METROLINK

Integrated Transport. Integrated Life.

A5.5 Glasnevin Construction Report

Contents

LIST OF ABBREVIATIONS

BoH	Back of House
Ch.	Chainage
D-wall	Diaphragm wall
GSWR	Great Southern and Western Railway
HGV	Heavy Goods Vehicle
IR	Irish Rail
MGWR	Midland Great Western Railway
OHLE	Overhead Line Equipment
SEB	Signalling building
TBM	Tunnel Boring Machine
TSS	Traction Sub Station
WI	Waterways Ireland

1. Introduction

This Constructability Report has been prepared to describe the sequencing and methodology required to construct the proposed Glasnevin Station situated in the AZ4 area (Northwood to Charlemont).

This report has been prepared based on a construction phase sequencing and methodology developed for Glasnevin by London Bridge Associates.

The Glasnevin Station development is a complex project with key interfaces with other infrastructure stakeholders. The station development includes the construction of the new Glasnevin Station, platforms for two commuter railways - Iarnród Éireann (Irish Rail) Sligo / Maynooth (old MGWR - Midland Great Western Railway) and Newbridge / Hazelhatch (old GSWR - Great Southern and Western Railway), a concourse area to connect all three railways together and dedicated substations for the proposed Glasnevin Station and Iarnród Éireann (Irish Rail).

There is a requirement to modify the track layout and alignment at Glasnevin, which involves lowering a large section of the track by circa 2m and modification to the existing junction. In preparing the construction sequence, a coordinated approach to the track lowering is proposed to avoid closing both railways at the same time for the station construction works. Following consultation with larnród Éireannn (Irish Rail), closure of the MGWR railway for a period of 21 months is proposed, re-opening, and then closure of the GSWR railway for 5 months. The overall sequence of works in the Glasnevin Station area has been linked with planned larnród Éireann (Irish Rail) infrastructure works.

The programme sequence developed in this report incorporates the works proposed by larnród Éireann (Irish Rail) for lowering of the MGWR and GSWR tracks, in order to ensure interfacing and timing of works is optimised to suit both parties. It assumes that OHLE (Overhead Line Equipment) has not been installed, and the lines are not electrified prior to start of MetroLink construction.

2. Location

The location of the proposed Glasnevin Station is shown in Figure 2.1. The station is to be located at the intersection between Royal Canal Way and the R108. The station will be located underground, beneath existing buildings which are to be demolished, and the existing railway cuttings. The underground station is between chainages 14+807 and 14+916 and will be 103.8m in length and 39.20m maximum wide (external).

In Figure 2.1, the dashed red line indicates the approximate outline of the station and the blue rectangles the platforms. The tunnel is shown by the dashed blue lines.

2.1 Construction Sites

The Glasnevin Station construction site will be on the west side of Prospect Road (R108). The construction area is currently occupied by a furniture retailer, a public house and some office accommodation. The site is also intersected by two commuter railways - Iarnród Éireann Sligo / Maynooth (old MGWR - Midland Great Western Railway) and Newbridge / Hazelhatch (old GSWR - Great Southern and Western Railway).

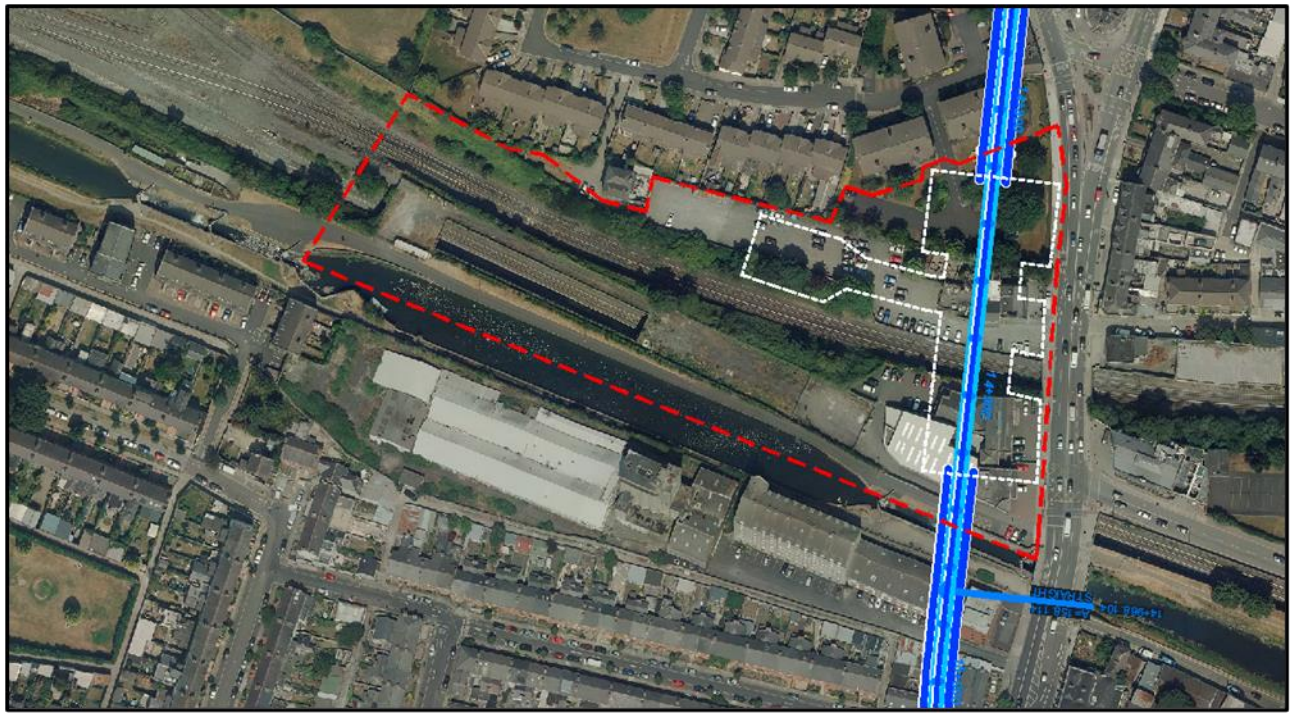


Figure 2.1: Glasnevin Station Location

There are several permanent structures on the site that have been identified as requiring demolition. In addition, as the works are carried out, demolition of existing railway infrastructure including existing tunnels and retaining walls will be undertaken.

The proposed construction site is very constrained and in order to carry out the works, multiple phasing of activities will be required. A small additional site will be required as a lorry holding area.

The signalling building (SEB), Traction Sub Station (TSS) and other buildings associated with the electrification upgrade is incorporate within the MetroLink construction.

2.2 Site Access/Egress

The proposed site entrances will be from Prospect Road (R108) and will be adjusted several times during the phasing of the works. The construction boundary on Prospect Road will occupy most of the existing footpath at the north-east corner of the station box. At the north-west corner the station footprint extends into the adjacent property and the construction boundary will have to be locally amended to suit. Refer to the Scheme Traffic Management Plan (Appendix A9.4 in Volume 5 of this EIAR) for full details of temporary traffic management works.

Traffic coming to site from the north will turn right from Prospect Road (R108) into the site. Most traffic leaving the site will be heading north, and after turning left out of the site will travel up Finglas Road, turning right into Prospect way, on to Botanic Road, St. Mobhi Road and Ballymun Road towards the M50 which is approximately 6km away.

A separate pedestrian entrance is proposed off Prospect Road for those working on or visiting site who arrive on foot or by public transport.

Refer to Figure 2.2 and Figure 2.3 below.

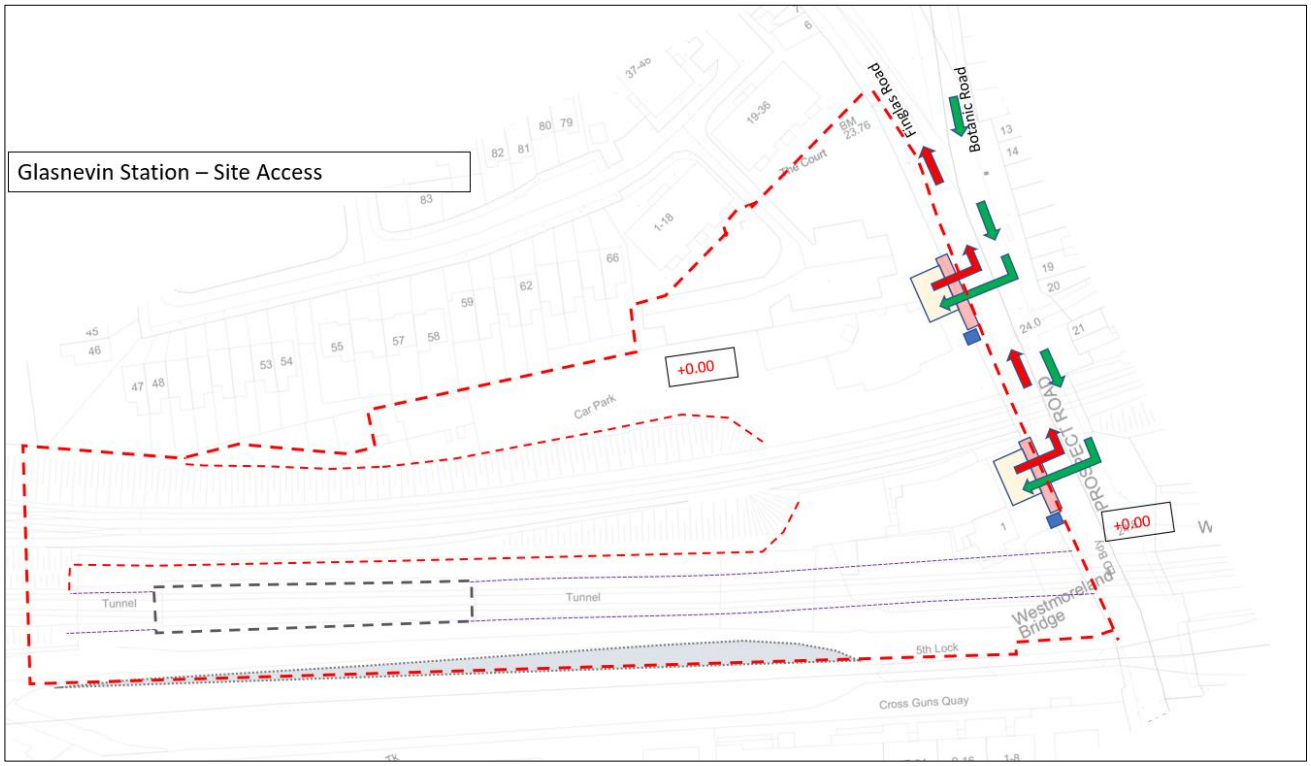


Figure 2.2: Plan of Site Access

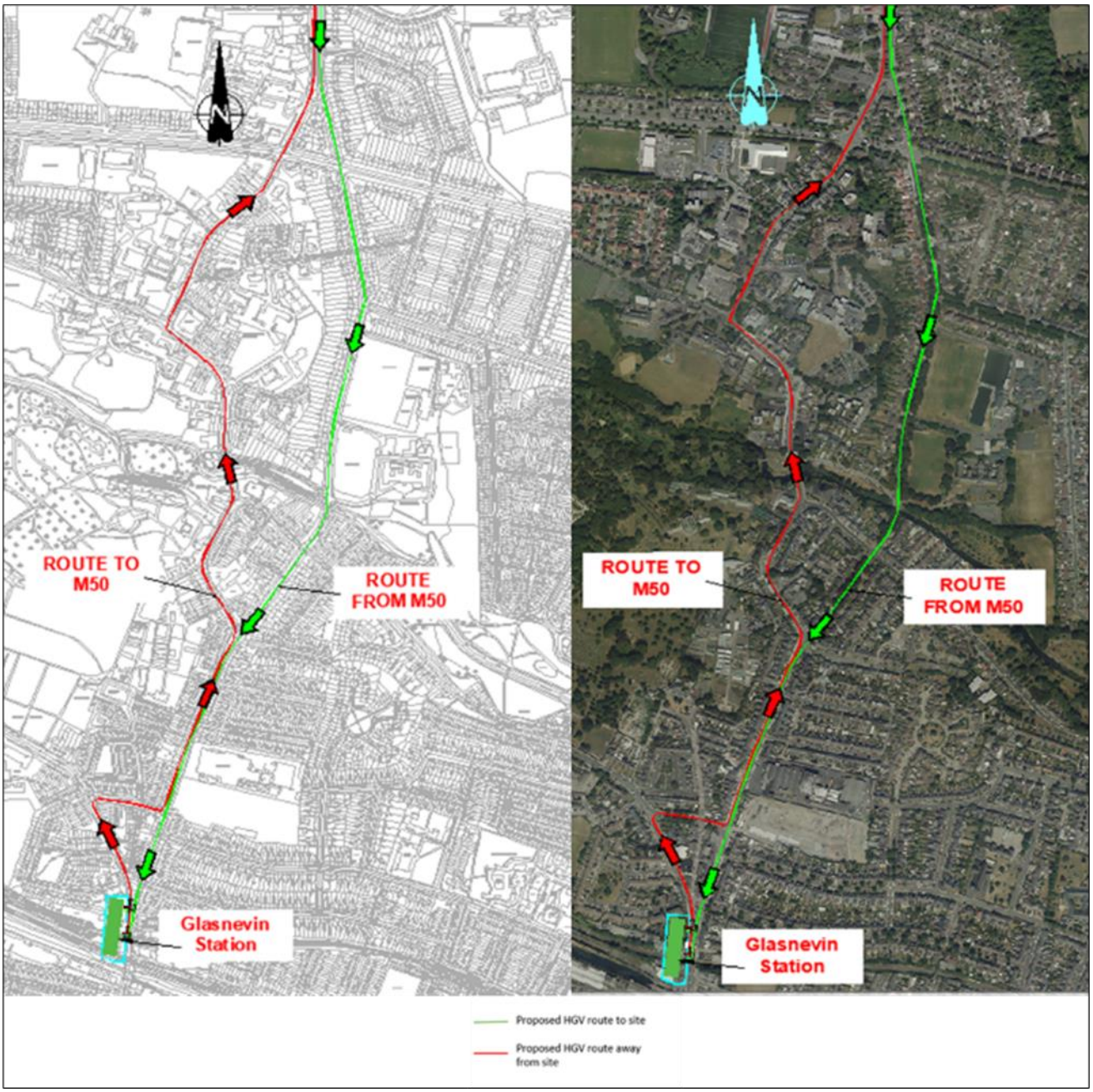


Figure 2.3: Proposed HGV route to and from site (for most of the HGVs)

3. Geotechnical Considerations

3.1 Geology

The anticipated geology for the proposed Glasnevin Station is shown in Figure 3.1.

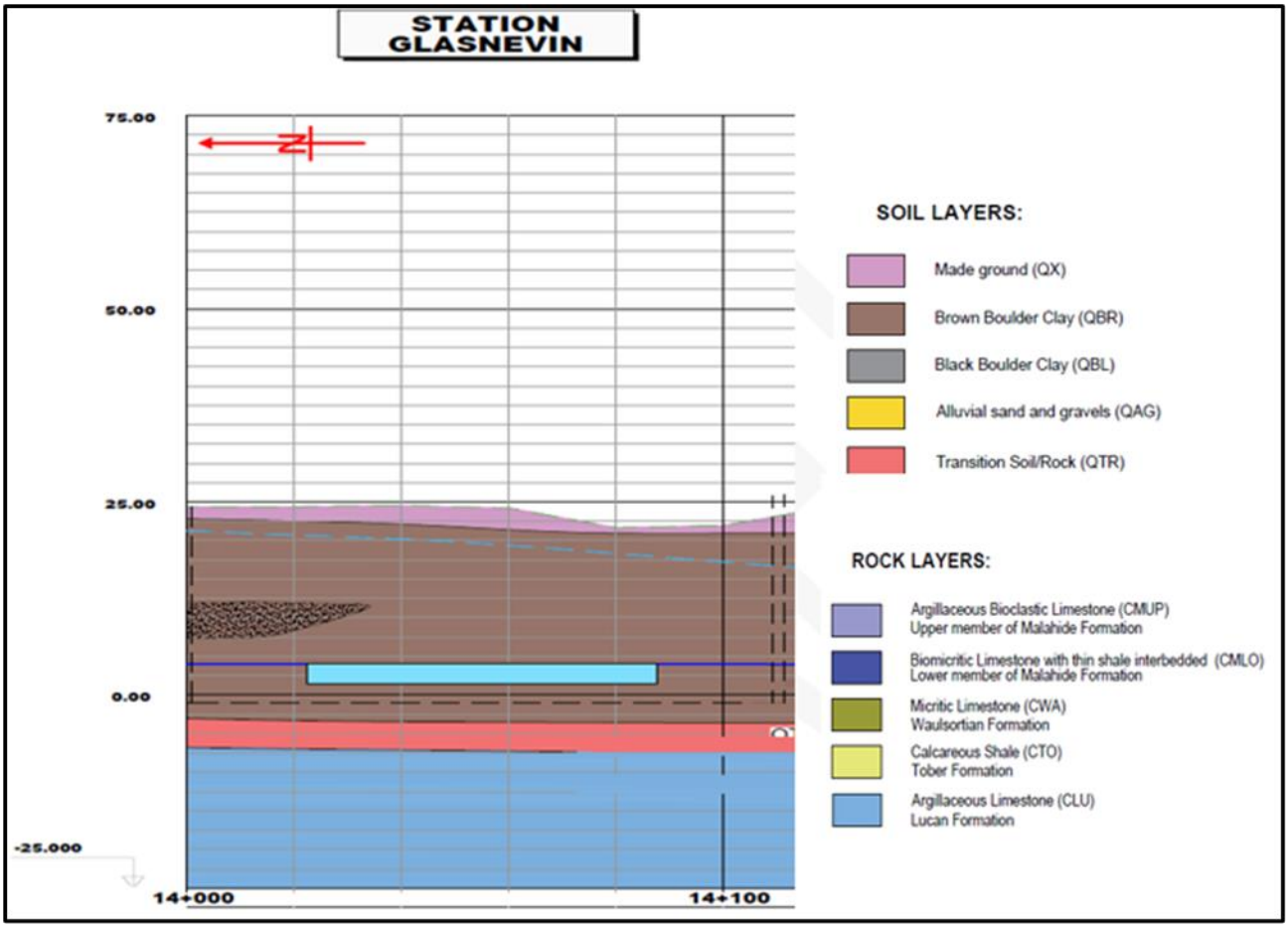


Figure 3.1: Glasnevin Station: Anticipated Geology

As shown in Figure 3.1 the dashed black line denotes the station box and the light blue rectangle the platforms. The light blue dashed line shows the top of rail position for the planned station, which is 5.5m (approximately) below existing street level.

A description of the soil anticipated to be encountered within the station box is outlined in Table 3-1.

Geotechnical testing was undertaken on approximately 150 samples as part of the ground investigations to support the proposed Project. The testing indicates an average compressive strength of around 60MPa for the argillaceous limestone in this area.

Table 3-1 Typical Geotechnical Section at Glasnevin Station

DEPTH (m)	DESCRIPTION
0.00-2.00	Made Ground (**QX**)
2.00-10.00	Brown Boulder Clay (**QBR<10m**)
10.00-27.00	Brown Boulder Clay (**QBR>10m**)
27.00-31.00	Transition Soil/Rock Layer (**QTR**)
> 31.00	Lucan Formation (**CLU**), Dark grey to black argillaceous limestone with interbedded calcisiltite and calcilutite

Table 3-2: Proposed Parameters for Bedrock Geotechnical Units at Glasnevin Station

LITHOLOGY	ROCK PARAMETERS										PERMEABILITY		CUTTABILITY	ABRASIVITY
	BULK UNIT WEIGHT t/m^3)	DRY DENSITY (t/m3)	DIRECT SHEAR STRENGTH OF ROCK DISCONTINUITIES		UCS (MPa)	YOUNG'S MODULUS (E') (GPa) intact rock	POISSON'S RATIO (γ)	Kh (t/m^3) (average estimated values)	COEFFICIENT OF EARTH PRESSURE (k0)	POROSITY (%)	LUGEONS	(m/s)	SPECIFIC ENERGY (MJ/m3)	CERCHAR
			FRICTION ANGLE (φ') (º)	EFFECTIVE COHESION (c') (kPa)										
MICRITIC LIMESTONE (CLU)	2.67	2.64	35	200	60.00	45 (*)	0.25	20000	0.33	3.6	56.26	5.64E-06	21.30	0.80

(*) *20 GPa in calcisiltites*

3.2 Groundwater

Ground investigations undertaken to support the proposed Project show that the groundwater in the Glasnevin area ranges from 6.0mbgl to 8.0mbgl. The fluctuation in groundwater levels in individual borehole installations ranged from 0.1 to 1.0m over the monitoring period.

Excavation below the groundwater level can result in significant water flow into the excavation and a lowering of the water table, and if not carefully managed could result in a loss of material through washing out of fine materials and also compaction or consolidation of soil and made ground. The combination of these processes could produce settlement at the ground surface, with the potential for damage to surrounding buildings and utilities.

To avoid the risk of settlement, the excavation of the deep stations must be carried out without any effect on the water table. Grouting will therefore be carried out to seal any leaks that are found at diaphragm wall panel junctions. Grouting is described in Section 5.

3.3 Groundwater Inflow

There will be a requirement for dewatering as excavation of the Glasnevin Station box proceeds. An assessment of the expected water quantities to be extracted during excavation has been undertaken using geotechnical computer modelling (refer to Chapter 19 (Hydrogeology) of this EIAR for further information). Based on the modelling an allowance of 6.95 l/s for groundwater inflow has been made.

An allowance of 10l/s has been considered for the assessment of the expected quantities of water for the construction of the Glasnevin Station, which will also cater for run off, wheel wash and welfare.

3.4 Extraction and Disposal Methods

There are several methods for extracting the water in the ground and several possible methods of disposing of this water. Agreements with the local authorities will be required for the solution adopted.

Groundwater Extraction

At this stage, and subject to detailed design, it is suggested to allow for a deep well dewatering system to be installed to lower the water table level within the excavation in advance of excavation.

A deep well system uses bored wells, typically pumped by submersible pumps. These systems work by several wells acting in combination to lower groundwater levels across the area of the excavation. Pumping from an individual well lowers the groundwater level and creates a cone of depression (or cone of drawdown) centered on the well. Deep well dewatering systems involve multiple wells being pumped simultaneously. The cones of drawdown from each well interact and can lower groundwater level over a wide area beneath an excavation. Large drawdowns can be achievable, limited only by the depth of the wells and the hydrogeological conditions.

The deep wells are generally sited just outside the area of proposed excavation and are pumped near the base of each well. For station boxes, where the drawdown of the water table outside of the box footprint may result in ground settlement, the wells are installed within the footprint of the station box and the water lowered within the diaphragm wall (D-wall) retaining structures. To limit drawdown outside of the station footprint, it is sometimes necessary to install grout curtains beneath the base of the d-walls to seal up loose rock, fissures etc. and increase the water flow path.

Each well is connected to a header pipe (sometimes known as a discharge main). Each well is also provided with electrical power via cables and distribution units. It is common to provide back up or standby generators to be used if the duty power supply system is interrupted. As well as the pumped wells there will be a requirement for

monitoring wells to allow groundwater levels to be monitored both inside the excavation area and outside to ensure drawdown is limited.

It is important to protect the wells during the excavation process and include suitable details for how the wells are sealed as the base slab is cast.

Groundwater Disposal

The Royal Canal is situated adjacent to the construction site and, subject to approval from Waterways Ireland (WI), it may be possible to treat the extracted groundwater and discharge into the canal. However, for planning purposes, it has been assumed that dewatered water will be discharged to a local foul sewer, subject to agreement with Irish Water. A local discharge point will need to be agreed with Irish Water and an agreed discharge rate established, together with any conditions relating to quality and reduced volume in the event of heavy rain. This then allows the required on-site attenuation volume to be calculated; a volume equivalent to one day's discharge is currently assumed to be required.

4. Enabling Works

Prior to the start of construction, the following works will be required:

- Background surveys and environmental base line monitoring;
- Environmental enabling works including vegetation and tree clearance and removal of any invasive species;
- Demolition and the removal or remediation of any contaminated land if not already undertaken;
- Archaeological excavations (if required);
- Utility diversions and protection.
- Ground movement monitoring and mitigation works; and
- Site establishment.

These are described in the following sections.

4.1 Background Surveys and Base Line Monitoring

Several surveys will be required to establish the existing site conditions, for example:

- Flora and fauna surveys;
- Contamination investigations;
- Traffic counts;
- Track and structure monitoring;
- Noise and vibration monitoring;
- Air and water quality monitoring; and
- Ground movement monitoring.

These will determine whether any special precautions are necessary and establish baseline conditions for future comparison.

4.2 Vegetation and Tree Clearance

There are a significant number of trees that will require clearing to allow for the construction of the proposed Glasnevin station as indicted on Figure 4.1. Refer to Chapter 15 (Biodiversity) of this EIAR for an assessment of biodiversity impacts arising from vegetation and tree clearance.

Figure 4.1: Plan Showing Main Areas of Vegetation Clearance

4.3 Invasive Species Mitigation Works

There is indication from initial site inspections there is presence of the non-native invasive plant species Japanese Knotweed. The knotweed locations identified include areas 300m west of Prospect Rd and stretches in pockets along the MGWR embankments for several meters further west as indicated in Figures 4-2 and 4-3 (yellow outline indicates suspected locations of Japanese Knotweed). A Non-native Invasive Species Management Plan has been prepared (see Appendix A15.8 of Chapter 15 (Biodiversity) of this EIAR) and will direct the construction contractor in implementing the specific mitigation measures required.

Figure 4.2: Location of Japanese Knotweed at West of Prospect Rd (1 of 2)

Figure 4.3: Location of Japanese Knotweed West of Prospect Rd (2 of 2)

4.4 Demolition

The proposed Glasnevin Station will be located on land occupied by several existing building structures. These will require clearance before construction can commence. There are also existing Irish Rail structures (retaining walls and tunnel) that will be demolished and removed as the works are carried out.

The buildings to be demolished are shown in Figure 4-4 and denoted in yellow with a black dashed outline. The demolition will take place inside the site compound area (red dashed line).

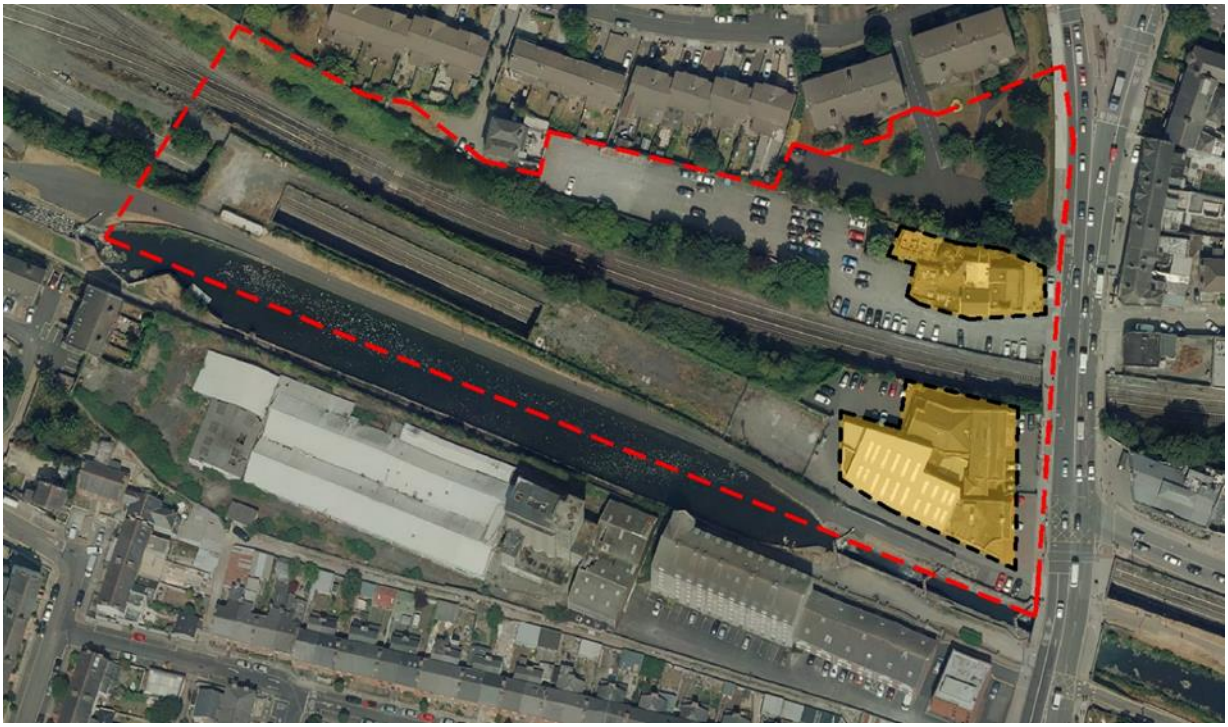


Figure 4.4: Plan Showing Properties to be Demolished and Site Area

4.5 Archaeology

There are no archaeological or cultural heritage assets assessed as being of Very High importance located within the proposed station area (see Chapter 25 of this EIAR). However, there are a number of architectural heritage constraints. These are detailed in Chapter 26 of this EIAR (Architectural Heritage), along with associated mitigation measures.

4.6 Utility Diversions and Protection

The main known utilities impacted throughout the proposed Glasnevin Station development include:

- 225mm foul water on north and south side;
- 4 No. communication ducts;
- 1 No. electrical cable >150m north of the station;
- 1 No. surface water main;
- Potable water main along the canal towpath; and
- Railway utilities along the railway.

Further assessment of the utilities impacted by the construction of the station at Glasnevin will be carried out including investigation of the asset's true location and condition.

It is assumed that utility diversions and protection will be planned, agreed, and managed by the Advanced Enabling Works Contractor, the utility diversion and protection works will be carried out in advance of the date that the site is handed over to the Mains Work Contractor.

Close coordination and cooperation between the Advanced Enabling Works and the Main Works Contractors will be required to:

- Ensure that the utilities diversions are appropriate for the planned permanent and temporary works.
- That the protection works are appropriate for the temporary loading (including that from a conservative assessment of ground movement) based on the proposed station design.
- The Advance and Enabling Works Contractor will hand-over accurate and detailed utility As-built Drawings for the Main Works Contractor to manage throughout the main work.

4.7 Ground Movement Monitoring and Mitigation Works

During the construction of the station, the ground and / or structures may move due to dewatering, movement of the retaining walls, passage of the TBM, or from an external factor such as seasonal variations or other nearby construction projects.

Combined conservative settlement analyses for station and tunnel will be carried out together with Building Condition Surveys and Building Damage Assessments. Should these predict any structural damage to buildings, other structures, or utilities, then mitigation measures will be considered in advance of construction. Depending on the level of damage predicted, mitigation measures can be implemented prior to construction or during construction when a particular 'trigger' value of movement is reached.

In advance of any excavation being carried out, monitoring points will be established on all structures as required by the design (such as residential buildings, bridges, tunnels, retaining walls for IR and canal etc) and a set of base line readings taken to quantify existing movement (e.g. due to the sun, weather, temperature).

During construction, these points will be monitored against predicted settlement values in accordance with the Project Monitoring Plan, to determine whether the structure is behaving as predicted.

5. Construction

The Glasnevin Station development is a complex project with key interfaces with other infrastructure stakeholders. The station development includes the construction of the new MetroLink station, platforms for two commuter railways - Iarnród Éireann Sligo / Maynooth (old MGWR - Midland Great Western Railway) and Newbridge / Hazelhatch (old GSWR - Great Southern and Western Railway) a concourse area to connect all three railways together and dedicated substations for Metrolink station and Irish Railway. See Figure 5.1.

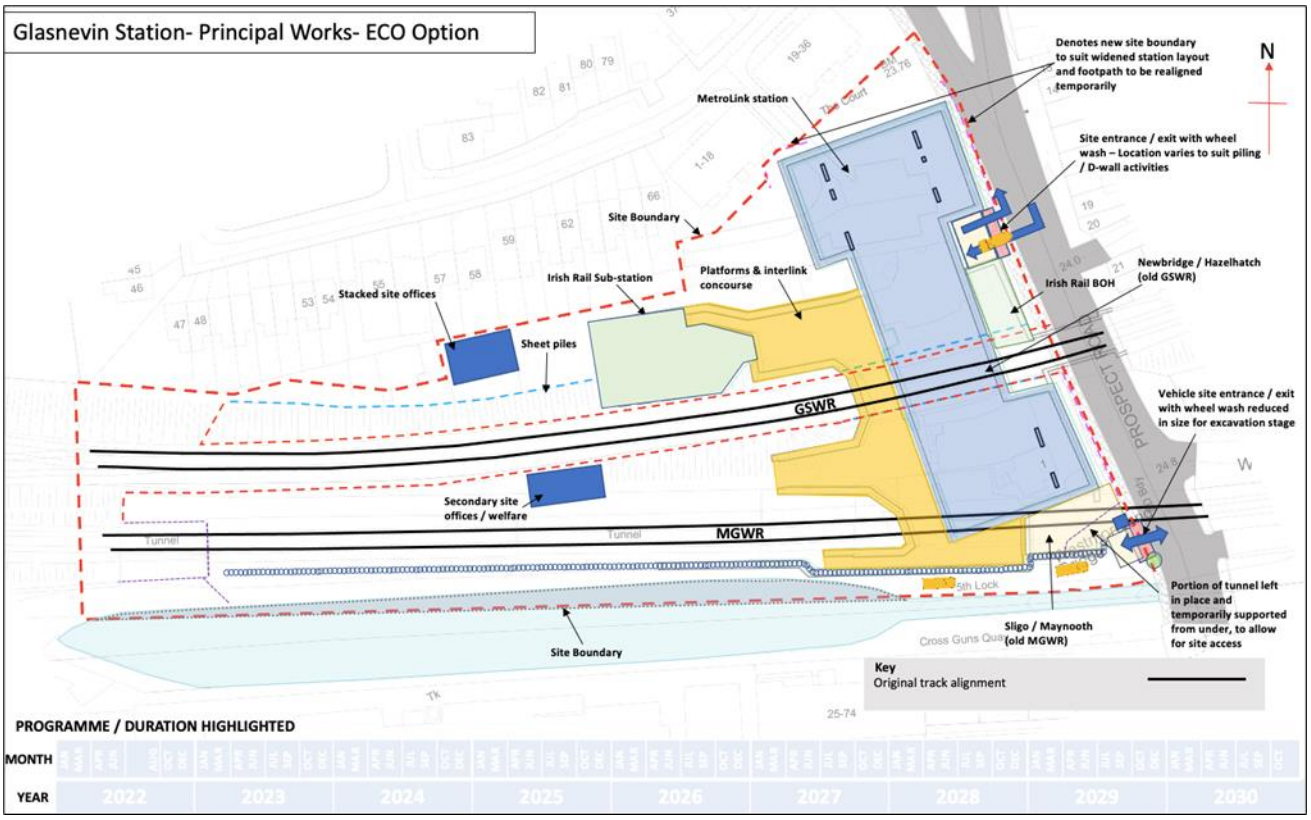


Figure 5.1: General Layout of Glasnevin Station

Sequence diagrams have been prepared to help develop the Reference Design programme. They are indicative of the works likely at each stage. Also refer to the Longitudinal Section details in Appendix A for information relating to the various stages reflected in the plan diagrams, particularly levels based on Ordinance Datum Dublin (ODD).

The construction sequence includes a coordinated approach to the track lowering, which results in closure of the MGWR railway for a period of approximately 21 months, reopening, followed by closure of the GSWR railway for 5 months, for track lowering and GSWR bridge slide works.

The majority of the construction stages and work phases are based around works in the northern or southern site areas, with the Newbridge/ Hazelhatch (GSWR) railway line acting as the divide between each section. Refer to Figure 5.2 for the demarcation of north and south sites.

Five other work areas are identified; the north, central and south sections of the MetroLink station box and the railway interlink structures and the substations for MetroLink station and Irish Railway. Refer to Figure 5-3 for demarcation of these various areas.

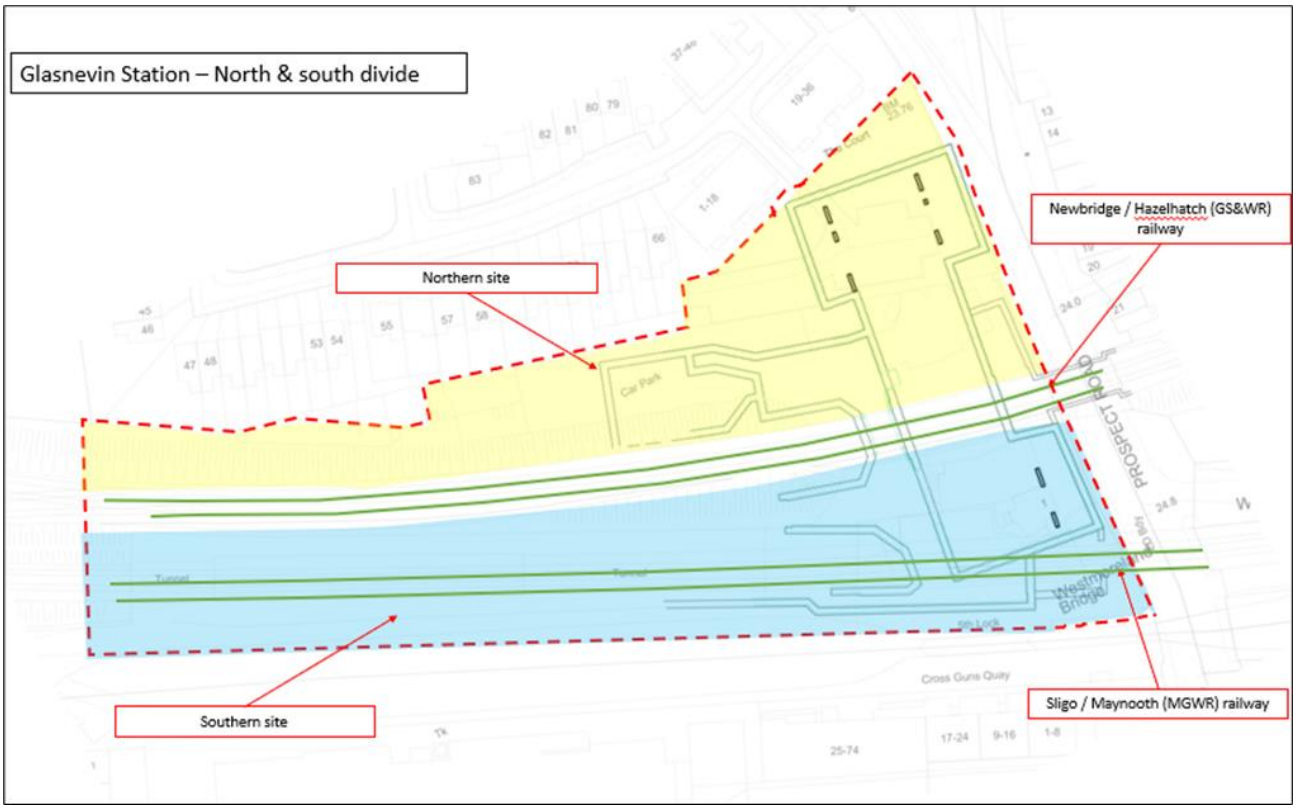


Figure 5.2: Demarcation of North and South sites

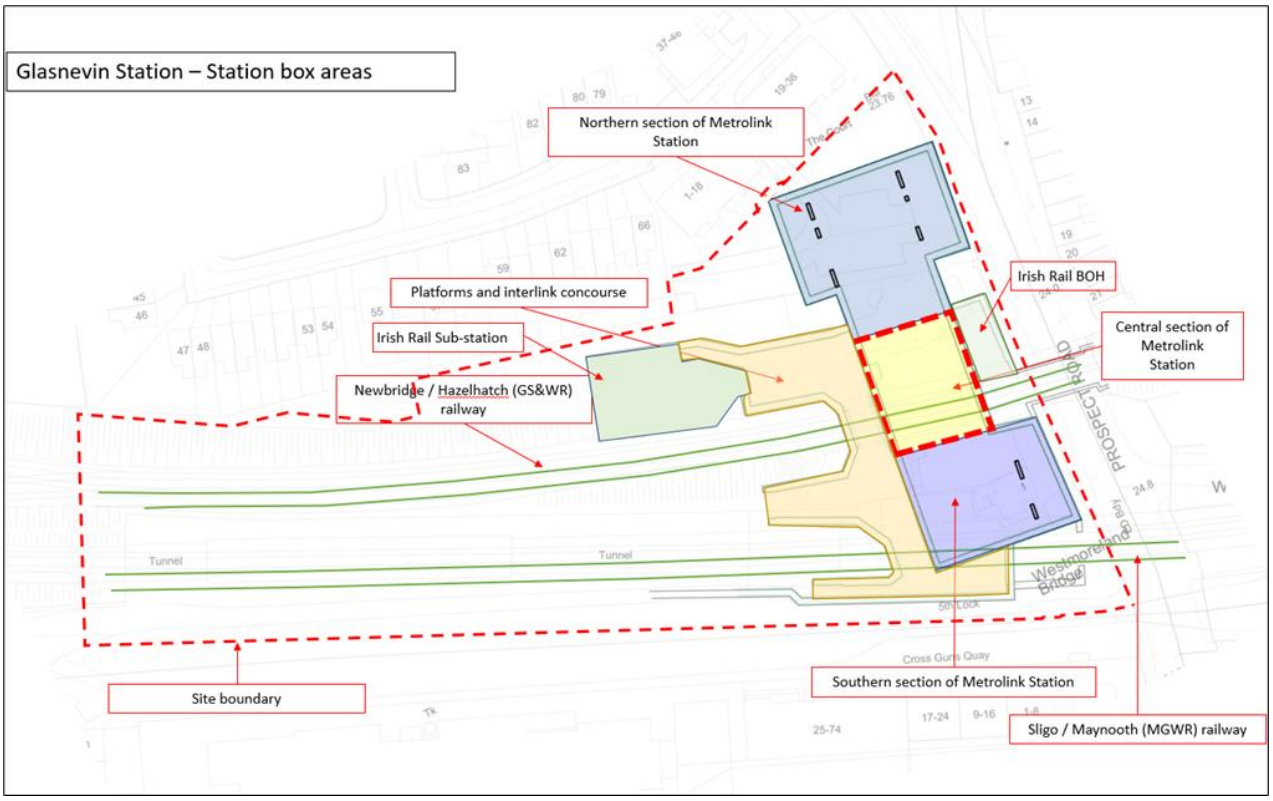


Figure 5.3: Demarcation Areas

The high-level staged construction sequence considering the north and south sites is presented in Table 5-1.

Table 5-1: Summary of Main Activities for High-Level Staged Construction Sequence

Stage	Whole site works
1	Advance works
2	Site Establishment; including installation of Footbridge over GSWR (1 possession GSWR) and demolition of existing properties. (3 Possessions GSWR); Close MGWR

Stage	Northern works	Southern works
3	D-walling/barrettes and Secant piling for station boxes and GSWR embankment strengthening (sheet piling) Tracks at existing level (Track lowering Phase 1)	D-walling L shape station box wall on southeast side & 1 no soft pile MGWR closed Piling for MGWR embankment adjacent to existing canal Tracks at existing level (Track lowering Phase 1)
4	Construction of Station Box roof slab and commence Top-Down construction of northern section of station box Possession work to install GSWR hoarding and remove footbridge.	MGWR railway Closed. Remove infrastructure Demolish existing tunnel in phase 1 and phase 2 and bulk excavation to -7.73m below street level (BSL)

Stage	Northern works	Southern works
	Possession work to install cross track ducting for bentonite supply to south site Install temporary sheet piles to support GSWR railway on south side/remove existing retaining wall in possession work Diesel rolling stock operating.	Retainment of MGWR/GSWR. Install sheet piled walls (west of station) for track lowering MGWR and GSWR. (Track lowering Phase 2)
5	Continue Top-Down construction. Bulk excavation north side of GSWR to -6.73m below street level.	Install 1 No soft pile southwest side Commence D-walling for station box from lower level -7.73m below street level Excavate existing MGWR retaining walls adjacent to canal secant pile wall
6	Continue Top-Down construction. Piling for interconnecting subway N & S of railway (adjacent to GSWR railway) and IR/Metrolink substations	Continue D-walling for station box Piling for interconnecting subway N & S of railway (adjacent to MGWR railway)
6A	Continue Top-Down construction.	D-Wall and Piling for interconnecting Subway N & S complete
7	Top-Down construction on hold until the earthen berm is lowered to mezzanine slab.	Trim down D-walls in sections to south and west side and construct capping beams. Install access ramp at south-west. Construct southern subway roof across MGWR railway tracks, track trough, and southern platforms Construct lining walls/southern platforms
8	Top-Down construction on hold until the earthen berm is lowered to mezzanine slab.	Excavate area for bridge slide to -8.49m BSL level and cast temporary 600mm thick slab, incorporating slide rails. Install formwork on Temporary slab for pre-casting GSWR bridge slab Demolish West tunnel (OBD 221), reduce level and install MGWR to tracks to final alignment. Break out last section of existing tunnel, southeast corner (adj. to Prospect Road) and install temporary Bailey bridge. Install OHLE supports MGWR Full track lowering west of Ch 850 Track lowering phases 3 and 3.1
9	GSWR closed Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Install 2 Nos soft piles Install 2 Nos single bite D-wall panels Install secant piles across GSWR railway	MGWR to Dockland re-open Foundations and slide rail extensions Commence casting of GSWR bridge deck for sliding. Preparation for GSWR bridge slide Track lowering Phase 4 commences. Diesel rolling stock operating on MGWR

Stage	Northern works	Southern works
	Capping beams (secant piles) GSWR, foundations and slide rail extensions. Full track lowered to final alignment. Install OHLE supports to GSWR	
10	Top-Down construction on hold until the earthen berm is lowered to mezzanine slab Construct retaining walls/embankment to GSWR Slide new rail bridge into position Install precast beams/planks to northern subway roof across railway tracks Complete track lowering in GSWR closure	Set up jacking equipment and slide bridge into position. Track lowering Phase 5
11	Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Install GSWR Northern & Central platforms in closure and reopen GSWR to operate at lowered alignment. Diesel rolling stock operating on GSWR	Commence in-situ construction of the external station walls - 7.73m BSL to u/s of station roof Install MGWR central platform during possessions
12	Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Construct subway adjacent to GSWR platform Cast permanent station box roof slab	Cast permanent station box roof slab Construct subway in-between railway tracks. MGWR operating at lowered alignment. Diesel rolling stock operating on MGWR Track lowering Phase 6
13	Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Install MetroLink substation & subway roof slab. Construct slab/precast planks over GSWR bridge during possessions Install OHLE supports to u/s of GSWR cover slabs	Start Top-Down construction Construct subway roof slab Remove intermediate southern access ramp Remove fill/sheet piles and reinstate canal Remove Bailey Bridge and construct slab/precast planks over MGWR rail during possessions Install OHLE supports to MGWR cover slabs
14	Complete Top-Down construction. Install OHLE wiring through station and GSWR GSWR railway operating on lowered alignment with Electric rolling stock Complete station works	Complete top-down construction. Install OHLE wiring through station and MGWR MGWR railway operating on lowered alignment on Electric rolling stock
Stage	**Whole site works**	
	Complete station works	

Each stage is expanded upon in the following sections.

5.1 Stage 1: Advance Works

The advance works are to construct a temporary access road and bridge over the Royal Canal. This is required so that the existing parts of Royal Canal Way (the canal tow path) land can be taken and used during station construction. The road and bridge are to be of suitable standard to allow for access to Coke Ovens Cottages. These works are shown in Figure 5-4.

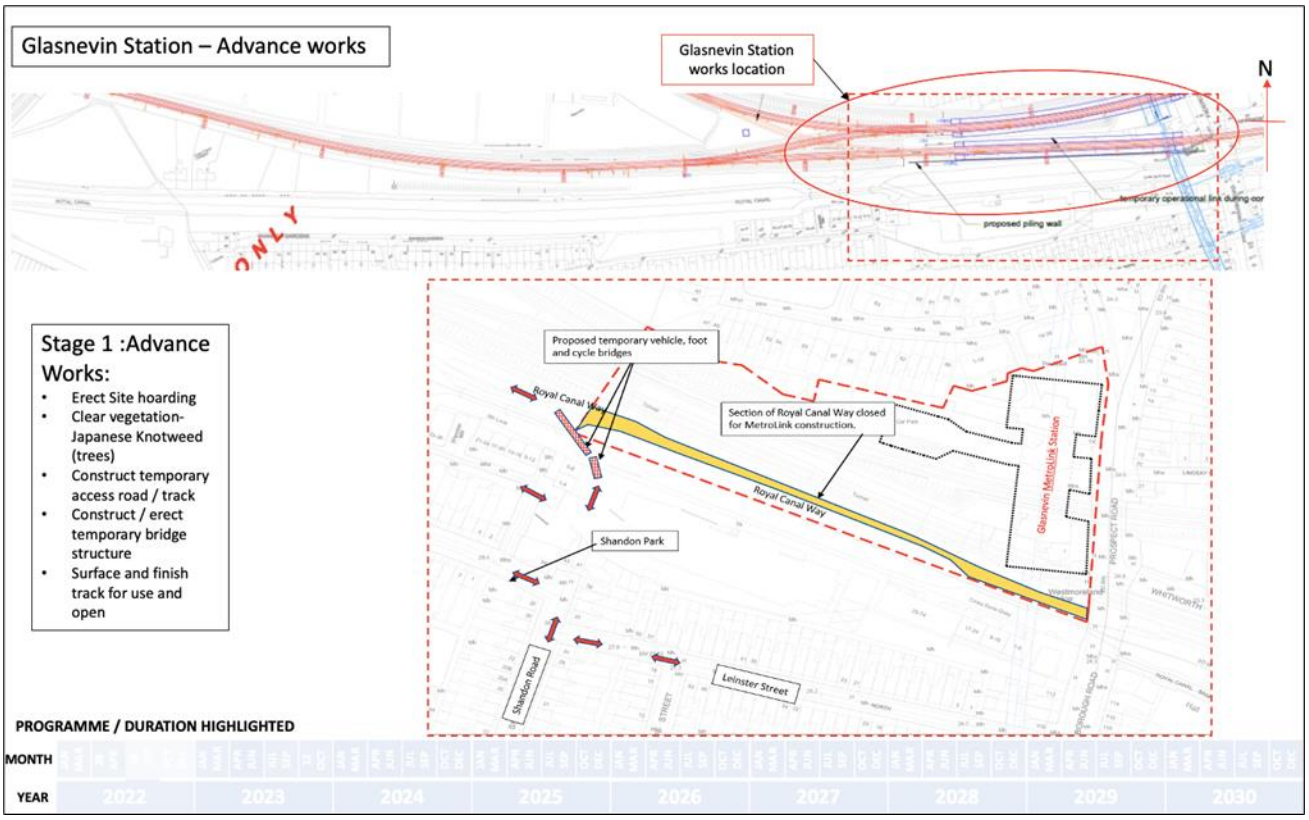


Figure 5.4: Advance Works

5.2 Stage 2: Site Establishments and MGWR Railway Closure

Site hoardings and security will be established to ensure that the site is secure and a wheel wash facility will be installed at each site exit. Due to the nature of the site for the proposed Glasnevin Station development, the site establishment works will be split into multiple areas and will evolve throughout the duration of the station works. The station layout is wider at the north end extending the construction boundary into Prospect Road and most of the existing northbound footpath. This will have an impact on the temporary traffic management plan and the existing roads would need to be realigned to suit. Refer to the Scheme Traffic Management Plan (Appendix A9.4 in Volume 5 of this EIAR) for full details of temporary traffic management works.

The existing buildings within the site will be demolished, utilities diverted or protected and any vegetation and trees cleared. These specific enabling works activities are detailed in Section 4.

Several measures are available to prevent debris from falling onto the MGWR from the upper areas of the tunnel opening as outlined in Table 5-2.

To prevent minor debris from falling onto the railway and also to protect against the risk of any plant/equipment falling into the tunnel opening, it is anticipated that an enclosure would be assembled. Interlocking or stacked

concrete “Jersey” blocks could then be placed of the type shown in Figure 5.6 could then be placed around the opening as protection against vehicles driving into the enclosure.

The MGWR railway closure starts at this stage and will remain closed for a period of approximately 21 months

Table 5-2: Options for Preventing Debris Falling on MGWR Railway

Method	Pros	Cons
Do nothing	No works / possessions required that may impact on MGWR for installation and removal.	If debris falls, then impact not mitigated. Potential for catastrophic incident. Slew restrictions required on items of lifting equipment in proximity of opening.
Mesh netting	Minor impact on MGWR operations during installation and removal	May stop minor items from impacting on railway If debris falls, then impact not mitigated. Potential for catastrophic incident Slew restrictions required on items of lifting equipment in proximity of opening. Limited possessions of MGWR required.
Standard hoarding/ High hoarding – (can be used in conjunction with netting)	Minor impact on MGWR operation during installation and removal.	Will stop minor items at site level from impacting on railway. If debris falls, then impact not mitigated. Potential for catastrophic incident. Slew restrictions required on items of lifting equipment in proximity of opening Limited possessions of MGWR required.
Enclosure	Minimum impact on MGWR operation during installation and removal	Will stop minor items at site level from impacting on railway. If debris falls, then impact may be mitigated. Possessions of MGWR required. Still the potential for catastrophic incident. Slew restrictions required on items of lifting equipment in proximity of opening. Risk of operators slewing over decking due to erroneous belief that it is a crash deck
Structural crash deck	Will stop items at site level from impacting on railway Slew restrictions not required on items of lifting equipment in proximity of opening.	Impact on MGWR operation during installation and removal. Possessions of MGWR required

Sections of the Royal Canal will be filled to create working space in the southern part of the site. The detailing for this will need to be agreed with Waterways Ireland with a close liaison maintained throughout the works.

The establishment of the site areas shown in Figure 5.5.

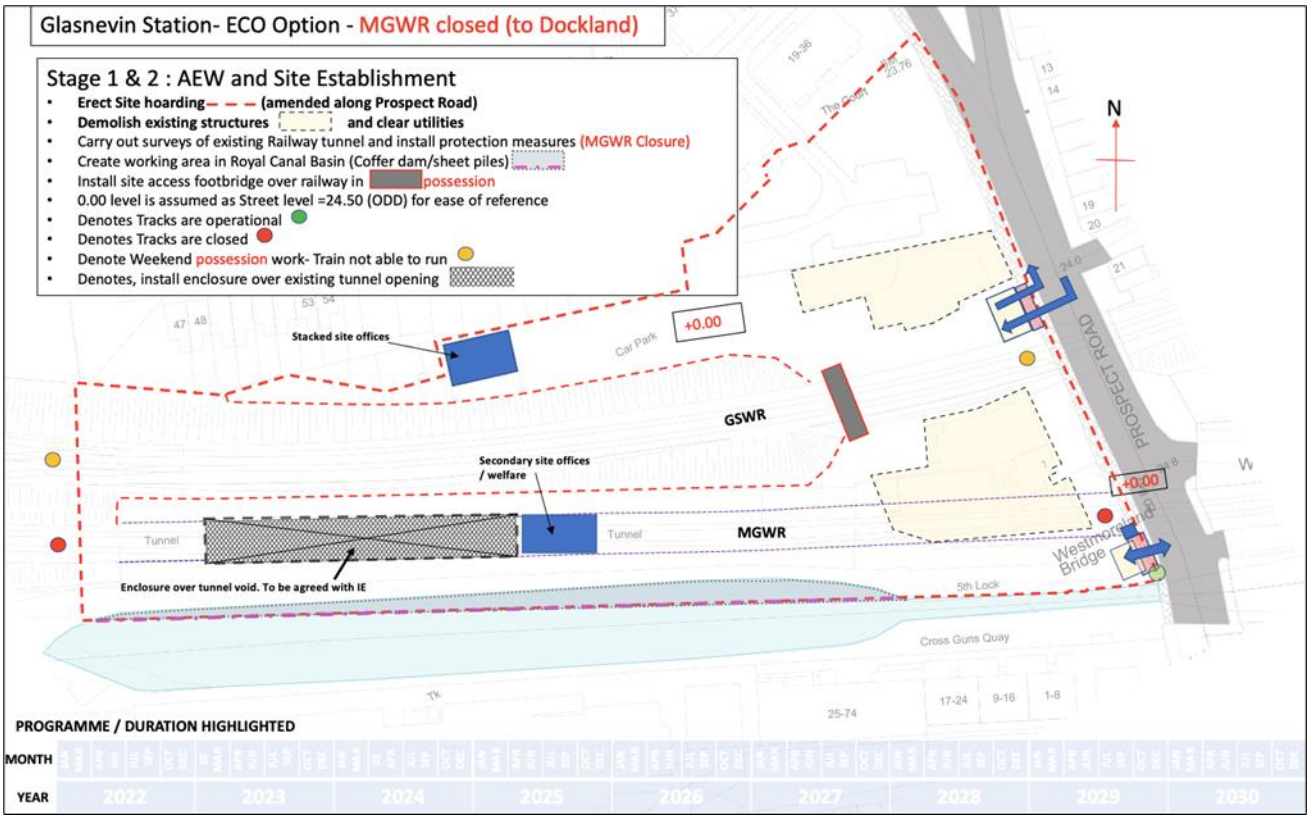


Figure 5.5: Advance Works and Site Establishment Areas

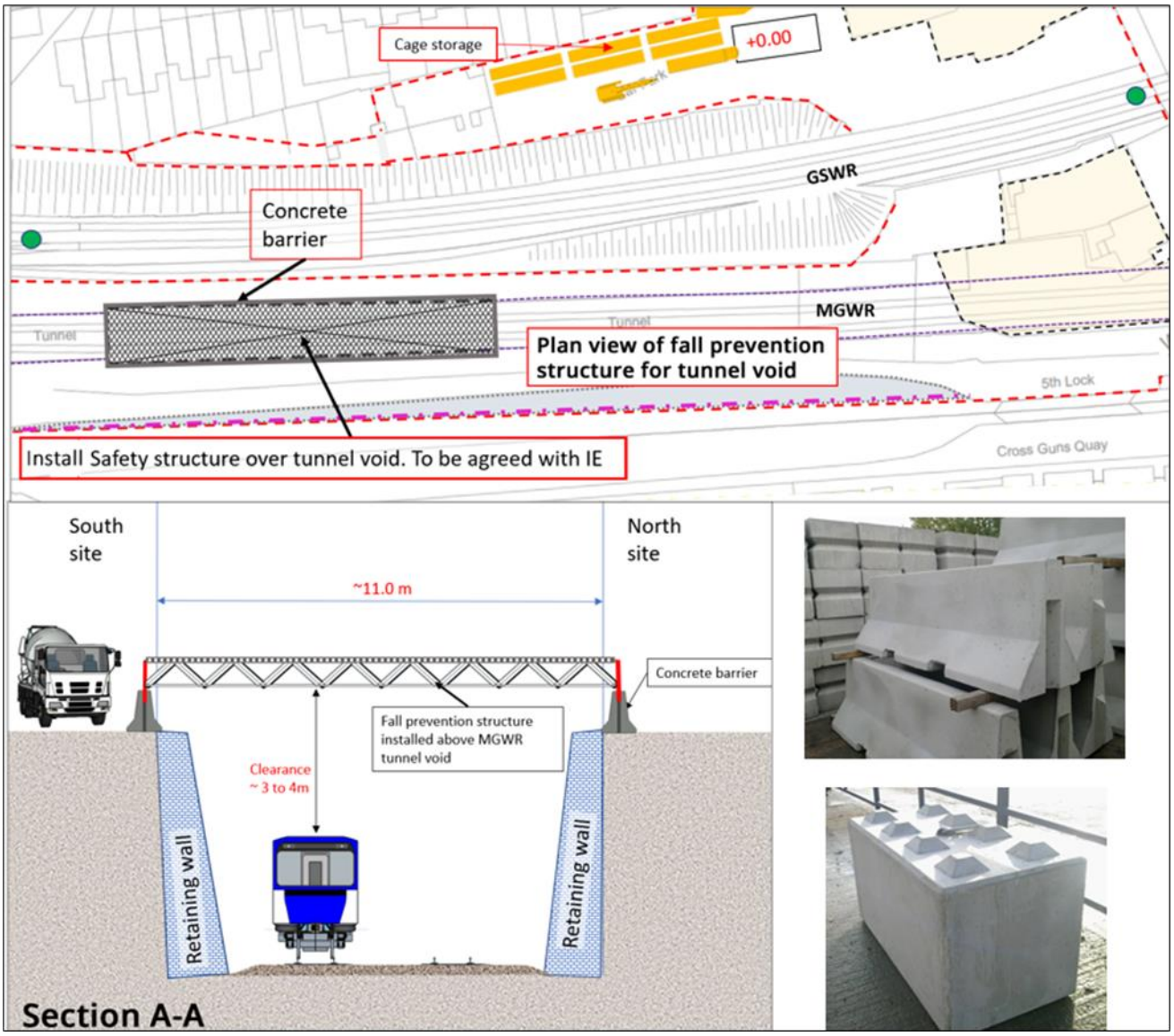


Figure 5.6: Plan view and cross section through enclosure over MGWR tunnel opening

Mains water, power and communications will be installed along with site offices and welfare. There is very limited space available on this site and accommodation will be the minimum required to service the works. Safe, segregated walking routes will be established to the working areas. This will require a footbridge to be installed over the Newbridge/Hazelhatch (GSWR) railway to provide access between the north and south sites.

It is noted that the secondary site offices in the southern site are situated on the existing railway tunnel. The capacity of the existing tunnel will have to be checked for the expected loads during all phases of the works including the operation of piling rigs and cranes required to install equipment.

5.3 Diaphragm Wall (D-wall) Construction

It is envisaged that the D-walls for the north site are installed utilising the guide wall and piling mat positioned at street level as per the detail in Figure 5.7: Top of Slab to Diaphragm Wall Construction Detail.

The D-walls will be cast to the top of the proposed roof slab level (with the rebar in reservation tubes to the base of roof slab level) and the section above this will be backfilled with pea gravel to ground surface. After the walls and grouting have been completed, the D-wall panels will be broken down to the underside of roof slab level so that the roof slab reinforcing cage can be tied into the D-wall reinforcement.

It is noted that the site boundary will have to be extended and retained in the new position throughout the station works. This is to ensure a minimum distance can be maintained from the external face of the D-wall to the face of the site hoarding. This will allow space for installing groundwater monitoring equipment (see Section 3.2) and unhindered access for the site operatives.

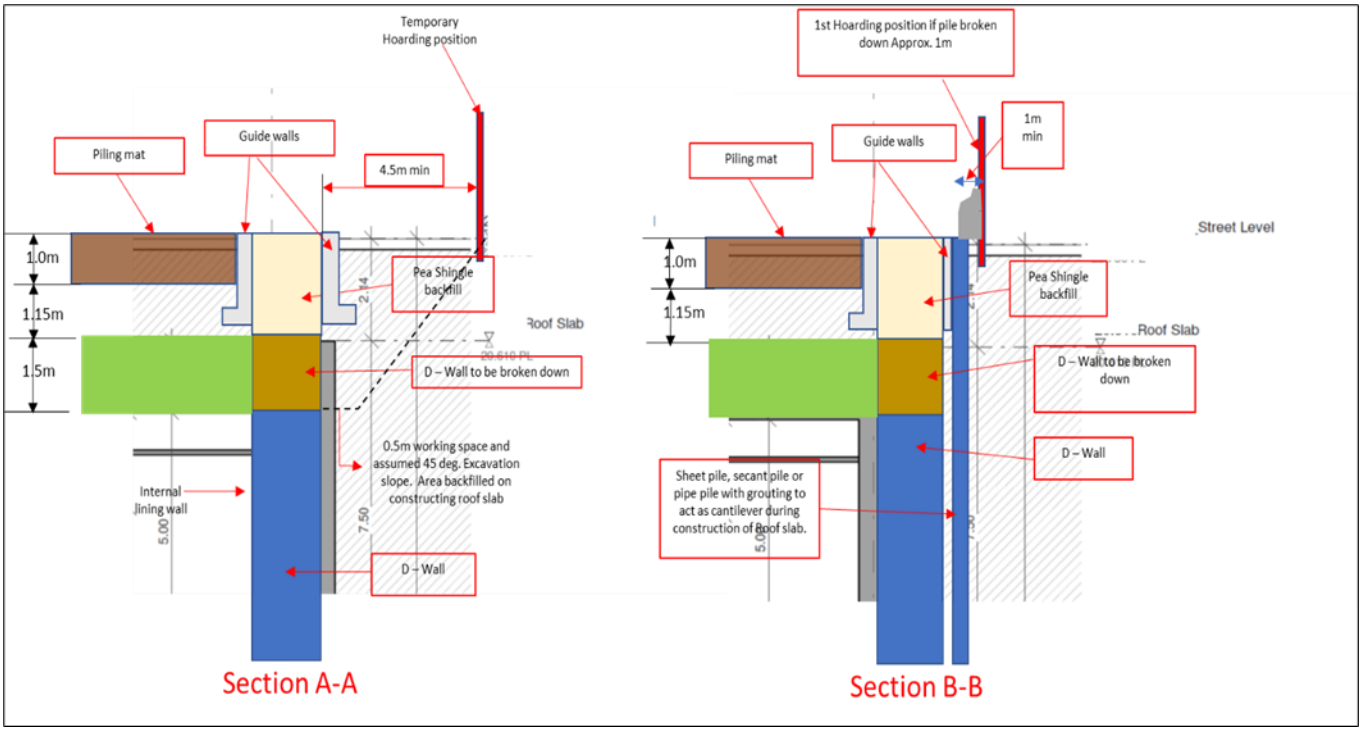


Figure 5.7: Top of Slab to Diaphragm Wall Construction Detail

The methodology described above and illustrated in Figure 5-7, Section A-A is based on a minimum distance of 4.5m from the external face of the diaphragm wall to the face of the site hoarding. Where space from the site boundary to the kerb is restricted, Section B-B is likely to be adopted.

For the south site and the works across the railway, similar considerations and methodologies will apply, but the works will be carried out from both existing ground levels and a reduced level following bulk excavation works.

D-walling requires the rigs to work near the operational railway. With regard to Irish Rail infrastructure, specific guidance for operating piling construction equipment adjacent to live railways has not been identified. Reference has been made to UK Network Rail standard NR/L3/INI/CP0063 – Piling Adjacent to the Running Line, which was prepared in conjunction with the Federation of Piling Specialists. This document makes a number of recommendations with regard to prevention of the oversailing of railway infrastructure and specifically to prevent encroachment within 3 metres of the nearest running rail. The use of slew restrictors to limit the arc of rotation of any crane or track mounted plant is a key requirement. Cranes should be operated with booms either facing away, parallel or slightly oblique to the running line to ensure that the risk of collapse of a jib onto the line is prevented.

Design and preparation of piling platforms is a key element in ensuring stability of plant during operation, and to include:

- Size and position to allow for rigging and derigging;
- Platform to be greater in width/length than theoretical working area, with physical demarcation (e.g., timber baulks) to delineate the edge of the working area;
- Platforms to be designed for full capacity of the rigs;
- Platforms to be constructed with positive drainage;
- Access to allow for delivery of materials, and other equipment; and
- A planned inspection regime to be proposed by the designer.

NR standard NR/L3/INI/CP0063, Appendix B, shows diagrams in relation to best practice and what is permissible with regard to positioning and operation of cranes and piling rigs (Refer to Figure 5.8 and Figure 5.9).

Before any work commences, a method statement detailing design of working platforms, positioning of rigs and cranes, and operating procedures will be agreed with the rail operator. In addition, the impact on the existing retaining walls and structures, when installing diaphragm walling from the high level, will need to be carried out to confirm the extent of works can be safely undertaken.

Figure 5.10 and Figure 5-11 show clarity with regard to expected clearance for the soft piles and diaphragm walls to be installed near to the (GSWR) running rails when working from the south site. Figure 5-11 indicates a 5m clearance to the nearest rail from the piling rig in accordance with the NR guidance above.

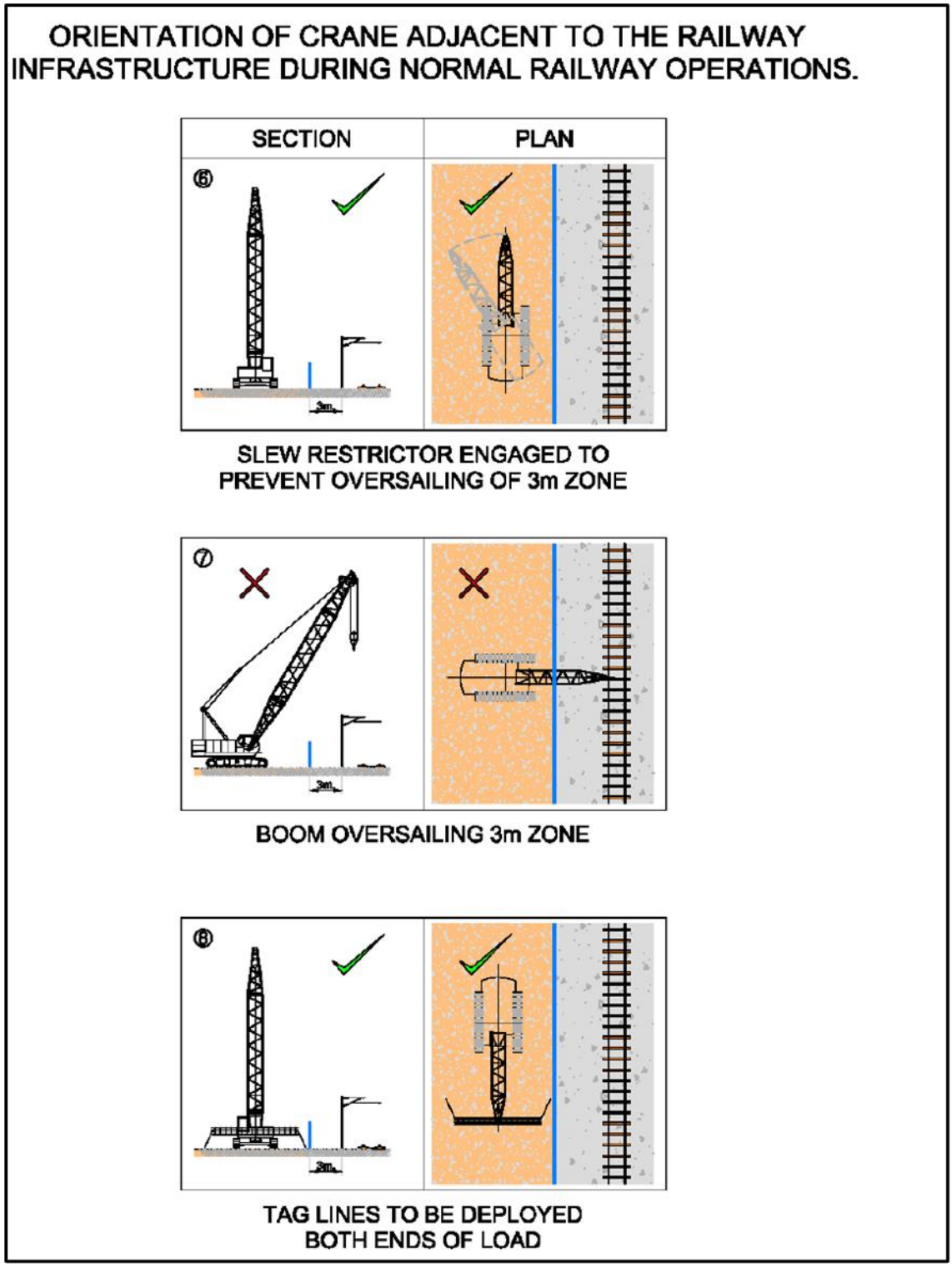


Figure 5.8: NR Standard NR/L3/INI/CP0063 Safe Crane Operations Adjacent to Normal Railway Operations

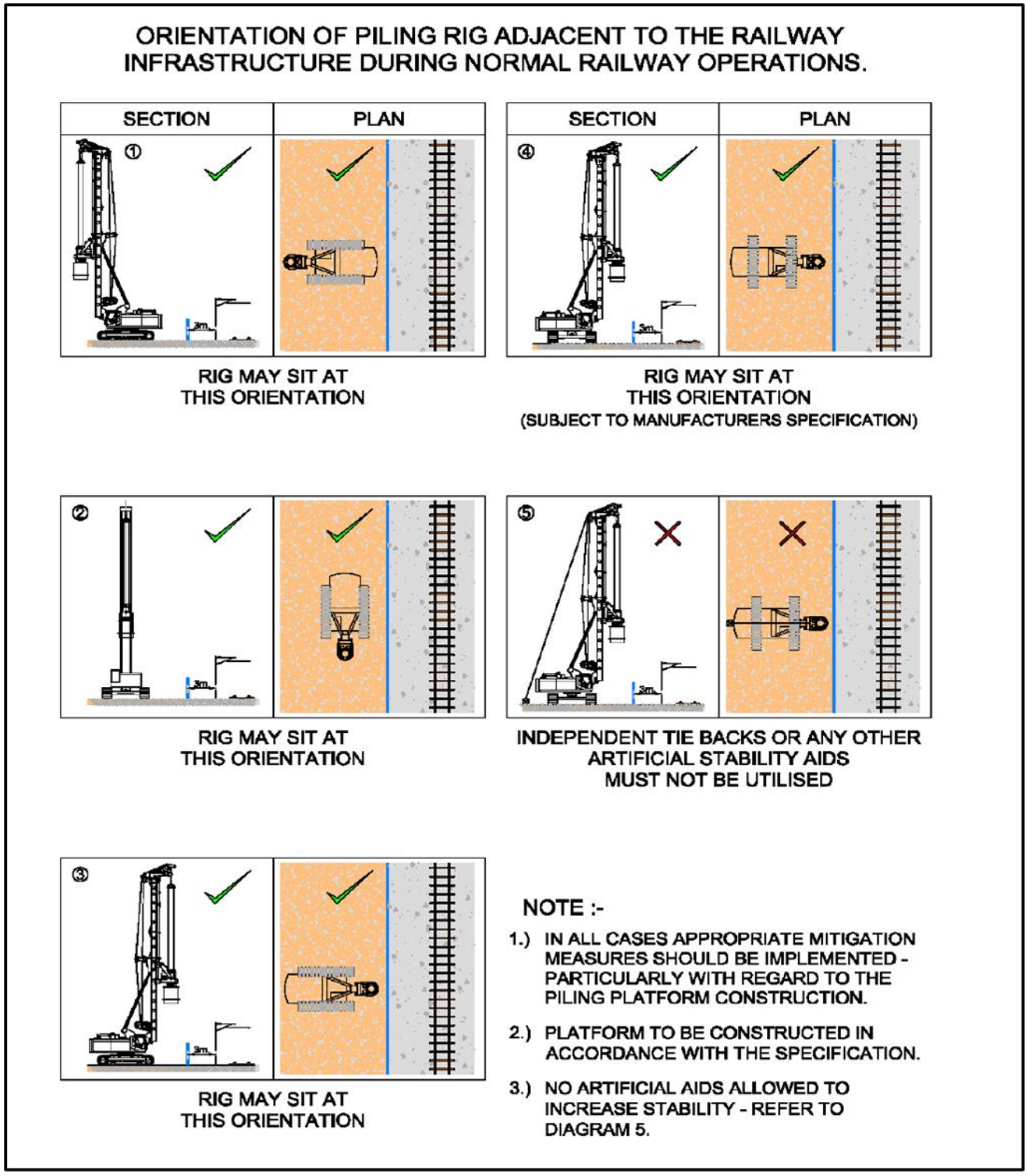


Figure 5.9: NR Standard NR/L3/INI/CP0063 Safe Rig Operations Adjacent to Normal Railway Operations

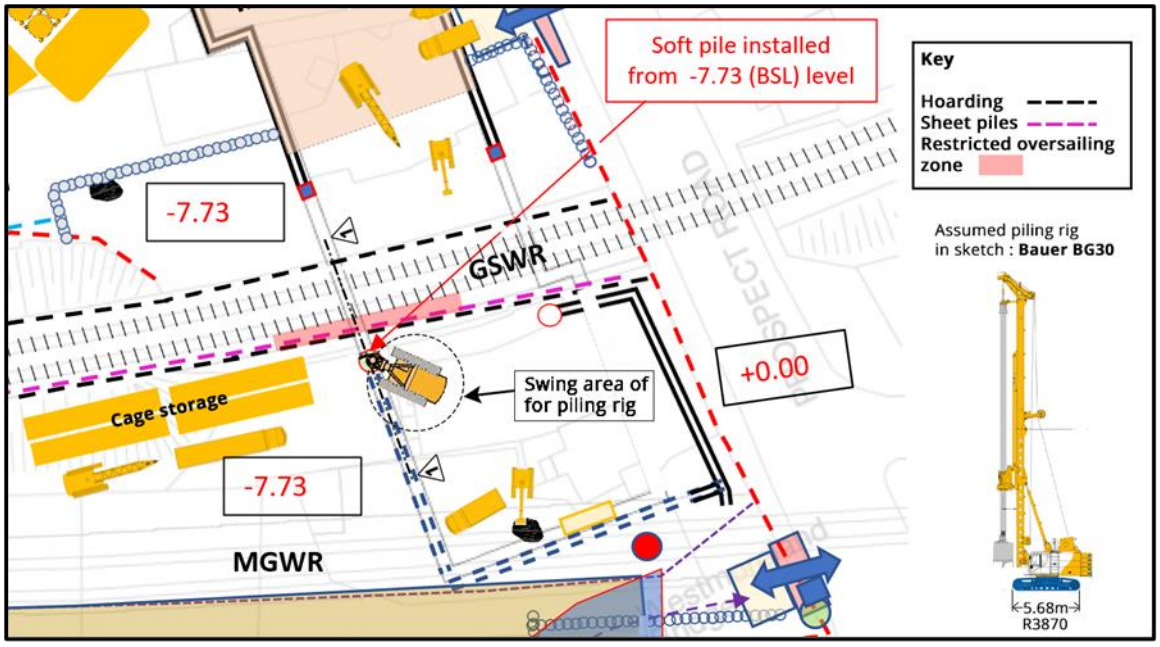


Figure 5.10: Plan View of Distance Between Piling Rig and Operating GSWR Railway

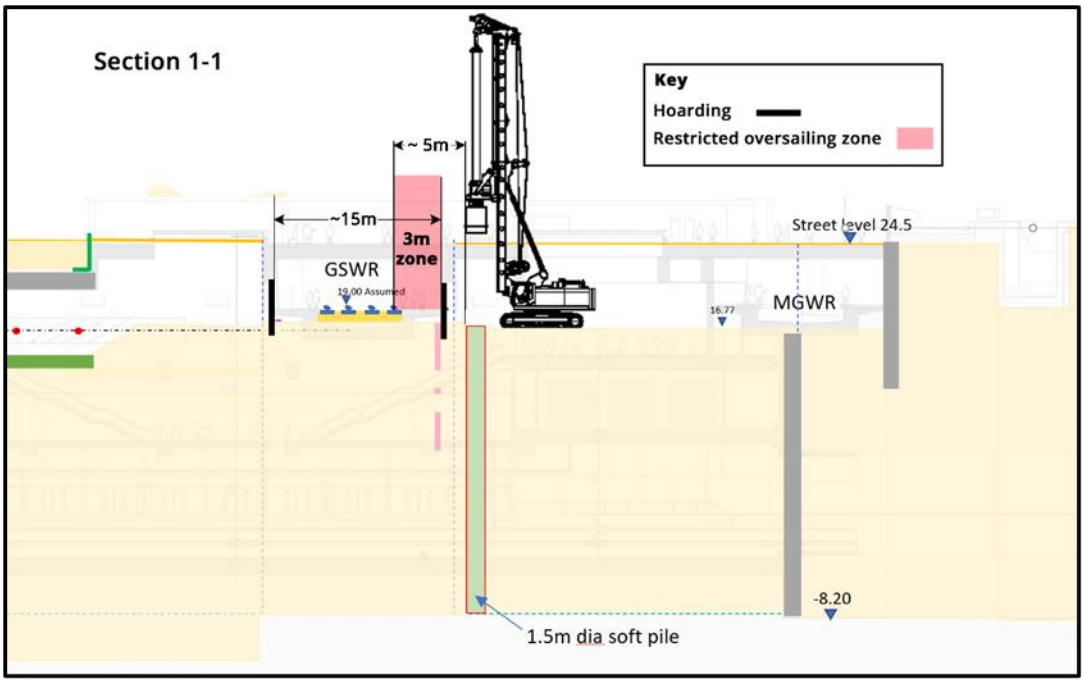


Figure 5.11: View of Section 1-1 as Indicated in Figure 1-3

5.4 Grouting below Diaphragm Walls

The diaphragm walls extending into the solid limestone (as will be the case for the whole of Glasnevin Station), will act as a barrier to water ingress from the Made Ground, Boulder Clay and Transition zone materials. Grouting will be carried out to seal any leaks that are found at diaphragm wall panel junctions, as the excavation within the diaphragm wall box progresses.

It is likely that the base of the box will need to be sealed by grouting.

The main layer for water transmission is recognised as the Transition Zone between the bedrock and Boulder Clay. To restrict flow from this layer into the base of the excavation beneath the toes of the diaphragm walls along fissures in the rock, permeation grouting will be undertaken at the toe of the diaphragm walls.

The permeation grouting is anticipated to consist of the drilling of a number of boreholes through reservation tubes cast into the diaphragm walls as illustrated in Figure 5.12, followed by the staged injection of cementitious grout covering the required depth, injecting to a pre-set target pressure.

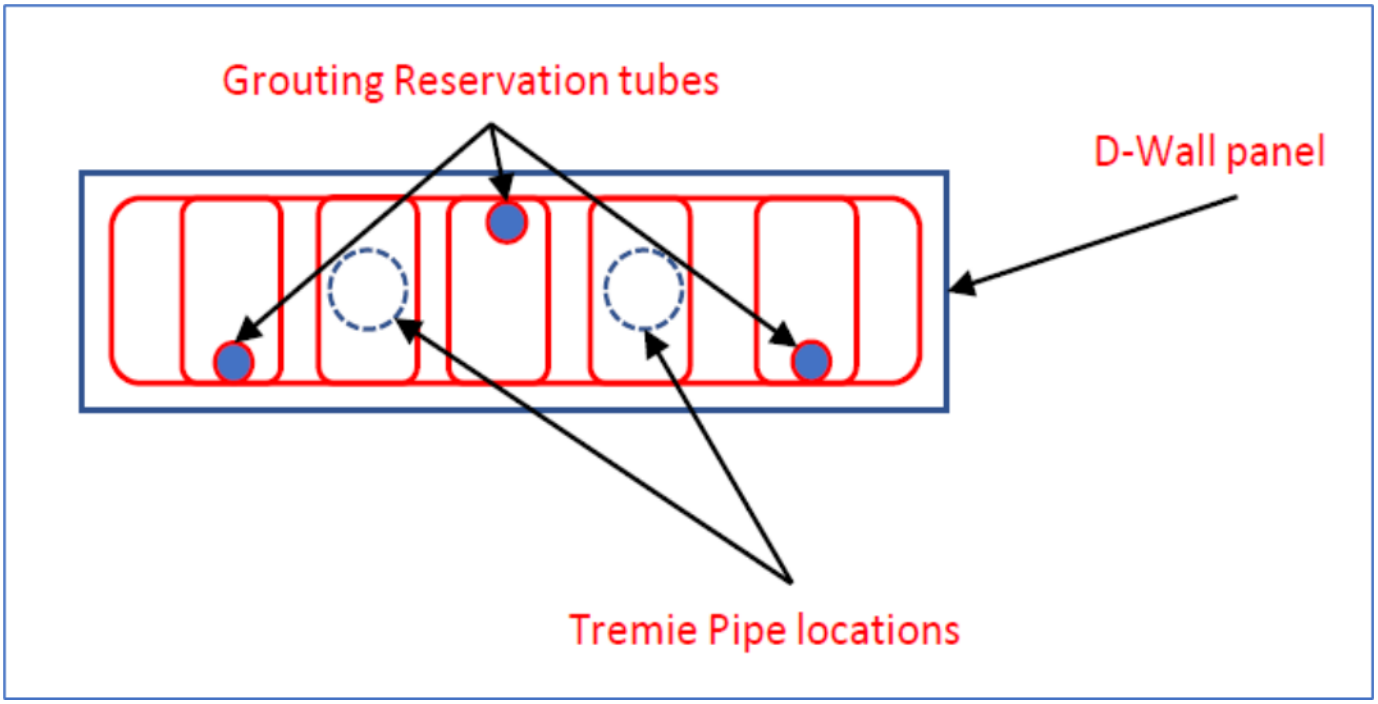


Figure 5.12: Grouting Reservation Tube layout in a Diaphragm Wall Panel

The grouting requirements will be defined following additional ground investigation, including permeability tests. They will then be refined on site, reacting to conditions encountered and grout volumes injected.

5.5 MGWR and GSWR Track Lowering

There is a requirement to modify the track layout and alignment at Glasnevin which involves lowering a large section of the track by approximately 2m and modification to the existing junction. Throughout the assessment and development stages, the most considered approach is the full track lowering methods throughout the closure periods.

Full track lowering, under a closure, involves lowering the tracks in one go before reopening the line. This includes the GSWR tracks, the junction and the MGWR (Ch. 0900-1350) tracks throughout the blockade period.

It is assumed that both railways will not be electrified prior to Metrolink Station construction commences.

5.6 Stage 3: D-wall and Piling – Phase 1

The works during this phase are detailed in Table 5-3.

Table 5-3: Diaphragm Wall and Piling Activities for Northern and Southern Sites

Northern	Southern
Configure the site for D-wall operations and mobilise the necessary plant to site. Configuration includes the installation of a working platform for the safe operation of the rigs, the installation of a Bentonite plant and a water storage area for both waste and ground water, including temporary sheet piles adjacent to Prospect Road. Install guide walls for the D-walling works. Install sheet piles to strengthen the GSWR embankment so that the area above can be used for reinforcement cage storage and allow for heavy plant movements. Commence D-walling for the north half of the station box.	MGWR is closed. Configure the site for piling operations and mobilise the necessary plant. During these works the existing tunnel over the MGWR railway will be used as a haul road. The existing railway tunnel may need to be accessed and potentially strengthened to ensure the capacity for the expected site traffic. Commence secant piling strengthening operations for the MGWR embankment retaining wall adjacent to existing canal D-wall works will commence from street level concurrently with the northern site D-walls operations.

The site layout for these works is shown in Figure 5-13.

The key activities during this stage are preparation for commencement of the D-wall construction for the northern and southern section of the station box, which includes installation of sheet piling to support the north embankment to maintain a working platform and along Prospect Road adjacent to the perimeter D-wall.

The rebar for the D-walls and pile construction in the north site will likely be stored at a separate logistics site and delivered to site when required.

Once the northern D-walls are complete, the rig will be remobilised to construct the D-walls to the south station box wall which are installed from the lower level.

The piling works are within close proximity of the operation railway, however possession are not expected. This situation also arises for the plant constructing the high-level section of diaphragm walls to the south side of the station box and the secant piled retaining wall adjacent to the MGWR tunnel parallel to the Royal Canal. Refer to Figure 5-14 for the extent of permanent works and proximity to the stakeholders' structures.

Construction Stage 3 assumes that secant piling for the new retaining wall between the canal and the south wall of the MGWR is carried out with the MGWR closed. The typical distance from the existing retaining wall to the alignment of the piles is 4.2m as indicated in Figure 5.15. This is an indicative cross section across the MGWR and Royal Canal Way showing where major plant items can be located relative to the tunnel.

Table 5-4 lists the main plant items likely to be working in proximity to the existing tunnel, whether crossing from Prospect Road on to Royal Canal Way or operating adjacent to the existing retaining wall during secant piling construction. The GSWR and MGWR tracks will remain at existing level, this means that no track lowering occurs within the station construction site at this stage.

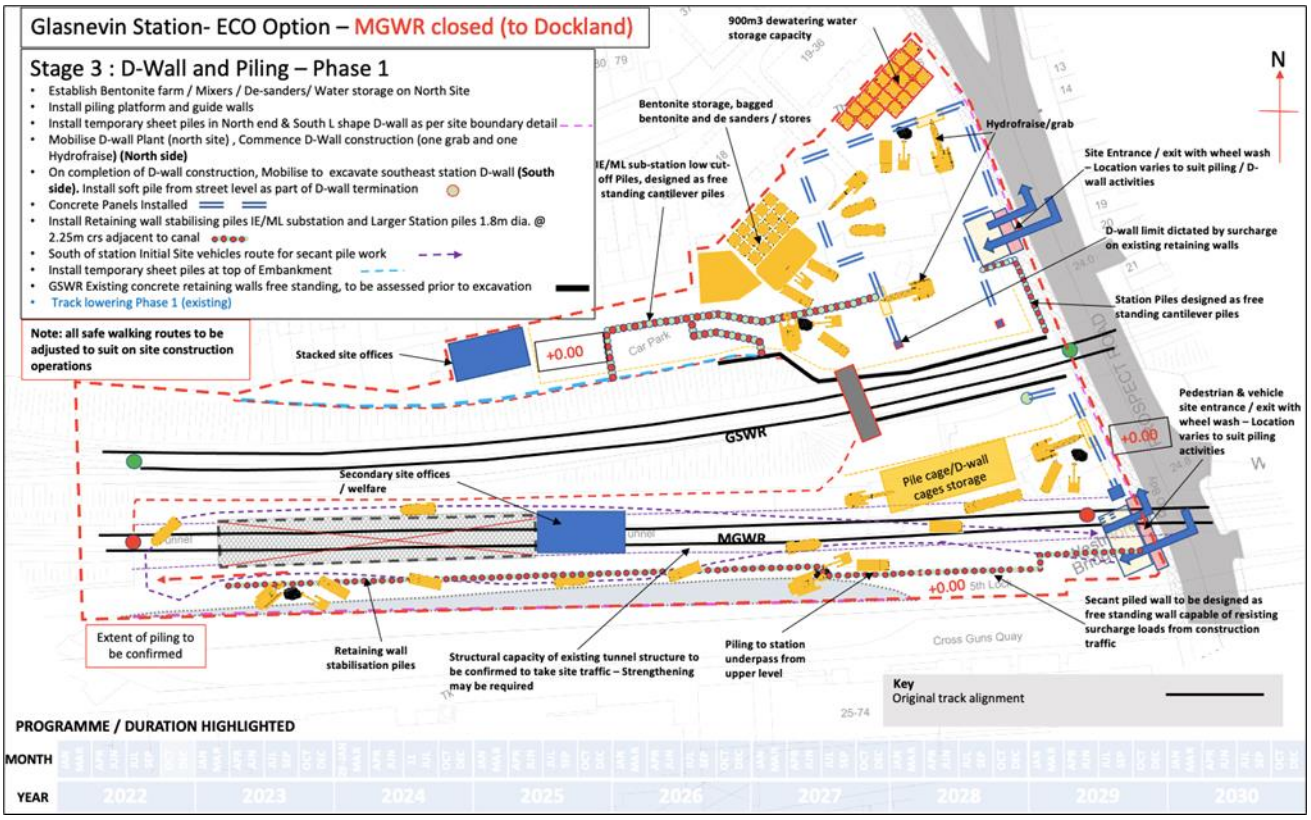


Figure 5.13: D-wall and Piling Phase 1

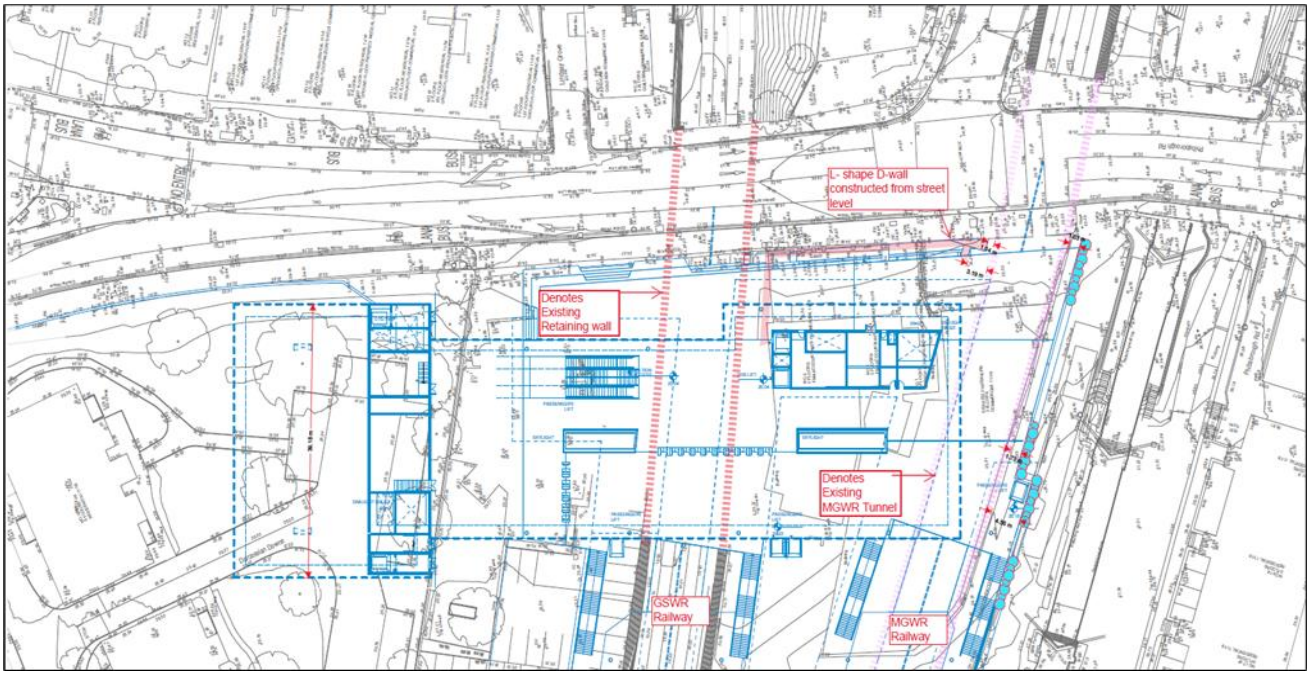


Figure 5.14 Permanent Structure in Close Proximity of Stake-Holders Structure

Table 5-4: Main Plant Items Working in Proximity to the Existing Tunnel

Plant/ Equipment Type	Typical Manufacture	Tare / Travel Weight (Tonnes)	Gross/operating Weight (Tonnes)	Axles/ground pressure (kPa)
360* excavator – 22T	Hitachi ZX190LC-6	22	22	35.4kPa
360 excavator – 45 T	Hitachi ZX470 870LCR	46	46 - 80	52kPa
110T crawler crane	Liebherr LR 1110	99	99	92.9kPa
250T mobile crane	Liebherr LTM 1250	60	60	5 axles
Piling Rig (R3870)	Bauer BG 30 (R3870)	60	102	137kPa
Truck mixer 6m^3	Various	12	26	3 axles
Truck mixer 8m^3	Various	13	32	4 axles
Road Sweeper	Bucher V65	4.5	4.5	2 axles
Low loader	Various	9+22	According to load	6+6 axles
Tipper 6 wheel	Various	10	25	3 axles
Tipper 8 wheel	Various	12	32	4 axles
Flatbed	Various	8	18	3 axles

5.7 Stage 4: North Top-Down Construction and Excavation and Demolition (South)

The works during this phase are explained in Table 5-5.

Table 5-5: Sequence of Main Construction Activities for Stage 4

Northern	Southern
Construct the roof slab for the northern half of the station box and re-arrange site for Top-Down excavation and construction. Commence Top-Down construction of the northern station section. Remove temporary footbridge. Install cross track ducting for bentonite supply to south site during possession works. Diesel rolling stock is operating.	MGWR is closed. Install a protection screen to the GSWR railway to allow commencement of excavation. Commence phase 1, followed by phase 2, of demolition and excavation of MGWR tunnel down to level -7.73m below street level. Reduce height of existing retaining walls to south side of GSWR/ Install sheet piles / complete removal of remainder of retaining wall (during possessions). The site infrastructure (offices) will be relocated as the works progress. Commence Track lowering phase 2: MGWR retainment, install sheet piled wall (west of station) for track lowering MGWR/GSWR. Install working platform below -7.73m BSL for lower-level D-wall construction.

The site layout for these works is shown in Figure 5.16.

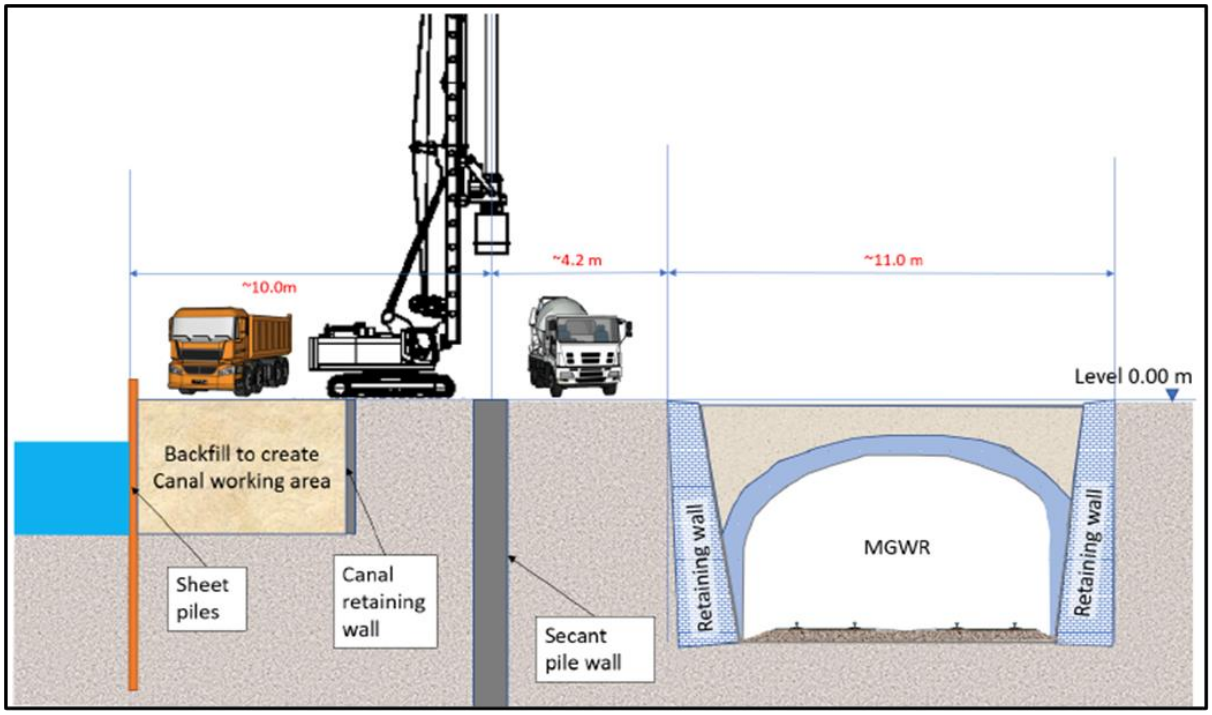


Figure 5.15: Typical Section Across the MGWR / Canal for Secant Piling Activities

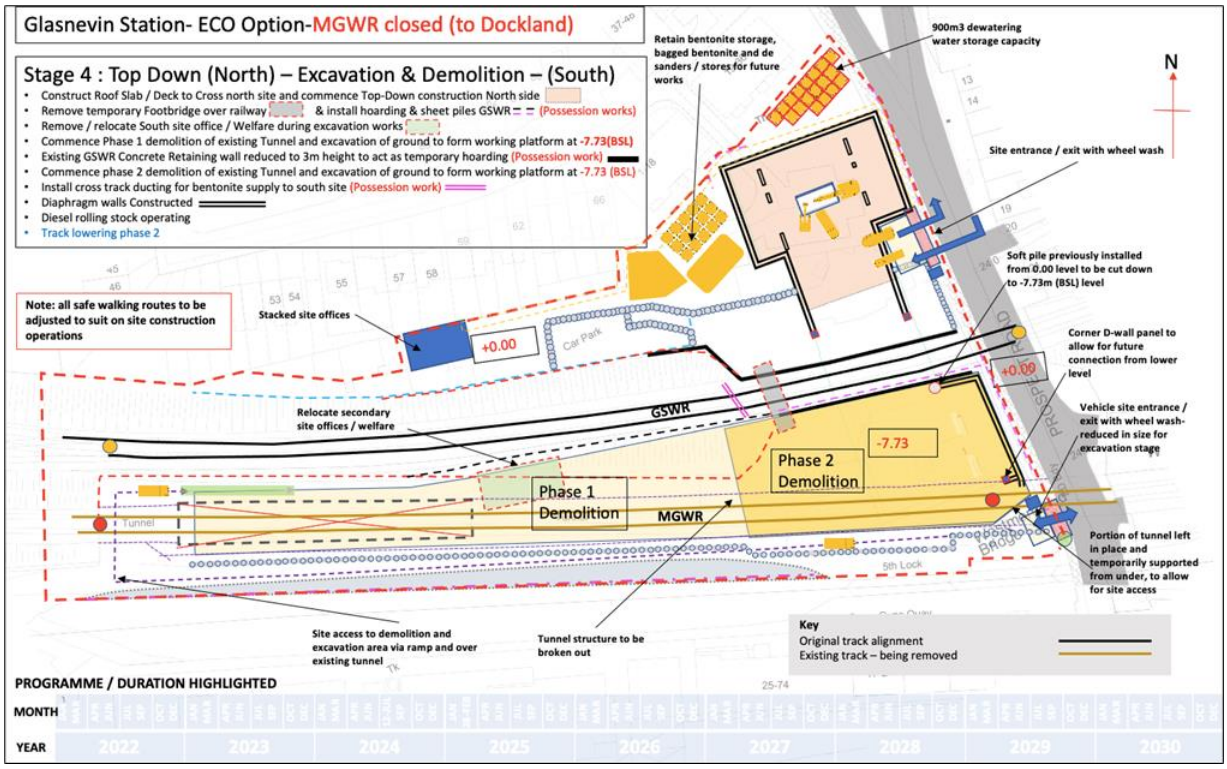


Figure 5.16: Top- down (North) and Phased Excavation and Tunnel Demolition (South)

Possessions on the GSWR are required during Stage 4 for removal of the temporary bridge connecting the north site to the south at high level and to install the hoarding and sheet piles at the southern side of the GSWR to start demolition and excavation of the south site down to level -7.73m below street level to form a working platform. The demolition and excavation of the south side is done in two phases. In Phase 1, the section from MGWR track chainages ch.900 to approximately ch.1050 is demolished and excavated. Phase 2 involves the demolish and excavating of the remaining section of the tunnel towards Prospect Road. A portion of the tunnel is to be left to maintain vehicle access to the southern site. It is assumed that a temporary works design will be required for separating the tunnel roof from its connection with Prospect Road bridge; likely involving stitch drilling and saw cutting.

This stage also sees commencement of the demolition of the existing retaining wall on the south side of the GSWR. Initially it will be reduced to 3m in height in order to maintain a protection barrier/screen for the railway. Diesel rolling stock will be operating during this stage on the GSWR tracks and these will remain in place until the permanent station roof above the GSWR is in place above the tracks (Stage 13) to facilitate installation of the OHLE.

It is planned to install a cross track ducting across the GSWR railway in possession during this stage.

For the cross track ducting, a section of track would need to be lifted and a minimum of 6 No. 300mm diameter steel ducts would need to be laid side by side, at least 1m below the track bed and of sufficient length to clear beyond the protective barriers/screening either side of the track by at least 3m. The ducts would likely need to be bedded and surrounded with concrete prior to reinstating the track formation. 150mm diameter flexible pipes can then be fed through from north to south for the bentonite supply. Alternative solutions would require a non-disruptive operation utilising micro tunnelling techniques to install a steel or concrete pipeline, with sufficient cover beneath the track to ensure ground movement or settlement is within acceptable limits - generally below 5mm. Figure 5.18 shows typical micro tunnelling equipment, and Figure 5.19 shows an indicative cross section beneath the GSWR railway for what could be an arrangement to pipe jack or auger bore.

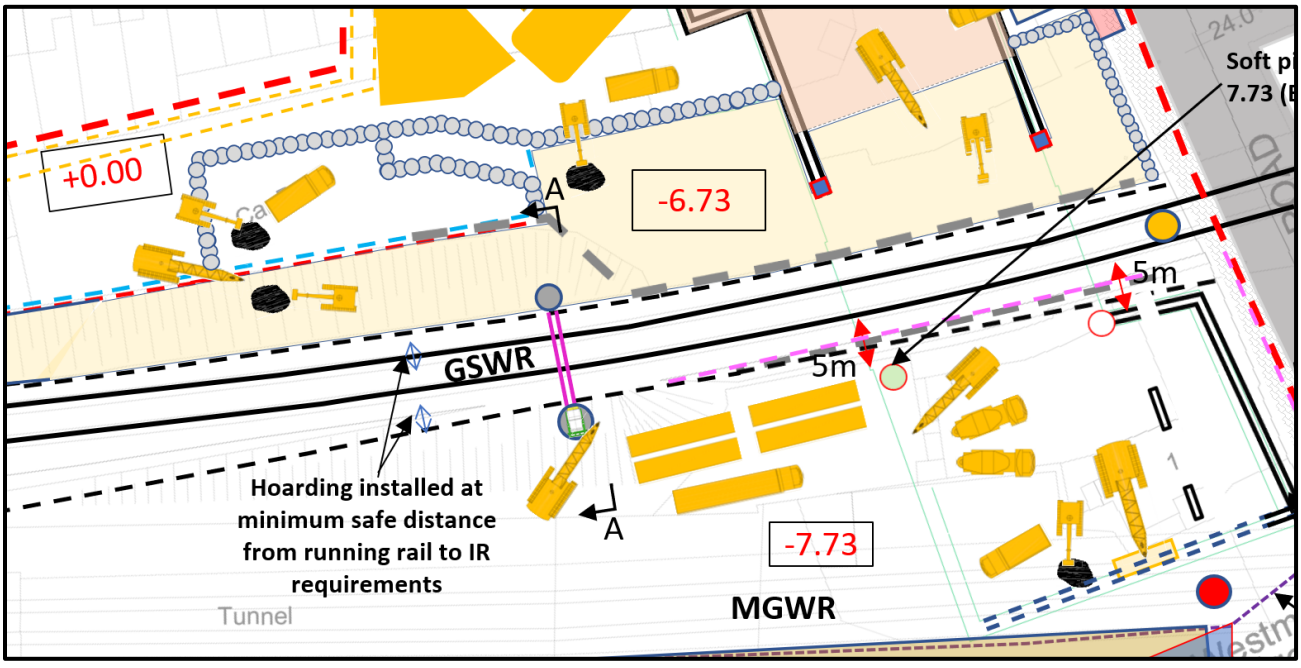


Figure 5.17: Plan view of location of underground track crossing for GSWR railway

Figure 5.18: Typical micro tunnelling set ups and equipment

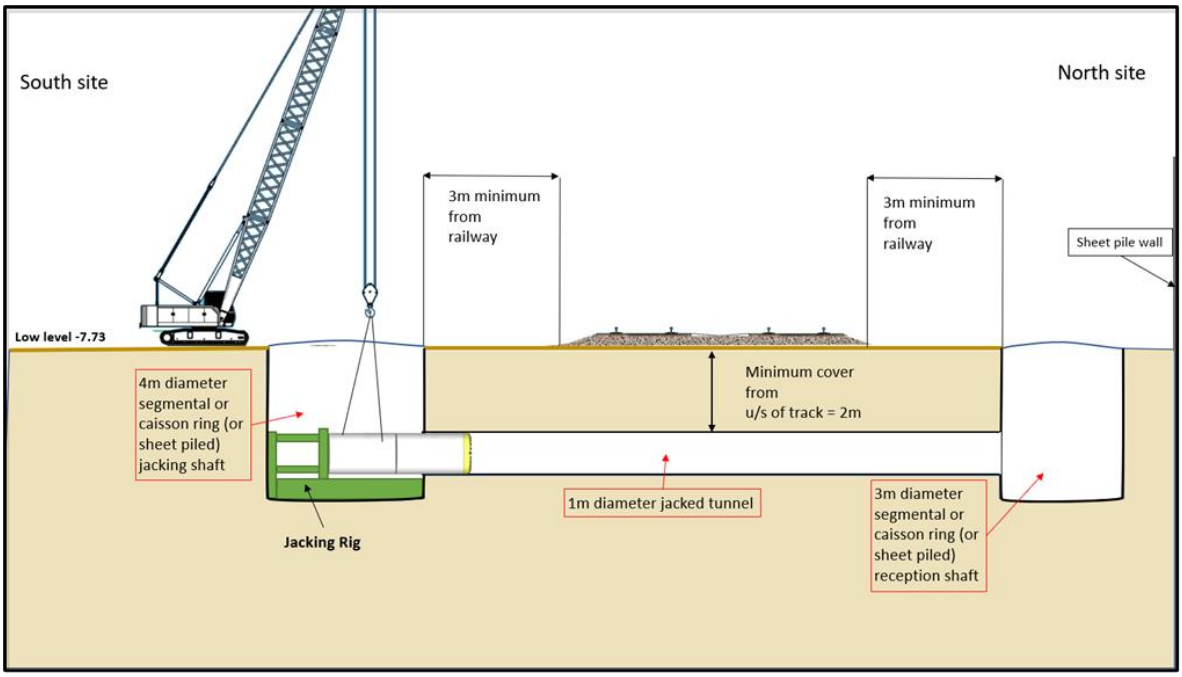


Figure 5.19: Cross Section A-A of a Pipe Jack or Auger Bore Arrangement Beneath the GSWR Railway

5.8 Stage 5: North top down construction and low level D-Wall South – Phase 2

The works during this phase are explained in Table 5-6.

Table 5-6: Key Construction Activities for Stage 5

Northern site and station box	Interlink concourse	Southern site
Install protection hoarding / screen to GSWR to allow commencement of excavation. Reconfigure north site entrance to allow excavation to commence to -6.73m(BSL) whilst working behind the protection screen. Continue Top-Down construction of the northern half of the station box. Remove existing retaining wall. Diesel rolling stock is operating.	Install protection screen to the south and west of the GSWR railway. Install sheet piles to retain the splayed section of the Metrolink substation for vehicle access to site office. Commence the excavation for MetroLink substation /parts of the Interlink concourse adjacent to the operational GSWR railway.	MGWR is closed. Configure the southern site area for D-walling. Install working platform, guide walls. No possession of the GSWR railway is expected. Route lines for bentonite supply from the north to the south of the site via undertrack ducting. Install 1 No soft pile southwest side. Commence D-walling for the remaining portion of the southern half of the station box.

The site layout for these works is shown in Figure 5.20.

Excavation on the north side of the GSWR behind screening, to reduce level to - 6.73m below street level is carried out during this phase.

The Low level D-walling requires the rigs to work near the operational railway as per the guidance outlined in Section 5.3 above. Possession of the railway is not expected for these works.

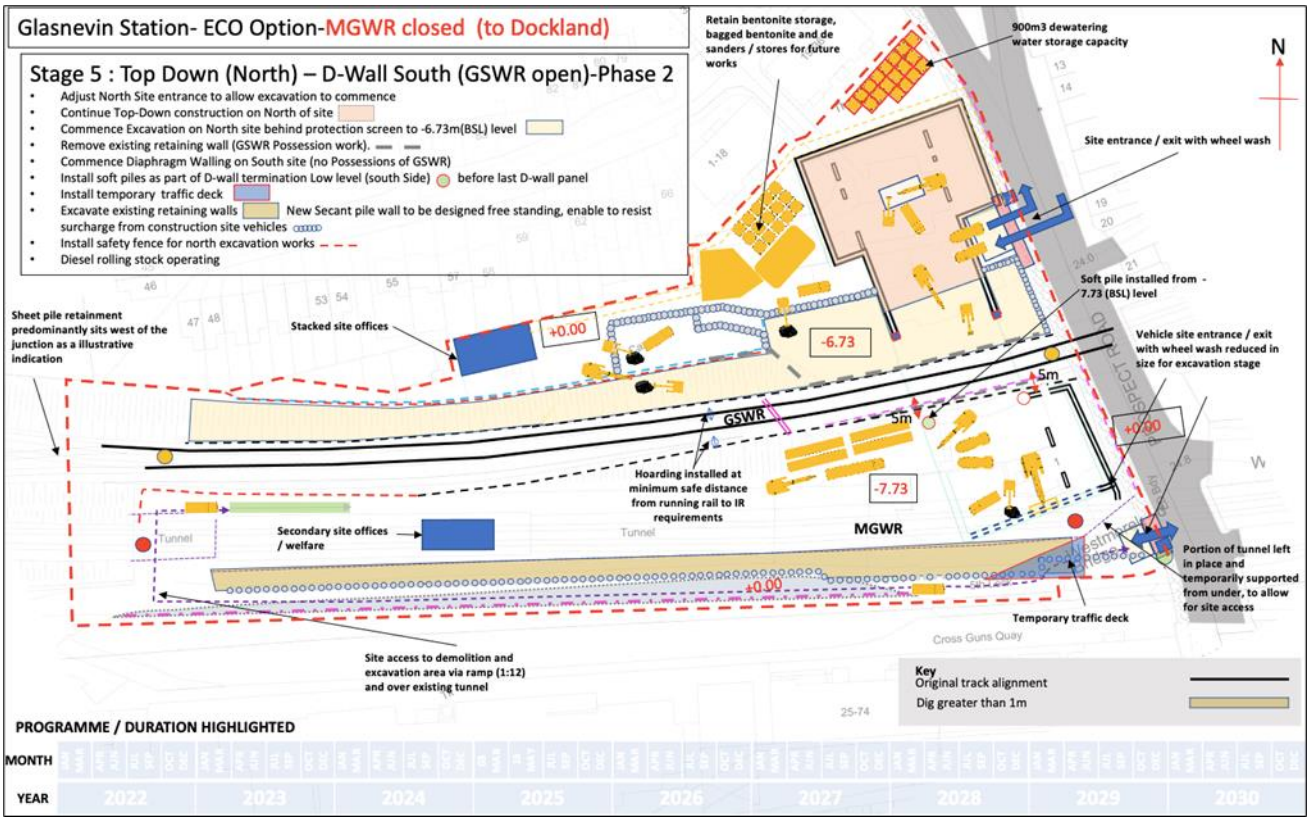


Figure 5.20: Top Down (North) and Low Level D-Wall (South)

Figure 5.21: Diaphragm Wall Panel Arrangement and Sequence of Construction for the Low-Level South Side

5.9 Stage 6: Top-Down construction and Piling interchange

The works during this phase are shown in Table 5-7.

Table 5-7: Key Construction Activities for Stage 6

Northern Site	Interlink Concourse	Southern site
Continue Top-Down construction of the northern half of the station box. Install piling for Interchange basement north of GSWR	Install secant piling for IR substation & interchange basement south of railway. Install soft piles as part of diaphragm wall termination.	MGWR closed. Continue D-wall construction in the southern half.

The site layout for these works is given in Figure 5.22.

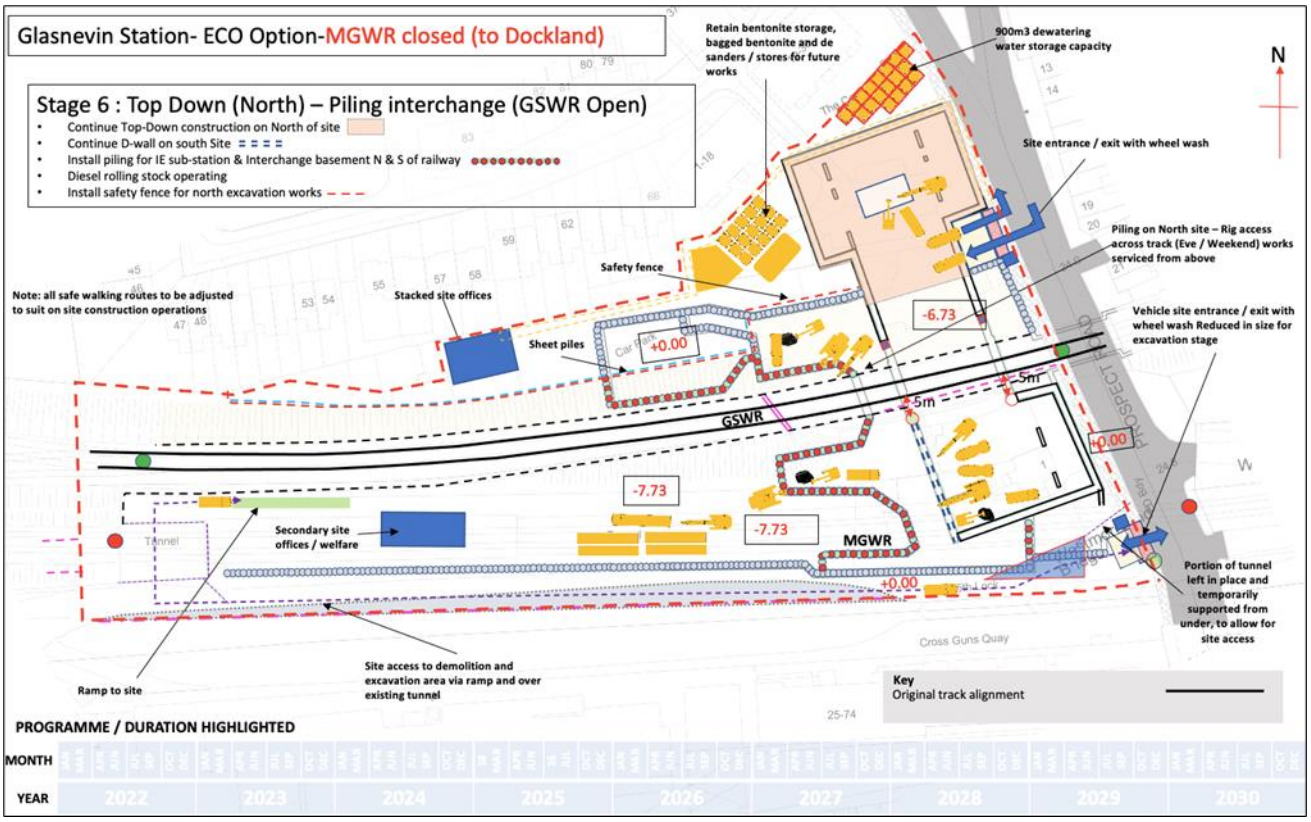


Figure 5.22: Top Down (North) & D-Wall (South)

5.10 Stage 6a: Completion of Piling and D-wall south side

The works during this phase are shown in Table 5-8.

Table 5-8: Key Construction Activities for Stage 6a

Northern Site	Interlink Concourse	Southern site
Continue Top-Down construction.	Complete installation 900mm diameter secant piling to interchange concourse.	MGWR closed. Complete D-wall construction. Construct splayed wall/beam & corner column.

The site layout for these works is given in Figure 5.23.

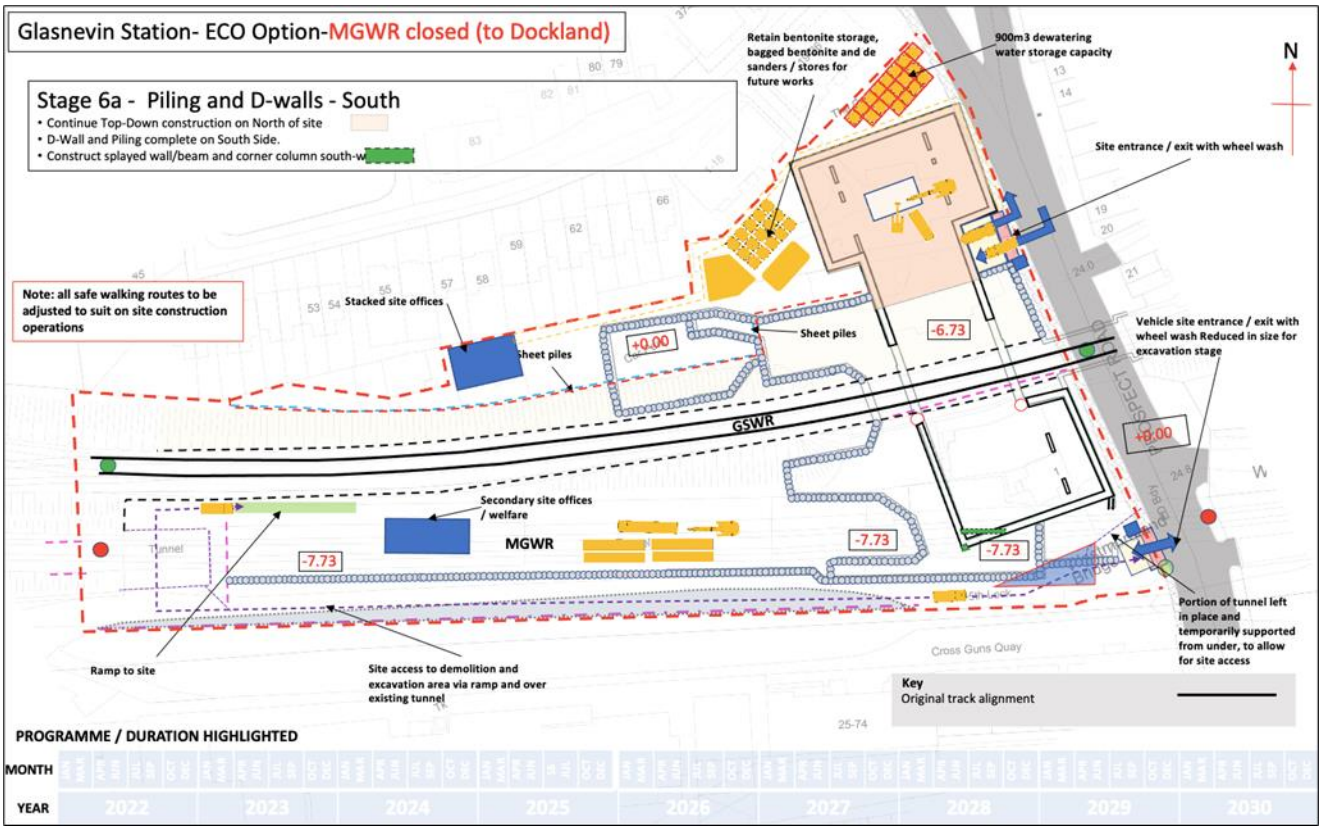


Figure 5.23: D-Wall and Piling Completion on South Side

It is likely that line speed restrictions will be in place throughout the Glasnevin Station construction. Determining a line speed is likely to involve a temporary design, several technical standards (IR) and agreement between various engineering and operating departments.

Based on a train travelling 50kph over a set kilometre length of track, not including braking and acceleration distances, takes 1 min and 12 seconds. Reducing the speed to 25kph along half of the kilometre length would take 1 min and 48 seconds, or an increased journey time of 36 seconds.

Top-Down excavation and construction continues to the north station box, and D-wall to the south and west walls of the station box.

5.11 Stage 7: Top Down on hold (North) - Reduce levels and Cast MGWR bridge slab - South end (south) and Access Ramp (South)

The works during this phase are indicated in Table 5-9.

Table 5-9: Key Construction Activities for Stage 7

Northern Site	Interlink Concourse	Southern site
Top-Down construction on hold until the earth berm is lowered to mezzanine slab.	Secant piling south and north sides complete.	MGWR closed. Breakdown 1.0m of tremie concrete on south and west side D-wall in sections and construct capping beam Construct subway roof/MGWR track trough and install temporary crash deck over Cast lining walls to southern retaining walls adjacent to canal basin Install access ramp into south site bridging over MGWR railway (TBC by designer) Construct southern platforms

The site layout for these works is given in Figure 5-24.

Installation of an access ramp from +0.00m to -7.73m for all Metrolink site vehicles to use is carried out during this stage. This ramp will have to bridge the MGWR railway and have sufficient capacity for all site vehicles to use and allow the railway to be reopened underneath in due course. The ramp will provide alternative access to construction activities in the central section.

An indicative cross section through the location is shown in Figure 5-25. Refer to Table 5.4 for a list of the plant expected to use the bridge and their relevant weights regarding design loads for the temporary bridge structure.

A Swept Path Analysis exercise has been carried out to assess the viability of installing at this location.

The bridge and ramp should be bi-directional and will also need to have a cantilever on one side for pedestrian access.

It is planned that the bridge and ramp are installed while the MGWR is closed, providing an alternative access to the existing western access via bridge OBD 221, which will be demolished for the MGWR track lowering east of chainage 850. The temporary bridge will remain in place until completion of the central MGWR platform and all MetroLink works which require access to the central area of site (Stage13).

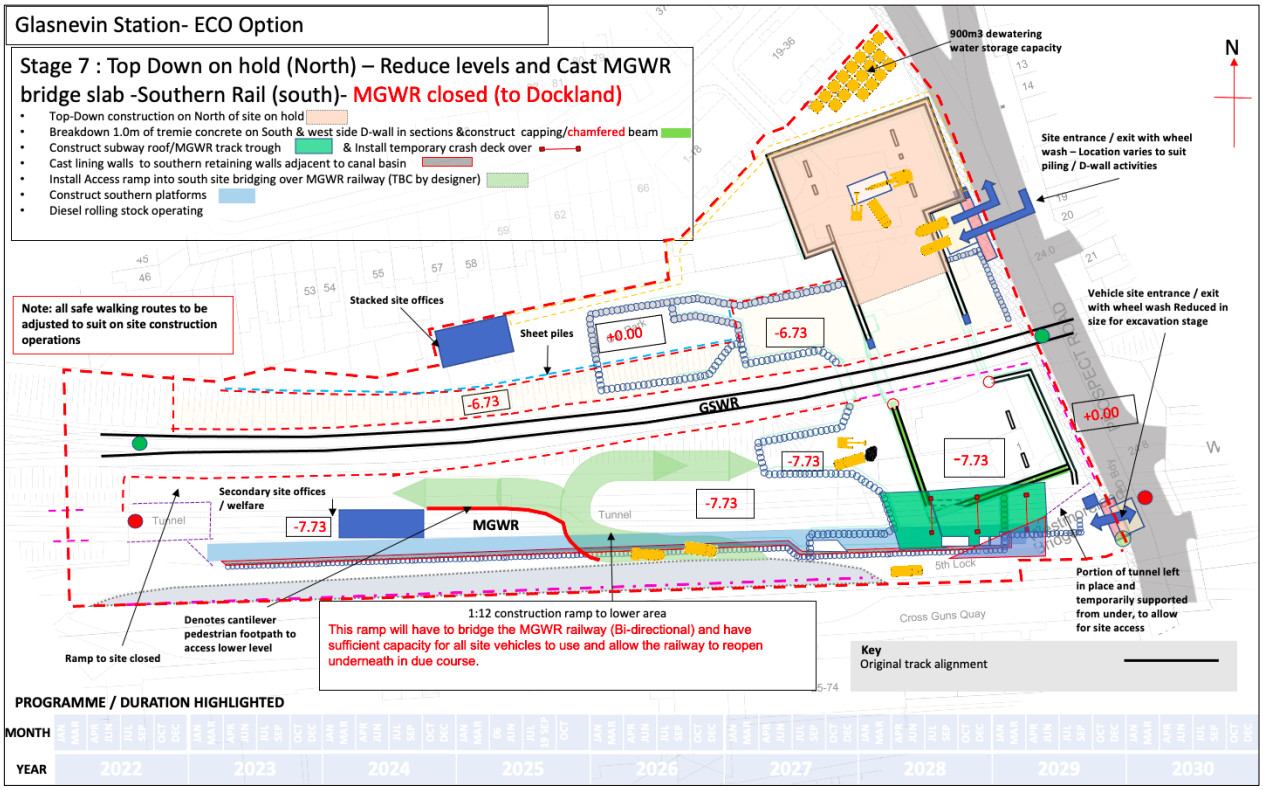


Figure 5.24: Top Down (North)-Access Ramp (South)

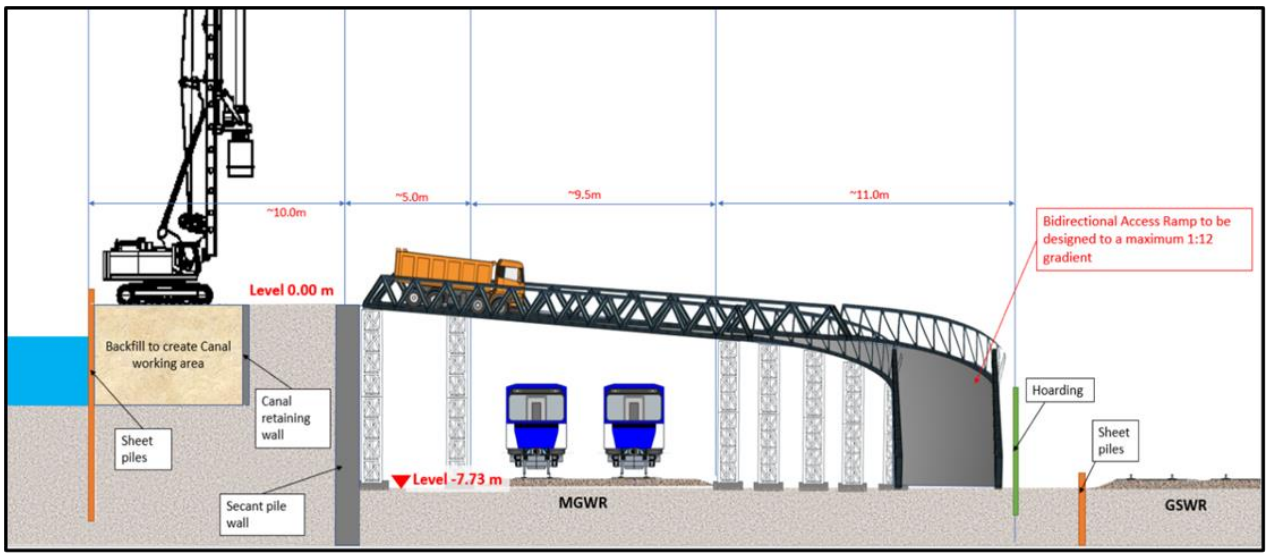


Figure 5.25 Indicative Cross Section of a Temporary Bridge Structure Over MGWR

5.12 Stage 8: Top Down (North) on hold – Full Track lowering west of CH 850 – Commence GSWR bridge deck pre-casting.

The works during this phase are shown in Table 5-10.

Table 5-10: Key Construction Activities for Stage 8

Northern Site	Interlink Concourse	Southern site
Top-Down construction on hold until the earthen berm is lowered to mezzanine slab Diesel rolling stock operating		MGWR closed. Full track lowering of MGWR west of chainage 850. Demolish West tunnel & carry out final track lowering to both MGWR lines east of chainage 850. Demolish remaining tunnel adjacent to Prospect Road & install Bailey bridge. Excavate area for bridge slide to -8.49m BSL level and cast temporary 600mm thick slab, incorporating slide rails. Install OHLE supports MGWR.

The site layout for these works is given in Figure 5.26.

Within Stage 8, full track lowering of MGWR west of Chainage 850 is carried out within the two week MGWR closure. Subsequently, the final track lowering to the MGWR railway lines for the south site east of chainage 850 is carried out. This includes the demolition of the west access provided by bridge OBD 221. The remaining portion of the tunnel adjacent to Prospect Road is also demolished. It is assumed that a temporary works design will be required for separating the tunnel roof from its connection with Prospect Road bridge; likely involving stitch drilling and saw cutting.

This stage includes pre-casting of the GSWR bridge deck and preparation for sliding into position.

It is noted that the GSWR tracks during this stage and preceding stages are maintained at their current level and supported by the rows of temporary sheet piling only on the south side. As part of the excavation sequence for the north box, a berm will be left in place to ensure stability. Sheet piling to support the tracks north side of the GSWR are no longer required. Excavation on the north side reduced to -6.73 BSL. Excavation battered against and to support the rail formation as required.

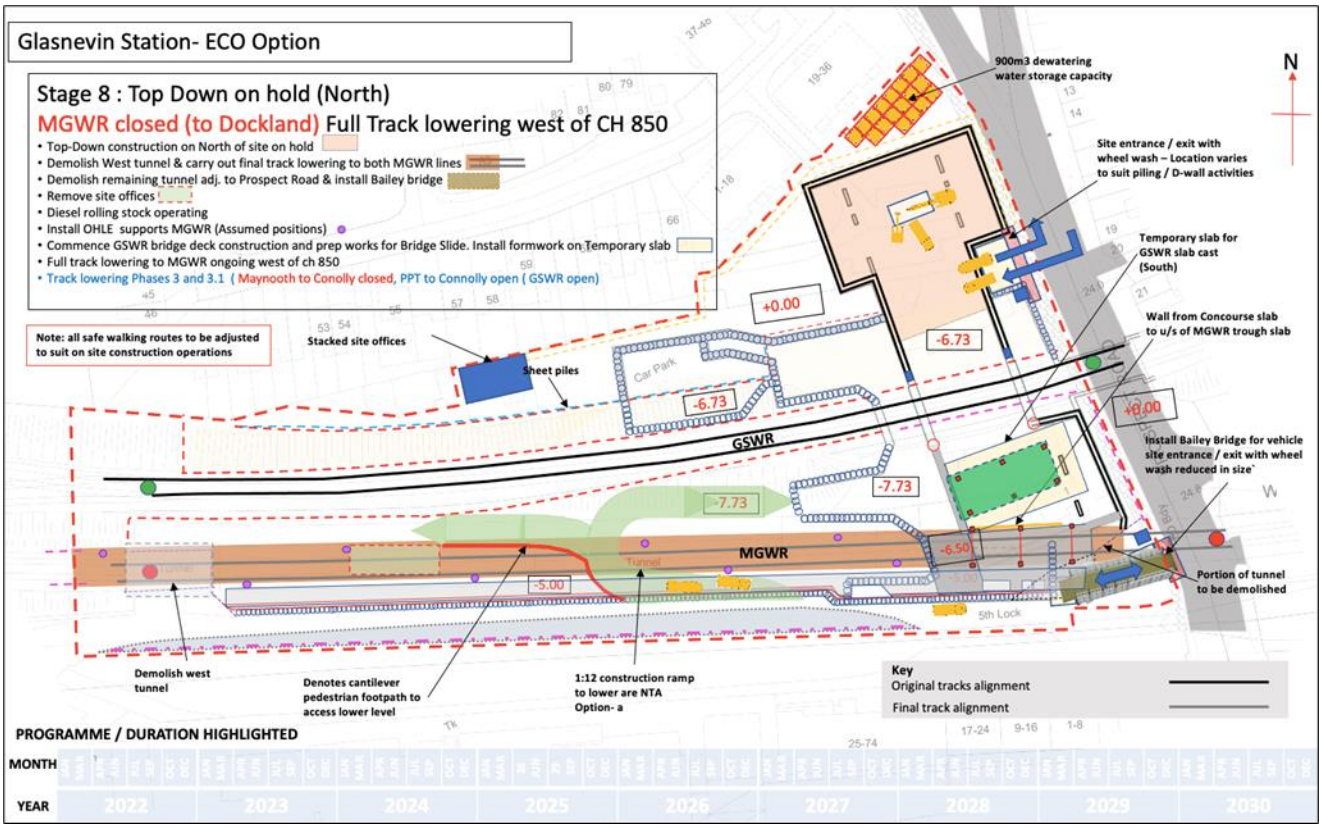


Figure 5.26: Top Down (North) on hold – Full Track Lowering West of ch. 850 - Start GSWR Bridge Build

5.13 Stage 9: Top Down (North) on hold – Remove and prepare for Bridge Slide – GSWR closed

The works during this phase are shown in Table 5-11.

Table 5-11: Key Construction activities for Stage 9

Northern station box	Central station box and interlink concourse	South site
GSWR is closed. Top-Down construction on hold. Mobilise piling equipment from the south side of the railway. Lift tracks, excavate and install piling mat. Construct 2 soft piles. Construct 2 Nos single bite D-wall panels. Construct 1.5m diameter secant piles to central station box.	GSWR closed. Remove track to west. Prepare piling mat & construct 900mm diameter secant piles to subway wall across GSWR. Construct capping beams, excavate and cast temporary beams to support extended slide rails. Excavate and lower GSWR railway tracks to final alignment.	MGWR reopened. Preparation for bridge slide. Install temporary crash deck over GSWR bridge prior to slide.

The site layout for these works is given in Figure 5.27.

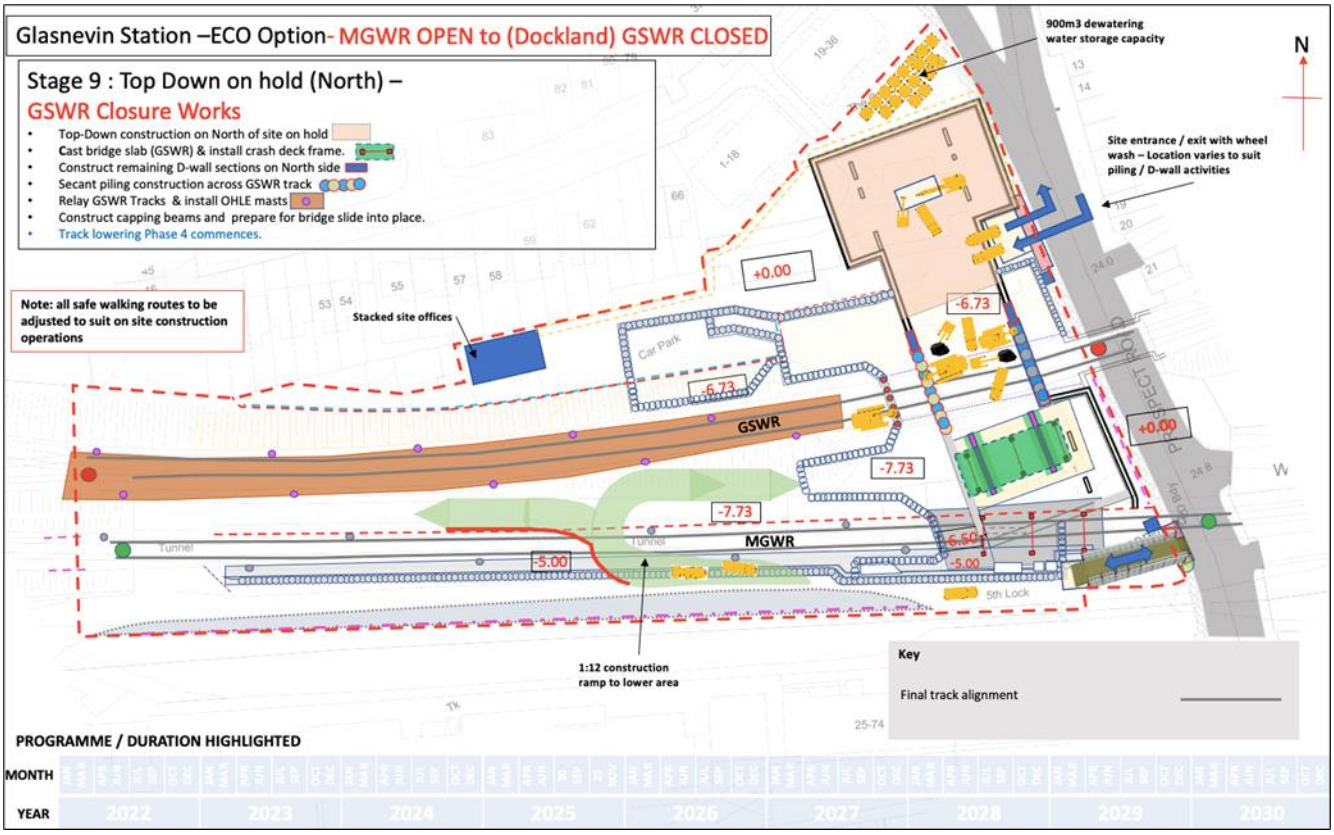


Figure 5.27: Top Down on Hold (North), Lower GSWR and Prepare for Bridge Slide

In this phase the tracks are removed, piling mat installed and two soft piles adjacent to the north side of the GSWR are constructed. Following the completion of the soft piles, two single bite D-wall panels, to connect the previously installed soft piles to the north station box D-walls are constructed.

On demobilising the D-wall rig, the 1.5m diameter secant piles for the central section of the station box, and 900m diameter secant piles for the subway wall crossing the GSWR railway tracks are undertaken. One rig for each operation.

The final preparation activities for the GSWR bridge slide are programmed to be carried out within this closure such that the bridge can be in place for the final stage of the track lowering.

The casting operation will include provision for a temporary crash deck structure to enclose and protect the railway during follow on works to place precast planks forming the roof above the railway.

5.14 Stage 10: Top Down (North) -Subway roof and bridge slide – GSWR closed.

The works during this phase are shown in Table 5-12.

Table 5-12: Key Construction Activities for Stage 10

Northern station box	Interlink concourse	Central station box working from south site
GSWR closed Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Retaining wall construction to the north of GSWR railway.	Slide GSWR bridge into position. Construct northern subway roof GSWR rail alignment. (precast beams). Construct splayed section of the Metrolink substation roof to form working platform for vehicle access	MGWR open Install jacking system, test and commence bridge slide.

The site layout for these works is given in

Figure 5.28.

This stage focuses on the operation to slide the GSWR bridge deck into position, lay ballast and new tracks to reopen the GSWR railway.

Installation of precast slab/beams to form the roof of the interlink concourse subway is carried out at the same time.

Construct the splayed section of the Metrolink substation roof to form a working platform for vehicle access.

Construction of the retaining wall to the north side of the GSWR tracks is ongoing during Stage 10, taking advantage of the closure for the bridge slide and the GSWR track lowering. Figure 5.29, illustrates the assumed north embankment retaining wall detail and the envisaged construction sequence stages.

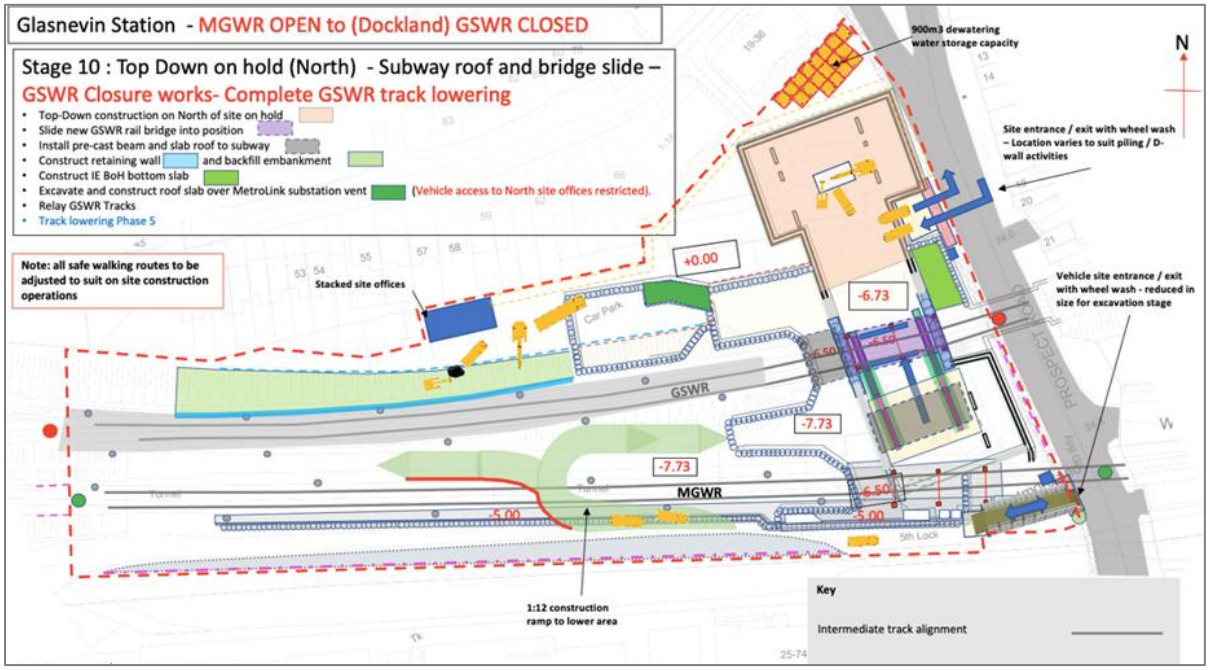


Figure 5.28: Top Down (North)- Subway base and Bridge slide – GSWR closure

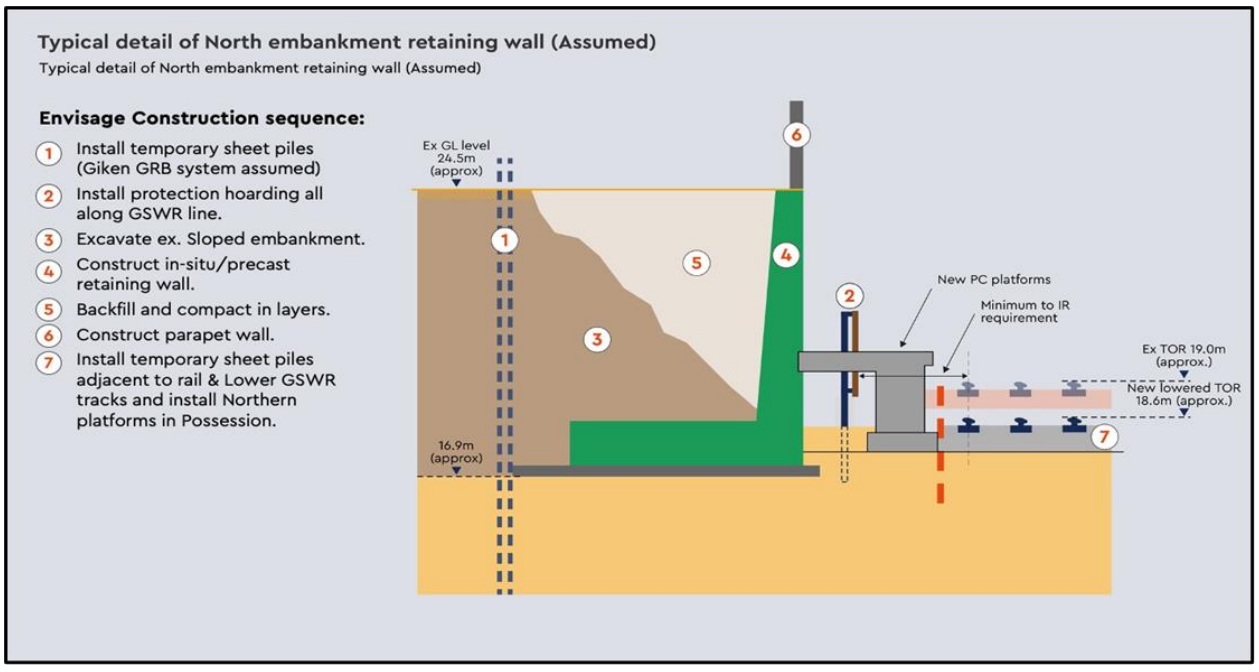


Figure 5.29: Typical North Embankment Retaining Wall Detail (Assumed)

5.15 Stage 11: GSWR Rail Works and Tying Together of Station Structure

The works during this phase are shown in Table 5-13.

Table 5-13: Key Construction Activities for Stage 11

Northern station box	Interlink concourse	Central and South station box
GSWR closed. Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Construct station walls and columns for the permanent Roof slab across the Central section of station box. Construct GSWR Northern /Central platform and prepare to GSWR to re-opened.	Commence construction of the central area above the GSWR railway. Construct station walls and columns for the permanent top slab across the central station box. Excavate remainder of the IR sub-station to bottom slab level.	MGWR open. Remove temporary structures associated with the bridge slide. Construct station walls and columns for the permanent Roof slab across the southern station box. Reconfigure the south site ready for Top-Down construction. Construct MGWR Central platforms in possession work.

The site layout for these works is given in Figure 5.30.

This stage advances construction of the station box and interlink concourse surrounding and over the GSWR tracks up to station roof slab level. Similarly, construction of the station walls and columns for the permanent Roof slab across the southern/central station box, in preparation for the Top-Down construction.

For this activity, a crash deck will be in place over the tracks to guard against any material falling on to the operational railway (refer to Figure 5.31).

During casting of the bridge deck, provision will be made for holding down bolts to be cast into the upstands forming the platform, to which columns can be erected as part of the structure for the crash deck. The intent is that the columns and framework for the crash deck could be assembled either prior to, or on completion of the bridge slide such that the assembly can be in place when the railway is reopened. It is envisaged that the structure could be formed from (minimum) 150 x 150 UC sections and lightweight (steel/aluminium) trusses with safety netting and a deck which could be similar to the patent steel decking shown in

Figure 5.32. Total depth of the crash deck is approximately 600mm with combination of truss/precast planks.

Excavate remainder of the IR sub-station to bottom slab level. Once excavation to IR substation commences, access to site offices is no longer possible for vehicle traffic.

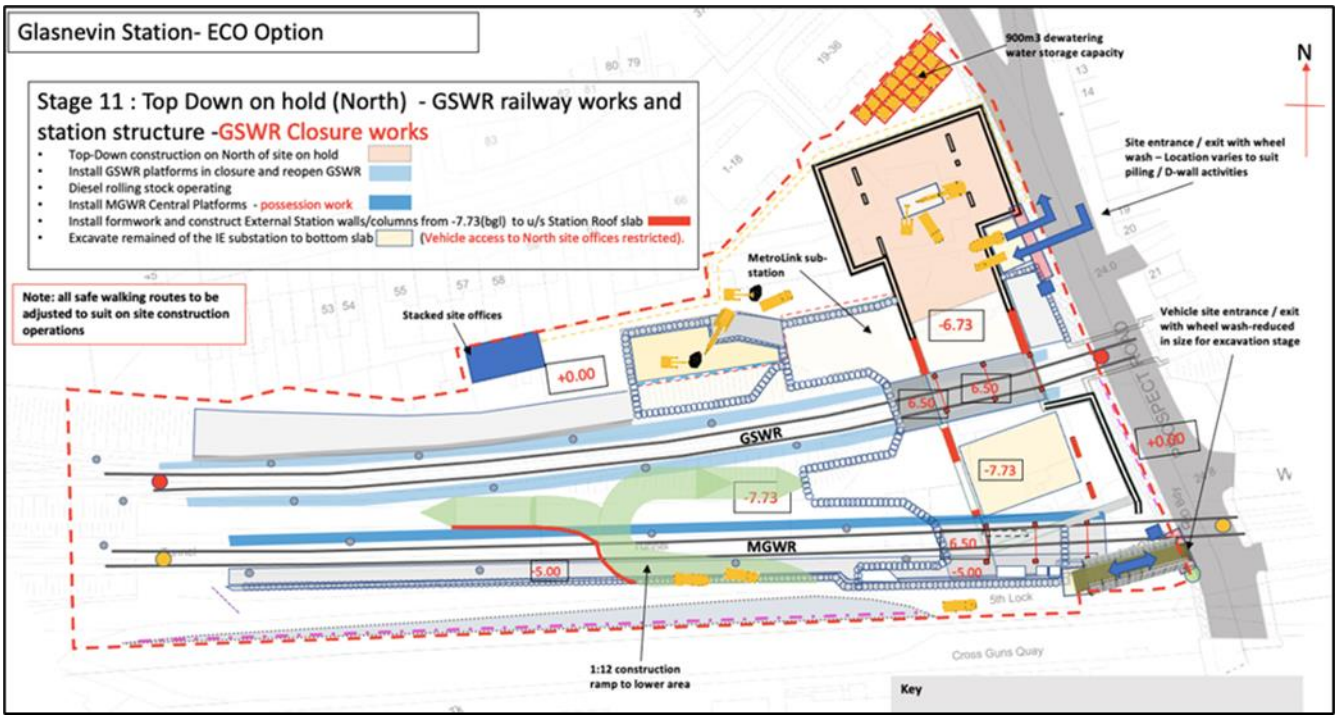


Figure 5.30: Top Down (North)- GSWR rail work and Station structure

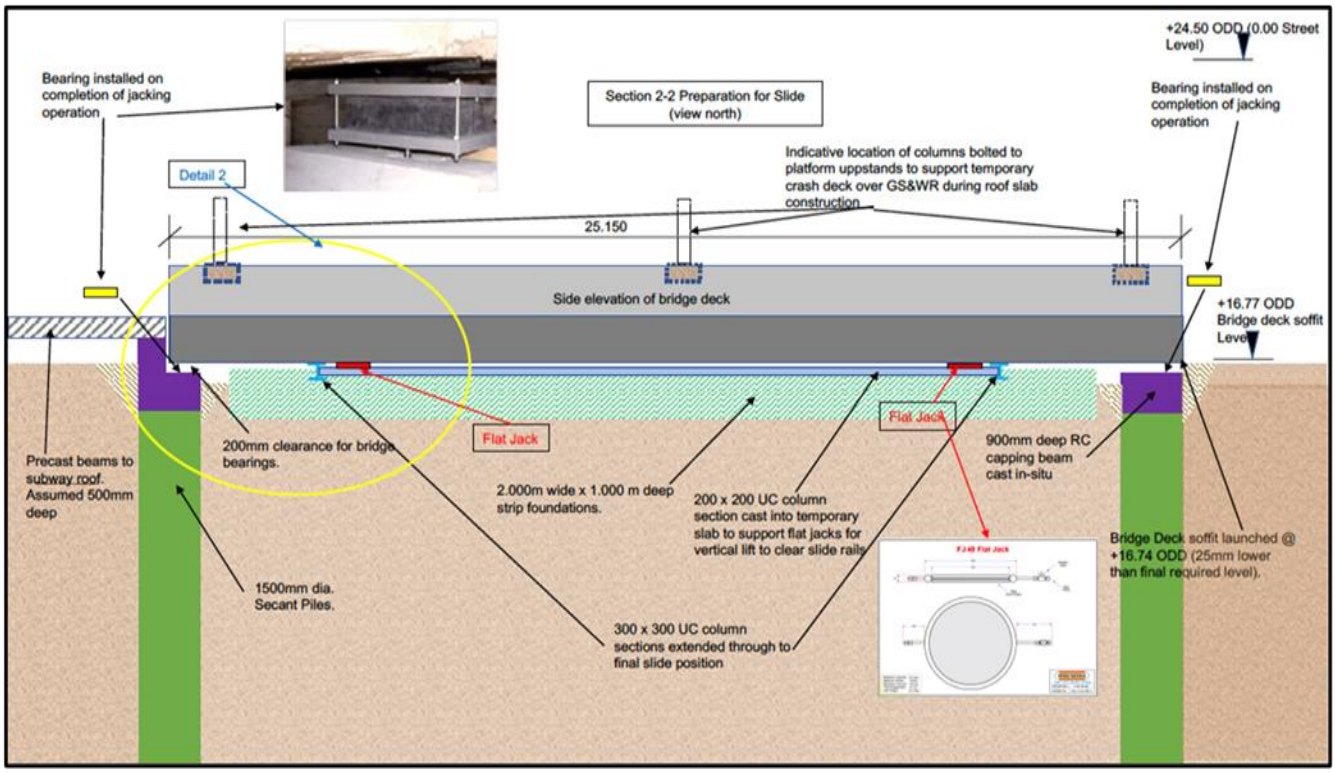


Figure 5.31: Housing for Temporary Columns for Crash Deck in the Bridge Deck

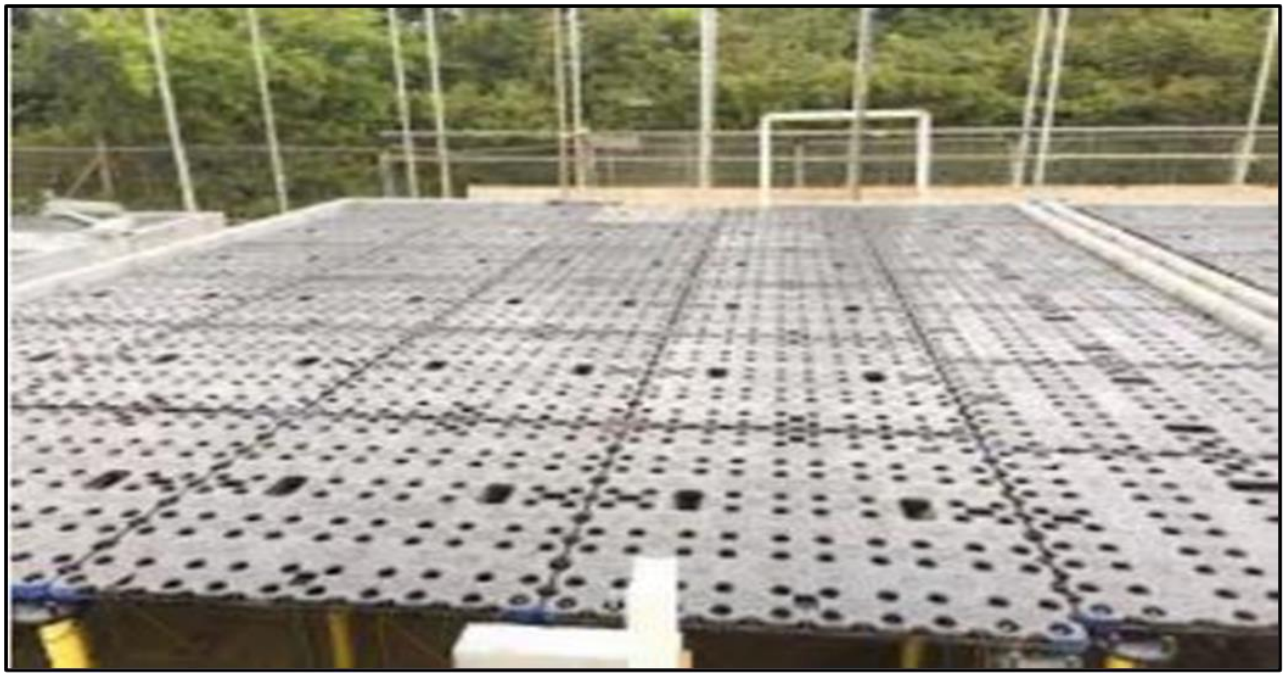


Figure 5.32: Steel crash deck

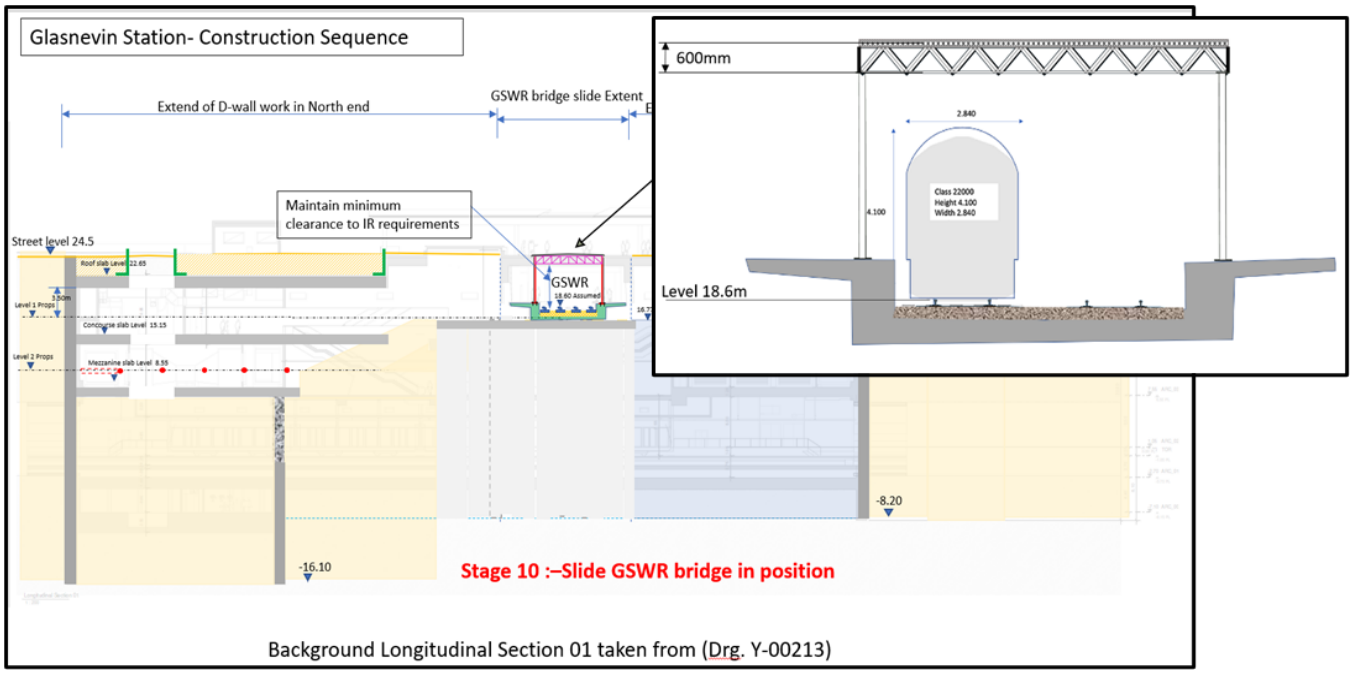


Figure 5.33: Cross section of crash decks over GSWR and MGWR

Figure 5.33 shows an indicative section through the GSWR alignment.

In Stage 11, the MGWR is open and central platform construction is undertaken in possessions. The track lowering is complete and it is assumed that the new OHLE has been installed concurrently with the lowering

operation. Re-opening of the MGWR follows completion of the central platform construction with diesel rolling stock.

5.16 Stage 12: Top Down (North) - Station Roof slab construction

The works during this phase are shown in Figure 5.15.

Table 5-14: Key Construction Activities for Stage 12

Northern station box	Interlink concourse	Central and South station box
GSWR open. Top-Down construction on hold until the earth berm is lowered to mezzanine slab. Cast roof slab north and south of MGWR/GSWR.	Construct subway adjacent to GSWR platform. Construct subway beneath GSWR railway tracks. Construct IR/Metrolink substation bottom slab, followed by structural walls to u/s of the roof slab.	MGWR open. Construct Roof slab south end and Central section. Prepare for Top-Down construction of the southern sections of the station box from street level via new entrance.

The site layout for these works is given in Figure 5.34.

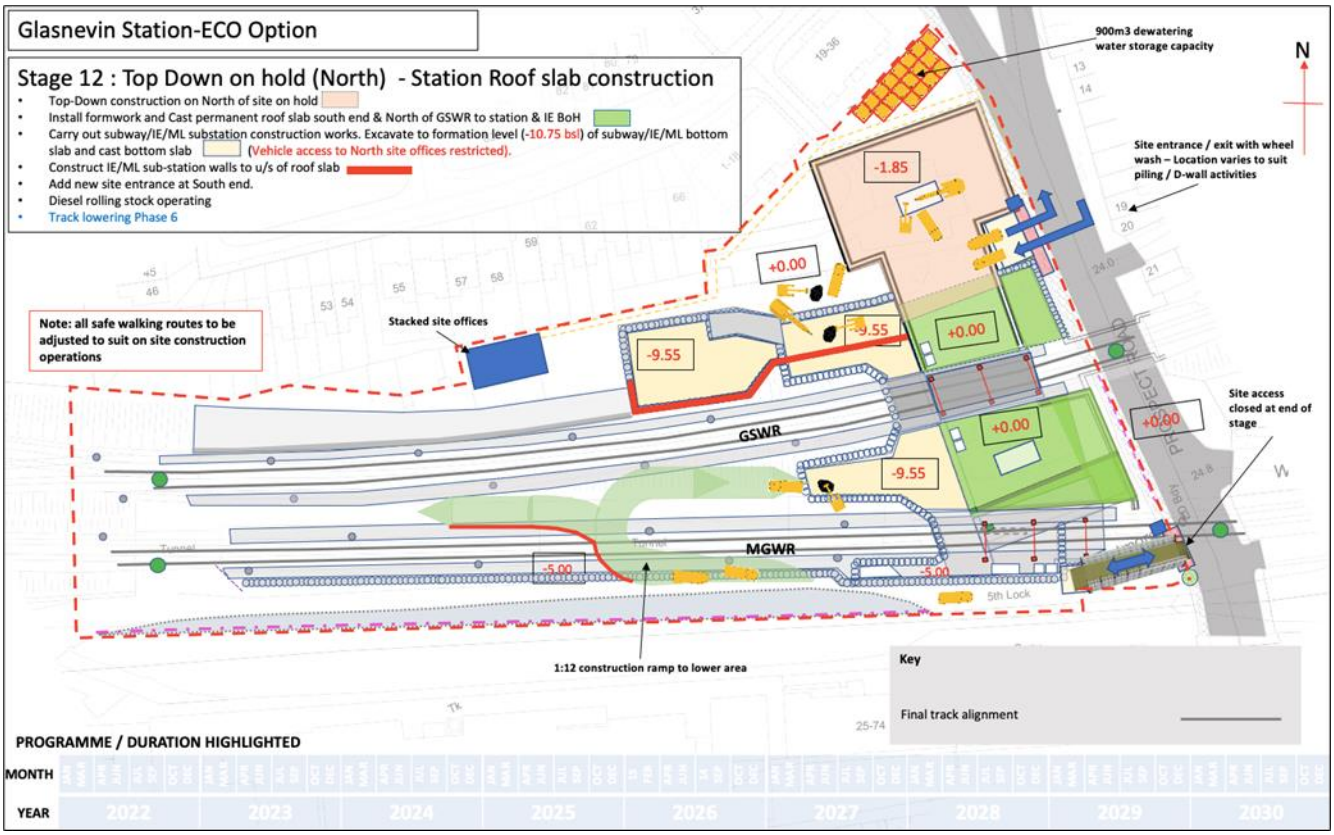


Figure 5.34: Top Down (North) - Station Roof Slab Construction

Key activities in this stage are for construction of the station roof slabs north and south of the GSWR.

Preparation for Top-Down excavation to the south station box via a new entrance at street level is ongoing, along with construction of the subway under the GSWR.

Placing of precast planks during the possession, to form the roof of the MGWR is carried out during this stage prior to removal of the temporary (bailey) bridge, Access to Royal Canal Way continues during this stage for completion of the central platforms via the temporary bridge and ramp.

Construct IR/Metrolink substation bottom slab, followed by structural walls to u/s of the roof slab

5.17 Stage 13: Top Down (North) and Subway Works

The works during this phase are shown in Table 5-15.

Table 5-15: Key Construction Activities for Stage 13

Northern station box	Interlink concourse	Central and South station box
Top-Down construction on hold until the earth berm is lowered to mezzanine slab. MetroLink substation construction. Install cover slab/precast planks over GSWR bridge (possession works) OHLE installed through station. Operation reverts back to electric units.	Subway roof slab construction IR/Metrolink substation roof slab construction	Commence Top-Down construction. Subway roof slab construction Install PC planks to cover slabs over MGWR (possession works)

The site layout for these works is shown in Figure 5.35.

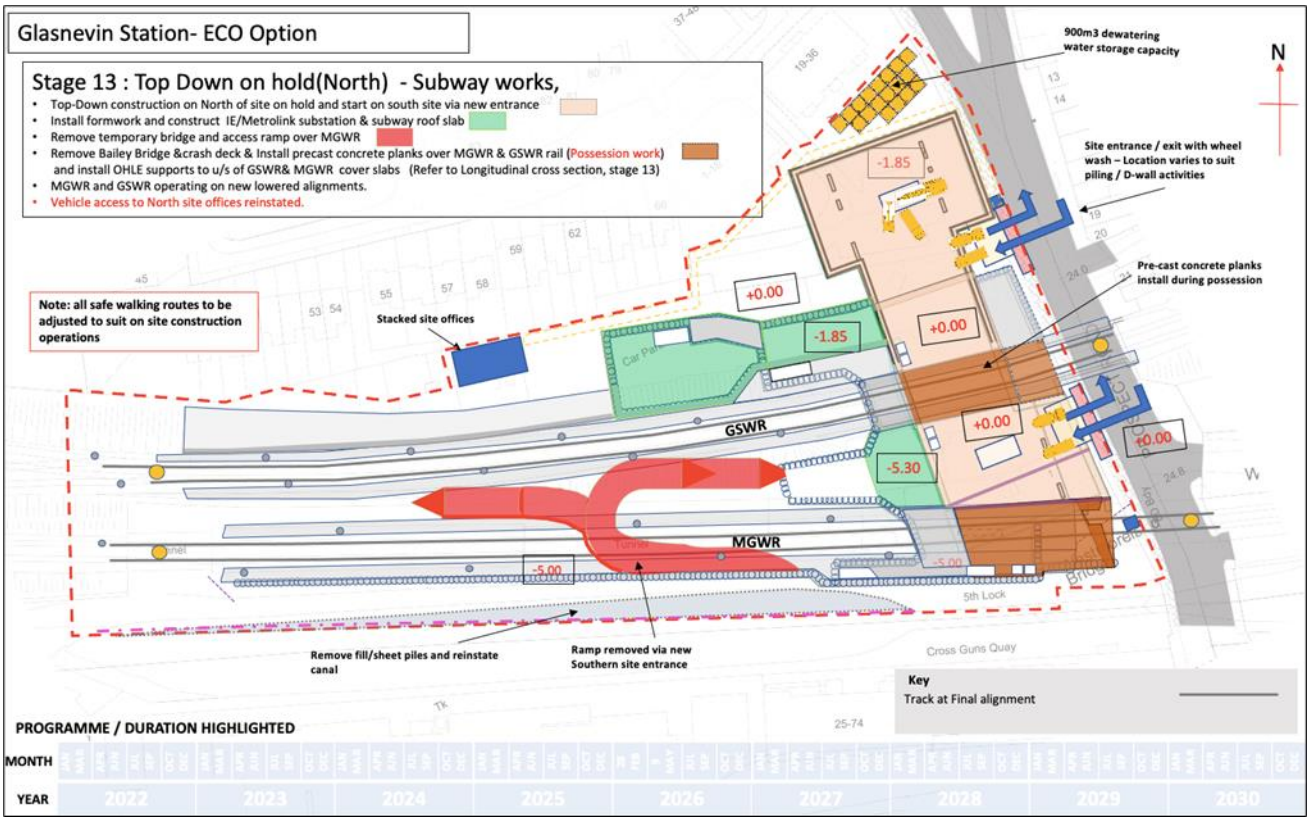


Figure 5.35: Top Down (North) -Subway Works

Key activities in this stage are the commencement of Top-Down excavation to the south station box via a new entrance at street level, construction of the subway roof slab either side of the GSWR, and possession working to install pre-cast concrete planks over GSWR bridge.

Stage 13 sees the installation of the GSWR OHLE through the station box and energised such that the GSWR can use electric rolling stock again.

Construction of the IR/Metrolink substation roof slab is undertaken.

Also, for Stage 13, the temporary bridge and ramp spanning the MGWR for access to the central area is removed. Subsequently to this, there will be no access via road to the central site. Access for construction traffic to Royal Canal Way is closed.

5.18 Stage 14: Top Down (North & South) –Open Railways

The works during this phase are shown in Table 5-16.

Table 5-16: Key Construction Activities for Stage 14

Northern station box	Interlink concourse	Central and South station box
Continue Top-Down construction. Fully open GSWR railway on new lowered alignment. Complete station works from street level access.	Continuing sub way construction.	MGWR fully operational on new lowered alignment. Complete station works from street level access.

The site layout for these works is given in Figure 5.36.

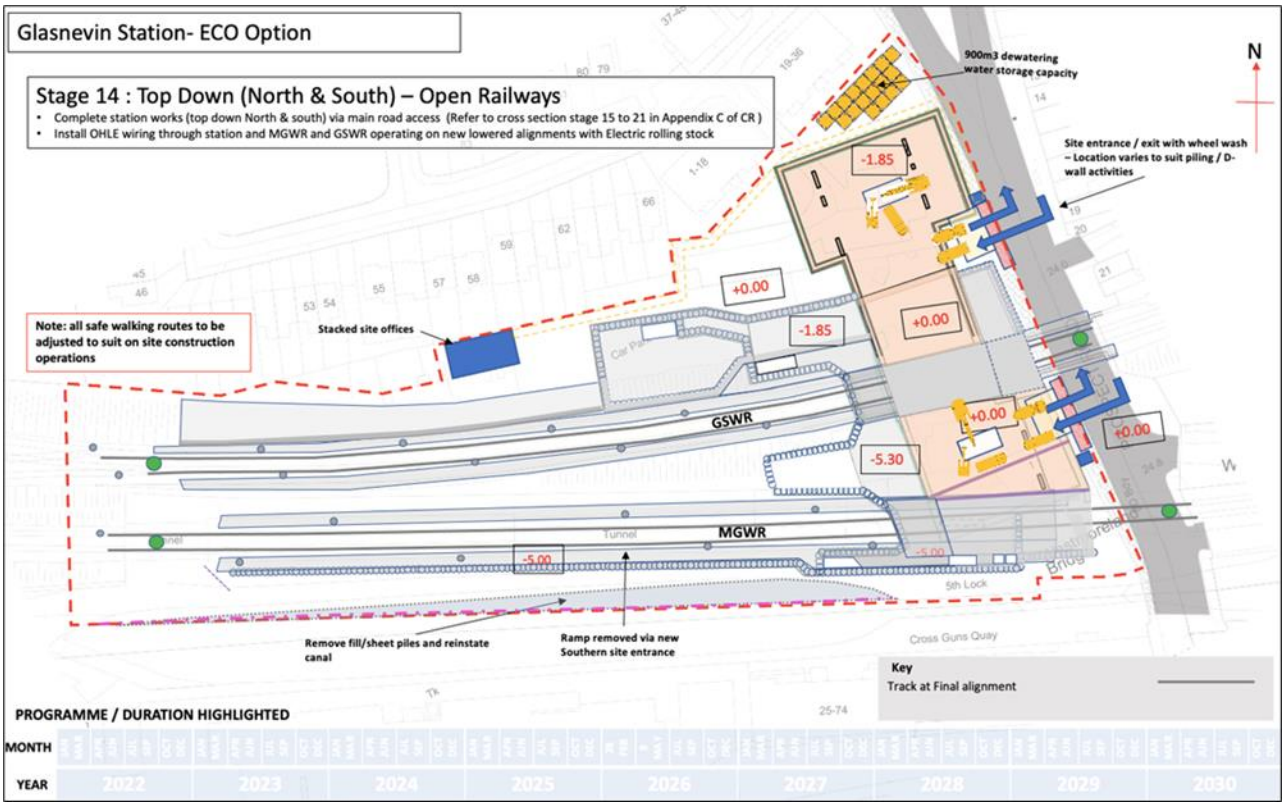


Figure 5.36: Top Down (North & South) – Open Railways

In this stage, rail works are completed, and the GSWR and MGWR railways are fully opened on the new lowered alignments with electric rolling stock.

5.19 Construction Methods

Generally, the construction methods adopted at Glasnevin station will be in line with other methods adopted for the TBM first scenario, employed on the Metrolink project.

5.20 TBM Passage

As indicated from Stage 6, on completion of the Concourse slab in this section, excavation of the northern section of the station box is on hold. Essentially this is to leave a berm in place to support the north side of the GSWR tracks until the works to lower the track alignment and slide the new bridge deck into place are completed. The Top-Down construction from the north end can commence when the earth berm is lowered to the mezzanine slab level. Refer to Figure 5.37.

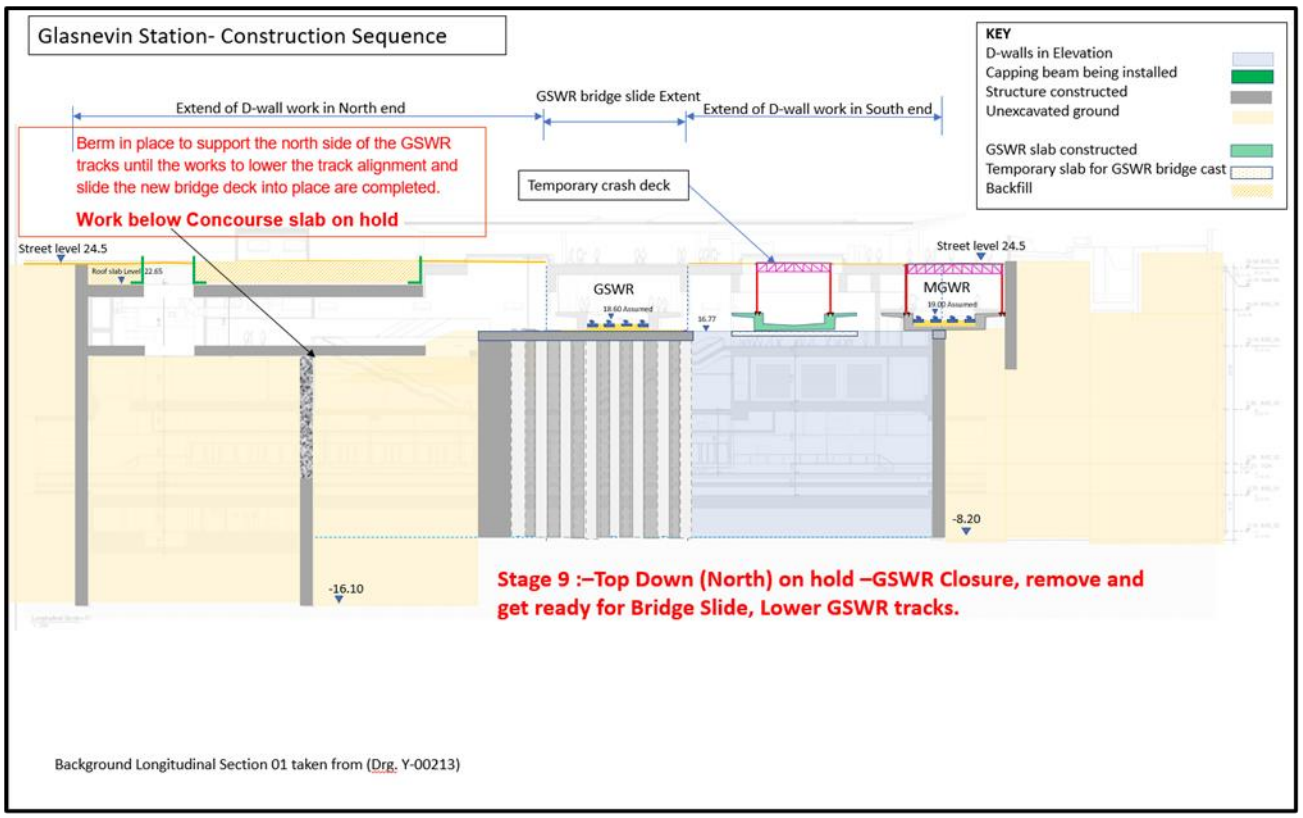


Figure 5.37: Work below Concourse slab on Hold as Berm in place to support GSWR tracks

There is insufficient allowance to then excavate to formation and construct the base slab in the Back of House (BoH) area prior to the TBM arrival and subsequent transit through the station box.

There is an opportunity to mitigate this delay by constructing the BoH intermediate D-wall up to ground level and excavating the north of the station in a self-contained box. The D-wall would then be broken down at a later stage when excavation to the south of the station is undertaken. Refer to Figure 5.38.

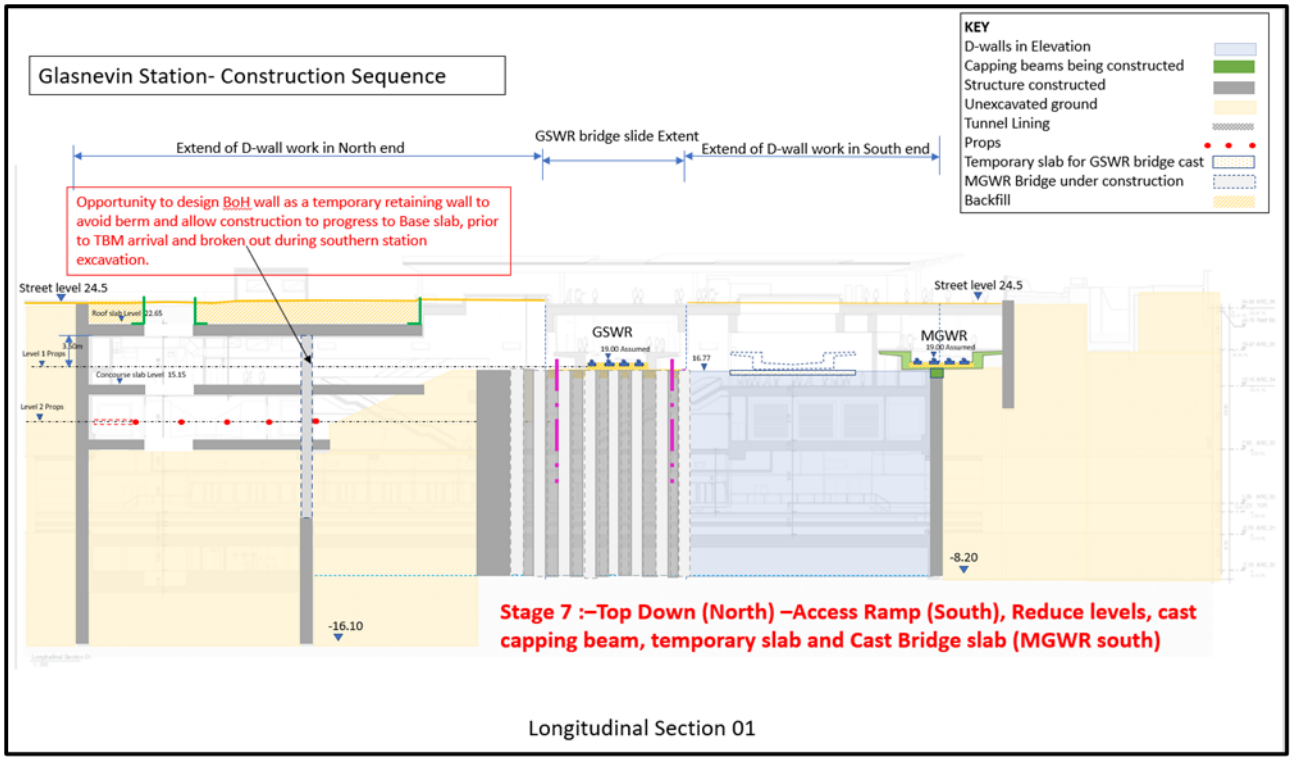


Figure 5.38: BoH Wall Designed as Temporary Retaining Wall

5.21 Internal Civil Works

Internal stations work including waterproofing, lining walls, internal structure, platforms, lift and staircases, Architectural finishes and Mechanical and Electrical (M&E) fit out will adopt a similar approach to that presented for other stations. The sequence and timing of such works will vary depending on the location and the overall Glasnevin station programme.

6. Royal Canal Interfacing Works

The phasing of these works is referred to above in the overall sequencing of the Glasnevin Station Construction, this section outlines the direct impact of the works on the canal. The predicted impacts on the Royal Canal have been assessed against greenfield settlement contours for tunnel and station excavation. This assessment (ML1-JAI-GEO_XX-RP-Y-00024) is contained within Chapter 5 Appendix 5.16. Further impacts and mitigations are described below.

The Damage Assessment report of Buildings and Other assets has assessed the impact of the works on the Royal Canal Structure.

The assessment and construction methodology is based on the Preliminary design produced for Railway Order and refers to information provided by Waterways Ireland and others. This design will be developed by the Contractor and the methodologies and sequencing referred to herein will be developed to suit the design and agreed with Waterways Ireland. The use of alternatives is not precluded so long as the overarching environmental impact of the work is not worse than that assessed currently in the EIAR.

6.1 Cross Guns Quay Canal Lock Gates

The Damage Assessment Report states the following in respect of the lock gates:

The MetroLink scheme is predicted to have moderate impact on the 'cross guns quay canal lock'.

The Cross Guns Quay Canal Lock – walls and gates are further referred to in table 6.1 as Structure ref ST-5b and section 6.9 states that:

Cross Guns Quay Canal Lock – walls and gates (ST-5b)

The settlement contours surrounding the Quay Canal Lock (ST-5b) are shown in Figure 6-2. These Canal Lock structures have a small footprint and are therefore relatively rigid structures. The middle gate is predicted to settle 70mm and the gates either side are predicted to settle 35-50mm. Although these structures are not anticipated to undergo significant tilt, due to their relatively close position to the Glasnevin Station, some form of protection measures might be required depending on the form and condition of the existing structures. One of the primary risks is the potential jamming of the gates due to relative movements on the vertical guide rail which could impede gate operations.

The anticipated mitigation measures required to manage the risk to the operation of the gates and the wider impact on the canal walls are detailed below.

6.2 Royal Canal Asset Protection Measures

- The Contractor shall not:
    - damage assets beyond agreed limits which will be specified in the Contract or
    - cause lasting negative impacts on assets with regards to:
        i. safety
        ii. structure
        iii. operation

iv. reliability

v. security.

- In the event of damage to any Waterway Ireland assets, the Contractor shall limit to levels agreed with Waterways Ireland and accepted by the TII.
- Any damage will be repaired.
- The Contractor shall comply with the Guidelines for the Conservation of Built Heritage: for the repair and maintenance of heritage structures on the inland waterways of Ireland where applicable.

6.3 Interfacing Construction Works

6.3.1 Vehicular, pedestrian and cycleway diversion

During all phases of construction, local access to Coke Ovens Cottages via Royal Canal Way will be impacted due to the construction footprint. The proposed diversion will be via Leinster Street North or Connaught Street, where traffic will then route north on Shandon Road, utilising a temporary bridge to re-join Royal Canal Way approximately 300 meters west of the existing access. This vehicular diversion route is illustrated in Figure 1 below and will be in place for approximately 4 years. For further details refer to the STMP Chapter 7.6.

The main works will require a closure of a 300m section of the Royal Canal Way, which is a dedicated Greenway in the GDA Cycle Network Plan. During the closure cyclists will be diverted via Leinster Street North or Connaught Street, and routed north on Shandon Road, crossing over the temporary bridge to re-join Royal Canal Way. This pedestrian and cycle route diversion is illustrated in Figure 1 and will be in place for approximately 4 years.

On Prospect Road, adjacent to the site, the western footway will have a small reduction in width where the northeast perimeter of the site will slight cut across the existing footway.

Figure 6.1 Planned Diversion Strategy

6.3.2 Temporary Bridge construction

The temporary bridge is a combined vehicular, pedestrian and cyclist bridge. A standard Bailey Bridge structure will be utilised (see illustration below – Figure 3). The detailed design of the bridge and foundations will be completed by the contractor and be approved by Waterways Ireland prior to installation.

The proposed bridge would utilise the abutments of the existing disused rail crossing next to the 6th lock. A mobile crane will be used to lift the Temporary Bridge into position.

Figure 6.2 Temporary bridge location

Figure 6.3 Typical Bailey bridge structure

Figure 6.4 Proposed southern access to the temporary bridge

The southern access to the bridge is shown in Figure 4.

6.3.3 Cross Guns Quay Canal Lock / Balance beam modifications

Prior to any construction works that are likely to affect the operability of the lock gates, the gates will be surveyed and adjusted to accommodate the predicted ground movements.

It is likely that the proposed hoardings will additionally impact on the operation of the existing lock balance beams for gates 1 to 3 as shown indicatively in Figure 5. Subject to approval from Waterways Ireland, the contractor will develop electrically / mechanically actuated lock gates or suitable alternative solution as agreed with Waterways Irenland and,, install these and develop appropriate access to them.

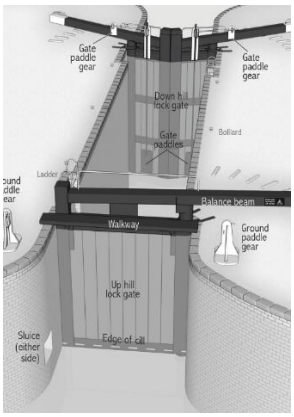


Figure 6.5 Canal Lock schematic (http://narrowboatingforbeginners.com/wordpress/locks-bridges-and-tunnels/)

6.3.4 Canal partial infill

As part of the MetroLink scheme a retaining wall is to be constructed between the MGWR platform and the northern wall of the Royal Canal impinges on the canal wall at one location as shown in Figure 6 below. The wall is designed as a secant pile wall.

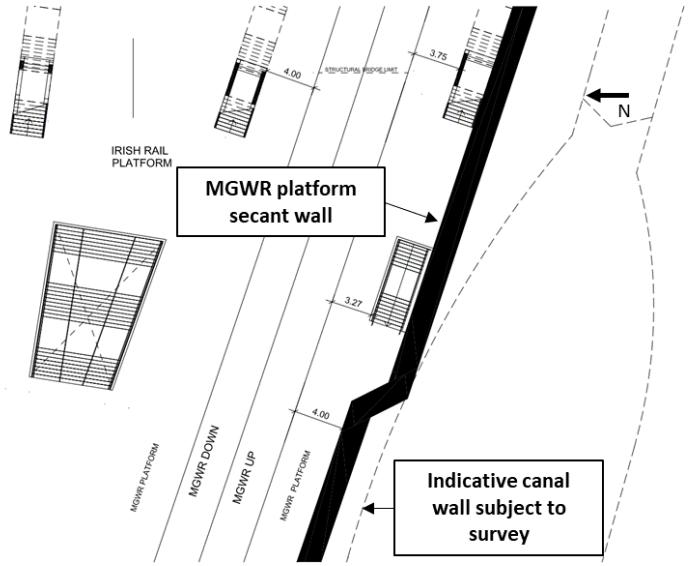


Figure 6.6 MGWR Platform Retaining Wall

To create sufficient construction space and the protect the northern canal wall from the direct impact of the secant piling works, it is proposed to partially infill the canal. This sequence is shown indicatively below.

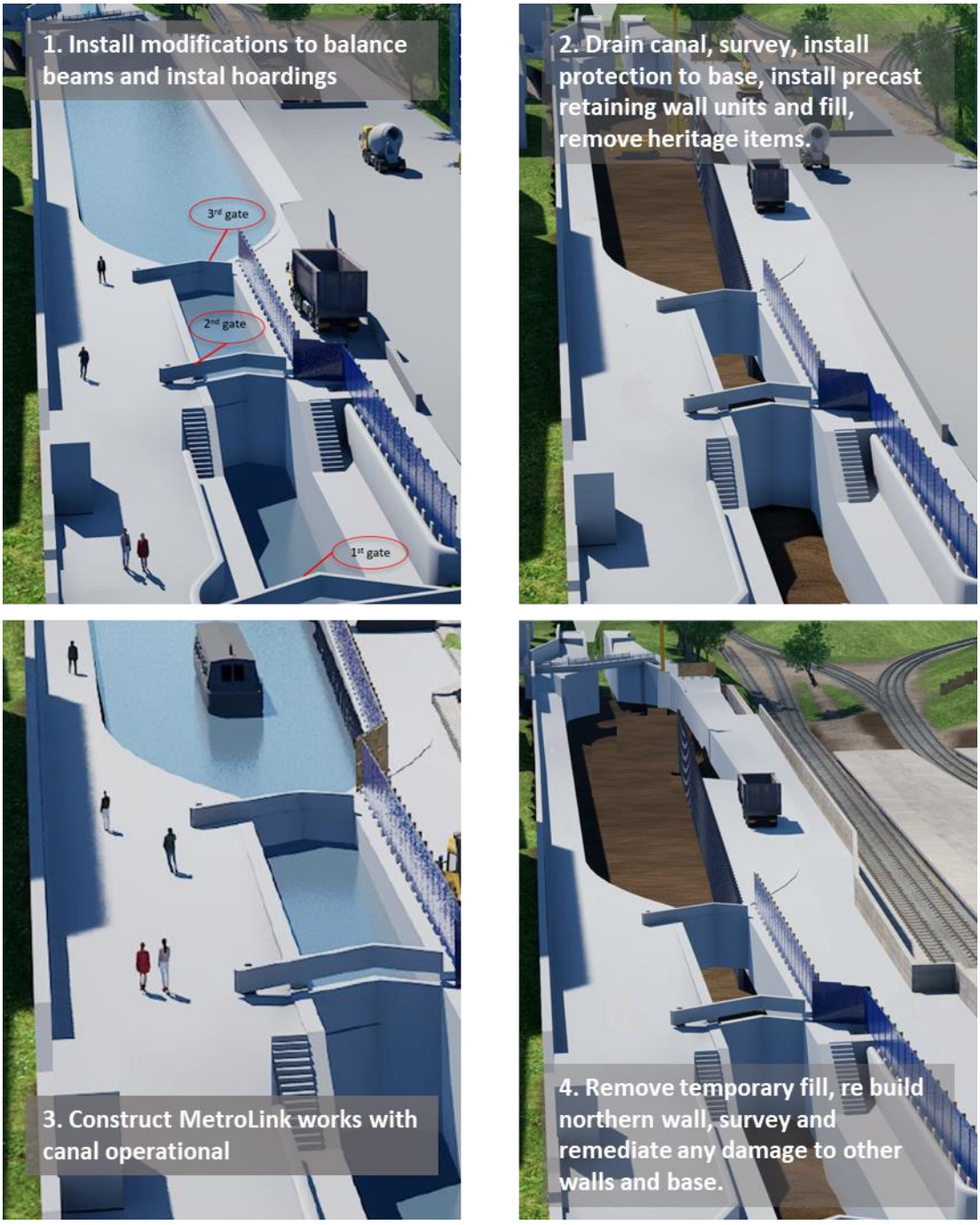


Figure 6.7 Canal protection and infill sequence

The structural shape and form of the canal are understood by reference to drawings and other data provided by Waterways Ireland 2016 publication by J. Kelly, A. O'Shaugnessy and M. Quinlan 'Guidelines for the Repair and Conservation of the Built Heritage: Repair and Maintenance of Heritage Structures on the inland waterways of Ireland.

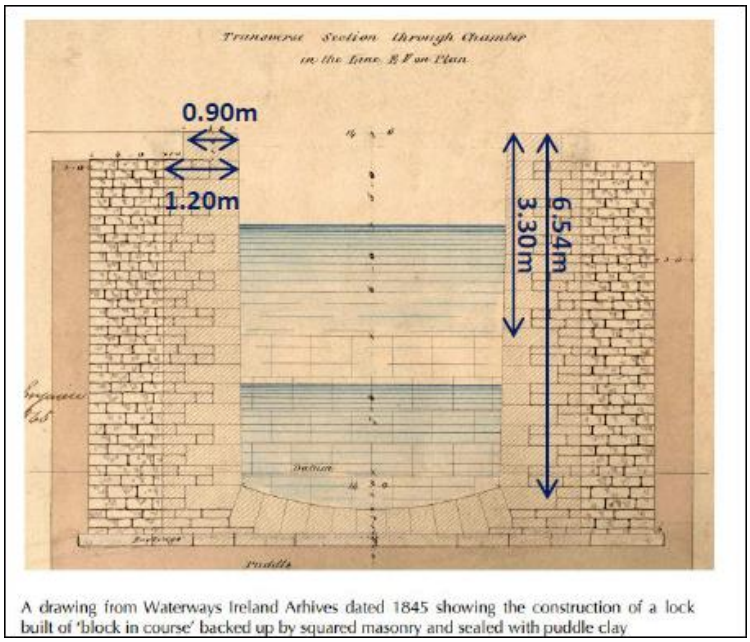


Figure 6.8 Indicative Canal Lock Structure

Further detailed surveys and assessments will be carried out prior to any works progressing. The retaining wall design will minimise impact on the canal structure and likely incorporate precast retaining wall sections founded on the base of the canal. Protection to the existing fabric of the canal will be provided as required to include/for example:-

a. Instrumentation and monitoring

b. Removal and storage and subsequent replacement of any heritage items as agreed with WI

c. Protection to WI assets, surfaces etc. by use of screening, hoardings and membranes

d. The installation of the protective retaining wall structure and infill

e. The design of piling platforms to minimise ground loading

It is anticipated that the northern canal wall will be partially dismantled with any heritage items (e.g. facing or coping stones) stored and replaced on completion of the works. The contractor will build a piling platform adjacent to and on top of the canal fill to cater for any temporary construction loading. The design of the platform will be undertaken so as to minimise impact on the canal structure. This wall and any impacts on the base will be made good on completion. The blocks to the base of the canal may settle during the works due to the loading. These would be reseated, joints repointed and any damage items replaced.

Beyond impacts to the northern wall and base, it is not anticipated that there will be material damage to the other sections of the canal structure. If, however, risks of further damage are identified during the detailed design stage, the following further steps will be taken in order to eliminate same:

- A full re-assessment of previous assumptions including detailed construction methods and sequencing. This would detail all asset structures, foundations, survey measurements and condition surveys and incorporate any baseline monitoring data.

- If the risks were still evident, the Contracor would then need to modify the methods and sequence of operations to mitigate such risk;

- any additional mitigation measures, including extending the scope of those mitigations identified above to any new areas of impact, or the implementation of construction load restrictions and exclusion zones will be deployed (subject to approval of Waterways Ireland).

6.3.5 Impact on canal operation

The canal will be closed to through traffic when:

- building and removing the Coke Ovens Cottages Bailey Bridge,

- during the partial infilling of the canal, and

- whilst rebuilding the northern canal wall and undertaking any remedial measures to the base

First closure (3 months – timing to be agreed with Waterways Ireland):

a. Close and drain the canal in advance of main works to carry out condition surveys of all walls and other structures to determine what repairs / mitigations are needed. A water management system designed to take peak flows will be installed to allow the flow of water through this area.

b. Undertake the planned works to the northern wall (removal and storage of heritage items) and install temporary fill retaining walls, protection membrane and infill.

c. Undertake any additional measures identified in a) above

d. Inspect and remediate if needed the old railway bridge abutments.

Second closure (3 months – timing to be agreed with Waterways Ireland):

a. Close and drain the canal on completion of main works to allow reinstatement of north wall

b. Removal of temporary southern pedestrian cycleway and the bailey bridge

c. Removal of the temporary retaining wall and fill. Re build the wall (and base if required).

d. Remediation and reinstatement of any additional measures identified during the initial condition survey or subsequently installed

e. Reinstate any modifications to balance beams or other WI assets

f. Full photographic survey on completion.

At other times, the canal will be operable albeit that temporary moorings for barges and canoes would be prevented at this location. Alternate mooring locations are available upstream of lock 4 and lock 6.

7. Interface with Irish Rail Works

The overall sequence of works in the Glasnevin Station area has been linked with the planned Irish Rail (IR) works in the station area as well as works, principally, to the west of the station.

A review of key Irish Rail assumptions, listed below and integration of the MetroLink programme with the planned Irish Rail works are incorporated.

Assumptions for managing the electrification and integration of the track lowering with MetroLink Station construction activities.

1. IR works (track lowering & platform construction) are independent of the MetroLink Station works.

2. The works for lowering the MGWR tracks will be serviced by rail.

3. The works for lowering the GSWR tracks will be serviced principally by road.

4. Worksite areas, office and welfare accommodation will be independent of, and will not impact on Metrolink works.

5. Track lowering for the MGWR railway west of chainage 850, will be carried out in a two week's full track lowering within the planned closure, which will not impact on MetroLink works.

6. Track lowering for the MGWR railway east of chainage 850 will be carried out during the planned closure of the MGWR railway for the MetroLink station construction and programmed to follow completion of the MetroLink works to construct a trough to carry the tracks through the station on box.

7. The IR works for the MGWR track lowering will include construction of the southern and central platforms. The southern platform works will be completed prior to the final reopening the MGWR railway and the Central platform works will be undertaken in possession after the MGWR is reopened.

8. Track lowering for the GSWR railway will be carried out within a single 5 month's closure of the railway, which will incorporate the final works for sliding the bridge in to place to carry the railway through the station.

9. The works to construct the northern and central platforms to GSWR will be carried out during the GSWR 5 months closure.

10. MetroLink access ramp will be designed and constructed so it can be used for IR works and will be removed by IR Works contractor on completion of MGWR central platforms.

11. The GSWR demolition of the existing retaining walls assumes the OHLE is not in place and reinstalled on completion of the station roof in Stage 13.

12. The MGWR OHLE is reinstalled concurrently with track lowering works.

13. It is assumed that Diesel rolling stock will be used from Stage 4 onwards and will remain operational until the new OHLE system is ready for use.

14. It is assumed that the new OHLE structures will be installed concurrently with the track lowering operation.

15. Re opening of the MGWR follows completion of the demolition of the section of the tunnel adjacent to Prospect road, with diesel rolling stock

16. It is assumed that the signalling building (SEB), Traction Sub Station (TSS) and other buildings associated with the electrification upgrade will not affect the worksites for MetroLink construction.

8. Construction Compound

8.1 Land Requirements

The overall land requirement will consist of the land necessary for the following activities:

- Access works to Coke Ovens Cottages
- Site compound
- Demolition, refer to Section 4.4 for details
- Utility diversion and protection, refer to Section 4.6 for details
- Utility connections
- Groundwater control measures
- Monitoring
- Traffic management
- Station construction

The site compound for MetroLink works shown in Section 5 and has been defined to include:

- The working area;
- Limited area for the storage of materials (including excavated material);
- Limited office and welfare facilities;
- Limited parking for site vehicles; and
- Shared site entrance and exit with segregated vehicle and pedestrian routes within the site, unloading and holding areas, security, and a wheel wash.

The construction site is not anticipated to vary in size between phases – refer to Section 5.

8.2 Working Hours

The construction working hours differ from the proposed standard working hours at this location due to the interface with existing Iarnród Éireann infrastructure and live railway line and will require working to be carried out on a 24 hour a day, seven days a week basis for some activities. This has been assessed within the EIAR.

8.3 Demolition

The demolition required is shown in Section 4. It is anticipated that the demolition can be carried out within the construction site defined, but the demolition is to be carried out by the Owner under separate permissions.

8.4 Utility Connections

The construction site will need temporary site connections to:

- Main's electricity;
- Water;
- Sewer (for office and welfare discharge);
- Storm sewer (for groundwater discharge); and
- Communications (telephone and data).

The groundwater discharge is likely to require a water treatment plant and an attenuation tank to store water during storm events (when it may not be possible to discharge).

It is likely that 'grey water' from site will be collected for re-use, requiring appropriate cleaning and storage tanks.

The permanent works will require the following permanent connections:

- Main's electricity
- Water
- Sewer.

8.5 Groundwater Control Measures

The groundwater control measures will require access to land for:

- The installation, maintenance, reading, and ultimately backfilling and reinstatement of the necessary pumping wells and piezometers to record the groundwater level;
- The grouting of the D-walls;
- The facility to drill behind the D-walls and grout to stop or reduce ground water inflow; and
- The grouting of the tunnel eyes before/after the passage of the TBM.

It is anticipated that all these activities can be carried out within the construction site as defined.

8.6 Traffic Management

Local traffic management will be required for activities such as the installation and removal of the site entrances and the delivery and removal of large equipment like piling plant and cranes.

It is assumed that HGV vehicle delivery times to Glasnevin Station site will generally be restricted to:

- Monday to Friday: 07:00 to 19:00
- Saturday: 07:00 to 13:00

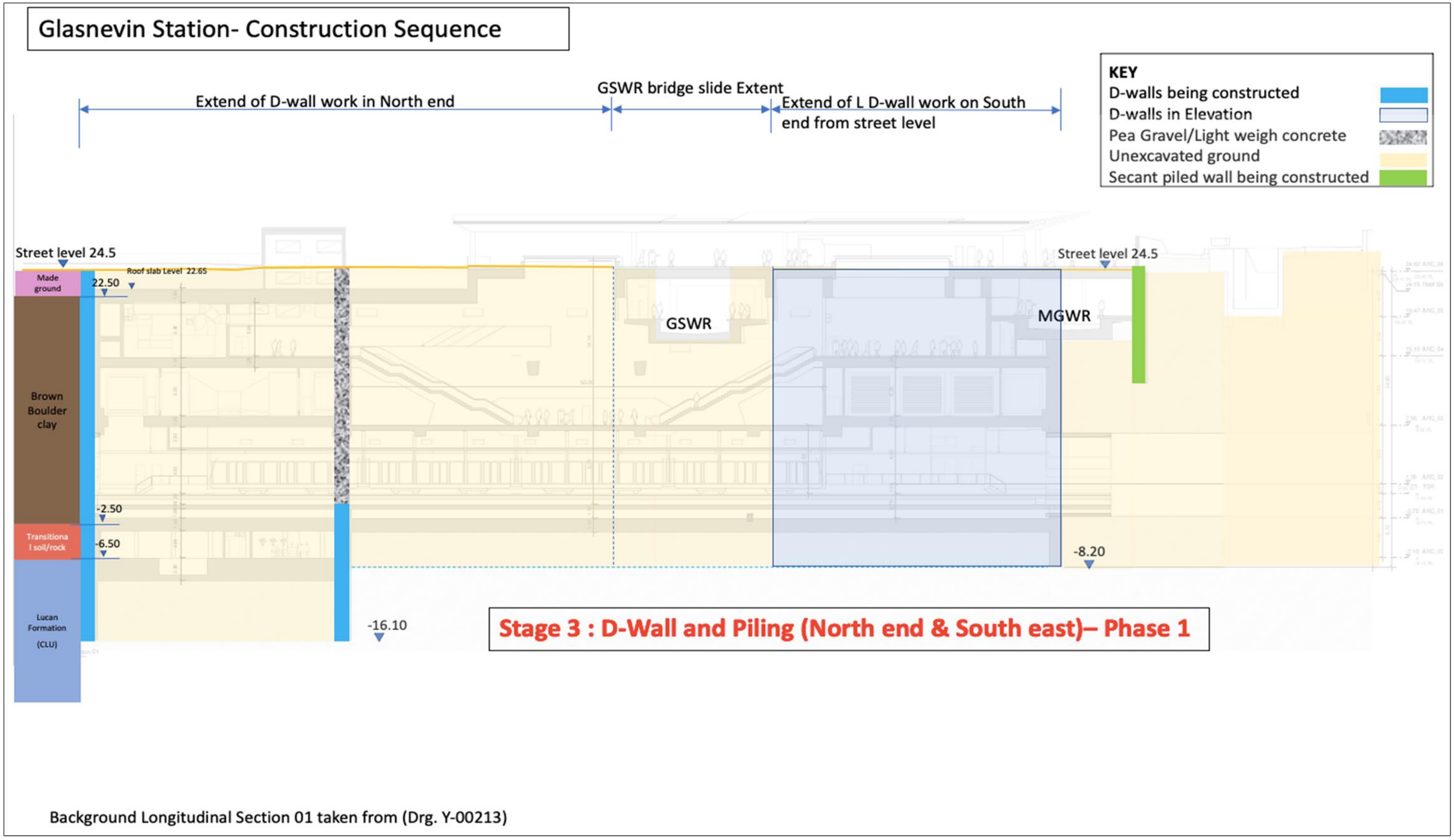
- Sunday / Bank holidays: None

For those activities that require working outside of the standard hours, the proposed schedule of hours is set out in Table 5.4 of Chapter 5 of the EIAR (Construction Phase).

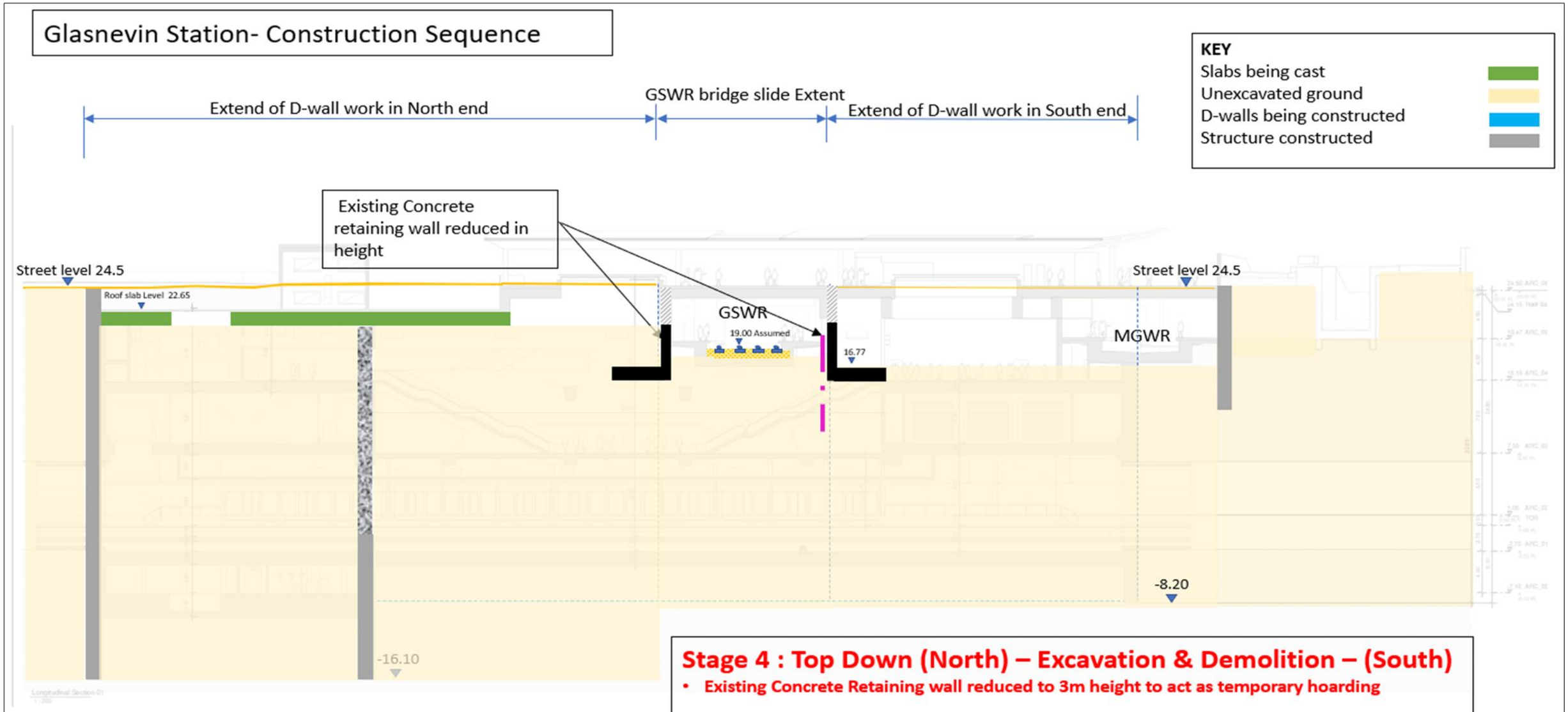
All staff and workforce will be encouraged to make their way to site and home from site by public transport or by bicycle. Secure storage for bicycles will be provided on site. The Contractor may decide to offer a minibus pick-up and drop off service from suitable stations.

Appendices

Appendix A: Longitudinal Section Details



Glasnevin Station- Construction Sequence

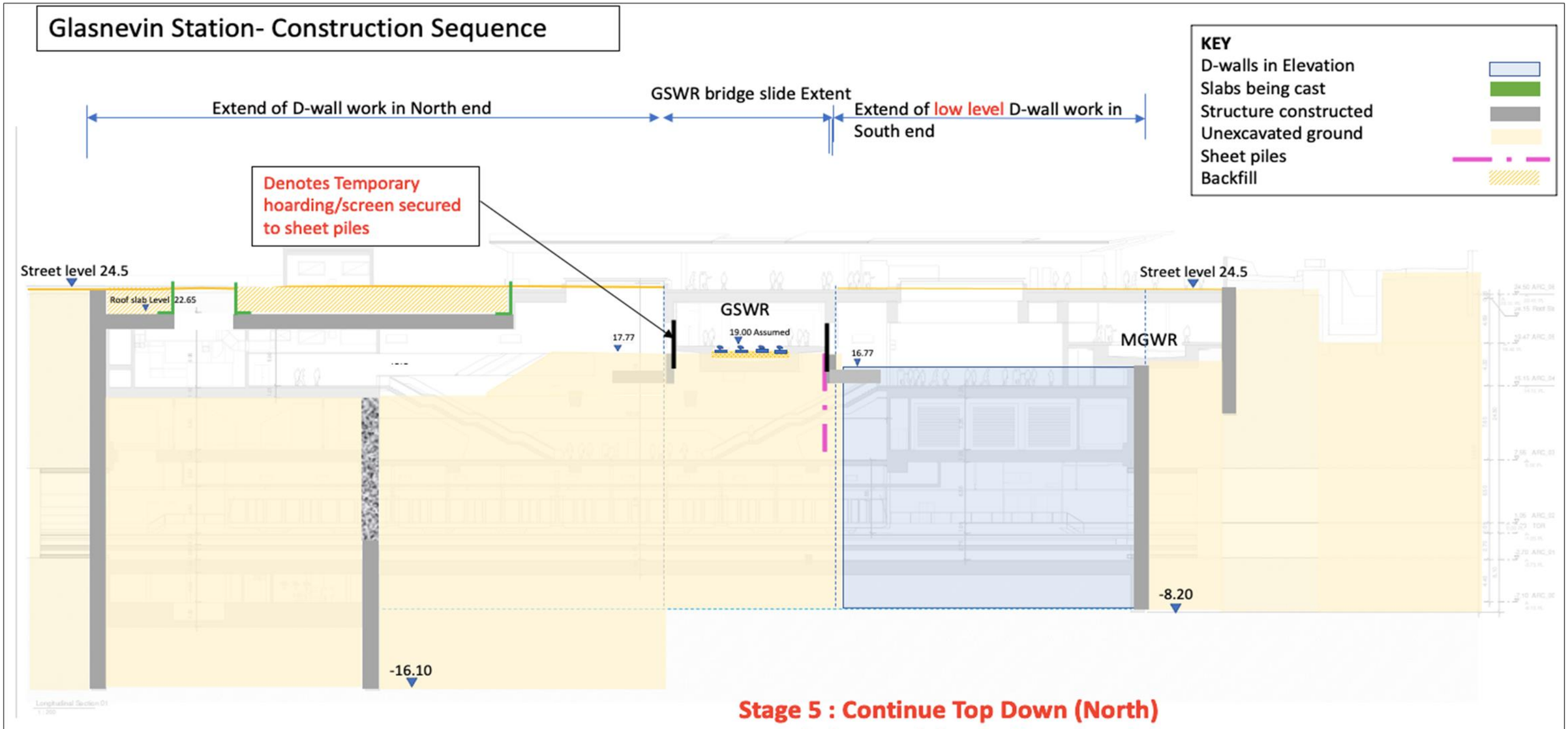


Stage 4 : Top Down (North) – Excavation & Demolition – (South)

- **Existing Concrete Retaining wall reduced to 3m height to act as temporary hoarding**

Background Longitudinal Section 01 taken from (Drg. Y-00213)

Glasnevin Station- Construction Sequence

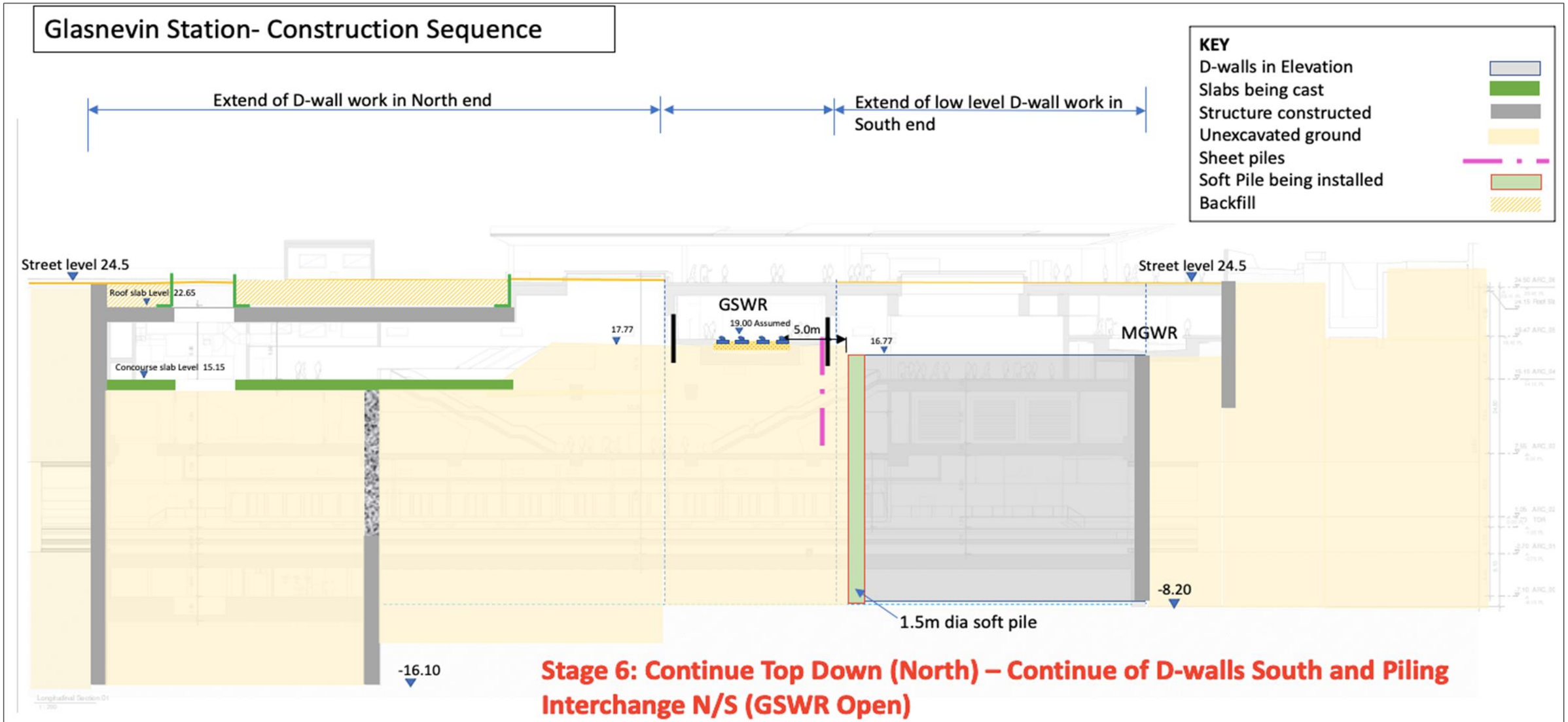


Stage 5 : Continue Top Down (North)

- **Existing retaining wall removed**
- **Start construction of D-Walls South end**

Background Longitudinal Section 01 taken from (Drg. Y-00213)

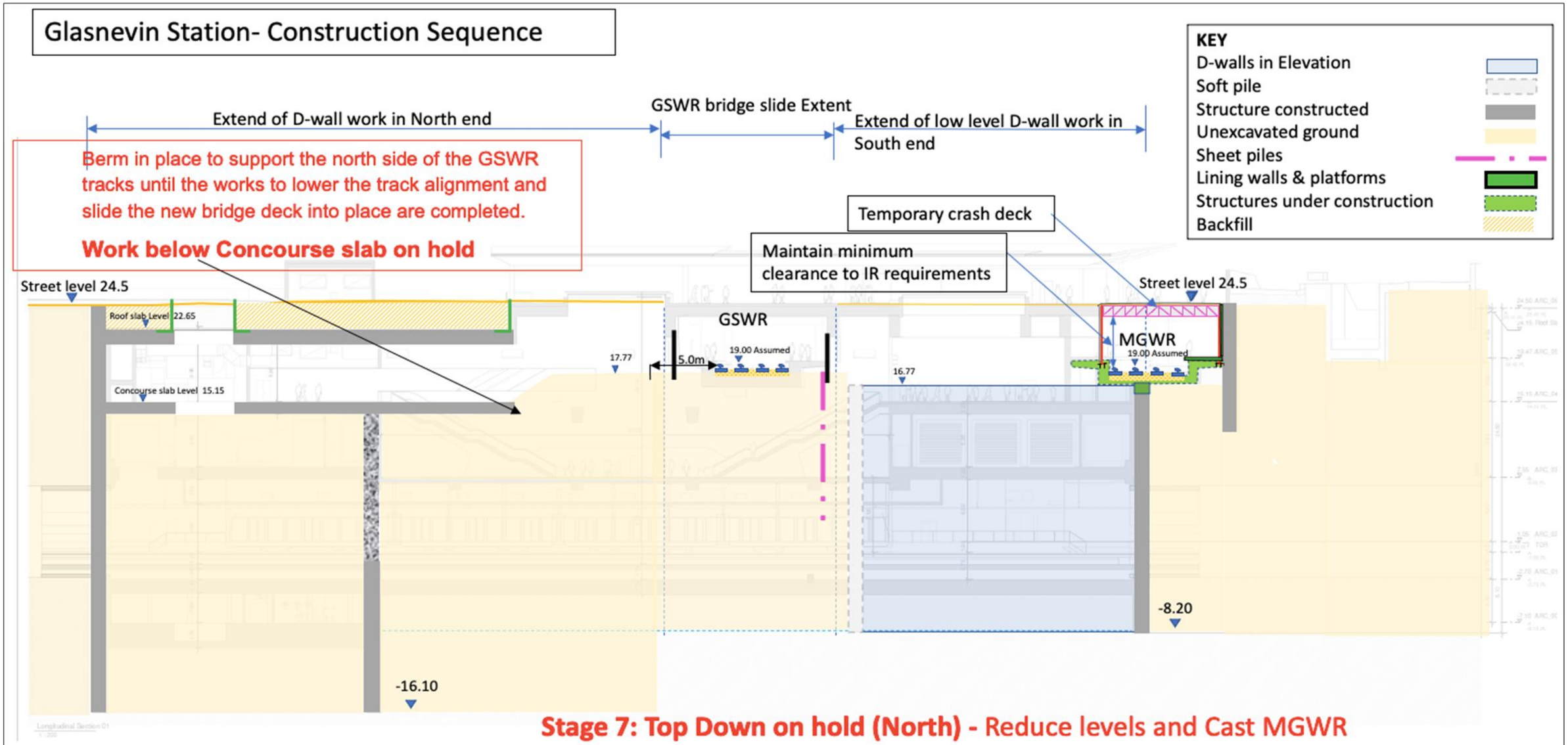
Glasnevin Station- Construction Sequence



Stage 6: Continue Top Down (North) – Continue of D-walls South and Piling Interchange N/S (GSWR Open)

Background Longitudinal Section 01 taken from (Drg. Y-00213)

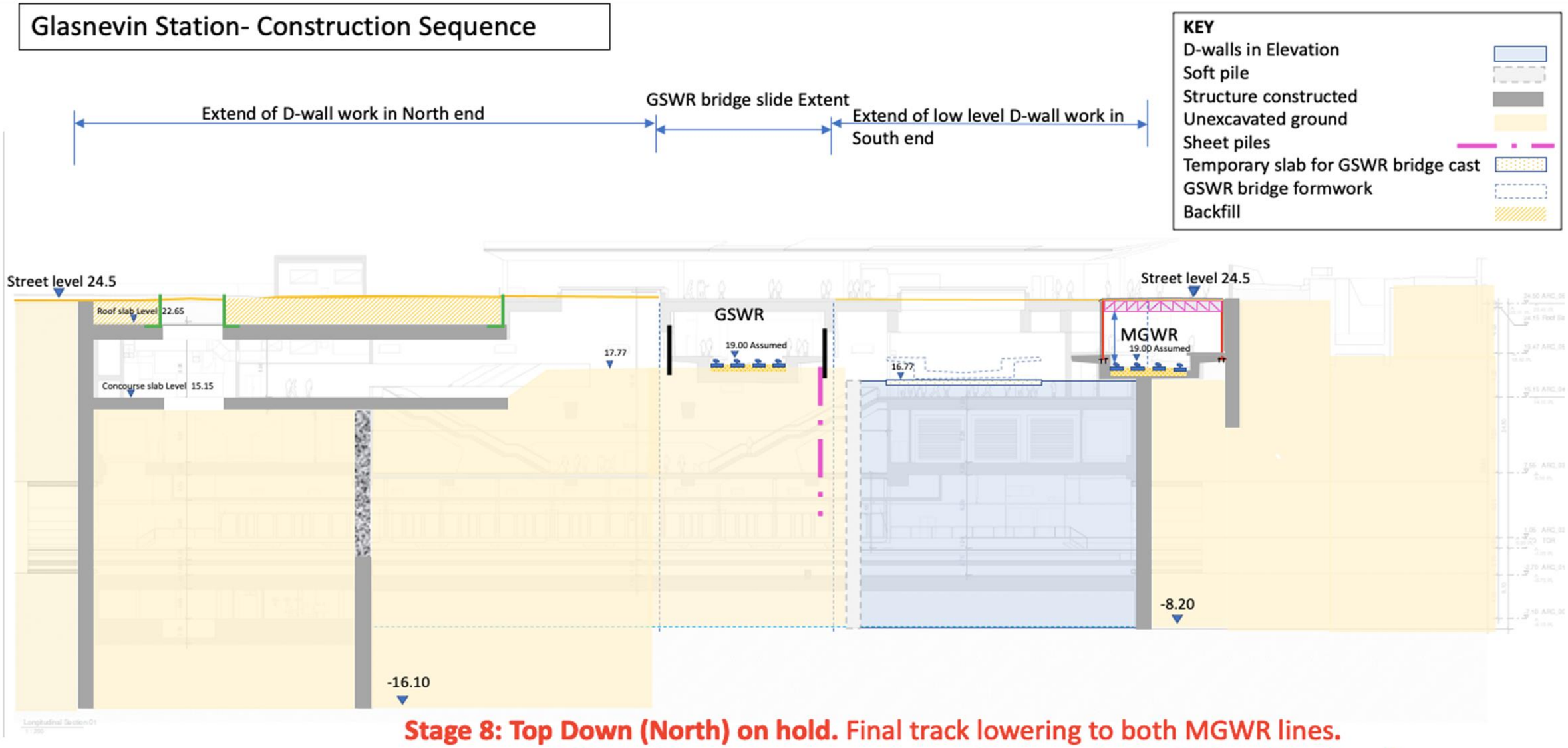
Glasnevin Station- Construction Sequence



Stage 7: Top Down on hold (North) - Reduce levels and Cast MGWR bridge slab -Southern Rail (south) – construct MGWR south platforms and lining walls to retaining wall adjacent to canal

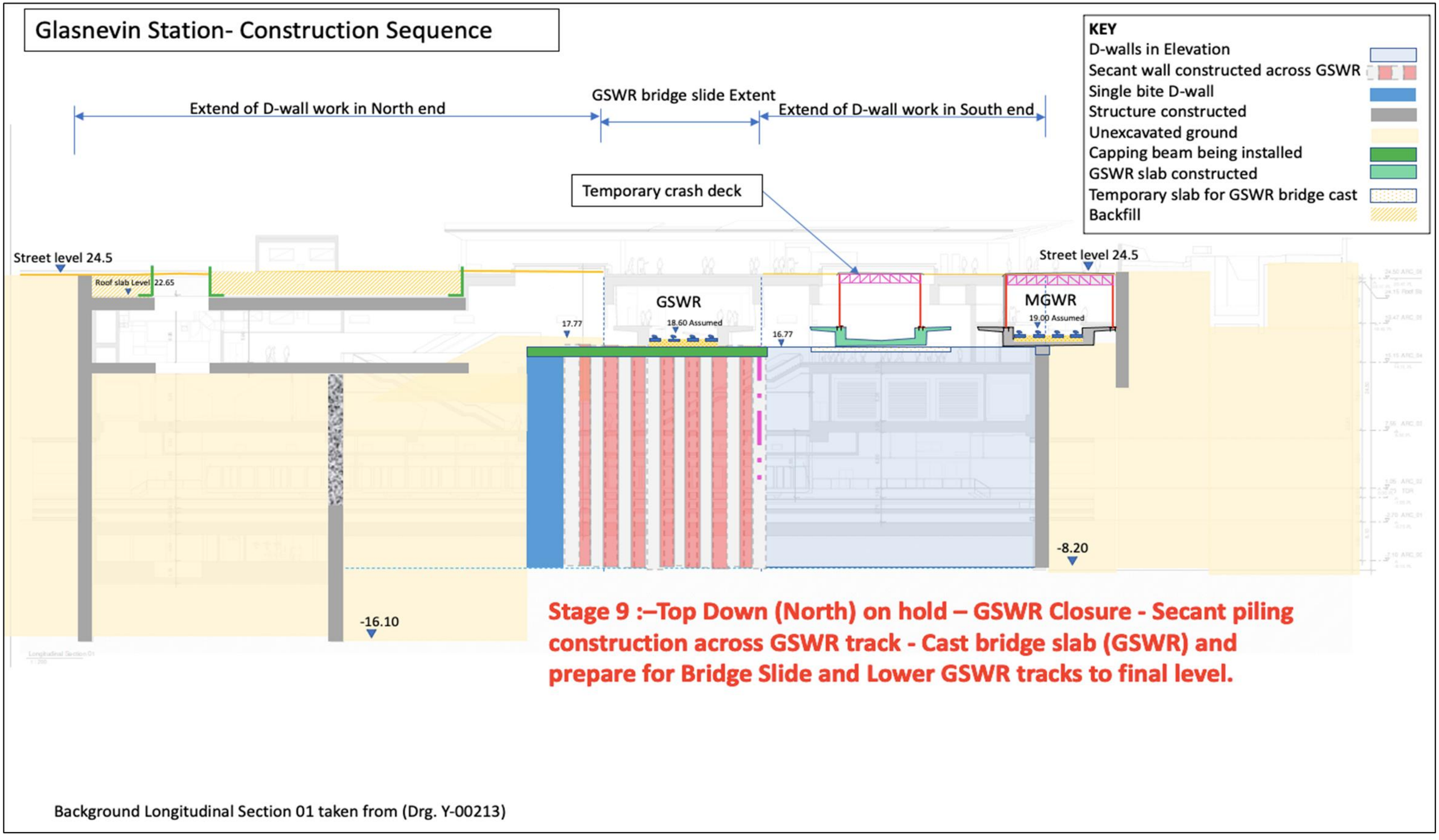
Background Longitudinal Section 01 taken from (Drg. Y-00213)

Glasnevin Station- Construction Sequence

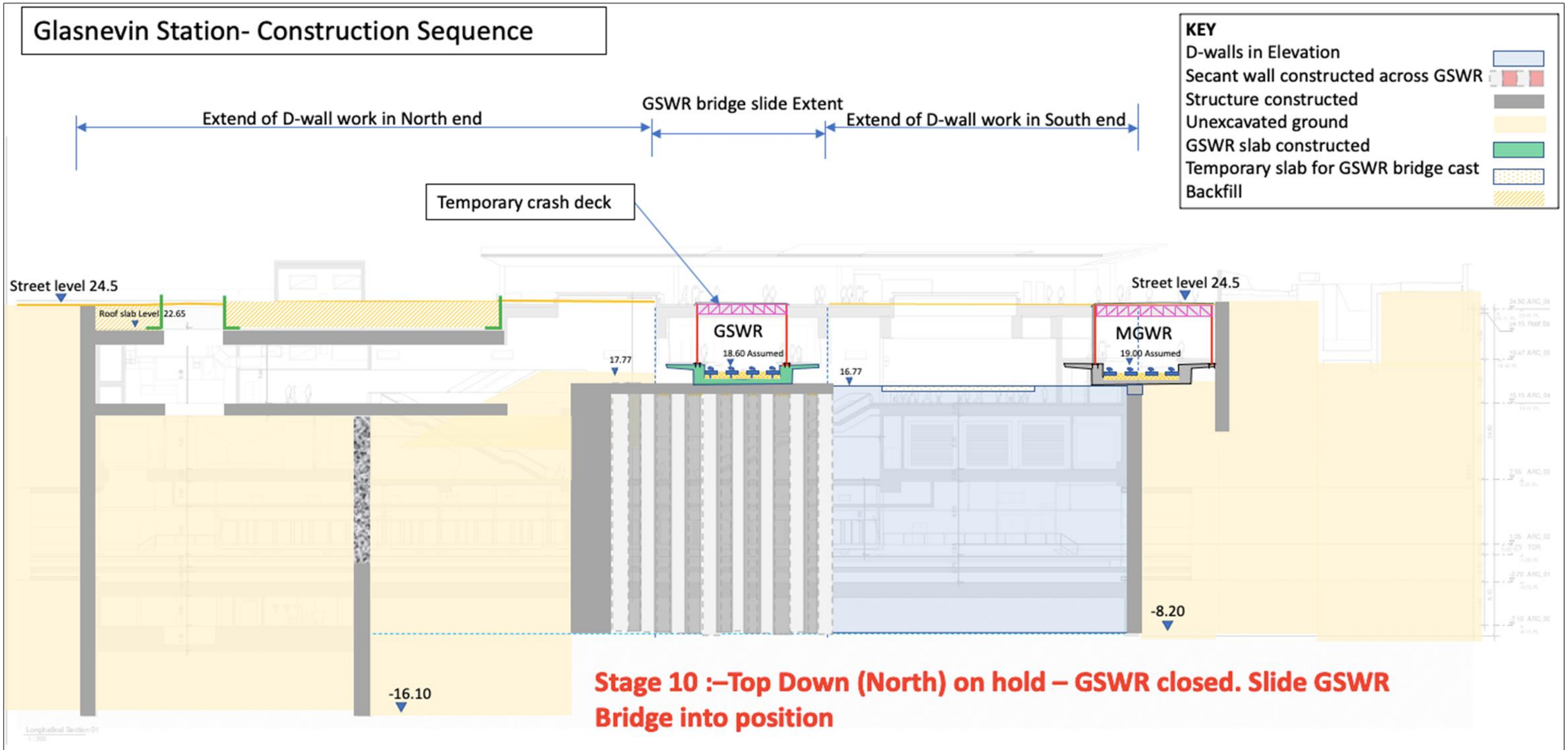


Stage 8: Top Down (North) on hold. Final track lowering to both MGWR lines. Commence GSWR bridge deck construction and prep works for Bridge Slide. Install formwork on Temporary slab

Background Longitudinal Section 01 taken from (Drg. Y-00213)

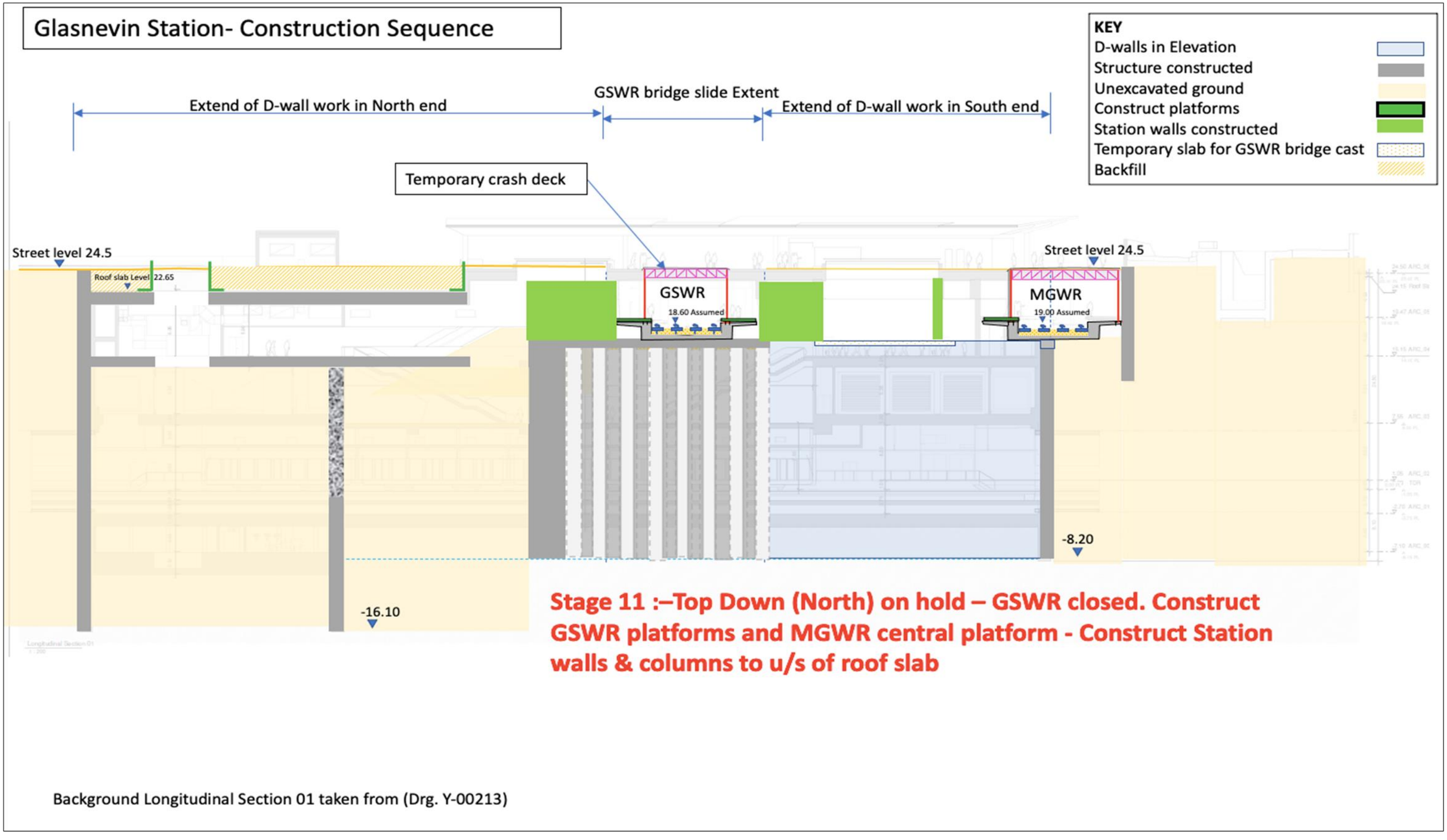

Glasnevin Station- Construction Sequence
Extend of D-wall work in North end
GSWR bridge slide Extent
Extend of D-wall work in South end
Temporary crash deck
KEY
D-walls in Elevation
Secant wall constructed across GSWR
Single bite D-wall
Structure constructed
Unexcavated ground
Capping beam being installed
GSWR slab constructed
Temporary slab for GSWR bridge cast
Backfill
Street level 24.5
Roof slab Level 22.65
GSWR
17.77
18.60 Assumed
16.77
MGWR
19.00 Assumed
Street level 24.5
-8.20
-16.10
Stage 9 :–Top Down (North) on hold – GSWR Closure - Secant piling construction across GSWR track - Cast bridge slab (GSWR) and prepare for Bridge Slide and Lower GSWR tracks to final level.
Background Longitudinal Section 01 taken from (Drg. Y-00213)

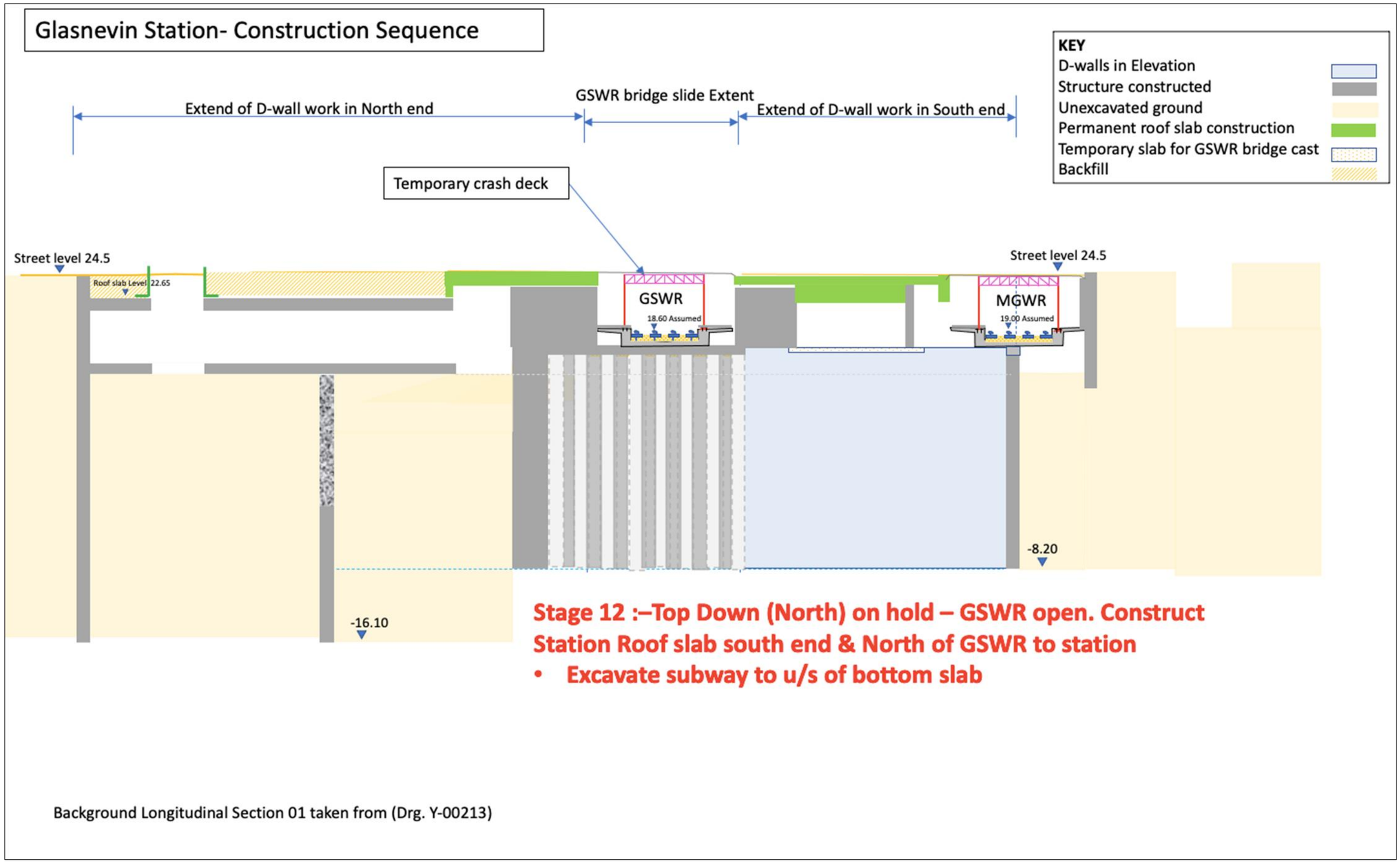
Glasnevin Station- Construction Sequence



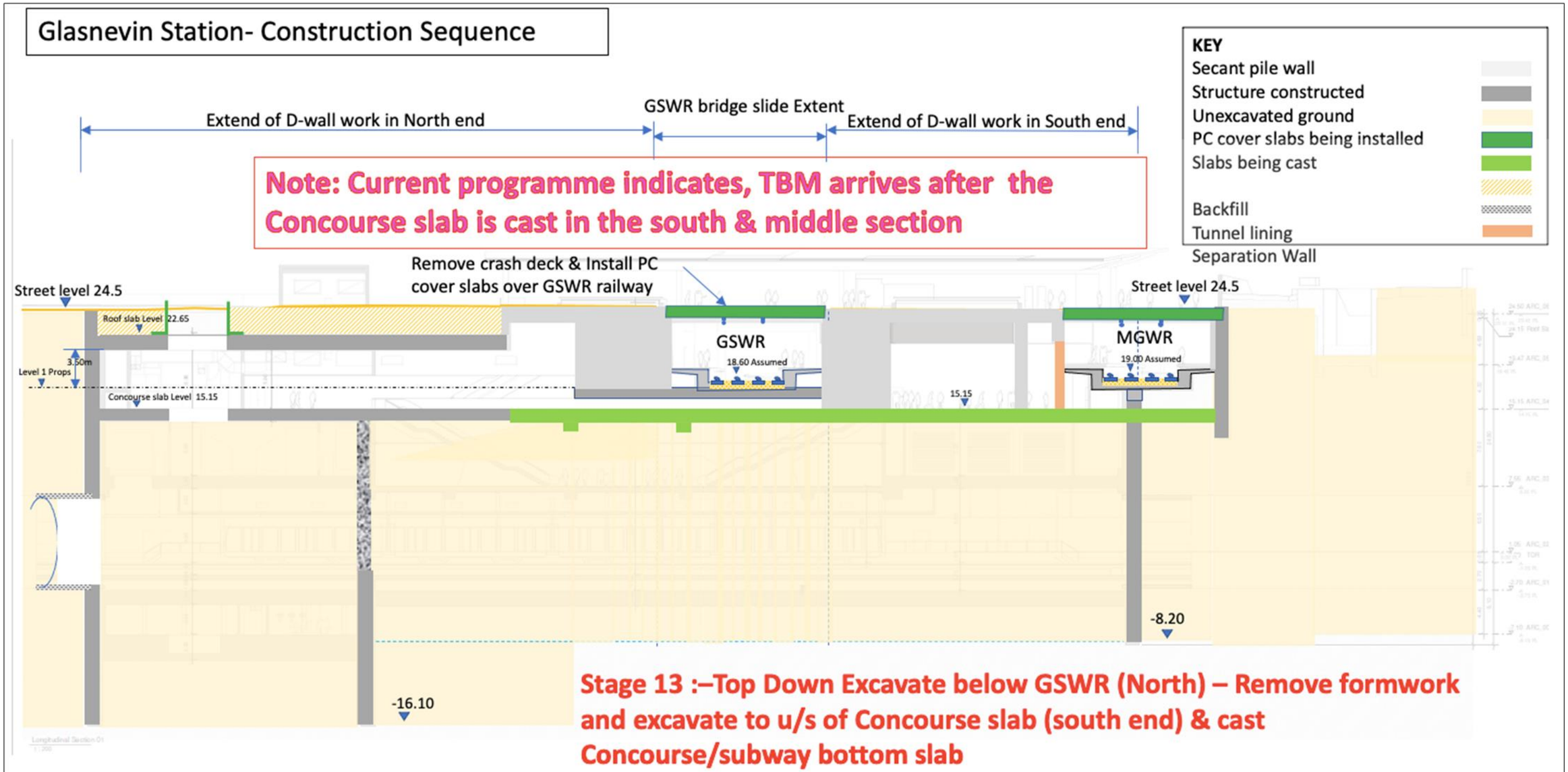
Stage 10 :–Top Down (North) on hold – GSWR closed. Slide GSWR Bridge into position

Background Longitudinal Section 01 taken from (Drg. Y-00213)


Glasnevin Station- Construction Sequence
KEY
D-walls in Elevation
Structure constructed
Unexcavated ground
Construct platforms
Station walls constructed
Temporary slab for GSWR bridge cast
Backfill
Extend of D-wall work in North end
GSWR bridge slide Extent
Extend of D-wall work in South end
Temporary crash deck
Street level 24.5
Roof slab Level 22.65
GSWR
18.60 Assumed
MGWR
19.00 Assumed
Street level 24.5
-8.20
-16.10
Stage 11 :–Top Down (North) on hold – GSWR closed. Construct GSWR platforms and MGWR central platform - Construct Station walls & columns to u/s of roof slab
Background Longitudinal Section 01 taken from (Drg. Y-00213)


Glasnevin Station- Construction Sequence
KEY
D-walls in Elevation
Structure constructed
Unexcavated ground
Permanent roof slab construction
Temporary slab for GSWR bridge cast
Backfill
Extend of D-wall work in North end
GSWR bridge slide Extent
Extend of D-wall work in South end
Temporary crash deck
Street level 24.5
Roof slab Level 22.65
GSWR
18.60 Assumed
Street level 24.5
MGWR
19.00 Assumed
-8.20
-16.10
Stage 12 :–Top Down (North) on hold – GSWR open. Construct Station Roof slab south end & North of GSWR to station
• Excavate subway to u/s of bottom slab
Background Longitudinal Section 01 taken from (Drg. Y-00213)

Glasnevin Station- Construction Sequence



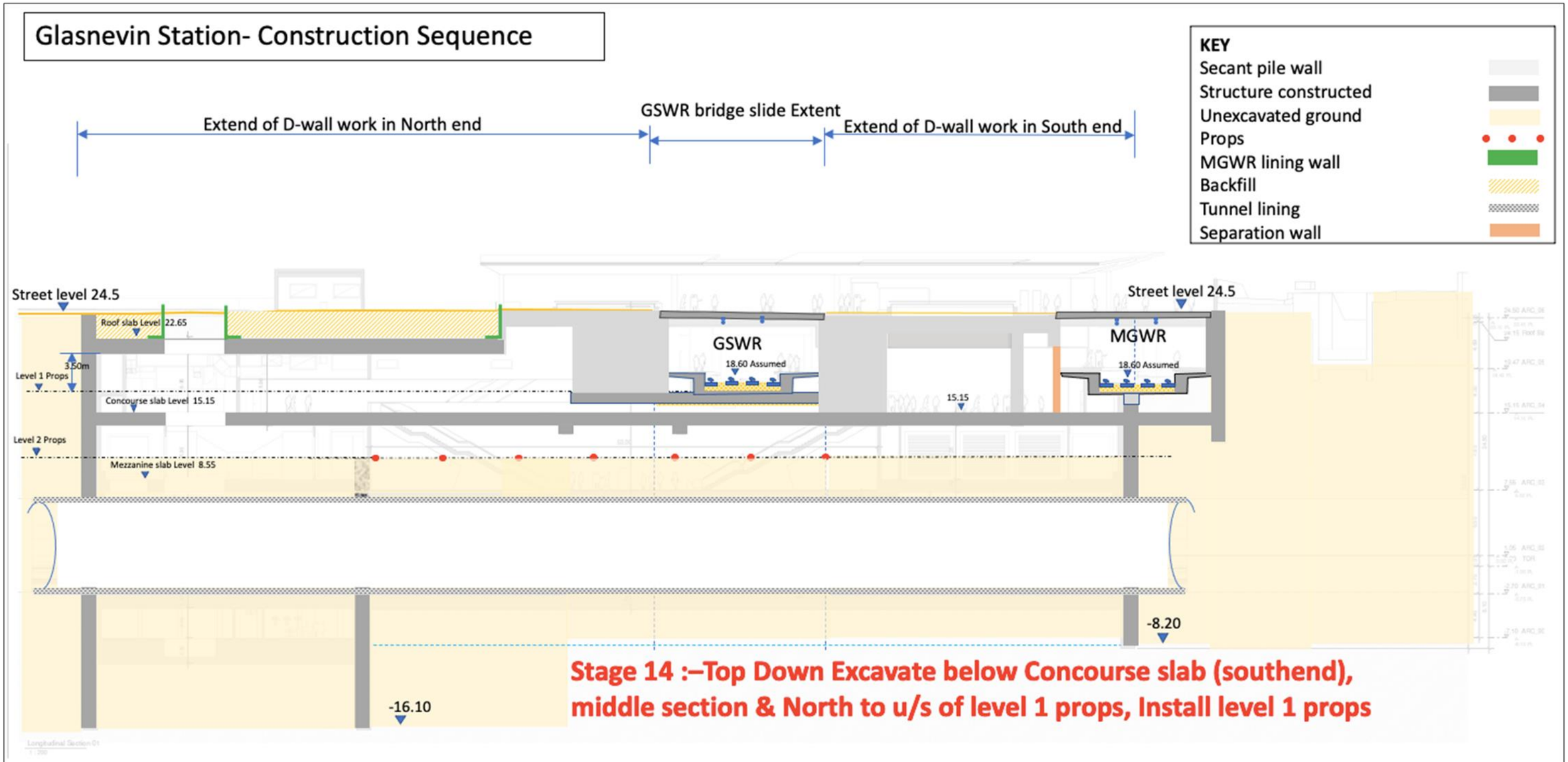
Stage 13 :–Top Down Excavate below GSWR (North) – Remove formwork and excavate to u/s of Concourse slab (south end) & cast Concourse/subway bottom slab

- **Remove crash deck & install PC cover slabs over MGWR and GSWR railway in Possession**

Date of TBM arrival: 17th June 26

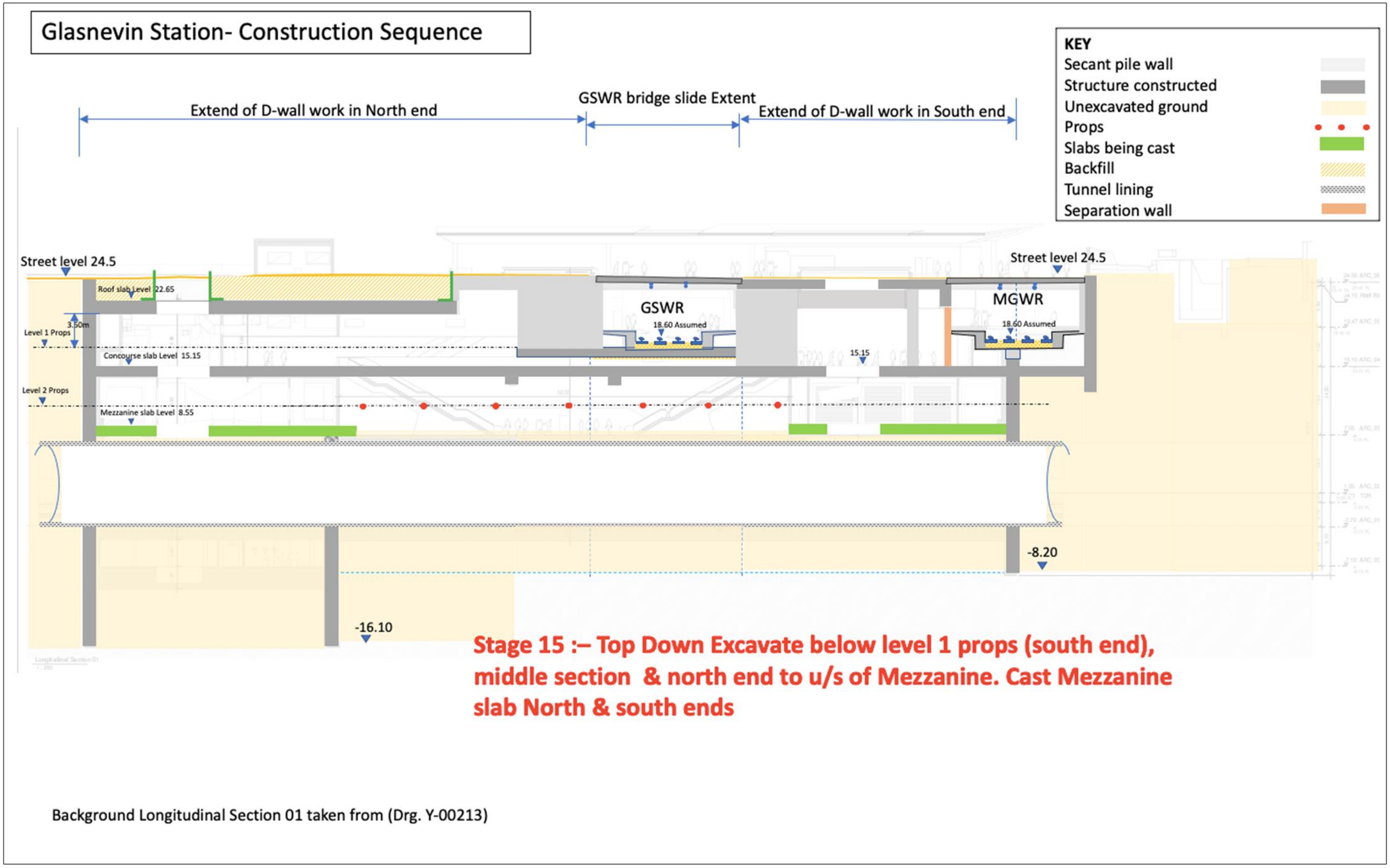
Background Longitudinal Section 01 taken from (Drg. Y-00213)

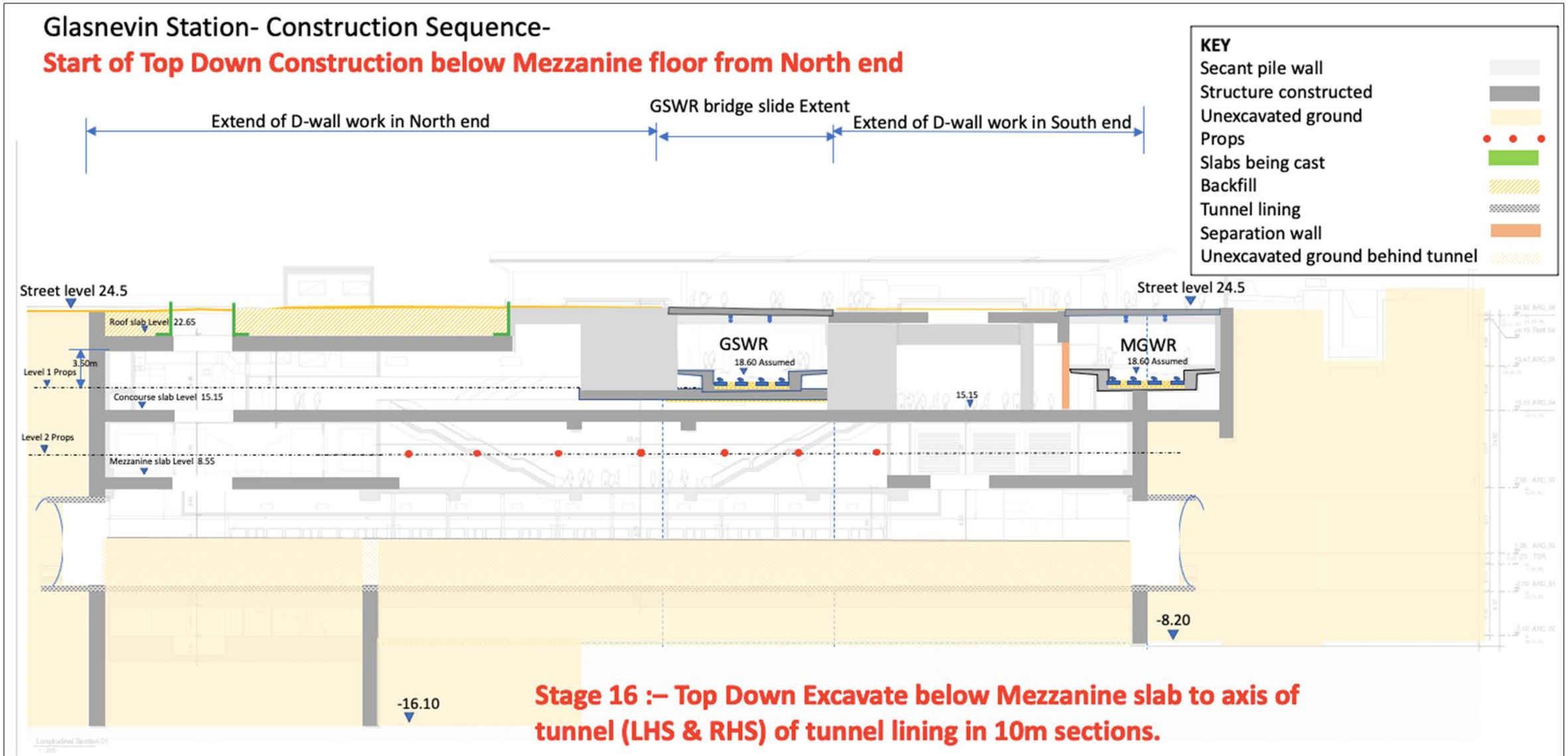
Glasnevin Station- Construction Sequence



Date of TBM departure from station: 28th July 2026

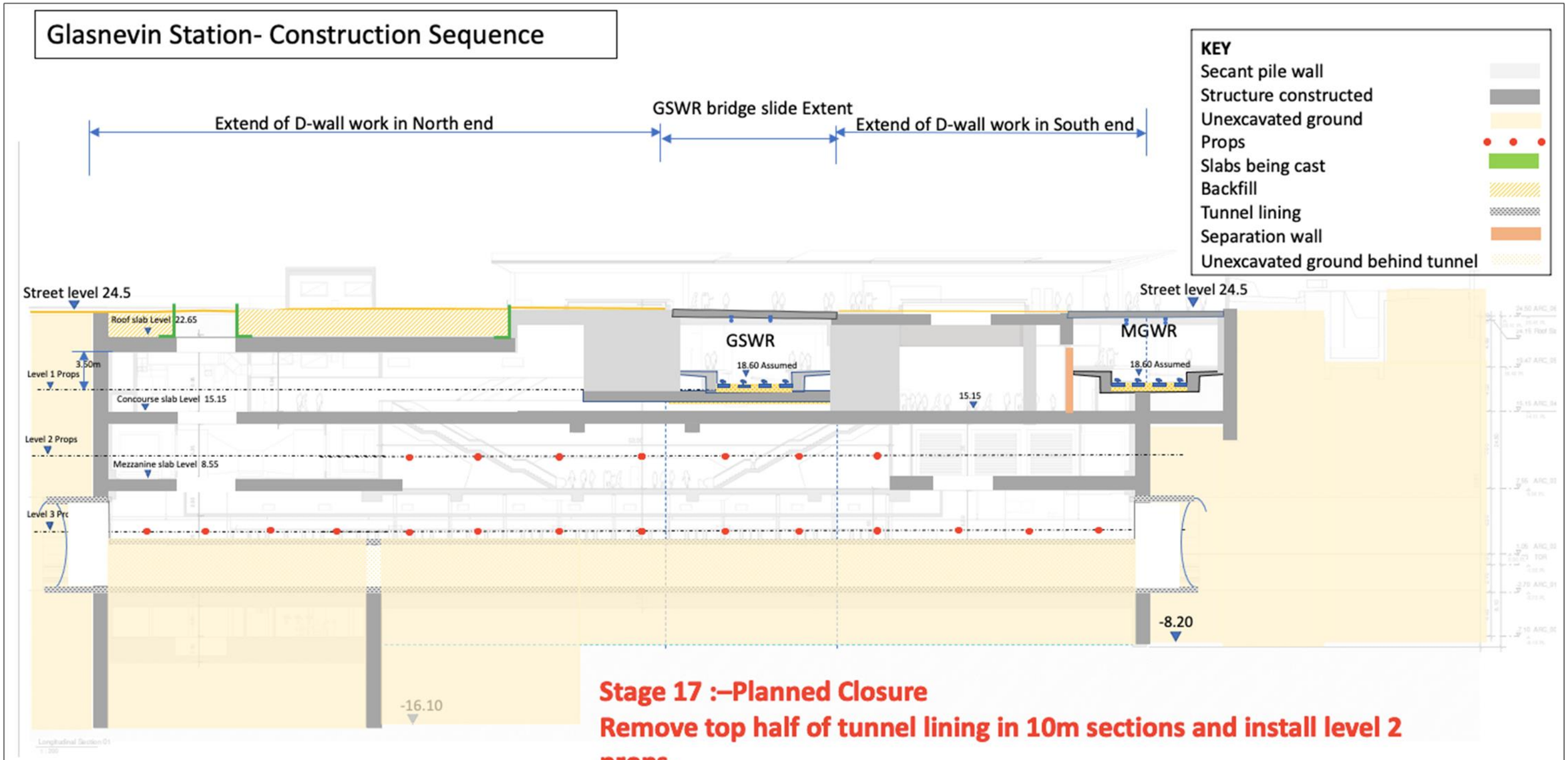
Background Longitudinal Section 01 taken from (Drg. Y-00213)


Glasnevin Station- Construction Sequence
Extend of D-wall work in North end
GSWR bridge slide Extent
Extend of D-wall work in South end
KEY
Secant pile wall
Structure constructed
Unexcavated ground
Props
Slabs being cast
Backfill
Tunnel lining
Separation wall
Street level 24.5
Roof slab Level 22.65
3.50m
Level 1 Props
Concourse slab Level 15.15
Level 2 Props
Mezzanine slab Level 8.55
GSWR
18.60 Assumed
15.15
Street level 24.5
MGWR
18.60 Assumed
-8.20
-16.10
Stage 15 :– Top Down Excavate below level 1 props (south end), middle section & north end to u/s of Mezzanine. Cast Mezzanine slab North & south ends
Background Longitudinal Section 01 taken from (Drg. Y-00213)



Background Longitudinal Section 01 taken from (Drg. Y-00213)

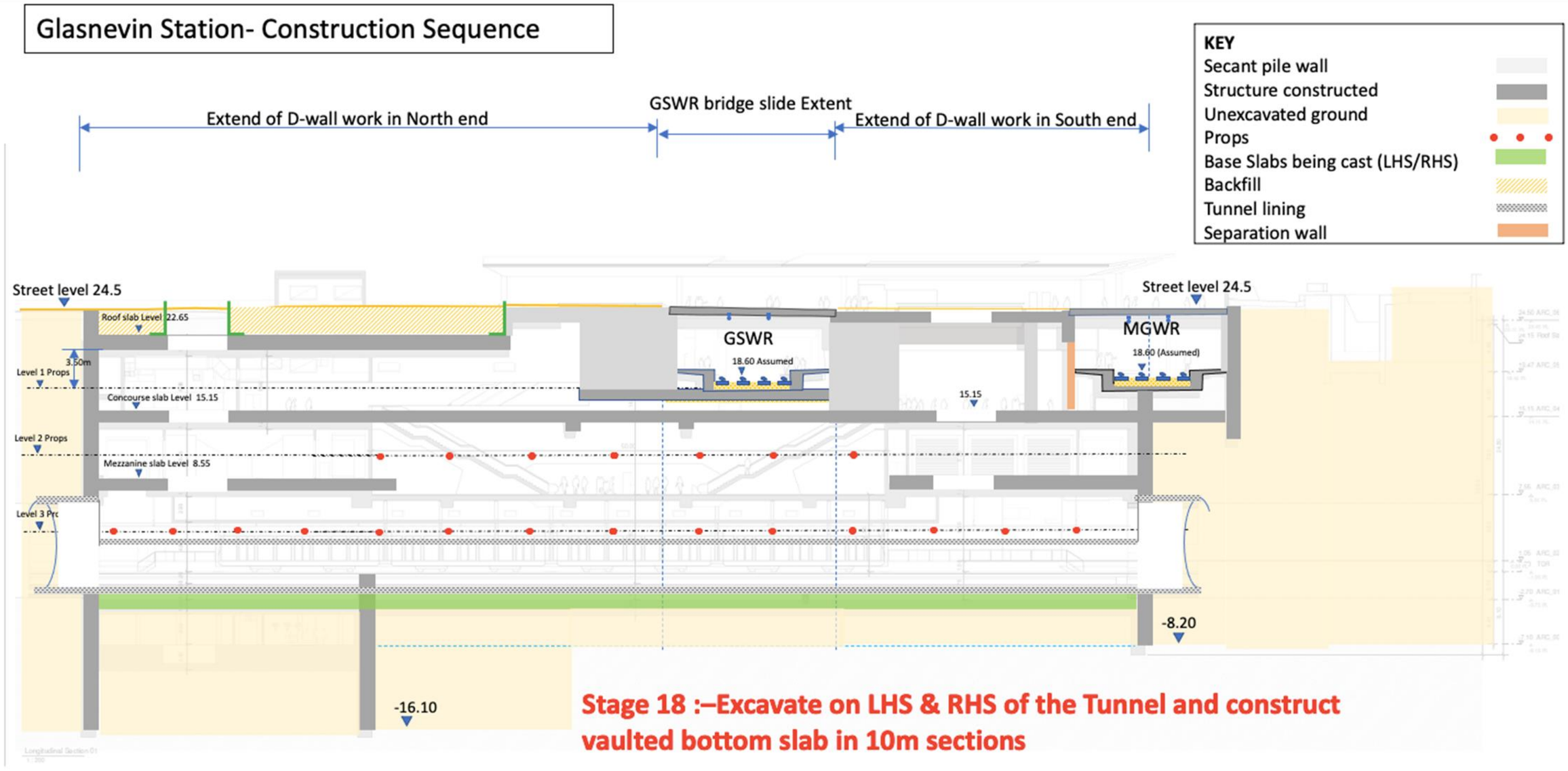
Glasnevin Station- Construction Sequence



Stage 17 :–Planned Closure
Remove top half of tunnel lining in 10m sections and install level 2 props.

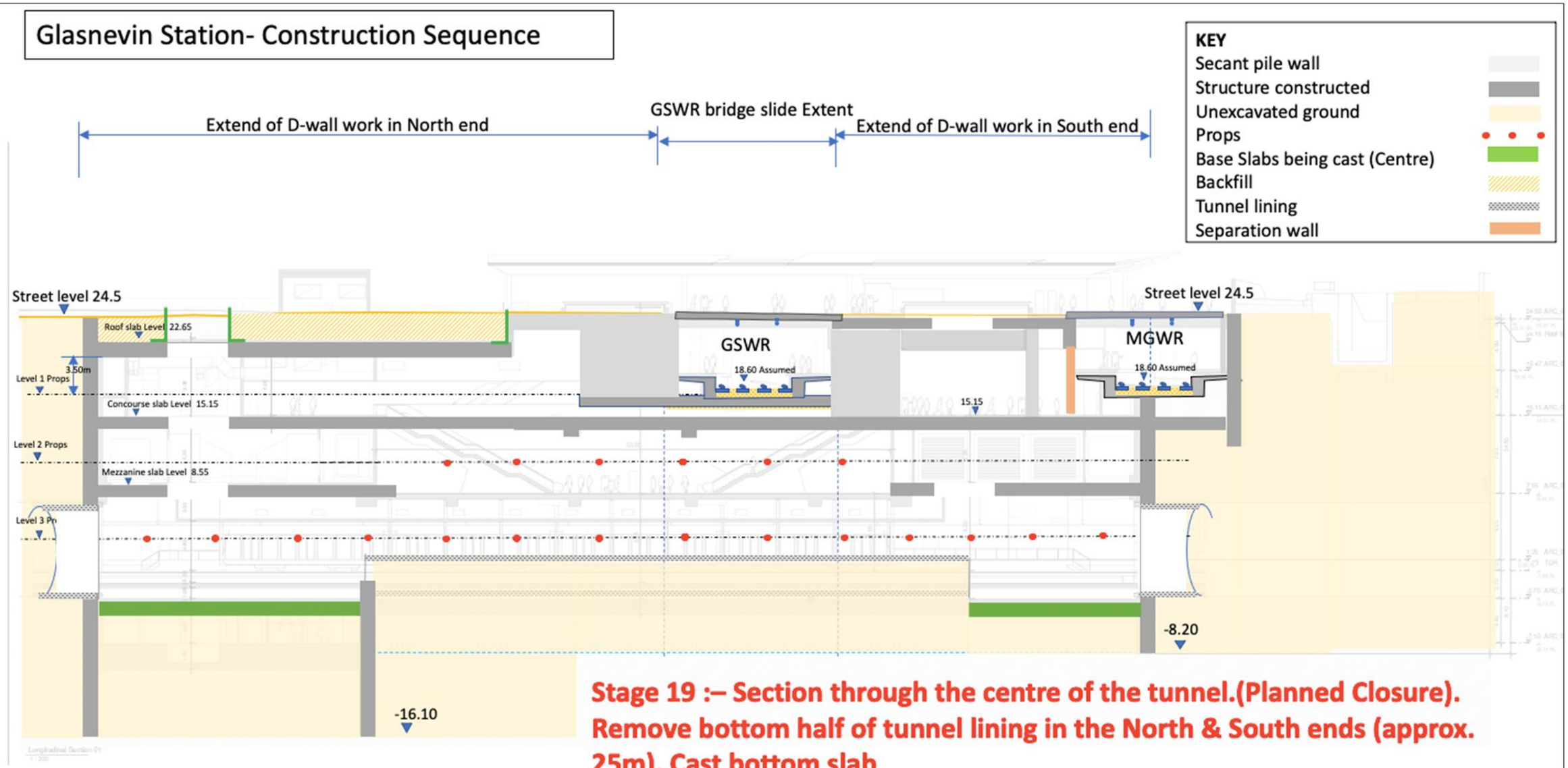
Background Longitudinal Section 01 taken from (Drg. Y-00213)

Glasnevin Station- Construction Sequence



Background Longitudinal Section 01 taken from (Drg. Y-00213)

Glasnevin Station- Construction Sequence

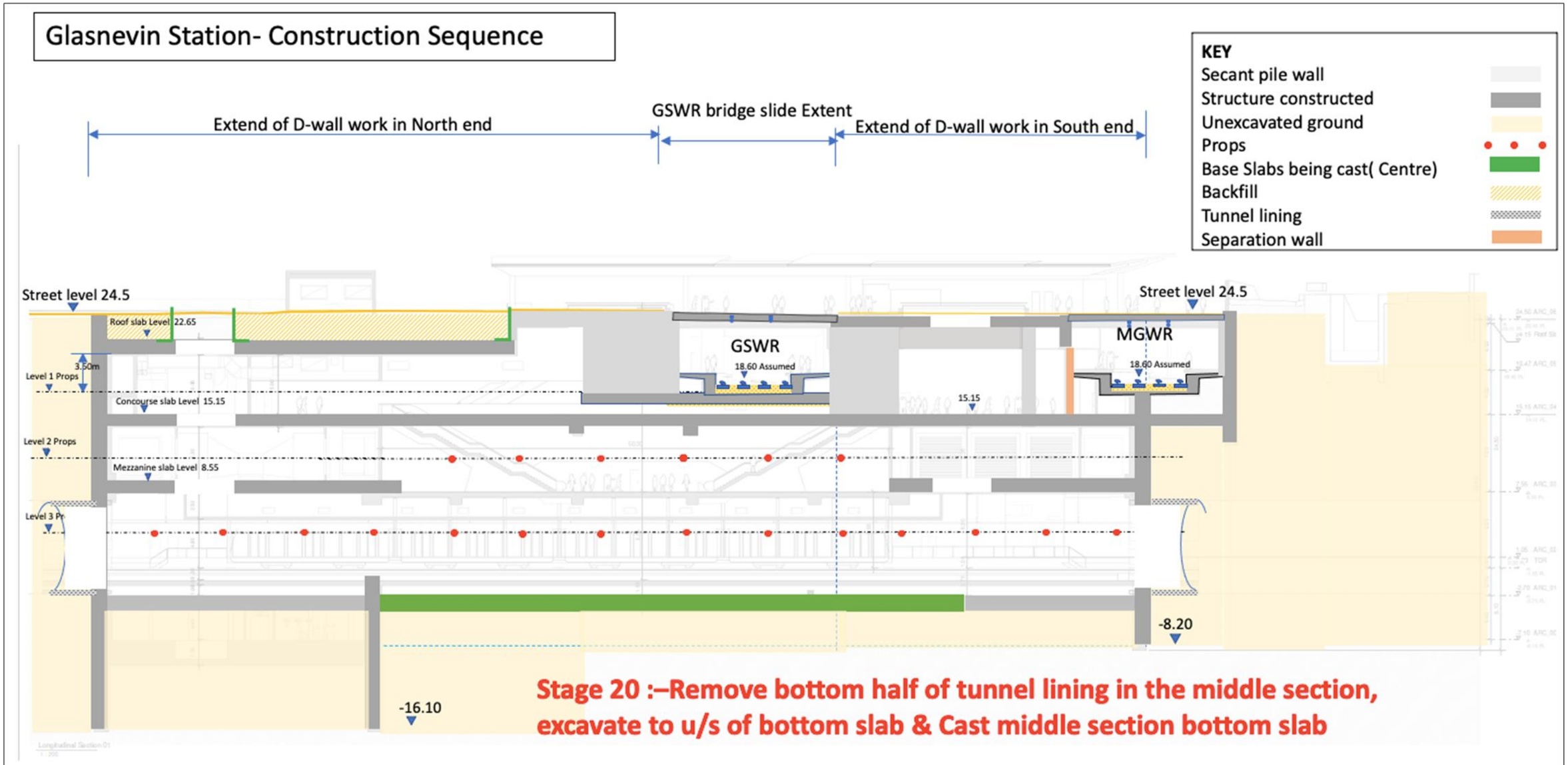


Stage 19 :– Section through the centre of the tunnel.(Planned Closure).
Remove bottom half of tunnel lining in the North & South ends (approx. 25m), Cast bottom slab
Rearrange ventilation/muck conveyor and divert MVH one side

Background Longitudinal Section 01 taken from (Drg. Y-00213)

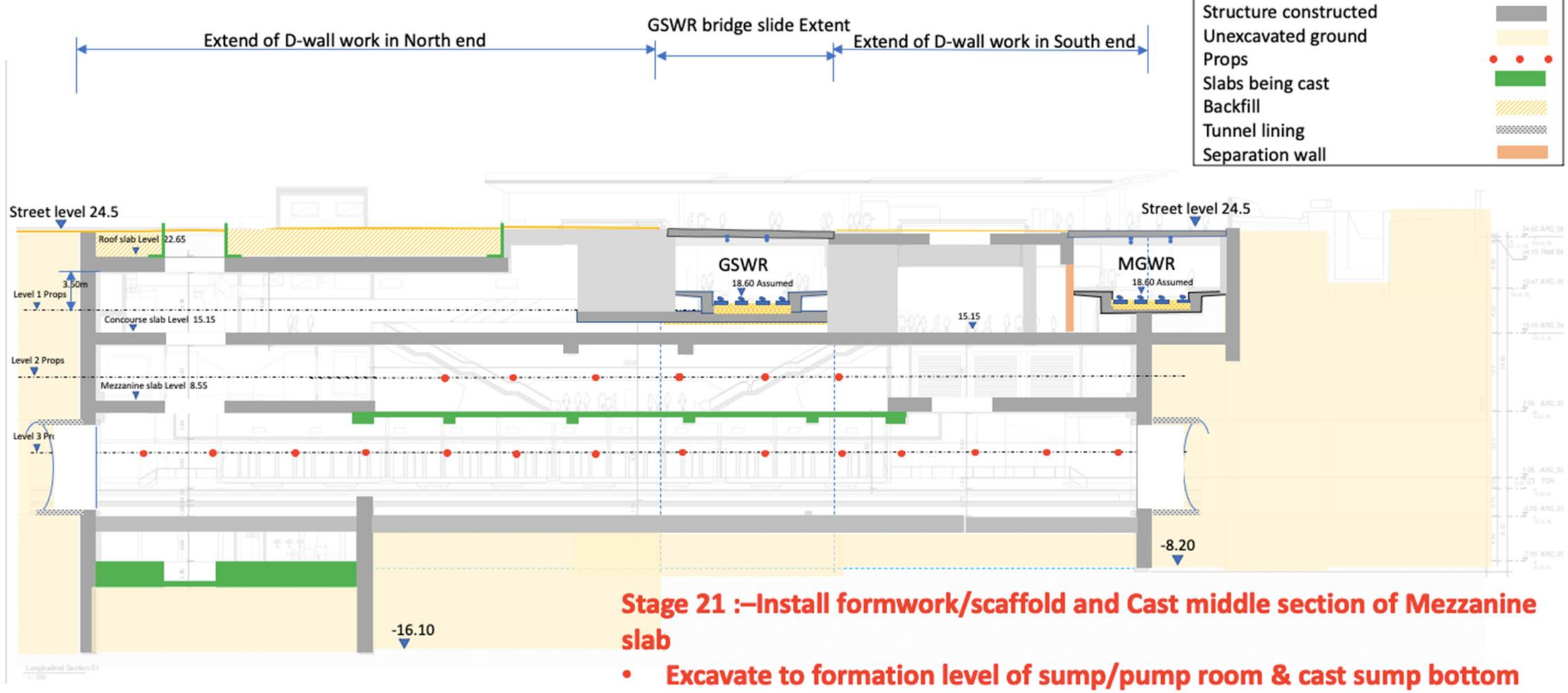
JACOBS IDOM

Glasnevin Station- Construction Sequence



Background Longitudinal Section 01 taken from (Drg. Y-00213)

Glasnevin Station- Construction Sequence



Stage 21 :–Install formwork/scaffold and Cast middle section of Mezzanine slab

- **Excavate to formation level of sump/pump room & cast sump bottom slab**

Background Longitudinal Section 01 taken from (Drg. Y-00213)