Xie, Shie-Leng, 1981, Scouring patterns in front of vertical breakwaters and their influences on the stability of the foundations of breakwaters, report Delft University of Technology

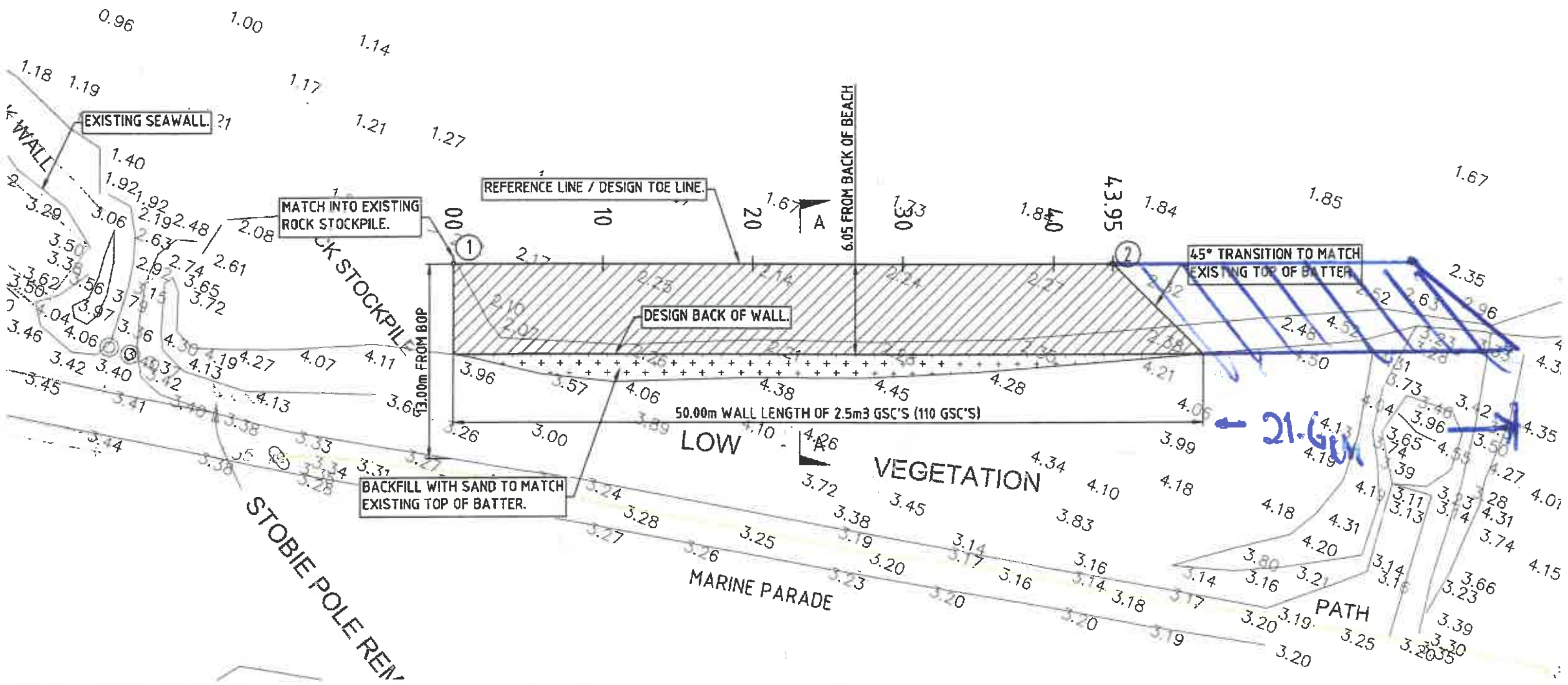
Appendix A Existing structures – key design drawings

Received
- 2 APR 2019
Kingston District Council



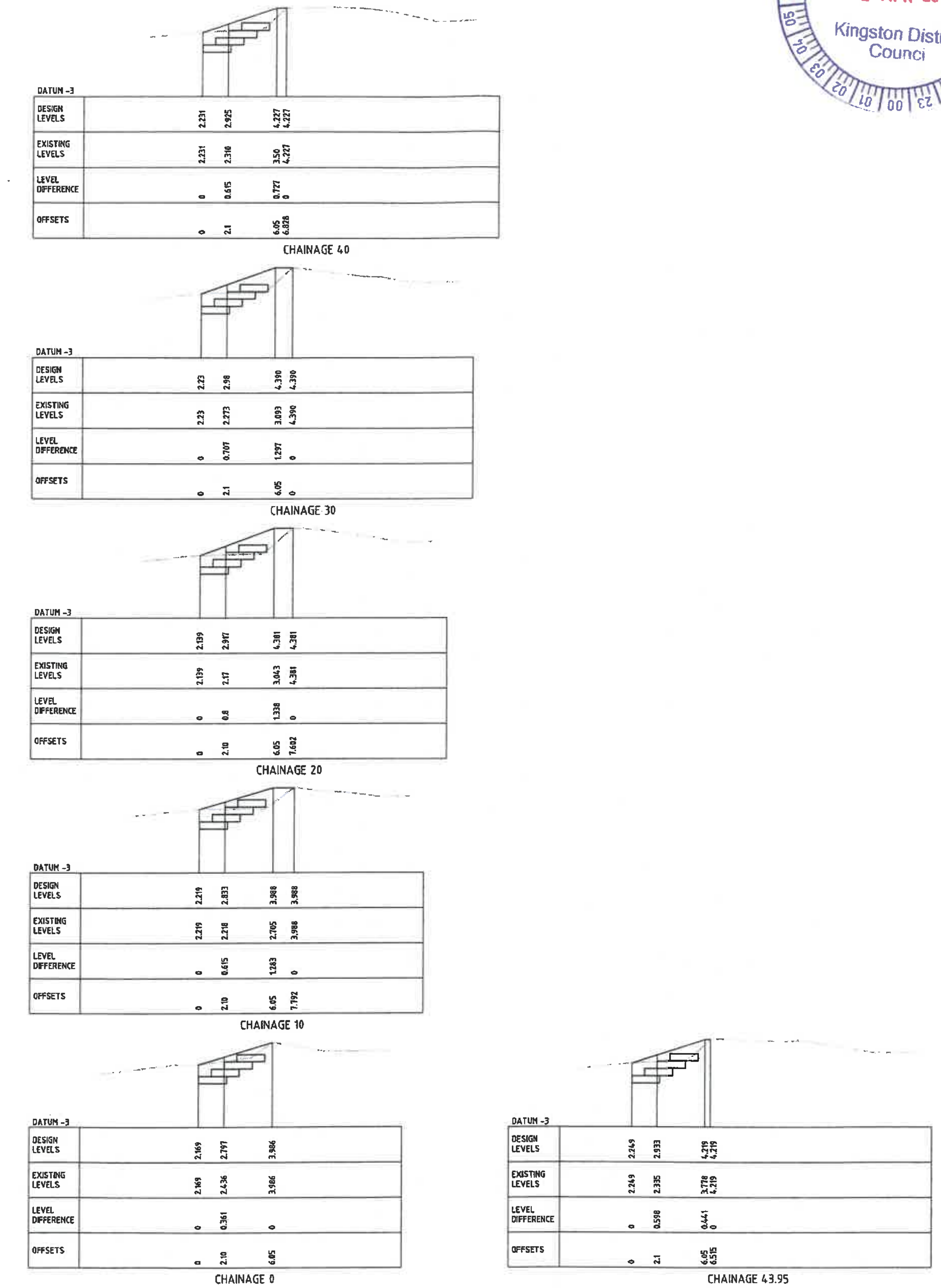
TYPICAL SECTION A - NORTH OF LACEPEDE AVENUE

SCALE H 1:5 V 1:5 @ B1



PLAN VIEW - GENERAL CONSTRUCTION

HORIZONTAL SCALE 1:200 @ B1



CROSS SECTIONS

HORIZONTAL SCALE 1:200 VERTICAL SCALE 1:200 @ B1

FOR CONSTRUCTION

CONSTRUCTION NOTATION:

1. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL EXISTING SERVICES BY CONTACTING DIAL BEFORE YOU DIG (DIAL 1100). CONTRACTOR TO REFER TO ALL ARCHITECTURAL, ELECTRICAL, MECHANICAL, HYDRAULIC, LANDSCAPE AND STRUCTURAL DRAWINGS TO PREVENT CLASHING OF SERVICES.
2. MINIMUM CLEARANCES TO EXISTING SERVICES SHALL BE MAINTAINED TO THE RELEVANT SERVICE AUTHORITY REQUIREMENTS. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER.
3. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL REVIEW AND CONFIRM NO CLASHES OCCUR BETWEEN EXISTING AND PROPOSED SERVICES.
4. SERVICE TOPSTONES AND PRIVATE SERVICE CONNECTIONS TO BE REVIEWED AGAINST NEW DESIGN PAVEMENT LEVELS AND ADJUSTED AS REQUIRED.
5. ANY SOFT, WET OR WEAK AREAS ENCOUNTERED DURING COMPACTION OF SUBGRADE MUST BE OVER EXCAVATED AND REPLACED WITH ENGINEERED FILL.

GSC COUNT:

NORTHERN SECTION - 110 GSC'S
SOUTHERN SECTION - 96 GSC'S
206 GSC'S

SETOUT TABLE

REF	EASTING	NORTHING	TYPE	LEVEL	COMMENTS
1	396005.160	5920055.011	TOE	0.6	START GSC WALL
2	396032.220	5920089.644	TOE	0.6	END GSC WALL

REVISIONS

NO.	DESCRIPTION	BY	DATE
1	SOUTHERN SEAWALL LENGTH AMENDED	AMO	APR 2019
0	FOR CONSTRUCTION	AMO	MAR 2019
A	FOR INFORMATION	AMO	MAR 2019

SERVICE	IDENTIFIER	REMARK
STORMWATER	STORMWATER	CHECKED
OVERHEAD POWER	X	CHECKED
ETSA	ETSA	CHECKED
TELSTRA	TELSTRA	CHECKED
OPTUS	OPTUS	CHECKED
NBN	NBN	CHECKED
GAS	GAS	CHECKED
SEWER	SEWER	CHECKED
WATER	WATER	CHECKED

HORIZONTAL SCALE
0 4 8 12
SCALE 1:200 Metres

Civil & Environmental Solutions

MOLLOYCONSULTING

SURVEYED	ALEXANDER AND SYMONDS
DRAWN	MOLLOY CONSULTING
DESIGNED	CIVIL AND ENVIRONMENTAL SOLUTIONS
LAST EDIT	Tuesday, 2 April 2019 10:40:21 AM

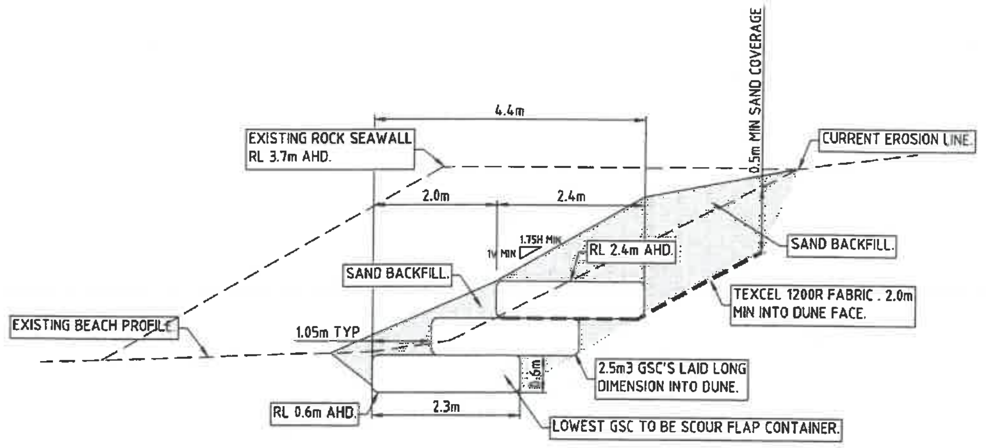
GEOSYNTHETIC SAND CONTAINER SEAWALL

WYOMI BEACH

NORTHERN SEAWALL - GENERAL CONSTRUCTION

KINGSTON DISTRICT COUNCIL

SHEET	3 OF 4
REVISION	1
DRAWING NUMBER	



TYPICAL SECTION B - SOUTH OF PETER AVENUE

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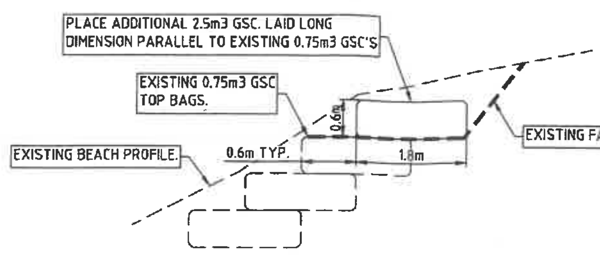
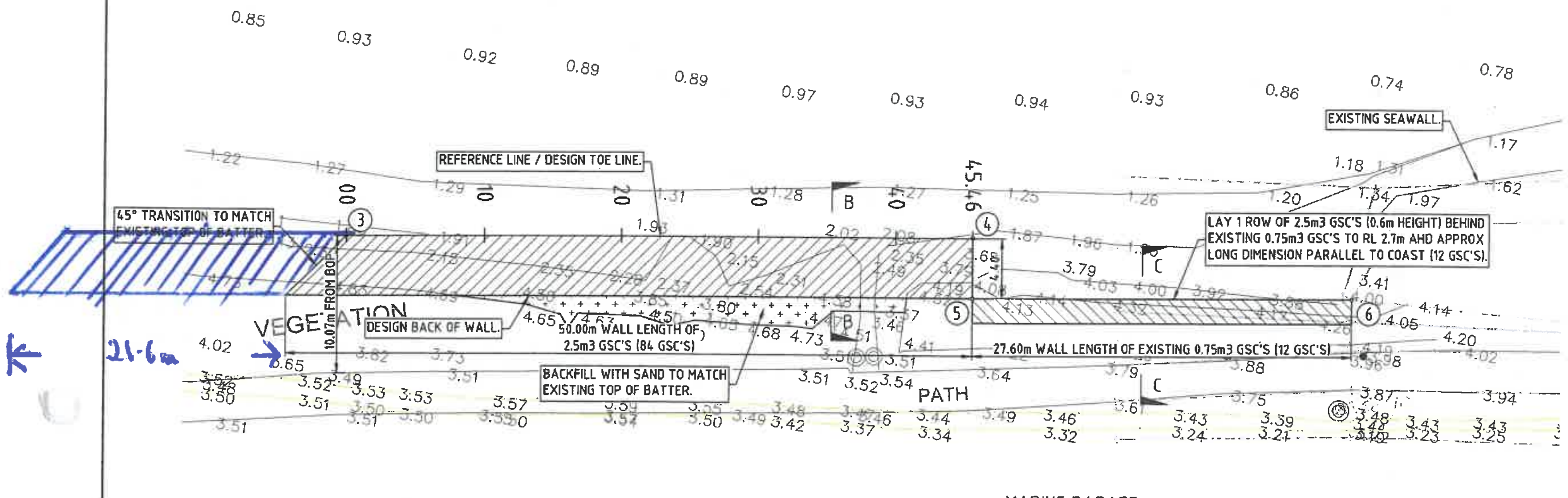


TYPICAL SECTION C - SOUTH OF PETER AVENUE

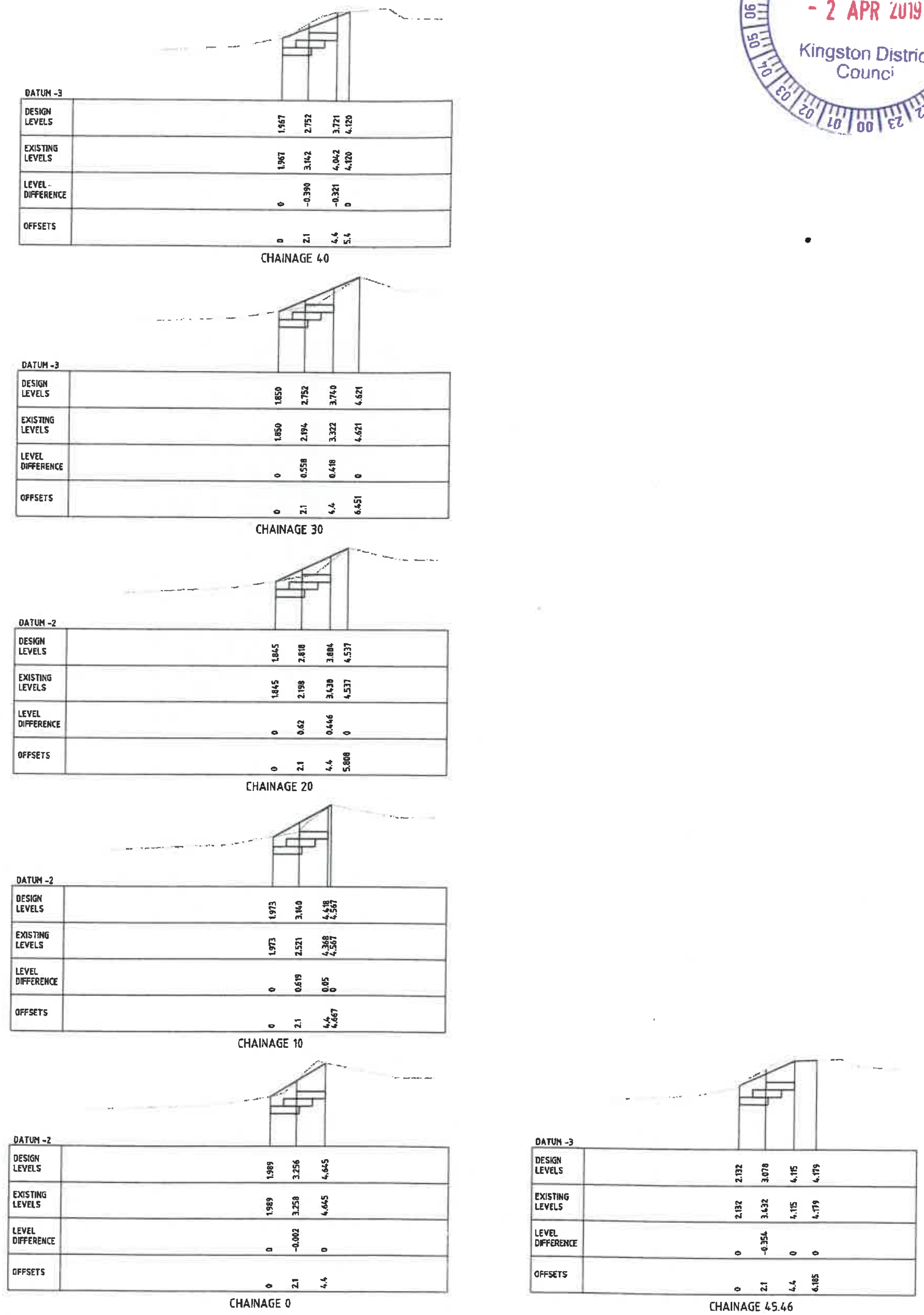
SCALE H 1:5 V 1:5 @ B1



MARINE PARADE

PLAN VIEW - GENERAL CONSTRUCTION

HORIZONTAL SCALE 1:200 @ B1



CROSS SECTIONS

HORIZONTAL SCALE 1:200 VERTICAL SCALE 1:200 @ B1

CONSTRUCTION NOTATION:

1. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL EXISTING SERVICES BY CONTACTING DIAL BEFORE YOU DIG (DIAL 1100). CONTRACTOR TO REFER TO ALL ARCHITECTURAL, ELECTRICAL, MECHANICAL, HYDRAULIC, LANDSCAPE AND STRUCTURAL DRAWINGS TO PREVENT CLASHING OF SERVICES.
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5. ANY SOFT, WET OR WEAK AREAS ENCOUNTERED DURING COMPACTION OF SUBGRADE MUST BE OVER EXCAVATED AND REPLACED WITH ENGINEERED FILL.

GSC COUNT:

NORTHERN SECTION - 110 GSC'S
SOUTHERN SECTION - 96 GSC'S
206 GSC'S

SETOUT TABLE

REF	EASTING	NORTHING	TYPE	LEVEL	COMMENTS
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4	395671.215	5920565.909	TOE	0.60	END GSC WALL
5	395673.999	5920562.496	TOE		START GSC WALL
6	395695.370	5920579.962	TOE		MATCH TO EXISTING GSC WALL

FOR CONSTRUCTION

REVISIONS

NO.	DESCRIPTION	BY	DATE
1	SOUTHERN SEAWALL LENGTH AMENDED	AMO	APR 2019
0	FOR CONSTRUCTION	AMO	MAR 2019
A	FOR INFORMATION	AMO	MAR 2019

SERVICE	IDENTIFIER	REMARK
STORMWATER	STORMWATER	CHECKED
OVERHEAD POWER	X	CHECKED
ETSA	ETSA	CHECKED
TELSTRA	TELSTRA	CHECKED
OPTUS	OPTUS	CHECKED
NBN	NBN	CHECKED
GAS	GAS	CHECKED
SEWER	SEWER	CHECKED
WATER	WATER	CHECKED

HORIZONTAL SCALE
0 4 8 12
SCALE 1: 200 Metres

Civil & Environmental Solutions

MOLLOY CONSULTING

SURVEYED	ALEXANDER AND SYMONDS
DRAWN	MOLLOY CONSULTING
DESIGNED	CIVIL AND ENVIRONMENTAL SOLUTIONS
LAST EDIT	Tuesday, 2 April 2019 10:40:22 AM

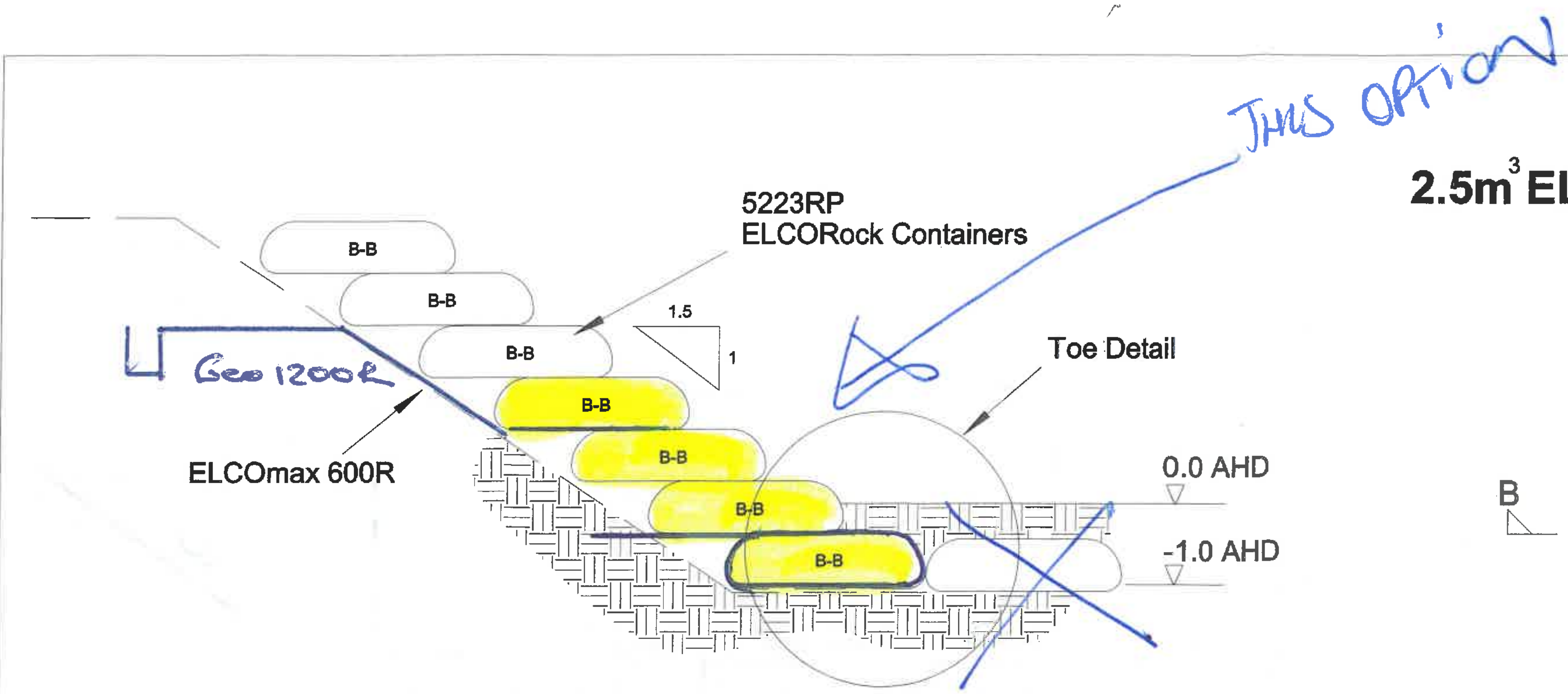
GEOSYNTHETIC SAND CONTAINER SEAWALL

WYOMI BEACH

SOUTHERN SEAWALL - GENERAL CONSTRUCTION

KINGSTON DISTRICT COUNCIL

SHEET	4 OF 4
REVISION	1
DRAWING NUMBER	



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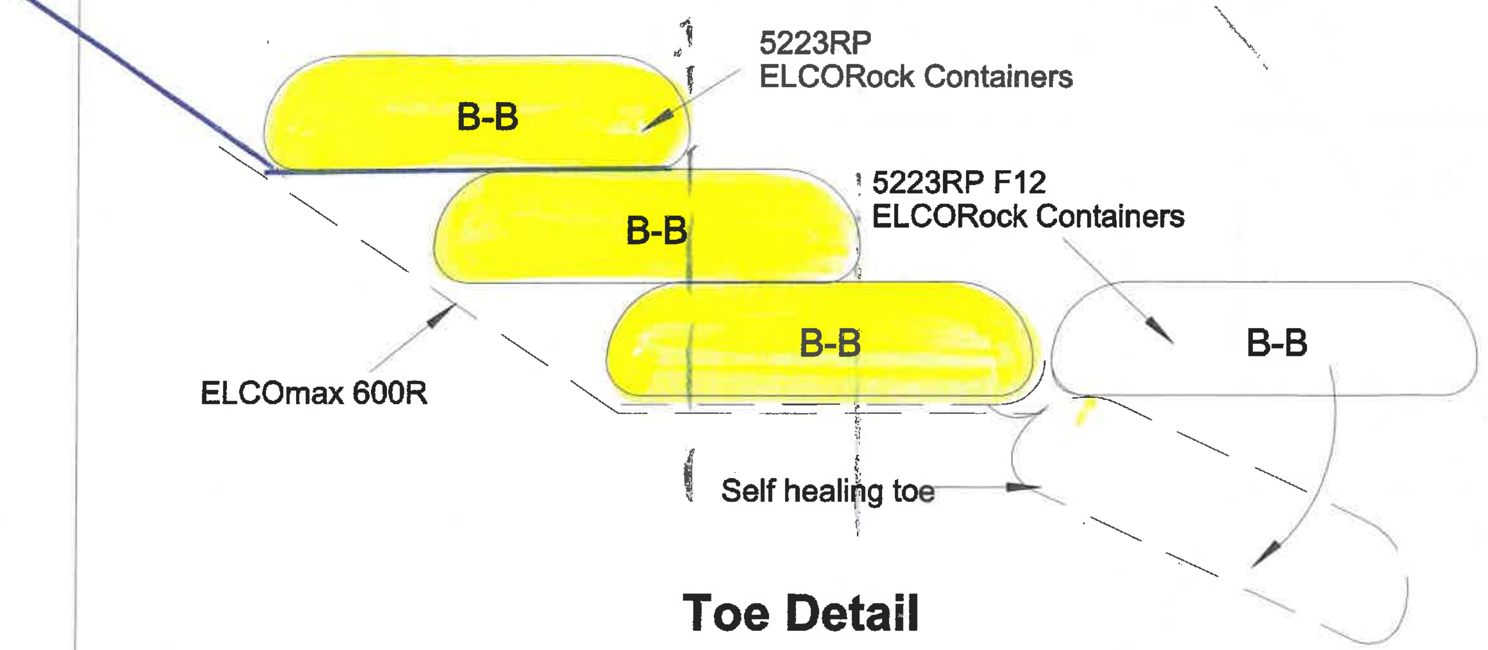
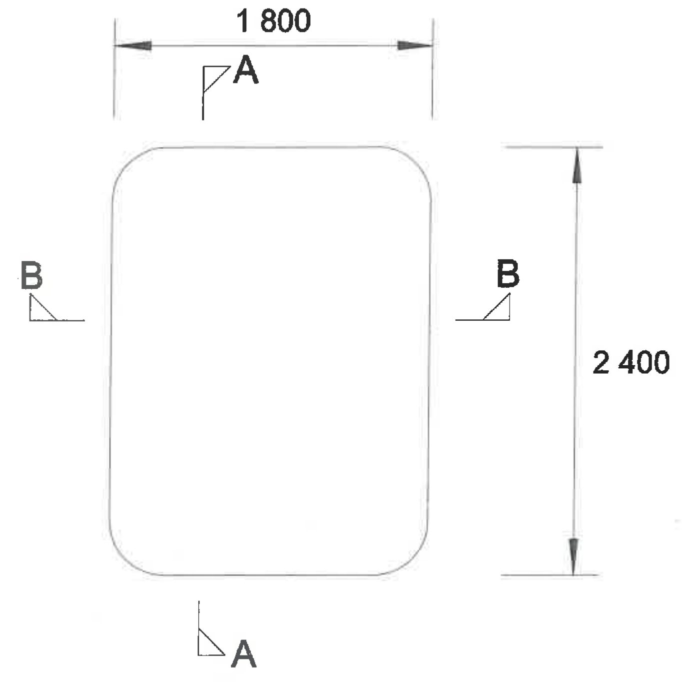
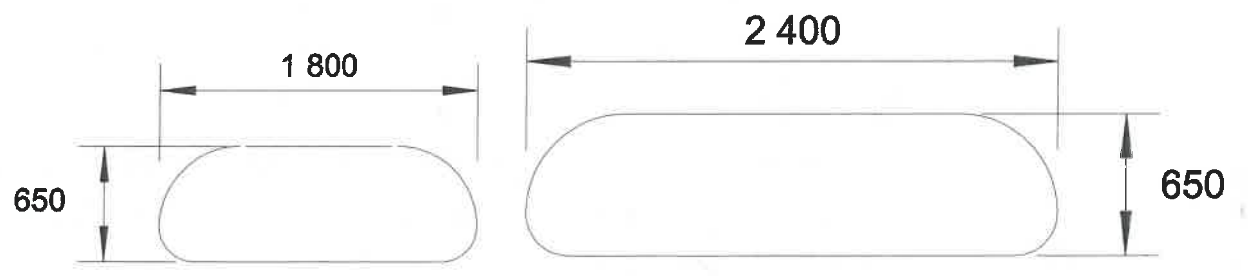


Toe Detail

2.5m³ ELCORock Dimensions



Full Container



Section B-B **Section A-A**

Disclaimer:
This document is not to be considered a full design and is provided without obligation. Complete engineering design is to be performed by a suitably qualified engineer.

Date: 29/07/10

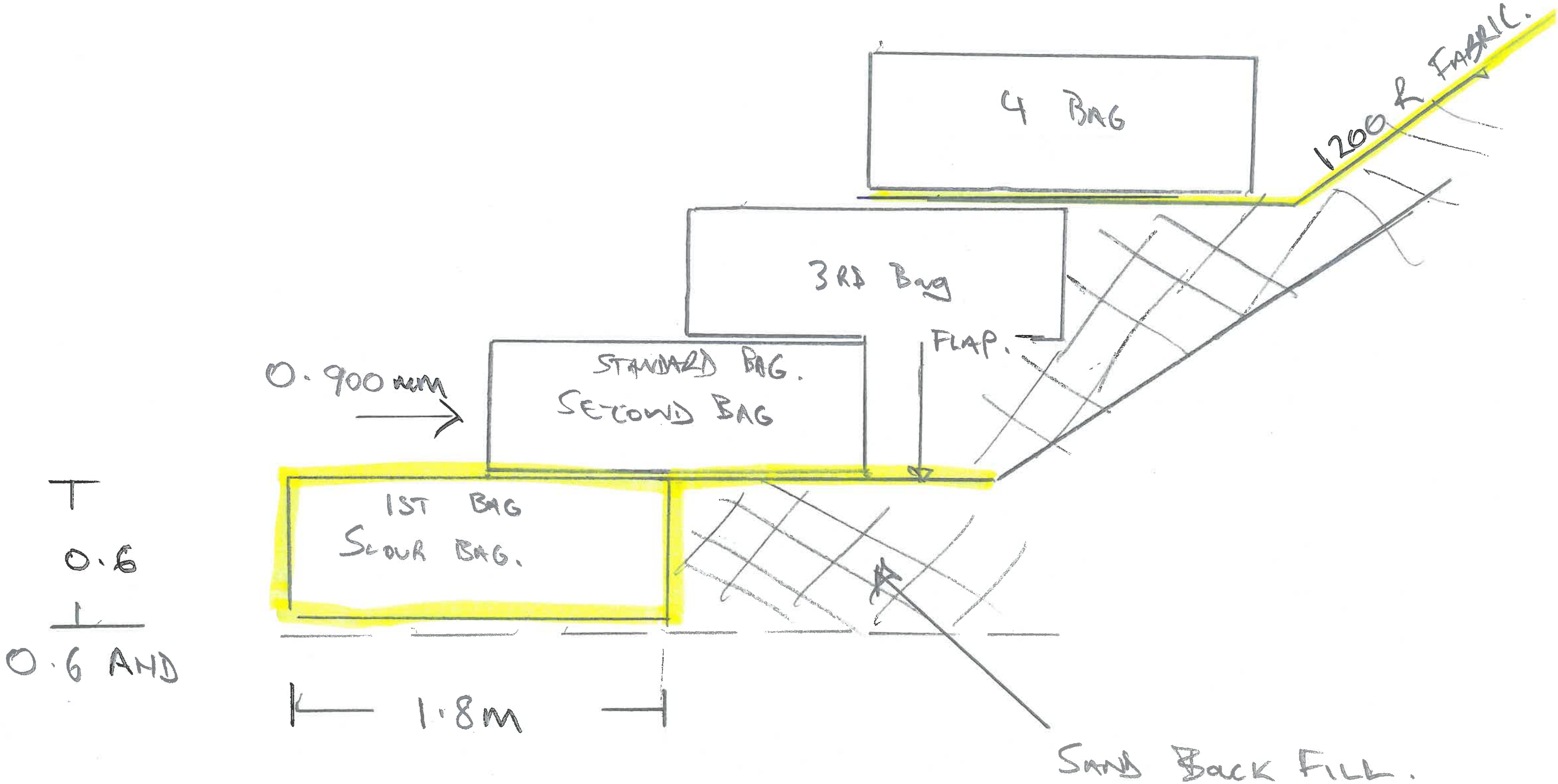
For Information only
Issue:

GEOFABRICS AUSTRALASIA PTY LTD

Designed:
Date:
Drawn:
Scale: NTS

ELCORock 2.5m³ Revetment Typical Details

Drawing no:
Version: A
Sheet no: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1200 & FABRIC.
3RD Bag
FLAP.
STANDARD BAG.
SECOND BAG
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1ST BAG
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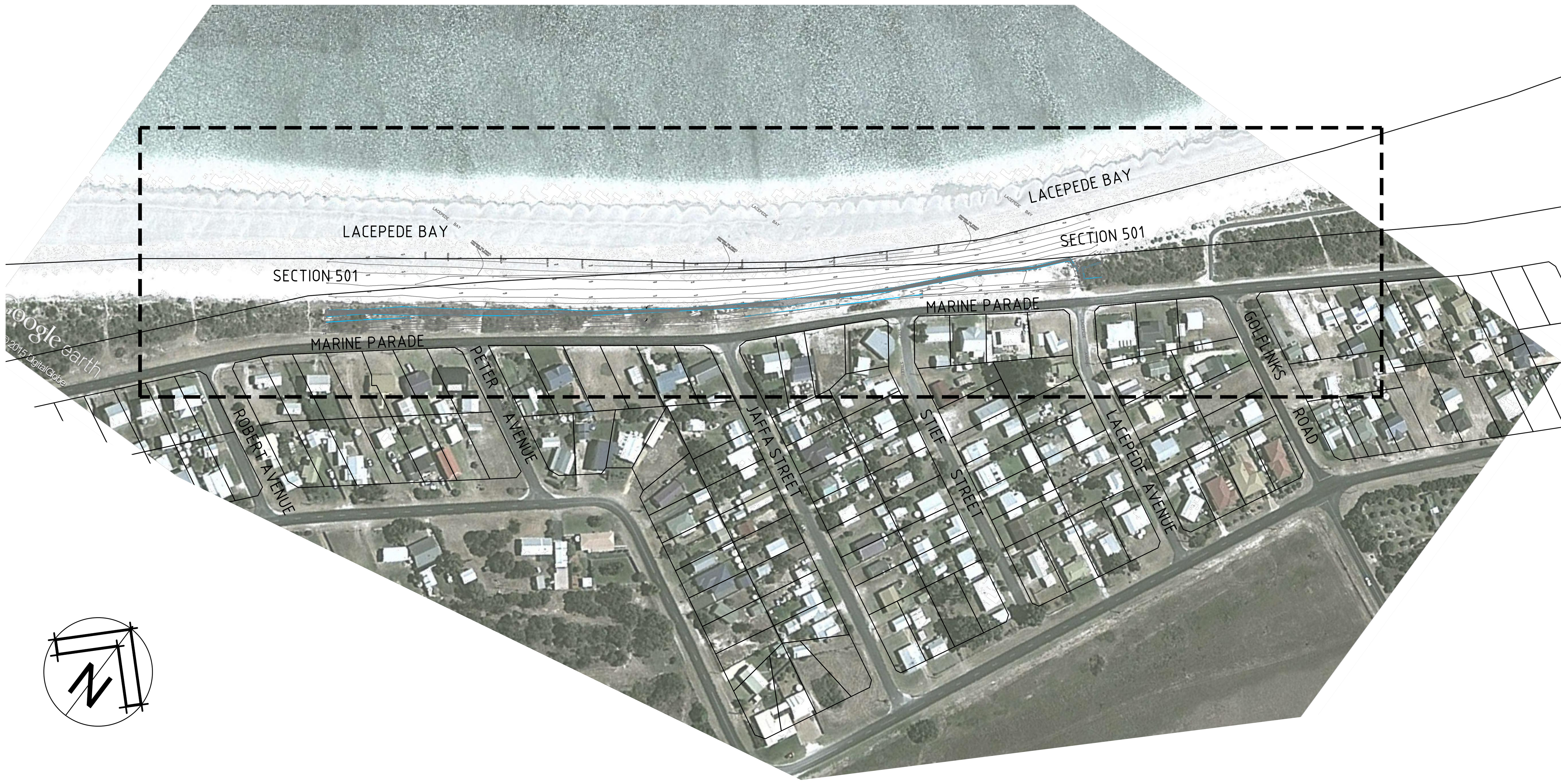
0.6
0.6 AND
1.8m
SAND BACK FILL.

WYOMI BEACH GRANITE ROCK SEAWALL

WYOMI BEACH, SA

INDEX



SITE LOCALITY MAP
SCALE 1:2000

SAFETY IN DESIGN NOTES

SID1 CIVIL & ENVIRONMENTAL SOLUTIONS HAVE CONDUCTED A PRELIMINARY SAFETY IN DESIGN REVIEW OF THE DESIGN ON THESE DRAWINGS. IT IS SUMMARIZED IN THE NOTES BELOW. THE REVIEW IS BASED GENERALLY ON THE PROCEDURE OUTLINED IN THE SAFE WORK AUSTRALIA PUBLICATION "SAFE DESIGN OF STRUCTURE CODE OF PRACTICE".

SID2 THE DESIGN HAS NOT BEEN REVIEWED WITH CONTRACTOR/BUILDER AT THE TIME OF ISSUE FOR TENDER OR CONSTRUCTION. CONSTRUCTION METHODS VARY BETWEEN CONTRACTORS, SO IT IS NOT POSSIBLE FOR CIVIL & ENVIRONMENTAL SOLUTIONS TO PERFORM AN EXHAUSTIVE SAFETY IN DESIGN OR SAFETY IN CONSTRUCTION REVIEW. ONCE APPOINTED, THE CONTRACTOR IS REQUIRED TO UNDERTAKE A THOROUGH REVIEW OF THE DESIGN WITH THEIR SUBCONTRACTORS TO IDENTIFY SAFETY RISKS DURING CONSTRUCTION AND DURING THE LIFE OF THE BUILDING.

SID3 THE SAFETY RISK MITIGATION ITEMS BELOW ARE BASED ON CIVIL & ENVIRONMENTAL'S DESIGN OFFICE EXPERIENCE AND DO NOT NECESSARILY ACCOUNT FOR ALL CONSTRUCTION, OPERATION, MAINTENANCE AND DEMOLITION SAFETY RISKS BASED ON INFORMATION WHEN THIS DRAWING WAS MADE IN ITS CAPACITY AS DESIGNER ONLY. CIVIL & ENVIRONMENTAL SOLUTIONS HAVE TRIED TO IDENTIFY SAFETY RISKS PERTAINING TO CONSTRUCTION, OPERATION, MAINTENANCE AND DEMOLITION PHASES OF THE ASSET. INCLUSION (OR NOT) OF ANY ITEM DOES NOT REDUCE OR LIMIT OBLIGATIONS OF CONSTRUCTOR, USER, MAINTAINER AND DEMOLISHER TO UNDERTAKE APPROPRIATE RISK MANAGEMENT ACTIVITIES TO REDUCE RISK AND IS NOT AN ADMISSION BY CIVIL & ENVIRONMENTAL SOLUTIONS THAT INCLUSION OF ANY ITEM IS THE DESIGNER'S RESPONSIBILITY.

SID4 CONSTRUCT BUILDING ELEMENTS THAT CONTRIBUTE TO SAFETY SUCH AS HAND RAILS AND TOE BOARDS, FALL ARREST SYSTEMS, etc. AS EARLY AS POSSIBLE.

SID5 PROVIDE SAFETY BARRIERS AT EDGES OF OPENINGS AND ELEVATED AREAS.

SID6 REVIEW ADEQUACY OF WORKING SPACE AVAILABLE FOR CONSTRUCTION ACTIVITIES. ENSURE SEPERATION OF PLANT AND PERSONNEL ON SITE, INCLUDING MOVEMENTS OF BOTH.

SID7 LOCATE LIFTING SLEW AND LAY DOWN AREAS AWAY FROM REGULAR CONSTRUCTION TRAFFIC.

SID8 PROVIDE PROTECTION OF PERSONNEL FROM PLANT AND EQUIPMENT, INCLUDING POST-TENSIONED GROUND ANCHOR INSTALLATION WORKS

SID9 ENSURE ISOLATION SAFE SYSTEMS OF WORK OR PROTECTIVE MEASURES ARE INSTALLED BEFORE WORKING NEAR LIVE ELECTRICAL INFRASTRUCTURE. PROVIDE PROTECTION OF ELECTRICAL OVERHEAD WIRING SYSTEMS DURING CONSTRUCTION.

SID10 WRITTEN RISK ASSESSMENTS ARE ADVISED FOR ACCESS TO OPEN EXCAVATIONS.

SID11 PROVIDE ACCESS AND EGRESS TO EXCAVATIONS APPROPRIATE IN CASE OF INUNDATION, COLLAPSE OF ENGULFMENT.

SID12 LOCATE STOCKPILES AND HEAVY EQUIPMENT INCLUDING CRANES AWAY FROM BURIED SERVICES AND BUILDING BOUNDARIES WHERE ADJACENT BASEMENTS ARE PRESENT.

SID13 SEEK ADVICE FROM SUITABLY QUALIFIED GEOTECHNICAL OR STRUCTURAL ENGINEER PRIOR TO OPERATION OF HEAVY SURFACE PLANT AND EQUIPMENT OR STOCKPILING MATERIAL NEAR OPEN EXCAVATIONS OR EXISTING RETAINING STRUCTURES.

SID14 DO NOT STOCKPILE MATERIALS BEHIND OR EXCAVATE IN FRONT OF EXISTING RETAINING WALLS UNTIL WALL STABILITY HAS BEEN REVIEWED BY SUITABLY QUALIFIED STRUCTURAL ENGINEER.

SID26 TRY TO AVOID WORKING IN CONFINED SPACES. IF CONFINED SPACES WORK CAN'T BE AVOIDED, PROVIDE A SAFE WORK METHOD STATEMENT ADDRESSING MITIGATION OF RISKS. PROVIDE ADEQUATE SIGNAGE TO TEMPORARY AND PERMANENT CONFINED SPACES TO AS2865.

SID28 SOME SITES IN AUSTRALIA AND EXTENSIVE REGIONS OF SE ASIA CONTAIN UNEXPOSED ORDNANCE (UXO) IN THE GROUND. UNDERTAKE DESKTOP REVIEWS FOR THE LIKELIHOOD OF UXO'S BEFORE COMMENCING ANY GROUND INVESTIGATION OR EXCAVATION IN THESE AREA'S. SHOULD EVIDENCE INDICATE POTENTIAL UXO PRESENCE, DO NOT COMMENCE GROUND WORKS UNTIL ENGAGING A SPECIALIST CONSULTANT WHO CAN HELP DEFINE ANY FUTURE CLEARANCE TASKS.

SID34 REMOVE MATERIAL FROM STORAGE STRUCTURES BEFORE UNDERTAKING MAINTENANCE WORKS.

SID35 BEWARE OF UNDERGROUND SERVICES. THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR LOCATION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

DIAL 1100 BEFORE YOU DIG

GENERAL NOTES

1. THESE DRAWINGS ARE NOT CADASTRAL PLANS AND MUST NOT BE USED IN DETERMINING PRECISE DETAILS WITH RESPECT TO BOUNDARIES.
2. ALL DIMENSIONS SHALL BE VERIFIED ON SITE.
3. ALL LEVELS ARE EXPRESSED IN METRES UNLESS NOTED OTHERWISE.
4. ALL CO-ORDINATES ARE LOCAL, UNLESS NOTED OTHERWISE.
5. LEVEL DATUM IS A.H.D.
6. SET OUT SHALL BE SUPPLIED TO THE CONTRACTOR IN AN ELECTRONIC 2D FORMAT (AutoCAD 2010) WHICH CONTAINS CONTROL POINTS AND T.B.M. NO TABULATED SET OUT INFORMATION IN HARD COPY WILL BE ISSUED. CONTRACTOR TO ALLOW FOR FILE CONVERSION AS REQUIRED. ORIGINAL FULL SIZE DRAWINGS MAY BE SCALED SUBJECT TO CORRECT BAR SCALE VERIFICATION.
7. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATIONS.
8. REFER TO DETAIL DRAWINGS FOR ALL UNDERGROUND PIPEWORK AND DETAILS.
9. SPOIL TO BE STOCKPILED AS DIRECTED BY THE SUPERINTENDENT AND EXCESS NOT USED IS TO BE REMOVED FROM SITE BY CONTRACTOR.
10. THESE DRAWINGS ARE A SCHEMATIC REPRESENTATION OF SERVICES INFORMATION CONTAINED IN DRAWINGS ISSUED BY THE RELEVANT AUTHORITIES. THE INFORMATION CONTAINED IN THESE DRAWINGS IS INDICATIVE ONLY, AND REFERENCE SHOULD BE MADE TO THE RELEVANT AUTHORITIES DOCUMENTATION TO CONFIRM ACCURACY AND COMPLETENESS. WHERE INFORMATION IS AVAILABLE, THE SUB-SURFACE SERVICES INSTALLED BY CONTRACTORS OTHER THAN THE AUTHORITIES HAVE BEEN SHOWN, BUT ADDITIONAL UNDOCUMENTED SERVICES MAY BE PRESENT. SHOULD THE CONTRACTOR BELIEVE THAT SUB-SURFACE SERVICES ARE AT RISK OF DAMAGE DURING CONSTRUCTION, THE CONTRACTOR SHOULD NOTIFY THE RELEVANT AUTHORITIES AND ESTABLISH THE EXACT LOCATION OF THE SERVICES.
11. THE FINISHED SURFACE SHALL BE EVENLY GRADED BETWEEN DESIGN SURFACE LEVELS.
12. DEMOLISH AND REMOVE ALL EXISTING INSTALLATIONS WHICH ARE TO BE AFFECTED BY NEW WORKS. EXTENT OF DEMOLITION TO BE CONFIRMED ON SITE WITH THE SUPERINTENDENT PRIOR TO CONSTRUCTION.
13. CONTRACTOR TO ADJUST LIDS OF EXISTING SERVICE PITS TO MATCH FINISHED SURFACE LEVEL. PROVIDE HEAVY DUTY COVER IF IN PAVED AREA TO THE REQUIREMENTS OF THE RELEVANT AUTHORITY, IF APPLICABLE. RELOCATE SERVICE AS REQUIRED.
14. CONTRACTOR IS TO NEATLY HORIZONTALLY AND VERTICALLY MATCH NEW DESIGN TO EXISTING AT EXTENT OF WORKS, ENSURING THAT THERE IS NO PONDING OF WATER BETWEEN NEW AND EXISTING.
15. WORKMANSHIP AND MATERIALS ARE TO BE IN ACCORDANCE WITH THE RELEVANT CURRENT S.A.A. CODES INCLUDING ALL AMENDMENTS, AND THE LOCAL STATUTORY AUTHORITIES, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.

EXISTING SERVICES NOTES:

1. ALL DRAWINGS AND DOCUMENTS CONTAINED WITHIN THIS PROJECT WILL HAVE ALL IDENTIFIED EXISTING SERVICES SHOWN.
2. OTHER SERVICES MAY EXIST, WHICH WERE NOT KNOWN OR IDENTIFIED AT THE TIME OF DETAIL DOCUMENTATION. THESE UNKNOWN SERVICES MAY POSSIBLY INTERFERE WITH THE PROPOSED WORKS AS SET OUT WITHIN THESE DESIGN DOCUMENTS.
3. ALL IDENTIFIED EXISTING SERVICES ARE A SCHEMATIC REPRESENTATION OF THE INFORMATION PROVIDED BY THE VARIOUS SERVICE AUTHORITIES.
4. THE ACCURACY OF CIVIL & ENVIRONMENTAL SOLUTIONS' DOCUMENTATION WITH RESPECT TO SERVICES IS LIMITED TO THE ACCURACY OF 3RD PARTY INFORMATION, AS SUPPLIED BY THE RELEVANT SERVICE AUTHORITIES AND THE ENGINEERING SURVEYOR.
5. IN SUMMARY, THE LIMITS REFER TO THE ACCURACY OF THE INFORMATION, AND NO LIABILITY WILL BE ACCEPTED BY THE SERVICE AUTHORITIES, INCLUDING CIVIL & ENVIRONMENTAL SOLUTIONS.
6. THE CONTRACTOR MUST FULLY INFORM HIMSELF AS THE NATURE AND EXTENT OF ALL UNDERGROUND SERVICES THAT MAY IMPACT ON THE PROPOSED WORKS.
7. ALL SERVICES MUST BE FULLY VERIFIED, AND COMPARED AGAINST THE PROPOSED DESIGN WORKS.
8. UNDER NO CIRCUMSTANCES SHALL ANY FIXTURE OF FITTING BE ORDERED AND INSTALLED THAT HAS THE POTENTIAL TO REQUIRE ANY REWORK AS A DIRECT OR INDIRECT RESULT OF FAILURE TO VERIFY EXISTING SERVICES.
9. SHOULD REWORK BE REQUIRED OF ANY NEW FIXTURE OR FITTING AS A RESULT OF THE ABOVE, NO CLAIM AGAINST CIVIL & ENVIRONMENTAL SOLUTIONS OR ITS AGENTS WILL BE CONSIDERED.
10. UPON VERIFICATION OF ALL EXISTING UNDERGROUND SERVICES, THE CONTRACTOR SHALL ADVISE THE SUPERINTENDENT OR THEIR NOMINATED REPRESENTATIVE AS SOON AS POSSIBLE, IN THE EVENT OF ANY POTENTIAL CLASH OR INTERFERENCE WITH THE PROPOSED WORKS.
11. ALL WORKS DIRECTLY OR INDIRECTLY RELATED TO THE POTENTIAL CLASH / INTERFERENCE SHALL CEASE IMMEDIATELY, AND SHALL NOT RESUME UNTIL SUCH TIME AS INSTRUCTED TO DO SO BY CIVIL & ENVIRONMENTAL SOLUTIONS OR ITS NOMINATED AGENT.
12. NO FINANCIAL CLAIMS ARISING FROM THE SUBCONTRACTOR FOR DELAYS WILL BE CONSIDERED BY CIVIL & ENVIRONMENTAL SOLUTIONS OR ITS AGENTS.
13. IN THE EVENT THAT ANY CLASH / INTERFERENCE IS BY A SERVICE THAT CAN ONLY BE POTENTIALLY MODIFIED BY THE SERVICE PROVIDER, THIS WORK SHALL BE COORDINATED BY CIVIL & ENVIRONMENTAL SOLUTIONS OR ITS NOMINATED AGENT. IN THIS CIRCUMSTANCE, CHARGES LEVIED BY THE SERVICE PROVIDER FOR THE MODIFICATION / ALTERATION WILL NOT BE THE RESPONSIBILITY OF THE CONTRACTOR. THIS RELATES ONLY TO THE MODIFICATION WORKS UNDERTAKEN BY THE SERVICE PROVIDER

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY

0 METRES 100
SCALE 1:2000

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER	ENGINEER	MANAGER
SY	D.N.B.	N.M.

PROJECT
WYOMI BEACH GRANITE ROCK SEAWALL

CLIENT
KINGSTON DISTRICT COUNCIL

DATE	PROJECT NUMBER	DRAWING SCALE
FEB 2017	2015-4324WY	1:2000

DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE
INDEX, SITE LOCALITY PLAN AND NOTES

DRAWING NUMBER	SHEET SIZE	REV
C01	A1	0

PLAN
SCALE 1:500

PLAN
SCALE 1:500

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY
1	12.02.2018	AMENDED WITH NEW SURVEY	SY

0 METRES 25
SCALE 1:500

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER SY | ENGINEER D.N.B. | MANAGER N.M.

PROJECT
WYOMI BEACH GRANITE ROCK SEAWALL

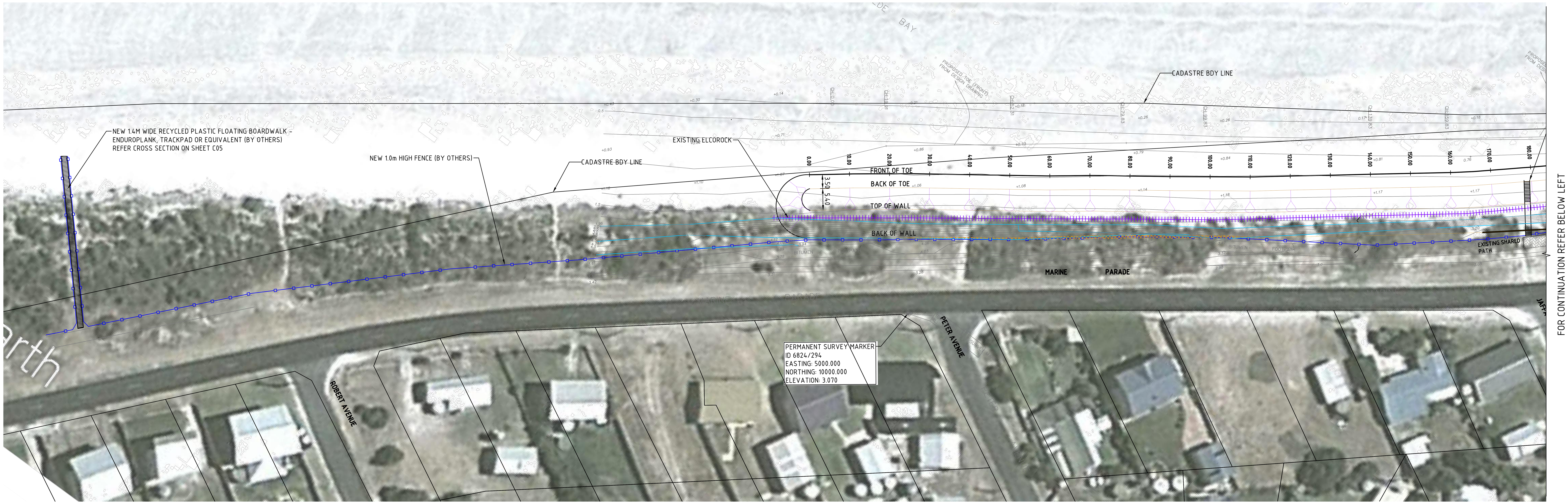
CLIENT
KINGSTON DISTRICT COUNCIL

DATE FEB 2017 | PROJECT NUMBER 2015-4324WY | DRAWING SCALE 1:500

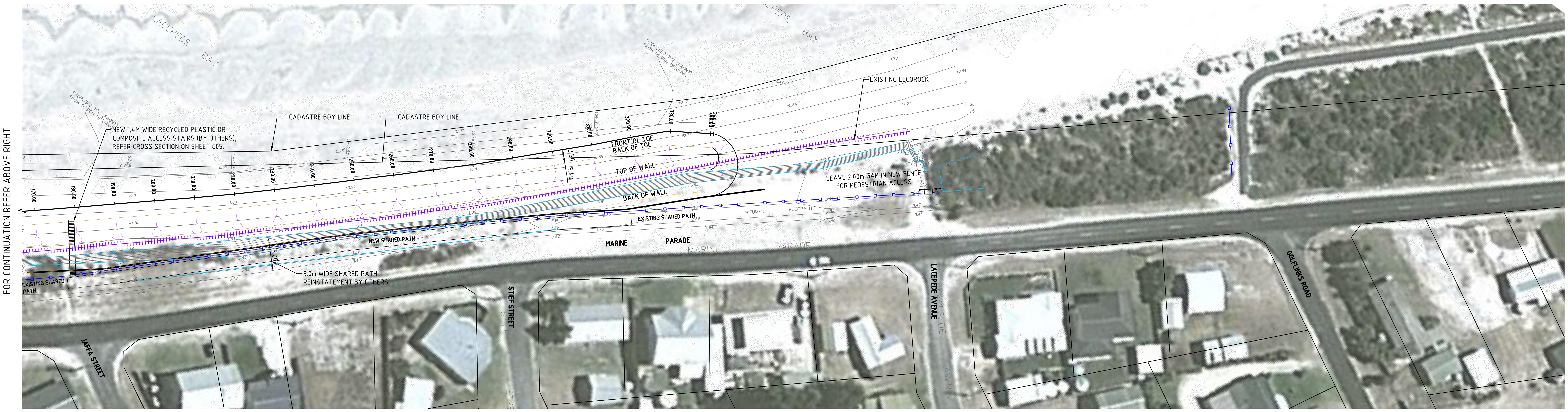
DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE
EXISTING SITE SURVEY

DRAWING NUMBER C02 | SHEET SIZE A1 | REV 1



PLAN
SCALE 1:500



PLAN
SCALE 1:500

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY
1	12.02.2018	AMENDED WITH NEW SURVEY	SY

LEGEND

1m HIGH FENCE WITH 3 HORIZONTAL WIRES. 0.5m SET BACK FROM EXISTING PATH. PLASTIC POSTS @ 3m CTS. 135mm x 135mm SQUARE. BY OTHERS.

0 METRES 25
SCALE 1:500

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER	ENGINEER	MANAGER
SY	D.N.B.	N.M.

PROJECT
WYOMI BEACH GRANITE ROCK SEAWALL

CLIENT
KINGSTON DISTRICT COUNCIL

DATE	PROJECT NUMBER	DRAWING SCALE
FEB 2017	2015-4324WY	1:500

DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE
SITE LAYOUT PLAN

DRAWING NUMBER	SHEET SIZE	REV
C03	A1	1

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY

LEGEND

1m HIGH FENCE WITH 3 HORIZONTAL WIRES. 0.5m SET BACK FROM EXISTING PATH. PLASTIC POSTS @ 3m CTS. 135mm x 135mm SQUARE. BY OTHERS.

SAND FILL BACK FROM BACK TOP OF WALL TO THE EROSION LINE.

DESIGN PATH REINSTATEMENT

0 METRES 10

SCALE 1:250

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER	ENGINEER	MANAGER
SY	D.N.B.	N.M.

PROJECT
WYOMI BEACH GRANITE ROCK SEAWALL

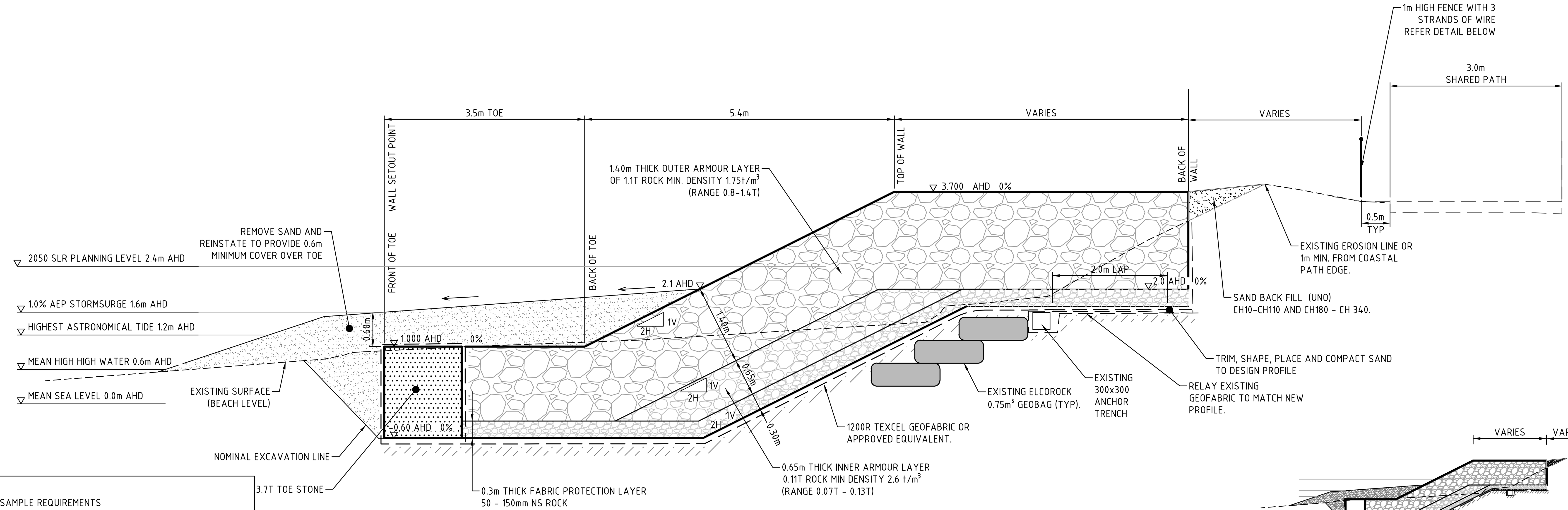
CLIENT
KINGSTON DISTRICT COUNCIL

DATE	PROJECT NUMBER	DRAWING SCALE
FEB 2017	2015-4324WY	1:250

DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE
ROCK WALL LAYOUT AND SETOUT PLAN

DRAWING NUMBER	SHEET SIZE	REV
C04	A1	0



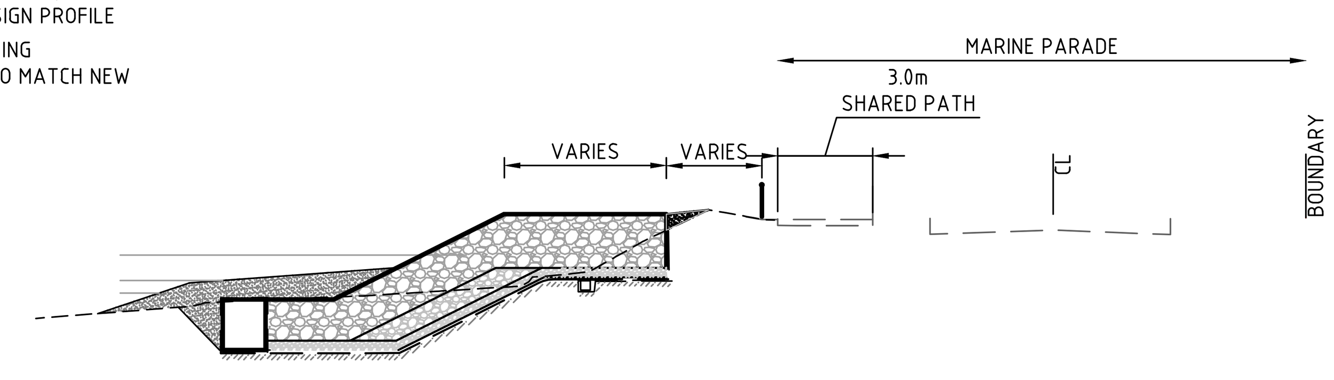
NOTES

1. REFER TECHNICAL SPECIFICATION FOR ROCK SOURCE AND SAMPLE REQUIREMENTS
2. ADDITIONAL SAND (IF REQUIRED) CAN BE OBTAINED FROM BEACH AREAS OPPOSITE STOCKER AVENUE OR OPPOSITE WYOMI BEACH STORE.
3. ALL EXCAVATION, LINER AND ROCK PLACEMENT TO BE UNDERTAKEN DURING LOW TIDE AND LOW WIND TIMES
4. ALL HORIZONTAL SETOUT TO GDA94
5. ALL VERTICAL SETOUT TO AUSTRALIAN HEIGHT DATUM (AHD)
6. SURPLUS SAND (IF ANY) TO BE DISPOSED ON BEACH IN FRONT OF THE TOE OF WALL.

TYPICAL ROCK SEAWALL CONSTRUCTION CROSS SECTION

SCALE 1:50

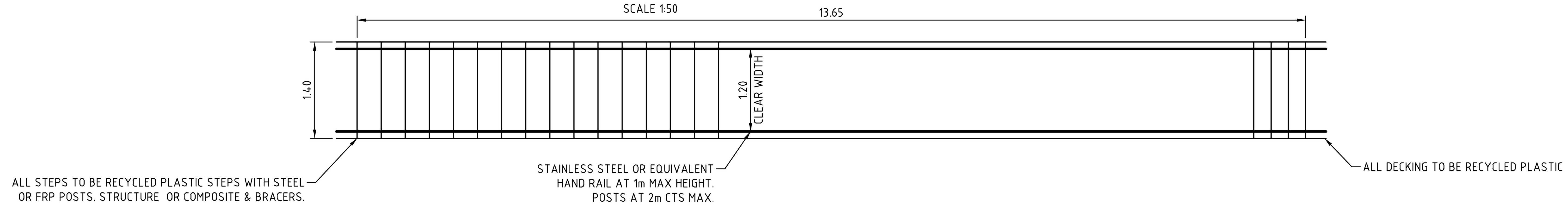
0 METRES 2
SCALE 1:50

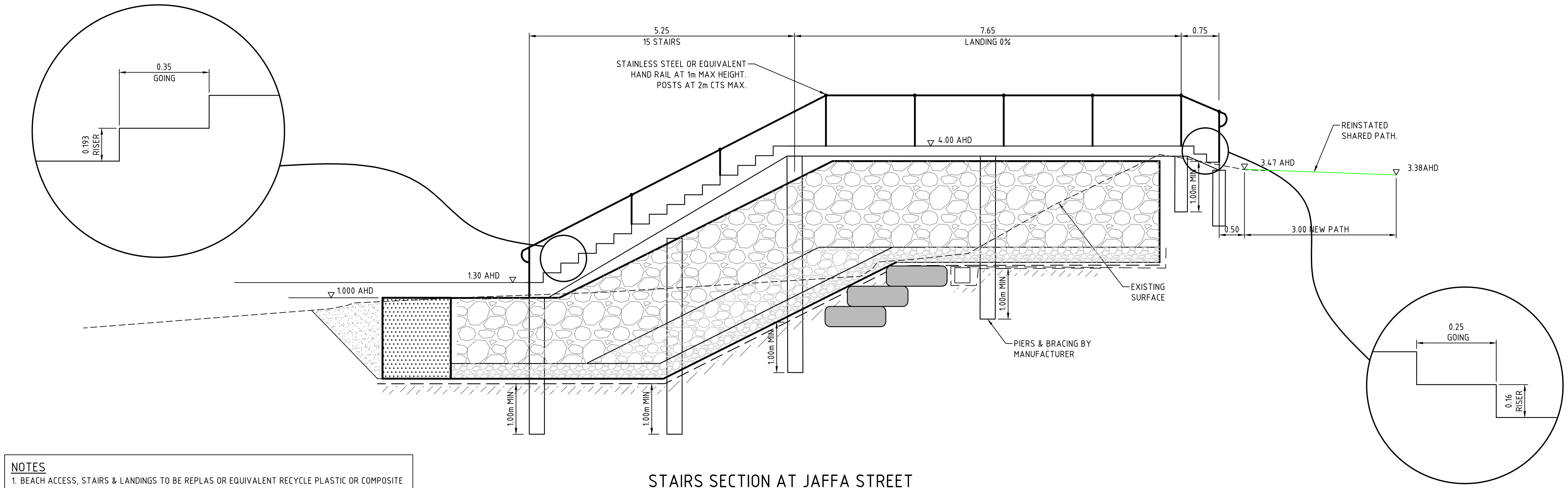


TYPICAL ROCK SEAWALL CROSS SECTION

SCALE 1:200

0 METRES 10
SCALE 1:200





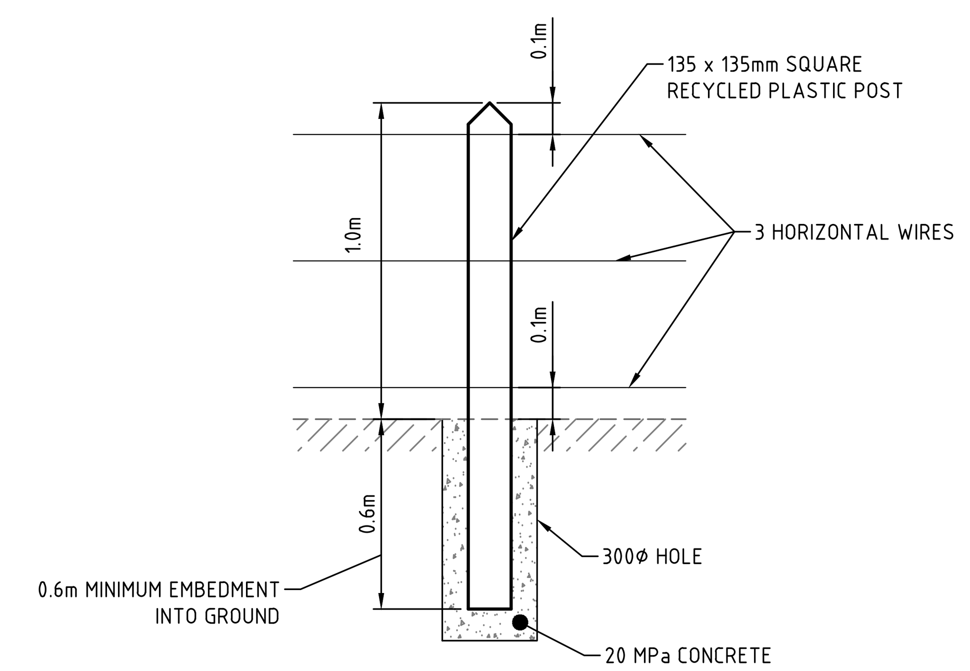
NOTES

1. BEACH ACCESS, STAIRS & LANDINGS TO BE REPLAS OR EQUIVALENT RECYCLE PLASTIC OR COMPOSITE PRODUCT MANUFACTURED TO AS 1657-2013, MANUFACTURERS SPECIFICATION & DRAWINGS.
2. STEPS, PLATFORM AND 1m HIGH FENCE TO BE CONSTRUCTED BY OTHERS.

STAIRS SECTION AT JAFFA STREET

SCALE 1:50 (BY OTHERS)

0 METRES 2
SCALE 1:50



FENCE DETAIL (BY OTHERS)

SCALE 1:20

0 METRES 1
SCALE 1:20

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER SY | ENGINEER D.N.B. | MANAGER N.M.

PROJECT: WYOMI BEACH GRANITE ROCK SEAWALL

CLIENT: KINGSTON DISTRICT COUNCIL

DATE: FEB 2017 | PROJECT NUMBER: 2015-4324WY | DRAWING SCALE: 1:250

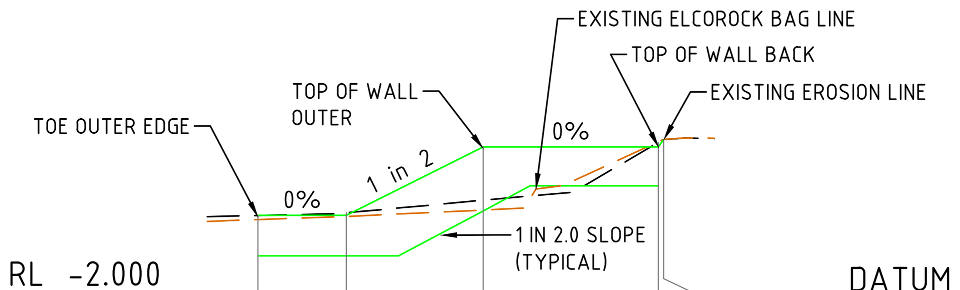
DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE: TYPICAL ROCK SEAWALL CROSS SECTION AND DETAILS

DRAWING NUMBER: C05 | SHEET SIZE: A1 | REV: 0

LEGEND

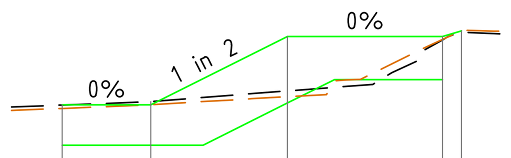
PREVIOUS EXISTING SURFACE
NEW EXISTING SURFACE



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.998
DESIGN UNDERSIDE	-0.600	-0.600	1.174	2.161	
EXISTING SURFACE	0.995	1.102	1.594	3.878	3.996
OFFSET	0.000	3.500	8.900	15.829	16.038

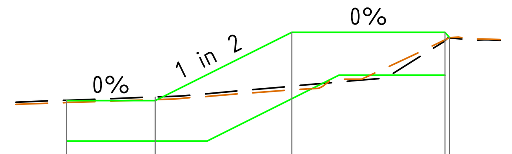
CHAINAGE 30



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.926
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	0.991	1.129	1.551	3.563	3.879
OFFSET	0.000	3.500	8.900	15.021	15.778

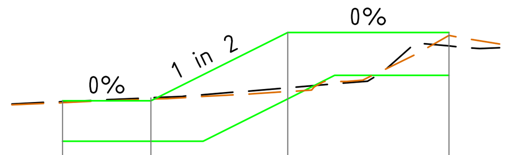
CHAINAGE 70



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.486
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	1.011	1.139	1.568	3.367	3.470
OFFSET	0.000	3.500	8.900	14.955	15.136

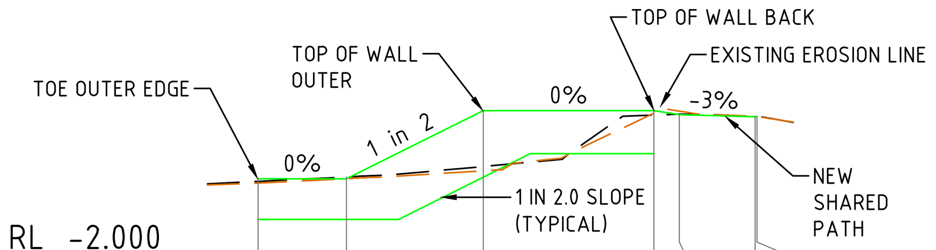
CHAINAGE 110



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000
EXISTING SURFACE	0.964	1.118	1.509	3.165
OFFSET	0.000	3.500	8.900	15.271

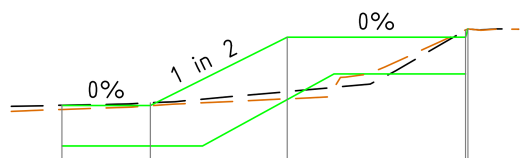
CHAINAGE 150



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.546	3.456	3.474
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.901	1.078	1.492	3.526	3.565	3.469	3.467
OFFSET	0.000	3.500	8.900	15.648	16.650	19.650	19.723

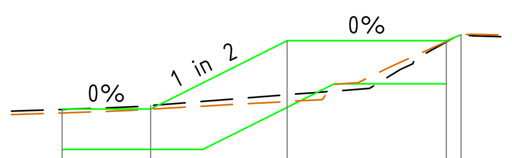
CHAINAGE 190



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	4.019
DESIGN UNDERSIDE	-0.600	-0.600	1.224	2.240	
EXISTING SURFACE	1.005	1.102	1.546	3.978	4.023
OFFSET	0.000	3.500	8.900	15.955	16.042

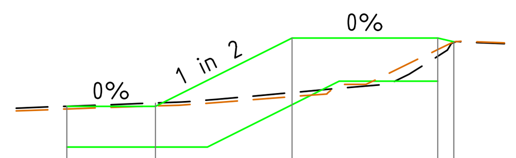
CHAINAGE 20



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.936
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	0.986	1.139	1.565	3.654	3.939
OFFSET	0.000	3.500	8.900	15.192	15.773

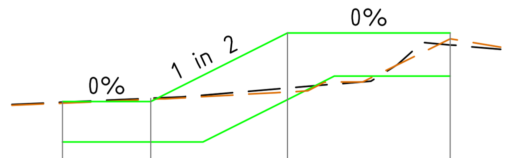
CHAINAGE 60



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.555
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	1.007	1.135	1.547	2.984	3.523
OFFSET	0.000	3.500	8.900	14.657	15.296

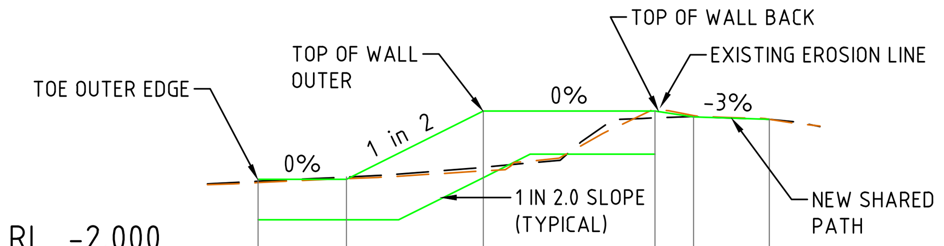
CHAINAGE 100



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000
EXISTING SURFACE	0.970	1.123	1.526	3.232
OFFSET	0.000	3.500	8.900	15.338

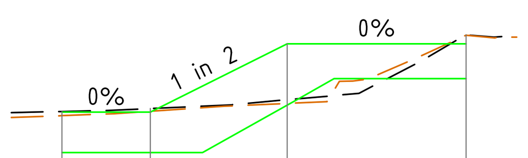
CHAINAGE 140



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.465	3.375
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000		
EXISTING SURFACE	0.922	1.092	1.478	3.426	3.475	3.367
OFFSET	0.000	3.500	8.900	15.687	17.211	20.211

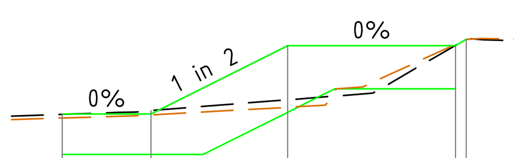
CHAINAGE 180



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.275	2.319
EXISTING SURFACE	1.028	1.145	1.488	4.057
OFFSET	0.000	3.500	8.900	15.970

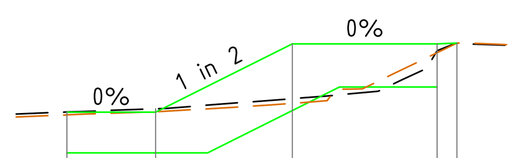
CHAINAGE 10



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.950
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	0.988	1.136	1.564	3.715	3.960
OFFSET	0.000	3.500	8.900	15.522	15.944

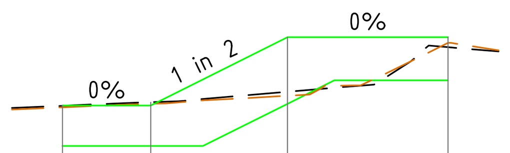
CHAINAGE 50



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.732
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	1.011	1.139	1.539	3.426	3.721
OFFSET	0.000	3.500	8.900	14.621	15.395

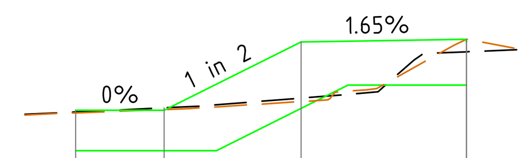
CHAINAGE 90



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000
EXISTING SURFACE	0.991	1.134	1.547	3.311
OFFSET	0.000	3.500	8.900	15.253

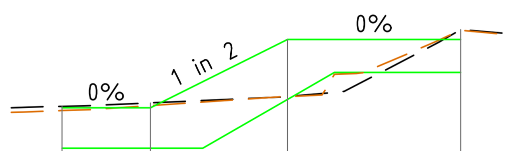
CHAINAGE 130



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.808	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	2.000
EXISTING SURFACE	0.933	1.099	1.480	3.312	3.312
OFFSET	0.000	3.500	8.900	15.431	15.432

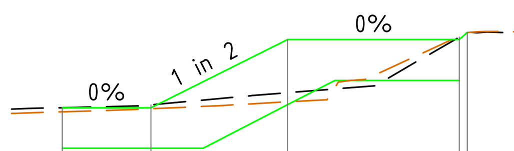
CHAINAGE 170



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.327	2.400
EXISTING SURFACE	1.054	1.195	1.443	4.090
OFFSET	0.000	3.500	8.900	15.739

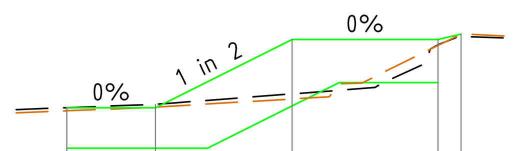
CHAINAGE 0



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.974
DESIGN UNDERSIDE	-0.600	-0.600	1.122	2.081	
EXISTING SURFACE	1.004	1.119	1.594	3.797	3.979
OFFSET	0.000	3.500	8.900	15.675	15.991

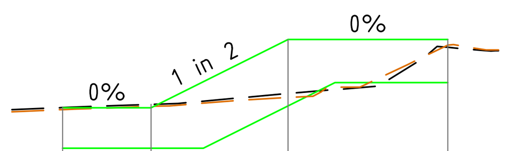
CHAINAGE 40



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.907
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	1.005	1.136	1.550	3.488	3.819
OFFSET	0.000	3.500	8.900	14.675	15.582

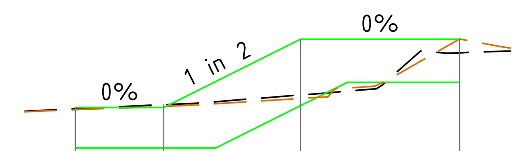
CHAINAGE 80



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000
EXISTING SURFACE	1.008	1.136	1.562	3.388
OFFSET	0.000	3.500	8.900	15.207

CHAINAGE 120



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000
EXISTING SURFACE	0.950	1.115	1.497	3.163
OFFSET	0.000	3.500	8.900	15.187

CHAINAGE 160

SEAWALL CROSS SECTIONS
SCALE 1:250

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY
1	07.02.2018	AMENDED WITH NEW SURVEY	SY

0 METRES 10
SCALE 1:250

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER SY | ENGINEER D.N.B. | MANAGER N.M.

PROJECT
WYOMI BEACH GRANITE ROCK SEAWALL

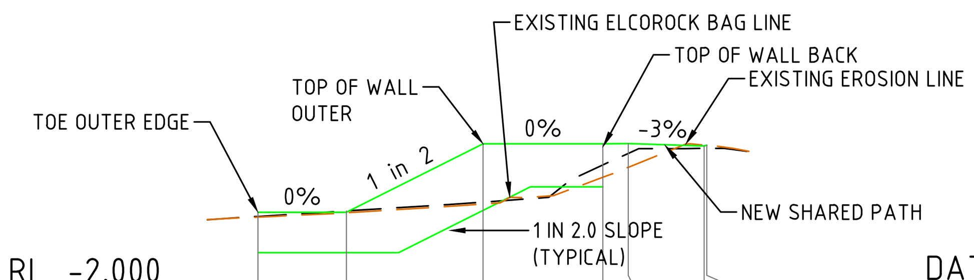
CLIENT
KINGSTON DISTRICT COUNCIL

DATE FEB 2017 | PROJECT NUMBER 2015-4324WY | DRAWING SCALE 1:250

DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE
SEAWALL CROSS SECTIONS
CH 0 - 190

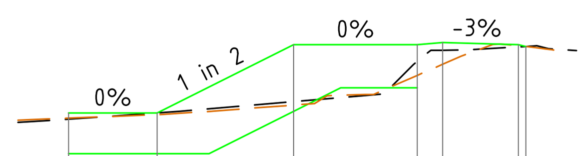
DRAWING NUMBER C06 | SHEET SIZE A1 | REV 1



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.715	3.625	3.650
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.829	1.051	1.399	2.869	3.327	3.522	3.522
OFFSET	0.000	3.500	8.900	13.626	14.627	17.627	17.730

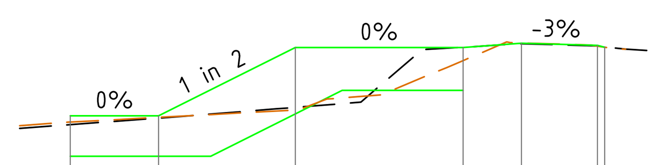
CHAINAGE 230



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.791	3.701	3.627
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.760	1.005	1.453	3.048	3.482	3.612	3.630
OFFSET	0.000	3.500	8.900	13.792	14.792	17.792	18.089

CHAINAGE 270



DATUM RL -2.000

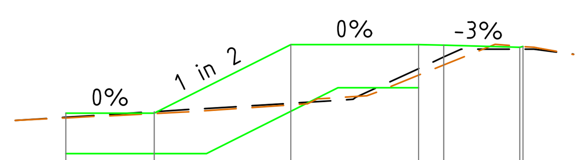
DESIGN SURFACE	1.000	1.000	3.700	3.700	3.865	3.775	3.702
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.647	0.903	1.328	3.706	3.844	3.757	3.726
OFFSET	0.000	3.500	8.900	15.536	17.849	20.849	21.141

CHAINAGE 310

LEGEND

PREVIOUS EXISTING SURFACE

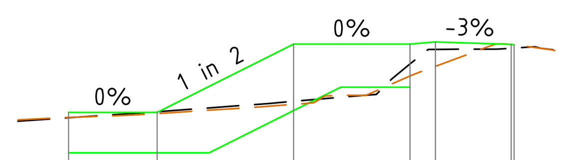
NEW EXISTING SURFACE



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.684	3.594	3.627
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.833	1.055	1.388	2.755	3.213	3.528	3.528
OFFSET	0.000	3.500	8.900	13.943	14.944	17.944	18.075

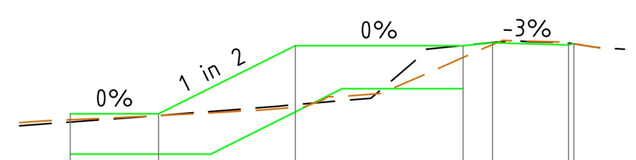
CHAINAGE 220



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.782	3.692	3.664
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.785	1.029	1.434	2.911	3.491	3.535	3.542
OFFSET	0.000	3.500	8.900	13.506	14.506	17.506	17.617

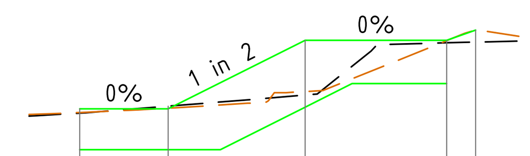
CHAINAGE 260



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.816	3.726	3.781
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.672	0.932	1.361	3.708	3.822	3.804	3.770
OFFSET	0.000	3.500	8.900	15.540	16.705	19.705	19.925

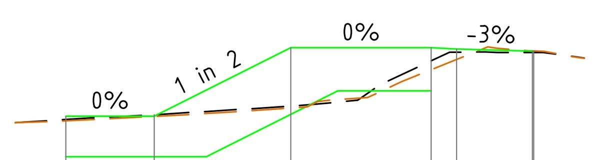
CHAINAGE 300



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	4.109
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	0.837	1.111	1.547	3.604	3.632
OFFSET	0.000	3.500	8.900	14.490	15.631

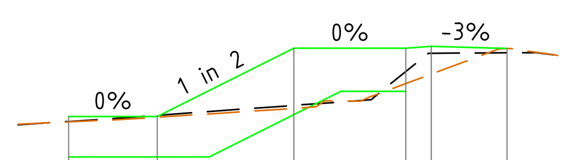
CHAINAGE 340.74



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.654	3.564	3.577
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.866	1.058	1.392	3.181	3.526	3.516	3.516
OFFSET	0.000	3.500	8.900	14.441	15.443	18.443	18.492

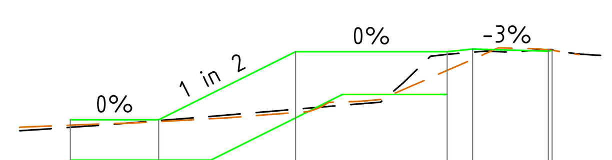
CHAINAGE 210



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.774	3.684
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000		
EXISTING SURFACE	0.804	1.047	1.439	2.779	3.500	3.513
OFFSET	0.000	3.500	8.900	13.326	14.326	17.326

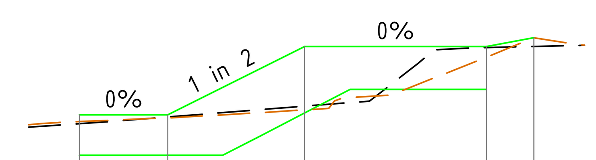
CHAINAGE 250



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.808	3.718	3.755
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.700	0.964	1.413	3.586	3.682	3.777	3.777
OFFSET	0.000	3.500	8.900	14.895	15.898	18.898	19.045

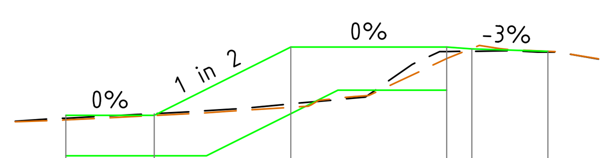
CHAINAGE 290



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	4.044
DESIGN UNDERSIDE	-0.600	-0.600	1.069	2.000	
EXISTING SURFACE	0.651	0.912	1.340	3.653	3.700
OFFSET	0.000	3.500	8.900	16.087	17.959

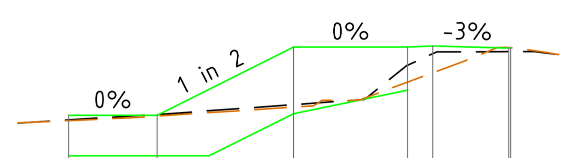
CHAINAGE 330



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.625	3.535
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000		
EXISTING SURFACE	0.889	1.066	1.454	3.522	3.532	3.503
OFFSET	0.000	3.500	8.900	15.050	16.052	19.052

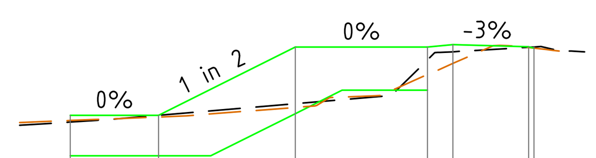
CHAINAGE 200



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.744	3.654	3.673
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.821	1.041	1.424	2.981	3.440	3.518	3.518
OFFSET	0.000	3.500	8.900	13.408	14.408	17.408	17.484

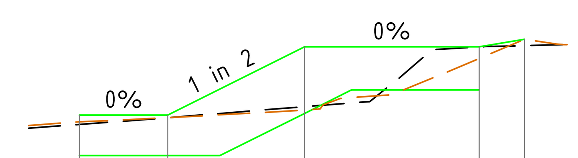
CHAINAGE 240



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.799	3.709	3.655
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000			
EXISTING SURFACE	0.735	1.006	1.464	3.192	3.515	3.689	3.701
OFFSET	0.000	3.500	8.900	14.134	15.135	18.135	18.349

CHAINAGE 280



DATUM RL -2.000

DESIGN SURFACE	1.000	1.000	3.700	3.700	3.999
DESIGN UNDERSIDE	-0.600	-0.600	1.070	2.000	
EXISTING SURFACE	0.634	0.897	1.333	3.694	3.745
OFFSET	0.000	3.500	8.900	15.801	17.595

CHAINAGE 320

SEAWALL CROSS SECTIONS

SCALE 1:250

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY
1	07.02.2018	AMENDED WITH NEW SURVEY	SY

0 METRES 10

SCALE 1:250

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER SY | ENGINEER D.N.B. | MANAGER N.M.

PROJECT
WYOMI BEACH GRANITE ROCK SEAWALL

CLIENT
KINGSTON DISTRICT COUNCIL

DATE FEB 2017 | PROJECT NUMBER 2015-4324WY | DRAWING SCALE AS SHOWN

DO NOT SCALE FROM THIS DRAWING

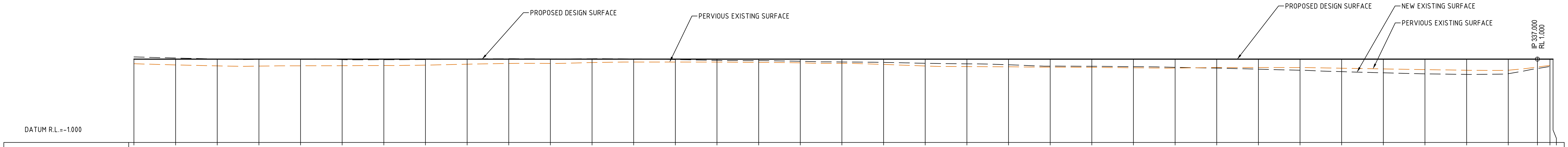
DRAWING TITLE
SEAWALL CROSS SECTIONS
CH 200 - 340.74

DRAWING NUMBER C07 | SHEET SIZE A1 | REV 1

LEGEND

PREVIOUS EXISTING SURFACE

NEW EXISTING SURFACE



CHAINAGE	REFERENCE STRING W1	EXISTING SURFACE
0.000	1.000	1.054
10.000	1.000	1.028
20.000	1.000	1.005
30.000	1.000	0.995
40.000	1.000	1.004
50.000	1.000	0.988
60.000	1.000	0.986
70.000	1.000	0.991
80.000	1.000	1.005
90.000	1.000	1.011
100.000	1.000	1.007
110.000	1.000	1.011
120.000	1.000	1.008
130.000	1.000	0.991
140.000	1.000	0.970
150.000	1.000	0.964
160.000	1.000	0.950
170.000	1.000	0.933
180.000	1.000	0.922
190.000	1.000	0.901
200.000	1.000	0.889
210.000	1.000	0.866
220.000	1.000	0.833
230.000	1.000	0.829
240.000	1.000	0.821
250.000	1.000	0.804
260.000	1.000	0.785
270.000	1.000	0.760
280.000	1.000	0.735
290.000	1.000	0.700
300.000	1.000	0.672
310.000	1.000	0.647
320.000	1.000	0.634
330.000	1.000	0.651
337.000	1.000	0.776
340.000	1.000	0.825
340.740	1.000	0.837

HORIZONTAL ALIGNMENT

VERTICAL ALIGNMENT: G=0.000% L=337.000; G=-0.000% L=3.741

ROCK SEAWALL CONSTRUCTION LONGITUDINAL SECTION

SCALE SCALE H. 1:500 V. 1:50

0 METRES 25 SCALE 1:500

0 METRES 2 SCALE 1:50

ROCK WALL SETOUT			
NOTE: SETOUT TO THE FRONT OF TOE AT FIXED ELEVATION OF 1.000 AHD TO GDA94 (REAL WORLD)			
CH	EASTING	NORTHING	ELEVATION
0.0	4959.485	10012.805	1.0
20	4975.303	10025.044	1.0
40	4991.400	10036.911	1.0
60	5007.557	10048.699	1.0
80	5023.536	10060.724	1.0
100	5039.621	10072.610	1.0
120	5055.473	10084.800	1.0
140	5071.166	10097.199	1.0
160	5086.881	10109.571	1.0
180	5102.001	10122.659	1.0
200	5116.932	10135.965	1.0
220	5131.825	10149.313	1.0
240	5146.331	10163.082	1.0
260	5160.705	10176.988	1.0
280	5174.919	10191.058	1.0
300	5188.699	10205.551	1.0
320	5202.317	10220.196	1.0
337	5215.119	10231.220	1.0
340	5217.619	10232.879	1.0
340.74	5218.236	10233.288	1.0

REVISION			
ISSUE	DATE	DESCRIPTION	INITIAL
0	21.02.2017	ISSUED FOR CONSTRUCTION	SY
1	12.02.2018	AMENDED WITH NEW SURVEY	SY

ISSUED FOR CONSTRUCTION

Civil & Environmental Solutions

DRAFTER SY | ENGINEER D.N.B. | MANAGER N.M.

PROJECT: WYOMI BEACH GRANITE ROCK SEAWALL

CLIENT: KINGSTON DISTRICT COUNCIL

DATE FEB 2017 | PROJECT NUMBER 2015-4324WY | DRAWING SCALE AS SHOWN

DO NOT SCALE FROM THIS DRAWING

DRAWING TITLE: SEAWALL LONGITUDINAL SECTION AND SETOUT TABLE

DRAWING NUMBER C08 | SHEET SIZE A1 | REV 1