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MetroLink

Addendum to the EIAR - Downward Tunnel Realignment:

St Stephen's Green Station to Charlemont Station

| P01

06/03/24

Document history and status

Revision	Date	Description	Author	Checker	Reviewer	Approver
01	06/03/24	For Issue	SB	RH	RH	PB

Contents

1. Introduction and Background

Following submission of the MetroLink Railway Order (RO) application on 30th September 2022, TII received further information in 2023 during the statutory consultation process on a number of buildings along the proposed MetroLink alignment where deeper basements and/or other elements of underground infrastructure were identified. All of the buildings in question were identified on a section of the alignment between St Stephen's Green Station and Charlemont Station. (Chainage [Ch] 18+540 and Ch19+300).

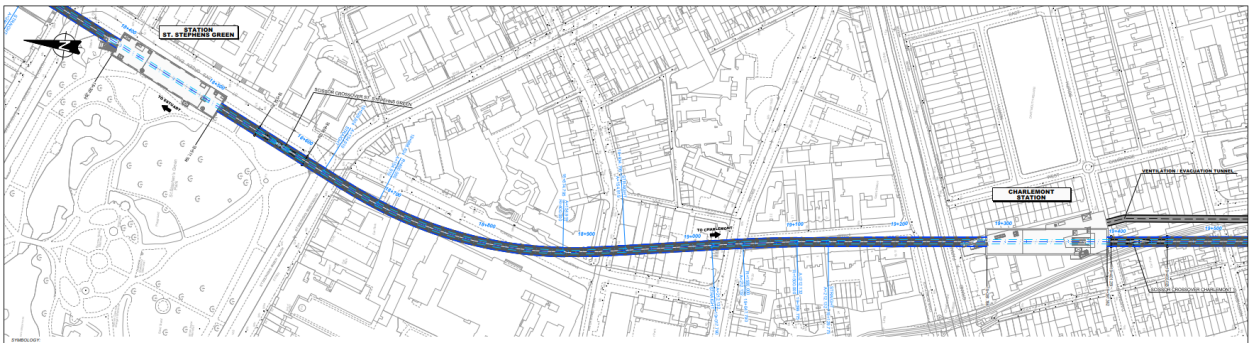

Figure 1 Horizontal Alignment

In order to ensure that there is no direct impact on these properties and to minimise any potential indirect impacts it is proposed to lower the tunnel a further 5m deeper along the tunnel at Ch18+940 (Below the junction of Hatch Street and Earlsfort Terrace). This will mean that the tunnel will be at a maximum of 5m deeper at the location identified above with the differential in depth decreasing as the alignment ties back into St Stephen's Green Station to the north and Charlemont Station to the south.

The purpose of this addendum to the EIAR is to describe this change to the proposed MetroLink design (hereafter referred to as the Proposed Works) and to present an assessment of any environmental effects resulting from the Proposed Works. This document will include:

- A technical description of the proposed amendment:
- Reference information considered in assessing the impact of the design change;
- A description of the construction works required for the proposed amendment;
- Details of the assessment methodology used;
- A review and assessment of potential environmental effects arising from this design change; and
- Conclusions of the review.

For the purposes of clarity, the design and works that are outlined within the RO will be referred to as "Proposed RO Works".

2. Reference Information

The information reviewed and taken account of in the development of this technical note includes the following information:

2.1 Figures

- ML1-JAI-RTA-ROUT_XX-DR-Y-01027 (Sheet 1 of 2): Tunnel Alignment Saint Stephens Green – Charlemont – RO Application Alignment.
- ML1-JAI-RTA-ROUT_XX-DR-Y-01027 (Sheet 2 of 2): Tunnel Alignment Saint Stephens Green – Charlemont – RO Application vs Deeper Vertical Alignment Option.
- ML1-JAI-RTA-ROUT_XX-DR-Y-00601: Underground Pumping Station Method Statement

3. Technical Description of the Proposed Alignment

The vertical alignment has been reviewed to provide 5m deeper clearance below the ground anchors at the Irish Life building (Ch19+000). The horizontal alignment between St Stephen's Green and Charlemont Station (Ch18+540 and Ch19+300) is unchanged from the Proposed RO Works.

The new vertical alignment follows the design criteria:

- Avoids overlapping of vertical and horizontal clothoid curves to maintain the 80 km/h speed throughout the layout.
- Minimum length of each element forming the vertical alignment: 20m.
- Retains distance from the end of the vertical revised vertical alignment to the Charlemont Station at 20m.

From the end of the clothoid at the entrance to the 400m curve in plan, the alignment descends with a gradient of 1.2% and then ascends with a gradient of 3% to link up with the Charlemont Station.

There is a low point at Ch18+958 with an elevation of -16.15 m. From this low point of the layout, a drainage system is designed to carry the water to the sump pump located at Ch18+919, under Hatch Street Upper, to minimize potential construction settlement and noise impacts on properties. The drainage slope required to locate the sump pump at this point is achieved by adjusting/deepening the drain profile under the tracks inside this short section of the tunnel.

The figures below show the horizontal alignment (Figure 2), vertical alignment (Figure 3) and coordination check between horizontal and vertical alignment (Figure 4).

Figure 2 Horizontal Alignment

HORIZONTAL ALIGNMENT. AXIS 1. Centreline

No.	TYPE	LENGTH	STATION	X TANGENCY	Y TANGENCY	RADIUS	PARAMETER	AZIMUTH
57	RECTA	332,233	18+296,591	716.186,573	733.503,377			227,495
	CLOT.	60,000	18+628,824	716.047,505	733.201,651		154,919	227,495
58	CIRC.	185,971	18+688,824	716.023,766	733.146,563	-400,000		222,720
	CLOT.	60,000	18+874,795	716.000,894	732.963,687		154,919	193,122
59	RECTA	82,995	18+934,795	716.010,335	732.904,450			188,347
	CLOT.	30,000	19+017,797	716.025,442	732.822,842		212,132	188,347
60	CIRC.	51,985	19+047,797	716.030,804	732.793,325	1.500,000		188,984
	CLOT.	30,000	19+099,775	716.038,866	732.741,971		212,132	191,190
61	RECTA	484,594	19+129,775	716.042,806	732.712,231			191,827

Figure 3 Vertical Alignment

VERTICAL ALIGNMENT. AXIS 1. Centreline

GRADE [o/oo]	LENGTH [m]	PARAMETER Kv	PVI		PVC		PVT		ANGLE [m]
			STA.	ELEV.	STA.	ELEV.	STA.	ELEV.	
27,000	99,900	3.700,000	18+351,014	-13,200	18+301,064	-14,549	18+400,964	-13,200	0,337000
0,000	37,200	3.000,000	18+708,281	-13,200	18+689,681	-13,200	18+726,881	-13,431	0,058000
-12,400	84,300	2.000,000	18+975,647	-16,515	18+934,795	-15,993	19+017,797	-15,261	0,444000
29,750	59,500	2.000,000	19+248,962	-8,384	19+219,212	-9,269	19+278,712	-8,384	0,221000
0,000							19+757,687	-8,384	

Figure 4 Speed Analysis

OVERLAPPING ANALYSIS. AXIS 1. Centreline

No.	STA. i	STA. f	TYPE	LENGTH [m]	RADIUS [m]	CANT [mm]	SPEED [km/h]	OVERLAPPING		PARAMETER Kv [m]	CANT GRADIENT [mm/m]	CANT GRADIENT LIMIT [mm/m]	OVERLAP SPEED LIMIT [km/h]
	18+060,268	18+090,268	CLOT.	30,000									
56	18+090,268	18+266,591	CIRC.	176,323	2.000,000	20	80						
	18+266,591	18+296,591	CLOT.	30,000									
	18+628,824	18+688,824	CLOT.	60,000									
58	18+688,824	18+874,795	CIRC.	185,971	-400,000	90	80	18+689,681	18+726,881	3.000,000			
	18+874,795	18+934,795	CLOT.	60,000									
	19+017,797	19+047,797	CLOT.	30,000									
60	19+047,797	19+099,775	CIRC.	51,978	1.500,000	20	80						
	19+099,775	19+129,775	CLOT.	30,000									
	19+614,369	19+644,369	CLOT.	30,000									

4. Description of the Proposed Works

4.1 Tunnel Realignment

The tunnel realignment does not present any change to the Tunnel Boring Machine (TBM) tunnelling methodology as presented in EIAR Appendix A5.13 as the tunnel will remain within the Limestone with 5m additional cover.

4.2 Low Point Sump

There will however be a need for an additional sump pump. The construction methodology for sump pumps is described and assessed in EIAR Appendix 5.13. The low point sump passages will be constructed using Sprayed Concrete Lining (SCL) techniques from the main tunnel after the TBM has finished. The sequence of works will be:

- Install survey monitoring points in the main tunnel;
- Divert any in tunnel services;
- Provide fissure grouting to reduce in situ permeability following drilling and testing;
- Install in tunnel props;
- Pull or break out top section of tunnel lining rings or remove the top half of the segmental open set;
- Excavate top heading of 1st advance of passage;
- Spray SCL to support top heading;
- Pull or break out lower section of tunnel rings;
- Excavate and shotcrete bottom section;
- Continue advancing passage until end chainage; and
- Construct internal concrete finishes.

Prior to any works on the low point sump passage, monitoring points will be established in the main tunnel and background readings taken to establish baseline values. These monitoring points will be surveyed daily while the works are carried out to ensure no movement in the main tunnel. The monitoring points will be installed shortly after the TBM passes, which would give plenty of time to obtain a stable baseline.

Any services that will still be required will be diverted around the proposed opening before breaking out the tunnel rings and excavating the initial advances of the eye of the passage.

The top section of the passage will be excavated and sprayed concrete applied before the lower section of tunnel rings are broken out. The passage will then be advanced by top heading and invert to the location of the sump in advances typically 1m to 1.3m long. All inverts will be closed with sprayed concrete to provide a stable tunnel. Once the passage is at the end chainage, a timber shutter will be set up and a reinforced concrete slab cast.

All SCL works will be controlled by a Required Excavation and Support Sheet (RESS) which will be produced by a Senior SCL Engineer as described in Appendix A.13, Section 4.8 of the EIAR

5. Assessment Methodology

An analysis of the differences between the Proposed RO Works and the Proposed Works has been undertaken to determine the environmental effects of the proposed change and to identify whether there is potential for additional significant environmental effects over and above that identified in the MetroLink EIAR. This assessment consisted of a two stage process:

- **Stage 1 Assessment of Potential for Environmental Effects:** A review of the potential for additional environmental effects not previously considered by the MetroLink EIAR as a result of the Proposed Works.
- **Stage 2 Assessment of Significance of Environmental Effects:** A review of the potential environmental effects identified to determine significance of effects, the required mitigation measures and residual effects.

This environmental review has had regard to the following key issues:

- Potential for impacts as a result of tunnel lowering and addition of sump pump,
- Potential for the generation of higher or lower emissions, material or waste not considered in the MetroLink EIAR, and
- Potential for works at new locations with reference to sensitive receptors (over and above those assessed in the MetroLink EIAR).

6. Environmental Assessment

6.1 Introduction

This section summarises the environmental review, undertaken in accordance with the two stage methodology described in Section 5 to determine if there is potential for additional impacts on the receiving environment over and above those assessed in the MetroLink EIAR.

6.2 Stage 1 – Assessment of Potential for Environmental Effects

Table 6.1 summarises the results of the environmental assessment exercise undertaken, identifying the potential for additional environmental effects.

Table 6.1: Environmental Review Summary

Environmental Effects	Potential for Additional Effects	Rationale
Traffic and Transport	Yes	Potential for additional vehicles required to support the construction of the additional pump sump.
Planning Policy	No	No impact on planning policy.
Human Health	Yes	Potential for human health effects in the event of exceedances of relevant criteria arising from other environmental assessments.
Population and Land Use	No	There is no discernible impact on Population and Land Use from this adjustment as all works are below ground. In addition the proposed pump sump is located under the public road and so will not affect any potential for future oversite development.
Electromagnetic Compatibility and Stray Current	No	The lowering of the alignment would result in lower predicted electromagnetic field levels at all identified stakeholder locations. Therefore, there is no potential for additional effects.
Airborne Noise & Vibration	Yes	Potential for impact due to the SCL batching works proposed at Charlemont.
Groundborne Noise & Vibration	Yes	Potential for short term effects during the construction of the new required sump pump.
Biodiversity	No	The lowering of the alignment does not give rise to any additional biodiversity impacts already assessed within the EIAR.
Air Quality	Yes	Potential for emissions to air should significant additional generation.

Environmental Effects	Potential for Additional Effects	Rationale
Climate	No	Significance for climate relies on alignment with Ireland achieving Net Zero by 2050 and the level of mitigation taking place across the project. The alignment change does not affect these elements and therefore there is no potential for additional effects.
Hydrology	No	No potential for additional impacts in context of vertical deviation downwards. The lowering of the alignment will result in no overall change in the natural hydrological regime and will not impact the assessment outcomes presented in the EIAR. Furthermore, the discharge of track drainage to surface waters following effective treatment and attenuation remains unchanged and consistent with the EIAR assessment.
Hydrogeology	Yes	Potential for additional impacts in context of vertical deviation downwards. The lowering of the alignment will result in construction in more competent rock. Tunnel construction methodology will be consistent. In summary, there will be no change in the natural groundwater regime and the scale of variation within the LOD will not impact the assessment outcomes presented in the EIAR. Fissure grouting will ensure that the water table is not lowered outside of the structure
Soils & Geology	Yes	Potential for change in bedrock arisings generated by the TBM advancement and excavation of the .
Settlement	Yes	Potential for additional settlement impacts.
Land Take	Yes	Potential for additional land-take impacts.
Infrastructure & Utilities	Yes	Potential for addition impacts on infrastructure & utilities due to the inclusion of the sump pump.
Agronomy	No	This location is in an urban environment and therefore there is no potential for impacts on agricultural lands, as all the works are below ground.
Material and Waste Management	Yes	Potential for additional waste generation due to the proposed changes.
Archaeology and Cultural Heritage	No	No impacts on the archaeological or cultural heritage resources, in addition to those already assessed as part of the EIAR, will be introduced as a result of the proposed lowering of the tunnel.

Environmental Effects	Potential for Additional Effects	Rationale
Architectural Heritage	Yes	Potential impacts due to the potential for settlement changes.
Landscape & Visual	No	No impacts as all works are below ground.
Risk of Major Accidents and Disasters	No	There is no additional risk of major accidents and disasters due to the nature of the design changes.
Interactions	No	No additional interactions are predicted due to the nature of the design changes.
Cumulative Impacts	No	No additional cumulative impacts are predicted due to the nature of the design changes.

6.3 Stage 2 – Environmental Assessment

6.3.1 Traffic and Transport

Due to the construction of the sump pump, there is a potential for additional vehicles required to manage the additional waste generated through the Construction Phase. This change will result in 8-10 additional truckloads of excavated material over the lifetime of the Construction Phase. There are no additional construction compounds required to facilitate this work and therefore there is no additional impacts on haul routes. Excavation of the sump pump will not result in any additional impacts on traffic and transport during the Construction Phase.

Therefore, there is no additional significant effects above what was assessed within the EIAR as a result of this change.

6.3.2 Airborne Noise & Vibration

There is no additional impact on airborne noise and vibration from the Proposed Works as all works are below ground. Any support works required at surface level for the SCL construction will be within the existing enclosed compound at Charlemont. There is no additional plant or equipment required within the construction compound. The same criteria and controls will be in place for this compound and impacts are within the assessment criteria in the EIAR. The sump pump is fully underground and, hence, there are no airborne noise emissions during the operational phase. SCL batching will be fully mitigated as it will be within the noise enclosure at the proposed Charlemont construction site.

Therefore, there are no significant additional impacts as a result of the Proposed Works.

6.3.3 Air Quality

There is no additional potential for dust effects due to the Proposed Works. Traffic numbers are considered to be imperceptible over the lifetime of the Construction Phase. This results in no additional for air quality impacts due to traffic emissions.

Therefore, there is no potential for likely additional, significant effects as a result of the Proposed Works.

6.3.4 Hydrogeology

For the proposed alignment lowering, there is no change to the proposed tunnel construction methodology. The lowering of the alignment and the construction of the sump pump will result in construction in more competent rock. This will result in no change in the natural groundwater regime and the scale of variation within the LOD will not impact the assessment outcomes presented in the EIAR. Tunnel construction methodology will be consistent. Fissure grouting will ensure that the water table is not lowered outside of the structure.

Therefore, there is no significant additional impacts as a result of the Proposed Works.

6.3.5 Soils and Geology

The Proposed Works are entirely within the sub-surface and will not alter the assessment of impact on near surface attributes (such as soils and land contamination). The change may result in a slight increase in bedrock arisings generated by the TBM however this does not alter the assessed negligible significance of impact.

Therefore, there is no significant additional impacts as a result of the Proposed Works.

6.3.6 Land Take

The substratum land take has been generated by creating a limit of deviation (LOD) ranging from 5m vertically upwards and 10m downwards to 15m laterally for the tunnel alignment. The lateral extent of the land take required as a result of the proposed lowering of the alignment is unchanged.

The substratum land take will differ, however as the alignment depth is increasing by a maximum of 5m (for the chainage described in Section 1) the likelihood of any increase in direct impacts to overlying properties or structures is very low.

Therefore, there is no significant additional impacts as a result of the Proposed Works.

6.3.7 Waste

The construction of the proposed sump pump would require small additional quantities of materials with 52m^3 of concrete. Arising from the excavation there is predicted to be 173m^3 of material generated. The volume of additional materials required for this construction is insignificant in the context of the overall project materials required for the Metrolink project. The management of material and waste will be managed as outlined in Chapter 24 of the EIAR.

Therefore, there is no significant additional impacts as a result of the Proposed Works.

6.3.8 Settlement

Lowering the alignment will reduce the predicted greenfield settlement over the tunnel. With this, the impact on utilities has reduced.

In general, this is the same for the buildings. However, the Phase 2 building assessments have been updated with new information where it has been made available. All buildings along the altered alignment have been assessed and fall within Category 1 (very Slight) or below. All buildings along the altered alignment have been assessed and fall within Category 1 (very Slight) or below.

6.3.9 Architectural Heritage

There is no potential for additional settlement impacts as a result of the Proposed Works. Therefore, no additional significant impact on architectural heritage features within this area.

6.3.10 Groundborne Noise & Vibration

The duration of this construction activity will be four weeks. This will fit into the programme and will not result in any additional programme requirements. The work is predicted to occur within the existing project programme approximately 12 months after the TBM has passed this location.

There is the potential for additional groundborne noise and vibration effects during the excavation of the sump niche passage at Ch18+919. This is an additional construction activity at this location, resulting from the lowering of the tunnel alignment.

During the construction of the tunnel using the TBM the highest predicted groundborne noise levels having regard to new building information provided for the buildings along this section of the alignment are at the Arthur Cox Building and the Cadenza Building both at 53.5 dB $L_{Amax,S}$. Predicted construction noise levels at both of these properties remains above the significance threshold utilised in the EIAR. This effect will be at this level for up to 3 days, and will be noticeable for a period of up to 2 weeks.

The predicted construction groundborne vibration levels during the passage of the TBM for these two buildings are 0.398 VDV_{day} $ms^{-1.75}$ and 0.405 VDV_{day} $ms^{-1.75}$ respectively, which are considerably lower than the significance threshold of 1.6 VDV_{day} $ms^{-1.75}$.

The mechanical excavation of the sump niche passage adjoining the tunnel will result in additional groundborne noise at a level of 45 dB $L_{Amax,S}$ in the Arthur Cox building. This will exceed the groundborne noise threshold of 40 dB $L_{Amax,S}$ which is a significant effect. The threshold of 40 dB $L_{Amax,S}$ will not be exceeded at adjacent buildings further to the south. The vibration threshold of 1.6 $ms^{-1.75}$ VDV is not predicted to be exceeded during this activity.

During the operational phase of the project the highest predicted groundborne noise levels having regard to new building information provided for the buildings along this section of the alignment are at the Arthur Cox Building (38.5dB $L_{Amax,S}$) and the Cadenza Building 39.5dB $L_{Amax,S}$). Predicted operational groundborne noise levels at both of these properties is below the significance criteria utilised in the EIAR.

The predicted operational groundborne vibration levels for these two buildings are 0.015 VDV_{day} $ms^{-1.75}$ and 0.016 VDV_{day} $ms^{-1.75}$ respectively, which are considerably lower than the significance threshold of 0.8 VDV_{day} $ms^{-1.75}$..

There are no other potential environmental effects identified under the balance of environmental disciplines addressed in the main EIAR (to which this document is an addendum) as a result of the additional works required for the Proposed Works.

6.3.10.1 Mitigation Measures

TII will agree a Trigger Action Plan with the building owner/occupier in order to manage the effects of the construction works on the building.

There are no other additional mitigation measures above what was provided within the EIAR.

6.3.10.2 Residual Effects

There are no significant residual environmental effects once the mitigation measures described in Section 6.4 are introduced.

6.3.11 Human Health

On the basis that there are no significant emissions, noise and dust impacts, there is no additional significant impacts on human health within this area resulting from the Proposed Works.

6.4 Environmental Conclusions

The environmental assessment presented here outlines the outcomes of an assessment of the potential for additional significant environmental effects associated with the proposed alignment change and associated works as presented above in Section 3 and 4 above.

The assessment has identified that there are no significant effects other than potential for additional groundborne noise associated with the excavation of the associated pump sump during a four week period at an adjacent building.

This effect can and will be mitigated by the implementation of a Trigger Action Plan for the identified building.

A.1 Updated Tables for Appendix A5.17 Building Damage Assessment

Table 5-2: Result of Phase 2a building damage assessment – Representative Buildings

Ref	Chainage	Description	Height (m)	Number of Floors	Length (m)	Depth of basement (m)	Refined Phase 2a Assessment Damage Category	Updated Damage Category	RPS, NIAH, RMP or other heritage (Y/N/unknown)	Continue to next assessment phase? (Y/N)	Comments
B-53	18920	Earlsfort Centre	14	4	51	8.6	1 (Very Slight)	0 (Negligible)	N	Y	Case B (refer to section 4.1).
B-147	19020	Cadenza (Former Davitt House)	26.6	7	63	9.0	N/A	0 (Negligible)	N	Y	Case B (refer to section 4.1).
B-238	18980	Arthur Cox Building	40	7	17.8	8.6	2 (Slight)	0 (Negligible)	N	Y	Case B (refer to section 4.1)

Table 5-4: Result of Refined Phase 2a Building Damage Assessment – 'additional' buildings.

Ref	Associated Building	Chainage	Description	Estimated Height (m)	Number of Floors	Length (m)	Category of Damage	Listed/Sensitive Structure (Y/N)	Continue to next assessment phase? (Y/N)	Comments
AB-37	B-52a	18700	AerCap House	24	6	28.5	1 (Very Slight)	N	Y	Case B (refer to section 4.1). Depth of basement 7.26m.

Selected updates to Table F1: Building Damage Assessment Results for 'Representative' and 'Additional' Buildings – Critical Segments within Each Building

Specific Building	Parameter	Critical Segment	Start [m]	End [m]	Curvature	Max Slope	Max Settlement [mm]	Max Tensile Strain [%]	Min Radius of Curvature (Hogging) [m]	Min Radius of Curvature (Sagging) [m]	Damage Category
B-53	Max Slope	1	0	9.1263	Sagging	9.78E-04	14.945	0.01066	-	5736.7	0 (Negligible)
	Max Settlement	1	0	9.1263	Sagging	9.78E-04	14.945	0.01066	-	5736.7	0 (Negligible)
	Max Tensile Strain	2	9.1263	28.809	Hogging	9.78E-04	9.0542	0.026617	12904	-	0 (Negligible)
	Min Radius of Curvature (Hogging)	2	9.1263	28.809	Hogging	9.78E-04	9.0542	0.026617	12904	-	0 (Negligible)
	Min Radius of Curvature (Sagging)	1	0	9.1263	Sagging	9.78E-04	14.945	0.01066	-	5736.7	0 (Negligible)
B-147	Max Slope	2	-	-	Hogging	0.00162	19.45	0.0450	-	-	0 (Negligible)
	Max Settlement	2	-	-	Hogging	0.00162	19.45	0.0450	-	-	0 (Negligible)
	Max Tensile Strain	2	-	-	Hogging	0.00162	19.45	0.0450	-	-	0 (Negligible)
	Min Radius of Curvature (Hogging)	2	-	-	Hogging	0.00162	19.45	0.0450	-	-	0 (Negligible)
	Min Radius of Curvature (Sagging)	2	-	-	Hogging	0.00162	19.45	0.0450	-	-	0 (Negligible)
B-238	Max Slope	1	0	9.2693	Sagging	1.04E-03	9.3539	0.025526	-	11833	0 (Negligible)
	Max Settlement	2	9.2693	27.352	Sagging	1.04E-03	15.455	0.024347	-	5303.1	0 (Negligible)
	Max Tensile Strain	3	27.352	47.098	Hogging	1.03E-03	9.3938	0.025768	12079	-	0 (Negligible)
	Min Radius of Curvature (Hogging)	3	27.352	47.098	Hogging	0.001032	9.3938	0.025768	12079	-	0 (Negligible)
	Min Radius of Curvature (Sagging)	2	9.2693	27.352	Sagging	0.00104	15.455	0.024347	-	5303.1	0 (Negligible)
AB-37	Max Slope	9	-	-	Hogging	0.00208	22.14	0.0571	-	-	1 (Very Slight)
	Max Settlement	9	-	-	Hogging	0.00208	22.14	0.0571	-	-	1 (Very Slight)
	Max Tensile Strain	9	-	-	Hogging	0.00208	22.14	0.0571	-	-	1 (Very Slight)
	Min Radius of Curvature (Hogging)	9	-	-	Hogging	0.00208	22.14	0.0571	-	-	1 (Very Slight)
	Min Radius of Curvature (Sagging)	9	-	-	Hogging	0.00208	22.14	0.0571	-	-	1 (Very Slight)