






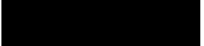

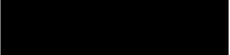


# South Quay Hill Shelters – Design Options Technical Note

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Report No: 60571547/0084/003

October 19

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<b>Purpose of Issue</b>	
<b>For Approval</b>	
<b>Nature of Change</b>	
<b>Revised in accordance with CORMAC comments</b>	

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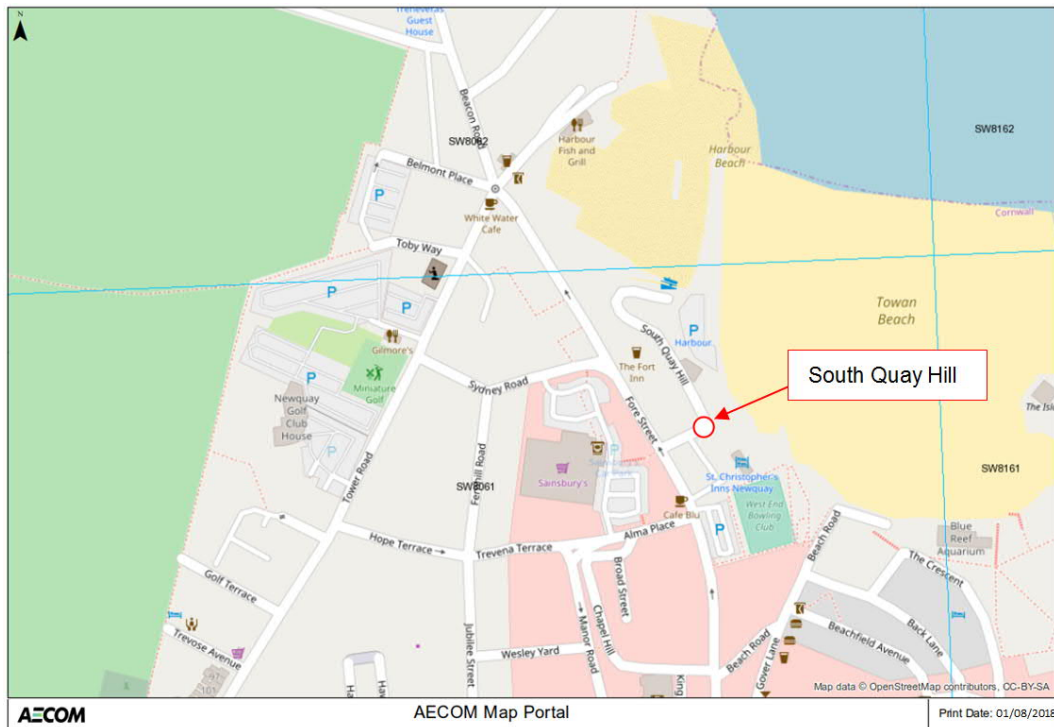
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# 1 Introduction

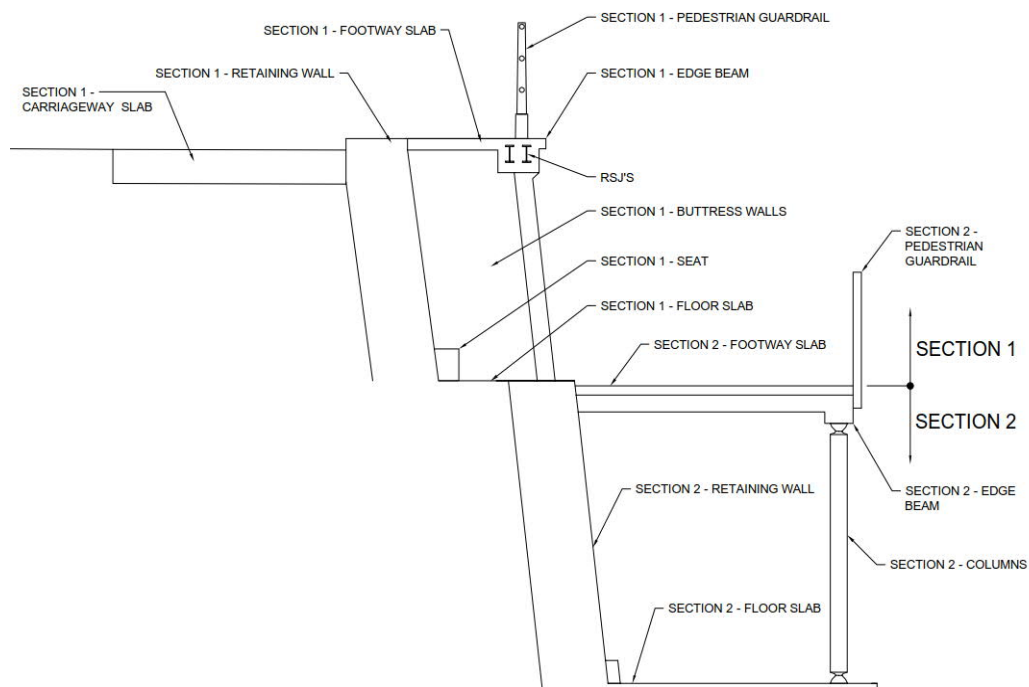
AECOM was commissioned by CORMAC to undertake an Inspection for Assessment (IfA), and subsequent structural assessment of South Quay Hill Shelters. South Quay Hill Shelters (SQHS) is a three-levelled structure which provides seating areas on the middle and lower levels, where views of Newquay Harbour can be enjoyed by members of the public. Refer to Appendix A for details.

South Quay Hill Shelters are located below South Quay Hill road U6091, in Newquay, Cornwall, with the nearest postcode TR7 1HR, OS Ref: SW 80817 61883. The location of the structure is shown below.



**Location plan of structure**

An annotated cross section of the existing structure is shown below:



This technical note primarily relates to Section 1 of the structure only, comprising the carriageway slab, upper retaining wall, footway slab, edge beam, guardrail and buttress walls. All elements of the structure beneath section 1 are considered to act as support foundations for section 1 for the purposes of assessment and design works.

The IfA and assessment found that the footway slab and edge beams of SQHS were in poor and deteriorating condition and did not comply with safety standards in the event of an errant vehicle colliding with the guardrail whilst negotiating the bend at the top of South Quay Hill. Without intervention there is the likelihood of significant structural damage and urgent maintenance being required, and the increasing risk to the public of spalling concrete and vehicle incursion through the sub-standard restraint system. It is therefore recommended that the existing edge beam and footway slab be upgraded to current standards for durability and strength, and to achieve this, these elements of SQHS should be replaced. This technical note summarises the investigation and assessment carried out to date and proposes options for the design of a new footway slab and edge beam, as well as a vehicle restraint system and pedestrian guardrail. The design options for these remedial works are covered in Section 2 of this technical note.

## 1.1 Inspection for Assessment

The results of the structural inspection and intrusive works can be found in the Inspection Report (document no. 60571547/0084/002).

### Section 1

The Inspection Report indicates large areas of hollow and cracked concrete to the existing edge beams, which comprise of rolled steel joists (RSJs) encased in concrete. The report also indicates spalling to the soffit of the existing footway slab over the shelters. These defects have occurred from expansive corrosion of the steel reinforcement, due to the particularly saline nature of the environment in Newquay and insufficient concrete cover protection provided to the steel reinforcement.

The report indicates a horizontal hairline crack near the top of the buttress and retaining walls, that runs the entire length of the structure. There is thought to be a construction joint between the mass concrete retaining wall and the carriageway slab at the location of the crack, which would explain its linear nature. There also appears to be no relative horizontal movement between the parts of the structure above and below the crack, and it is therefore thought that the crack has not arisen as a result of overstressing of structural elements. It is most likely therefore, that the crack has formed due to differential thermal expansion between the carriageway slab and the retaining wall.

### Section 2

The lower structure also has some minor defects that are noted in the Inspection Report. Most notably, there are two horizontal cracks in the edge beam, with hollow areas directly above the cracks. These cracks are most probably a result of corrosive expansion of steel in the edge beam. There is also a hairline crack that runs the length of the south buttress and wing wall. These cracks are most probably a result of differential thermal expansion between the walls and the slab above. None of the defect are thought to affect the integrity or stability of the section 1 (upper tier) structure.

## Results of Preliminary Assessment

A preliminary assessment has been carried out on the existing buttress walls and retaining wall in accordance with BS EN 1996-1-1:2005+A2:2012 (Eurocode 6 – Design of masonry structures) and BS EN 1992-1-1:2004+A1:2014 (Eurocode 2 – Design of concrete structures) for member resistances. A preliminary assessment has also been carried out on the RSJs in accordance with BS EN 1993-1-1:2005+A1:2014 (Eurocode 3 – Design of steel structures) for member resistances. The assessment loads have been calculated in accordance with BS EN 1991-2:2003 (Actions on structures – Traffic loads on bridges) and its UK National Annex.

It should be noted that assessments have been referred to as ‘preliminary’ whilst assessment methodology is subject to acceptance of an Approval in Principle (AIP) for SQHS, however all assessment and design work will subsequently be certified upon the endorsement of the AIP.

The shelters have been assessed for the combined effects of vehicle loading on the footway acting vertically, and errant vehicle collision loading with earth pressure acting horizontally on the retaining wall and edge beam. Global stability against overturning and sliding has been assessed, and also the load capacity of the various components of the shelters, including the retaining wall of section 1 which appears to form part the foundation for the upper structure, as it lies beneath the floor of the upper shelters and the buttress walls.

The assessment for the buttresses, retaining walls and RSJs have been carried out for the loading resulting from the various options that are outlined in Section 2 of this technical note.

As confirmed by the IfA, there was no evidence of structural distress to any part of the SQHS, therefore, due to the lack of as-built records, particularly of its hidden foundations and floor details, it was assumed that the foundations of section 2 of the structure are adequate for the options considered in this technical note. It is also assumed that section 1 of the structure acts independently from section 2, which are considered to be a pragmatic approach given the lack of as-built information. Whilst this assumption cannot easily be proven, without significant intrusive trial pitting excavation to prove the structure at its middle level, it is a judgement based on the layout of section 1 and section 2 and observed condition. For the purposes of calculating the stability of SQHS under the combined applied load effects above, a point of rotation is assumed at the front edge of the middle level floor slab, with the upper elements of the structure (retaining walls, buttresses, footway and carriageway slab) acting as a single unit. Further detail of the assessment methodology is contained within the AIP for assessment and design.

The assessment results indicate that the structure considered has suitable stability to resist overturning and sliding effects for a 100kN horizontal load applied at the height of the existing footway perpendicular to the pedestrian guardrail. However, the structure does not have suitable stability to resist overturning effects resulting from a 200kN horizontal load applied in the same position as described above. These horizontal loads correspond with Class A and Class B (normal containment for flexible, and normal containment for rigid parapets respectively) in accordance with NA to BS EN 1991-2:2003, Table NA.6. In carrying out this assessment for overall stability, it has been necessary to include the stabilising effect of the road slab acting together with the footway slab, retaining walls and buttresses. Without this structure element, the assessment fails assessment for collision loading.

As a result of the horizontal and overturning load limitation of section 1 of the structure, it would be logical to limit the design of the new structural elements so that individual structural elements become overstressed or fail prior to the whole structure reaching its stability limitation.

The assessment has indicated that the RSJs have inadequate bending resistance to accommodate bending effects from accidental vehicle loading. The beams have a utilisation factor (Load effect/member resistance) of 1.21. This assessment assumed the beams to be BSB8 6x3 beams with a yield strength of 230N/mm<sup>2</sup>.

The lower retaining wall of section 2, that supports (or partially supports) section 1 of the structure and carriageway slab, has been assessed for coexisting vertical and horizontal accidental loads. The assessment results indicate that the peak bearing stresses in the retaining wall are 1.69N/mm<sup>2</sup>, which is lower than the allowable stress of 3.63N/mm<sup>2</sup>. The allowable stress was derived by applying a factor of safety of 3 to the compressive strength of 10.9N/mm<sup>2</sup> obtained from core test results for the blockwork wall.

The assessment results also indicate that the carriageway slab does not have adequate resistance against the loads effects from the 100kN design horizontal impact load since investigation reveals that it contains virtually no reinforcement. The slab and its connection with the footway slab should therefore be strengthened or replaced to resist this load.

From the above results, it would appear logical and a practical solution to design a strengthening system to accommodate a 100kN horizontal impact load applied at the height of the existing footway perpendicular to the pedestrian guardrail.

## 2 Options for Rehabilitation of South Quay Hill Shelters

The design options outlined below are for a minimum design life of 120 years.

### 2.1 Options for the Footway Slab and Edge Beam

- Option 1A – Replace the existing footway slab and edge beam with a new reinforced concrete footway slab and edge beam, incorporating a 'Trief' safety kerb, using stainless steel reinforcement. This option would require the demolition of the top 80mm approx. of the buttresses and retaining walls, as the new slab would be designed for accidental wheel loading and so would have to be 200mm thick, i.e. thicker than the existing slab. The new slab will be dowelled into the retaining wall and road slab to provide lateral stability to the slab under horizontal forces, and continuity with the buttress and retaining walls. Stainless steel reinforcement would provide maintenance and durability benefits, as there will be limited risk of future concrete delamination as a result of expansive corrosion from the reinforcement. It also enables a reduction in concrete cover to the slab and hence a lighter-weight design. Further information on this option is displayed in figure 1 below.

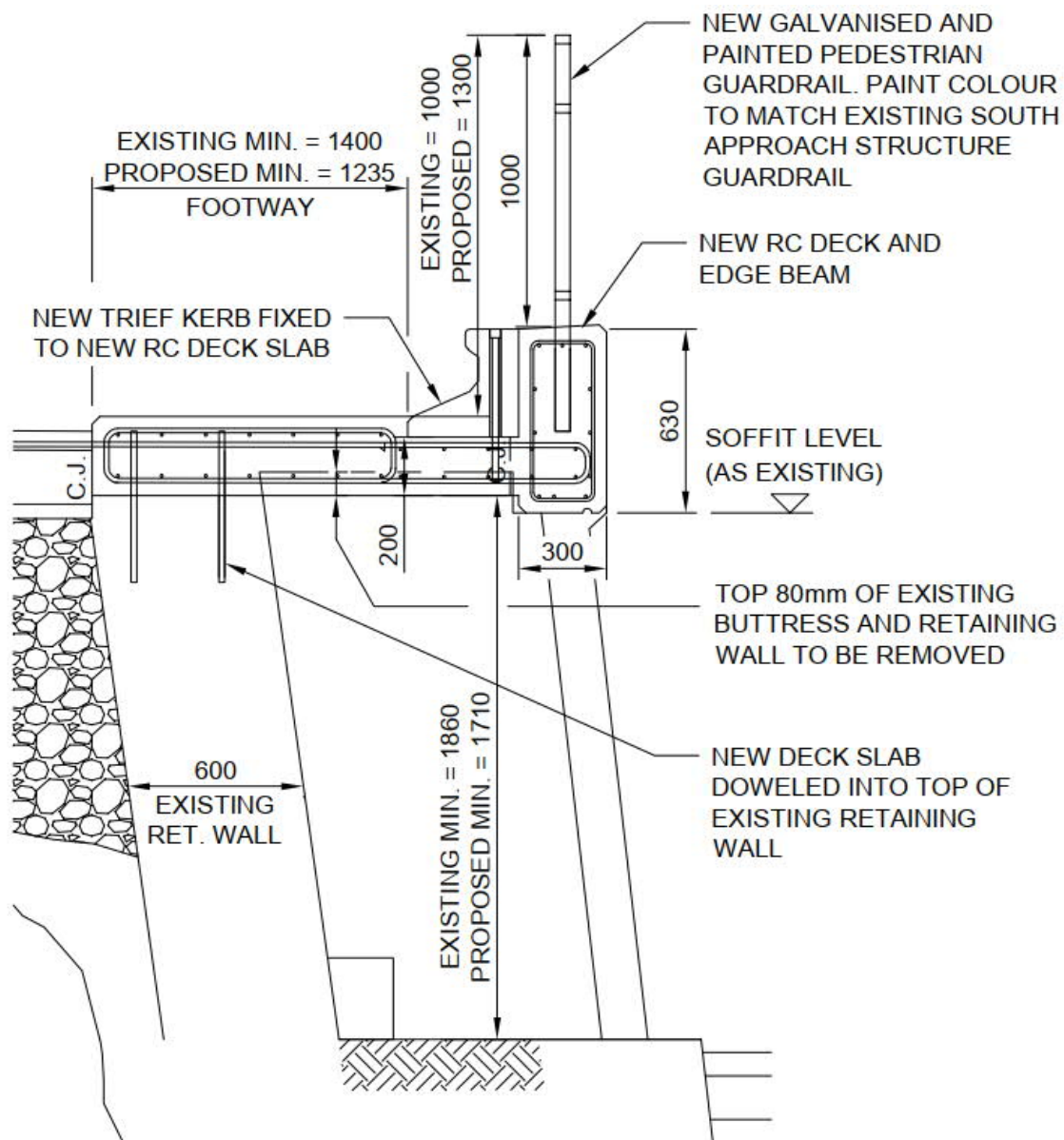


Figure 1: Option 1A -Stainless Steel Reinforced Concrete Deck and Edge Beam



- Option 1B – Replace the existing footway slab and edge beam as in Option 1A above but use carbon steel reinforcement instead of stainless steel reinforcement. This option would require an additional 20mm approx. (100mm approx. total) removal of the buttresses and retaining wall to accommodate the increased slab depth due to minimum cover requirements. Although this option may have a lower construction cost than Option 1A, maintenance costs may be incurred because of the lower durability of carbon steel in comparison with stainless steel in harsh marine environments. Further information on this option is displayed in figure 2 below.

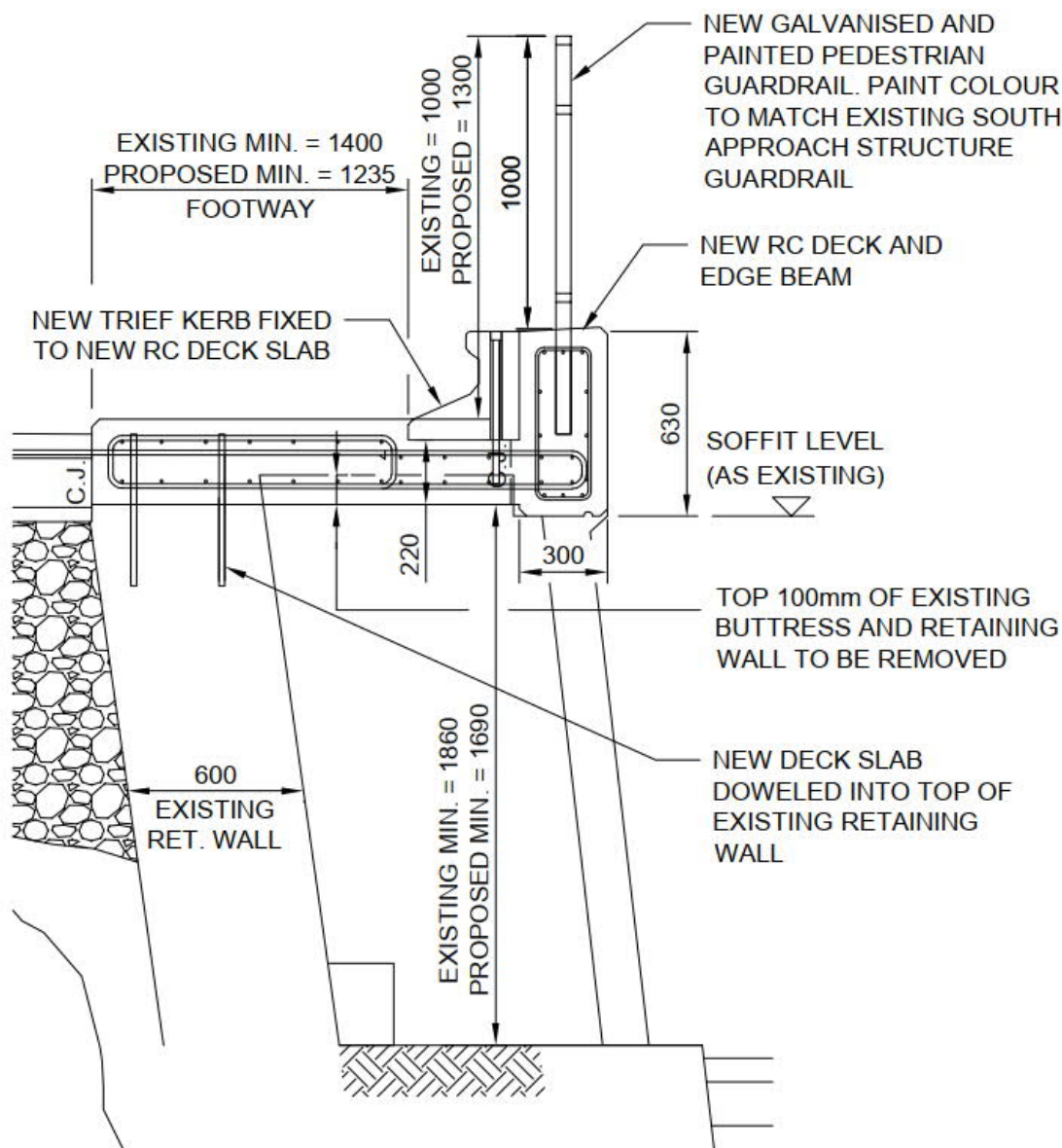


Figure 2: Option 1B - Carbon Steel Reinforced Concrete Deck and Edge Beam

- Option 1C – Replace the existing footway slab as per options 1A and 1B above. Reuse the RSJs or replace with new and encase them in new concrete. The current condition and material properties of the existing RSJs is unknown and has been assumed in assessment. Therefore, further investigation would be required to identify their current condition and obtain higher yield strengths if they were to be reused. Preliminary assessment of the RSJ's suggests that for them to pass assessment the yield strength would need to be  $> 280\text{N/mm}^2$ , however this assumes continuity of the RSJ's over the buttress supports – which is unknown. If they were found to be simply supported which we consider is more likely to be the case (as shorter lengths of beam would have been more manoeuvrable on site), then

the yield strength would need to be considerably higher, which is very unlikely to be achievable. The option of reusing the existing RSJ's is therefore not recommended due to uncertainty surrounding the existing RSJ's strength, condition, long term durability and support conditions. Similarly, the use of new larger cased RSJ's is not currently a favoured method of construction, because of the tendency for casing concrete to crack, and introduce durability defects like those currently exhibited.

## 2.2 Options for the Carriageway Slab

- Option 2A – Replacement of the entire carriageway slab with a new ground bearing reinforced concrete slab that ties into the new footway slab. This option would require a complete closure of South Quay Hill to vehicular traffic for approximately four weeks, since the width required for excavation would be approximately 2.5m in width, meaning that there would only be approximately 2.0m of carriageway width available. This option would have the longest time period of road closure of the options considered. Access to Newquay Harbour would only be possible to pedestrians and cyclists for this option. This option is therefore not recommended. Further information on this option is shown in figure 3 below.

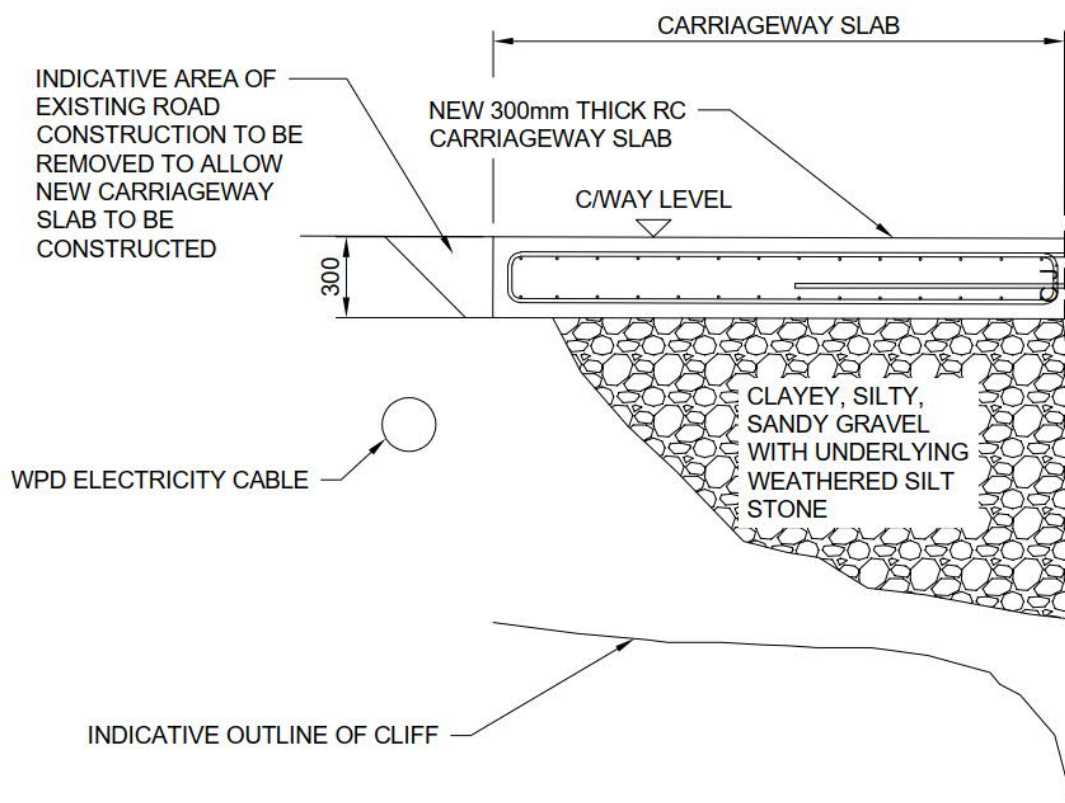


Figure 3: Option 2A - Replacement of Entire Carriageway Slab

- Option 2B – Chase out concrete channels or slots from the carriageway slab perpendicular to the road and insert steel reinforcement at regular intervals along the length of the slab. The reinforcement could either be stainless steel or carbon steel, depending on the option selected from section 2.1. Infill the areas of chased concrete using a rapid setting concrete mortar to minimise disruption to vehicle traffic on South Quay Hill. Apply a hard wearing, textured coating to the entire carriageway slab to improve aesthetics of the strengthened slab. This would also have the added benefit of enhancing skid resistance in wet/icy weather. Chasing of the concrete could be carried out under night-time closures and cover plates could be laid over the slab to allow the road to remain open during the day-time whilst concrete is curing. Further information on this option is shown in figure 4 below.

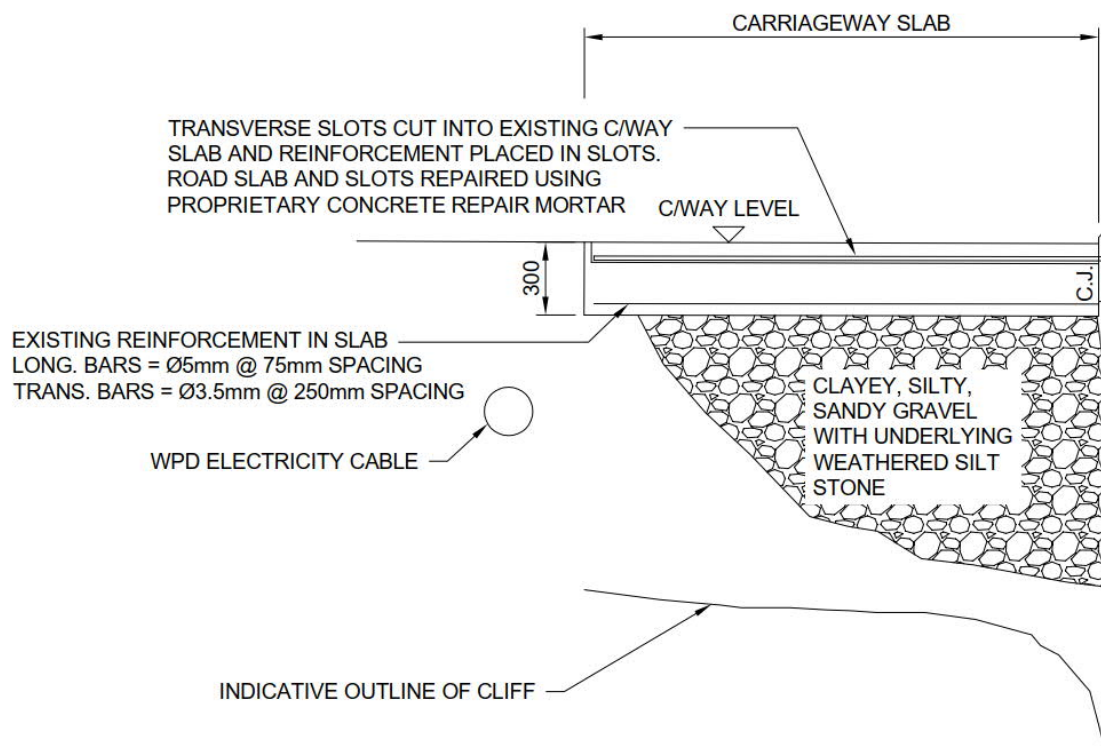


Figure 4: Option 2B - Chasing of Slots in Existing Slab for Reinforcement

- Option 2C – Hydro-demolish the top 150mm of concrete from the existing carriageway slab. Lay a grid of horizontal reinforcement and drill and fix dowel bars to allow a shear connection between the new and existing concrete in the carriageway slab. The horizontal reinforcement is to continue through the retaining wall to the new footway slab. Recast the top 150mm of concrete. This option would require closure of South Quay Hill to vehicle traffic for approximately four weeks, with pedestrian/cyclist access to Newquay Harbour available only during construction works. Further information on this option is displayed in figure 5 below.

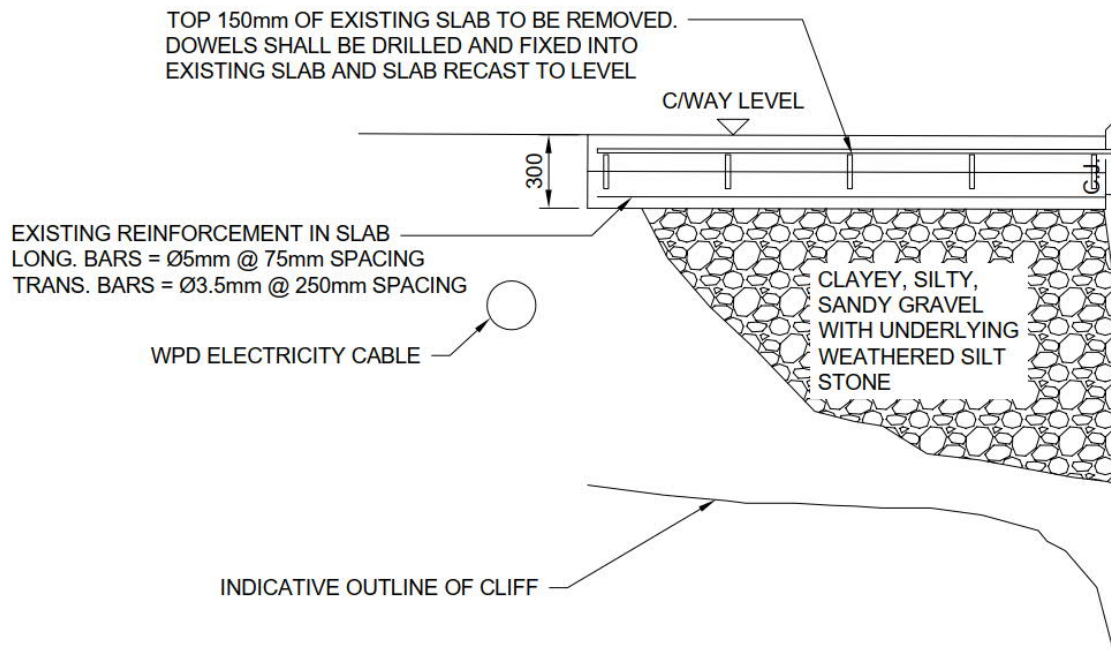


Figure 5: Option 2C – Replacement of top 150mm of existing slab

## 2.3 Discounted Options

- Tying the retaining wall back to the rockhead using soil nails or rock bolts was considered as a method of increasing the stability of the structure against overturning and sliding under errant horizontal vehicle impact loading. This option was rejected due to uncertainty over the rock profile and rock competence beneath the carriageway. If this option was taken forward further ground investigation works would be required, that would be very disruptive to South Quay Hill Road and include heavy and risky civil engineering construction. This option would be a last resort if the preferred proposals were unacceptable.
- The use of precast concrete construction was considered for the works to replace substandard elements of the shelters. Precast construction would still require insitu construction of joints between precast panels and would therefore not offer any significant time saving or cost benefits. In addition to this, traditional methods of insitu concrete construction can easily be undertaken, with support formwork erected on site and supported directly from the section 2 floor beneath. Parts of the existing structure are required to be demolished, and as a result, the geometry on site is quite variable for design geometry, and for this reason, insitu construction methods are more suitable.

### 3 Departures from Standard relating to Design Options

#### 3.1 Vehicle Containment Class Level

The Department for Transport: Design & Maintenance Guidance for Local Authority Roads, October 2011 – Provision of Road Restraint Systems on Local Authority Roads specifies that the default containment class level for a parapet on a highway structure with a speed of less than 50mph is N1 containment. The system of restraint proposed in section 2 provides less than N1, in fact the 100kN impact force corresponds with 50% of N1 for a solid restraint safety kerb, (Class B to BS EN 1991-2-2003) but would comply with N1 for a flexible restraint system (Class A). We have investigated available restraint systems that would provide flexible restraint, but they are designed specifically for highways and are less suitable for an urban environment. Furthermore, a flexible parapet requires space for deflection under impact, but the available space is limited if SQHS is to retain its existing appearance and verge width is not severely compromised.

Given that the South Approach structure adjacent to SQHS was upgraded in 1997 with a 'Trief' concrete safety kerb and pedestrian guardrail system, it would be desirable to provide visual consistency along both South Quay Hill structures by implementing a similar vehicle containment system. As discussed above this system would not conform to an N1 vehicle containment level as it has not been tested to be compliant with BS EN 1317 (Road restraint systems), and therefore a Departure from Standard will be required. Consideration should be given to carrying out a Road Safety Audit to assess whether additional control measures should be implemented, however we consider that this approach is acceptable, given the very low vehicle speed likely to exist at this location.

#### 3.2 Kerb Height

The kerb height between the carriageway and footway has been measured to vary from 38mm to 60mm from dimensions recorded during a survey undertaken on 24/07/2018. The Design Manual for Roads and Bridges: TA 57/87 – Roadside Features recommends that kerbs should have an upstand of preferably 75mm to 100mm. However, due to the height of the approach kerbs (approx. 30mm on the south approach and 60mm on the north approach), it is not possible to achieve a kerb height of 75mm. The new kerb height will match the profile for the existing approach kerbs, therefore this constitutes a Departure from Standard.

It is thought that a possible reason why the kerb height is lower than standard is to facilitate extra turning space sometimes needed by vehicles towing boat trailers etc. Following discussion with Cormac it was agreed that the existing kerb height is to remain, but that the new slab shall have a 25mm chamfer to its edge.

## 4 Recommended Option

Option 1A – Replace the existing footway slab and edge beam with a new reinforced concrete footway slab and edge beam, incorporating a 'Trief' safety kerb, using stainless steel reinforcement. This would be combined with Option 2B – Chase out concrete channels or slots from the carriageway slab perpendicular to the road and insert steel reinforcement at regular intervals along the length of the slab.

These are the recommended options for upgrading of South Quay Hill Shelters, to accommodate vehicle accidental loads applied vertically and horizontally in accordance with current standards. Upgrading could be carried out along with rehabilitation measures generally (to be further defined). These proposals (refer to Figure 6 overleaf) consist of reconstructing the edge beam and footway slab to accommodate a new vehicle restraint system comprising a concrete safety kerb and painted steel parapet fence to match the South Approach structure in appearance. The road slab is strengthened by the introduction of reinforcement and dowels into the retaining wall, to provide a monolithic structure. It should be noted that the footway width will be reduced slightly from 1400mm to approximately 1235mm minimum. However, this width is greater than the widths of the footway at the north and south approaches to the structure.

Footway slab option 1A offers the best long-term durability of the options for the footway slab and edge beam replacement, as the option offers minimal future maintenance because of the use of stainless steel reinforcement. Therefore, although the construction cost may be slightly higher using stainless steel in comparison with carbon steel, the whole life costs would be reduced. In addition to this, the concrete slab reinforced with stainless steel would offer a thinner slab, thereby reducing the dead load acting on the foundations of the shelters.

Construction of carriageway slab option 2B will cause much less disruption to the users of the South Quay Hill Road as the road can remain open during the day. This option also minimises the amount of concrete removal thereby reducing the overall duration of the works.

Although there are departures from standards relating to vehicle restraint standard, kerb height and footway width, the proposals should offer a significant reduction in errant vehicle incursion risk and future maintenance liability, given that the existing deck structure is highly sub-standard and in poor condition.

In addition to these works, the cracks within the existing retaining wall and pilasters at either end of the structure are to be repaired.

It is suggested that the existing reinforced concrete deck is removed using a concrete muncher and the existing RSJ's within the edge beam cut into sections and disposed of. The demolition works would take approximately 2 shifts to complete. The total duration of the construction works is estimated to be 4 weeks.

## 5 Additional Recommendations

A topographical survey should be carried out at the construction stage to obtain the precise on-site dimensions of the structure, which will then be used to confirm the dimensions given to the fabricator for the design of a bespoke pedestrian handrail system.

A thin-layer combined waterproofing and surfacing system should be applied to the carriageway and footway slabs. The system should be on the approved products list for either of the British Board of Agrément (BBA) or the Highways Authority Product Approval Scheme (HAPAS). Involvement with the contractor should take place during the detailed design phase to ensure that the thickness of surfacing required can be achieved based on the levels of the roadway and footway and the approaches to the structure. The detailing should ensure that the existing levels are maintained.

Detailed design should look to identify whether the public waste bin and telescope, which are currently placed adjacent to the shelter parapets, are moved to a more suitable new location, or incorporated into the new design in such a way that they would not further reduce the width of the footway, nor affect the level of vehicle containment provided by the 'Trief' kerbs.



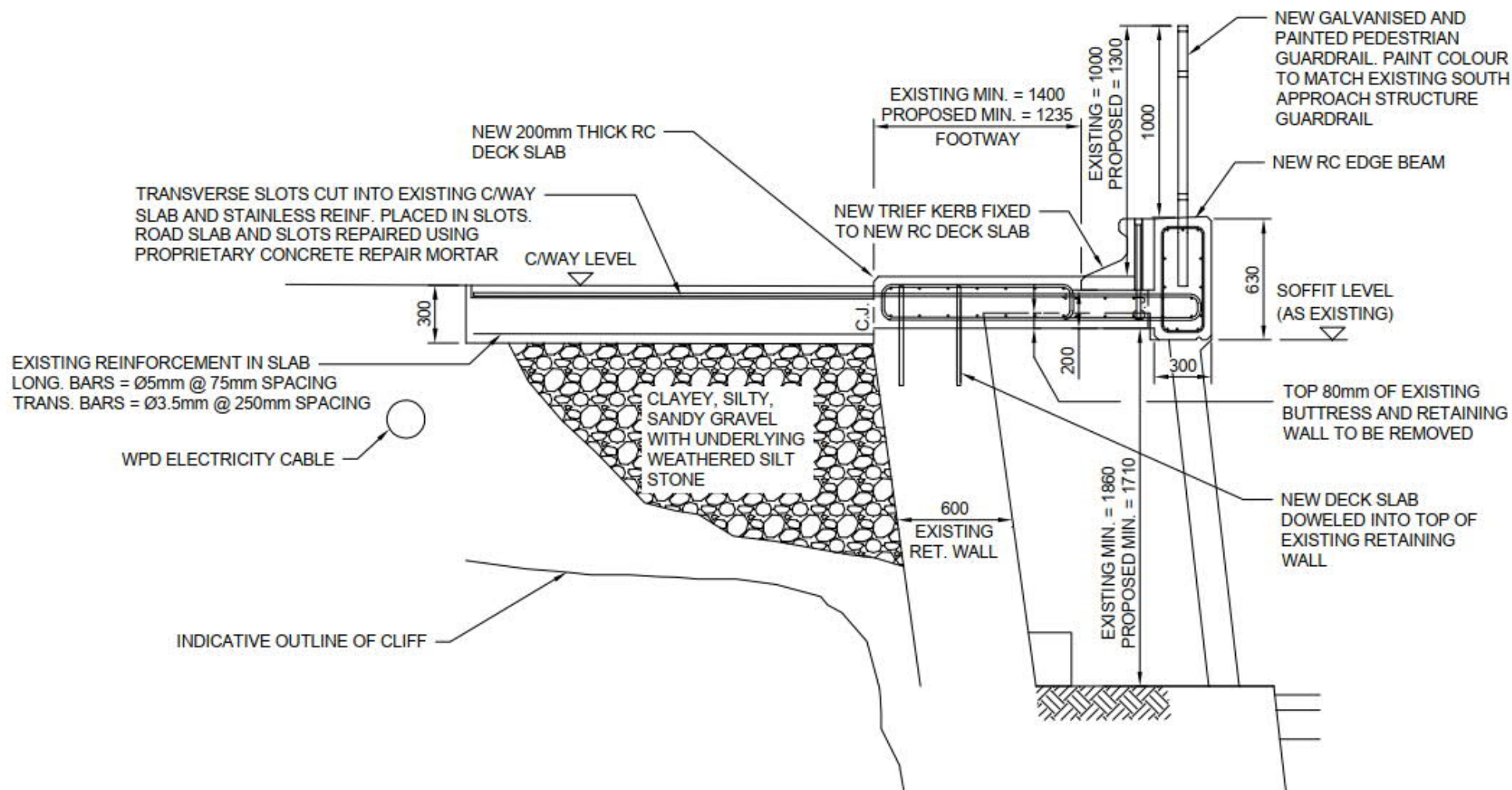


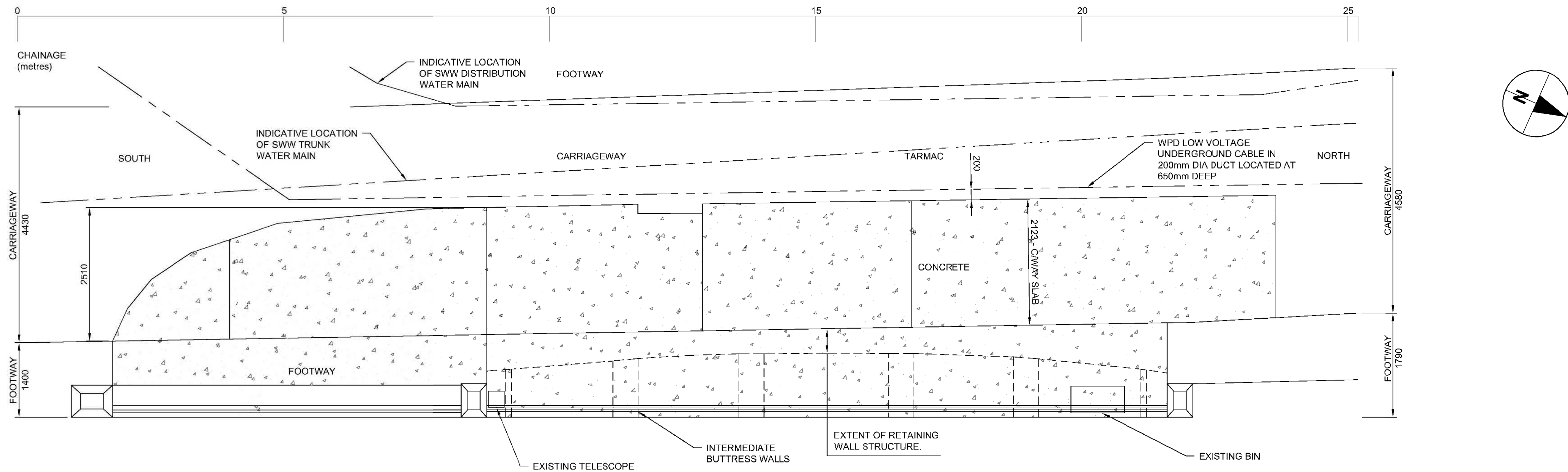
Figure 6: Recommended Option



## Appendix A – Existing General Arrangement

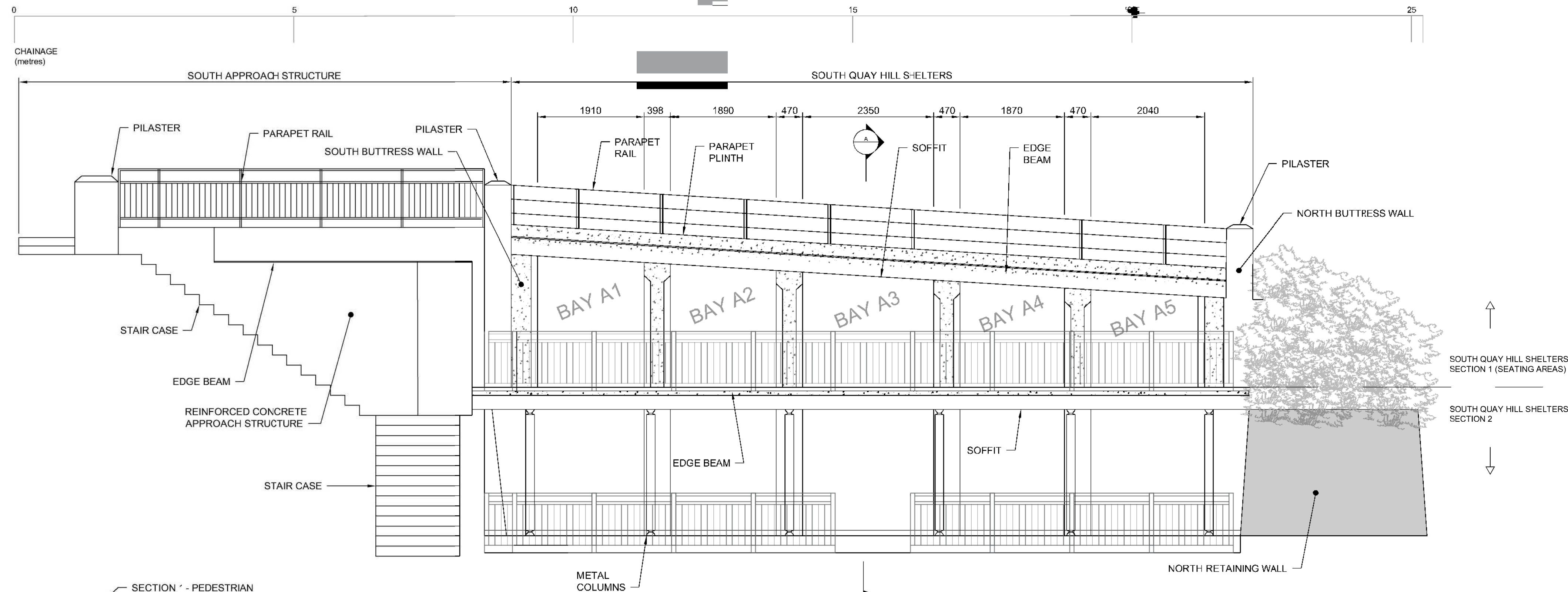
NOTES:

1. All dimensions are in millimetres unless otherwise stated.
2. Do not scale from this drawing.
3. Wall dimensions and defects were determined during an inspection undertaken on 24/07/2018.
4. The retaining walls in Section 1 and 2 had recently been painted which may have covered defects.



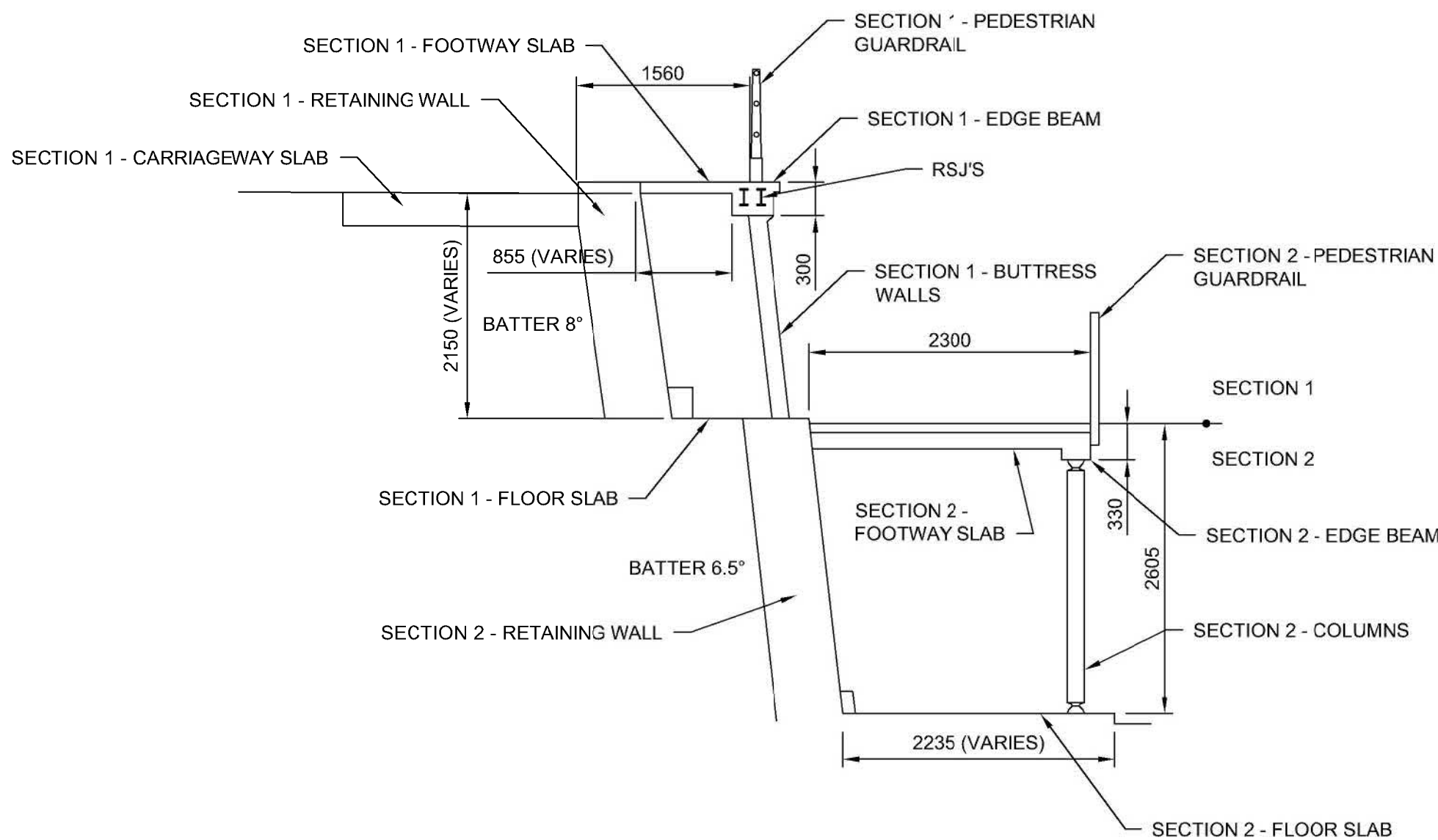
PLAN ON STRUCTURE

SCALE 1:50



ELEVATION

SCALE 1:50



SECTION A-A

SCALE 1:50

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REV	DATE	NATURE OF REVISION			
REVISIONS					
 CORNWALL COUNCIL					
Prepared by <b>AECOM</b> working in partnership with <b>CORMAC SOLUTIONS</b>					
PROJECT TITLE: SOUTH QUAY HILL SHELTERS					
DRAWING TITLE: EXISTING GENERAL ARRANGEMENT					
SCALE: As Shown @ A1					
PROJECT MANAGER: RW			DRAWN BY: SJF		
CHECKED: TM	DATE: 14/08/19	APPROVED:		DATE:	
DRAWING NO: PROJECT: CN1701220 - ACM - SRW - SW080619 - TYPE: DR - S - 0009					
PROJECT REF:	DRAWING STATUS:	SUITABILITY:	REVISION:		
CN1701220	INFORMATION	S2	P01		

## Appendix B – Designers Risk Assessment

AECOM

Concept Design - SiD Assessment

AECOM Project Name

South Quay Shelters

AECOM Project No

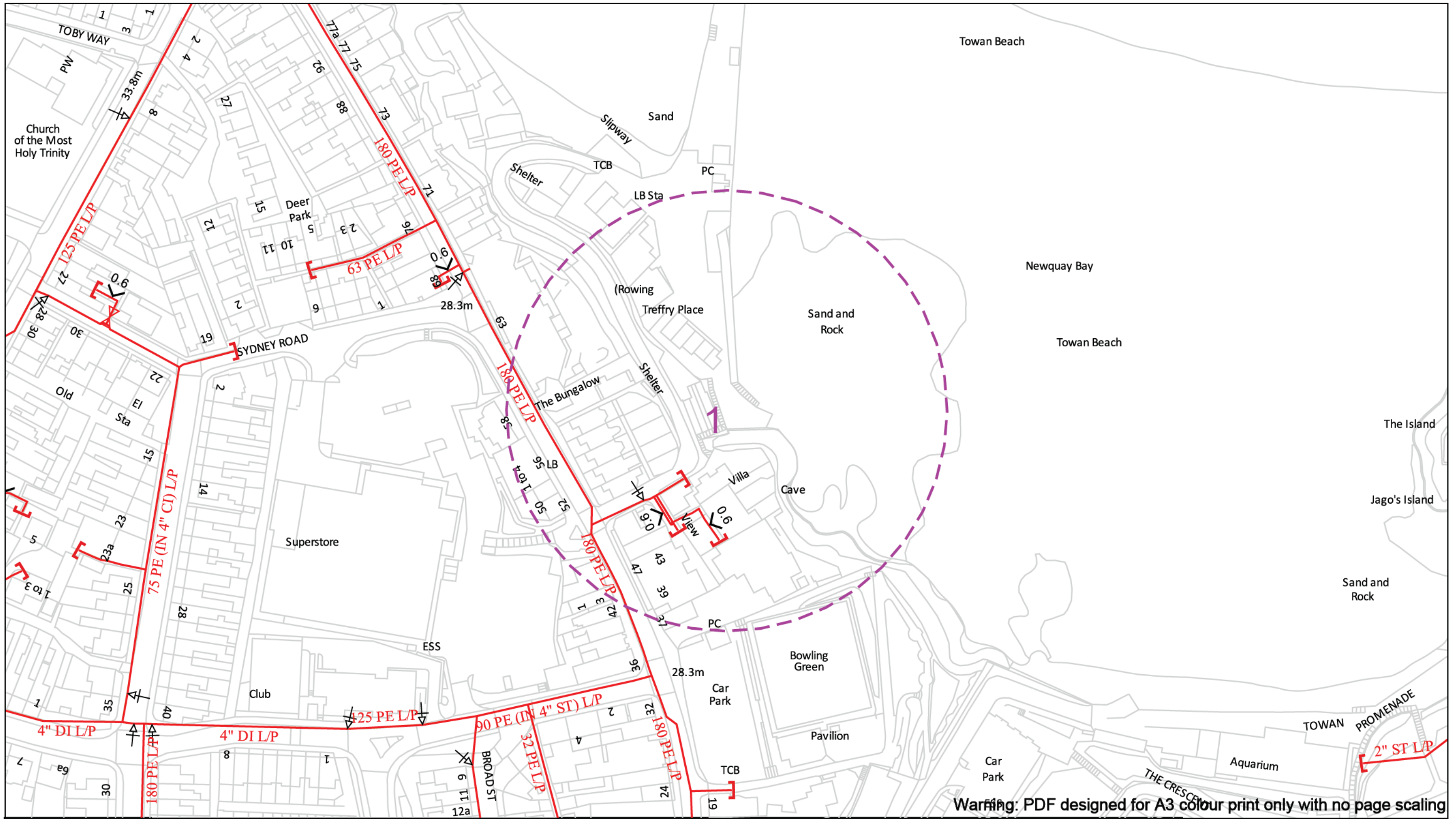
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Risk Rating (Probability x Severity)	Probability	Severity				
		5 - Catastrophic	4 - Critical	3 - Major	2 - Moderate	1 - Minor
1 to 4 (Low)	5 - Frequent	25	20	15	10	5
5 to 9 (Medium)	4 - Probable	20	16	12	8	4
10 to 25 (High)	3 - Occasional	15	12	9	6	3
	2 - Remote	10	8	6	4	2
	1 - Improbable	5	4	3	2	1

Hazard and Risk Identification						Pre-mitigation assessment			Mitigation	Post-mitigation assessment					Output				
Item No.	Feature, element, structures, process or activity considered	Client's or other H&S Information used	Significant Design Hazards Identified	Design Risks Identified	Environment/Persons at Risk?	Severity	Probability	Risk Factor	Design Input Control to Eliminate or Reduce Hazard and/or Reduce Risk	Has Selected Control created a new Hazard? (Y/N)*	Severity	Probability	Risk Factor		Output Residual Hazard to Residual Hazard Log	Output Residual Risk to Residual Hazard Log	Ownership	Output Residual Design Hazard Feedback Location	Closeout date for Output
1	Demolition/Construction Works - construction materials	Contractors Risk Assessment & Method Statement	Exposure to hazardous dust.	Adverse effect on health and quality of life	Contractors' workforce, members of the public	3	5	15	RAMS, PPE (dust masks), damping down of surfaces on site, works producing large levels of dust to be carried out during periods where presence of members of the public is minimised.	NO	1	5	5						
2	Construction Works - construction materials	Hot works permit, Contractors Risk Assessment & Method Statement	Use of hot bitumounous materials for repairs to road surface	Severe burns as a result of mishandling hot bitumounous materials	Contractors' workforce	4	2	8	RAMS, PPE (gloves, aproprate boots and overalls).	NO	1	1	1						
3	Construction Works - public road users	Contractors Risk Assessment & Method Statement	Conflict of construction works with public road users	Damage to contractors' property, risk of death or severe injury from vehicles entering the construction site, damage to public property, damage to road users' vehicles	Contractors' workforce, contractors' property, public vehicles, members of the public	4	5	20	Temporary road restraint such as varriogaurd to be installed adjacent to footway to give adequate protection to the workforce. Appropriate Traffic Management (TM) to communicate hazard to road users. Public to be notified in advance of commencement of works.	NO	4	1	4						
4		Contractors Risk Assessment & Method Statement, Control of Noise at Work Regulations 2005	Noise levels on site exceeding Lowest Observed Adverse Effect Level (LOAEL). Communication difficulties on site resulting from excessive noise levels	Adverse effect on health and quality of life, nuisance	Contractors' workforce, local residents and other members of the public	2	5	10	PPE (hearing protection). Implement noise exclusion zones to surrounding site area during periods of high noise levels. Works producing high noise levels to be terminated by 10:00pm.	NO	1	5	5						
5		Contractors Risk Assessment & Method Statement, Control of Vibration at Work Regulations 2005	Exposure to excessive vibration when using manually operated construction machinery	Hand-arm Vibration Syndrome (HAVS)/ White finger. Potential disablement resulting in adverse effect on health and quality of life	Contractors' workforce	4	4	16	Ensure use of operators with proper training to operate machinery. Rotate workforce to control exposure time to vibration.	NO	4	2	8						
6	Construction Works - construction materials	Contractors Risk Assessment & Method Statement, Control of Asbestos Regulations 2012, Client Information provided to Designer	Potential exposure to airborne asbestos	Adverse effect on health and quality of life	Contractors' workforce, members of the public	4	2	8	Information from client has been consulted and no asbestos is expected to be found during site works. Should an unidentified material be uncovered on site, the contractor must stop works immediately and the appropriate measures undertaken in order to confirm if the material is abestos containing. Contractor to have an Asbestos Management Plan prior to commencing works.	NO	4	1	4						
7	Demolition/Construction Works - working at night	Contractors Risk Assessment & Method Statement	Poor visibility leading to increased likelihood to slips, trips and falls from site hazards	Death or risk of serious injury resulting from fa ling from height. Death or risk of serious injury resulting from trips whilst operating construction equipment. Serious injury leading to adverse effect on health and quality of life	Contractors' workforce	5	5	25	Contractor to ensure that appropriate lighting is provided where working at night will occur. A site briefing will be carried out before night works commence to ensure contractors' workforce are aware of potential slip, trip and fail hazards at South Quay Hill Shelters.	NO	5	2	10						
8	Construction Works - public access to South Quay Shelters	Contractors Risk Assessment & Method Statement, The Health and Safety (Safety Signs and Signals) Regulations 1996	Unauthorised access to construction site from members of the public	Death or risk of serious injury resulting from fa ling from height. Damage to contractors' property. Theft of contractors' property	Members of the public, contractors' workforce	5	3	15	Site boundary to be made clear to members of the public and appropriate prohibitory signs should be put in place. Site materials and equipment to be securely stored.	NO	5	1	5						
9	Demolition/Construction Works - falling construction materials/debris	Contractors Risk Assessment & Method Statement	Construction materials/ debris falling during demolition/construction works	Death or risk of serious injury. Serious injury leading to adverse effect on health and quality of life	Members of the public, contractors' workforce	5	4	20	PPE (Safety helmets). Edge protection such as toe boards shall be used to prevent material and other objects from falling during works.	NO	3	2	6						
10	Operational - footway width	Construction Drawings, Site Survey	Footway width reduced from existing by design	Risk of vehicles mounting the kerb and entering the footway, or pedestrians entering carriageway. Death or serious injury to pedestrians	Pedestrians, road users	3	3	9	Footway is still wider than the adjacent South Approach and north retaining walls	NO	3	3	9						
11	Operational - vehicle skidding	N/A	Vehicle skidding may occur if the carrigeway slab has insufficient skid resistance	Risk of vehicles mounting the kerb and entering the footway. Damage to trrief kerb and pedestrian gura드릴 from vehicle collision. Death or serious injury to pedestrians	Pedestrians, road users, Cornwall Council property	3	3	9	Provide a layer of mortar skim over the carriageway slab to increase skid resistance.	NO	2	1	2						
12	Operational - kerb height	Construction Drawings, Site Survey	Low kerb upstand height between carriageway and adjacent east footway	Risk of vehicles mounting the kerb and entering the footway. Damage to trrief kerb and pedestrian guardrail from vehicle collision. Death or serious injury	Pedestrians, road users, Cornwall Council property	3	3	9	Provide a layer of mortar skim over the carriageway slabwhich delineates edge of carriageway.	NO	2	1	2						
13	Design - spalling of concrete	Contractors Risk Assessment & Method Statement, Inspection for assessment drawings	Falling concrete as a result of spalling and delamination due to expansive corrosion of steel	Risk of serious injury	Members of the public	3	2	6	Recommendation to use stainless steel reinforcement to prevent corrosion of reinforcement during design stage.	NO	2	1	2						
14	Design - loading on foundations	No as-built information of foundations is available	Lack of information regarding the foundations	Risk of settlement potentially resulting in structural distress.	Members of the public, Cornwall Council	5	2	10	Site investigation reveals rockhead, assumed that structure is founded on unyielding rock.	NO	5	1	5						
15	Construction Works - existing services	Site Investigation, Correspondence with Utility Companies	Excavation works may need to be carried out adjacent to existing services	Damage to existing services from excavation works	Utility Companies	3	3	9	General Arrangement to include position of known existing services. Contractor to stop works immediately if any unknown services are found during works.	NO	3	1	3						
16	Demolition - Edge Protection	Contractors Risk Assessment & Method Statement	Once the footway slab has been demolished, there will be no edge protection.	Risk of death or severe injury	Members of the public, Contractors' workforce	4	5	20	Temporary edge protection to be erected. Appropriate Traffic Management (TM) to communicate hazard to road users. Public to be notified in advance of commencement of works.	NO	4	2	8						
17	Construction Works - Working from height	Contractors Risk Assessment & Method Statement	Falls from height	Risk of death or severe injury	Contractors' workforce	4	5	20	Temporary edge protection to be erected. Appropriate Traffic Management (TM) to communicate hazard to road users. Public to be notified in advance of commencement of works.	NO	4	2	8						
18	Construction Works - Formwork & Temporary works	Contractors Risk Assessment & Method Statement	Collapse of tenporary works. Collapse of Deck and Edge beam formworks	Risk of death or severe injury	Contractors' workforce, members of the public	4	3	12	Formworks and temporary works to be designed, erected and checked at the required intervals by a competent contractor.	NO	4	1	4						
19	Design - stability of structure against overturning	No as-built information of foundations is available	Unknown foundation arrangement	Assumption that upper structure acts monolithically and would overturn about the toe of the upper buttresses. Risk of overturning if assumption not valid.	Principal Designer, Cornwall Council	5	3	15	Design load case is for an errant vehicle impacting at very low speed. Conservative assessment of structure. TAA to discuss and agree on the foundation assumptions.	NO	5	1	5						

## Appendix C – Statutory Undertaker Drawings





Contact Us  
Mapping Enquiries 02920 278 912  
General Enquiries 0800 912 2999

Date Requested: 04/03/2019  
Job Reference: 14977143  
Site Location: 180657 61764.  
Requested by: [REDACTED]  
Your Scheme/Reference: 60571547-0084

Scale: 1:1250 (When plotted at A3)

- IMPORTANT NOTICES**
- This information is given as a guide only and its accuracy cannot be guaranteed
  - The plan only shows those pipes owned by Wales & West Utilities (WWU) as its role as a licensed Gas Transporter
  - Service pipes, valves, syphons, stub connections etc. may not be shown but their presence should be anticipated
  - You must use safe digging practices in accordance with HS(G)47 to establish the actual position of mains, services and other apparatus before any mechanical excavation is used
  - It is your responsibility to ensure this information is provided to all persons working near our plant
  - If in doubt call the WWU dig team on 02920 278912

**In case of an emergency call 0800 111 999**

100m

**Dig Sites**

Area: [Dashed Purple Line]	Line: [Dashed Purple Line]
[Solid Red Line]	Low Pressure (LP) 21mbar – 75mbar
[Dashed Blue Line]	Medium Pressure (MP) 350mbar – 2bar
[Dashed Green Line]	Intermediate Pressure (IP) 2bar – 7bar
[Dashed Orange Line]	High Pressure (HP) >7bar

[Valve Symbols]

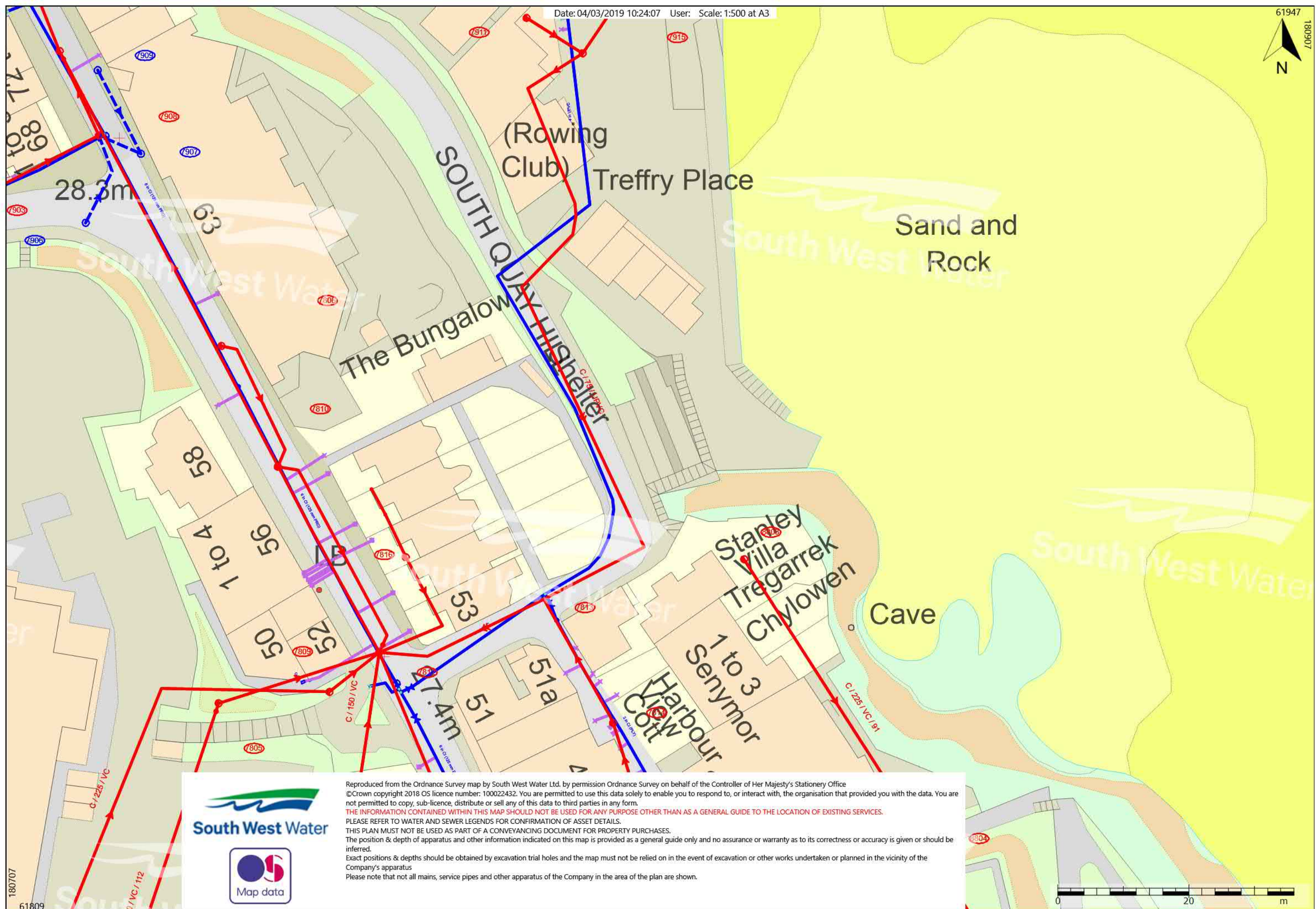
[Symbol]	Line/Fire Valve
[Symbol]	Governor Station
[Symbol]	Change of Diameter
[Symbol]	End Cap
[Symbol]	Depth of cover

**Smell gas?**  
Call the Gas Emergency Service on 0800 111 999.

**Dial before you dig**  
We need 10 days' notice

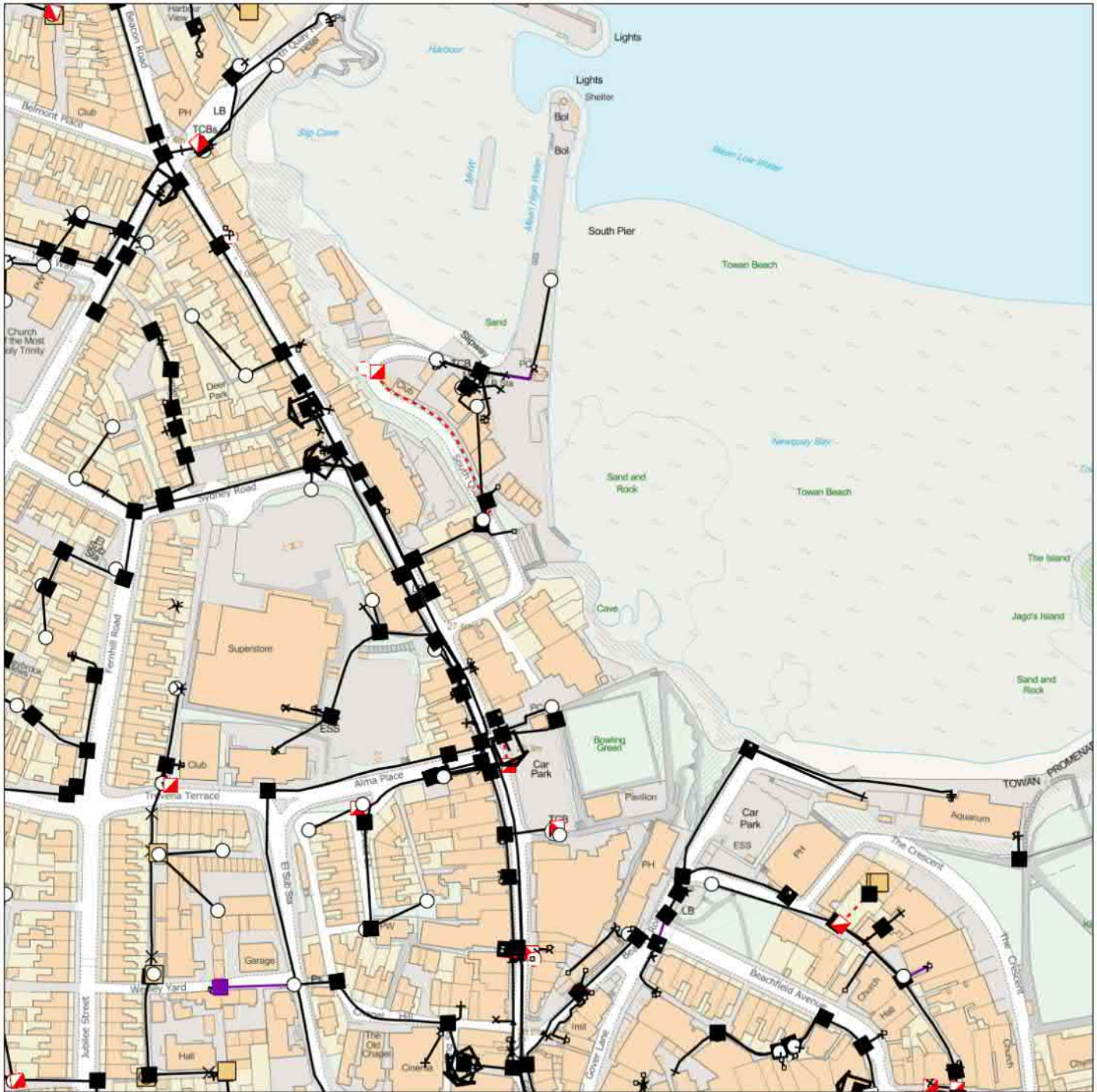
**Go ahead**  
Done your research? Now you can dig safely.







Maps by email Plant Information Reply



## IMPORTANT WARNING

Information regarding the location of BT apparatus is given for your assistance and is intended for general guidance only. No guarantee is given of its accuracy.

It should not be relied upon in the event of excavations or other works being made near to BT apparatus which may exist at various depths and may deviate from the marked route.



openreach

**CLICK BEFORE YOU DIG**


















FOR PROFESSIONAL FREE ON SITE ASSISTANCE PRIOR  
TO COMMENCEMENT OF EXCAVATION WORKS  
INCLUDING LOCATE AND MARKING SERVICE

email [cbyd@openreach.co.uk](mailto:cbyd@openreach.co.uk)








ADVANCE NOTICE REQUIRED  
(Office hours: Monday - Friday 08.00 to 17.00)  
[www.openreach.co.uk/cbyd](http://www.openreach.co.uk/cbyd)

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### KEY TO BT SYMBOLS

KEY TO BT SYMBOLS			Change Of State	+	Hatchings	
	<i>Planned</i>	<i>Live</i>	Split Coupling	×	Built	
PCP			Duct Tee	▲	Planned	
Pole			Building		Inferred	
Box			Kiosk		Duct	
Manhole			<p>Other proposed plant is shown using dashed lines.            BT Symbols not listed above may be disregarded.            Existing BT Plant may not be recorded.            Information valid at time of preparation. Maps are only valid for 90 days after the date of publication.</p>			
Cabinet						

	<i>Pending Add</i>	<i>In Place</i>	<i>Pending Remove</i>	<i>Not In Use</i>
Power Cable				
Power Duct				N/A

BT Ref : VWQ10058J

Map Reference : (centre) SW8081761883

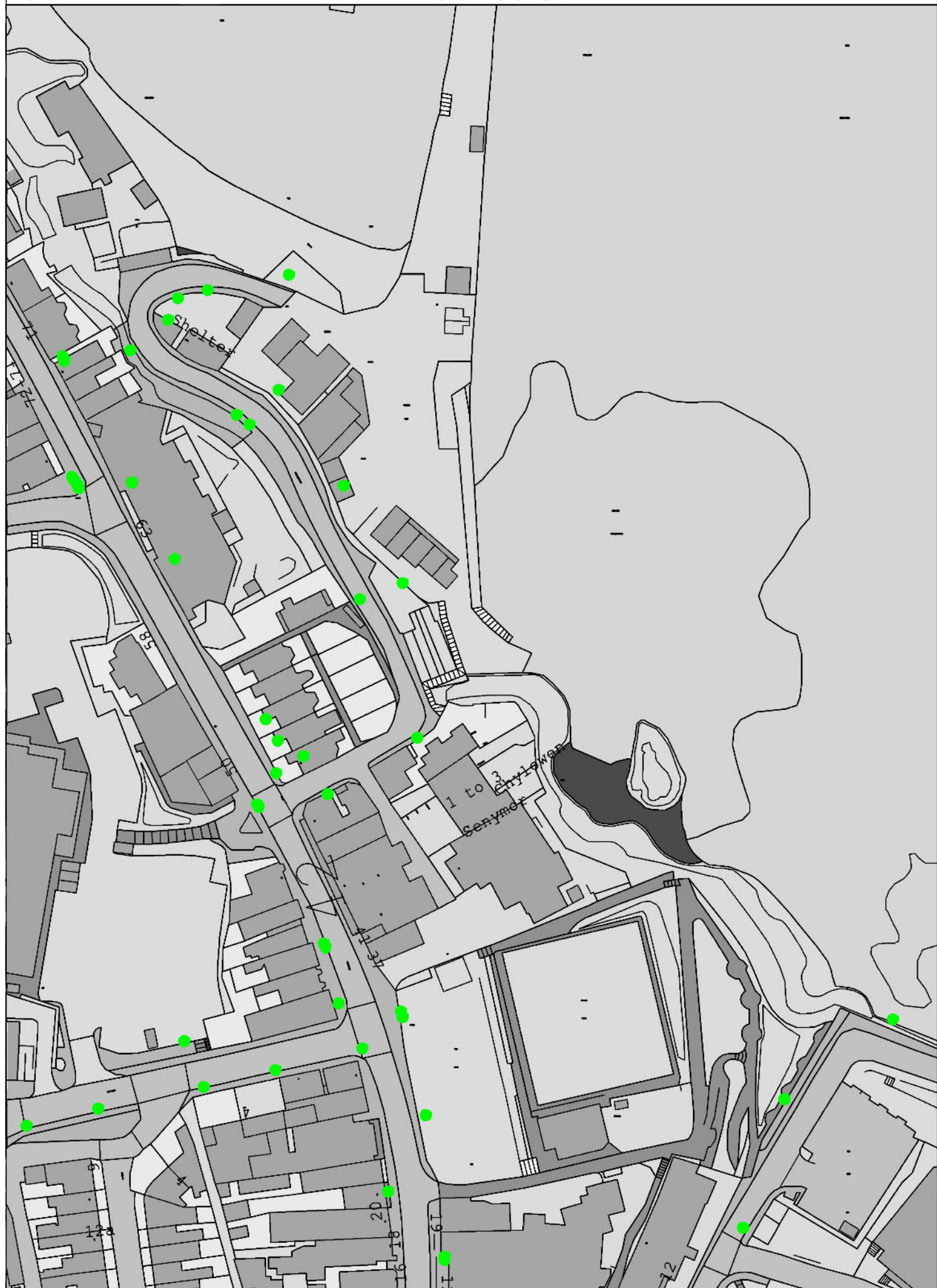
Easting/Northing : (centre) 180817,61883

Issued : 04/03/2019 10:05:14

**WARNING: IF PLANNED WORKS FALL INSIDE HATCHED AREA IT IS ESSENTIAL BEFORE PROCEEDING THAT YOU CONTACT THE NATIONAL NOTICE HANDLING CENTRE. PLEASE SEND E-MAIL TO: [nnhc@openreach.co.uk](mailto:nnhc@openreach.co.uk)**







Scale 1:1200



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## Contact Us

### Mapping Enquiries:

All areas 0121 623 9780

### General Enquiries:

All areas 0800 096 3080

**Report damage immediately – KEEP EVERYONE AWAY FROM THE AREA  
0800 6783 105**

Date Requested: 04/03/2019

Job Reference: 14977143

Site Location: 180815 61883

Requested by: [REDACTED]

Your Scheme/Reference: 60571547-0084

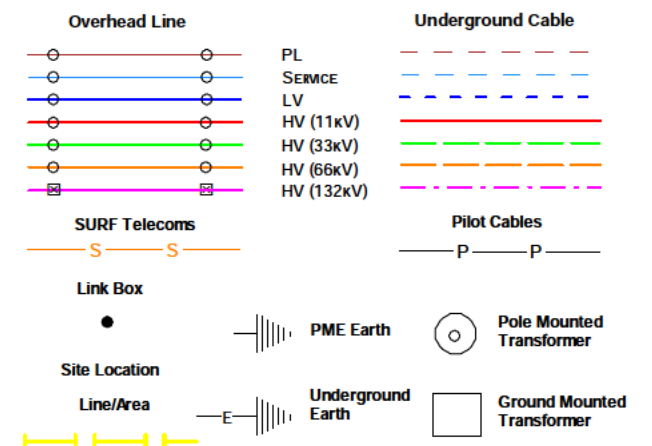
Exact Scales:

1:1250 Area or Circle dig site

1:500 Line dig site

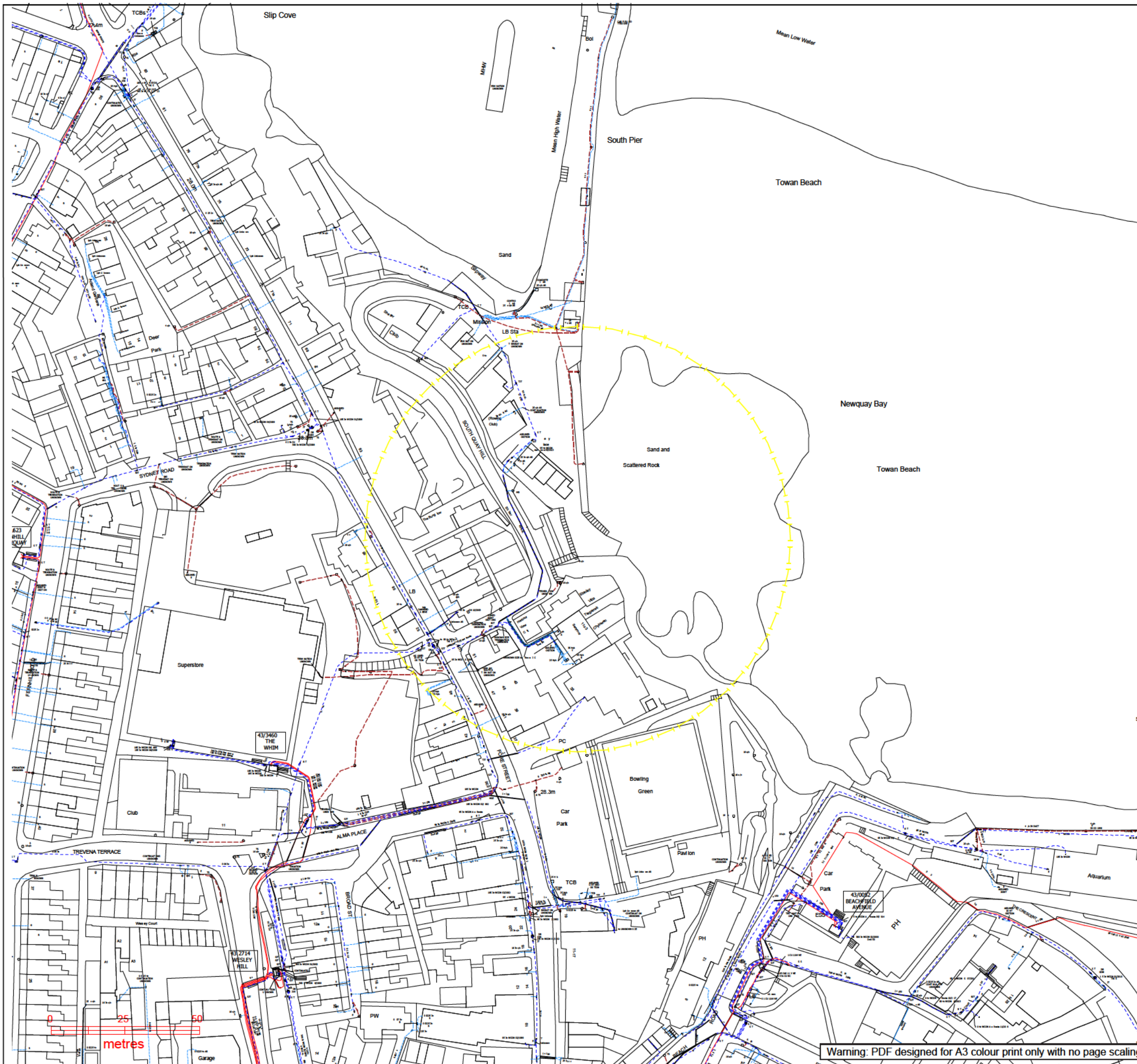
## IMPORTANT NOTICES

- This information is given as a guide only and its accuracy cannot be guaranteed. Services or recent additions to the network may not be shown.
- Cables, overhead lines & substations owned by other electricity network owners or private companies may be present and may not be shown.
- You should always verify exact locations of cables using a cable locator and by careful use of hand tools in accordance with HSE guidance note HSG47.
- When working within 10m of any overhead electric line you should follow the requirements of HSE Guidance Note GS6.
- For further advice on working near our electricity cables or lines, call our Contact Centre on 0800 096 3080.
- Advice should be sought from the Western Power Distribution Contact Centre for any work that is to take place in proximity to 66kV or 132kV underground cables and 66kV 132kV overhead lines – 0800 096 3080



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Warning: PDF designed for A3 colour print only with no page scaling.









Water Colour Codes and Abbreviations

Examples of the abbreviation details above a Water Pipe  
(details will be in the same colour as the pipe itself):

















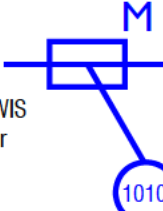








A B  
3 in CI

A: Size  
B: Material Abbreviation






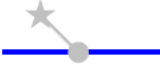

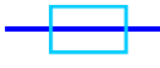
Distribution Main		Untreated Main	
Trunk Main		Private Pipe	
Communication Pipe		Abandoned Main	

Cast Iron	CI	Spun Iron	SI	Ductile Iron	DI	Steel	ST
Asbestos Cement	AC	Plastic	UPVC	High Density/ Medium Density Polyethylene	HDPE MDPE	High Pressure Polyethylene	HPPE

Water Features (shown in common colours)

Washout		Hydrant		Hatchbox		Washout Hydrant	
Air Valve (Single)		Air Valve (Double)		Closed Valve Closing Direction: Anti-Clockwise		Closed Valve Closing Direction: Clockwise	
Pump		Pumping Station Number of Pumps as indicated		Open Valve Opening Direction: Anti-Clockwise		Open Valve Opening Direction: Clockwise	
Customer Meter		EBCO M optional if meter fitted		Non-Return Valve /Reflux		Stoptap	
Mains Meter M=Normal DMA/WIS B=Boundary Meter		Optional Readout if location is different from the meter		Relief Valve		End Cap	
				Inlet / Outlet		Pipe Reducer	
Pressure Reducing Valve		Pressure Sustaining Valve		Abstraction Point		Bore Hole	

Water Pipe Furniture

Anode		Calgon / Aqarite		Chlorination Point		Flushing on a Sluice Valve	
Insert Flow Meter		Excavation Location		Strainer		Ferrule	



# Sewerage Pipe Details

Examples of the abbreviation details above a Sewer Pipe  
(details will be in the same colour as the pipe itself):

A B C D  
Cir / 225 / VC / 82

- A: Shape
- B: Diameter (replaced by width & length on non-circular pipes)
- C: Material
- D: Gradient (1: number shown)

Public - Foul		Highway	
Public - Surface		Abandoned Sewer	
Public - Combined		Pumping Main	
Public - Treated		Elevated Sewer	
Private Sewer		Syphon	
Unverified			


















## Shapes

Circular	Cir	Rectangular	Rec	Barrel	Brl	Trapezodial	Trpz
U Shaped	UShp	Horseshoe	Hsho				

## Materials

Vitrified Clay	VC	Clay (Salt Glaze)	SG	Pre-cast Concrete	PCO	Concrete	CO
Asbestos Cement	AC	Brick	BR	Stone (Masonry)	MAC	Alkathene	AK
Steel	ST	Concrete Box	CB	Glass Reinforced Plastic	GRP	Plastic	PL
Polypropylene	PP	Unplasticised Polyvinylchloride	UPVC	Polyethylene	PE	Polyvinylchloride	PVC
Concrete Segments Bolted	CSB	Pitch Fibre	PF	Concrete Segments Unbolted	CSU	Medium Density Polyethylene	MDPE
Not Known	NK						

Sewerage Structures (shown in common colours)

Manhole Foul / Trade		Manhole Surface		Manhole Private		Manhole Combined	
Soakaway	SK	Washout	WO	Catchpit	CP	Hatchbox	HB
Flushing	FC	Lamphole	 LH	Tank Online	 TN	Tank Offline	TO
Septic Tank	 S	Cesspit	C	Header	 E	Drain	 LD
Reflux Valve	 RV	Sluice Valve		Air Valve	 AV	Venting Pole	VP
Storm Overflow				Undefined Connection			
Outfall				Backdrop			

Sewerage Installations

Pumping Station		Treatment Works	 WWTW
-----------------	---	-----------------	--

Details on Covers

Lockable	k	Gas / Water Tight	t	Bolted	b
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Location

Buried	BL	Unable to Locate	UL
--------	----	---------------------	----