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Technical Note

Date: 12/4/2021

Client: Kingston District Council

Subject: Wyomi Beach – 2021 Nourishment Design

1 Introduction

1.1. Background

Wyomi Beach is located approximately 2.5km south-west of the Kingston township. Over the last two decades ongoing erosion has resulted in the loss of approximately 10 to 15m of dune width, damaging paths and threatening Marine Parade. In recent years, Kingston District Council (KDC) has constructed several seawall structures to protect these assets, including two temporary Geotextile Sand Container (GSC) seawalls and one rock seawall (refer Figure 1).

In March 2020, Wavelength investigated immediate adaptation options at Wyomi, whilst longer term adaptation options were being considered through the Coastal Adaptation Strategy (Wavelength, 2021). This review found that the GSC seawalls are in varying condition and are unlikely to protect assets in the area under the design storm erosion event (20 year ARI storm) (Wavelength, 2020). The short section of 0.75 m^3 GSC seawall immediately south of the rock seawall was found to have the highest risk from erosion. Further details of the key areas of concern are outlined in Section 2.1.

Nourishment was selected by KDC as the preferred short-term management approach and in March 2020 KDC engaged Wavelength to design a 13,000 m^3 nourishment campaign. The nourishment campaign was implemented in May 2020 and had the following objectives:

1. Provide protection to coastal assets from a 20-year ARI storm event.
2. Improve beach amenity and access in front of the rock seawall.

KDC recently gained Coast Protection grant funding for another nourishment campaign in 2021 of approximately 9,000 m^3. Wavelength has been engaged to review the 2020 nourishment campaign and undertake the 2021 nourishment design.

1.2. Approach

This Technical Note presents the following:

- A high-level review of the 2020 nourishment campaign effectiveness, including:
    - Comparison of design, placed and remaining nourishment volumes to assess the level of protection provided to assets (Objective 1).
    - Review of beach widths in front of seawall (Objective 2).
    - Review of nourishment source site to confirm suitability for use in a 2021 campaign.
- Design details for the 2021 nourishment campaign, including:
    - Lessons learnt from 2020 and improvements to be incorporated into the 2021 campaign.
    - Design modelling results and recommended profiles and extent.

2 Review of 2020 Nourishment Effectiveness

2.1. Areas of Concern

The key areas of concern and those targeted in the 2020 nourishment campaign are:

- **Southern reach** - the area immediately to the south of the rock seawall currently protected by a 0.75 m^3 GSC seawall in relatively poor condition and founded at approximately +1.2mAHD. The high foundation level increases the risk of the seawall being undercut by storm erosion.
- **Northern reach** - the area immediately to the north of the rock seawall, which is protected by a 2.5m^3 GSC seawall founded at approximately +0.6 mAHD. Placement at this location is required to protect against the edge effects (i.e. terminal scour) at the end of the seawall structure, which causes accelerated erosion.

Figure 1 presents the areas of concern, as well as the 2020 nourishment design.

2.2. Description of Works

The following pre-construction design volumes were estimated for the 2020 nourishment campaign:

- Approximately 7,000 m^3 (in situ volume) placed in southern reach.
- Approximately 6,000 m^3 (in situ volume) placed in the northern reach, including an additional 3,000 m^3 as a separable portion to be implemented dependent on tendered rates.

These volumes were estimated based on 2018 DEW and LiDAR surveys. Due to the age of the surveys at the time of the design they were expected to only provide an approximation of the beach profiles. Issued for Construction Drawings also contained in Appendix A.

The southern reach design profile was a 20m wide berm at +3 mAHD, with a seaward slope of 1V:5H. This aimed to achieve a design volume of approximately 60 m^3 per m to account for cross-shore storm erosion and estimated longshore transport losses of 15 to 45 m^3 per m per year (Wavelength, 2020). This nourishment volume was anticipated to stay in place for 1 to 4 years depending on the severity and frequency of storms experienced (Wavelength, 2020).

The 2020 nourishment works were commenced in late May 2020 and completed in mid-June 2020. Drone photographs of the placed nourishment are presented in Figure 2.

2.3. Review of Works

Through discussions with KDC officers, the following summarises lessons learnt from the 2020 nourishment works:

- **Southern reach:**
    - Loss of sand during construction was exacerbated by high water levels and storm waves experienced in late May 2020.
    - The high water levels at the start of winter meant the southern reach design profile was not able to be achieved with the volume of sand allowed for in the design. These conditions made it difficult to place the wide nourishment berm and relatively shallow seaward slope (1V:5H), which extended to the 0mAHD contour.
    - To increase nourished volumes, additional sand was placed in the southern half of the reach, where beach widths allowed. The front slope was also placed at the natural sand repose angle (approximately 1V:2H).
- **Northern reach:**
    - Due to the narrow beach widths and high water levels in early June 2020, the 30m extension of the nourishment on the northern edge of the rock seawall (Figure 1) was not able to be achieved with the volume of sand allowed for in the design.
    - To increase nourished volumes, the nourished berm width was increased from 10m up to 25m in some locations.

- Due to the nourished berm, a 1 m high erosion scarp formed at the rear of the beach following storm events. Signage was required to warn residents of the potential slumping hazard.
- Placement of seagrass wrack on top of the nourished profiles appeared to have helped stabilise the nourishment.
- The placement methodology led to significant compaction of the sand nourishment berm.

2.4. Review of nourishment volumes

Table 1 presents the results of volume analysis for the 2020 nourishment campaign. Volume calculations were undertaken by surveyors Alexander Symonds, as presented in Appendices B and C. Cross-sectional volumes were calculated by Wavelength using the beach and dune surveys.

Key findings from the volume review are outlined below:

- Final placed volumes of approximately 35 to 45 m^3 per m of sand were achieved, which are significantly less than the 60 m^3 per m design volume originally estimated in Wavelength (2020). This difference is likely due to the relatively limited pre-construction survey data available and the higher beach berm levels in 2020 compared to the 2018 DEW and LiDAR surveyed levels.
- Achieving the original design nourishment volume would require increasing the nourished berm height to approximately +5 mAHD. This is higher than the adjacent levels (approximately +4 to +4.5 mAHD) in the area and would result in significant wind-blown sand issues and formation of an approximate 3m high erosion scarp.
- Southern reach:
    - Approximately 20 to 30 m^3 per m nourishment was lost from the southern reach.
    - A higher rate of loss was experienced adjacent to the seawall than the southern dune area.
    - Approximately 3m of the nourished berm at +3mAHD is remaining to cover the critical 0.75 m^3 GSC seawall location.
- Northern reach:
    - Approximately 35 m^3 per m nourishment was lost from the southern reach. The losses were relatively uniform across the length of the nourishment placement.
    - Approximately 5m of the nourished berm at +3mAHD covers the northern GSC seawall.
- The rate of nourishment loss (~20 to 35 m^3 per m) is within the range of sand transport losses of 15 to 45 m^3 per m estimated in Wavelength (2020).

SBEACH modelling of the remaining nourishment profile was undertaken to identify the protection offered by the remaining nourishment. This used the 20-year ARI (July 2016) storm conditions presented in Wavelength (2020).

Modelling results, presented in Figure 3, show the following:

- Some protection is offered by the remaining nourishment. However, both the southern and northern GSC seawalls would be exposed and would likely be undercut in the design storm.
- Additional nourishment is required in the northern and southern reaches to maintain the protective buffer. Further details are provided in Section 3.2.

Figure 1: 2020 Design Nourishment Extent

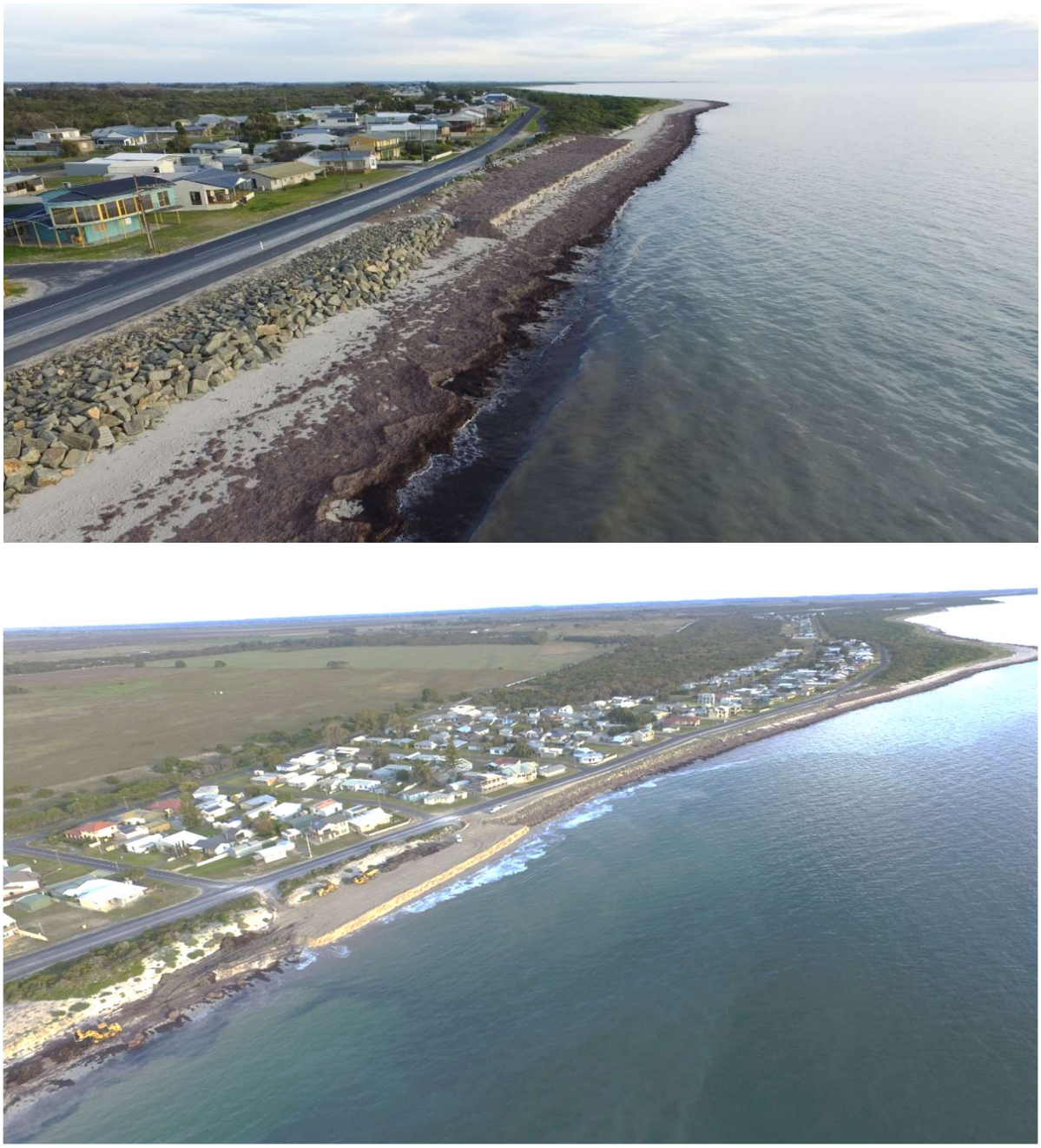


Figure 2: Southern (top) and northern (bottom) reach nourishment photographs (KDC 11 June 2020)

Table 1: Effectiveness Review

Reach	Location	Approx. Length of Nourishment (m)	Nourishment Design Volume (m^3)	Pre-construction Design Volume Estimate (m^3)	May 2020 Trucked Volume[2] (m^3)	May 2020 Surveyed Volume (m^3)		March 2021 Remaining Volume (m^3)	
						Total[3]	per m	Total[5]	per m
Southern	South 0.75m^3 GSC seawall	30	7,000	5,800	6,528	5,500[4]	35	500	5
	South 2.5m^3 GSC seawall	100							15
Northern	North GSC	100	6,000[1]	4,500	6,016	4,500	40	250	5

Notes:
1. Includes option to increase volume from 3,000 to 6,000 m^3 based on tendered rates.
2. Volumes based on trucking logs provided by Contractor.
3. Based on volume calculations from Alexander Symonds Drawing G002119.STG2 SOUTH WALL and G002119.STG2 NORTH WALL, presented in Appendix B.
4. Adverse weather on 25 May 2020 resulted in loss of sand from the southern reach prior to surveying. Trucking logs were used to determine volumes of sand carted over the stormy period but this is likely to be an underestimate of placed volume.
5. Based on volume calculations from Alexander Symonds Drawing 21G0026DETAIL-20P-STH WALL and 21G0026DETAIL-20P-NTH WALL, presented in Appendix C.

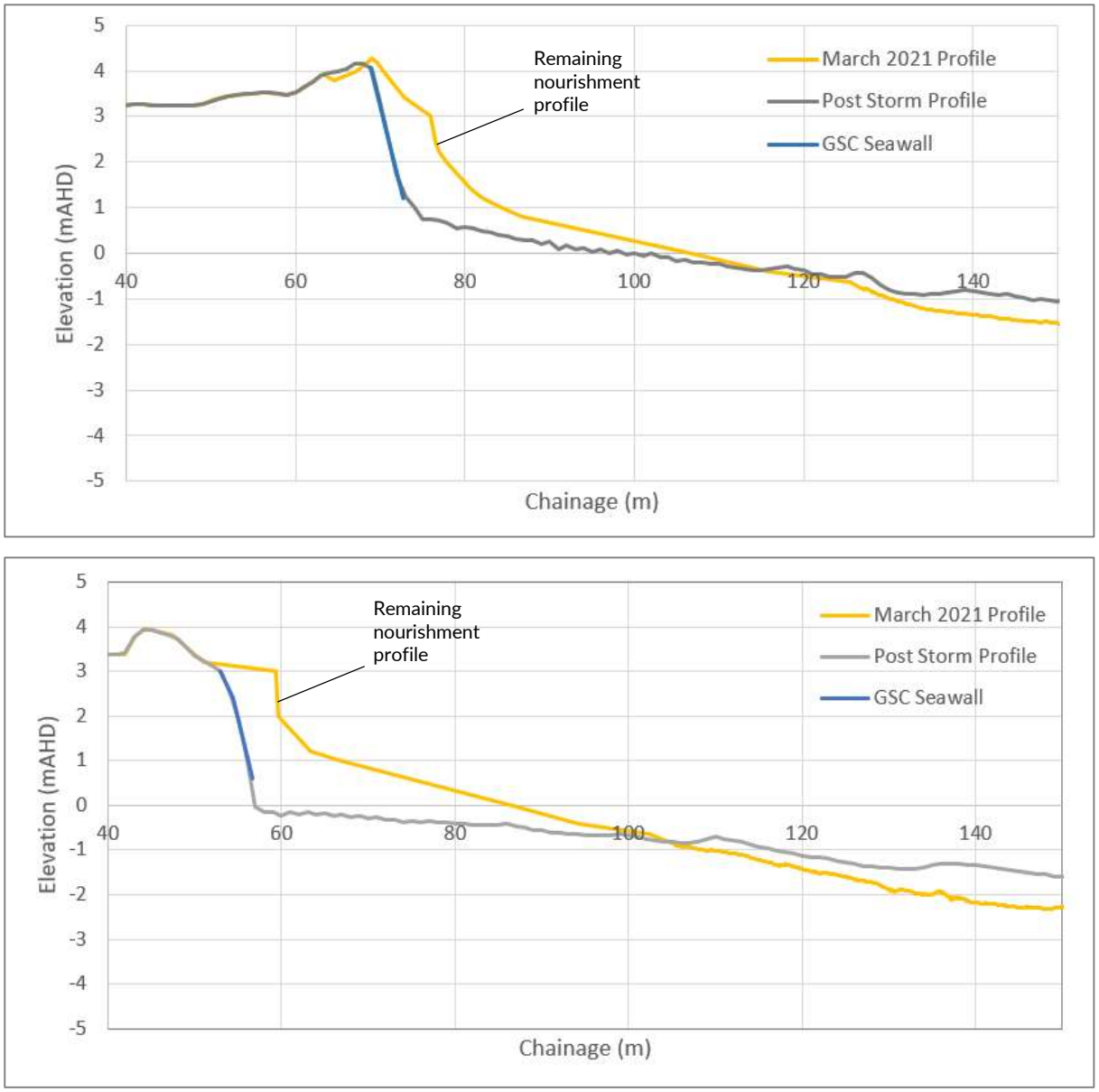


Figure 3: SBEACH modelling results of remaining nourishment: southern (top) and northern (bottom) reaches

2.5. Review of Beach Width

The second objective of the nourishment was to improve beach widths in front of the rock seawall for beach users, including walkers and vehicles. Anecdotally, residents have noted an improvement in the beach widths and amenity in front of the seawall in response to the nourishment (pers. Comm. Dave Worthley, 16 March 2021).

Drone photos of the beach taken at low tide in early February are presented in Figure 4. These show a significant beach in front of the seawall, which has been minimal in recent years.

DEW have monitored a beach profile (715008) in front of the seawall approximately every 2 to 5 years since 2003 (location shown previously in Figure 1). Comparison of the April 2018 DEW beach profile with the March 2021 survey (Figure 5) reveals the beach width in front of the seawall has increased by approximately 10m at the 0mAHD contour. This sand is likely to feed into the northern reach over the coming winter due to longshore transport.

Figure 4: Drone photos of summer beach width and remaining sand nourishment: southern (top) and northern (bottom) reaches (Patrick Hesp PhD; DSc Strategic Professor in Coastal Studies, Flinders University)

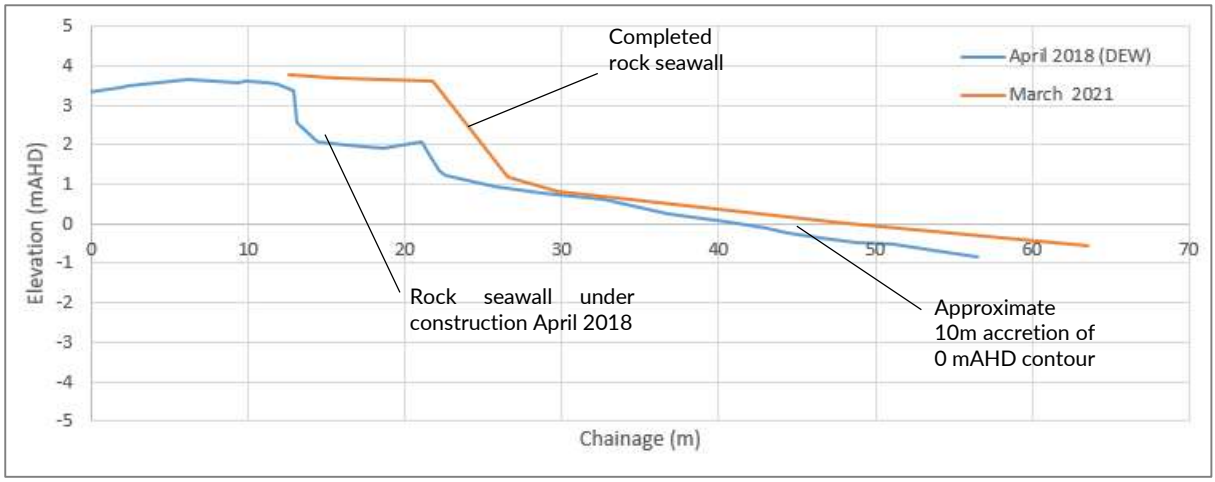


Figure 5: Comparison of April 2018 and March 2021 profiles at DEW profile 715008

2.6. Review of source site

The 2020 nourishment campaign sourced sand from the southern side of the Kingston Jetty, approximately 3km south of Wyomi Beach. This is a problematic area of accretion, where increasing beach widths and berm levels impact on the jetty amenity. The site visit completed by Wavelength 16 March 2021 identified on-going build up of sand on the southern side of the jetty (Figure 6), impacting amenity.

Recommendations for the 2021 campaign related to the source site are presented in Section 3.1.

Figure 6: Nourishment source site (16 March 2021)

2.7. Summary

Overall, the 2020 nourishment campaign achieved the overarching objectives below:

1. Assets and dunes in the area were protected over the winter period.
2. Beach widths in front of the rock seawall were increased, improving beach amenity and access.
3. No additional erosion beyond previous extents

Given the disconnected nature of surveys in the area, it is difficult to determine the total nourishment volume remaining in the Wyomi Beach area. However, it appears some of the nourished sand has remained in front of the rock seawall and on the dunes in the northern and southern reach. This is likely to contribute to protection and longshore transport feed for the 2021 winter.

A key finding of the 2020 nourishment review is that it is not possible to place the original design volume of 60 m^3 per m at the site. This original design volume allowed for some of the longshore transport losses anticipated at the site and maintained a protective buffer for an estimated 1 to 4 years depending on the severity of storms. Given approximately half to two-thirds of the design volume was placed in 2020, achieving a nourishment frequency beyond every 2 years is unlikely and it's possible that sand nourishment may be required each year to maintain the protective buffer, particularly in the most critical location in the southern reach.

A key objective for the 2021 nourishment campaign should be to try and increase the nourishment frequency to every second year, if possible. Achieving this objective will be dependent on the severity and frequency of the storms experienced over winter and the ability to keep sand in the area, which will continue to be mobilised by cross-shore erosion and longshore transport. The best method for maintaining the protective buffer in the area is to place the nourishment higher and further landward on the beach to minimise these on-going losses.

Further details on improving the design profile and extent to achieve this objective are discussed in Section 3.1.

3 2021 Nourishment Design Review

3.1. Design Recommendations

The following elements are recommended to be incorporated into the 2021 nourishment campaign:

Placement sites:

- **Timing:** Placement works should be undertaken as early in the year as possible, and prior to winter storm and high water level impacts during the placement works. Ideally prior to May.
- **Priority:**
    - The critical location is still the southern reach (Figure 1), as it has the highest storm erosion risk due to the relatively high existing GSC seawall foundation levels.
    - Additionally, any sand placed in the southern reach will likely move northward to in front of the rock seawall, potentially providing some improving beach amenity in the area and feeding into the northern reach.
    - As such, the largest nourishment volumes are recommended to be placed in the southern reach.
    - The second priority location is the northern reach at the northern end of the rock seawall. Placement at this location is required to protect against the edge effects (i.e. terminal scour) at the end of the seawall structure, which causes accelerated erosion.
- **Profile:** The design should aim to minimise the cross-shore footprint (i.e. seaward extension) of the nourished profile, through the following improvements:
    - Placement of nourished profile above spring tidal levels, approximately +0.4 mAHD. This can be achieved by increasing the seaward slope of nourishment from 1V:5H to the natural repose of sand (approximately1V:2H) and optimizing nourished berm widths.
    - As it will be primarily placed for protection and not amenity value, it is recommended that nourishment is placed at the back of the beach and out of the water, effectively reconstructing the eroding dune. As such, the height of the nourished berm should be increased from +3mAHD to +3.5 mAHD thus increasing cross-sectional area. This may have the following impacts which need to be considered:
        - A large erosion scarp at the rear of the beach, which may need to be managed by KDC at the end of winter to reduce risk of collapse.
        - Wind-blown sand is also likely to increase with increasing nourished height, which should be managed with seagrass or sand fencing (see below).
- **Extent:** Additional sand should be placed on the northern side of the southern reach to counteract localised edge effects from rock seawall. Sand could be end tipped over the rock seawall in this area or pushed with loaders.
- **Seagrass:** Seagrass wrack appeared to assist with stabilization and if available should be included in the 2021 works.
- **Vegetation:**
    - Minimise disturbance to established vegetation where possible, including truck and equipment access points.
    - Revegetation is not recommended as the sand is expected to be rapidly lost. However, to reduce the nuisance of wind-blown sand it is recommended the nourishment be covered with seagrass wrack, as in previous years. If this is not possible sand fencing is recommended where there is no leeward (landside) dune.

Sand source site:

- Sand should be taken from the front face of the beach in parallel cuts working towards the shoreline, including adjacent to the jetty.
- Sand should be taken from the beach face and berm when the area is not covered with water (i.e. at low tide) and can be completed in one tidal cycle, to prevent the requirement for an EPA dredge license for the removal works (EPA, 2020).
- The beach should be re-profiled after the excavation works to ensure there are no holes or depressions in the profile which may act as sinks for wrack or pooling of ocean water.

Schedules:

- The payment schedule should be updated to be more transparent, using a schedule of rates basis.
- Payment should be made using truck logs, as this is a more accurate method of measuring volumes compared to surveys, which have the potential for inaccuracies related to loss of sand from storm waves prior to survey of placement sites.
- Prior to works commencing, the Contractor should provide the following information to Council for review and confirmation:
    - Type of trucks to be used in the works.
    - Number of each truck type to be used.
    - In-situ (undisturbed) volume of sand in each truck type, including allowance for bulking, confirmed with Council prior to commencement of Works.
- The recommended bulking factor is 1:1.13 (in situ : disturbed) based on bulking factors used by DEW at Adelaide for the Adelaide Living Beaches program (Pers comm Jason Quinn, DEW).. Adelaide has similar sediment size characteristics to the Wyomi and Kingston foreshore.

Monitoring:

- KDC should also consider implementing on-going monitoring of the nourishment areas to improve understanding of the on-going nourishment effectiveness and key factors for sand mobilisation. If resources are available, this should include:
    - Weekly (or as a minimum after storm events) photographs of nourishment from a fixed location and angle over winter.
    - Installation of a pole at the rear of the nourished dunes and weekly measurement of the width of the nourished berm to the seaward erosion scarp.
    - Post-winter survey covering the survey extent established this year.

3.2. Design profiles

The following design profiles were modelled in SBEACH for the 20-year ARI storm event:

- **Southern reach:** 18m wide berm at +3.5mAHD, total placed volume of approximately 45 m^3 per m.
- **Northern reach:** 20m wide berm at +3.5mAHD, total placed volume of approximately 30 m^3 per m.
- Seaward slope at the natural sand repose angle (approximately 1V:2H) tying into adjacent dunes and beach.

SBEACH modelling results, showing the 20 year ARI design storm outputs, are presented in Figure 7 and Figure 8. These suggest adequate protection is provided by the above design profile for the design storm event.

The following should be noted regarding the modelling results:

- The northern GSC may become exposed in the design storm but is not expected to be undercut.
- A series of smaller storm events may have the same erosion impact as the larger design event, which may erode the protective buffer provided by the nourishment over time.
- Should the nourishment width at the critical location (i.e. 30m stretch of 0.75 m^3 GSC seawall in the southern reach) narrow to less than 5m in winter, it's recommended Council place emergency sand nourishment to prevent undercutting of the seawall and erosion risk to assets. On-going monitoring of the nourishment identified in Section 3.1 would help to identify when this trigger width has been reached.

3.3. Design extent and volumes

The recommended nourishment extent is presented in Figure 9, with key details summarised below:

- **Southern reach:**
    - Total nourished length of 130 m, similar to the 2020 campaign.
    - Where possible, place sand on the northern side of the southern reach to counteract localised edge effects from rock seawall (Figure 9).
    - **Total volume of 6,000 m^3 (in situ),** a trucked volume of approximately 6,800 m^3.
- **Northern reach:**
    - Total nourished length of 100 m, similar to the 2020 campaign.
    - **Total volume of 3,000 m^3 (in situ),** a trucked volume of approximately 3,400 m^3.

3.4. Additional nourishment

Should additional funds be available, the following locations, in order of precedence, would be able to accommodate additional volumes of sand:

1. **Northern reach:**
    - Place additional 5 m berm width at +3.5 mAHD, providing an additional 15 m^3 per m, and a total 1,500 m^3 sand. This will increase the protective capacity in the northern reach and increase the likelihood of a suitable buffer remaining in place for longer than one year.
2. **Southern reach:**
    - Extend nourishment 50 m to south, at an approximate 40 m^3 per m, and a total 2,000 m^3 sand. This will increase longshore transport feed into the southern reach, having a minor impact on:
        - protective buffer in the critical southern GSC location, and
        - beach widths in front of the rock seawall.

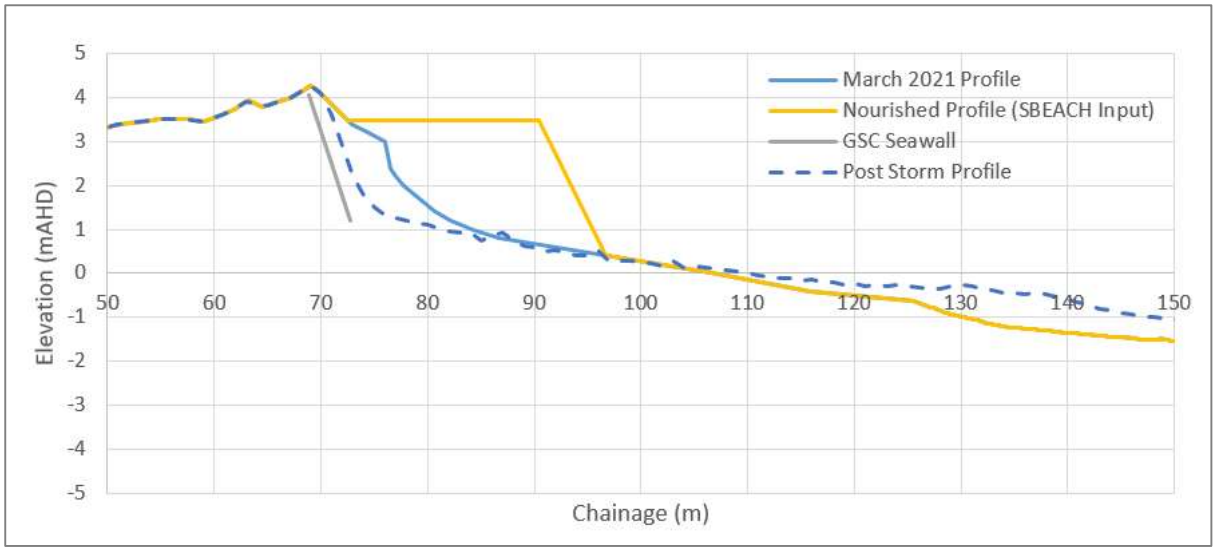


Figure 7: Southern reach SBEACH model results

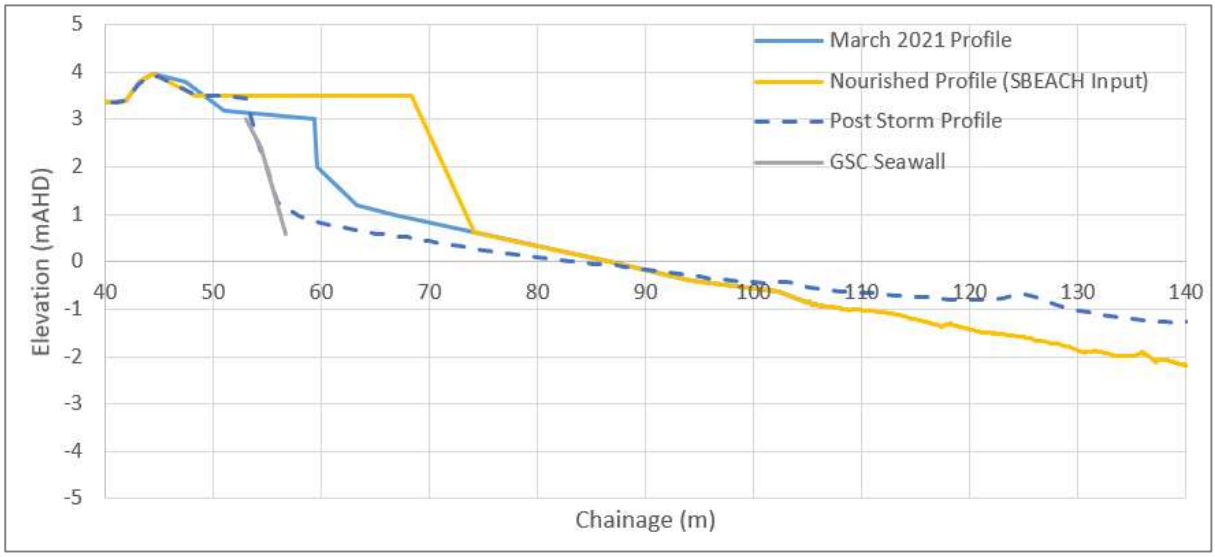


Figure 8: Northern reach SBEACH model results

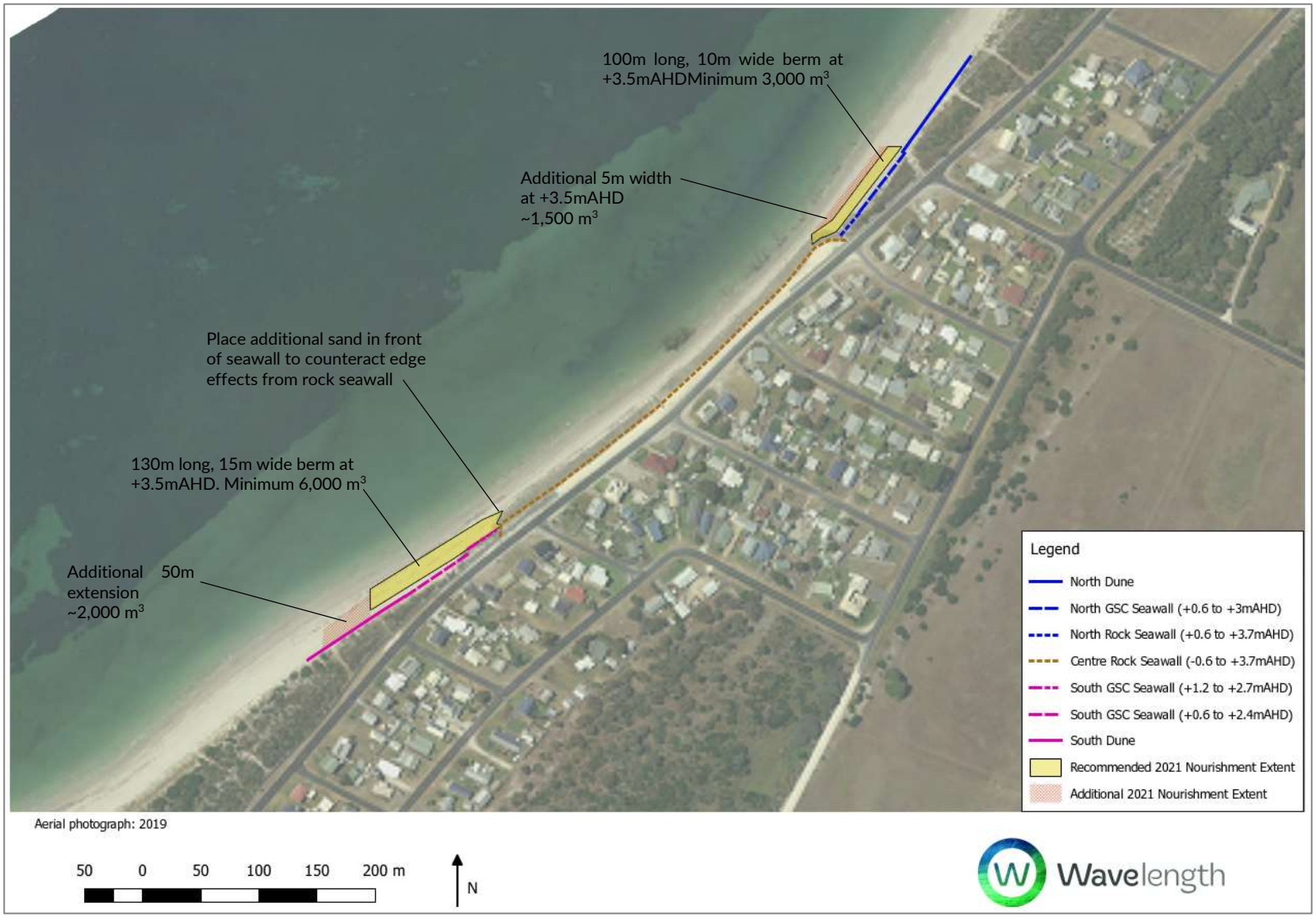


Figure 9: 2021 Design Nourishment Extent

4 Summary

Key findings of the review include:

- Overall, the 2020 nourishment campaign achieved the overarching objectives below:
    1. Assets and dunes in the area were protected over the winter period.
    2. Beach widths in front of the rock seawall were increased, improving beach amenity and access.
    3. No additional erosion beyond previous extents.
- Final placed volumes of approximately 35 to 45 m^3 per m of sand were achieved, which are significantly less than the 60 m^3 per m design volume originally estimated in Wavelength (2020).
- Given approximately half to two-thirds of the design volume was placed in 2020, achieving a nourishment frequency beyond every 2 years is unlikely and it's possible that sand nourishment may be required each year to maintain the protective buffer, particularly in the most critical location in the southern reach (i.e. 30m stretch of 0.75 m^3 GSC seawall in the southern reach).
- **Sand Placement Sites:** The best method for maintaining the protective buffer in the area is to place the nourishment higher and further landward on the beach to minimise on-going losses. Following is recommended to be placed:
    - **Southern reach:** 6,000 m^3 in situ total, 130m long, 18m wide berm at +3.5 mAHD.
    - **Northern reach:** 3,000 m^3 in situ total, 100m long, 20m wide berm at +3.5 mAHD.
- **Sand Source Site:** Sand should be taken from the front face of the beach in parallel cuts working towards the shoreline, including adjacent to the jetty. This should be completed when the beach face and berm area is not covered with water and can be completed in one tidal cycle, to prevent the requirement for an EPA dredge license for the removal works (EPA, 2020).
- **Monitoring:** Should the nourished berm width at the critical location narrow to less than 5m in winter, it's recommended Council place emergency sand nourishment to reduce erosion risk to assets. On-going monitoring of the nourishment identified in Section 3.1 would help to identify when this trigger width has been reached.

5 References

Environmental Protection Authority (EPA), 2020. Dredge guideline - Public consultation.

Wavelength, 2020. Wyomi Beach seawall – immediate term adaptation options assessment, prepared for Kingston District Council.

Wavelength, 2021. Kingston Coastal Adaptation Strategy, prepared for Kingston District Council.

Appendix A 2020 Nourishment Design Drawings

DRAWING SHEETS

KDC-01-01	DRAWING SUMMARY
KDC-01-02	NOURISHMENT LAYOUT PLAN
KDC-01-03	NOURISHMENT SECTIONS

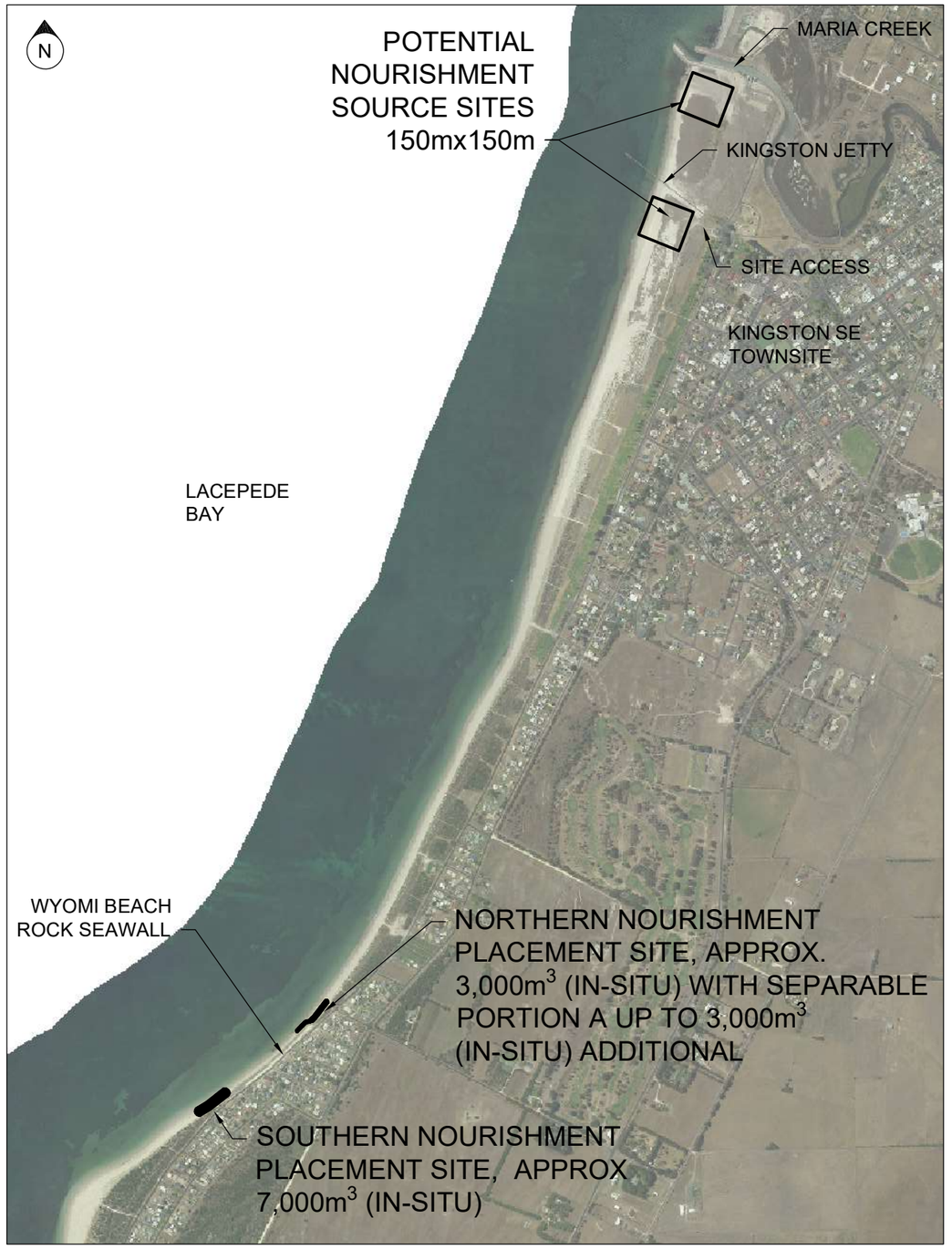
TIDAL LEVELS - KINGSTON

TAKEN FROM 2019 TIDE TABLES FOR SA PORTS

MEAN HIGHER HIGH WATER (+0.44 mAHD)

MEAN SEA LEVEL (+0.04 mAHD) 0 mAHD

LOWEST ASTRONOMICAL TIDE (-0.76 mAHD)



WORKS PLAN

SCALE 1:20,000

DRAWING NOTES:

1. HORIZONTAL COORDINATE SYSTEM: MAP GRID OF AUSTRALIA 1994 (MGA94) ZONE 54.
2. VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM (AHD).
3. AERIAL PHOTO TAKEN 2019.
4. NOURISHMENT SOURCE SITE LOCATION, EXTENT AND DEPTH TO BE CONFIRMED ON SITE WITH COUNCIL.

Revision notes:

Rev:	Date:	Notes:
A	1/4/2020	DRAFT FOR REVIEW
B	2/4/2020	INCORPORATED KDC COMMENTS
0	6/5/2020	ISSUED FOR CONSTRUCTION

Drawn by: B Smith	**Project:** WYOMI BEACH SAND NOURISHMENT
Client: KINGSTON DISTRICT COUNCIL	**Drawing Number & Title:** KDC-01-01 DRAWING SUMMARY
Date: 6/5/2020	
Scale @ A3: AS SHOWN	
Revision: 0	

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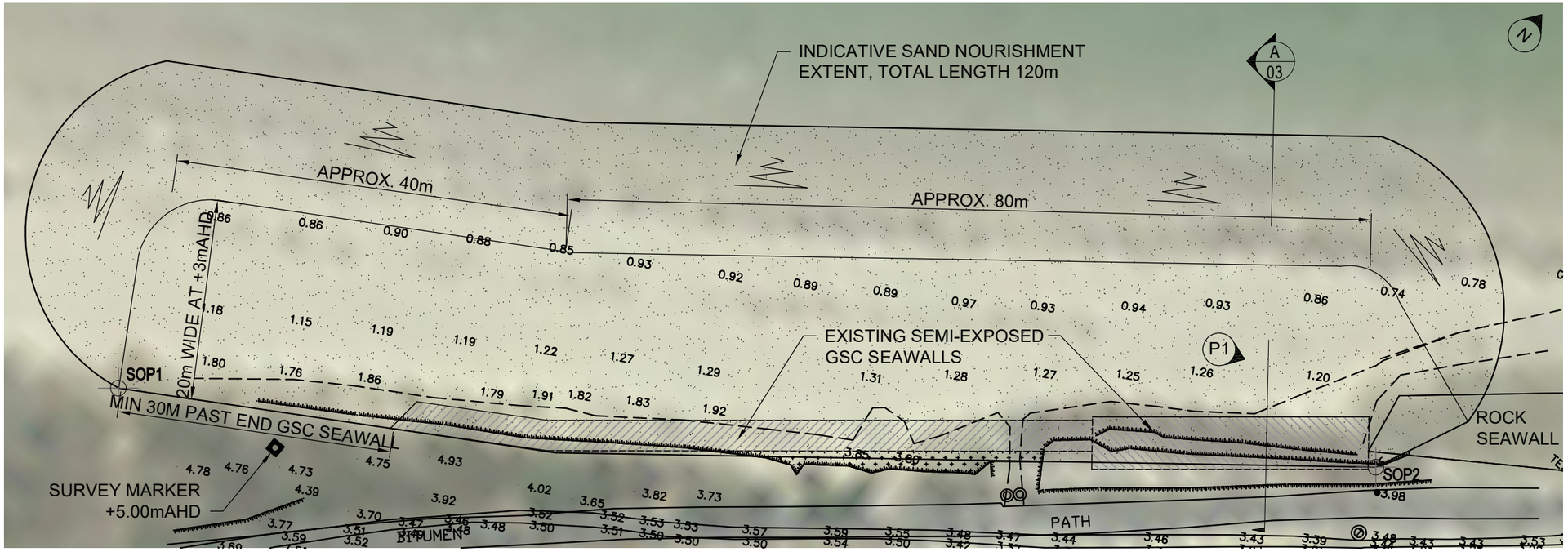
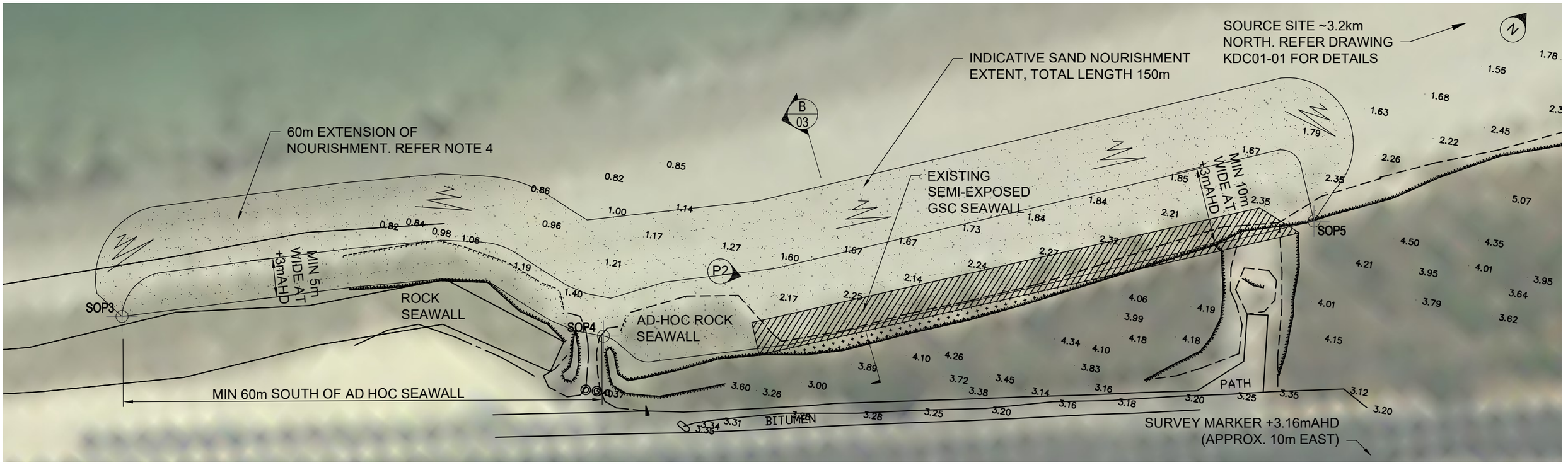


SOUTHERN NOURISHMENT SITE ~7,000m^3 (IN-SITU)

INDICATIVE SET OUT POINTS (MGA94 Z54)		
SOP	**EASTING**	**NORTHING**
1	395,595	5,920,506
2	395,697	5,920,579
3	395,943	5,920,803
4	395,993	5,920,840
5	396,055	5,920,910

NOTES:

1. BEACH & DUNE LEVELS INDICATIVE ONLY, BASED ON FEBRUARY 2019 FEATURE SURVEY & OCTOBER 2018 LIDAR. EXISTING LEVELS TO BE CONFIRMED ON-SITE WITH COUNCIL.
2. SITE PHOTOGRAPHS TAKEN 21/2/2020.
3. AERIAL PHOTOGRAPH TAKEN 2019.
4. CONTRACTOR SHALL REDUCE WIDTH OF NOURISHMENT CREST TO 5m AT +3mAHD FROM SOP3 TO SOP4 FOR A DISTANCE OF 60m IN FRONT OF EXISTING ROCK SEAWALL



NORTHERN NOURISHMENT SITE ~3,000m^3 (IN-SITU)

Revision notes:

Rev:	Date:	Notes:
A	1/4/2020	DRAFT FOR REVIEW
B	2/4/2020	INCORPORATED KDC COMMENTS
0	6/5/2020	ISSUED FOR CONSTRUCTION

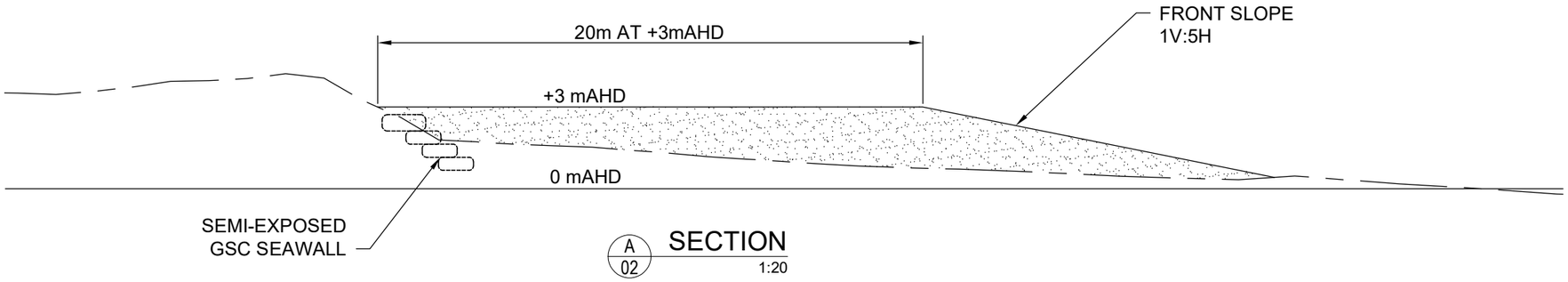
Drawn by: B Smith	**Project:** WYOMI BEACH SAND NOURISHMENT	**Date:** 6/5/2020	Wavelength
Client: KINGSTON DISTRICT COUNCIL	**Drawing Number & Title:** KDC-01-02 NOURISHMENT LAYOUT PLAN	**Scale @ A3:** 1:500	www.wavelengthconsulting.com.au
		Revision: 0	

LEGEND:

SAND NOURISHMENT DESIGN PROFILE

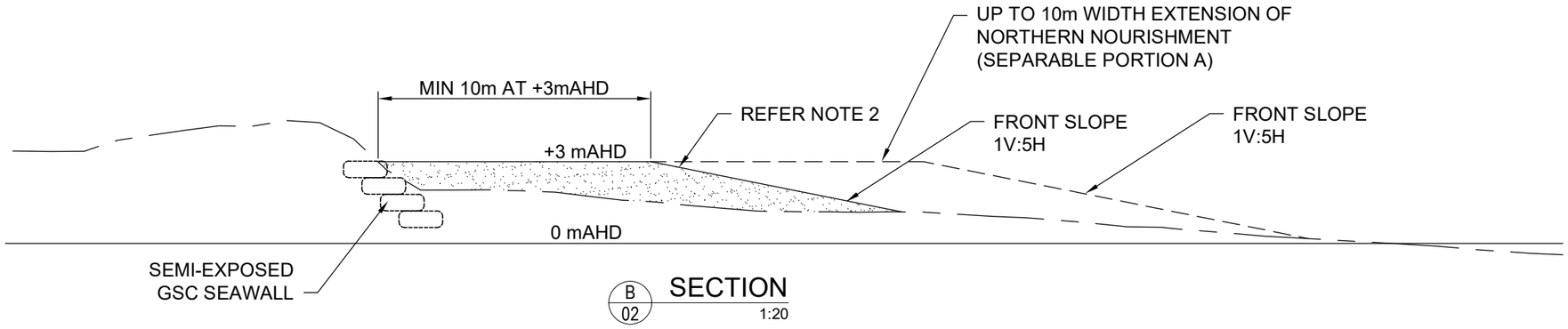
INDICATIVE BEACH & DUNE PROFILE

POTENTIAL WIDTH EXTENSION OF NORTHERN NOURISHMENT (SEPARABLE PORTION A)



A 02 SECTION
1:20

PHOTOGRAPH P1



B 02 SECTION
1:20

PHOTOGRAPH P2

NOTES:

1. BEACH & DUNE LEVELS INDICATIVE ONLY, BASED ON FEBRUARY 2019 FEATURE SURVEY & OCTOBER 2018 LIDAR. EXISTING LEVELS MAY HAVE CHANGED FROM SURVEY DATE & TO BE CONFIRMED ON-SITE WITH COUNCIL.
2. SEPARABLE PORTION B, TRANSPORT & PLACE EXCAVATED SEA WRACK OVER NOURISHED PROFILE TO A MAXIMUM DEPTH OF 0.2m UNDER DIRECTION OF COUNCIL.

Revision notes:

Rev:	Date:	Notes:
A	1/4/2020	DRAFT FOR REVIEW
B	2/4/2020	INCORPORATED KDC COMMENTS
0	6/5/2020	ISSUED FOR CONSTRUCTION

Drawn by: B Smith	**Project:** WYOMI BEACH SAND NOURISHMENT
Client: KINGSTON DISTRICT COUNCIL	**Drawing Number & Title:** KDC-01-03 NOURISHMENT SECTIONS
Date: 6/5/2020	
Scale @ A3: 1:20	
Revision: 0	

Wavelength
www.wavelengthconsulting.com.au

Appendix B Placed Nourishment Volume Survey and Estimates

LISCAD Cut / Fill Report 11:09 Thursday, 28 May 2020

File: EXISTING SURFACE 12.05.2020
Projection: Plane grid

Model Name: south existing A

File: G002119.10PROGRESS25.05.2020
Projection: Plane grid

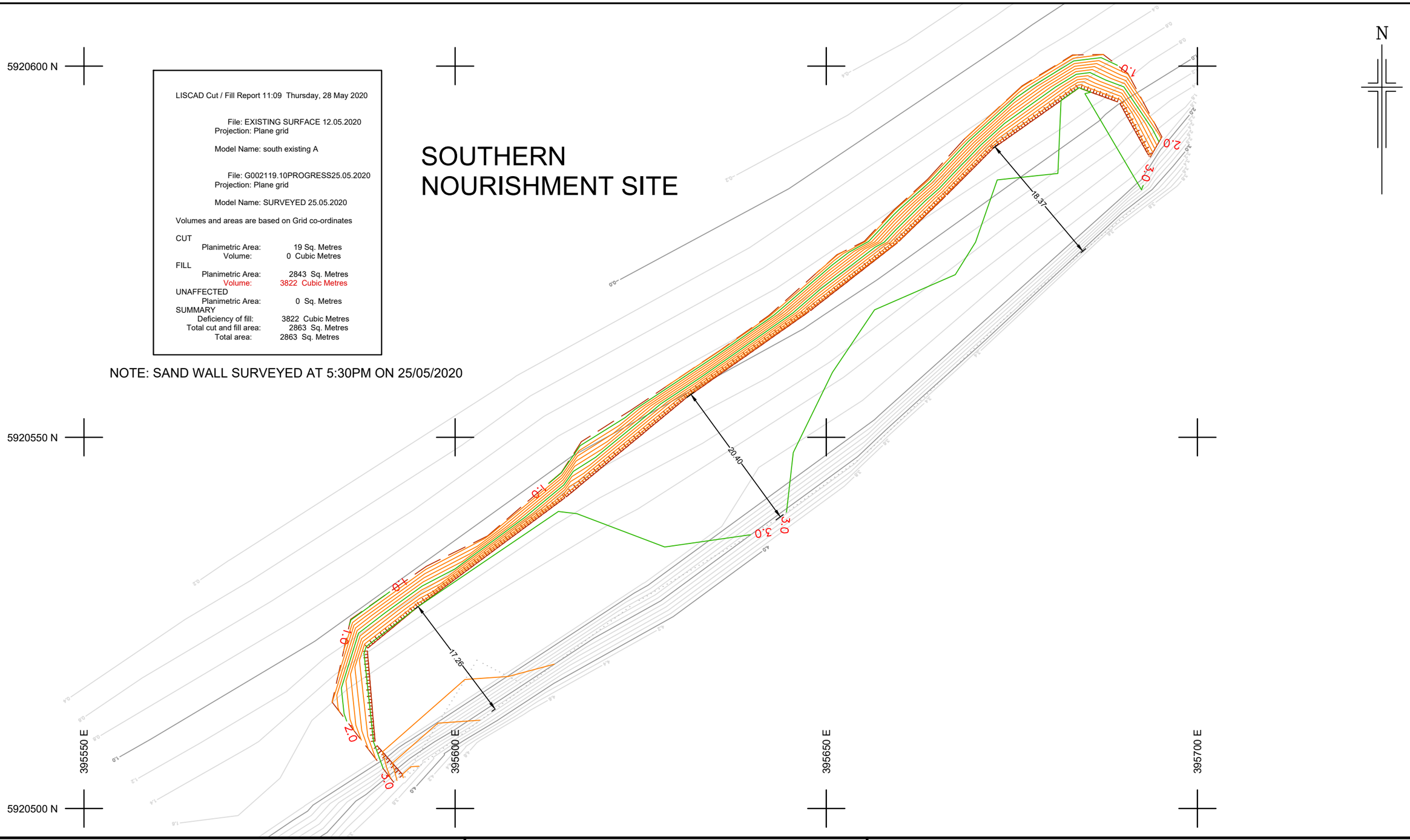
Model Name: SURVEYED 25.05.2020

Volumes and areas are based on Grid co-ordinates

CUT
Planimetric Area: 19 Sq. Metres
Volume: 0 Cubic Metres
FILL
Planimetric Area: 2843 Sq. Metres
Volume: 3822 Cubic Metres
UNAFFECTED
Planimetric Area: 0 Sq. Metres
SUMMARY
Deficiency of fill: 3822 Cubic Metres
Total cut and fill area: 2863 Sq. Metres
Total area: 2863 Sq. Metres

NOTE: SAND WALL SURVEYED AT 5:30PM ON 25/05/2020

SOUTHERN NOURISHMENT SITE



 ORIGINAL SHEET SIZE A3

COORDINATES:	GDA 2020 PLANE	SURVEY: MJR	25.05.2020
HEIGHT DATUM:	AHD	DRAWN: MJR	28.05.2020
DATA FILE:	G002119.10		
FLD/LVL BOOK:		CHECKED:	

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DETAIL SURVEY 25.05.2020
WYOMI BEACH
KINGSTON S.E.

DRAWING No. G002119.STG2 SOUTH WALL

SHEET 1 OF 1

REVISION

LISCAD Cut / Fill Report 10:04 Thursday, 28 May 2020

File: G002119.10PROGRESS27.05.2020
Projection: Plane grid

Survey Date: 2020-05-27

Model Name: exist surface 12.05.2020

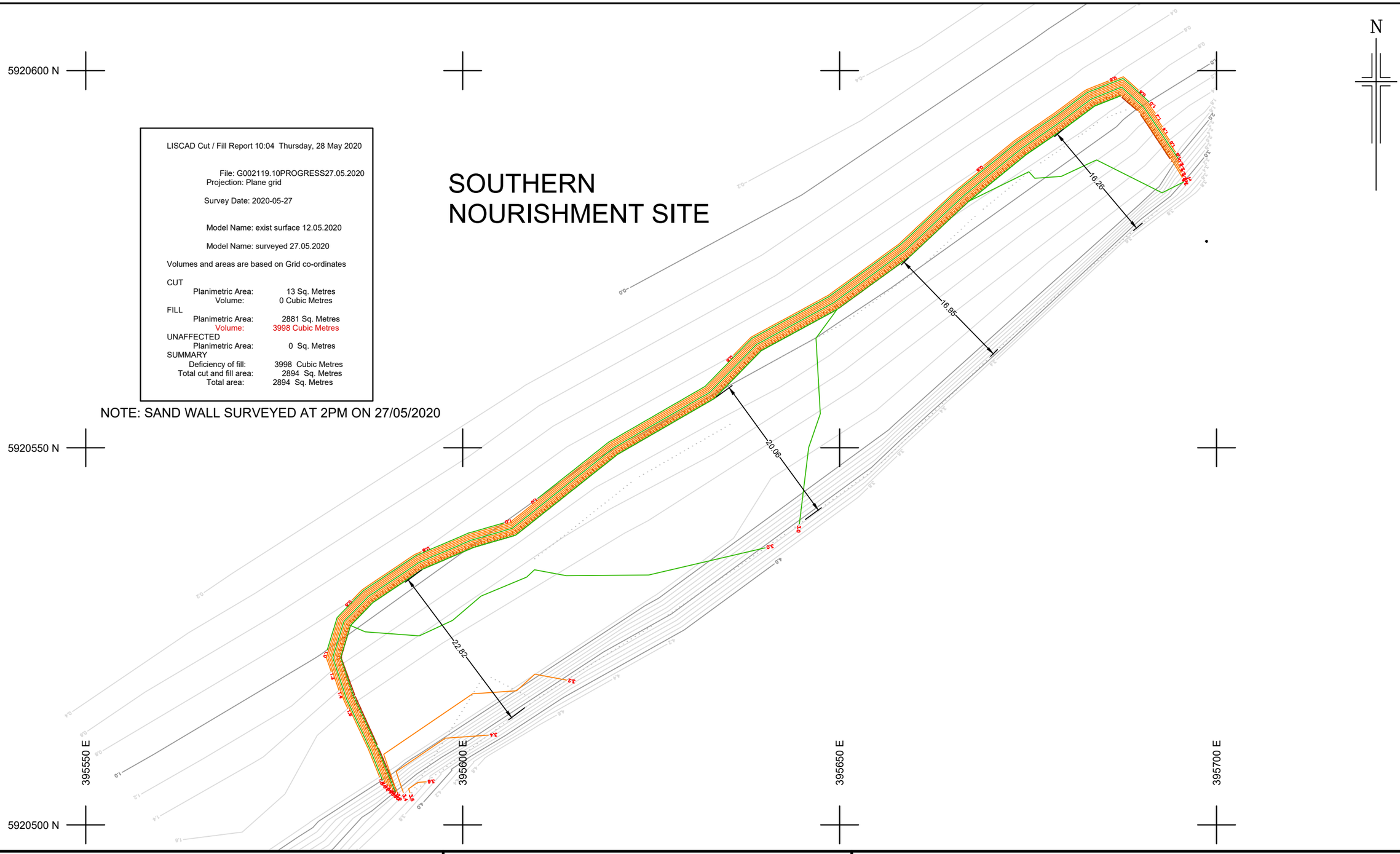
Model Name: surveyed 27.05.2020

Volumes and areas are based on Grid co-ordinates

CUT
Planimetric Area: 13 Sq. Metres
Volume: 0 Cubic Metres
FILL
Planimetric Area: 2881 Sq. Metres
Volume: 3998 Cubic Metres
UNAFFECTED
Planimetric Area: 0 Sq. Metres
SUMMARY
Deficiency of fill: 3998 Cubic Metres
Total cut and fill area: 2894 Sq. Metres
Total area: 2894 Sq. Metres

NOTE: SAND WALL SURVEYED AT 2PM ON 27/05/2020

SOUTHERN NOURISHMENT SITE



0m 5 10 20 30 40 50 1:500

 ORIGINAL SHEET SIZE A3

COORDINATES:	GDA 2020 PLANE	SURVEY: MJR	27.05.2020
HEIGHT DATUM:	AHD	DRAWN: MJR	28.05.2020
DATA FILE:	G002119.10		
FLD/LVL BOOK:		CHECKED:	

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DETAIL SURVEY 27.05.2020
WYOMI BEACH
KINGSTON S.E.

DRAWING No.	SHEET	REVISION
G002119.STG2 SOUTH WALL	1 OF 1	

LISCAD Cut / Fill Report 9:51 Monday, 15 June 2020

File: EXISTING SURFACE 13.08.2019

Model Name: EXIST SURFACE 13.08.2019

File: G002119.10 NORTH WALL 11.06.2020

Model Name: SAND WALL NORTH

Volumes and areas are based on Grid co-ordinates

CUT
- Planimetric Area: 22 Sq. Metres
- Volume: 4 Cubic Metres

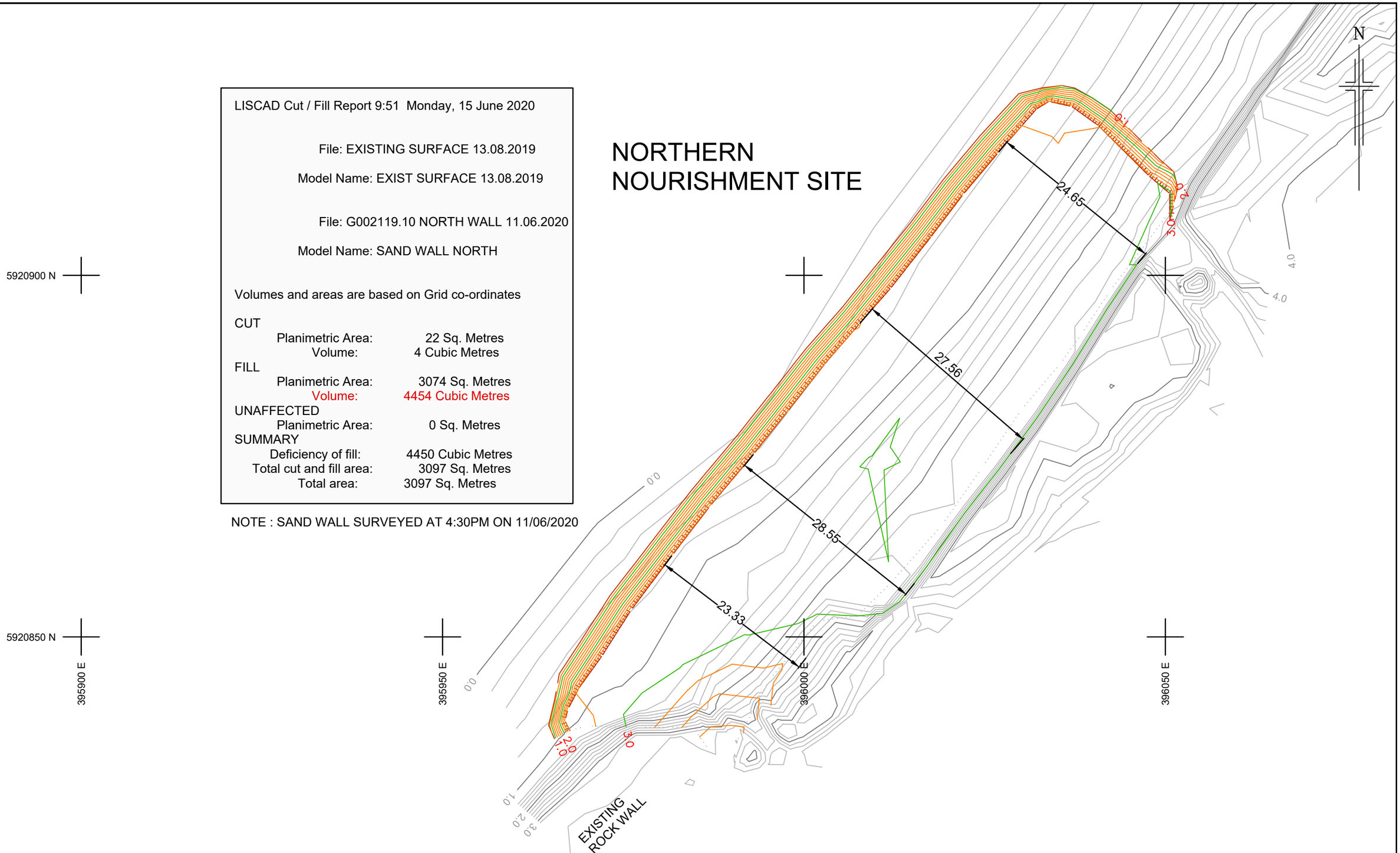
FILL
- Planimetric Area: 3074 Sq. Metres
- Volume: 4454 Cubic Metres

UNAFFECTED
- Planimetric Area: 0 Sq. Metres

SUMMARY
- Deficiency of fill: 4450 Cubic Metres
- Total cut and fill area: 3097 Sq. Metres
- Total area: 3097 Sq. Metres

NOTE : SAND WALL SURVEYED AT 4:30PM ON 11/06/2020

NORTHERN NOURISHMENT SITE



0m 5 10 20 30 40 50 1:500

REV	DATE	DESCRIPTION	CALC	FIELD

ADDITIONS, AMENDMENTS AND APPROVALS

LEGEND

47.51TK TOP KERB
47.36WT WATER TABLE
45.16FL FLOOR LEVEL
48.12IL INVERT LEVEL
or TAP
WATER METER
SPRINKLR / IRRIG VALVE
or HYDRANT
DOMESTIC OUTLET
DOWNPIPE
DOMESTIC SUMP
STORMWATER M'HOLE
SEP / GRATING
TEL. COMM. PILLAR / PIT
TRAFFIC LIGHT
SIGN / BUS SIGN
LITTER BIN
MAIL BOX / SIGNAL BOX
TICKET MACHINE
ROAD / ELEC. SERVICE
WATER SV / FP
ELEC. /
GAS SERVICE
PSM
PEG / TBM
SURVEY MARKS
BOREHOLE
POWER / LIGHT POLE
CABLE MARKER
STOBIE /WOODEN POLE
POST / BOLLARD
SEWER MH / IO / SIP
UNKNOWN POINT / SERVICE
EDGE OF VEGETN
ROAD SIGN / HOARD
TREE / SHRUB
Possible REGULATED / SIGNIFICANT TREE by measurement only (trunk greater than 2.0m circumference). Professional advice from council / arborist required.
BOTTOM OF BANK
TOP OF BANK
CHANGE OF GRADE
DRAIN
SEWER PIPE UG
TEL. COMM. UG
WATER PIPE UG
BUILDING
WALL
GI BUILDING
CONCRETE
FENCE
GATE

CONTOUR INTERVAL:	MAJ. 1.0m, MIN 0.20m
SURVEY:	MJR 11.06.2020
DRAWN:	MJR 15.06.2020
CHECKED:	- -

Notes:
Property boundaries and easements shown hereon have been compiled from government records and show discrepancies to Certificate of Title dimensions. Boundaries have not been verified by field survey. Construction or design on or near boundaries or easements will require additional survey work.

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DETAIL SURVEY 11.06.2020
WYOMI BEACH
KINGSTON S.E.

SHEET SIZE	DRAWING No.	SHEET	REVISION
A3	G002119.STG2 NORTH WALL	1 OF 1	

Appendix C Remaining Nourishment (March 2021) Volume Survey and Estimates

LISCAD Cut / Fill Report 12:59 Thursday, 11 March 2021

File: SOUTH WALL EXISTING SURFACE 12.05.2020
Projection: Plane grid

Model Name: south existing A

File: 21G0026DETAIL-20P
Projection: Plane grid

Model Name: DTM NOURISHMENT STH WALL

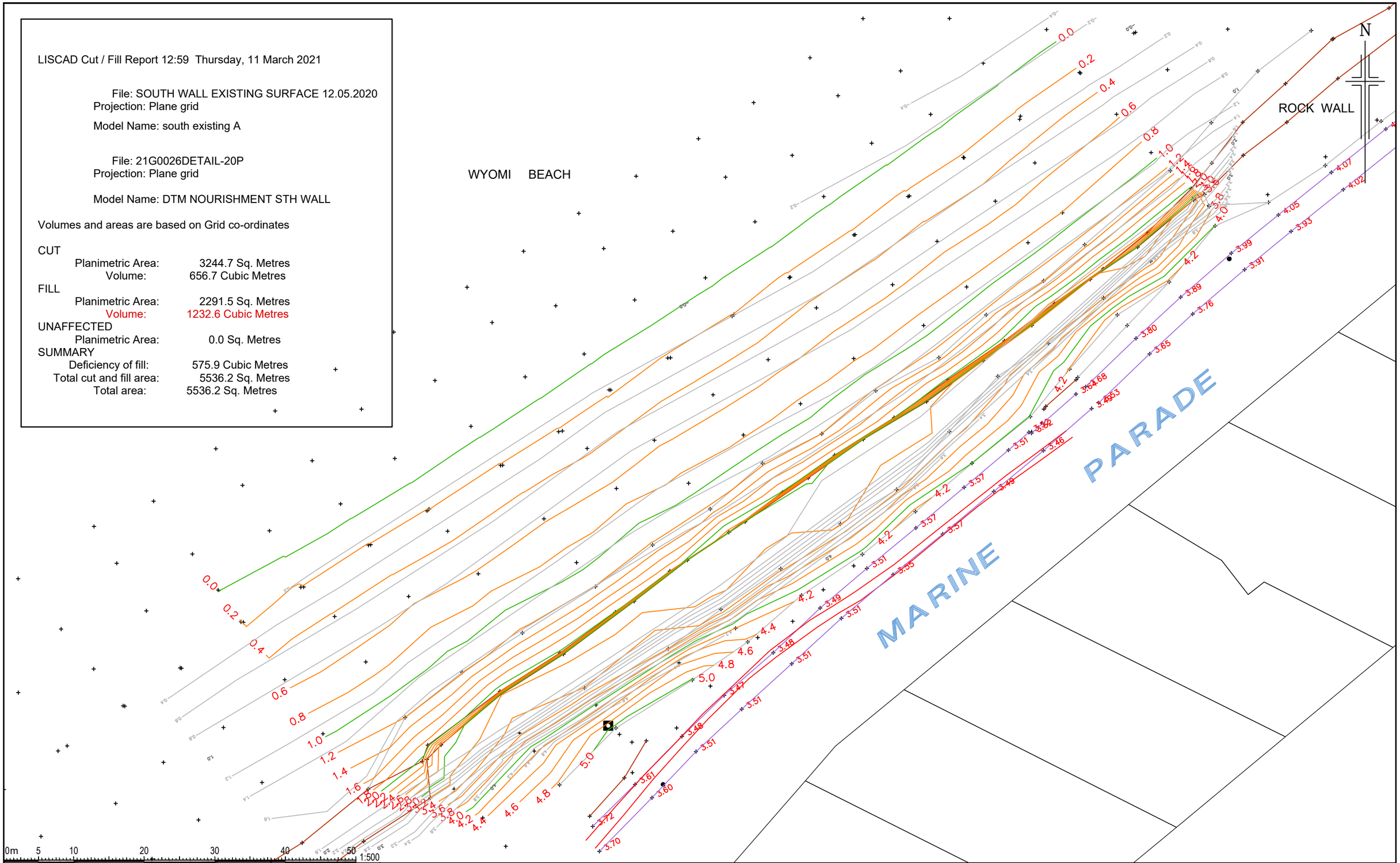
Volumes and areas are based on Grid co-ordinates

CUT
- Planimetric Area: 3244.7 Sq. Metres
- Volume: 656.7 Cubic Metres

FILL
- Planimetric Area: 2291.5 Sq. Metres
- Volume: 1232.6 Cubic Metres

UNAFFECTED
- Planimetric Area: 0.0 Sq. Metres

SUMMARY
- Deficiency of fill: 575.9 Cubic Metres
- Total cut and fill area: 5536.2 Sq. Metres
- Total area: 5536.2 Sq. Metres



REV	DATE	DESCRIPTION	CALC	FIELD

ADDITIONS, AMENDMENTS AND APPROVALS

LEGEND

- 47.51TK TOP KERB
- 47.36WT WATER TABLE
- 45.16FL FLOOR LEVEL
- 48.12IL INVERT LEVEL
- or TAP
- WATER METER
- SPRINKLR / IRRIG VALVE
- or HYDRANT
- DOMESTIC OUTLET
- DOWNPIPE
- DOMESTIC SUMP
- STORMWATER MHOLE
- SEP / GRATING
- TEL. COMM. PILLAR / PIT
- TRAFFIC LIGHT
- SIGN / BUS SIGN
- LITTER BIN
- MAIL BOX / SIGNAL BOX
- TICKET MACHINE
- ROAD / ELEC. SERVICE
- WATER SV / FP
- ELEC. /
- GAS SERVICE
- PSM
- PEG / TBM
- SURVEY MARKS
- BOREHOLE
- POWER / LIGHT POLE
- CABLE MARKER
- STOBIE /WOODEN POLE
- POST / BOLLARD
- SEWER MH / IO / SIP
- UNKNOWN POINT / SERVICE
- EDGE OF VEGETN
- ROAD SIGN / HOARD
- TREE / SHRUB
- Possible REGULATED / SIGNIFICANT TREE by measurement only (trunk greater than 2.0m circumference). Professional advice from council / arborist required.
- BOTTOM OF BANK
- TOP OF BANK
- CHANGE OF GRADE
- DRAIN
- SEWER PIPE UG
- TEL. COMM. UG
- WATER PIPE UG
- BUILDING
- WALL
- GI BUILDING
- CONCRETE
- FENCE
- XXXXXXX GATE

CONTOUR INTERVAL:	1.0m/0.20m
SURVEY:	MJR 2/03/2021
DRAWN:	MJR 11/03/2021
CHECKED:	- -

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VOLUME PLAN
SOUTHERN NOURISHMENT SITE
WYOMI BEACH
KINGSTON SE

SHEET SIZE	DRAWING No.	SHEET	REVISION
A3	21G0026DETAIL-20P-STH WALL	1 OF 1	

LISCAD Cut / Fill Report 12:55 Thursday, 11 March 2021

File: NORTH WALL EXISTING SURFACE 13.08.2019
Projection: Plane grid

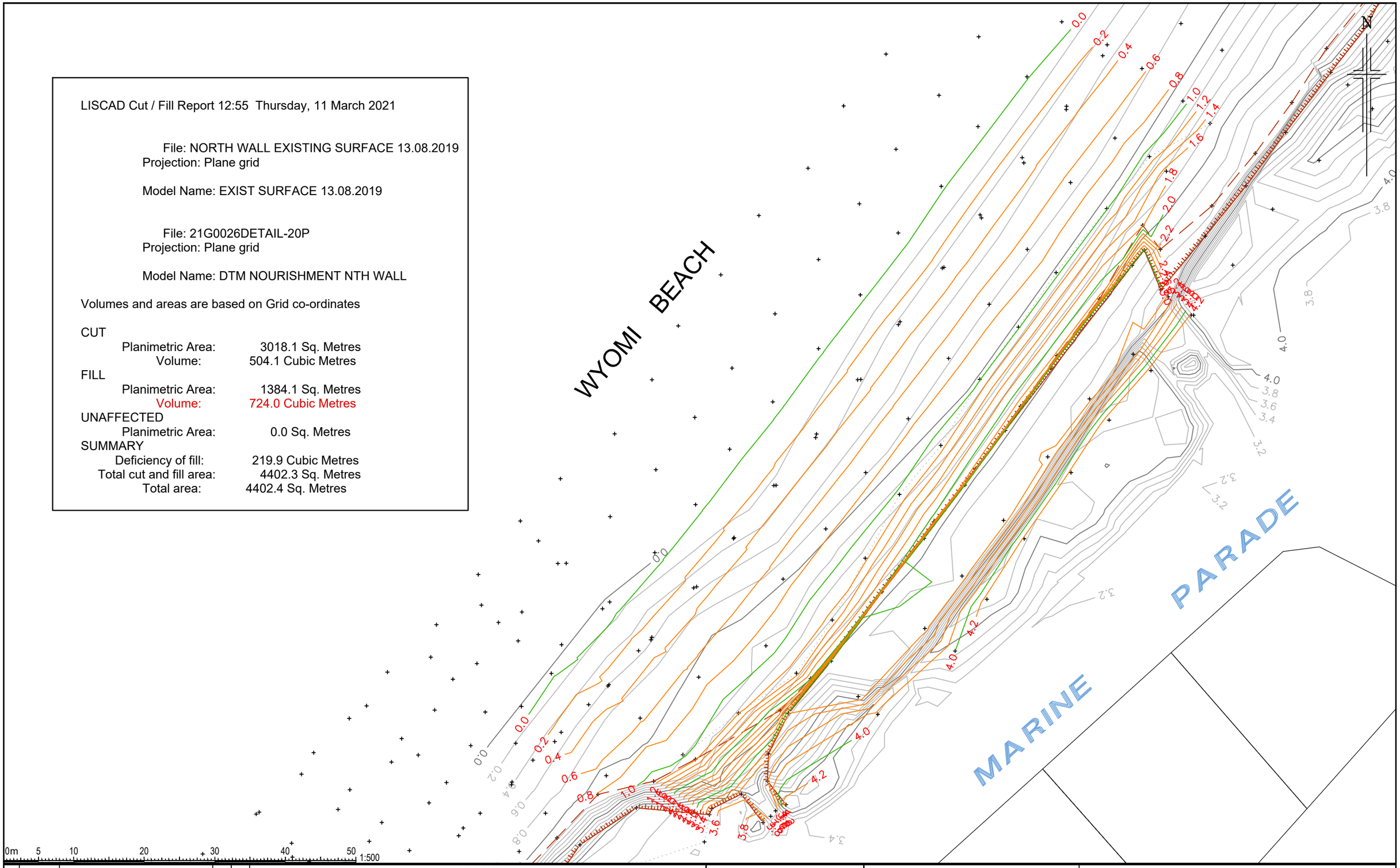
Model Name: EXIST SURFACE 13.08.2019

File: 21G0026DETAIL-20P
Projection: Plane grid

Model Name: DTM NOURISHMENT NTH WALL

Volumes and areas are based on Grid co-ordinates

CUT
Planimetric Area: 3018.1 Sq. Metres
Volume: 504.1 Cubic Metres
FILL
Planimetric Area: 1384.1 Sq. Metres
Volume: 724.0 Cubic Metres
UNAFFECTED
Planimetric Area: 0.0 Sq. Metres
SUMMARY
Deficiency of fill: 219.9 Cubic Metres
Total cut and fill area: 4402.3 Sq. Metres
Total area: 4402.4 Sq. Metres



REV	DATE	DESCRIPTION	CALC	FIELD

ADDITIONS, AMENDMENTS AND APPROVALS

LEGEND

47.51TK TOP KERB
47.36WT WATER TABLE
45.16FL FLOOR LEVEL
48.12IL INVERT LEVEL
or TAP
WATER METER
SPRINKLR / IRRIG VALVE
or HYDRANT
DOMESTIC OUTLET
DOWNPIPE
DOMESTIC SUMP
STORMWATER MHOLE
SEP / GRATING
TEL. COMM. PILLAR / PIT
TRAFFIC LIGHT
SIGN / BUS SIGN
LITTER BIN
MAIL BOX / SIGNAL BOX
TICKET MACHINE
ROAD / ELEC. SERVICE
WATER SV / FP
ELEC. /
GAS SERVICE
PSM PEG / TBM
SURVEY MARKS
BOREHOLE
POWER / LIGHT POLE
CABLE MARKER
STOBIE /WOODEN POLE
POST / BOLLARD
SEWER MH / IO / SIP
UNKNOWN POINT / SERVICE
EDGE OF VEGETN
ROAD SIGN / HOARD
TREE / SHRUB
Possible REGULATED / SIGNIFICANT TREE by measurement only (trunk greater than 2.0m circumference). Professional advice from council / arborist required.
BOTTOM OF BANK
TOP OF BANK
CHANGE OF GRADE
DRAIN
SEWER PIPE UG
TEL. COMM. UG
WATER PIPE UG
BUILDING
WALL
GI BUILDING
CONCRETE
FENCE
GATE

CONTOUR INTERVAL:	1.0m/0.20m	
SURVEY:	MJR	2/03/2021
DRAWN:	MJR	11/03/2021
CHECKED:	-	-

Notes:
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VOLUME PLAN
NORTHERN NOURISHMENT SITE
WYOMI BEACH
KINGSTON SE

SHEET SIZE	DRAWING No.	SHEET	REVISION
A3	21G0026DETAIL-20P-NTH WALL	1 OF 1	