REPAIRS TO SEAWALLS AT 4 CHILDE STREET, BELONGIL

URGENT WORKS

Prepared By

International Coastal Management

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1. OVERVIEW

A DA for minor but necessary repair works to make safe the existing wall protecting 4 Childe Street (lots 35 and 36 Section 3 DP 1623) from erosion is being prepared (Figure 1).

This technical report, with the attached technical drawings (Attachment A), has been prepared to support the DA.



Figure 1 Site

2. BACKGROUND

The existing erosion protection works at, and adjacent to, the subject property has been damaged over time. These works have been in a state of disrepair for some time.

The existing erosion protection works consist of a rock along the seaward boundary of the subject property. The wall is located to seaward of the property in lands designated as “esplanade” under the control of the state of NSW (Figure 2 High definition aerial image of 6 Childe Street (ICM 13/10/16)Figure 2).

The historical records show that the seawall structure protecting the subject property was designed and constructed in about 1999 - 2000 during a period of severe erosion as the second stage (lots 27-36) of the longer seawall along this section of Belongil. The wall was an emergency rock structure

designed to the engineering standards and specifications at the time with technical input from Byron Shire Council officers and their coastal engineering advisors at the time (ICM 2000 [Attachment B] and Figure 3). At about this time Byron Shire Council (BSC) also undertook emergency works along Belongil Spit to protect public and some private lands while a coastal management plan was developed and implemented. This work by BSC, with the works by private landowners, effectively created a continuous wall along the developed beachfront section of Belongil Spit. A coastal management plan has still not been implemented.

There is now a continuous rock seawall from the northern flank of the northern most private property on Belongil spit to the rock protection at the Old Jetty Site (State lands). With the natural sandstone outcrops at the southern end of the Old Jetty site and southward from Border Street with the BSC sandbag walls at Border Street and Don Street, there is now effectively a continuous protection structure (natural and artificial) between the SLSC to the south of Jonson Street and the northern most private property on Belongil Spit (WRL 2013) (Figure 4).



Figure 2 High definition aerial image of 6 Childe Street (ICM 13/10/16)

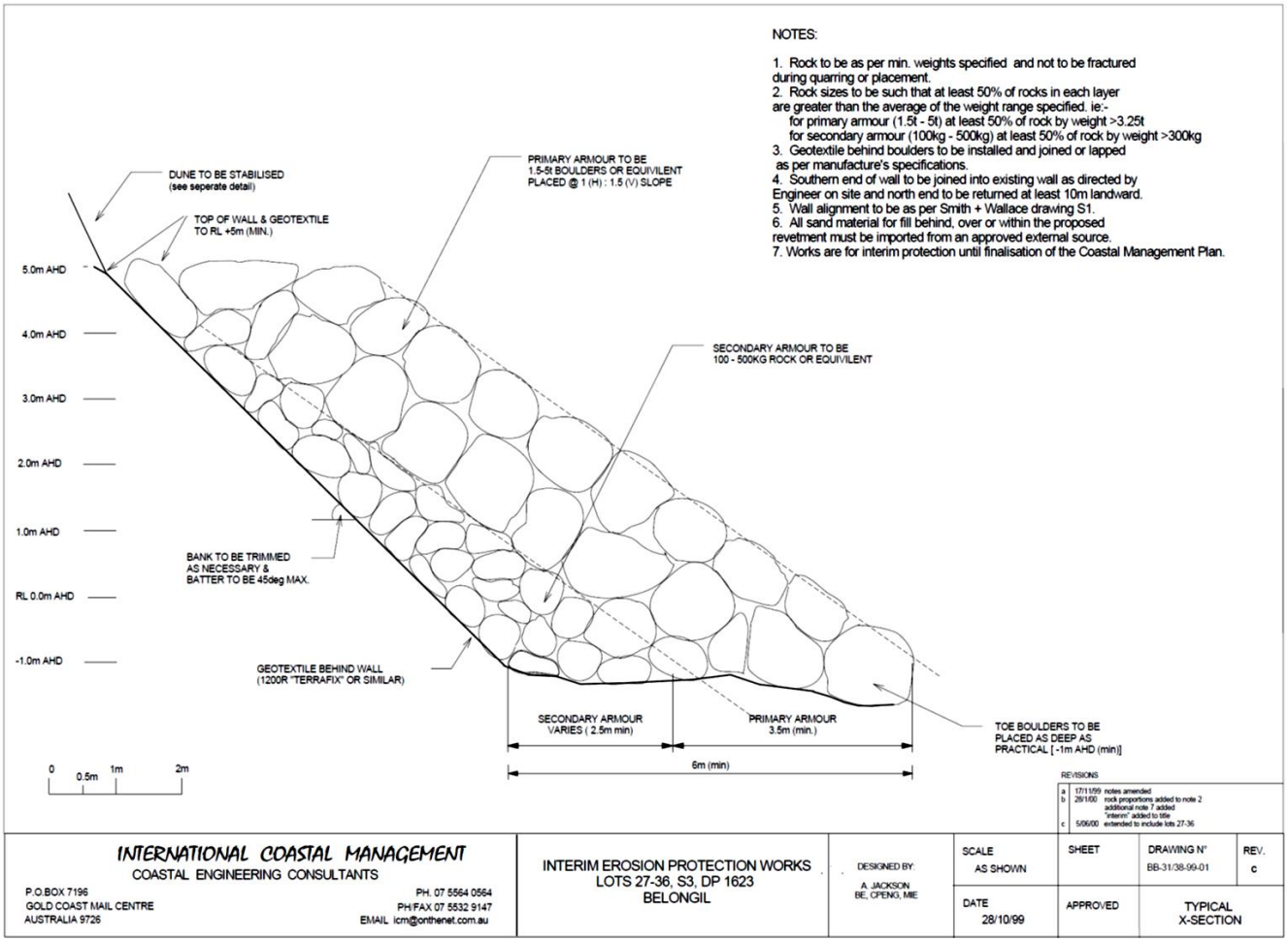


Figure 3 ICM 1999 Seawall design

The Belongil seawalls are generally landward of wave forces but the walls along Belongil, including the subject wall, have been subjected to wave impacts during a number of severe erosion events. Rock seawalls require maintenance and this is needed for the subject wall.

The subject wall has been subject to several court cases. Most recently on 12/8/16, the Supreme Court of NSW issued orders made in proceedings brought by multiple plaintiffs including the owners of the subject property. These orders were based on the long-documented impact of the Jonson Street structure constructed and maintained by Byron Shire Council on the down-drift beaches and seawalls at Belongil. These orders require that the subject wall and the other walls protecting the multiple plaintiff's properties must remain in place and cannot be removed as per Schedule 1 of the Orders (Figure 5).

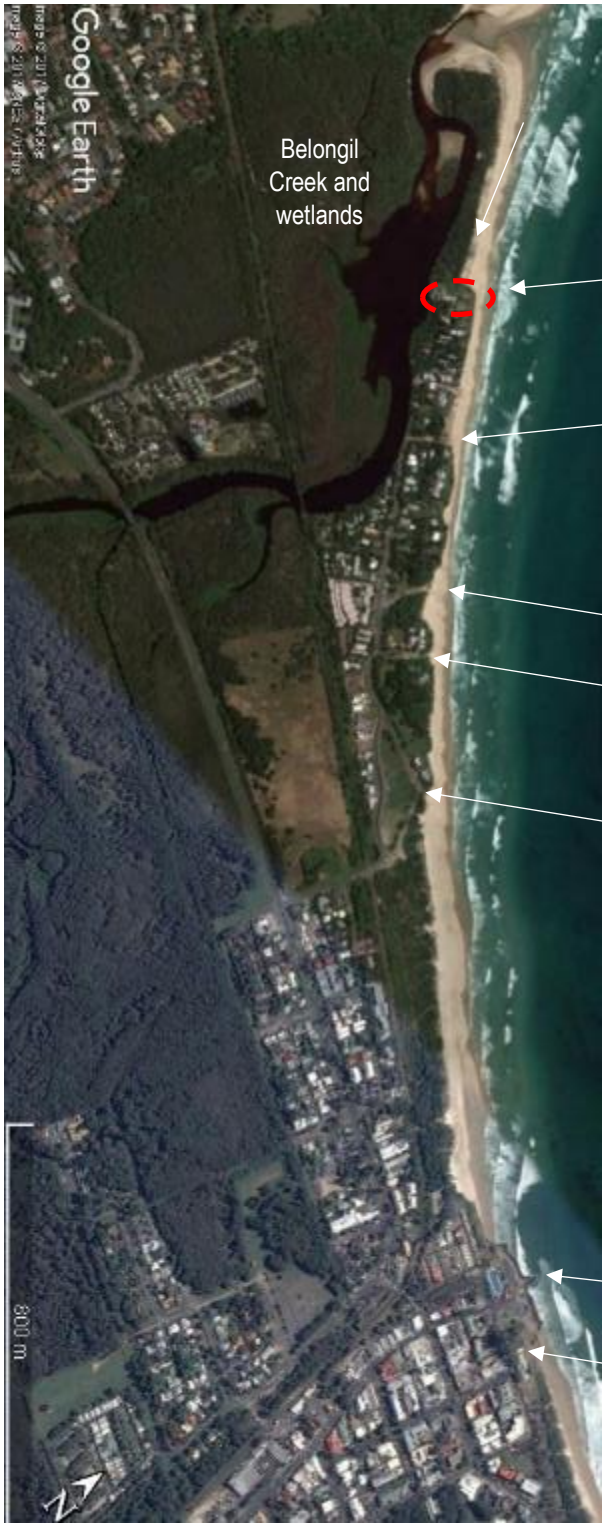


Figure 4 Locality Plan

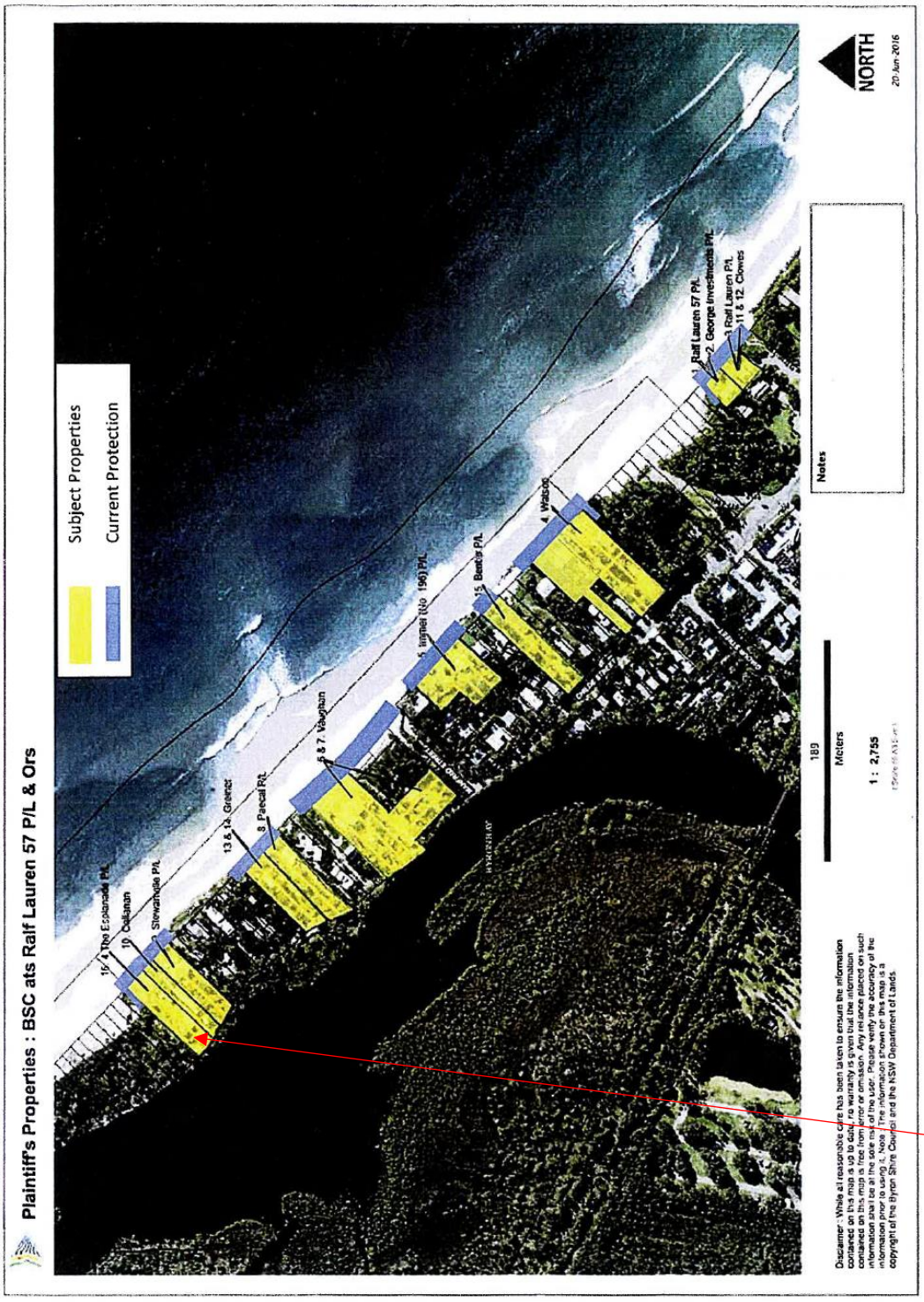


Figure 5 Schedule 1 from Court Orders

3. CONDITION OF THE WALL

There is considerable data on the walls along the Byron Bay embayment. The urgent need for repairs was identified to Council in the 2013 report to BSC by Worley Parsons entitled "Byron Bay Erosion Protection Structures – Risk Assessment" (WP 2013). Without repairs the existing works could be further damaged, and become increasingly a threat to the public.

WP 2013 found that all of the structures along Belongil to be substandard as per Table 1 of WP 2013 (copied below as Table 1). Notes re Table 1:

- The Belongil walls are numbered 2.1 to 3.5.
- The walls along the subject property are part of Structure 3.4.
- Structures 3.2 and 3.3 have been upgraded by Byron Shire in 2015 from geotextile containers to an engineered rock wall.

WP 2013 provided a risk assessment only and no recommendations were made to repair and make safe any of the walls. Since the WP 2013 report:

- Structures 3.2 and 3.3 have been upgraded by BSC to a rock wall and, it is understood, a similar rock wall upgrading is being considered for 2.3.
- WP have prepared a report in 2014 for BSC investigating the options to upgrade at and adjacent to Jonson Street (Collectively referred to as Jonson Street Structure and structure numbers 1.1 – 1.7 in Table 1).
- Periods of beach erosion have occurred including erosion due to a major storm in early June 2016 that caused erosion along the NSW coastline and further damage to the walls.

Table 1 Summary of risk Assessment (from WP2013, Table 1)

Structure No.	Structure Description	Structure Resilience Rating	Coastal Processes Rating	Coastal Ecology Rating	Public Use and Amenity Rating
1.1	Interim coastal protection works at Byron SLSC	HIGH	LOW	LOW	LOW
1.2	Rock protection at Byron SLSC	MODERATE	MODERATE	MODERATE	LOW
1.3	Rock protection in front of the main reserve area adjacent to the surf club, separated from adjacent protection by concrete ramp	MODERATE	MODERATE	MODERATE	MODERATE
1.4	Rock protection in front of main reserve	EXTREME	MODERATE	MODERATE	MODERATE
1.5	Rock protection in front of Jonson Street carpark and east of groyne marking location of original jetty	MODERATE	MODERATE	MODERATE	MODERATE
1.6	Rock protection in front of Jonson Street carpark and west of groyne marking location of original jetty	HIGH	MODERATE	MODERATE	MODERATE
1.7	Rock toe protection in front of First Sun Caravan Park	HIGH	MODERATE	LOW	MODERATE
2.1	Border Street geotextile container interim protection works	LOW	LOW	LOW	MODERATE
2.2	Rock protection adjacent to Border Street works	MODERATE	MODERATE	EXTREME	EXTREME
2.3	Don Street geotextile container interim protection works	LOW	MODERATE	MODERATE	MODERATE
2.4	Concrete cube and rubble protection works adjacent to Don Street works	MODERATE	MODERATE	EXTREME	EXTREME
2.5	Geotextile container revetment adjacent to ad-hoc rubble works	MODERATE	MODERATE	MODERATE	MODERATE
3.1	Rock revetment north of old jetty site	EXTREME	HIGH	EXTREME	EXTREME
3.2	Manfred Street geotextile container interim protection works	MODERATE	MODERATE	MODERATE	MODERATE
3.3	Geotextile container revetment fronting private land adjacent to the Manfred protection works	MODERATE	HIGH	MODERATE	MODERATE
3.4	Rock protection north of the geotextile container revetment	EXTREME	HIGH	EXTREME	EXTREME
3.5	Geotextile container revetment works at northern flank of the rock protection at Belongil Spit.	MODERATE	MODERATE	MODERATE	MODERATE

The detailed hydraulic stability evaluation for the subject property (part of structure 3.4) from WP 2013 (Table 5) has been copied below as Table 2.

Table 2 Hydraulic Stability (from WP2013, Table 5)

Structure No.	Structure Description	Design standard 30 – 40% damage (from Table 3); initial damage for geotextile revetments	Rating	Comments
3.4	Rock protection north of the geotextile container revetment	<1yr ARI	Poor	Rock armour is too small to withstand estimated wave heights at this structure for events greater than the 1 year ARI

The public use and amenity rating by WP 2013 for the private structures along Belongil is between moderate and extreme. The public use and amenity rating for the subject property was extreme. These ratings were in 2013 and the public use and amenity rating may now be worse and the structure should be repaired and made safe.

ICM engineers have made regular inspections of the walls along Belongil Spit since 1999 and a condition survey of the walls along Belongil, with particular attention to the walls covered under the consent orders, was carried out by ICM engineers on 13/10/16 using high precision photogrammetry with RTK positioning to ascertain and record the condition of the walls. During that inspection, it was observed that:

- the subject wall was partially covered by sand and was landward of high tides and wave action.
- some loose rocks are exposed on the exposed seaward face that are of a lesser size than required for stability (Figure 6). During erosion events, these rocks can be 2-3m above sand level and there is a risk of them falling.
- There is a substantial geobag wall on the NW flank (Figure 7)

The WP 2013 findings regarding risk and hydraulic stability reflected the small rocks on the seaward face of the wall. The proposed repair works will improve the public use, amenity, risk and hydraulic stability ratings.

Many of these inspections by ICM engineers since 1999 were during erosion events when the lower section of the wall was uncovered. The historical ICM photos along with publicly available aerial photos from Google Earth and Nearmap provide details of the condition of the wall below present sand level.

The wall design (Figure 3) is well documented and the exposed face should be 1.5-5t boulders, well interlocked at a slope of 1.5 (horizontal) to 1 (vertical).



Figure 6 Continuous rock seawall along 6B Childe Street, 6A Childe Street and No. 4 The Esplanade (ICM 13/10/2016)



Figure 7 SFGC bag wall transition to large basalt boulder wall (ICM 13/10/16)

The typical x-section of the wall is shown in
Figure 8.

Some of the rocks now exposed on the seaward face are smaller than 1.5-5t. These rocks are not hydraulically stable in conditions when the wall is exposed to storm wave impacts.

The need for maintenance is to be expected after this time as rock seawalls are flexible structures that can accommodate some rock movements (“damage”) and should be maintained after major storm impacts. Present engineering rock seawall design formulas and guidelines incorporate the notion that a level of damage is acceptable and maintenance is required to limit the extent of damage.

The existing works have been damaged to an extent that they are now in need of repair to restore them to their original condition and safety.

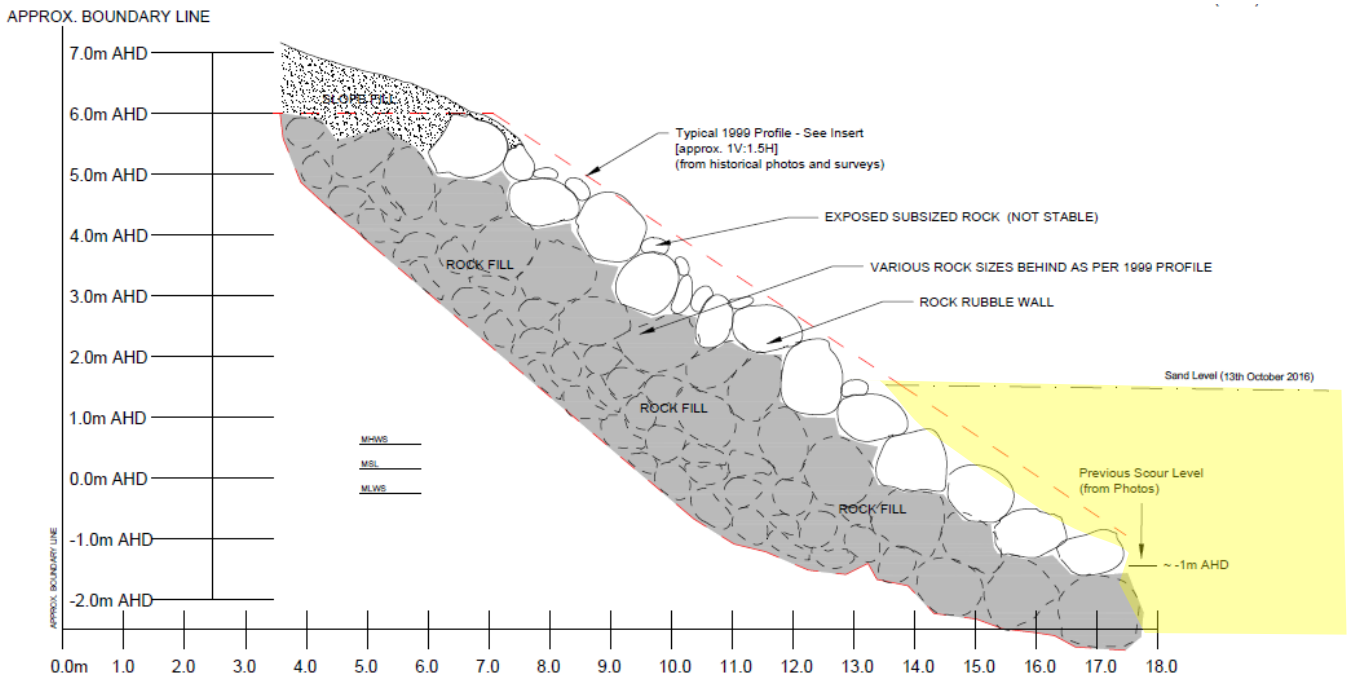


Figure 8 Typical present condition of wall

4. REPAIR DESIGN

The most urgent works are to restack any unstable rocks on the exposed (above beach level) seaward face of the wall in a stable configuration. To achieve this, some additional rocks may be required. This will not change any characteristics, such as void ratio and energy dissipation.

For the initial urgent and subsequent full repairs of the existing wall structure, all appropriate engineering principles, codes and standards will be applied. These include:

- Coastal Engineering Guidelines (Institution of Engineers, Australia, 2012)
- Guidelines for the design of maritime structures (Australian Standard AS 4997-2005)
- The Rock Manual (CIRIA, 2007)
- Actions from Waves and Currents on Coastal Structures (International Standard ISO 21650:2007)

The original rock wall design consists of well stacked layers of graded rock placed on a geotextile filter layer (Figure 3). The original design has performed its function satisfactorily to date (about 17 years) and the works are repair of the existing structure, not redesign and rebuild.

The present typical x-section of the wall has been inferred from the survey and photographic data available (

Figure 8). The seaward face of the rock wall is exposed from about +2m AHD (present beach level) to about +4m AHD (crest).

The urgent repair works now requested (August 2017 DA) are of a much lesser extent and will only restack the primary armour layer above sand level to present crest level (about 2m height) to a stable configuration without excavation. The restacking will achieve at least 3 points of contact for each rock. Undersized secondary armour rocks that are presently exposed will be placed in the voids under the primary armour layer.

Drawings 003 and 004 (Attachment A), show the existing and as-repaired profile overlaid on the existing profile.

Some additional rock, primarily in the 1.5-5t size grading rock will need to be imported to make up any deficit (Figure 9).

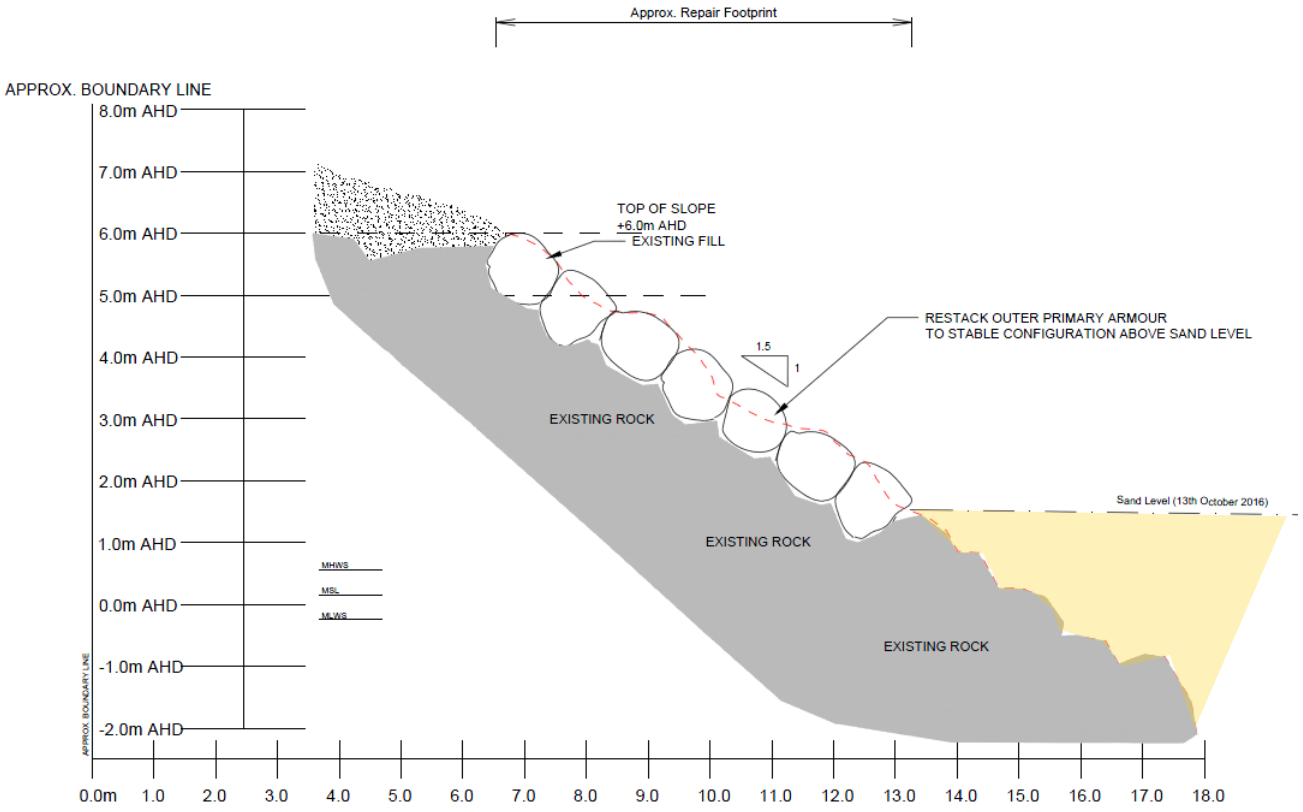


Figure 9 Urgent repair works

1.5 – 5t is the primary armour size specified in the original design and is the primary armour size that has generally been used along Belongil, including the recent wall at Manfred Street designed and constructed for BSC. Thus, the boulders to be used to repair the present wall are of similar size (1.5 – 5t), and hydraulic stability as the rock seawall constructed recently for BSC at the seaward end of Manfred St and along the seaward boundary of the private property to the NW of Manfred Streel (Umwelt 2013, WRL 2013).

It is important to note that the proposed works are not design and construction of new works. The proposed works are for repair of an existing structure that has been in place for about 17 years and has performed satisfactorily. We have not determined theoretical design criteria such as waves, winds, water levels and overtopping. This is not necessary for repair works as the works are minor repair of existing works that have provided a full-scale model that has proved to be more than adequate. The NSW Coastal Panel has queried design criterial for the January DA for a nearby property. In our responses, we advised that the works were repairs and also referred the Panel to the previous comprehensive design studies for this area. The most relevant is the design studies for the Manfred Street seawall (WRL 2013). We refer the Panel to all information and reports of this nature provided with the January application for this reference.

WRL 2013 provided a detailed hydraulic stability assessment of the rock seawall proposed for the Manfred Street and ICM have reviewed the assessment calculations and concurred with them. As a check only, during the repair design, ICM recalculated the theoretical design rock sizes on the wall using Van der Meer formulae as per CIRCA (2007). For these calculations, the design data developed by WRL 2013 for the recently designed and constructed rock seawall at Manfred Street for Byron Shire was used with some minor modifications for the subject site and a design life of about 30 years with maintenance as required; estimated at 10 yearly intervals. The future conditions will depend on the coastal management plan and mitigation of impacts caused by the Jonson Street structures. Repair, using similar size rock to existing, is a practical approach for an existing structure that has proven to be adequate in service over 17 years. The adopted design conditions, including waves and ocean water levels, are based on the extensive theoretical calculations by WRL (2013) at the structure for the design check were as follows:

Adopted Design Conditions at Structure			
Design Event		50	year ARI
Design interval between maintenance		10	year
Wave height at structure	H_S	2.50	m
	$H_{2\%}$	3.50	m
Critical wave period	T_{cr}	*13.0*	*sec*

The design check indicates the following theoretical rock sizes:

Adopted Boulder Weight & Grade (t)			
		Primary	Secondary
M_{15}		1.62	0.16
Adopted M_{50}		**3.00**	**0.30**
M_{85}		4.37	0.44

This compares well with the typical rock sizes in the existing structure and other structures along Belongil. Seawall design is not exact and there are uncertainties in the various inputs and, as a design check, it has been previously noted that these armour sizes are similar to the Manfred St wall rock design sizes (WRL 2013). Copies of the WRL 2013 and WP 2013 have previously been provided to the NSW Coastal Panel and can be provided again if required.

The additional rock required is minor – a maximum of 24t / 2 trucks. This is not a substantial increase. Any imported rock will be similar to the existing rock that is primarily basalt and greywacke, both of which are hard dense rocks with SG > 2.6. Potentially suitable quarries include:

- Ballina (NSW, 30 km from Belongil);
- Corndale (NSW, 35 km);
- Tumbulgum (NSW, 60 km);
- Piggabeen (NSW, 75 km); and
- West Burleigh (Qld, 80 km).

5. REPAIR CONSTRUCTION METHODOLOGY

Works to repair the existing seawall structures protecting this property are to be carried out as anticipated by the recent Supreme Court of NSW consent orders made 12/8/16. BSC has agreed to and signed the consent orders.

The proposed method of carrying out the works is as follows:

- Pre-Construction
    - All consents from adjacent landowners are to be formalised.
    - All statutory approvals to be obtained and notifications made.
    - A programme of works to be prepared that coordinates all of the private repair works such that the individual works proceed in an orderly manner, one property at a time, with the repair for each property completed and that section of beach opened before commencing on the next repair.
    - Safety fencing and signage is to be erected as per the construction drawing (Attachment A) to restrict public access to the work area. This fencing will be erected on the subject

property and along the toe of the exposed face of the wall above beach level. Access will be through the private properties as per the traffic plan. (Attachment A).
    - The traffic management plan which includes pedestrian access to and along the beach to be approved by BSC (attached in Attachment A). Truck traffic will be limited to a low loader to deliver and remove the excavator and two 12t trucks to deliver rocks over the repair time (estimated at 2-5 days).
    - Construction of a temporary construction track along the landward side of the wall from the subject property, where similar works are proposed.

- Construction (Estimated repair time 2 -5 days on weekdays, 7am to 6pm.)
    - Access for equipment and materials to be through the subject property and along the back of the seawall as per the construction plan (Attachment A).
    - Work areas as per the construction plan (Attachment A) will be kept as small as practical and fenced with safety signage and barricades to restrict public access to work and stockpile areas. Safe public accesses to and along the beach will be maintained.
    - The works will be carried out with a long reach excavator using a rock bucket and rock grab to position face rocks above beach level in a stable and safe configuration.
    - The works shall be carried out by a long reach excavator from the top of the wall starting at the SE end. The excavator will operate from the landward side of the wall and not on the beach.
    - Loose rocks to be removed and temporally stockpiled on the landward side of the wall and the subject property. These rocks will be replaced in a stable configuration and well interlocked.
        - Any additional rocks will be imported by truck through the subject property and stockpiled on the landward side of the wall. About 2 trucks with 12t load max. load will be used. Impact on local traffic will be minor and over a short period only. A traffic management plan has been prepared (Drawing 006, Attachment A)

    - Post-Construction
        - The access track is to be removed and the area impacted by the track revegetated and restored to the original condition in a clean condition free from rock or rubble.
        - The safety fencing is to be removed.
        - Maintenance by owners as required after major storms – estimated every 10 years.

6. NO IMPACTS

The proposed repair works to make safe the existing wall above beach level are minor and limited. Due to the nature and scope, the proposed repair works will not change the size, location or key physical characteristics (including voids ratio) of the existing wall. As a result, there will be no change to the present interactions between the wall, when intermittently exposed to waves, and the coastal processes. In particular, there will be no adverse impacts on adjacent properties or down-drift impacts caused by the repair works.

The proposed repairs will improve the stability of the wall and will have positive impacts on safety and the protection of adjacent private and public properties.

The existing wall is part of a continuous seawall designed and constructed in about 1999 to protect the private properties to NW of Manfred Street from intermittent storm erosion events. The 2015 BSC rock sea wall constructed to protect Manfred Street and the adjacent private wall to the NW connects into the 1999 seawall. There is now a substantial continuous rock seawall from the northern flank of the northern most private property (4 Childe Street – Subject Property) on Belongil spit to the rock protection at the Old Jetty Site (State lands). With the natural sandstone outcrops at the southern end of the Old Jetty site and southward from Border Street with the BSC sandbag walls at Border Street and Don Street, there is now almost a continuous protection (natural and artificial) of varying standards between the SLSC to the south of Jonson Street and the northern most private property on Belongil Spit (WRL 2013).

The alignment of the walls along Belong Spit is landward of normal high water and these walls act as a terminal seawall that not only protects public and private beachfront properties and infrastructure during major erosion events but also provides environmental benefits as it mitigates the risk of a breakthrough of Belongil Spit that, if allowed to occur, would have large adverse impacts on Council and Crown Lands and the natural environment.

The proposed works to make safe the existing wall are minor and limited to the top section of the wall only from about +2m to +6mAHD. Due to the nature and scope, the proposed repair works will not change the size, location or key physical characteristics of the existing wall. Smooth tie-ins are proposed for the full repair works but there will be no need to tie these initial urgent works into adjacent walls as the works will not cause a discontinuity. As a result, there will be no change to the present interactions between the wall, when intermittently exposed to waves, and the coastal processes. In particular, there will be no adverse impacts on adjacent properties or down-drift impacts caused by the repair works.

The proposed repairs will improve the stability of the wall and will have positive impacts on safety and the protection of adjacent private and public properties.

Furthermore, the repairs are to a wall that is generally inactive with respect to coastal processes. The alignment of the walls along Belong Spit, including the subject wall, is landward of normal high water (Figure 4) and these walls act as a terminal seawall that not only protects public and private beachfront properties and infrastructure during major erosion events but also provides environmental benefits as it mitigates the risk of a breakthrough of Belongil Spit that, if allowed to occur, would have large adverse impacts on Council and Crown Lands.

The potential effect of specific coastal hazards and processes on the proposed repair works can be summarized as follows:

Processes and Hazards [from NSW Coastal Protection Act 1979]		Impact on repaired wall
a)	beach erosion	The works are repair of an existing structure. The coastal hazards and processes on the repair works will be the same as the status quo. However, the repaired wall will be better able to resist the present and future coastal processes and hazards. In particular, the repairs will reduce the hazards of: - coastal and tidal innundation of low areas due to a breakthrough of the existing wall - slope instability along the subject properties. - erosion of Belongil Creek and wetlands due to breakthrough of Belongil spit
b)	shoreline recession	
c)	coastal lake or watercourse entrance instability	
d)	coastal inundation	
e)	coastal cliff or slope instability	
f)	tidal inundation	
g)	erosion caused by tidal waters, including the interaction of those waters with catchment floodwaters	
h)	Sea level rise and associated climate change impacts	

The impacts of the proposed repair works on the coastal processes and hazards will be similar to the status quo as the works are repair of an existing structure.

The impacts of the repair of the existing coastal protection works on coastal processes and hazards can be summarized as follows:

Processes and Hazards [from NSW Coastal Protection Act 1979]		Impact by repaired wall
a)	beach erosion	The works are repair of an existing structure. The impact of the repair works on the coastal hazards and processes will be the same as the status quo - no change
b)	shoreline recession	
c)	coastal lake or watercourse entrance instability	
d)	coastal inundation	
e)	coastal cliff or slope instability	
f)	tidal inundation	
g)	erosion caused by tidal waters, including the interaction of those waters with catchment floodwaters	
h)	Sea level rise and associated climate change impacts	

In the design of the repair works, Section 55M of the Coastal Protection Act has been considered. Section 55M requires that:

(a*) the works will not over the life of the works:*

(i) unreasonably limit or be likely to unreasonably limit public access to or the use of a beach or headland, or

(ii) pose or be likely to pose a threat to public safety, and

(b) satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works:

(i) the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works,

(ii) the maintenance of the works.

With reference to the above Section 55M conditions:

Re (a) (i); *the works will not over the life of the works unreasonably limit or be likely to unreasonably limit public access to or the use of a beach or headland*

- The proposed works are to make safe existing works by restacking of the wall to restore a stable slope without loose rocks that could be dislodged during erosion events.
- The completed repair works will improve safety of public access along the beach.

Re(a) (ii); *the works will not over the life of the works pose or be likely to pose a threat to public safety*

- The proposed repair works will improve public safety by restacking loose rocks. Thus, the repair works will not "pose a threat to public safety".

Re (b) (i); *satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works: (i) the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works.*

- The proposed repair works will restore a stable slope above present sand level. Impacts on the beach and adjacent land will be unchanged from present. Thus, any repairs will not cause "any increased erosion of the beach or adjacent land".
- The proposed repair works will also reduce the risk of erosion and a breakthrough of the Belongil Spit at this site. A breakthrough would result in:
    - Damage to Childe Street and the associated public infrastructure to westward of the subject property.
    - Inundation and erosion of the Belongil Creek, wetlands and littoral rainforest to westward of the subject property.

Re (b) (ii); *satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works: (ii) the maintenance of the works*.

- The proposed repair works can and should be maintained by the landowners after each major erosion event that impacts the wall. It is expected that repairs will be required about every 10 years.
- The wall should be inspected after each erosion event that exposes the seaward face of the wall to wave action. This inspection should compare the condition of the wall to the "as repaired" condition after the proposed repairs. Specifically, the inspection should:
    - Identify any loose, broken or displaced rocks.
        - Any loose rocks should be repositioned to be in a well interlocked and stable orientation.
        - Any broken rocks shall be replaced by a sound unbroken rock of similar size as the broken rock and placed in a well interlocked and stable orientation.

        - Any displaced rocks should be removed and replaced in a similar position to the original position in a well interlocked and stable orientation.
    - Check the crest level and seaward slope angle. Any subsidence or slope adjustment should be repaired to the original “as repaired” condition.

Other potential impacts considered

End Effects:

A common concern re seawalls, particularly those like the Jonson Street Structure that generally extend into the surf zone, is that they have long term end effects. As the proposed works are repair of an existing wall that is landward of the general influence of the waves and tides, this is not an issue.

However, as the NSW Coastal Panel requested a review for the full repairs in the January 2017 DAs for other properties that were part of the court orders, the lack of down drift impact beyond the status quo will again be confirmed.

Previous studies for BSC of existing and proposed upgrading of existing walls along the Byron embayment found that the only structure that had significant end effects was the Jonson Street structures. Near to the subject site, a geobag wall has been upgraded to a much larger rock seawall recently by BSC. In the consideration of the potential for end effects of this rock seawall with a length of 100m, WRL (2013) considered the McDougal et al 1987 diagramme as well as more recent work by NSW researchers (see WRL 2013 Section 8.7.2). WRL concluded that there would be no incremental end effects beyond the status quo ie referring to the McDougal et al 1987 diagramme (Figure 10):

- L (length of hard / protective structures) = 1,727m
- r (increased end effect recession) = 0m
- S (extent of increased end effect recession) = 0m

This assessment by WRL was supported by Umwelt 2013 (see Section 5.2.1):
“They are a replacement for an existing protection structure, so they would have no incremental (additional) impact beyond the status quo.”

ICM concluded, similarly, that there will be no incremental end effects from repairing the existing wall with a length of 20m at the subject site. That is, r = 0m and S = 0m as per the McDougal et al 1987 diagramme overlaid on Belongil (Figure 10) with dimensions.

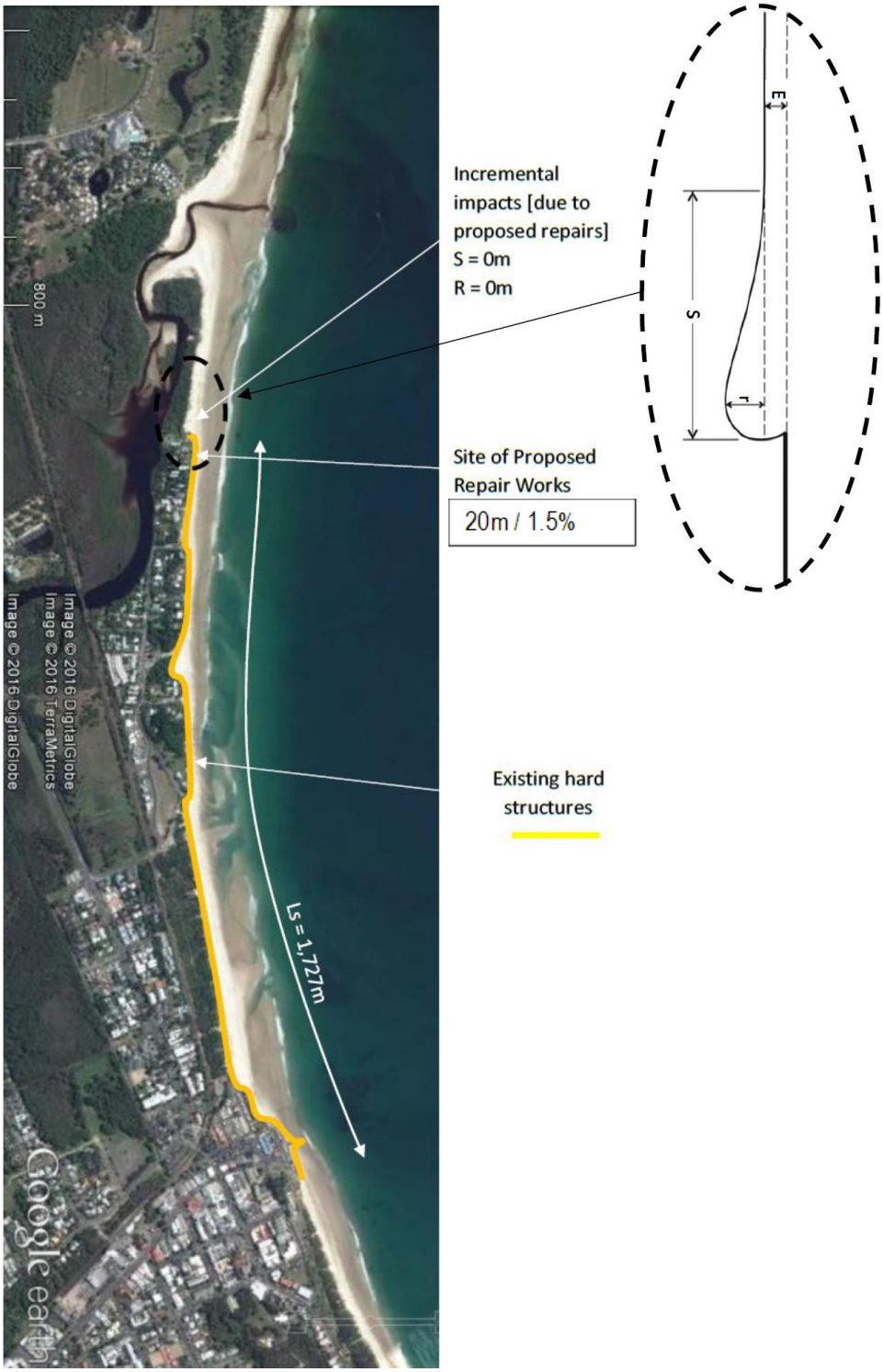


Figure 10 McDougal et al 1987 diagram applied to Belongil curved coastline

Summarising, there is now a continuous rock seawall from the northern flank of the northern most private property on Belongil spit to the existing rock protection at the NW section of the Old Jetty Site (State Crown Lands). With the natural sandstone outcrops at the southern end of the Old Jetty site and southward from Border Street with the BSC sandbag walls at Border Street and Don Street, there is now almost continuous protection (natural and artificial) of varying standards between the SLSC to the south of Jonson Street and the northern most private property on Belongil Spit. (WRL 2013). This repair is to a wall that is part of this continuous protection. This is the most northerly private property on Belongil Spit.

Habitat impacts:

A detailed environmental impact assessment was done for the new rock seawall recently constructed nearby to the subject site at Manfred St for BSC. This rock wall was found to have minimal environmental impacts (Umwelt 2013 Table 2.1) The impacts of the proposed repairs will be much smaller and there will be no impacts on shore bird and turtle nesting.

Extreme weather events:
The repair time is only about 3 -5 days so works can be timed to avoid extreme weather events. Before commencement of the works the short and long-range weather forecasts will be checked and works will not be commenced unless weather is suitable. Should extreme weather events be predicted during the course of the works that could affect the works, then the works will be suspended and made sound for the predicted weather impacts

7. SUMMARY

Urgent works are necessary to make safe the existing wall.

The present application is for minor urgent works above beach level. The additional rock to be imported will be limited to 24t. No excavation on the beach or works on crown lands will be required.

The cost estimate for the repairs is $15,000 over a period of thirty years.

These repairs will:

- make safe the existing wall
- have positive benefits to the safety of beach users
- improve protection to private and public property and infrastructure

These repairs will <u>not</u>:

- increase the footprint of the existing wall
- move the existing wall seaward.
- change the characteristics of the existing wall with respect to to the status quo of impacts on or by coastal processes
- cause environmental impacts

8. REFERENCES

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ATTACHMENT A

TECHNICAL DRAWINGS