

URS

York Street Interchange

Public Inquiry
Technical Paper

City Reparo Alternative
Design Proposal

10 November 2015

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Rev	Date	Details	Prepared by	Checked by	Approved by
0	10 Nov. 2015	First Issue	John McBride Principal Engineer	Michael Megarry Associate	Michael Megarry Associate

URS

Beechill House
40 Beechill Road
Belfast
BT8 7RP

Telephone: +44(0)28 9070 5111

Fax: +44(0)28 9079 5651

www.ursglobal.com

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1. INTRODUCTION

1.1 Purpose

URS has assessed the validity of the City Reparo alternative design proposal (hereafter referred to as CRP) prepared as an alternative to the Proposed Scheme. This report presents a summary of findings from this assessment.

The assessment completed by URS has been limited only to the information made available in relation to the CRP, as submitted to the Public Inquiry on 23 October 2015 and subsequently on 6 November 2015.

Consultation has not been undertaken with City Reparo to address any identified gaps in information provided for assessment.

The documents provided by City Reparo for assessment are listed in Table 1.

Table 1: Reference Documents

Document Title	Dated
York Street Road Interchange – Alternative Design Proposal (Version 1)	23 October 2015
Drawing (filename: YSI alternative -4.jpg)	23 October 2015
York Street Road Interchange – Alternative Design Proposal (Version 2)	23 October 2015
Drawing (filename: YSI section A3.pdf)	6 November 2015

1.2 Background to Development of the CRP

City Reparo are, according to details provided in their submission, “...a multi-disciplinary consultancy focussed on city transformations.” The organisation is led by Mr. Mark Hackett, formerly of Forum for Alternative Belfast, a notable objector to the Proposed Scheme developed by TransportNI.

It should be noted that Mr. Hackett, sits on the Strategic Advisory Group established by TransportNI for the Proposed Scheme, whose purpose is:

- to provide strategic guidance to facilitate the integration of York Street Interchange with other Government and private initiatives in the setting of the project, in order to maximize opportunities for investment across all the sectors with the aim of enhancing the end product
- to review scheme aesthetics and enhance user appreciation.

Mr Hackett has worked with other members of the group to develop options to improve the aesthetics of the Proposed Scheme. The output from the group has been separately summarised in its summary report dated November 2015.

In City Reparo’s view, the Proposed Scheme has been designed as a “motorway engineering only” solution that does not strategically address urban repair. City Reparo consider that the Proposed Scheme has not improved over the course of the completed Stage 3 scheme assessment process to address this issue sufficiently. In their view, this is due to the absence

of a multi-disciplinary and co-design approach, i.e. the development of the roads scheme by roads engineers. City Reparo have noted that they suggested this approach in 2012.

City Reparo consider that the failure of the Proposed Scheme to address these issues is evident in the impact it has on the residents of Little Georges Street. City Reparo consider that the Proposed Scheme has an illegal impact on these residents.

Mr. Hackett, in his former role with Forum for Alternative Belfast, has objected to the Proposed Scheme on the basis of, amongst other things, the reduction in daylight levels to the properties at Little Georges Street and Molyneaux Street. In his view, the residents' legal rights to light would be impacted by TransportNI.

Given the claim, TransportNI commissioned URS to separately undertake a daylight assessment of the Proposed Scheme, which was completed by URS' specialist building physics team, led by Dr. Foroutan Parand. URS has prepared and published its summary report which confirms that all living rooms affected by the Proposed Scheme will still achieve adequate daylight.

1.3 Benefits Claimed

It is claimed that the CRP provides:

- maximum free traffic flow at a much reduced cost
- greatest potential for good pedestrian and cycle connectivity
- greatest potential for urban repair
- higher value building site assets
- maximum number of sites for the public purse
- maximum city benefit for business and civic connectivity
- minimised impact on residents
- retention of landscape and improved planting to residents.

2. DESCRIPTION OF THE CRP

2.1 Overview

City Reparo claims that their alternative is a value engineered design that provides the best balance of benefits to the maximum number of city stakeholders and needs. The CRP is based on the concept of realigning York Street below existing ground level into a new underpass, with strategic road links between the Westlink, M2 and M3 carried on overbridges above the underpass.

2.2 CRP Road Design Links

2.2.1 *Westlink to M2*

- For the Westlink to M2 movement, traffic flows are carried on a new overbridge structure above an underlying York Street.
- Two lanes appear to be provided, with no widening of North Queen Street bridge indicated.
- Given the absence of a direct off-slip to York Street, it would appear that the design intent is to downgrade the Clifton Street on-slip from a lane gain to an auxiliary lane merge arrangement.
- Based on the engineering drawings provided by City Reparo, the finished road level (FRL) on the bridge above York Street would be 4.5m above existing ground levels.
- The road alignment lowers north of the York Street overbridge to tie in with existing ground level at the Dargan Bridge.
- On approach to the Dargan Bridge, on the downhill section, a taper diverge is proposed for M3 bound traffic, who are routed via a circuit arrangement on Dock Street.
- On this off-slip, a left-in arrangement is provided immediately beyond the Dargan Bridge to provide a connection to York Street, presumably to maintain access to Cityside Retail Park.

2.2.2 *M2 to Westlink*

- The existing Nelson Street off-slip continues to be used in the CRP, with its proposed realignment bringing two lanes in a right hand radius under the Lagan and Dargan bridges (south of our crossing point) at existing ground level.
- City Reparo have quoted a horizontal radius of 127m for this main bend.
- The alignment straightens thereafter and climbs vertically over the York Street underpass, with the FRL identified as 4.5m above existing ground level.
- Two lanes continue to join Westlink over the existing North Queen Street bridge.
- Importantly, City Reparo have indicated that the movement from the M2 to Westlink would be uninterrupted by merging traffic.
- On this basis and as shown on the drawings, this precludes a merge arrangement for Docks traffic to access the Westlink.

- It is unclear how Docks traffic can access the Westlink in lieu of this connection.

2.2.3 **Westlink to M3**

- No direct connection between Westlink and M3 is provided, with M3 bound traffic from the Westlink re-routed via a new slip road to Dock Street.
- The new slip road is positioned between the existing Dargan Bridge and the existing M2 embankment, and continues to a revised junction arrangement at Dock Street.
- At Dock Street, this traffic flow is routed into a circuit arrangement around the Dock Street road and rail bridges using a widened westbound carriageway, before being turned right into Nelson Street, with a slip road thereafter providing connection to the M3 motorway.
- The southern footway on Dock Street is removed to provide sufficient space for the new free-flow lane running eastbound to service the Westlink to M3 movement.

2.2.4 **M3 to Westlink**

- A new interchange link is provided between the M3 and Westlink via an alignment to the north of the existing off-slip arrangement, similar to the alignment of the Proposed Scheme. However, the main radius on the alignment under Dargan Bridge appears to be significantly less than the Proposed Scheme, to facilitate a connection to the realigned M2 to Westlink link. A single lane is provided between the M3 and Westlink that joins the adjacent M2 to Westlink link and continues over the new York Street overbridge.
- No detail is provided of the proposed treatment of the southbound lanes heading towards Westlink. At present, the three lanes leading away from York Street onto Westlink reduce to two lanes by North Queen Street bridge (with the outer lane 3 dropped). If this layout is to be retained in the CRP, two options exist, either:
 - provide a lane reduction taper on the outer lane 3 on approach to North Queen Street bridge
 - provide an auxiliary lane merge for the M3 to Westlink movement.
- The use of a similar lane drop on the outer lane 3 would cause associated disruption to traffic flows on both lanes of the M2 to Westlink interchange link. This would create congestion and reduction in air quality.
- Similarly, the use of an auxiliary lane merge for the M3 to Westlink movement would also cause associated disruption to traffic flows on the M3 to Westlink interchange link and lane 1 of the M2 to Westlink interchange link. This would create congestion and reduction in air quality.
- In the absence of clarity, it is assumed that City Reparo intends to mirror the provision within the Proposed Scheme, with the widening of North Queen Street bridge on its southern side to provide a three lane weaving section over North Queen Street bridge and a lane drop to Clifton Street. This approach would be consistent with their stated aims for their CRP, i.e. to “...reduce congestion and pollution in the middle of the city to meet EU regulations.”

3. ASSESSMENT OF THE CRP

3.1 General

- Overall, there is little evidence that the CRP has been designed by a multi-disciplinary consultancy that includes competent roads engineers with knowledge and experience of road and junction design standards.
- The submitted CRP takes no account of the fundamentals of road design geometry, as established by the engineering standards in Volume 6 of the Design Manual for Roads and Bridges.
- URS has completed an exercise to trace the CRP to identify the alignments presented by its road links.
- As this exercise progressed, it quickly became evident that there were significant shortcomings in the layout that could not be easily overcome without modification to the horizontal and vertical alignments. These shortcomings included:
 - Absence of transition curves on radii in horizontal alignments
 - Absence of parabolic vertical curves in vertical alignments
 - Incorrect relative levels elsewhere on road links, requiring gradients in excess of 10% in places
 - Insufficient headroom to underlying road links.
- Simply put, the CRP as presented is not feasible from an engineering perspective.
- However, to enable some comparison to be made with a feasible CRP, the team performed adjustments to the horizontal and vertical alignments of its road links to include the required transitions and vertical curves. We offer no comment on the acceptability of the resultant road geometry to TransportNI.
- Plan and profile drawings of the resultant best-fit alignment to the CRP are included in Appendix A for reference.
- Specific issues are highlighted in the following sub-sections.
- We have sought the views of an experienced team of Road Safety Auditors on the CRP. A summary report following their review is included in Appendix B.

3.2 Design Speeds and Speed Limits

- It is not apparent what Design Speeds or speed limits are intended to apply to the interchange.
- When considered against Design Speed requirements under TD 22/06, it would appear that Design Speeds of 70 kph, supported with 40mph speed limits, should be applied for the interchange links, reducing to 60kph for its slip roads to the local road network.
- This would be a similar level of provision with that of the Proposed Scheme.

- We note the CRP proposes a 30mph speed limit on the M2 to Westlink movement, to the end of the 127m main horizontal radius, at the merge with the M3 to Westlink movement.

3.3 Horizontal Alignments

- A basic principle in the design of horizontal road geometry is the inclusion of clothoid spiral transition curves to provide comfortable connections between circular curves and straights. Superelevation is typically applied and removed over these transition curves, with the lengths of transitions extended as necessary to achieve smooth roll-overs of carriageway edge profiles.
- The importance of transitions within horizontal alignments is such that they are a requirement that requires a Departure from Standard to omit. Whilst TransportNI may accept the omission of transition curves on city streets to a lower design standard, it would not normally accept their omission on road links within the strategic road network.
- By tracing the CRP road link alignments and introducing the necessary transition curves, it is apparent that the road alignments are not possible as shown and would require significant further modification to fit within the constraints.
- The radii of the main curves on each of the strategic road links are substandard, falling below the Desirable Minimum values set by the DMRB. Whilst reductions below Desirable Minimum values can be acceptable, using the Departures from Standard process, it is noted that the radii on the M2 to Westlink, M3 to Westlink, Westlink to M3 and Dock Street to M3 are lower than their equivalents in the Proposed Scheme. This would be a significant factor affecting road safety that would require approval of associated Departures from Standard.
- Superelevation is not considered by City Reparo and it is assumed that it would be limited to 5%.
- For the Dock Street to M3 link, the shown horizontal alignment is likely to encroach into lands adjacent to the scheme registered to a third party. This is likely to require additional vesting and therefore land loss not currently anticipated with the Proposed Scheme.

3.4 Vertical Alignments

- In terms of the vertical alignment of the road links, it would appear that City Reparo has not complied with the requirement within the DMRB to use parabolic crest and sag curves to provide smooth, comfortable and safe changes in gradients.
- TransportNI will not accept vertical road geometry that does not include these parabolic curves.
- Further investigation has confirmed that the shown relative spot heights in the CRP drawings are not achievable once the necessary vertical curves are introduced.
- City Reparo notes that their road alignments have been designed to a proposed headroom envelope of 5.1m to 5.5m. Normally, a minimum envelope of 5.3m (plus additional sag compensation) is required. For sag curves with radii greater than or equal to 900m, this sag compensation is up to 100mm. Therefore, the clearance envelope would be a minimum of 5.4m (for new bridges) and 5.13m (for existing bridges).
- Construction depths are not indicated by City Reparo for the proposed bridges. Relative levels provided along the road links would suggest a maximum FRL to FRL level

difference of 6.5m. It is noted that the minimum construction depth possible on bridges with spans up to 15m using conventional precast concrete beams is typically 1.2m. Allowing for the clearance of 5.4m the difference between overlying road link FRLs should be a minimum of 6.6m.

- Once the necessary vertical curves are included, it is apparent at both bridges above York Street that the overlying road links would require to be raised further to achieve the necessary clearance envelopes. In its present form, the CRP is simply unfeasible.
- The K value of crest and sag curves required is expected to be below Desirable Minimum values, particularly for the main crest curves at the York Street overbridges.
- Significantly, at the eastern end of the Westlink to M2 alignment, the CRP identifies that the road alignment FRL would be 1.5m higher than existing ground level (EGL), approximately 13m away from the proposed tie in point under the Dargan Bridge. With reference to the survey information, this would put the FRL at approximately 4.4mAOD, relative to the typical ground level of 2.9mAOD. Even if this could be provided without the use of vertical curves, this would create, over the 13m distance, a downhill gradient of 11%, significantly in excess of the 6% Desirable Maximum gradient allowed by DMRB Standard TD 22/06 for interchange design.
- The CRP vertical alignment of the Westlink to M2 link would be higher than existing ground level on the section between North Queen Street bridge and York Street underpass, i.e. the section of carriageway running parallel to Little Georges Street. An indication of the increase in FRL, relative to EGL, for a range of the existing properties at Little Georges Street is presented below:
 - Nos. 1 to 11, -0.11m to +0.8m increase in FRL relative to EGL
 - Nos. 13 to 23, +0.8m to +4.4m increase in FRL relative to EGL
 - Nos. 25 to 31, +4.4m to +9.6m increase in FRL relative to EGL
 - Nos. 33 to 47, +9.6m to +8.7m increase in FRL relative to EGL.
- City Reparo have claimed that the Proposed Scheme would have an illegal impact on the existing properties at Little Georges Street due to the changes in road level and position blocking natural daylight to rear windows. This claim has been proven incorrect by the daylight assessment completed by TransportNI in accordance with legal guidelines. In the Proposed Scheme, the road level of the Westlink is raised by a maximum of 4.5m, with the largest increase being at house nos. 33 to 47. Elsewhere, the raising of the road alignment is more modest, typically up to 650mm.
- The profile of a best-fit CRP alignment (to overcome the noted problems with headroom with the original submission) would have a much more significant increase in road level past all the houses. The necessary embankments and/or structures to support this raised road alignment would therefore have a much worse impact on daylight levels to properties at Little Georges Street than the Proposed Scheme. It is likely that the CRP would potentially impact upon the residents' legal right to light.
- Having completed a best-fit alignment of the CRP, it would appear that the vertical alignment on the Westlink to Dock Street (and onward to M3) off-slip would clash with the position of the existing foundations of the Dargan Bridge and would therefore be unfeasible.

3.5 Stopping Sight Distances

- Within the road geometry standards of the DMRB, the concept of a Desirable Minimum Stopping Sight Distance is perhaps the most important factor governing road safety.
- The provision of Desirable Minimum Stopping Sight Distances allows drivers to understand the road ahead and take action to avoid hazards.
- The Desirable Minimum Stopping Sight Distance for a 70kph Design Speed is 120m, reducing to 90m for Design Speeds of 60kph.
- The provision of the Desirable Minimum Stopping Sight Distance at junctions is critical as research has shown the majority of accidents occur at junctions. Junctions include merge and diverge arrangements such as those included in the CRP.
- The maximum Stopping Sight Distance on any road link is generally limited by, vertical curvature and verge widening.
- On crest curves, Desirable Minimum K values are specified in the DMRB which should achieve the associated Desirable Minimum Stopping Sight Distance on a straight alignment. Where horizontal curves are also present, the width of the verge along with the superelevation used on the road may act in combination to limit this Stopping Sight Distance.
- Typically, verges are widened on bends to ensure that the sight line is contained within the width of the road. This applies equally to bridges.
- The K value of crest and sag curves required is expected to be below Desirable Minimum values, particularly for the main crest curves at the York Street overbridges. When coupled with the expected steep approach gradients, it is expected that they will automatically limit the Stopping Sight Distance that can be provided on these strategic road links.
- We would be concerned that with the vertical profiles and absence of verge widening that the CRP provides any acceptable level of Stopping Sight Distance. It is our view that the road layouts are likely to be unsafe, particularly in the vicinity of the merges and diverges, notably on the Westlink to M2 link.

3.6 Cross-Sections

- City Reparo advocate the use of narrow bridges and this is reflected in the CRP.
- The proposed cross-sections on the links, particularly those of the bridges, are notably substandard, with no provision for hardstrips or hard shoulders. Verges shown are notably substandard in width.
- Whilst the value of widened verges may ultimately be limited by the vertical geometry on the link, widened verges are still necessary in many instances to provide signs, ducting and chambers. Verge widening should therefore not be omitted or limited without good reason. The CRP does not appear to take cognisance of this.
- Whilst standard lane widths may be provided, the absence of hard shoulders and hardstrips will present operational and maintenance issues.

- It is noted that City Reparo criticise the underpasses in the Proposed Scheme as narrow tunnels, however, bridge structures of limited width, such as those in the CRP, could be equally considered to present the same constraint. The lack of width on the structures would also limit the ability of emergency vehicles to attend the scene in the event of incidents, as backlogged traffic would be unable to manoeuvre out of the way.
- This is particularly notable on the single lane off-slip from Westlink to M3. The CRP layout shows no nearside hard shoulder on the diverging single lane. This means that in the event of an incident, the lane will be blocked, not just leading to congestion, but potentially rear-end shunt type accidents as drivers are forced to stop at the scene.

3.7 Junction Layouts

- The standards for merges and diverges are set out in Standard TD22 of the DMRB. These standards set out minimum geometric parameters for interchanges in rural and urban locations. The Standard recognises the constraints formed by built infrastructure in urban areas and permits reduced geometric standards to be applied in these circumstances.
- These urban merge/diverge standards set out the lengths of tapers and auxiliary lanes, the proximity and location of merge and diverge points and the length and angle of nosings. The length and angle of nosings is important to ensure a smooth change of direction at diverges and to ensure visibility at merges, to avoid blind spot areas on wing mirrors.
- Again, an initial review of the CRP highlights that these standards have not been considered when developing the proposals. Taper lengths are below standards, with nosings too short in length and too shallow in angle. Examples of this include the diverge nose on the Westlink to M3 link and the merge nose on the York Street to M2 link. The latter is particularly concerning as there will be a level difference between the merging flows. The alignment of the Westlink to M2 link is likely to be supported either on structure or with a retaining wall at this point and the width of the merge nose does not take account of the presence of a retaining wall and associated vehicle restraint system.
- The CRP includes changes to the Dock Street junction to introduce a segregated loop circuit for Westlink to M3 traffic using widening of the westbound carriageway (and removal of its southern footway). All other through traffic on Dock Street would be unchanged. The junctions at Brougham Street and Nelson Street would require modification to accommodate this change, particularly to redirect non-motorised users to the northern footway on Dock Street at the Nelson Street junction. The resultant loss of the southern footway is therefore not in keeping with the scheme objective to maintain access for pedestrians and cyclists.
- The width of the single Westlink to M3 loop at Dock Street appears limited to not more than 4m, which again, in the event of an incident, leaves no additional available width to drivers to manoeuvre around a stopped vehicle. As there appears to be no feasible option to provide additional width without loss of lanes for through traffic on Dock Street, this would be a significant vulnerability in the CRP.
- The off-slip from Westlink to M3 (via Dock Street) is highlighted as notably poor, with successive changes in substandard horizontal radii of approximately 100m on a downhill gradient without transitions, on a limited width cross-section with the opening of a second lane and an almost immediate downstream left-in arrangement to York Street.

- The absence of a direct connection between the Docks and Westlink within the layout is highlighted as this is in direct conflict with the stated scheme objective of improving access to the regional gateway. City Reparo have provided no indication of a substitute route for Docks traffic nor would it appear they have entered into any form of consultation with them.
- The layout on York Street is considered inefficient, with a lane reduction taper sited at the entry to the underpass. Again, the lane reduction taper shown is significantly substandard and certainly not DMRB compliant. The use of such short lane reduction tapers will limit the ability of traffic to merge in-flow, with resultant impacts for traffic congestion on approaches.

3.8 Flood Risk

- In the CRP, a new underpass would be constructed at York Street. This would require the advance diversion of services around York Street, in a similar manner to those required for the Proposed Scheme.
- It is noted that City Reparo has claimed that no pumping station is required with their design. The lowest point on the new underpass at York Street would be up to 2.5m below ground level, with the lowest point on the new underpass for the southbound bus lane up to approximately 6m below ground level. The depth of the underpass for the bus lane is dictated by the level of the rising York Street to M2 link road. URS, having completed preliminary services enquiries with NI Water, is aware that the nearest deep sewer that would potentially facilitate routine discharge from these underpasses would be the low level sewer at Corporation Street. This sewer is approximately 4m below existing ground level. It will therefore be necessary to include a pumping station to discharge collected stormwater from the road surface and convey it to the existing drainage infrastructure. Therefore the claimed advantage of not requiring a pumping station is considered spurious.
- In addition, City Reparo present as an advantage of their scheme that it has no flood risk and concern on tidal floods. This assertion is presumed to be based on the fewer number of underpasses in their CRP. As illustrated in the published flood risk assessment for the Proposed Scheme, York Street and its environs are currently at risk of inundation from a coastal flood event with an Annual Exceedance Probability of 0.5% or more. The shown extents of this floodplain will reach as far inland as York Street and Henry Street.
- With or without underpasses, the flood risk is the same. The Proposed Scheme includes measures to prevent these flood waters entering the underpasses. Whilst City Reparo's layout only has one layout on York Street, it cannot easily be protected from flood inundation, with adjoining areas largely remaining at existing ground level. Furthermore, flood water will be able to reach the parts of York Street to the north and south of the entry into the underpasses and so, will be able to reach its low point and cause flooding. To prevent floodwater inundation of the underpass, it would be necessary to erect a barrier transverse to the carriageway and close the underpass in advance of, during and after the event. As the parts of York Street to the north and south of the underpass would be flooded in any event, there would be an increased downtime for the closure of York Street relative to the Proposed Scheme.
- The assertion that the CRP has no flood risk and concern on tidal flood serves to further highlight the limited engineering knowledge, experience and competence of their multidisciplinary consultancy.

3.9 Review of CRP Advantages

Table 1 provides a summary of the claimed advantages of the CRP and our response on the basis of our considerations of its merits.

Table 1 Consideration of CRP Advantages

Claimed Advantage	Considered Response
Less cost	No details have been supplied to confirm this statement but it would appear reasonable that the CRP would offer a reduced cost
Achieves same connectivity and improvement to motorway network	This is a spurious claim given the poor connection between Westlink and M3, the poor geometry standards generally offered on the remaining road links and the omission of an important connection to the Westlink from the Docks
Avoids deeply sunken roads	Accepted, the Proposed Scheme has deeper underpasses. However, we note from consultation responses received from Forum for Alternative Belfast (now City Reparo) that they would favour depressed links for the strategic roads, contrary to what has been shown in the CRP
Less movements through descent and climbing	Our assessment indicates that the movements over the new bridges would require significant climbing and descent
More simple layout and choices for drivers, assists flow/safety	As we have noted, the CRP layout has some significant geometry issues that will not assist traffic flows and will furthermore present risks to road users. Our concerns are reinforced by the concerns raised by a separate Road Safety Audit team who has performed a review of the layout. In addition, the junction layout at Dock Street is unusual and may lead to driver confusion.
Less danger of driver confusion (current East bound splits into tunnels)	We would note that the Proposed Scheme does not include tunnels as defined by the DMRB. We expect that the combination of poor road geometry and unusual junction layouts (particularly at Dock Street) is likely to increase driver stress levels and confusion, with an increased potential for accidents

Claimed Advantage	Considered Response
Less land take	Whilst the CRP may require less land take overall, it would require land from third parties at Corporation Street for the realigned Dock Street to M3 link. This land is not required for the Proposed Scheme.
No pumping station	A spurious claim, a pumping station will be required to service the two York Street underpasses for stormwater run-off.
No flood risk and concern on tidal floods	A spurious claim, York Street and its environs remain at risk of coastal flooding and the proposed York Street underpass cannot easily be modified to prevent against flooding.
Much less bridge construction and adaption	The CRP would not require works to the northern side of North Queen Street bridge and the widening of Dock Street bridge. However, works may be required to widen the southern side of North Queen Street bridge for traffic capacity on the M3 to Westlink movement.
Less time, phasing and disruption	No evidence has been provided to substantiate this claim.
Uses existing roads to best advantage	The statement made is vague. From what has been submitted, it would appear that the CRP would have impacts on York Street, Dock Street and Nelson Street (which is equally true for the Proposed Scheme).
Easier working space for train line upgrade at later date	The shown layout for the widening of the Dargan Bridge within the CRP is asymmetrical and would require significant additional works to provide widened pier supports and foundations. The position of the Westlink to Dock Street/M3 slip road may limit the opportunity to widen the bridge in due course due to its proximity and headroom requirements.
Air quality should be better, less climbing/descent	A limited view of the factors that influence vehicle emissions and effects upon air quality. It does not factor in the effects of speed variation, overall road geometry, changes in route length and the distribution of flows.

Claimed Advantage	Considered Response
<p>More distant to existing residents/less risk of NOx failure post 2023</p>	<p>Agreed, however it would seem City Reparo is content to alleviate impacts at Little Georges Street at the cost of the Sailortown Community (at the Garmoyle/Dock Street Junction). We would highlight that the Proposed Scheme does not suffer from risks associated with NOx emissions.</p>
<p>Less maintenance ongoing</p>	<p>Road links are of similar length and of similar construction to the Proposed Scheme. The intentional narrowing of carriageways and omission of hardstrips/hard shoulders will make maintenance operations more difficult to complete without full road closures.</p>
<p>No cutting of existing landscape</p>	<p>The new overbridges will have a significant impact on the landscape along with the raising of the Westlink road embankment. The new overbridges will create a more dominant road network thus extending perception of severance to North Belfast. We would note that the Forum for Alternative Belfast raised similar concerns with overbridges included in options considered during the Stage 2 Scheme Assessment process.</p>
<p>Allows more landscape screen planting to occur</p>	<p>No evidence has been provided to substantiate this claim. In the Proposed Scheme landscape screen planting is proposed for areas of lands effectively severed by the various road links.</p>

Claimed Advantage	Considered Response
<p>Greater connectivity and regeneration potential</p>	<p>We would contend that the scheme reduces connectivity on the Regional Strategic Transport Network, particularly for the Port of Belfast, through the removal of direct access to the Westlink. The removal of this direct access is considered contrary to the stated scheme objective of improving access to the regional gateways, which is underpinned by regional development strategies and transport policies. This is significantly worse than with the Proposed Scheme.</p> <p>With regard to regeneration potential, the Forum for Alternative Belfast has considered the existing York Street junction a 'shatter zone' due to the disconnection caused by the Lagan and Dargan bridges and the M2 embankment. The provision of additional overbridges across York Street would potentially add to this by creating the perception of severance of North Belfast from the City Centre, thereby affecting regeneration potential, the M2 and Dunbar Link, would elevating the strategic links not contribute to further disconnection by providing a continuous elevated barrier through this area. We would highlight that for similar reasons the new Broadway junction was changed from an elevated overbridge to a depressed underpass in response to concerns over community severance.</p>
<p>York Street can be repaired as a street, safer environment</p>	<p>We would contend that the Proposed Scheme, through the removal of strategic traffic flows, repairs York Street as a safer environment for non-motorised users.</p>
<p>York Street easier for pedestrians and cyclists on grade (level)</p>	<p>Accepted.</p>

Claimed Advantage	Considered Response
<p>Better connection from York St station to Ulster University</p>	<p>City Reparo states that no strategic connections exist on the eastern side of York Street north of the scheme. The location of the Yorkgate train station on the eastern side of York Street north of the scheme would therefore appear to have been ignored in arriving at this statement. The importance of this train station is set to increase following the relocation of the Ulster University campus as the nearest rail connection to the Jordanstown campus, where student accommodation will remain.</p> <p>With the absence of provision for non-motorised users on the leaving Yorkgate train station will be required to cross over at the Dock Street junction. Also, no specific provision is made for public transport compared to the provision in the Proposed Scheme.</p>
<p>More land assets of higher value</p>	<p>No evidence has been provided to substantiate this claim.</p>
<p>City to M2 evening peak traffic cleared with two less sets of lights</p>	<p>The proposed lane reduction arrangements on York Street in the underpass are likely to have operational traffic impacts that will limit the benefits offered by the removal of signals.</p>
<p>Less site extent, less impacts on Environmental statement</p>	<p>A full environmental impact assessment would need to be carried out to confirm, improvements in some areas may be offset by larger adverse impacts in other areas.</p>
<p>Less urban severance and impact on Dock Street</p>	<p>The CRP increases the urban severance and impact on Dock Street (i.e. increased traffic, limitations of access, poorer quality walking routes, and change in desire lines). This is important in light of the existing degree of severance with regards to east/west movements in the area. The CRP will further add to this disconnection.</p>
<p>Corporation Street can be fully regenerated</p>	<p>The absence of a direct connection from the Port to the Westlink may lead to reassignment of traffic onto Corporation Street, thereby limiting options for its regeneration.</p>

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4. RECOMMENDATIONS

We note the aspiration of City Reparo in their proposal to promote their view of urban design philosophy, however as highway engineering specialists we clearly believe that this would be to the detriment of the operational needs of the project and the safety of road users.

The submitted CRP takes limited cognisance of recognised UK road design standards, which have been developed on the basis of research carried out by the Transport Research Laboratory and mandated as Standards within the DMRB. These Standards exist to safeguard the safety of road users and any reduction in these must be carefully considered by TransportNI.

The CRP is, as presented, unfeasible from an engineering perspective as fundamentally, road levels do not tie up. It is noted that City Reparo had claimed in its submission that “...*We have checked all the key dimensions and gradients and the proposal is drawn to scale and in detail, we believe all of the technical issues can be resolved*”. This statement would not appear to have been borne out when checked by URS.

Having identified these technical issues, we have attempted to create a modified best-fit alignment, to demonstrate how some of the most obvious technical issues could be resolved. Unfortunately, we do not consider it possible to correct the potential clash between the Westlink to Dock Street off-slip and the existing foundations of the Dargan Bridge. Notwithstanding this issue, this best-fit alignment would still have significant shortcomings in terms of geometry and we would expect the geometry to be unacceptable to TransportNI.

City Reparo have alleged that TransportNI is breaching the legal rights to light of residents at Little Georges Street. TransportNI has completed a daylight assessment that demonstrates this is not the case. However, in examining the best-fit alignment, it would appear that the solution prepared by City Reparo may potentially create a more significant detrimental impact for these residents.

The proposed removal of a direct access for the Port of Belfast to the Westlink, as suggested by City Reparo, is contrary to the identified scheme objective of improving access to the regional gateways, the principles of the published regional transportation strategies and plans and would be unacceptable to the Port of Belfast.

Away from the road alignment, City Reparo has demonstrated their lack of engineering competence in the assertion that no pumping station is required for the underpass. Similarly, their lack of competence in civil engineering is highlighted in the assertion that the CRP has no flood risk, in spite of published evidence to the contrary.

In summary, major road engineering projects such as the York Street Interchange requires a multi-disciplinary team led by roads engineers at their core, to ensure that the various road alignments achieve basic and fundamental engineering standards for feasibility and safety.

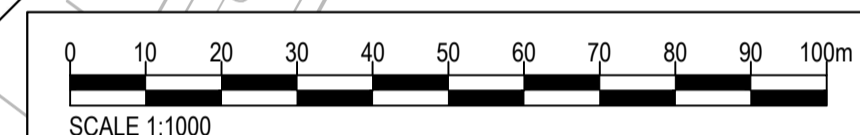
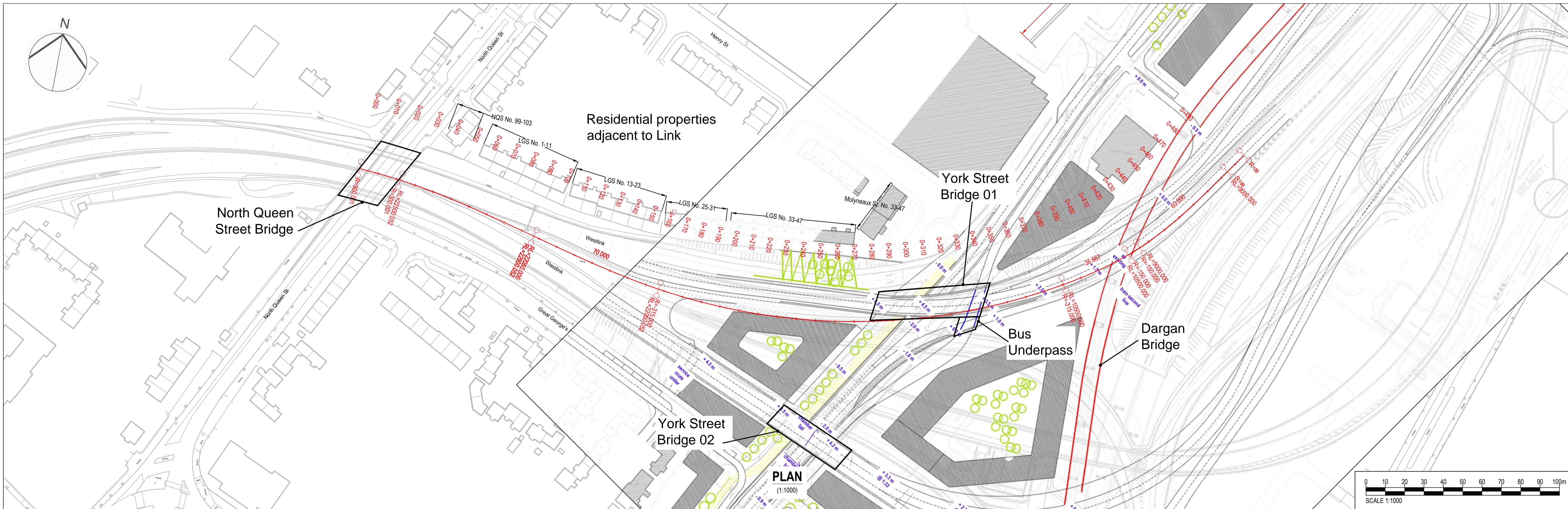
Contrary to City Reparo's views that “...*only later should come the details of road engineering, which can be, and should be in our view, manipulated to suit...*” road design to DMRB standards must always come first and foremost in the development of a scheme at York Street to safeguard the 100,000 people who will be using the junction on a daily basis.

Whilst TransportNI draw in experienced professionals from other disciplines to advise on pertinent matters, the issues highlighted within this report with respect to the CRP reinforce the rationale for putting the safety of road users ahead of aspirations for future land development.

On the basis of our assessment, we consider the CRP to be unfeasible and cannot be fitted within the vertical and horizontal constraints. As such it does not warrant further consideration.

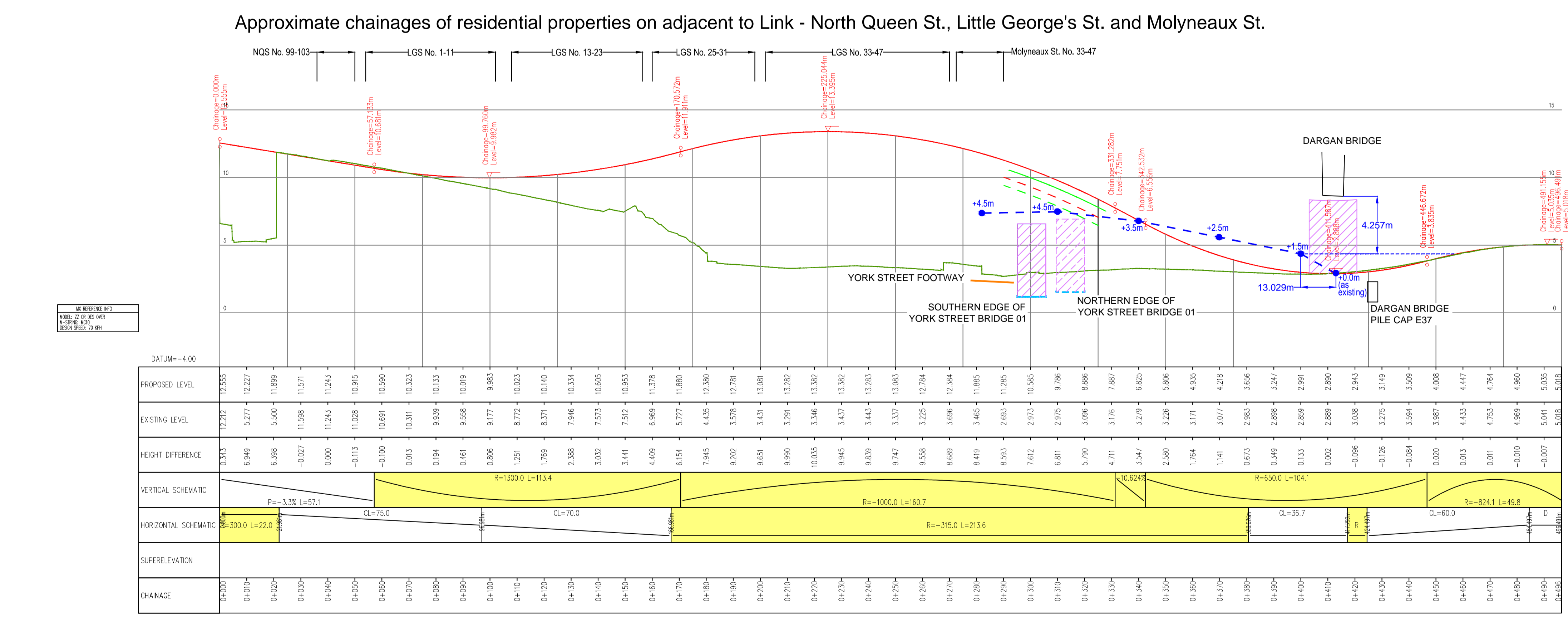
APPENDIX A DRAWINGS

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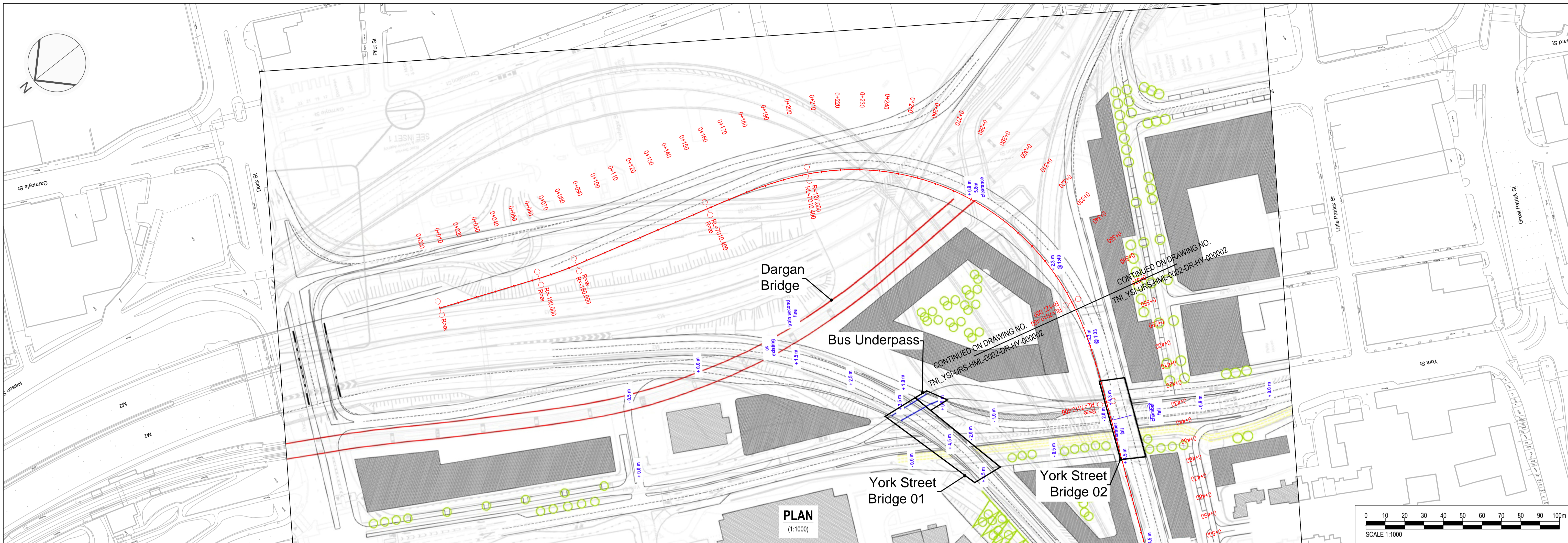
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- Proposed York Street Bridge 01 Soffit
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level Northern Channel Line - Westlink to M2
- Proposed York Street Bridge 01 Northern Edge Soffit
- Existing Ground Level
- City Reparo's Alternative Design Proposed Levels Westlink to M2
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level York Street Carriageway
- Interpretation of City Reparo's Alternative Design Proposal Footway Level York Street Footway
- Headroom Clearance Envelope = 5.4m
- Substandard Geometry



PROFILE
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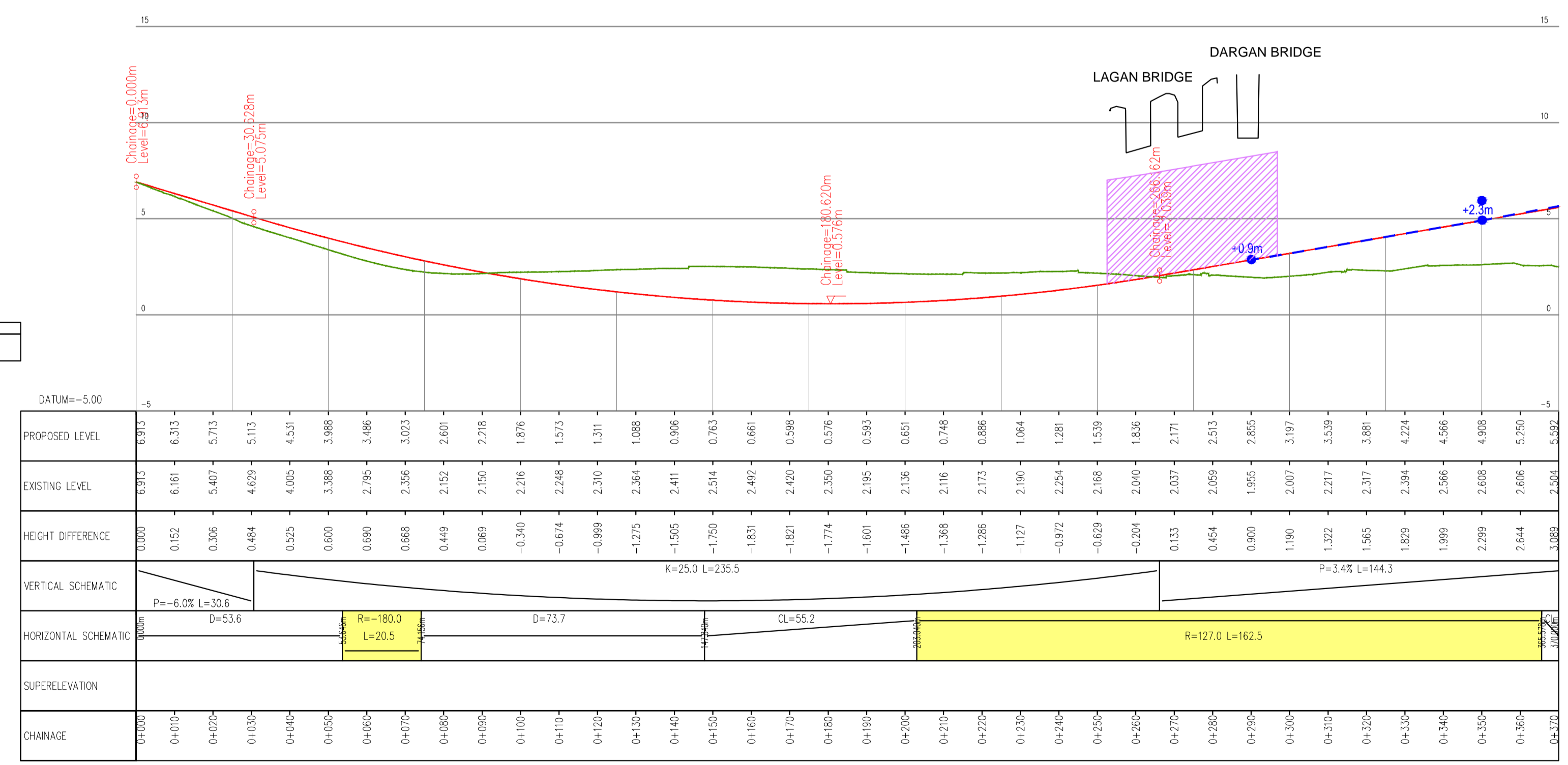
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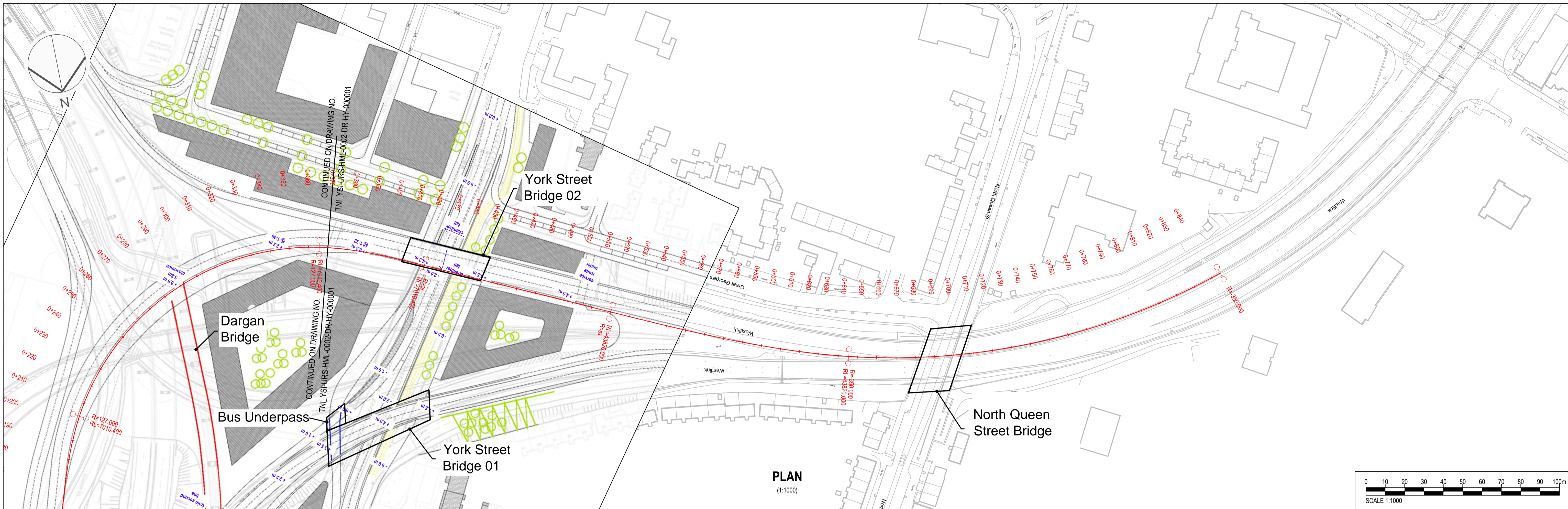
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- Existing Ground Level (Green line)
- City Reparo's Alternative Design Proposed Levels M2 to Westlink (+0.0m) (Blue line)
- Headroom Clearance Envelope = 5.4m (Pink hatched area)
- Substandard Geometry (Yellow shaded area)



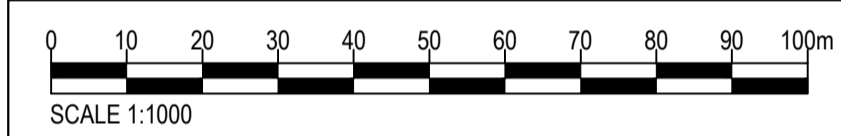
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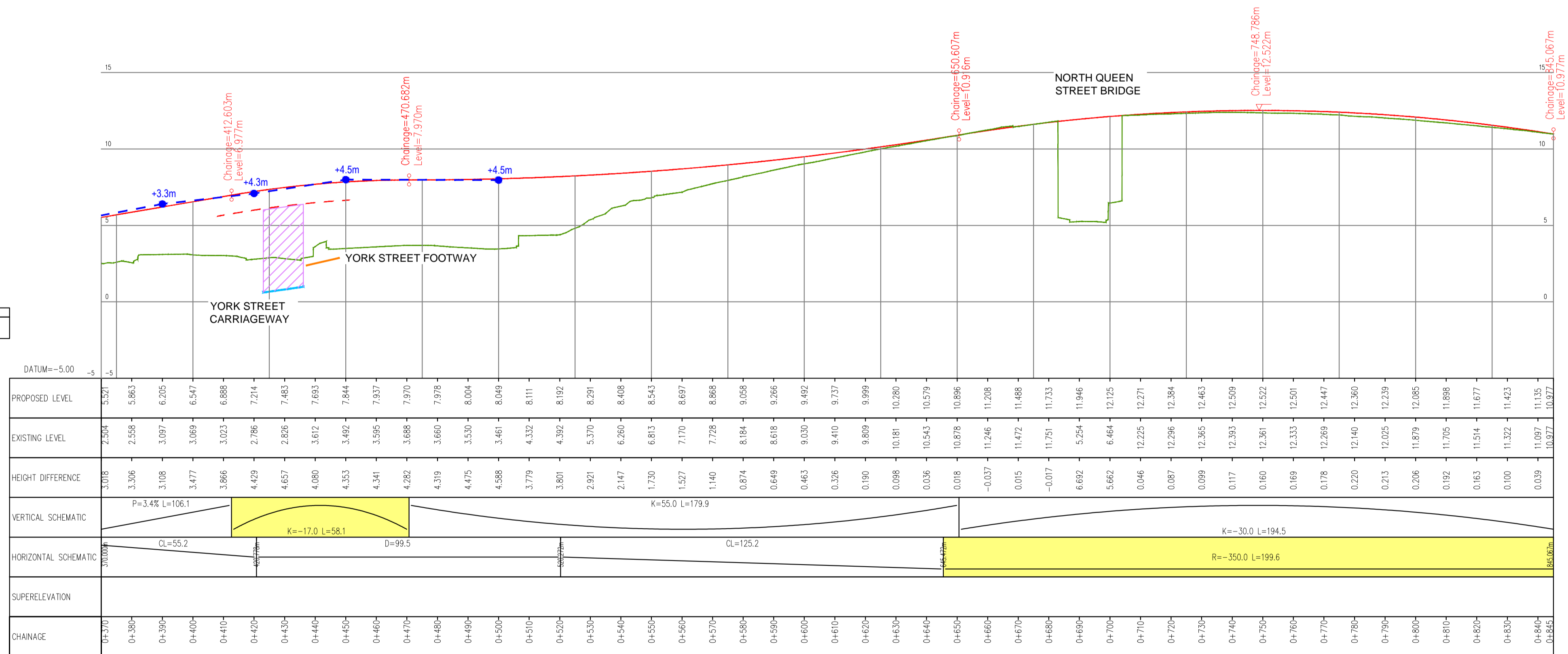


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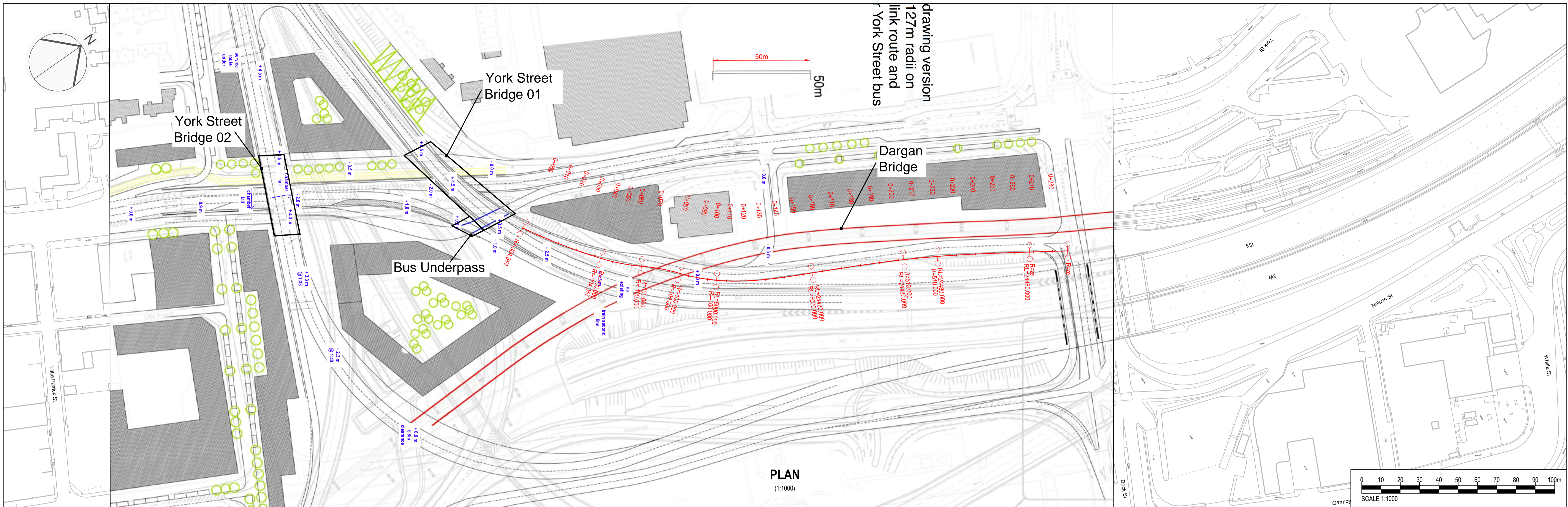
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- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level M2 to Westlink (Red dashed line)
- Proposed York Street Bridge Soffit (Red dashed line)
- Existing Ground Level (Green line)
- City Reparo's Alternative Design Proposed Levels M2 to Westlink (+0.0m) (Blue line)
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level York Street Carriageway (Blue line)
- Interpretation of City Reparo's Alternative Design Proposal Footway Level York Street Footway (Orange line)
- Headroom Clearance Envelope = 5.4m (Purple hatched area)
- Substandard Geometry (Yellow shaded area)



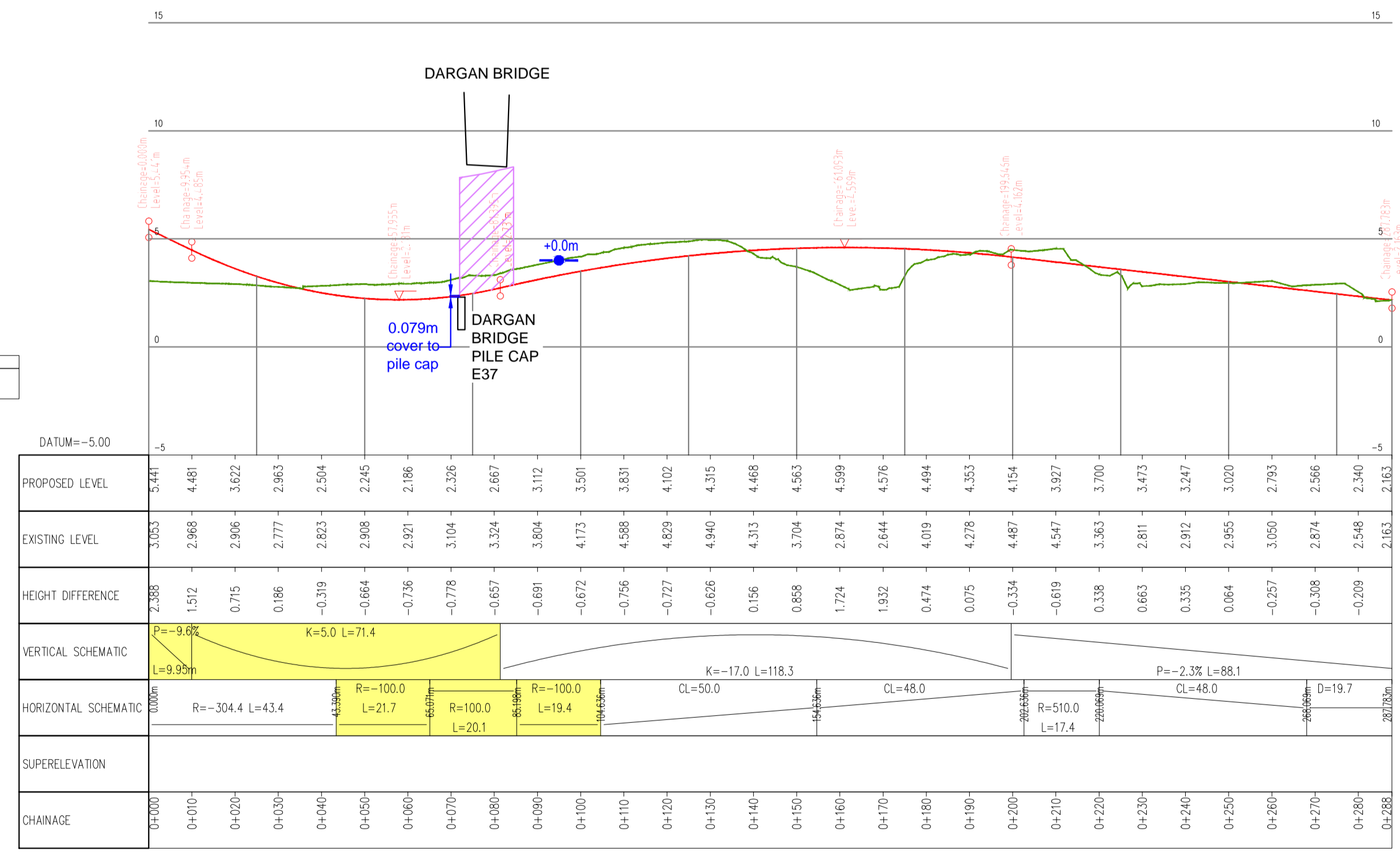
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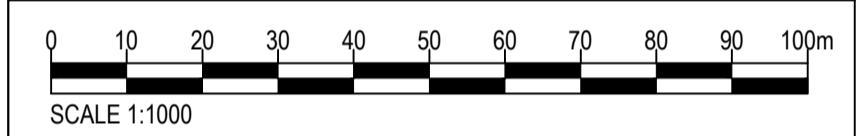
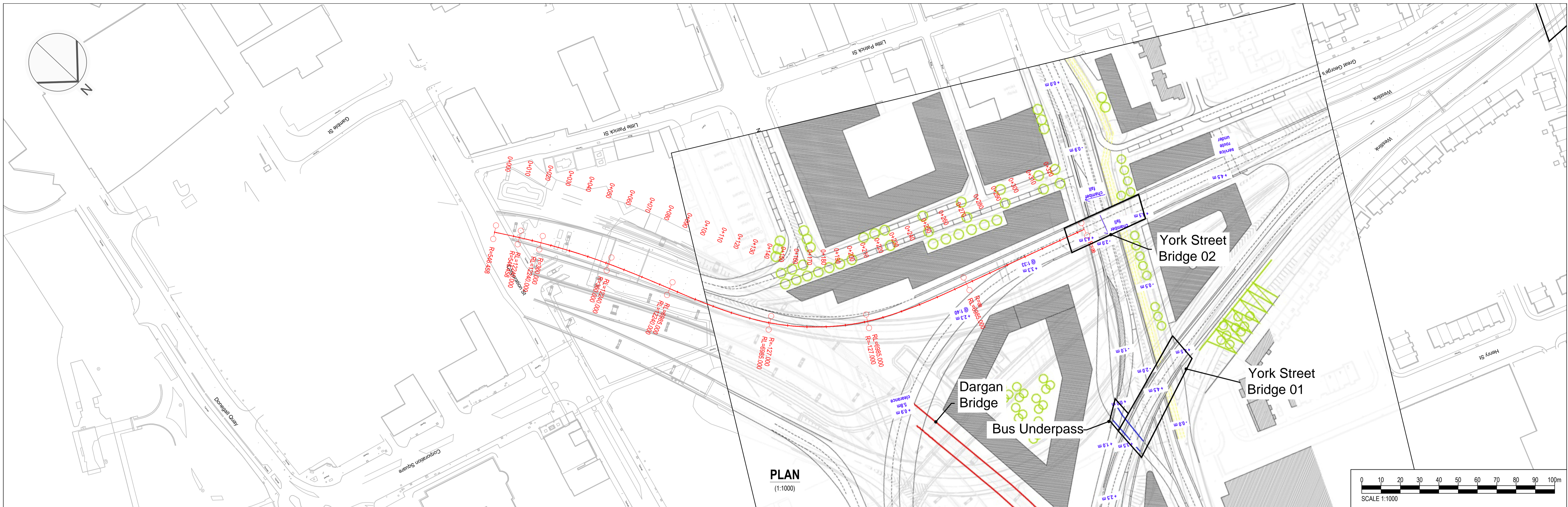
LEGEND

- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level - Westlink to M3 (via Dock Street)
- Existing Ground Level
- City Reparo's Alternative Design Proposed Levels Westlink to M3 (via Dock Street)
- Headroom Clearance Envelope = 5.46m
- Substandard Geometry



PROFILE
(Horiz. 1:1000 Vert. 1:200)

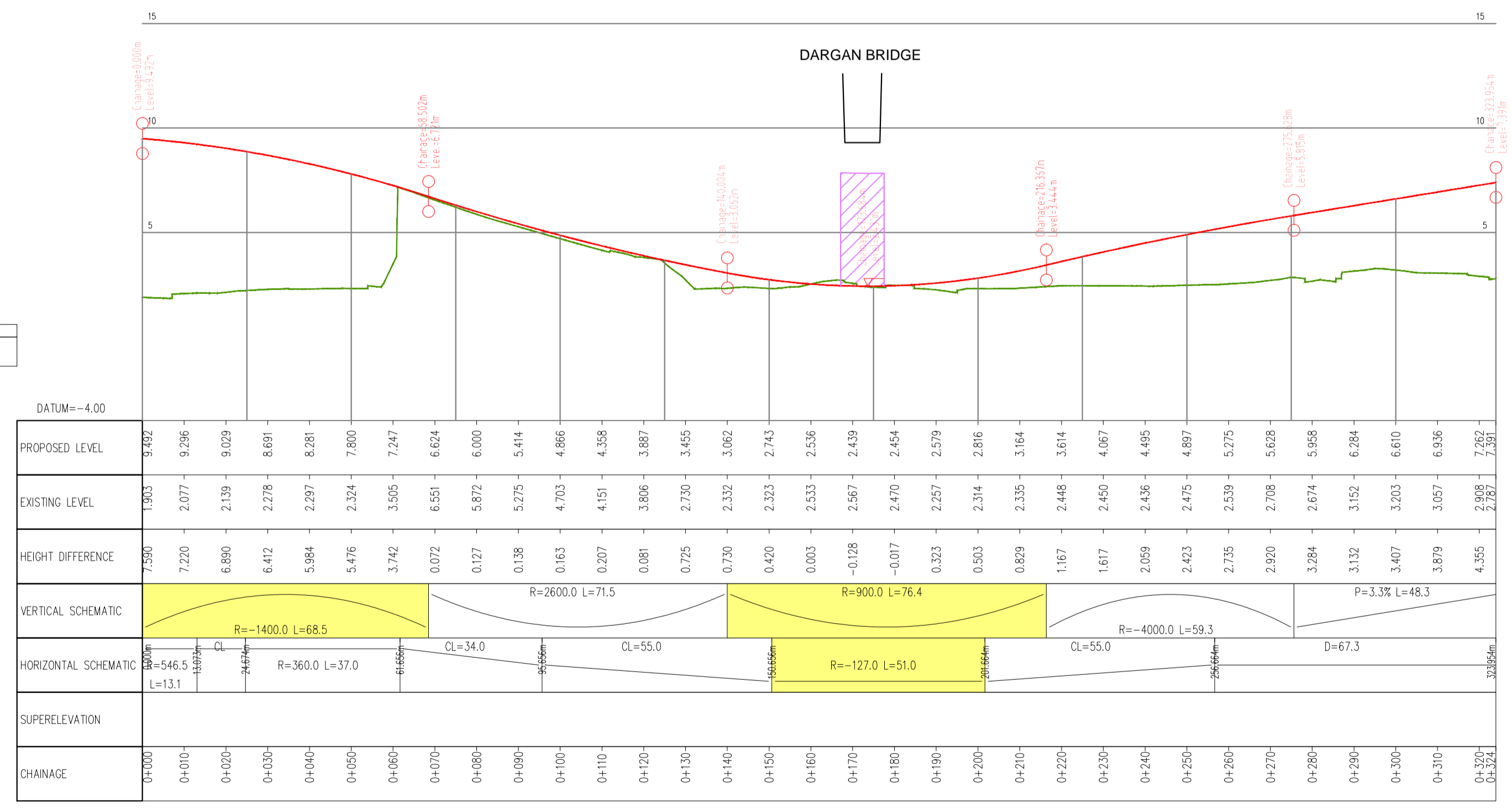
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Scale @ A1 AS SHOWN		Zone / Mileage																					



LEGEND

- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level M3 to Westlink (Red line)
- Existing Ground Level (Green line)
- Headroom Clearance Envelope = 5.4m (Purple hatched area)
- Substandard Geometry (Yellow shaded area)

WE REFERENCE INTO
 M3: 72 OR 85 OVER
 M3: 72 OR 85
 REASON: 72 OR 85



PROFILE
 (Horiz. 1:1000 Vert. 1:200)

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Revision Details	By	Date	Suffix
	Check		

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Purpose of issue: **INFORMATION**

Client: **TRANSPORT NI**

Project Title: **YORK STREET INTERCHANGE**

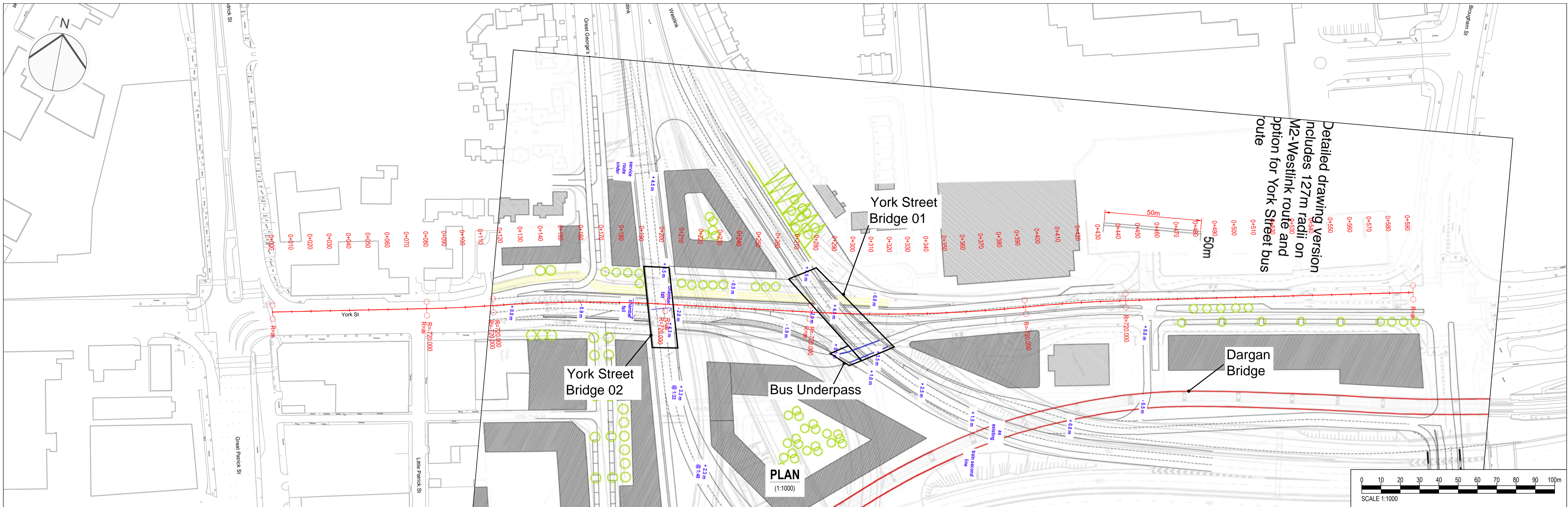
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Designed: EB	Drawn: AN	Checked: JM	Approved: JM	Date: 09/11/15
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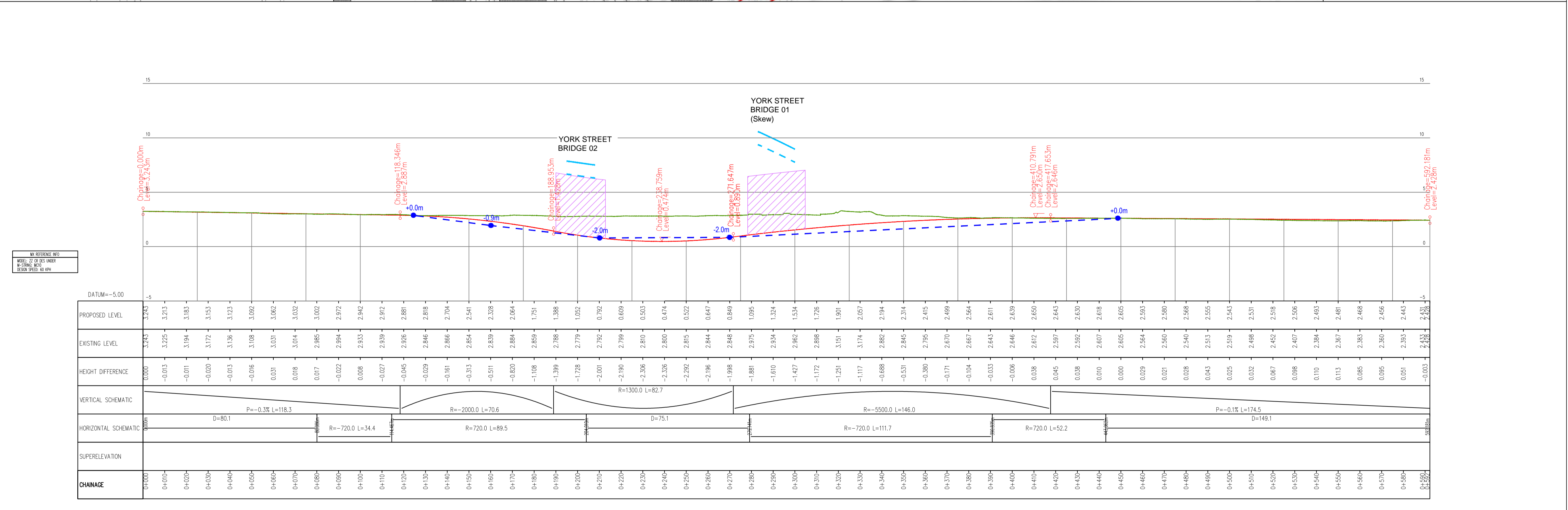
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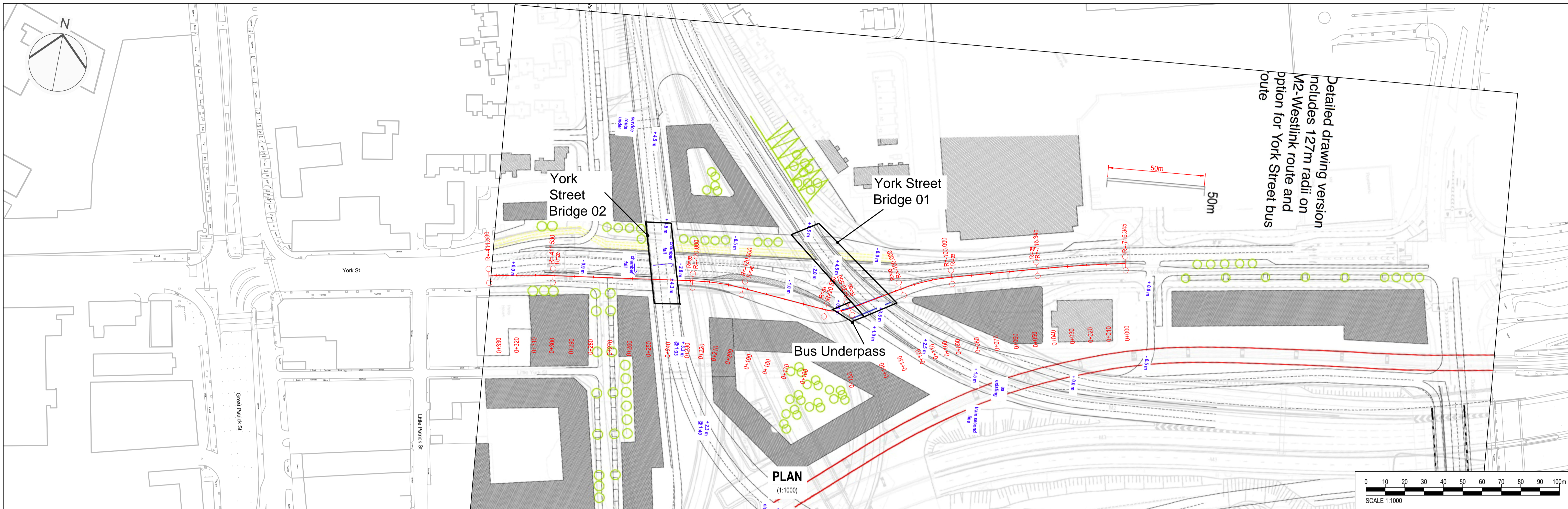


LEGEND

- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level York Street
- Existing Ground Level
- City Reparo's Alternative Design Proposed Levels York Street
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level York Street Bridges
- Proposed York Street Bridges Soffit
- Headroom Clearance Envelope = 5.4m

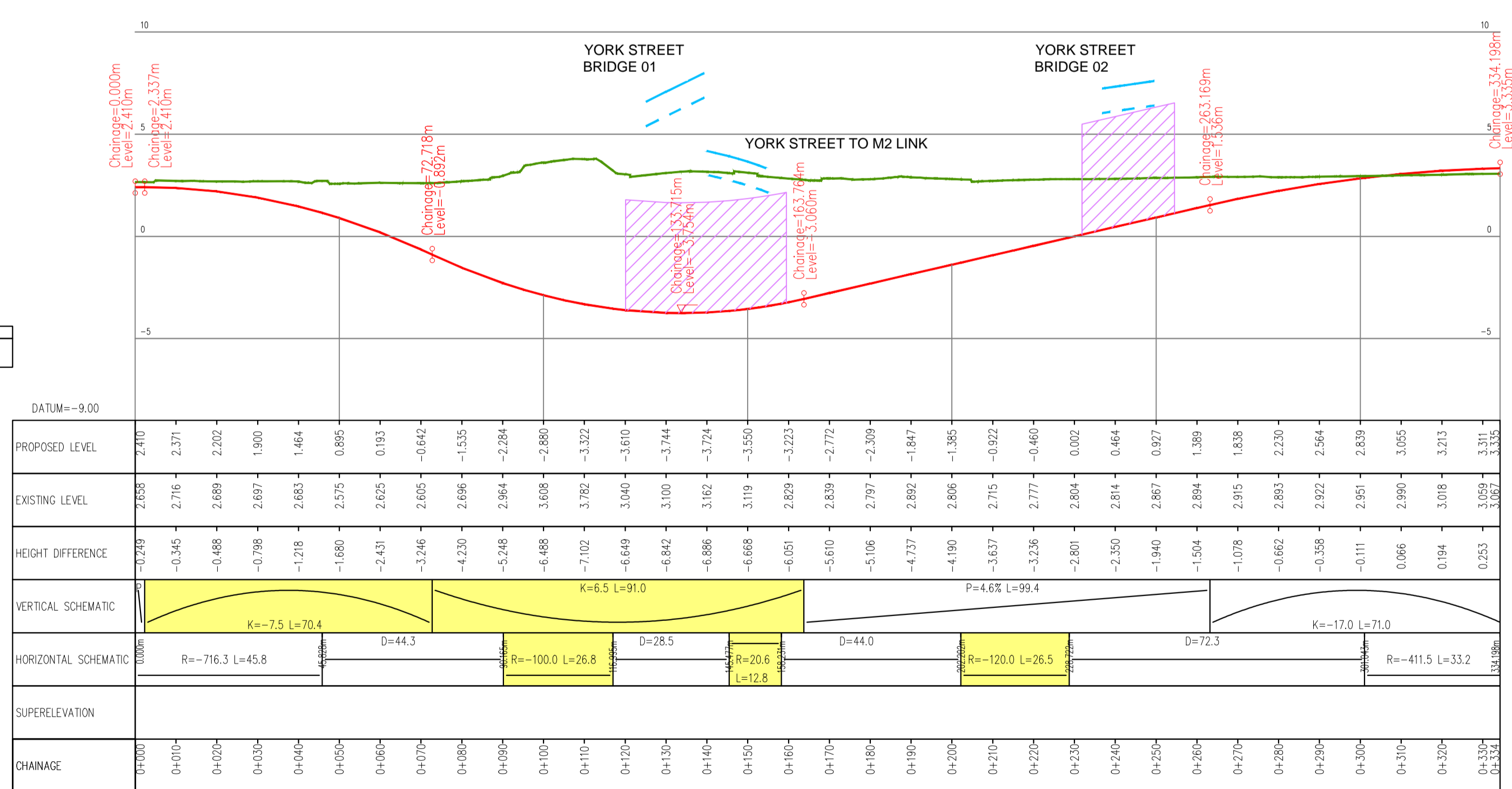


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LEGEND

- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level (Red line)
- York Street Bus Lane (Green line)
- Existing Ground Level (Green line)
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level (Blue line)
- York Street Bridges (Blue dashed line)
- Proposed York Street Bridges / York St - M2 Bridge Soffit (Blue dashed line)
- Headroom Clearance Envelope = 5.4m (Pink hatched area)
- Standard Geometry (Yellow area)



PROFILE
(Horiz. 1:1000 Vert. 1:200)

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First Issue	AN	09/11/15	P01
Revision Details	By	Date	Suffix
	Check		

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Purpose of issue: **INFORMATION**

Client: **TRANSPORT NI**

Project Title: **YORK STREET INTERCHANGE**

Drawing Title: **YORK STREET INTERCHANGE PLAN & PROFILE CITY REPARO ALTERNATIVE YORK STREET BUS LANE LINK**

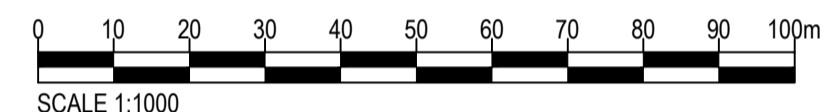
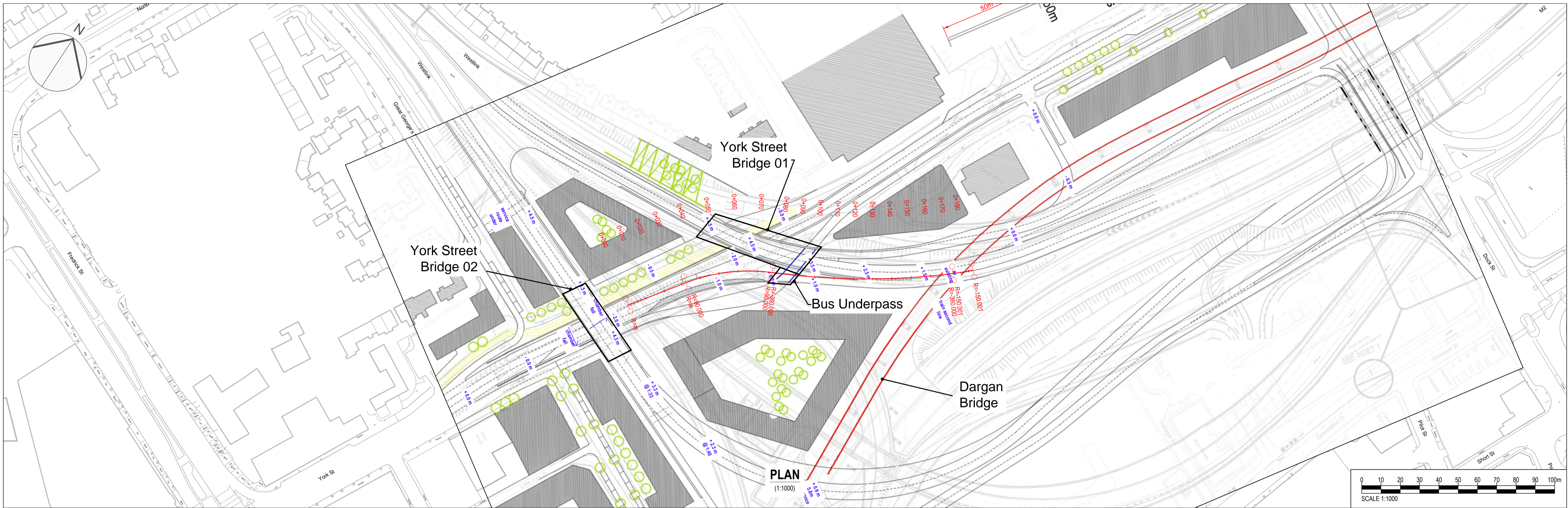
Designed: EB	Drawn: AN	Checked: JM	Approved: JM	Date: 09/11/15
URS Internal Project No. 47037827		Subsidiary: Fit for Information		
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URS Infrastructure & Environment Ltd (EMI)
Beechill House
40 Beechill Road
Belfast
Tel: +44 2890 705 111
Fax: +44 2890 795 651
www.ursgroup.com

URS

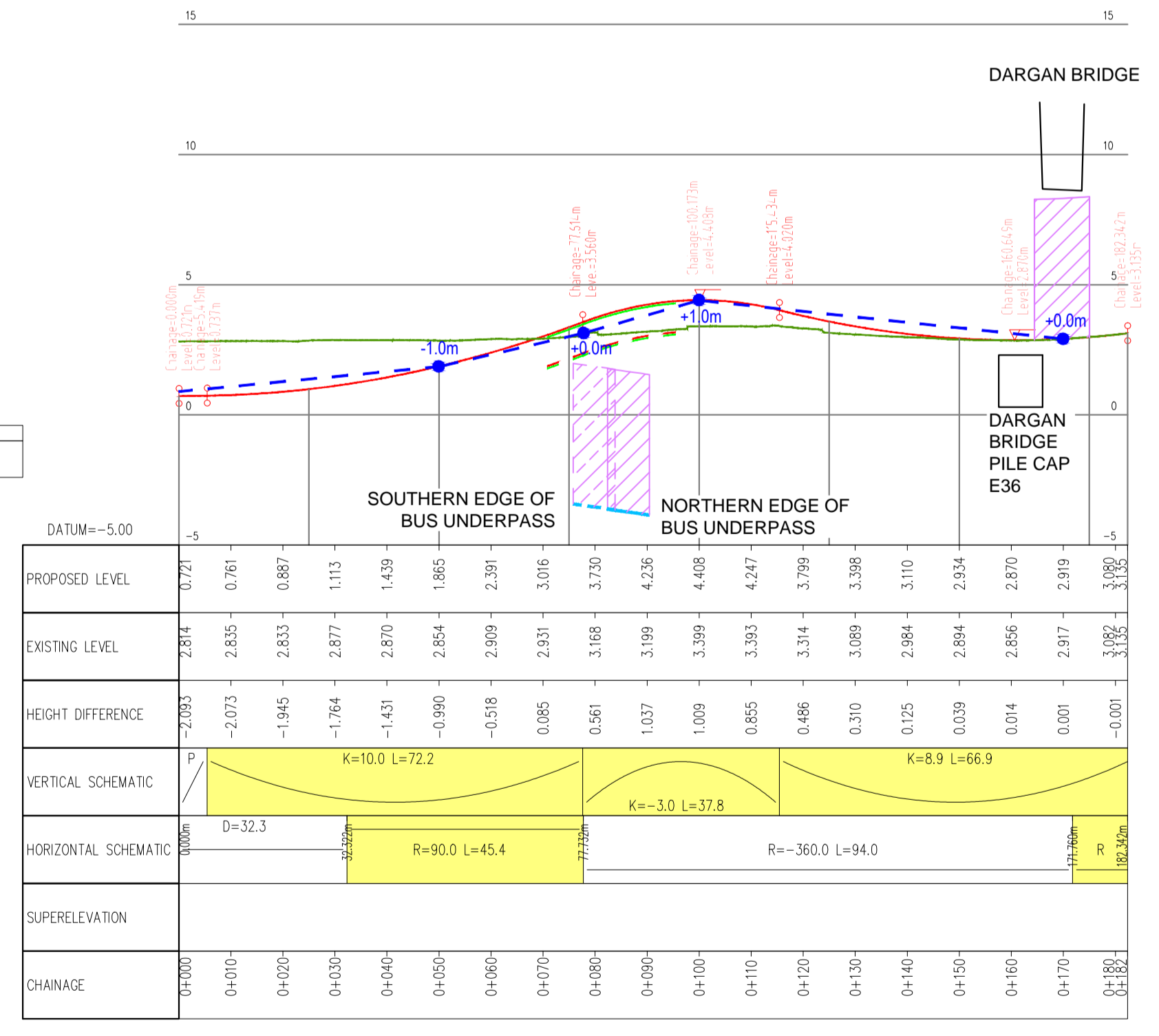
Drawing Number: **TNI_YSI-URS-HML-0011-DR-HY-000002**

Rev: **P01**



LEGEND

- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level York Street to M2 (Red solid line)
- Proposed York Street to M2 Bridge Soffit (Red dashed line)
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level Northern Channel Line - York Street to M2 (Green solid line)
- Proposed York Street to M2 Bridge Northern Edge Soffit (Green dashed line)
- Existing Ground Level (Blue solid line)
- City Reparo's Alternative Design Proposed Levels Westlink to M2 (+0.0m) (Blue dashed line)
- Interpretation of City Reparo's Alternative Design Proposal Carriageway Level Bus Underpass Carriageway (Blue solid line)
- Headroom Clearance Envelope = 5.4m (Pink hatched area)
- Substandard Geometry (Yellow shaded area)



PROFILE
(Horz. 1:1000 Vert. 1:200)

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Purpose of issue: **INFORMATION**

Client: **TRANSPORT NI**

Project Title: **YORK STREET INTERCHANGE**

Drawing Title: **YORK STREET INTERCHANGE PLAN & PROFILE CITY REPARO ALTERNATIVE YORK STREET TO M2 LINK**

Designed: EB	Drawn: AN	Checked: JM	Approved: JM	Date: 09/11/15
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URS Infrastructure & Environment Ltd (EMI)
Beechill House
40 Beechill Road
Belfast
Tel: +44 2890 705 111
Fax: +44 2890 795 651
www.urscorp.com

Drawing Number: **TNI_YSI-URS-HML-0015-DR-HY-000001**

Rev: **P01**

APPENDIX B ROAD SAFETY REVIEW SUMMARY REPORT

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***York Street
Interchange
City Repairo
Alternative Design
Proposal***

Road Safety Review

November 2015





Prepared by:
Becky Jackson
Principal Engineer



Checked by:
Richard Kilner
Associate Director



Approved by:
Richard Kilner
Associate Director

Vector Motorway Optimisation Proposal – Road Safety Review

Rev No	Comments	Checked by	Approved by	Date
1	Draft Issue to Client	RK	RK	06/11/15

First Floor, One Trinity Gardens, Quayside, Newcastle upon Tyne, NE1 2HF
Telephone: 0191 224 6500 Website: <http://www.aecom.com>

Job No: 47037827

Reference: 47037827/RSRCR01

Date Created: November 2015

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Introduction

01

1 Introduction

This report results from a road safety review of the City Reparo Alternative Design Proposal, which was produced in response to the York Street Interchange scheme. This road safety review has been requested by Transport Northern Ireland (TNI) to inform the upcoming Public Inquiry. This road safety review was carried out in November 2015.

This road safety review was carried out by:

R Kilner BEng(Hons) CEng MICE

AECOM, Newcastle

(Certificate of Competency in Road Safety Audit)

R Jackson MEng(Hons) CEng MICE

AECOM, Newcastle

(Certificate of Competency in Road Safety Audit)

The road safety review comprised an examination of the document and drawing provided and these are listed in Appendix A. The staff undertaking the review had visited the site on 11th & 12th February 2014 as part of the Stage 1 Road Safety Audit of the York Street Interchange (YSI) Scheme. During the site visit, the weather was fine and the existing road surface was wet. Traffic conditions were free flowing during off peak times and congested at peak times.

The City Reparo Alternative Design Proposal has been examined and reported only on the road safety implications of the Alternative Design Proposal as presented and has not been examined or verified as to the compliance of the design to any other criteria.

The City Reparo Alternative Design Proposal as contained in the 23 Oct 2015 document and YSI Alternative -4.jpg drawing provides a conceptual design; it does not appear to have fully developed road geometry, so the level of the review is therefore limited in scope. It is assumed that the design layout as detailed within the YSI Alternative -4.jpg provides the most up-to-date design layout and the other drawings and images included within the 23 Oct 2015 document are for illustrative purposes and are superseded in some respects by the YSI Alternative -4.jpg.

*City Reparó Alternative
Design Proposal*

02

2 City Reparo Alternative Design Proposal

The Alternative Design Proposal is as described in City Reparo's document; York Street Road Interchange, Alternative Design Proposal, dated 23 October 2015 by Mark Hackett.

The existing York Street Junction provides links between the M2, M3 and A12 Westlink, together with connections to the local road network that provide access to Belfast city centre and the docks. At present, there is a direct link between the M2 and the M3, but the connections to and from the Westlink all pass through an at-grade signal-controlled gyratory system with numerous links to the local road system.

City Reparo have generated the Alternative Design Proposal with objectives to provide good pedestrian and cycle connectivity, the potential for good urban repair and minimised impacts to residents. The design presented illustrates proposed road alignments; however, it does not appear to have fully developed road geometry including transitions and very little information is provided on the vertical geometry. The road safety review is therefore limited in scope and it has not been possible to comment on road geometry, other than at a superficial level.

The Alternative Design Proposal is understood to incorporate re-routing of the following links:

Cyan:	Westlink to M2
Magenta:	Westlink to M3
Purple:	Westlink to York Street
Blue:	City to M2
Orange:	M2 to Westlink
Green:	M3 to Westlink

The City Reparo proposal promotes a design which aims to optimise the existing road network, including two bridges to carry free-flow motorway links over York Street, whilst York Street continues at grade level with the carriageway slightly depressed.

The key element of the City Reparo proposal is the Westlink connection to the M3 (Magenta); passing over York Street and then diverging via a slip road between the existing rail line and M2 and then utilising the Dock Street bridge underpass to connect with Nelson Street and merge onto the M3. This design compromise allows the rest of the routes (Cyan, Orange and Green) to operate as free-flow links.

No detail has been provided on how docks traffic will access the Westlink and how this restriction will impact other junctions within the local road network.

Issues Identified

3 Issues Identified

General

Issue 3.1 Lack of verge and hard shoulder provision could result in collision hazards

Location: All routes

No provisions for verge or hard shoulders have been included within the design. Without hard shoulders it is unclear how the road network, particularly single-lane links, will cope with broken down vehicles. A vehicle breakdown could block the link upstream with the potential for related shunt type collision incidents.

Issue 3.2 Lack of safe access to new land locked development

Location: York Street

The City Reparo design includes proposals for development sites within the land locked areas inside the Westlink/M2/M3 Interchange. It is unclear how safe vehicular access could be provided, with the majority of the free-flow highway links being at ground level. Similarly it is unclear how pedestrian access will be provided particularly to the pentagon shaped development area.

Cyan: Westlink to M2

Issue 3.3 Congestion related accidents due to limited lane provision

Location: Northbound Westlink approach to York Street overbridge

At present the Westlink / Clifton Street junction operates as a lane gain type merge with the northbound merge slip road joining the 2-lane Westlink to form a 3-lane carriageway. The City Reparo design layout appears to reduce the Westlink northbound carriageway to two lanes over the new York Street bridge. Restricting traffic with this proposed two lane arrangement could result in congestion upstream of the York Street bridge and potential shunt type collisions.

Magenta: Westlink to M3

Issue 3.4 Shunt type collisions on approach to M3 diverge

Location: Westlink approach to York Street overbridge

The M3 / local traffic slip road diverge from the Westlink northbound carriageway is on the inside of a bend which will reduce in forward visibility to this exit. It will be difficult for approaching drivers to gain a full appreciation of the layout ahead, leading to sudden braking and/or lane changes to exit the Westlink/M2 connector towards the off slip.

Issue 3.5 Loss of control collisions due to tight radii

Location: M3 link via Dock Street

The City Reparo proposal to re-route traffic from Westlink between the rail line and M2 corridor via Dock Street and Nelson Street to join the M3 in free-flow conditions requires vehicles to travel through the southern bridge portal on Dock Street, segregated by screening from other Dock Street traffic. This route includes two tight right turns that are well below recognised design standards for links and would need to be taken at very low speed to avoid loss of control or overturning. As well as considering the operation of this route at times of peak flows, this layout needs to cater for periods with low traffic volumes where vehicle speeds would be expected to be higher. This free-flow arrangement could result in relatively high speeds on the straight sections of carriageway and there is the risk that vehicles could enter the corners too quickly, potentially leading to loss of control collisions.

Issue 3.6 Loss of connectivity between docks and Westlink

Location: Local road network

The City Reparo proposal to re-route traffic from Westlink between the rail line and M2 corridor via Dock Street and Nelson Street to join the M3 will require this traffic to travel through the southern bridge portal on Dock Street. It is unclear from the design layout how the reduced capacity for other traffic under the bridge at Dock Street will affect the surrounding road network. Furthermore, it appears that direct links between the docks and Westlink will be severed by this design proposal (refer to issue 3.12).

This could potentially exacerbate or redistribute bottlenecks onto the surrounding road network and result in congestion related accidents; driver frustration; pulling out in front of traffic; poor manoeuvres e.g. U-turns. Without undertaking city-wide traffic modelling of the scheme, there is uncertainty as to where bottlenecks and accident conflict points could arise from the proposals.

Issue 3.7 Loss of control collisions due to tight radius

Location: Approach to M3 eastbound merge

Nelson Street is to be realigned to maintain the link to the M3 eastbound merge. The realignment includes a comparatively straight section, leading to a tight bend where it re-joins the existing approach to the M3 eastbound merge.

As well as times of peak flows, these design layouts need to also consider low traffic flow periods where vehicle speeds could be higher. This free-flow arrangement could result in high speeds on the straighter sections of carriageway which could lead to difficulties in negotiating the bend safely and to potential loss of control collisions.

Purple: Westlink off slip to York Street

Issue 3.8 Concealed access on M3 / local traffic diverge

Location: Galway House

The City Reparo proposal includes provision of an exit towards York Street adjacent to Galway House. To reach this exit, vehicles will have had to diverge off the Westlink, diverge again into the left-hand lane of the local traffic slip road, and then to turn off into the exit, all within quick succession. The exit is on the inside of a bend and therefore would have limited visibility to it on the approach. This combination of closely spaced manoeuvres and limited visibility may make it difficult for drivers to understand the road layout ahead, who could be confused over which lane/turning to take, with the potential for sudden braking and lane changes, leading to shunt or sideswipe collisions. This exit appears to be unnecessary in light of the local traffic exit at Dock Street.

Issue 3.9 Shunt type collisions due to stationary vehicles ahead

Location: Westlink diverge /local traffic off slip towards Dock Street

The Westlink off-slip towards Dock Street provides connections for local traffic in lane 1 and a link towards the M3 in lane 2. It is unclear from the design layout how the local traffic slip road will interact with Dock Street, whether this junction will be signalised or operate as a give way arrangement. However, it would be expected that local traffic would queue back to some extent from this Dock Street junction; the concern is how long this queue length could be during peak periods and whether this queue could restrict traffic movements towards the M3 or even result in congestion back onto Westlink with the potential for shunt type collisions. Analysis of the operation of this junction would be necessary to confirm if this would be an issue.

Blue: City to M2

Issue 3.10 Shunt or side impact collisions at merge taper

Location: York Street on approach to M2 slip road

The proposal for York Street includes three lanes traveling north from Great George Street. Lane 1 continues towards North Shore providing for local traffic and lanes 2 and 3 merge into a single lane on the approach to the M2 slip road.

It is unclear from the limited detail in the design proposal how this merge arrangement will operate and it may prove difficult for vehicles to merge in the limited distance available on York Street prior to entering the single-lane M2 slip road, with the possibility for lane-change and shunt type collisions.

Issue 3.11 Collisions involving Non-motorised Users

Location: Great George Street Junction with York Street

The City Reparo proposal includes a pedestrian and cyclist thoroughfare / public realm provision along the west side of York Street, but provision for Non-motorised Users (NMU) along the east side of York Street nor allowance for pedestrian / cycle crossing points in the vicinity of Westlink. With the identification of new development areas within the interchange, it is unclear how NMUs would gain safe access to development areas within the interchange and whether NMUs would create their own unofficial routes across any of the free-flow links.

Orange: M2 to Westlink

Issue 3.12 Congestion related accidents

Location: Dock Street

The City Reparo proposal shows a free-flow link from the M2 onto Westlink without any provision for local traffic to merge onto this connector. It therefore appears that direct links between the docks and Westlink will be severed by this design proposal.

This could potentially exacerbate or redistribute bottlenecks onto the surrounding road network and result in congestion related accidents; driver frustration; pulling out in front of traffic; poor manoeuvres e.g. U-turns. Without undertaking city-wide traffic modelling of the scheme, there is uncertainty as to where bottlenecks and accident conflict points could arise from the proposals.

Green: M3 to Westlink

Issue 3.13 Loss of control collisions due to tight radius

Location: M3 merge with M2/Westlink

The City Reparo proposed single lane merge from the M3 to join the M2/Westlink follows the same principal as the URS York Street Interchange design. However, a tighter radius is proposed which extends through the short merge taper / nosing prior to the three lanes crossing the York Street overbridge and there is concern that this could lead to side-to-side collisions at the point of merging.

Appendix A
Schedule of Documents
Used

Appendix A: Schedule of Documents Used

List of included documents and drawings		
Documents		
Reference	Title	Date
YSI alternative report small file	York Street Interchange Alternative Design Proposal, City Reparó – Mark Hackett Architect	23 Oct 2015
Drawings		
Drawing No.	Title	
YSI alternative -4.jpg	N/A	