The Legacy Way Project

Application for Project Change – Conveyor Tunnel

CO-WC-RP-0002 Rev B

Uncontrolled when printed 22/07/2011

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Table of Contents

Appendices

Document Version Control

Rev	Description	Originator	Reviewed	Approved	Date
A	Initial Document	Rob Munro	Chris Brett	Fernando Vara	04/07/2011
B	Revised for CoG	Rob Munro	Andrew Ross	Andrew Ross	22/07/2011

1. Executive Summary

Further to the Coordinator-General's December 2010 report on project changes for the Legacy Way Project, the contractor for the project Transcity Joint Venture (Transcity) proposes an additional change to the approved project.

This change relates to the proposed construction of the conveyor system for delivery of spoil from the mainline Legacy Way tunnel to the Mt Coot-tha Quarry (Quarry).The proposal would change the alignment of the conveyor from the western worksite to the Quarry from the current approved overland conveyor (Overland Conveyor) route to the proposed changed conveyor tunnel (Conveyor Tunnel) route.

The proposed Conveyor Tunnel would be constructed and operated under the existing Coordinator General Conditions for the Changed Project as per the December 2010 report. No changes to these existing conditions are proposed.

The proposed alignments and typical cross sections of the both the Overland Conveyor and Tunnel Conveyor are shown on Figure 1: Current Overland Conveyor (approved project) and Figure 2: Proposed Conveyor Tunnel (proposed change) respectively of this report. As shown, the Overland Conveyor route would be approximately 1,750m long from the western worksite along the northern side of the widened Western Freeway, and north through existing Mt Coot-tha bushland to the top of the Quarry. The Conveyor Tunnel route would be approximately 850m long from the western worksite directly to lower level in the Quarry at depths of between 15 and 35m below the public areas of the Brisbane Botanic Gardens.

The environmental and community benefits of the proposed Conveyor Tunnel in comparison to the Overland Conveyor are substantial and include:

- Reduced tree clearing by up to 2Ha;
- Enhanced noise and dust mitigation for local community;
- Enhance spoil handling resulting in all TBM tunnel spoil for the mainline tunnels being able to be delivered to the Quarry with no truck movements for this spoil;
- Enhanced reliability of conveyor system resulting in more certainty to the program for the mainline tunnel construction.

The construction of the conveyor tunnel would be drill and blast methods with approximately two thirds of the conveyor tunnel spoil being transferred to the Quarry and one third being transferred to the western worksite and for on-haulage to approved haulage sites.

The impact of truck movements overall will be significantly less using the conveyor tunnel than the current approved overland route.

Consultation with key stakeholders the Mt Coot-tha Quarry operator and Brisbane Botanic Gardens are approaching positive conclusion. The Western Community Liaison Group has been informed of Transcity's intent to pursue the conveyor tunnel.

Full community engagement will be undertaken as per the project documents and planning conditions following approval of the conveyor tunnel to proceed.

2. Introduction

Legacy Way (formally known as the Northern Link Road Tunnel project), is a tolled cross-city tunnel, just under 5km in length, linking the Centenary Motorway at Toowong in the west of Brisbane with the Inner City Bypass and Kelvin Grove / Herston to the north of Brisbane.

Legacy Way has been evaluated by the Coordinator-General in accordance with the State Development and Public Works Organisation Act 1971 (SDPWO Act). An EIS (September 2008) and a supplementary report (June 2009) were prepared for the Reference Design with the evaluation report and associated approval conditions provided by the Coordinator-General in April 2010. Amendments to the Reference Design were assessed in the first Application for Project Change of October 2010 and were evaluated in the Coordinator-General's report on project changes in December 2010. A complete description of the Project is available in the October 2010 Application for Project Change[1].

In this Application for Project Change (APC) the 'approved Project' refers to the Reference Design as varied by the Coordinator-General's report on project changes in December 2010.

2.1. Summary of proposed change

The mainline tunnels for Legacy Way comprise of two tubes each containing 2 lanes of traffic. The tunnels will be excavated using double shield Tunnel Boring Machines (TBM) with a bored diameter of 12.4m.

Under the approved project, the excavated material will be transported from the TBM to the Western portal via the tunnel conveyor system and from there to the Mt Coot-tha Quarry via an overland conveyor system. The overland conveyors run along a route adjacent to the shoulder of the eastbound lane of the Centenary Motorway. The conveyor will then continue northwards through the botanic gardens and entering the western boundary of the Quarry.

This request for project change addresses a different conveyor alignment and temporary works to the approved project. The proposed change will see spoil material transported to the Mt Coot-tha Quarry via a conveyor tunnel, which will travel in a straight line from the transfer station at the western worksite directly to the Quarry. This is a change from the current proposal for the overland conveyor.

2.2. Process for Evaluation of Project Change

Under the terms of Division 3A of the SDPWO Act, Council can apply to the Coordinator-General to assess a proposed change to the project or a condition of the project and to evaluate the environmental effects of the proposed change, its effects on the project and any other related matters.

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[1] The EIS, supplementary report and previous Applications for Project Change for Legacy Way are available at http://www.dlgp.qld.gov.au/northernlink

The application must:

- describe the proposed change and its effects on the project;
- state reasons for the proposed change; and
- include enough information about the proposed change and its effects on the project to allow the Coordinator-General to make the evaluation.

After receiving the application, the Coordinator-General may:

- refer details of the proposed change, its effects on the project or any other related matter to anyone the Coordinator-General considers may be able to give comments or information to help the making of the evaluation.
- ask the proponent for further information about the proposed change, its effects on the project or any other related matter.
- require the proponent to publicly notify the proposed change and its effects on the project, in a way decided by the Coordinator-General.
- In making the evaluation, the Coordinator-General must consider each of the following:
  - the nature of the proposed change and its effects on the project;
  - the project as currently evaluated under the Coordinator-General's Report for the EIS for the project;
  - the environmental effects of the proposed change and its effects on the project;
  - if public notification was required, all properly made submissions about the proposed change and its effects on the project; and
  - the submissions made to the EIS to the extent that it is relevant to the proposed change and its effect on the project.

The Coordinator-General may refer the proposed changes to anyone to seek input on the changes, and within this, may decide to publicly notify the change request for comment. Submissions made will be among materials the Coordinator-General uses to inform his decision on the changes. The Coordinator-General must prepare a report (a Coordinator-General's Change Report) that makes an evaluation and may make recommendations, amend any conditions, impose conditions or refuse to allow the proposed change.

After completing the Coordinator-General's Change Report, the Coordinator-General must:

- give a copy of it to the proponent; and
- publicly notify the report.

To the extent that there is any inconsistency between the Coordinator-General's Report and the Change Report, the Change Report prevails.

2.3. Application outline

This application provides information about the proposed change and its effects on the project to allow the Coordinator-General to make the evaluation. Section 3 states the reasons for the proposed change and its effects on the project. The proposed change to the conveyor system, spoil handling and spoil placement is described in Section 4. Details of the conveyor tunnel design and construction are provided in Sections 5 and 6 respectively. The environmental effects of the proposed change are discussed in Section 7. Section 8 provides information on the community and stakeholder issues, engagement strategy and consultation activities.

3. Reasons for the Proposed Change and its Effects on the Project

The reasons for the proposed change relate to the environmental and community benefits of the proposal and the improvement in the reliability of the conveyor operations which are provided by the proposed conveyor tunnel and temporary works. These environmental, community and operational benefits are outlined below and discussed in more detail in the following sections.

Environmental and community benefits are provided in terms of reduced effects from tree clearing, truck haulage, noise, dust and Carbon Dioxide (CO_2) footprint compared to the approved Project.

Under the previous overland conveyor system, whilst it was proposed to utilise as much as possible existing tracks, tree clearing would still have been required to construct the conveyor and adjacent maintenance track from the widened Centenary Motorway to the Quarry. With the conveyor tunnel, this clearing is not required. In addition, with a lesser impact on surface vegetation (2Ha and steep terrain) the risk of soil erosion and its effects are greatly eliminated.

The proposed change allows for reduced truck haulage on local roads compared to the approved Project as the proposed conveyor tunnel and temporary works provides for the full volume of tunnel spoil material to be accommodated in the Quarry. Under the approved Project approximately 10% of the tunnel spoil was expected to be transported off site by truck haulage.

Noise and dust management is greatly enhanced with the use of the tunnel conveyor in comparison to the overland conveyor. With the removal of the conveyor from the surface, the benefit of the conveyor tunnel to the community in terms of night time noise mitigation in particular is substantial.

As the conveyor tunnel would enter the Quarry at a lower level in comparison to the overland conveyor, the proposed change reduces the potential for dust generation during deposition of spoil.

It is also estimated that the conveyor tunnel option results in a significant reduction in the Carbon Dioxide (CO_2) footprint.

The proposed conveyor tunnel reduces the number of conveyor transfer points from seven to four and also reduces the length of conveyor from 1,750m to approximately 870m. The conveyor sections for the conveyor tunnel alignment are all straight with a maximum inclination of 6%, whereas the overland conveyor has substantial sections of curved alignment and a maximum inclination of 17%. These changes will substantially improve the reliability of the conveyor system thereby reducing the risk of conveyor breakdown and the corresponding risk of extending the project program and community exposure to the Legacy Way tunnel construction period.

For the conveyor tunnel the emergency stockpile at the western worksite for the tunnel will now become redundant, due to a large capacity temporary stockpile in the Quarry. This temporary stockpile in the Quarry will be able to accommodate a full weekend of spoil material which would not have been able to be stored at the western worksite under the previous arrangement.

The conveyor tunnel excavation will give Transcity the opportunity to test and develop similar excavation methods for cross passages and substations for the mainline tunnel. This will further enhance regenerated noise and vibration mitigation techniques for when these activities occur under residential areas thereby further minimising the impact on the community along the main tunnel alignment.

4. Conveyor System Overview

4.1. Current Approved Overland Conveyor

The approved project alignment is shown on Figure 2: Proposed Conveyor Tunnel (proposed change) of the First Application for Project Change October 2010. The design of the overland conveyor is shown in Figure 1: Current Overland Conveyor (approved project) of this report.

The length of the overland conveyor is approximately 1,400m from where it leaves the western worksite to the Quarry. Of this, approximately 600m would head west along the future third lane earthworks on the northern side of the realigned Centenary Motorway and would be returned as landscaped and stabilised road earthworks. Approximately 500m of the conveyor alignment would then head north from the Centenary Motorway through Mt Coot-tha bushland along the western boundary of the Brisbane Botanic Gardens to the Quarry. Dependent upon the final arrangement for depositing spoil, a 300m length of conveyor would be required along the northern side of the Quarry.

To date, the final temporary works design for depositing spoil into the Quarry has not been finalised.

4.2. Proposed Change - Conveyor Tunnel

The proposed conveyor tunnel is shown on Figure 2: Proposed Conveyor Tunnel (proposed change) of this report. The length of the proposed conveyor tunnel would be approximately 600m from where it leaves the western worksite directly to the Quarry. This route would take it under public areas of the Brisbane Botanic Gardens and under bushland to the Quarry.

Spoil placement and spoil handling is greatly enhanced with the proposed conveyor tunnel as described in the following sections.

Figure 1: Current Overland Conveyor (approved project)

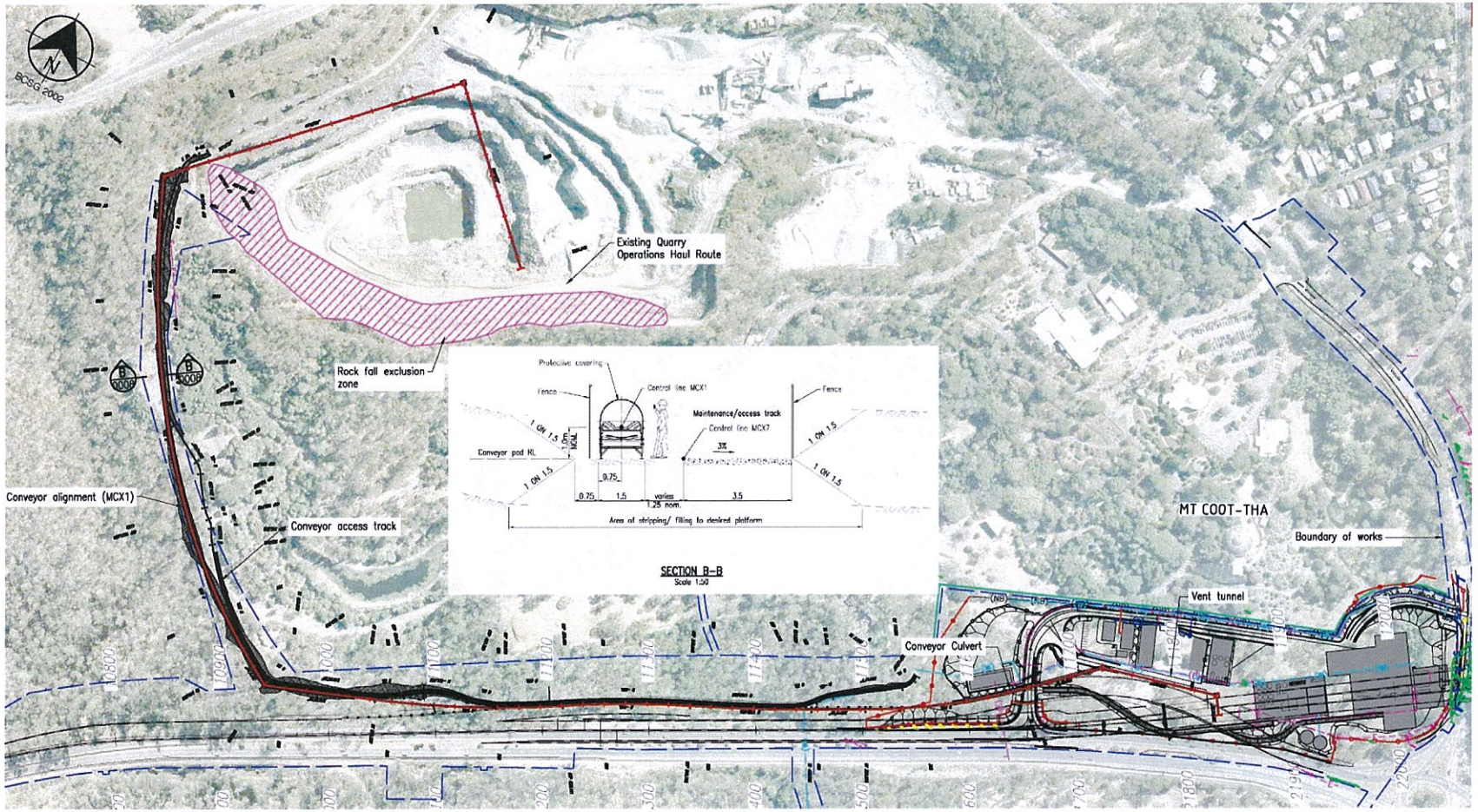
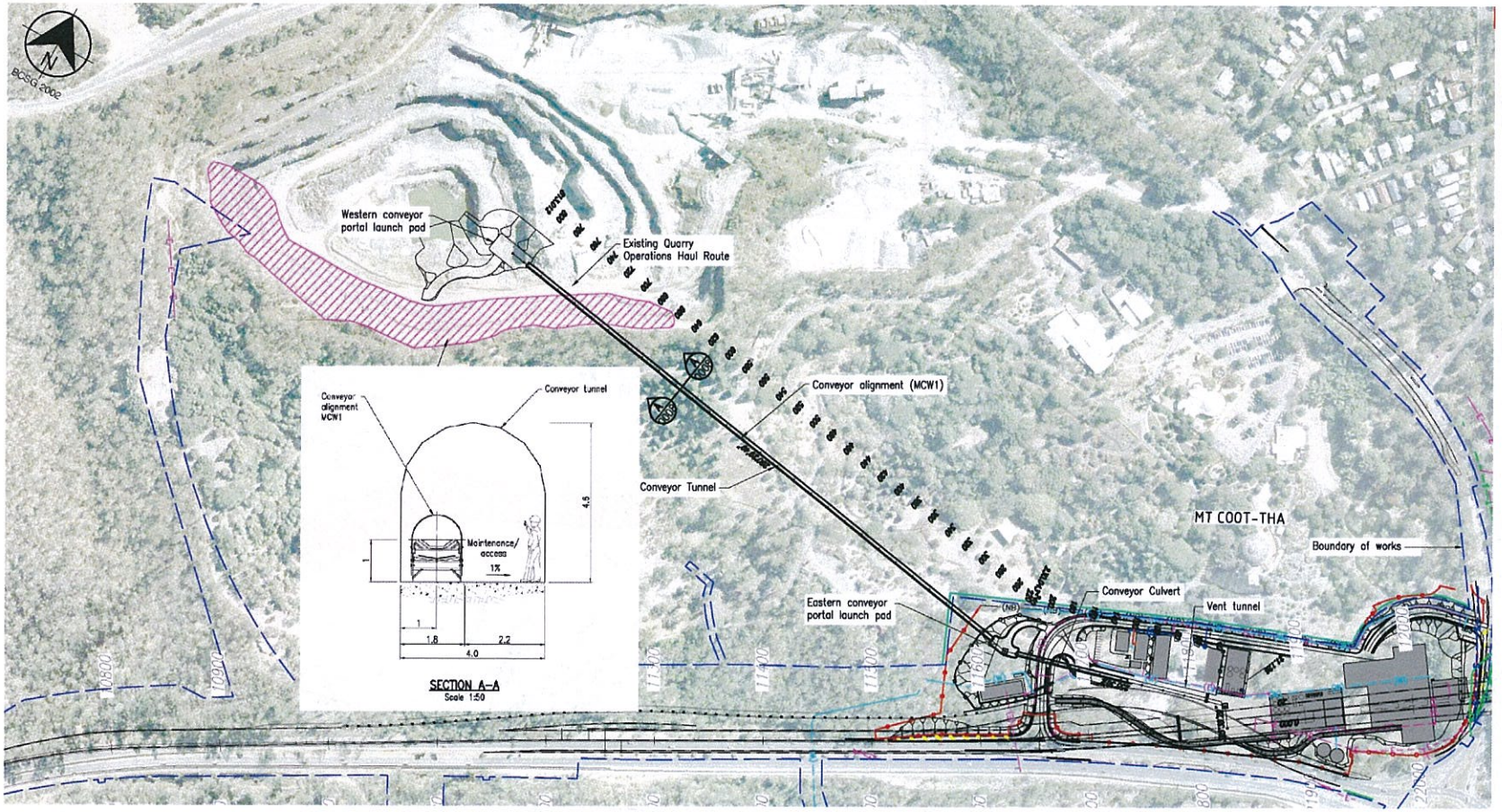


Figure 2: Proposed Conveyor Tunnel (proposed change)



4.3. Western Worksite TBM Spoil Handling

The spoil excavated by the TBMs will travel by conveyor from each TBM, exiting at the western tunnel portals to a transfer station located within the western worksite. From the transfer station, a single conveyor will transport the material to the Mt Coot-tha Quarry. The conveyor will be fully enclosed along its length between the worksite shed and the Quarry. All stockpiling, truck and conveyor loading activities at the western worksite will be undertaken entirely within the worksite shed or within the tunnel excavation area.

For the current approved Project approximately 964,000 BCM (bank cubic metres) of spoil has been allowed to be delivered to the Quarry with approximately 303,000m^3expected to be transported off site from the western worksite by truck. This haulage task would involve 4 – 5 trucks per hour for 12 months, but may be much higher (35 trucks per hour) should the spoil conveyor be out of operation.

Of the 303,000m^3 to be transported off site by haulage, approximately half of this amount would be TBM spoil (approximately 10% of the tunnel spoil or 151,700 bcm) not expected to be accommodated within the Quarry. Removal of this TBM spoil would require approximately 11,700 truck movements. During the detailed design of the Quarry spoil placement, it is noted that with some revision to the spoil placement zone within the existing Quarry boundary and with the enhanced Quarry spoil placement and operations of the conveyor tunnel, it is expected that the full volume of TBM spoil material will be able to be accommodated in the Quarry. With this outcome there will be further community benefits in terms of reduced truck haulage on local roads.

4.4. Quarry Spoil Placement and Operations

For the existing approved Project, the spoil would be placed to facilitate the eventual rehabilitation of the Quarry. The placement of spoil would not affect the continued operation of the Quarry.

The existing Quarry development approval remains in place for the Quarry operations. The following conditions have been set by the Coordinator-General:

- Conveyor spoil delivery into the Quarry must be managed to mitigate any adverse environmental impacts.
- Spoil may be delivered by conveyor into the Quarry providing the environmental objectives and the performance criteria for noise (Schedule 3, condition 22 of the Coordinator-General's conditions) and air quality (Schedule 3, condition 20 of the Coordinator-General's conditions) are met at adjacent residential properties.
- Spoil placement within the Quarry, being the distribution, spreading and compaction of conveyor spoil from the project works, must be in accordance with the existing Quarry development permit.

The conveyor transporting spoil material into the Quarry will operate on a 24/7 basis in line with TBM operations. The spreading and compacting of the tunnel spoil material within the Quarry will be carried out under the existing Quarry operating hours of Monday to Friday 7am to 5pm in accordance with the existing Quarry development permit.

5. Conveyor Tunnel Design

5.1. Horizontal Alignment

The conveyor alignment is shown in Figure 2: Proposed Conveyor Tunnel (proposed change).

The tunnel section of the conveyor route passes under public areas at the south west region of the Brisbane Botanic Gardens. However this poses no danger to the public during either construction, operation or closure of the conveyor tunnel.

At the Quarry a stacker conveyor picks up spoil via a transfer station and deposits into a temporary stockpile adjacent to the Quarry wall.

It is noted that the conveyor tunnel alignment crosses the proposed alignment of the future Inner Orbital tunnel motorway route at around the mid-point of the conveyor tunnel. At this location the conveyor tunnel is 35 m deep from ground surface to tunnel crown and well within the slightly weathered to fresh rock horizon. Whilst the proposed depth of the future Inner Orbital tunnel is unknown, given the quality of the rock being tunnelled through, allowance for this future infrastructure will be made by either backfilling a portion of the conveyor tunnel allowing the Inner Orbital to tunnel through this backfilled ground or a mined junction between two tunnels is also possible. By potentially not backfilling the conveyor tunnel after completion of Legacy Way an opportunity could be realised to use the conveyor tunnel for geotechnical planning and design on the Inner Orbital. Should geometrics not allow the conveyor tunnel to be incorporated into this planning of the Inner Orbital, the conveyor can be backfilled over the length that it influences the inner orbital tunnels ahead of tunnelling activities for that project.

5.2. Vertical Alignment

The spoil conveyor picks up spoil from the transverse feed conveyor in the ventilation tunnel at RL 24.1 (approx.) and rises along the ventilation tunnel at a grade of 5.6% until chainage 160 where the vent tunnel structure stops and changes to an earth cut (RL 29.717). The cut alignment moves south and rises at up to 8 per cent grade to join the site access road. The conveyor culvert maintains the 5.6% grade until it daylights at the ventilation station platform at RL 32.2.

The tunnel starts at chainage 240 with the floor set at RL 32.159, approximately 4.4 metres below the ventilation station platform. From this portal the tunnel falls at a constant grade to exit in the Quarry wall at RL 31.022, a grade of -0.207%.

Access to the tunnel for spoil removal is provided by a ramp cut into the ventilation station platform with access from the main western compound access road. The access has been designed to allow drilling machines (jumbos), mining excavators and other service vehicles to access the tunnel face.

The conveyor is generally underground with depths to the conveyor belt starting at 2.248 metres in the ventilation tunnel to 5.289 metres at the exit onto the ventilation platform. The depth of the conveyor through the tunnel from the existing ground surface varies from 11.5 metres at the eastern portal to a maximum depth of 52 metres as the tunnel passes under the crest of the Quarry wall. Under the public areas of the Brisbane Botanic Gardens, the conveyor tunnel would have between approximately 15m of cover at chainage 300 and 35m of cover at chainage 550.

The tunnel shall be a traditional D-shape, which has an excavated profile width of 3.6m and height of 4.4m.

5.3. Geological Setting

The conveyor tunnel traverses undulating shallow dipping terrain which is underlain by a metamorphic formation known as the Bunya Phyllite (BP). The Bunya Phyllite has been influenced by the presence of the Enoggera Granite, which intruded into and locally metamorphosed part of the Bunya Phyllite to a hornfels. Zones of quartzite and quartz-rich phyllite, again associated with the Enoggera Granite intrusion, may also be present within the Bunya Phyllite. The main rocks (phyllite, quartzite and hornfels) can occur as interbedded sequences and as thick beds.

The phyllite and quartzite is typically a dark grey to black rock with prominent foliation and abundant quartz veins and lenses. The hornfels is typically hard, dark grey and displays limited fabric. Zones of solidification of the phyllite can be expected, particularly near intervals of quartzite or hornfels.

The major structural elements within the Bunya Phyllite generally have a north-northwest to south-southeast trend, although in the vicinity of the conveyor tunnel, aerial photographs show lineaments which do not extend across the tunnel alignment.

The Bunya Phyllite typically displays a sub-topographic weathering profile (i.e. broadly consistent with topography), with the degree of rock mass weathering decreasing with depth and rock mass strength increasing with depth below ground surface. The majority of the conveyor tunnel (with the exception of the southern portal) is anticipated to be formed in high strength or better slightly weathered to fresh rock.

Geological effects of the tunnel are expected to be localised convergence around the excavated opening as excavations progress. Ground movements at surface are expected to be negligible.

5.4. Hydrogeological Setting

Based upon permeability testing carried out to date in 3 completed boreholes, hydrogeological conditions along the conveyor alignment are likely to be closely aligned with the geomorphology (topographical and near-surface ground conditions).

The topography comprises undulating dipping terrain. Soil thickness (colluvial deposits in surface valleys and residual soil elsewhere along the alignment) is expected to be comparatively thin. Soils will act as an unconfined aquifer resulting in perched water levels directly responsive to rainfall. The soils are considered to have limited groundwater potential due to limited extent and high clay (low hydraulic conductivity) content.

The Bunya Phyllite comprises metamorphosed sediments. Groundwater within the Bunya Phyllite is likely to be semi-confined or confined due to the laterally and vertically discontinuous nature of zones of structural deformation. The Bunya Phyllite is therefore considered to have limited groundwater potential.

Geophysics along the tunnel alignment is complete whilst borehole drilling and in-situ permeability testing is nearing completion. Investigation results confirm that the tunnel is to be constructed through fresh and slightly weathered rock. Also, in-situ permeability testing has confirmed that the slightly weathered and fresh rock is of low hydraulic conductivity. As such, groundwater inflows into the conveyor tunnel are expected to be minor due to the low hydraulic conductivity of the surrounding rock.

Groundwater inflows into the tunnel are expected to be limited to those areas associated with geological structural defects such as shear zones and fracture zones (note: aerial photographs did not reveal significant lineaments crossing the tunnel alignment, therefore no major faulting is anticipated). Steep and/ or near vertical fractures identified in the borehole rock core have the highest groundwater potential; however based on project wide investigations and excavations to

date indicated that in the Bunya Phyllite, these fractures are unlikely to be interconnected or regionally extensive. Drilling and permeability testing has also shown that fracture zones are typically clay infilled and have low hydraulic conductivity. Where persistent inflows are encountered during tunnel construction, these will be mitigated by grouting to achieve low hydraulic conductivity similar to majority of the main rock mass.

In addition to low hydraulic conductivity geological conditions, the topographic conditions are likely to influence the existing groundwater regime rather than the proposed tunnel. In particular, the Mt Coot-tha Quarry at the conveyor tunnel portal, extends some distance below the proposed tunnel. Similarly, at the southern end, a natural drainage line runs parallel to, and at a much deeper elevation than, the proposed tunnel. These deeper-lying features, rather than the proposed tunnel, will influence the groundwater regime.

Based on investigations and testing, low tunnel inflows are anticipated. Where inflows are encountered, these will be mitigated by grouting to ensure drawdown effects on existing ecosystems and groundwater users are negligible. Negligible drawdown effects will be confirmed by groundwater monitoring during tunnel operation.

6. Conveyor Tunnel Construction

A detailed construction management plan in the form of a Construction Method Statement (CMS) will be developed by Transcity for the management of the conveyor tunnel works. The following provides a brief overview of the activities for this management plan. The environmental effects of these activities are discussed in Section 7.

6.1. Portal Treatment

6.1.1. Land Clearing

For both the western worksite and the Quarry portals, there will be no requirement for clearing beyond what is authorised for the Approved Project. The western worksite portal is located within the ventilation station earthworks platform with no further clearing necessary. The Quarry portal is a rock face with no vegetation/clearing required.

6.1.2. Construction Access

Portal design, has been done to accommodate the entrance to the tunnel via ramps capable of allow particular plant and equipment to access the tunnel. The following plant and equipment are being considered to be used during the construction of the tunnel:

- Sanvik 533/Toro 400 articulated dump trucks
- Sandvik DS311 Rock bolt rig
- CatR 2900 Low profile loader
- Sandvik DT920i face drilling jumbo

Ramps and turning curves have been designed to allow for the safe movements of the above machinery.

Portals are constructed in areas where there is shallow overburden of rock material. Slope protection will be utilised in the areas above each of the portals so that the face of the portal will not destabilize during construction. The portal works shall include rock bolts and shotcrete were required, as well as a drainage berm to divert runoff away from the portal face.

6.2. Conveyor Tunnel Excavation

6.2.1. Method Of Excavation

Excavation will be carried out by full face drill and blast methods. The tunnel will advance from two headings at the Western Worksite Portal and Quarry Portal within the Quarry. The latter operating hours will be as per the Quarry operations. Below ground works at both faces of the conveyor tunnel will be undertaken on a 24/7 basis in accordance with the Coordinator General conditions. Underground blasting and above ground surface works activities will only occur during hours conditioned by the Coordinator General as described respectively in Sections 6.2.3 and 6.3 below.

6.2.2. Drilling

Drilling will be undertaken using electro-hydraulic twin boom trackless jumbos. The burn cut method shall comprise of 4 no. x 102mm diameter uncharged holes and 17 no. x 45mm blast holes. All other blast holes will be 45mm diameter. Perimeter holes will be charged with decoupled explosives to facilitate smooth wall blasting to limit impacts on the surrounding rock. For a standard length round holes will be drilled to a length of 4.3m for an excavation length of 4.0m.

6.2.3. Charging and Blasting

Charging and blasting will be undertaken under the supervision of qualified personnel. Electronic detonators & emulsion based explosives will be used where low vibration requirements are set in place, otherwise ANFO's will be the preferred production explosive agent. All initial excavation on the Western Portal are currently envisaged to be undertaken with excavator and small pop blasts which will be locally managed by blast curtains. Controlled blasting will be enforced to mitigate risk of fly-rock in both conveyor tunnel portals no road closures will be required.

Furthermore, in accordance with Coordinator General Conditions 22 (p) and (q), blasting is only to occur during the hours of 7.30am to 4.30pm Monday to Saturday, and not on Sundays or Public Holidays and at least 24 hours notice will be provided. At this stage, Transcity envisage that blasting activities will occur from October 2011 to mid-February 2012 with 1No. Blast from each face of the conveyor tunnel under construction on a daily basis and at an agreed set time each day within the above permitted hours. That is, two blasts per day (twelve blasts per week) will occur whilst the conveyor tunnel is under construction during this period. As a result of further discussions with the owners of the Botanic Gardens restaurant it is proposed to limit the times for blasting to between 7.30am and 9.30am Monday to Saturday

6.2.4. Spoil Removal

Excavation of spoil material will be undertaken using Toro 400 articulated dump trucks, which will be loaded by Cat2900 low profile front-end loaders. Below ground excavation at the faces of the conveyor tunnel will be undertaken on a 24/7 basis in accordance with the Coordinator Generals conditions. Mucking bays will enable specific cycle time for basting, and spoil removal, whilst enabling machinery to turn around underground.

To note, when opportunity arises, the tunnel will facilitate the Research & Development of various rock splitting techniques which will be later used in the development of similar excavation techniques below residential areas for the main line cross passages, sub-stations and low point sump.

6.3. Conveyor Tunnel Spoil Handling & Disposal

Approximately two thirds (6,500m^3) of conveyor tunnel spoil during its construction will be transported from the "quarry face" of the conveyor tunnel underground back to the Quarry itself via low profile articulated dump trucks. The remaining approximately one third (3500m^3) of material will be excavated from the "western worksite face" of the conveyor tunnel, transported to the western worksite and from here the material will be transported to an approved haulage spoil site for the western connection. From the expected geotechnical ground conditions along the tunnel length, it is anticipated the excavated spoil material will be suitable for re-use as rock fill.

For the approximate 6500m^3 of material being excavated from the Quarry face of the conveyor tunnel back to the Quarry, and then spread and compacted within the Quarry during the approved hours under Coordinator General Condition 17 (d) for the Quarry operations. No external haulage is required for this spoil material.

For the approximate 3500m^3 of material being excavated and hauled from the western worksite end of the conveyor tunnel, this would be undertaken in accordance with Coordinator-General Conditions 17 and 18. This spoil removal would result in approximately 3 truck movements on average per day for haulage transportation to the approved spoil sites. These truck movements are significantly less than the truck movements that would be expected for construction of the overland conveyor due to tree clearing, earthworks and additional conveyor construction.

6.4. Primary Conveyor Tunnel Support

6.4.1. Shotcrete

Based on the QLD Tunnelling Code of Practice 2007, no persons shall work under unsupported ground. To achieve this, before work continues at the face of the tunnel, a primary shotcrete sealing layer will be applied across the crown of the tunnel. This shotcrete layer can be applied by robotics such that no person is under unsupported ground behind the face.

6.4.2. Rock Bolt

In addition to shotcrete, rock bolts will be utilised as per the support classes. Drilling will be undertaken using a drill jumbo, and 45mm holes will drilled to 2m lengths or as determined by support requirements. The rock bolts will be installed using a rock bolting jumbo perpendicular to the tunnel profile and shall be installed with a driver.

6.4.3. Steel Sets

Steel sets shall be used where required as per the support classes.

6.5. Construction Program

Appendix 2 is an indicative time-chainage schedule showing predicted construction progress for the conveyor tunnel. As noted, it is estimated that this will take approximately 8 months to construct. Portal works for the conveyor tunnel as described in section 6.1 above are expected to start in August 2011.

6.6. Western Worksite TBM Spoil Handling

The tunnel spoil material conveyor system under the proposed arrangement will include a number of conveyors that will take spoil material from the TBM face to the Quarry. The travel of the spoil material is described in sequential order below;

(a) Face of the TBM's onto tunnel conveyor (C1a and C1b 1000mm belt width) onto;
(b) Common cross conveyor (C2 – 1400mm belt width- approx. 20 m long) onto;
(c) Conveyor in the vent tunnel (C3 – 1400mm – approx. 210m long) onto;
(d) Conveyor tunnel to the Quarry (C4 – 1400mm approx. 570m long) onto;
(e) Stacker conveyor (C5 – 1400mm – approx. 45m long)

The system described above is a simple conveyor to conveyor transfer system, with no need for mid transfer stacking or trucking of the material. In emergency operation if one belt were to stop all belts will stop in the system.

The benefit of the proposed system is that it has a total of four discharge points whilst the previous system had seven discharge points, so the likelihood of a breakdown or interruption is substantially reduced.

Conveyor access and maintenance during operation shall be obtained via maintenance path which will run alongside the conveyor within the tunnel. This path will be suitable for a small vehicle to enter to conduct inspections or maintenance.

6.7. Quarry Spoil Placement and Operations

The Quarry shall have capacity for a temporary stockpile of min 40.000m^3 which provides a substantial buffer volume over nights and weekends, so that it is very unlikely that we are not able to unload spoil in the Quarry.

The main difference with the conveyor tunnel compared with the overland conveyor is that the conveyor enters the Quarry at a much lower level. Apart from enhanced noise and dust mitigation, this allows for greater efficiency in spoil placement and will assist to place as much of the mainline tunnel spoil in the Quarry as possible. From the tunnel conveyor exit, stackers will be used to create temporary muck piles. Initially dozers will be used to spread the spoil material, and once the uppermost level has been reached the material will be trucked to higher levels.

Consultation with representatives from Mt Coot-tha Quarry has confirmed that the proposed conveyor tunnel works can be accommodated within the Mt Coot-tha Quarry operations and the works within the Quarry will be under the control of the Quarry Manager. Refer to Section 8.1.

6.8. Noise and Dust Management

There are significant real and community perception benefits in relation to noise and dust for the conveyor tunnel in comparison to the overland conveyor route. There would have been potential noise and dust impacts from spoil deposition from higher up in the Quarry. Whilst this activity may have been indistinguishable from the existing Quarry operations, it is expected that local community perception will support this change. Additionally, it is noted that whilst acoustic protection would have been provided to the conveyor, potential surface noise impacts from the construction of the overland conveyor itself are eliminated.

The proposed conveyor runs in a protected cover whilst within the ventilation tunnel. The conveyor discharge transfer at the conveyor tunnel portal, is also sunken into the ground which will minimize noise emissions. The drive of the vent tunnel conveyor and transfer station at the portal will be housed in an acoustically lined transfer structure. The conveyor in the tunnel will emit no noise to the surface, and the low position of the discharge to the stacker in the Quarry will minimize any noise impacts in the Quarry.

The only source of dust along the conveyor alignment is at the transfer from C3-C4. Here a proposed noise cover over the transfer station will be utilised which will also reduce dust production.

Dust within the spoil tunnel will be managed in a similar way to the spoil conveyor inside the mainline TBM's. Spoil will be sprayed with water as it enters the conveyor tunnel and the portal transfer station. Additionally a wash box will be located at the discharge point in the Quarry, to clean the belts so that material is not carried back in to the conveyor tunnel. It is noted that dust management is greatly enhanced with the conveyor tunnel in comparison to the overland conveyor.

6.9. Long Term Requirement for Tunnel and Portals

The rehabilitation of the conveyor tunnel at completion of conveyor operation and dismantling would comprise of the backfill and sealing of the tunnel at the western worksite portal to allow the construction of the ventilation station. The balance of the tunnel will be treated in the following fashion following post-construction assessment of in-situ ground conditions:

- Where the tunnel is excavated and supported in stable rock and there is not the possibility of progressive tunnel degradation with time, the tunnel will be abandoned as is. Where sections may suffer long term degradation with time, support in the form of additional shotcrete and corrosion protected rock bolts will be applied. The portal in the Quarry which underlies the operation haul road will be supported by rock reinforcement.
- Alternatively, in any section of the tunnel where the upgrade of supports would still not satisfy degradation requirements, the conveyor tunnel can be backfilled with grouted rockfill, or low strength fill to provide long term stability to the ground surrounding the conveyor tunnel. The elimination of large scale ground movements at conveyor tunnel level due to the backfilling of the conveyor tunnel void translates to negligible ground movement as the surface.

An opportunity to accommodate rainwater runoff transfer from the Quarry to the proposed water storage dam in the expanded Brisbane Botanic Gardens, following completion of the Legacy Way Project, is also being considered. This opportunity is to be further explored with the Brisbane Botanic Gardens and the Quarry as part of the overall water reuse management strategy for the Brisbane Botanic Gardens.

7. Environmental Effects of Project Changes

7.1. Coordinator General Conditions

No change to the Coordinator General Conditions is proposed. The conveyor tunnel provides for improved compliance against the existing Coordinator General Conditions in comparison to the approved overland conveyor. This compliance is particularly enhanced with respect to noise, dust, greenhouse gas generation/emissions, vegetation management and spoil management. As such, Transcity is confident the proposed conveyor tunnel can be constructed and operated in accordance with the current Coordinator General Conditions.

7.2. Permits and Approvals

The tunnel conveyor option results in no additional permits and approvals than have already been obtained or are in the process of being obtained for the project. Permits required for blasting which were originally envisaged for cross-passage and substation construction in the mainline tunnels will need to be obtained sooner for the conveyor tunnel construction.

The overland conveyor route would have involved clearing under both Vegetation Management Act (VMA) and Natural Assets Local Laws (NALL). The approvals and permits that will be required for the Conveyor Tunnel conveyor will replace those which would be required for the Overland Conveyor.

7.3. Greenhouse Gas

It is estimated that the conveyor tunnel option results in a significant reduction in the carbon dioxide (CO_2) footprint. The estimated use of electrical power for the transport to the Quarry via this option reduces from approximately 3 million kWh to 1.5 million kWh. This energy reduction would result in excess of 1500t of reduced CO_2 emission for the operation of the conveyor system.

7.4. Flora and Fauna

The proposed conveyor tunnel entry and exit will be located within areas already cleared or having approvals under to clear under the approved Change Report at the western worksite. However, notably, it is estimated that up to 2Ha of trees in the Brisbane Botanic Gardens and Mt Coot-tha will not be required to be cleared as a result of the conveyor tunnel in comparison to the overland conveyor route in the approved Project. This will result in significant environmental benefits including a reduced disturbance along the alignment, reduced potential impact on Brisbane Botanic Gardens operations and visitors and reduced potential for erosion and sediment impacts. Groundwater impacts on planting in the Brisbane Botanic Gardens as a result of the conveyor tunnel are expected to be negligible as described in Section 7.10 below.

7.5. Noise

Noise predictions for the approved overland conveyor alignment indicated that compliance with the noise levels at nearby noise sensitive receivers as per Coordinator-General Condition 22 (Noise and Vibration) would have been achieved, provided that mitigated noise levels did not exceed 62 dB(A) at 1m from the conveyor and transfer stations did not exceed 76 dB(A) sound power level. However, these mitigated levels to achieve compliance particularly for the

Coordinator-General night time noise limits, were, in practice, likely to be very difficult to achieve with significant treatment to the conveyor required. Consequently, there was a risk of non-compliance particularly to the nearby noise sensitive receivers at Wool Street and Broseley Road with the conveyor being the primary noise source to these receivers during the night time period.

This noise risk is reduced considerably with the proposed conveyor tunnel by removing the overland conveyor and elevated surface transfer stations (external to the worksite and the Quarry) as significant noise sources. The closest receivers to the south of the Centenary Motorway are located on Broseley Road and Wool Street. These are located approximately 200m away from the overland conveyor alignment at the closest point. The closest receivers to the north are located in Sir Samuel Griffiths Drive at around 500m from the closest point of the conveyor entering the Quarry. Additionally, in accordance with Coordinator-General Condition 22, Table 9, noise level objectives at the Brisbane Botanic Gardens are to be at a level that preserves the amenity of the Gardens.

Noise from the conveyor tunnel, either during conveyor tunnel construction or during conveyor operation, will primarily travel via the conveyor portals at either the Quarry or the western worksite. Noise mitigation measures for the conveyor tunnel would be the same as those described in the Noise and Vibration EMP Sub-plan and associated document 'Noise Mitigation Measures'. These measures ensure compliance with the requirements of Coordinator-General Condition 22 as per current approvals for the project.

We note that reductions of up to approximately 20 dB(A) for conveyor operation are predicted by adopting the conveyor tunnel in comparison to the overland conveyor. This is due to the noise from the overland conveyor and transfer stations which would have required significant acoustic screening to achieve compliance. Whilst noting that the overall daytime noise impact is not reduced by this amount due to other significant sources on the worksite, the benefit of the conveyor tunnel on noise mitigation, particularly at night, is substantial. In addition it is noted that construction noise from the surface works construction of the overland conveyor and transfer stations through Mt Coot-tha bushland, including associated earthworks for maintenance tracks, is avoided by adoption of the conveyor tunnel.

A detailed updated noise report for the western worksite, including the conveyor tunnel construction and operation activities, is currently being completed and will be made available on request.

7.6. Dust

The approved overland conveyor would have required significant dust mitigation controls which are substantially enhanced for the conveyor tunnel. During construction of the overland conveyor, clearing and earthwork activities for the overland conveyor, including the maintenance track, would have required dust control along the length of this route. For construction of the conveyor tunnel, dust is readily controlled at the conveyor tunnel portals.

During operation of the overland conveyor, the TBM spoil material would have required dust control both for transportation along the conveyor, transfer points and for deposition into the Quarry. Again, along the conveyor tunnel during operation, dust is more easily controlled as described in Section 6.8 above. Moreover, with the conveyor tunnel entering the Quarry at a lower level reduces the potential for dust during deposition at Quarry in comparison to the overland conveyor which would have required the conveyor to travel down from the top of the Quarry and/or deposited spoil from a higher level.

7.7. Vibration

In developing the construction methodology for the conveyor tunnel, reiterative predictive vibration modelling for the tunnel conveyor has been undertaken to assess levels of transient vibration (eg blasting) and continuous vibration (eg road heading). This predictive modelling was assessed against the guides contained in Coordinator-General Condition 22 (j) and (k) particularly in relation to the Brisbane Botanic Gardens (public areas and buildings); the nearby Freedom Wall (a structure of community value though not Heritage Listed) and an existing 1530mm diameter water main near the western worksite conveyor tunnel portal.

In accordance with Coordinator General Condition 22, vibration is to be mitigated, managed and monitored for human comfort, sensitive building contents and risk of cosmetic damage allowing the Brisbane Botanic Gardens to function as normal during construction and operation of the conveyor tunnel. Additionally, vibration to the Linkwater water main is to be maintained at a level so as not to impact this infrastructure. It is noted that no road closures or closure to the Brisbane Botanic Gardens will be required. On request, Transcity can provide a copy of the Conveyor Tunnel Predicative Vibration Modelling report and we note that we will be providing this with an Impact Assessment Report to both Linkwater and the Brisbane Botanic Gardens.

7.8. Mt Coot-tha Queensland Heritage Site

The tunnel conveyor option will be under the Mt Coot-tha Forest (State Registered Heritage Site) and as such the possibility of impacts to this Heritage Site are reduced compared with the overland conveyor route which would have required surface excavations and tree clearing to complete.

7.9. Contaminated Land

Both the overland conveyor and the tunnel conveyor are on a lot listed as contaminated land. Assessment and management of spoil is the same for both options. Transcity notes that contaminated land investigations have been undertaken at the western worksite portion of this lot with no contamination found to be present. This will be monitored during the extended excavation for the conveyor tunnel.

7.10. Surface Water and Ground Water

Any potential impacts to surface water will be greatly reduced from the change from overland conveyor to the tunnel conveyor. An opportunity to accommodate rainwater runoff transfer from the Quarry to the proposed water storage in the expanded Brisbane Botanic Gardens, following completion of the Legacy Way project, is also being considered. This opportunity is to be further explored with the Brisbane Botanic Gardens as part of the overall water reuse management strategy for the Gardens.

As described in Section 5.4 above, hydrogeological investigations at boreholes along the alignment of the conveyor tunnel, including in-situ permeability testing, is currently ongoing. The tunnel is to be constructed through fresh and slightly weathered rock. Completed in-situ permeability testing on similar geology over the mainline tunnels, has confirmed that the slightly weathered and fresh rock is of low hydraulic conductivity and that ground water flow occurs primarily within the overlying residual soil and highly weathered rock. During conveyor tunnel construction, inflows could occur through relatively narrow fractured / shear zones within the rock mass however as described in Section 5.4, this is expected to be very limited. Any inflows will be mitigated by grouting to achieve low hydraulic conductivity similar to the main rock mass.

Details of predicted groundwater movements and any required mitigation for the conveyor tunnel will be confirmed following completion of the hydrogeological investigations.

7.11. Surface Land Use

Above ground impacts of the proposed conveyor are confined to within the Western construction compound. The conveyor is totally underground with the western construction compound with the exception of an exposed segment within the ventilation station platform. The proposed conveyor tunnel provides no material change to surface land use during construction or operation of the project. Consultation with key users of the botanic gardens has been undertaken and is discussed in Section 8.1 below.

In comparison the approved overland conveyor may have required tree clearing and earthworks of approximately 2 Ha of land to allow for construction. As such the proposed conveyor tunnel has less Surface Land use impacts than the approved overland conveyor.

8. Community and Stakeholder Consultation

8.1. Communication activities to date

During the detailed design phase of the conveyor tunnel, the following communication activities were undertaken:

- Liaison with Brisbane Botanic Gardens Curator in early June 2011 regarding the proposed change and the required geotechnical investigations. This scope of liaison included access requirements for geotechnical investigations and location of investigations.
- Brisbane City Council's Legacy Way Project Team briefed the Brisbane Botanic Garden Curator, Ross McKinnon, who provided this information to Gardens staff regarding the proposed change and upcoming geotechnical investigations.
- Transcity provided information to the Western Community Liaison Group (CLG) meeting held on 13 July 2011 regarding proposed change. Discussions held at the CLG meeting were very broad and it was stressed that the option was still being investigated.
- Brisbane City Council's Legacy Way team met with the owners of the Botanical Café at the Botanic Gardens to follow up a concern they raised in the CLG.

Feedback from key stakeholders during this phase is detailed below:

- Brisbane Botanic Gardens: Representatives from the gardens have indicated that the proposed conveyor tunnel has significant advantages and would be preferred over the approved overland conveyor due to the 2Ha saving of trees.
- Mt Coot-tha Quarry: Positive about potential project change and has been working closely with the construction team about the interface of the tunnel and the Quarry.
- Western CLG: Supportive of the project change due to reduction of potential noise and dust when compared to the overland conveyor.
- The only concern raised was by the Botanical Café owners about the impacts from the drill and blast technique to construct the tunnel. To address this, Council's Legacy Way team met with the Cafe owners to discuss construction and operation of the conveyor tunnel. The Cafe owners suggested it would be helpful if blasting activities could be limited to early morning to reduce any potential impacts on their business.

8.2. Proposed Communication Activities Prior to Construction

Prior to construction of the proposed conveyor tunnel works Transcity will be engaging with the community on the following issues:

Potential issue	Engagement strategy
Community perception of impacts of the tunnel construction methodology, which involves drilling and blasting, under the Botanic Gardens on Botanic Gardens staff, volunteers, visitors and neighbours	The Community Relations team will ensure that perceptions of these risks are managed through direct communication with relevant stakeholders.
Community concern regarding environmental impacts, including groundwater drawdown, impacts on current and future plantings and management and surface settlement	The Community Relations team will work with the environment team to provide information on any potential impact and mitigation measures and alleviate undue community concern.

Potential issue	Engagement strategy
Communication challenges to address operational concerns, including possible tunnel collapse, impacts on areas of importance (e.g. Wall of Remembrance).	Again these concerns will be addressed through clear communication of any potential issues. Note that a building condition survey will be carried out on the Wall to ensure its current condition is recorded to the satisfaction of relevant stakeholders so that Transcity can reinstate the Wall to its current state if required following construction.
Addressing any changes to previously communicated messaging about tunnel spoil disposal and required truck movements and haulage routes	Transcity will undertake a number of key activities to ensure dissemination of information regarding the changes is accurate and controlled by Transcity.
Communication challenges to address any required surface work night works required to build the tunnel conveyor and noise implications for neighbouring residents	Transcity will follow the existing night work notification protocols to ensure all relevant stakeholders are aware and understanding of required night works. Noting that below ground conveyor tunnel works on a 24/7 basis is in conformance with the Coordinator General's conditions for the Project.

Transcity will undertake a number of key activities prior to construction to ensure dissemination of information is accurate and controlled by Transcity. These briefings will include:

- Briefing Brisbane Botanic Gardens management, staff and volunteers to convey the tunnel will not impact the operations of the gardens, future plantings or any areas of importance (eg the Wall of Remembrance)
- Briefings with local resident groups (Mt Coot-tha Residents Group).

Information will be provided once the Coordinator General has reviewed the project change. The table below provides an overview of proposed communication activities.

Proposed Communication Activities Prior to Construction	
Activity	**Details**
Key stakeholder briefings	Briefings will be offered to Botanic Gardens Management, Botanic Gardens volunteers and guides, Botanical Café, Crossway College, Mt Coot-tha Residents Group, Friends of Anzac Park, Mt Coot-tha Quarry, elected representatives and other parties as required.
Community Liaison Group briefing	Information will also be provided to the Western CLG members
Newspaper Advertisement	Quarterly construction update – information would be provided as a line item in the next update
Leaflets/ notifications	Information would be provided in the western monthly construction update
Conveyor factsheet	A fact sheet will be produced explaining the conveyor tunnel process
Website	The fact sheet will also be uploaded to the website

8.3. Community opportunity

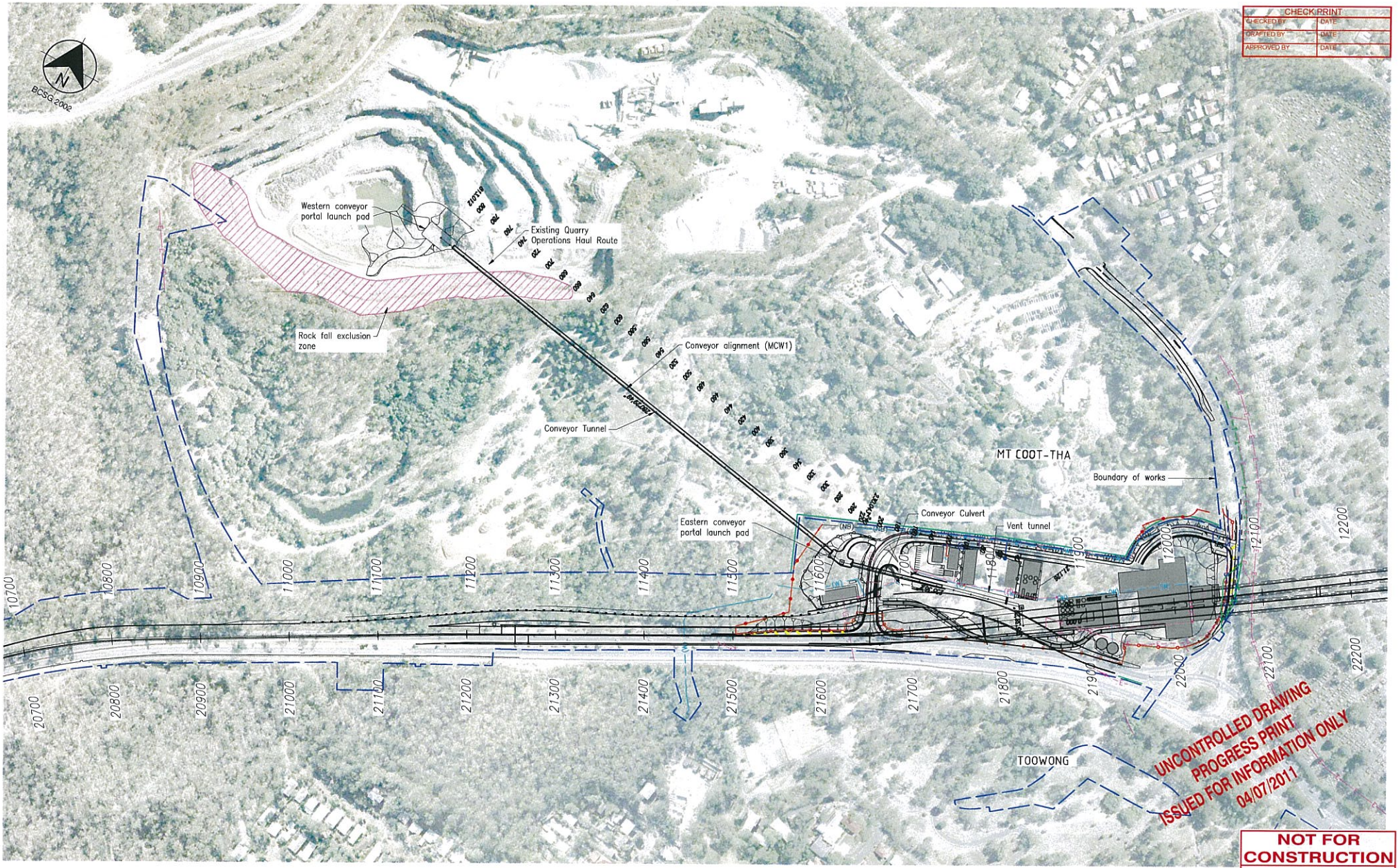
The proposed conveyor tunnel design provides the community a real tangible example of where Transcity have used design and construction innovations to minimise the impact on the surrounding residents and the environment.

The potential noise caused by the 24/7 operation of an overland conveyor has already been raised by representatives of local resident groups as a major concern. This concern is shared by residents living in close proximity to the western worksite in both Mt Coot-tha and Toowong.

The proposed conveyor tunnel provides not only a more direct route to the Quarry with reduced tree disturbance, but importantly provides enhanced noise and dust mitigation for local residents and businesses. This proposed change also represents a positive opportunity to demonstrate how Transcity has revised its operations to minimise impacts to the local community.

Appendix 1: Tunnel Conveyor Sketches

- CQ-2121-SK-01-0001 (A) – Conveyor Tunnel Layout Plan
- CQ-2121-SK-01-0002 (A) – Conveyor Tunnel Longitudinal Section Sheet 1 of 2
- CQ-2121-SK-01-0003 (A) – Conveyor Tunnel Longitudinal Section Sheet 2 of 2



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0 20 40 60 80m

Any coordinates shown on this drawing are to Brisbane City Survey Grid 2002 unless noted otherwise

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CONVEYOR TUNNEL LAYOUT PLAN

Drg No. CQ-2121-SK-01-0001 A

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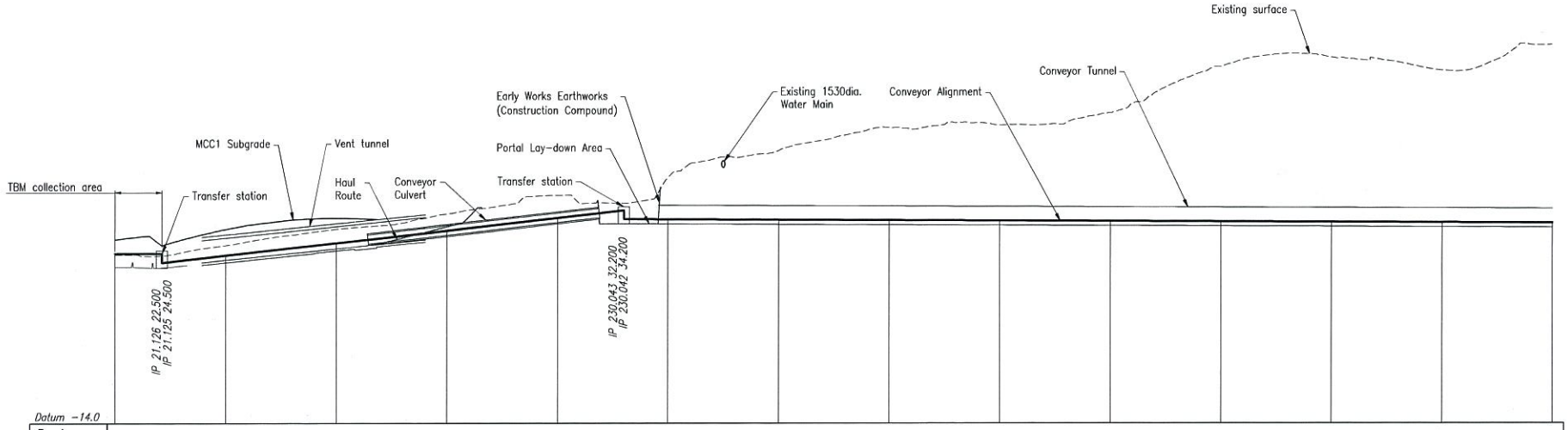

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Surface Height	24.230	26.365	30.066	33.441	37.806	43.669	47.697	52.999	53.455	56.227	66.689	68.840	65.903	71.737
Depth to Surface	0.27	−2.248	−3.149	−3.724	−5.289	−11.51	−15.641	−21.047	−21.606	−24.482	−35.048	−37.301	−34.468	−40.405
Horiz.Data														
Vert.Data	0 % 21.125m			5.6 % 208.916m						−0.207 % 580.418m				
Chainage	0	50	100	150	200	250	300	350	400	450	500	550	600	650
Superelev														

CONTROL LINE ALIGNMENT MCW1

Scale 1:500 Vert.
1:1000 Horiz.

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Horiz. 0 10 20 30 40m

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DRAWN BY: J.MCELLIGOTT
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MCW1 (CONVEYOR) SHEET 1 OF 2

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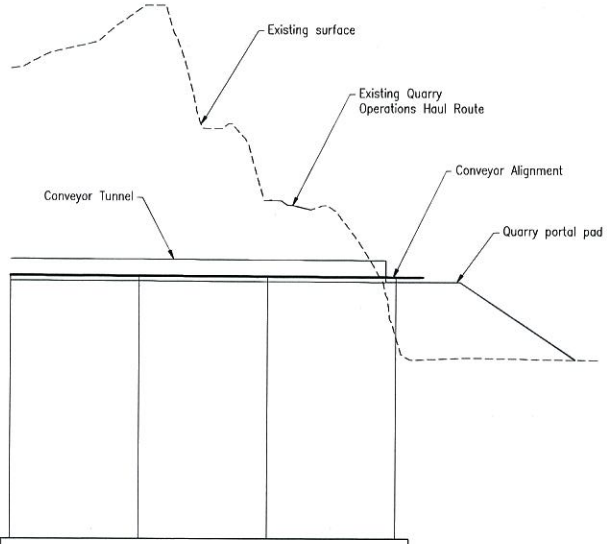

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Depth to Surface	−40.405	−52.007	−14.875	11.576	
Horiz.Data					
Vert.Data		−0.207 % 580.418m			
Chainage	650	700	750	800	813.012
Superelev					

CONTROL LINE ALIGNMENT MCW1

Scale 1:500 Vert.
1:1000 Horiz.

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Horiz. 0 10 20 30 40m

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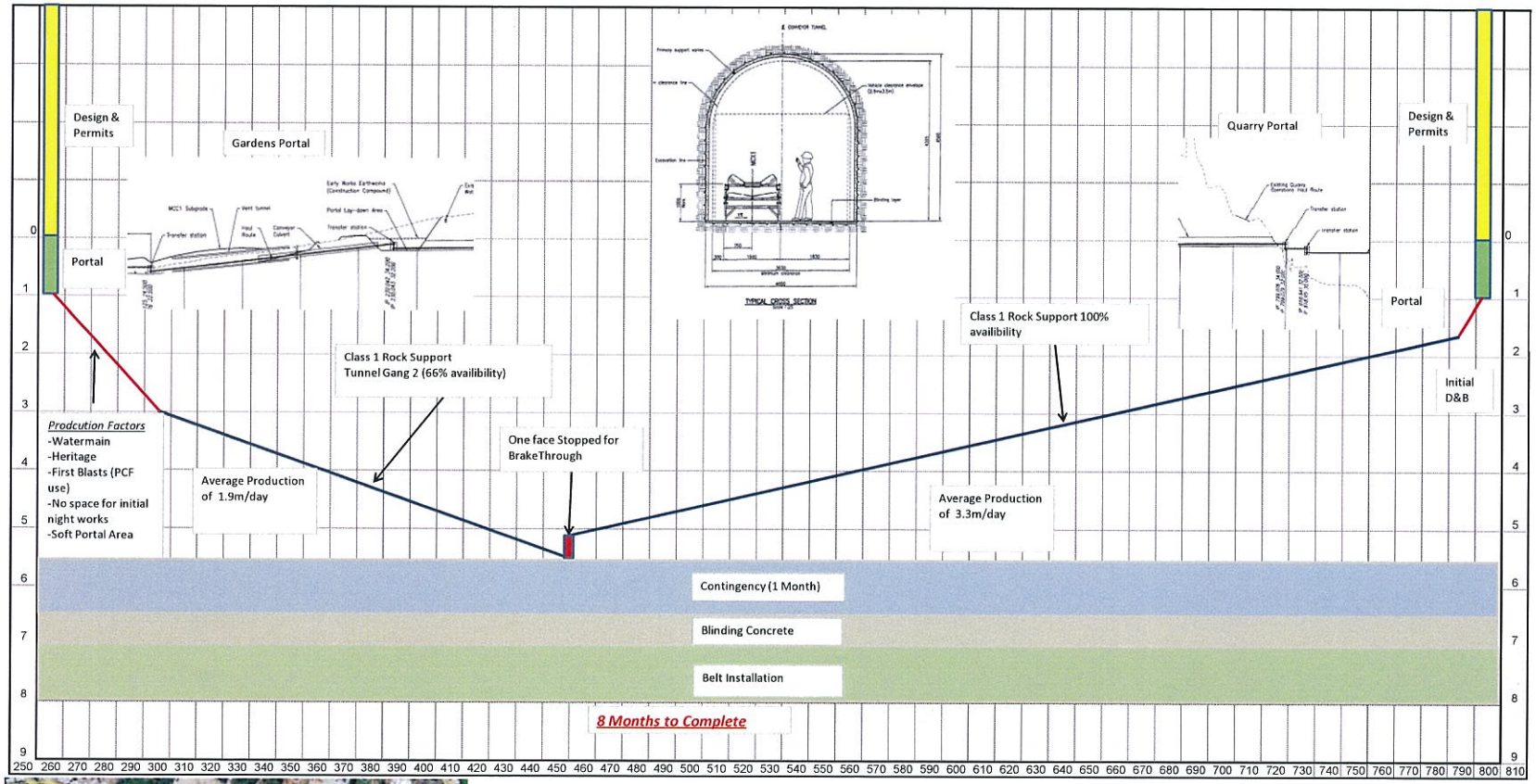
MCW1 (CONVEYOR) SHEET 2 OF 2

Drg No. CQ-2121-SK-01-0003 | A

Appendix 2: Program Schedule

- Conveyor Tunnel (Time Chainage)

Conveyor Tunnel (Time Chainage):



Comments:

- 90% Class 1 (50mm shotcrete & (2m by 1.75 by 1.75 Split Set bolts)
- 10% Rib Installation
- Slower production calculated for Freeway Portal (Incl Watermain / Initial blasts (PCF) & poor ground / night works)
- 100% availibility for crew from Quarry
- 66% availibility from Gardens crew
- 2 week break-through window left.