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20 September 2013

Julie McKee
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Dear Julie

Central Interceptor Main Project Works
Response to Section 41C RMA Direction

The Chairperson of the Independent Hearing Panel, Mr David Hill, has invited Watercare to provide further information in relation to two of the proposed Central Interceptor construction sites – Lyon Avenue and Keith Hay Park. The further information requested is set out in the document titled "S41C RMA Direction – Auckland Council Hearings Panel" dated 23 August 2013.

On 4 September 2013 Watercare confirmed that it would provide the further information requested by the Chairperson, and that it agreed to an extension to 24 September 2013 for the Panel to formally close the hearing.

Given the potential extent of work and significant cost to respond to the request in full, the timeframe, and the desire to conclude the hearing no later than 24 September 2013, our response is largely based on existing available information. In particular:

- In response to Item 4(a)(i), we have not carried out additional geotechnical investigations; and
- In response to Item 4(a)(v), we have undertaken a qualitative risk assessment based on inference from existing analysis and available information including Auckland Council's property files for the St Lukes Gardens Apartments.

We believe that this approach provides sufficient information to respond to the Commissioners' request, while not raising any new issues that need to be responded to by any submitter. The attached information has been prepared in direct response to the Chairperson's request and, to the extent possible, draws on existing information included in documents submitted with the Notices of Requirement and resource consent applications, and information presented at the hearing.

With regard to the Lyon Avenue site, a number of alternatives have previously been considered in this vicinity, and the latest alternative suggested by St Lukes Gardens Apartments is simply a further variation of alternative sites previously considered in Mount Albert Grammar School. In our view, there should be no opportunity given for further submissions from any other parties as a result of the Chairperson's request. As a result, the hearing can now be closed. Given the imminent notification of the Unitary Plan, if at all possible, it would be Watercare's strong preference for the decisions to be released before 30 September 2013.

Our response to the Chairperson's request is set out in the following attachments:

1 Response to further information requested in relation to the Lyon Avenue site, with the following supporting information:

   a) Drawings of proposed Lyon Avenue site and Mount Albert Grammar School Alternatives

   b) Memorandum from AECOM New Zealand Limited titled "CI – S41C Response – Technical Considerations Lyon Ave MAGS Alternative", 20 September 2013

   c) Memorandum from Arborlab Consultancy Services Limited titled "Arboricultural Memorandum – St Lukes", 19 September 2013

   d) Letter from Traffic Design Group Limited titled "Central Interceptor Project – Lyon Avenue Site (AS2): Access Options", 19 September 2013

   e) Correspondence from Ministry of Education

   f) Memorandum from Marshall Day Acoustics Limited titled "Lyon Ave site options assessment", 18 September 2013

   g) Memorandum from Tonkin and Taylor Limited titled "Central Interceptor Project – Technical report on settlement for site AS2 – S41C RMA Direction", 20 September 2013

   h) "Central Interceptor Main Project Works – Comparative assessment of proposed Lyon Avenue site and MAGS Alternative sites"

2 Response to further information requested in relation to the Keith Hay Park site, with the following supporting information:

   i) Amended drawing of proposed Keith Hay Park site – construction works plan (Drawing Number AEE-MAIN-7.2 Issue D)

As summarised in Attachment 1, the proposed Lyon Avenue site as set out in the August 2012 Notice of Requirement remains Watercare's preferred option for the Central Interceptor works at this location.

This letter and its attachments will shortly be available on Watercare's website, along with all of the evidence and legal submissions presented on behalf of Watercare at the hearing which are already on the website.

As the information requested by the Chairperson has now been provided, Watercare requests that the hearing is now formally concluded and that, if possible, a decision is released prior to 30 September 2013.

Yours sincerely

Belinda Petersen
Resource Consents Manager
Watercare Services Limited

ATTACHMENT 1

Response to further information requested in relation to Lyon Avenue site

Our response to the Chairperson's request for further information on the Lyon Avenue site is set out below, with reference to supporting information prepared by Watercare's technical advisors.

Each of the specific matters requested by the Chairperson is quoted in full (text in italics), followed by our response to each of those matters.

In respect of the matter of the two alternatives for the proposed Lyon Avenue (AS2) site - being the preferred site on the Roy Clements Treeway (RCT) and the Mt Albert Grammar School (MAGs) option proposed by Mr G. Maddren in evidence presented on behalf of St Lukes Garden Apartments Body Corporate (SLGA) – we have insufficient comparative information on which to review the adequacy of the preference. To that end we invite the applicant / requiring authority to consider providing the following [...]

Watercare's proposed works at the Lyon Avenue site are shown on Drawing Numbers AEE-MAIN-3.1 and 3.2 Issue D, attached.

An alternative site in the Mount Albert Grammar School (MAGS) was suggested by Mr G Maddren on behalf of the St Lukes Gardens Apartments (SLGA) at the hearing on 5 August 2013. We refer to this alternative as the "MAGS Alternative". There are a number of variations that could be developed for the MAGS Alternative, in particular, the connection between the existing infrastructure at the SLGA site and the new Central Interceptor tunnel could be pipe jacked or trenched. Different construction and permanent access arrangements could also be developed.

We have summarised the previous assessment of the proposed Lyon Avenue site in this response. We have also assessed two variations of the MAGS Alternative as these variations are considered more feasible than other possible combinations of site location and construction access options. Therefore, the three options assessed in this response to the Commissioners are:

- Watercare's proposed Lyon Avenue site
- MAGS Alternative 1 – pipe jacked option with construction access via SLGA and MAGS; and
- MAGS Alternative 2 – trenched option with construction access via MAGS only.

Drawings showing these options are attached. The new drawings showing construction layouts and tunnel alignment for the MAGS Alternatives are:

- LYON-SK1001 Issue C – Central Interceptor General – Mt Albert Grammar School Alternative 1 – Lyon Avenue (AS2) – Separate Construction Access (Pipe Jacked Option)
- LYON SK1101 Issue C – Central Interceptor General – Mt Albert Grammar School Alternative 2 – Lyon Avenue (AS2) – Construction Access From MAGS (Trenched Option)
- LYON-SK401_OA Issue B – Central Interceptor General – Mt Albert Grammar School – Lyon Avenue (AS2) – Tunnel Displacement

In the development of these construction layouts, we have aimed to reflect as far as possible the layout suggested by Mr Maddren. This includes developing a layout which avoids direct physical impact on the existing cricket nets. However we note that in doing so, the site is constrained, and if it were to be developed further, the footprint may need to be extended to create a more efficient construction site layout.

New drawings of permanent works layouts for the MAGS Alternatives have not been prepared, but the effects of the permanent works, including permanent access options, are included in the comparative assessments that have been undertaken.

Our Principal Engineering Advisor, AECOM, has prepared a technical memorandum commenting on the design, construction and operational issues associated with the MAGS Alternatives. This is attached.

(i) Sufficient geotechnical information to determine a practical location for and depth of a connecting pipe for a Mt Albert Grammar School ("MAGS") option.

A geological long section has been developed for the MAGS Alternatives. This is shown on the attached Drawings LYON-SK1001 and LYON-SK1101. The long section is based on existing information derived from boreholes undertaken by Tonkin and Taylor for other clients; publicly available borehole records sourced by Tonkin and Taylor; a borehole drilled at SLGA in 2009 as part of the Central Interceptor concept design; and the geological model developed for the Central Interceptor project. This level of geotechnical information is considered sufficient to determine a practical location and depth for a connecting pipe for the MAGS Alternatives.

(ii) An assessment of any required vegetation removal (including trees) for both options (including a description and number of mature trees requiring removal).

An assessment of the potential effects on trees arising from construction works at the proposed Lyon Avenue site was included in the Central Interceptor Main Project Works Assessment of Effects on the Environment (AEE) report, August 2012. The Aboricultural Assessment Report was included as Technical Report B of Part D of the AEE.

Arborlab has now also undertaken an assessment of the potential vegetation effects of the MAGS Alternatives, as requested by the Commissioners. Their memorandum is attached.

The table in Section 8.1 of their memorandum summarises the potential vegetation effects of the three options as follows:

	Lyon Ave site*	**MAGS alternative 1 – Pipe jack**	**MAGS alternative 2 – Open trench**
Number of trees removed	107	46 + 240m^2	54 + 240m^2
Number of trees WWRZ[1]	None identified	19	17
Number of trees retained**	None identified	47	39

* Refers to June 2012 Arborlab inventory
**Total number of retained trees includes all trees with WWRZ

[1] Works within the root zone

(iii) An assessment of the following, including realistic mitigation measures:

(a) the effect on the SLGA residents of all construction trucks passing through the SLGA internal private road;

(b) the option of providing construction-phase access through MAGs and operational-phase access through SLGA. For the MAGs phase this should include an assessment of the potential for disruptions to school functioning (e.g. for the existing driveway entrance on Alberton Avenue, and for sports activities); and

(c) the potential for disruptions to school functioning under the MAGS option both during construction and long term (e.g. for the existing driveway entrance on Alberton Avenue, and for sports activities). Mitigation measures in terms of location, access road surfacing, and shaft access lids (including surface treatment of the lids) should be considered.

Construction traffic effects in SLGA and MAGS

An assessment of the potential traffic effects of the proposed Lyon Avenue site was included in the Central Interceptor Main Project Works Assessment of Effects on the Environment (AEE) report, August 2012. The Traffic Impact Assessment was included as Technical Report E of Part D of the AEE. Further information was also provided in the Central Interceptor Main Project Works Section 92 Response Report to Auckland Council, December 2012, and in evidence presented at the hearing.

Alternative construction access options have also previously been considered, including construction access via Alberton Avenue and MAGS. The construction access options considered were summarised in a memorandum from AECOM dated 14 June 2013 and a letter from Traffic Design Group (TDG) dated 11 June 2013, both included in Attachment I of Belinda Petersen's primary statement of evidence at the hearing.

Based on the above information, TDG has prepared a more specific response to the Commissioners questions (iii) (a) and (b) above. Their response is attached. In summary, TDG has concluded that the proposed Lyon Avenue site and the MAGS Alternatives are all viable, but that access via Morning Star Place is the best access option from an overall traffic engineering perspective.

Potential disruptions to school functioning

General

The Crown owns most of the land required for the proposed Lyon Avenue site as well as the MAGS Alternatives. The land owned by the Crown is also designated for school purposes. A property access agreement and Requiring Authority approval from Ministry of Education (MoE) on behalf of the Crown would be required for any Central Interceptor works within the Crown land.

Neither MoE nor MAGS are a submitter in the current Resource Management Act proceedings. However, without their agreement, Watercare could not proceed with the proposed Lyon Avenue site, nor either of the MAGS Alternatives.

To assist with our response to the Commissioners question (iii) (c) above, we have sought further information from MoE and MAGS and have undertaken further site visits.

Both MoE and MAGS are opposed to a surface construction site in the MAGS playing fields and construction access via MAGS, but support in principle the proposed Lyon Avenue site as this is within an area of Crown land which is not used for school purposes.

The following recent correspondence from MoE is attached:

- Letter from MoE to Watercare dated 16 July 2013 – prepared in response to our earlier assessment of construction site and access options in MAGS; and
- E-mail from MoE to Watercare dated 3 September 2013 – prepared in response to information provided to MoE by Watercare in relation to the Commissioners Section 41C direction.

In summary, MoE is opposed to the construction works and access in MAGS for the following reasons:

- The works area required for an alternative site in MAGS is larger than the area of land required for the proposed Lyon Avenue site;
- MoE is considering future growth options for the school – the construction works would impact on consideration of options for this;
- The construction works may impact on MAGS own future building projects;
- Mitigation works can be implemented to address temporary adverse effects on the Roy Clements Treeway.

MOE also recently advised that MAGS will be building around 20 new classrooms on the site over the next three years in two or three different locations on the school site.

Construction access

The MAGS Property Manager has confirmed that the existing school access from Alberton Avenue via "Gate 1" is used for the following purposes:

- Maintenance access to the lower sports fields and cricket nets;
- Maintenance access to the School House boarding hostel ("School House");
- Access for maintenance and deliveries to the rear of the new sports pavilion; and
- Access to student parking areas at School House.

The response from TDG, attached, sets out possible mitigation measures that could be implemented to mitigate potential adverse effects on these activities if the MAGS access road was to be used for construction access.

Marshall Day has advised that a two metre high acoustic barrier would be required to achieve acceptable noise levels at School House.

We have assumed however that any construction access to the Central Interceptor surface construction site via MAGS could not be entirely fenced off from the school as access must be maintained for all of the activities noted above, as well as for emergency vehicles.

If the MAGS Alternatives were to be pursued, further detailed development and consultation with the school would be necessary in order to establish the required extent of physical works, fencing and other management measures to minimise potential disruptions to school functioning during construction.

Permanent works

For the MAGS Alternatives, the permanent features that would remain on the site are the access lids to the drop shaft and access shaft, and a permanent all-weather access road for future servicing and maintenance activities. As the area is known to flood, the shaft lids would need to be raised to an appropriate elevation and / or made watertight. Should the lids be raised, the surrounding land area could also be raised to tie in with the lid levels and prevent ponding of water at that location. Consideration would need to be given to prevent diversion of water exacerbating flooding in other areas of the playing fields.

The site area for the MAGS Alternatives is at the edge of the existing playing fields and immediately adjacent to the cricket nets. This construction site area would have less impact on recreational activities than other options in the MAGS playing fields previously assessed by Watercare. If the MAGS Alternatives were to be progressed, the levels of the shaft lids and surrounding ground would need to be assessed in more detail to ensure that potential effects on recreational activities were minimised.

A key consideration for any future school development is that no buildings could be constructed on the land above the access shafts as this area must be available in the long term for access, inspection and maintenance activities.

(iv) The noise effect on SLGA residents (and its duration) associated with the removal of basalt, taking into account the ability to use explosives and the geotechnical conditions for the shafts and connecting tunnel for both alternatives.

An assessment of the potential noise effects of the proposed Lyon Avenue site was included in the Central Interceptor Main Project Works Assessment of Effects on the Environment (AEE) report, August 2012. The Noise Impact Assessment was included as Technical Report F of Part D of the AEE. Further information was also provided in the Central Interceptor Main Project Works Section 92 Response Report to Auckland Council, December 2012, and in evidence presented at the hearing.

Marshall Day has now also undertaken an assessment of the potential noise effects of the MAGS Alternatives, as requested by the Commissioners. Their memorandum is attached.

In summary, their conclusion is that in terms of noise impact, the MAGS Alternative – pipe jacked option is preferable to a trenched option. Marshall Day has also concluded that the proposed Lyon Avenue site is preferred over the MAGS Alternatives as the predicted construction noise levels overall are lower for the SLGA apartments and playing fields, and the proposed site avoids the need for construction access adjacent to the dormitories at School House.

(v) A quantified risk assessment of the potential for ground settlement adversely affecting the SLGA buildings during construction of the tunnel and shafts for both alternatives.

Given the potential extent of work and timeframe required to undertake a quantitative risk assessment, a qualitative risk assessment has been undertaken. The assessment is based on inference from existing analysis and available information including Auckland Council's property files for the St Lukes Gardens Apartments.

The attached letter report from Tonkin and Taylor provides estimates of potential settlement that might arise as a result of construction activities for the proposed Lyon Avenue site and the MAGS Alternatives. Based on these estimates, AECOM has separately prepared an assessment of the potential for the settlement to adversely affect the SGLA buildings.

In summary, the work undertaken by Tonkin and Taylor and AECOM concludes that:

For the proposed Lyon Avenue site:

- The differential movements between building pads of SLGA are estimated to be less than 5mm, equivalent to a distortion of less than 1:3000; well below the commonly applied limit of 1:2000 and highly unlikely to be noticeable or cause anything other than minor cosmetic effects, even at the more sensitive parts of the building.

- The estimated settlement levels would be within the limits of the proposed consent conditions, but would trigger other requirements of the consent conditions relating to building condition surveys, analysis, monitoring, implementation of trigger levels and contingency planning.

For the MAGS Alternative sites:

- The main drop shaft and access shaft on the MAGS playing fields are far enough away from the SLGA buildings so as to cause no settlement risk to SLGA buildings. Similarly construction of the diversion chamber and trenching between the diversion chamber and intermediate drop shaft (for the pipe jacked option) or connection chamber (for the trenched option) are relatively shallow and will have no significant impacts on the deeper groundwater or cause settlement to the SLGA buildings.
- Because the intermediate drop shaft associated with the pipe jacked option will need to extend below the basalt it will draw down groundwater in the Puketoka Formation. The potential settlement effects of constructing an intermediate drop shaft near the existing Lyon Avenue overflow for the pipe jacked option will be similar to the effects of shaft construction for the proposed Lyon Avenue site. The effects of this drop structure on the Block B and Block C areas will be similar to the proposed Lyon Avenue site; i.e. negligible.

(vi) A Multi Criteria Analysis ("MCA") of the two alternatives, incorporating the above matters, any other matters considered relevant, and including estimated costs (capital and O&M) for shafts, connecting pipe and diversion chamber.

The multi-criteria analysis of the three options is presented in the attached table titled "Central Interceptor Main Project Works – Comparative assessment of proposed Lyon Avenue site and MAGS Alternative sites". The table summarises relevant information set out in documents submitted with the Notices of Requirement and resource consent applications, and information presented at the hearing, in this letter and in the technical attachments. The format of the table is similar to the format we have used for previous assessments at this site and other sites, but has been modified slightly and expanded to ensure that all matters raised by the Commissioners are addressed.

Having regard to the information presented in the comparative assessment table, the proposed Lyon Avenue site as set out in the August 2012 Notice of Requirement remains as Watercare's preferred option for the Central Interceptor works at this location. Key considerations are as follows:

- All three options are technically feasible and are of a similar order of cost.
- The proposed Lyon Avenue site is in the optimal location for connection to the Lyon Avenue overflow.
- The MAGS Alternatives require additional structures (intermediate drop shaft and connection chamber), with additional design complexities and maintenance requirements.
- The MAGS Alternatives would still require considerable construction activity, and associated potential effects, in the vicinity of SLGA, but would extend these effects to also impact on MAGS activities, students and residents of School House.
- The MAGS Alternative 1 – pipe jacked option, would reduce potential construction traffic volumes on Morning Star Place. Construction access would still be required via this road unless access is provided solely via Alberton Avenue, MAGS Gate 1 and a vehicle bridge across Meola Creek.
- Access via Alberton Avenue and MAGS Gate 1 would avoid or reduce potential traffic effects through the SLGA residential area, but would instead impact on the residents of School House and on access for other school activities.

- The MAGS Alternatives would have less overall impact on the vegetation in the Roy Clements Treeway compared to the proposed Lyon Avenue site, but would still require large areas of vegetation removal, particularly for the MAGS Alternative 2 – trenched option.
- The cost differential in favour of the MAGS Alternative 2 – trenched option with construction access via Alberton Avenue and MAGS Gate 1, is not sufficient to outweigh the potentially increased land requirements, construction complexities and environmental effects associated with this option, particularly the increased effects on Meola Creek.
- The potential settlement risks at the SLGA apartments are similar for the proposed Lyon Avenue site and the MAGS Alternative 1 – pipe jacked option.
- Permanent works associated with the proposed Lyon Avenue site would not impact on future development options for MAGS. The site can be reinstated to integrate with the Roy Clements Treeway, with potentially enhanced pedestrian access and safety compared to existing.

ATTACHMENT 2

Response to further information requested in relation to Keith Hay Park site

Our response to the Chairperson's request for further information on the Keith Hay Park site is set out below. The specific matters requested by the Chairperson are quoted in full (text in italics), followed by our response.

In the matter of the Keith Hay Park (AS5) site on Gregory Place:

(i) Confirmation of the mitigation measure(s) that are to be adopted with respect to:

(a) Mr and Mrs Whitehead at 18 Gregory Place, and

(b) Mr and Mrs Puertollano at 47A Arundel Street.

The potential noise mitigation measures to be implemented on the project are outlined in documents submitted in support of the Notices of Requirement and consent applications. The sections relevant to the noise mitigation measures at the Keith Hay Park site are:

Document title	**Relevant section**
Central Interceptor Main Project Works Assessment of Effects on the Environment (AEE) report, August 2012, Part A	Section 12.8 on page 121
Central Interceptor Main Project Works Assessment of Effects on the Environment (AEE) report, August 2012, Part B	Section 7.5.8.2 on page 109
Central Interceptor Main Project Works Assessment of Effects on the Environment (AEE) report, August 2012, Part D	Technical Report F – Noise Impact Assessment - Section 4.5.7 on pages 47 – 49 - Appendix 5 Draft Construction Noise Management Plan
Central Interceptor Main Project Works Section 92 Response Report to Auckland Council, December 2012	Attachment 7, letter from Marshall Day Acoustics Limited, response to Question (4) on page 3 and Table 1 on page 7
Primary statement of evidence of Mathew Cottle, Marshall Day Acoustics, 12 July 2013	Paragraphs 6.8 – 6.11, 6.47 – 6.49, 8.43 – 8.50

The layout of the proposed construction site incorporates a 3 metre high noise fence around the site boundary. The dwellings at 18 Gregory Place and 47A Arundel Street are two storied, so the fence alone is not sufficient for noise mitigation and other measures will need to be adopted to ensure noise levels are reasonable. The potential mitigation measures that have been identified in the above documents are:

a) Communications and consultation with residents in advance of, during and after the works
b) Contractor to maintain tight construction timeframes and keep construction to a minimum
c) Contractor to use construction methods and equipment which results in lowest practicable noise levels, including regular maintenance of construction equipment
d) Contractor to manage day to day construction practices to avoid unnecessary noise nuisance (e.g. use of horns, air brake release noise, reversing alarms)
e) Temporary noise barriers around specific items of equipment such as the piling rig if practicable
f) Arrange a suitable time with residents to carry out short term noise intensive works when dwellings are unoccupied

g) Activities not complying with the Construction Noise Standard be restricted to Monday to Friday and do not occur on Saturdays
h) Consideration of other measures requested by affected residents when they can be reasonably met.

The specific mitigation measures to be adopted at the site will be reviewed and confirmed once the detailed design is complete and a contractor appointed, and in consultation with adjacent property owners. The detailed design or construction method finally confirmed may result in effects which are different (hopefully less) than those assessed to date, therefore it is sensible to retain flexibility to adopt mitigation measures which properly reflect the final details of the proposed work.

Watercare's aim is to implement construction methods, programming and physical noise mitigation measures within each site to achieve compliance with the NZS6803:1999 Construction Noise Standards. If full compliance is not possible, we would then look at other mitigation options as identified in the documents referred to earlier. In a worst case situation, this could include acoustic treatment of adjacent dwellings (for example if significant exceedance of the Construction Noise Standards are predicted for extended durations). Marshall Day has advised that this could include retrofitting laminated glazing and insulation of external walls facing the construction site. As this type of measure would involve intrusive works, any acoustic treatment at individual dwellings would need to be agreed by both parties.

In relation point (h) above, Watercare has been consulting with Mr and Mrs Whitehead and with Mr Puertollano in relation to the proposed works. In response to a specific request from Mr Whitehead, a minor change has been made to the location of the proposed noise fence in the north eastern corner of the site. The noise fence had been shown as following the designation boundary in this area, but has now been amended so that it is a minimum of 5 metres from the property boundary and closer to the main construction site area. The amended Drawing Number AEE-MAIN-7.2 Issue D is attached.

Watercare has also been discussing other potential noise mitigation measures with Mr and Mrs Whitehead and with Mr Puertollano. The intent of the current discussions is to establish an agreed process for confirming the need for acoustic treatment at the dwellings and, if so, the process to implement that. This process will include notifying the property owners six months prior to commencement of work, and then reviewing at that time the need and options for acoustic treatment based on the confirmed construction method.

SUPPORTING INFORMATION

Plot Date: 18-Jul-13 3:03 p.m.
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Project No.

ISSUE	DATE	AMENDMENT	BY	APPD.
D	18/7/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
C	12/07/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
B	28/05/13	CONSENT ISSUE - DESIGNATION BOUNDARY/ACCESS REVISED	AP	PR
A	17/08/12	CONSENT ISSUE	AP	PR

DESIGNED	NL		
DES. CHECKED	JS	-	
DRAWN	AP		
DWG. CHECKED	NL	-	
REV'D P.MGR	JS		
APP'D P.DIR	CC		
BY		DATE	

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

AEE JULY 2013

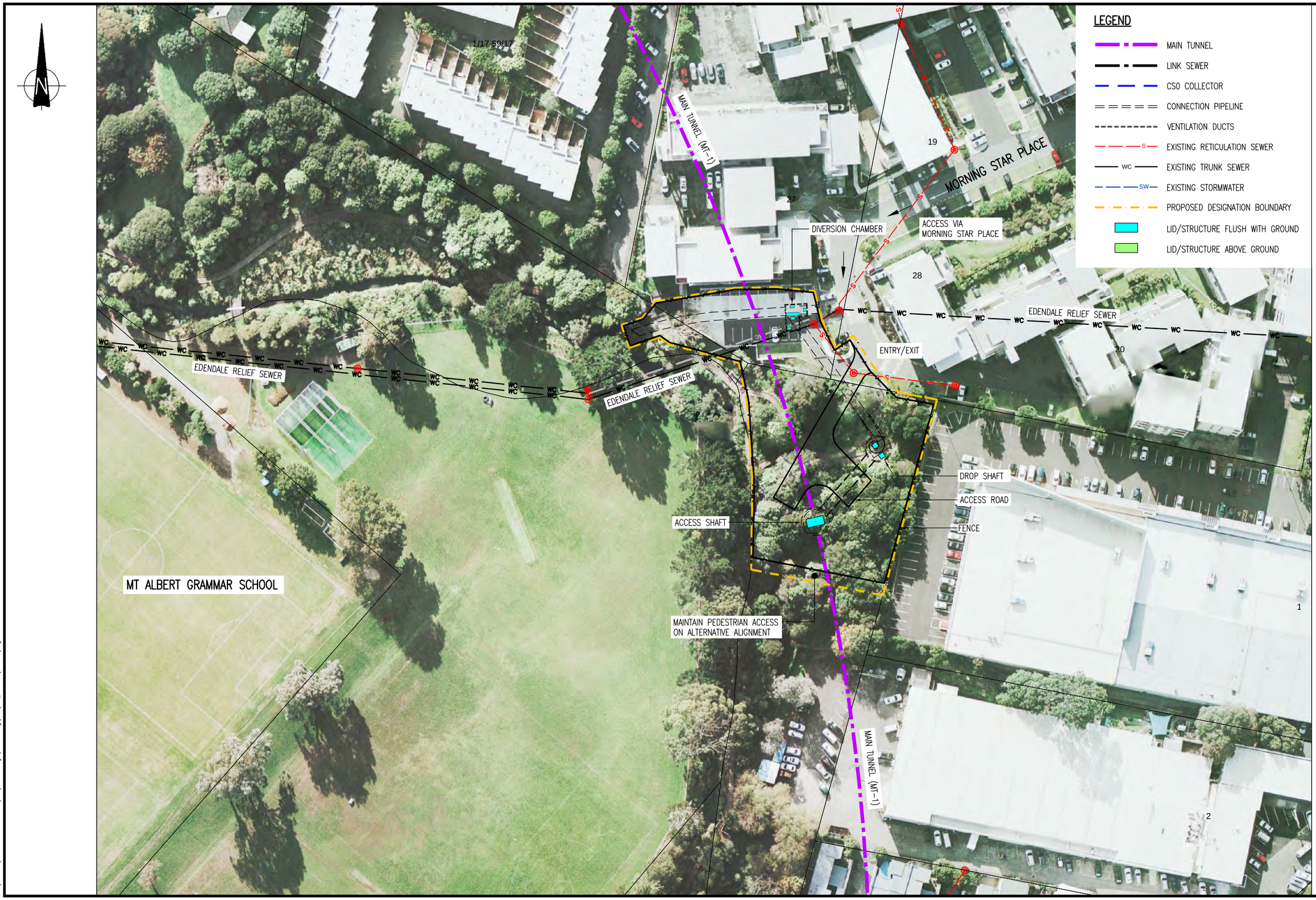
water Care services limited

CENTRAL INTERCEPTOR
GENERAL
LYON AVENUE (AS2) - PERMANENT WORKS PLAN

CAD FILE AEE-MAIN-3.1_D | DATE 18-Jul-13

ORIGINAL SCALE A1 1:1000 A3 | CONTRACT No. 0538

DRAWING No. AEE-MAIN-3.1 | ISSUE D



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ISSUE	DATE	AMENDMENT	BY	APPD.
D	18/7/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
C	12/07/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
B	28/05/13	CONSENT ISSUE – DESIGNATION BOUNDARY REVISED	AP	PR
A	17/08/12	CONSENT ISSUE	AP	PR

DESIGNED	NL	
DES. CHECKED	JS	–
DRAWN	AP	
DWG. CHECKED	NL	–
REV'D P.MGR	JS	
APP'D P.DIR	CC	
	BY	DATE

Project No.

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

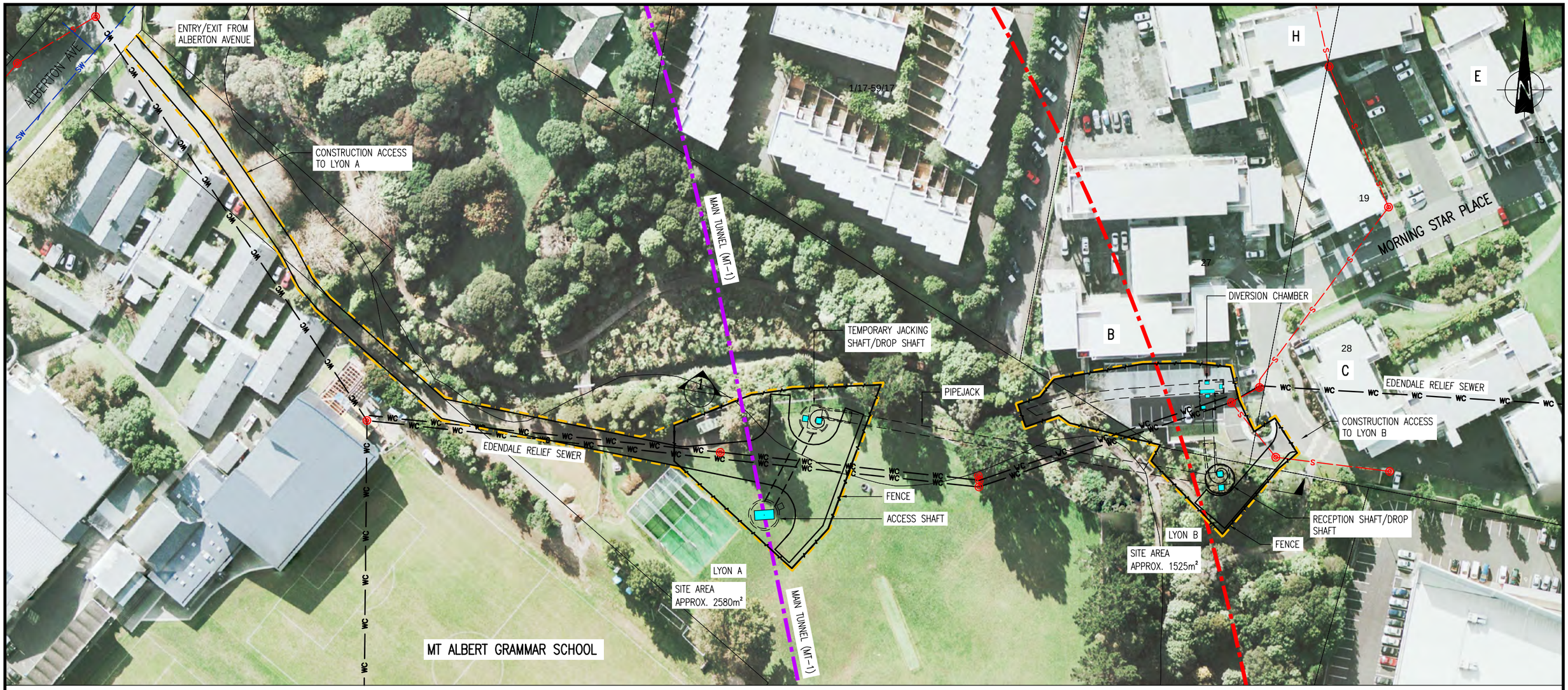
AEE JULY 2013

CENTRAL INTERCEPTOR
GENERAL
LYON AVENUE (AS2) – CONSTRUCTION WORKS PLAN

CAD FILE AEE-MAIN-3.2_D | DATE 18-Jul-13

ORIGINAL SCALE A1 1:1000 A3 | CONTRACT No. 0538

DRAWING No. AEE-MAIN-3.2 | ISSUE D

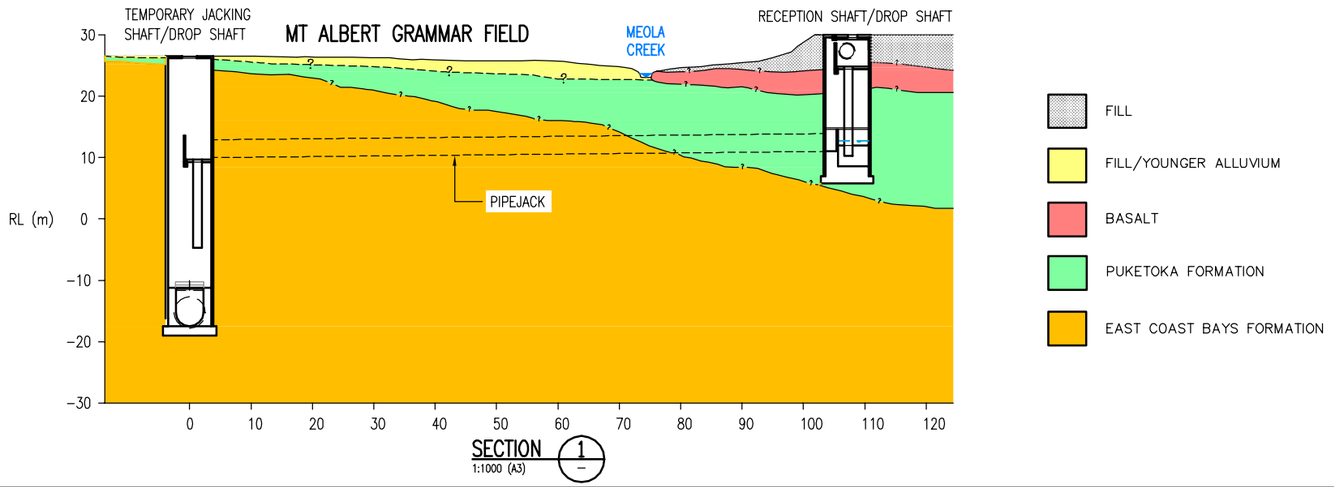


LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER (S)
- EXISTING TRUNK SEWER (WC)
- EXISTING STORMWATER (SW)
- PROPOSED SITE BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND

NOTES:

1. SEE DRAWING LYON-SK401_0A FOR PLAN OF TUNNEL ALIGNMENTS FOR LYON AVE SITE OPTIONS.



SECTION 1/– 1:1000 (A3)

ISSUE	DATE	AMENDMENT	BY	APPD.
C	19/09/13	LEGEND UPDATED	AP	JQC
B	17/09/13	FOR INFORMATION	AP	JQC
A	–	DRAFT	AP	PR

DESIGNED	NL	
DES. CHECKED	JQC	–
DRAWN	AP	
DWG. CHECKED	NL	–
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
	BY	DATE

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

water Care services limited

CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 1
LYON AVENUE (AS2) – SEPARATE CONSTRUCTION ACCESS (PIPEJACK OPTION)

CAD FILE LYON-SK1001	DATE 19-Sep-13
ORIGINAL SCALE A1 1:1000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK1001	ISSUE C

Project No.

Plot Date: 19-Sep-13 9:26 a.m.
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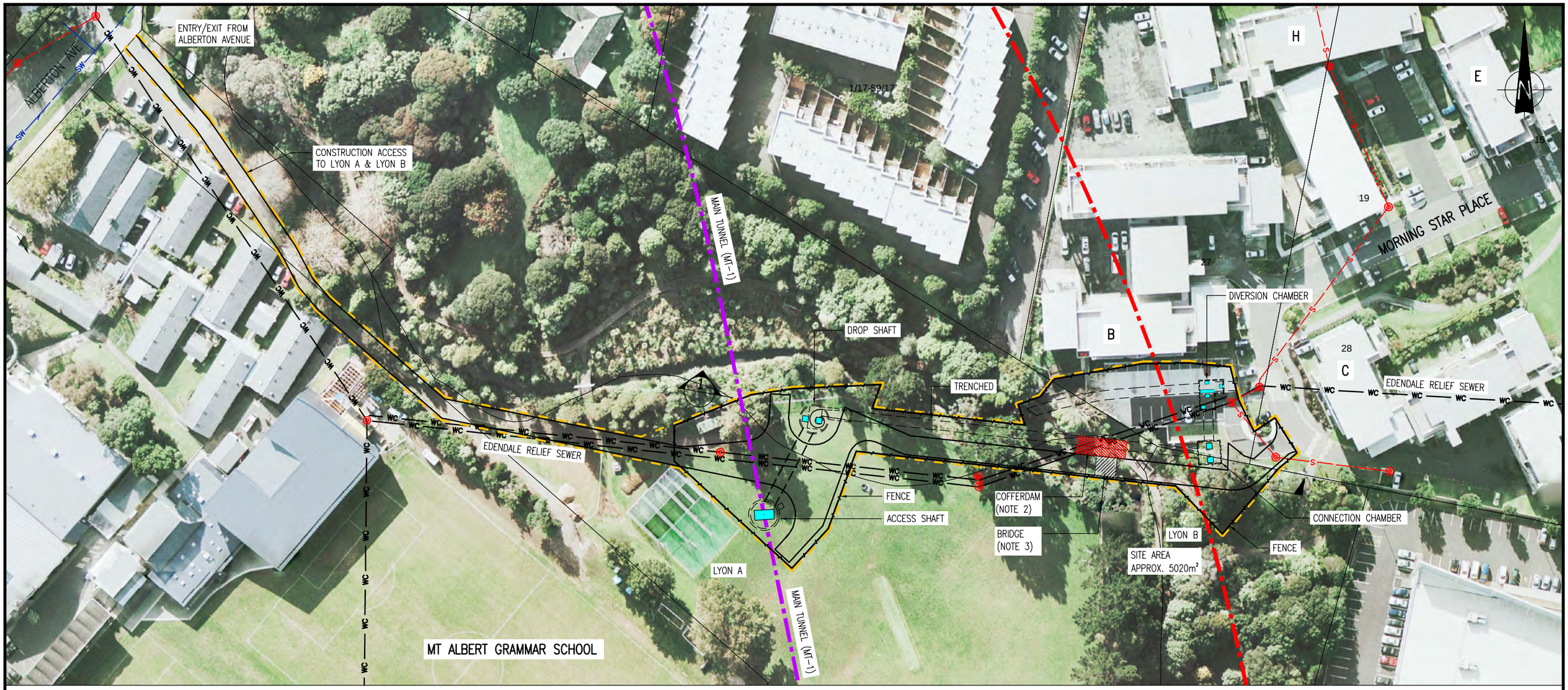
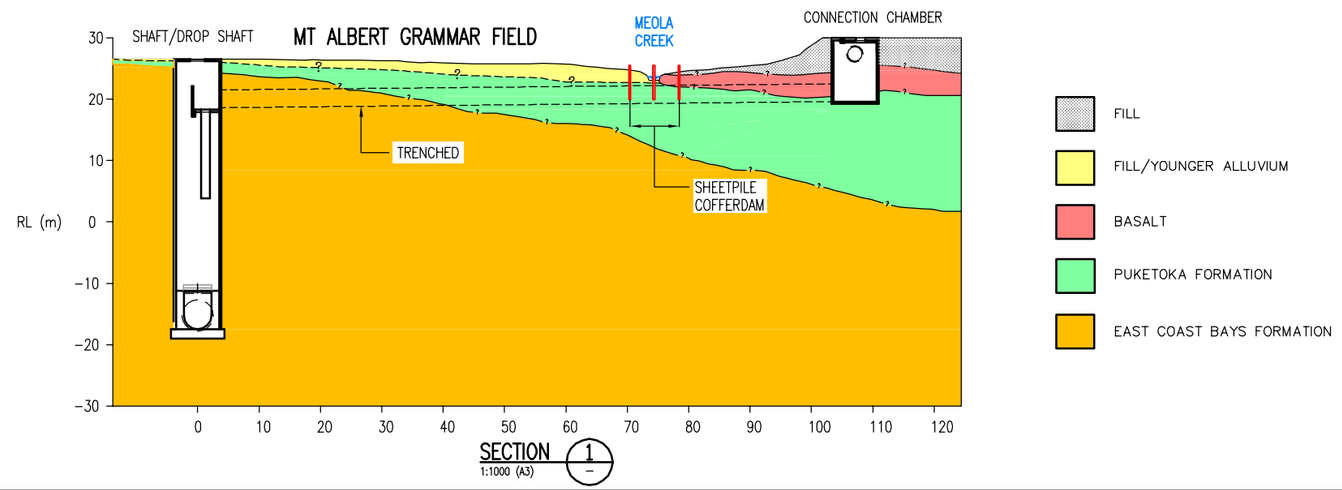


LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
- PROPOSED SITE BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND

NOTES:

1. SEE DRAWING LYON-SK401_0A FOR PLAN OF TUNNEL ALIGNMENTS FOR LYON AVE SITE OPTIONS.
2. MEAOLA STREAM TO BE DIVERTED LEFT AND THEN RIGHT WITHIN SHEETPILE COFFERDAM TO ALLOW CONSTRUCTION OF TRENCH AND PIPE LAYING. FOOTPATH TO BE DIVERTED.
3. BRIDGE REQUIRED FOR ACCESS ACROSS STREAM (EITHER PERMANENT OR TEMPORARY, DEPENDING ON ACCESS ARRANGEMENTS).



SECTION 1 — 1:1000 (A3)

Plot Date: 19-Sep-13 9:25 a.m.
File path: P:\0538 - Central Interceptor\11.0 Compiled Drawings\3_AS2_Lyon Ave\Alternatives-Options

ISSUE	DATE	AMENDMENT	BY	APPD.
C	19/09/13	LEGEND UPDATED	AP	JQC
B	17/09/13	FOR INFORMATION	AP	JQC
A	–	DRAFT	AP	PR

Project No.

DESIGNED	NL	
DES. CHECKED	JQC	–
DRAWN	AP	
DWG. CHECKED	NL	–
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
BY		DATE

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

water Care services limited

CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 2
LYON AVENUE (AS2) – CONSTRUCTION ACCESS FROM MAGS (TRENCHED OPTION)

CAD FILE LYON-SK1101	DATE 19-Sep-13
ORIGINAL SCALE A1 1:1000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK1101	ISSUE C

LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- CORRIDOR

Plot Date: 17-Sep-13 9:55 a.m.
File path: P:\0538 - Central Interceptor\11.0 Compiled Drawings\3_AS2_Lyon Ave\Alternatives-Options

ISSUE	DATE	AMENDMENT	BY	APPD.
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DWG. CHECKED	NL	–
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
	BY	DATE

Project No.

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

water Care services limited

CENTRAL INTERCEPTOR
MT ALBERT GRAMMAR SCHOOL ALTERNATIVE
LYON AVENUE (AS2) – TUNNEL DISPLACEMENT

CAD FILE LYON-SK401_0A	DATE 17-Sep-13
ORIGINAL SCALE A1 1:5000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK401_0A	ISSUE B

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Memorandum

To	David Ward	Page	1
CC	Belinda Petersen / Peter Roan / Zahni Hefferon		
Subject	CI - S41C Response - Technical Considerations Lyon Ave MAGS Alternative Rev D		
From	John Q Cooper		
File/Ref No.	60102004 3.5	Date	20-Sept-2013

David, Belinda

1. Introduction

Watercare is preparing a response to the Central Interceptor Main Project Works Hearing S41C which will include a comparison of the proposed Lyon Avenue site and an alternative site in the Mount Albert Grammar School (MAGS) grounds. This memo provides a commentary of design, construction and operational issues associated with the MAGS Alternative site.

There are two methods available for connecting the existing Lyon Avenue overflow to the shafts at the MAGS Alternative site; pipejacking or trenching. These two methods dictate the extent of the works and influence the access requirements as shown on the Drawing No's LYON-SK1001 Rev C and LYON-SK1101 Rev C (attached).

The Commissioners have also requested a more detailed risk assessment of the potential for ground settlement adversely affecting the SLGA buildings during construction for the proposed Lyon Avenue site and the MAGS Alternative.

Existing geotechnical information has been assessed by Tonkin & Taylor (T&T) to help define the extent of basalt in this area, which is a key influence on the arrangements to connect the existing Lyon Avenue overflow to the MAGS Alternative site. The geology also affects the assessment of settlement risk. Figures 1 and 2 (attached) summarise the interpretation of the local geology.

2. MAGS Alternative

2.1 Design

The attached drawings show the access and drop shaft arrangements within the MAGS Alternative site. The configuration is similar to the proposed Lyon Avenue site, with a connecting de-aeration tunnel at depth. The drop shaft must be connected to the existing Lyon Avenue overflow and across Meola Creek. We have considered two options for this: trenching across Meola Creek or connecting at a greater depth below the stream using a jacked pipe; both options are technically feasible from an engineering point of view.

In using a jacked option it is necessary to lower the connection pipe below the basalt which requires an intermediate drop structure between the diversion chamber at the Lyon Avenue overflow and the main drop shaft. This shaft will also serve as a reception pit to receive the pipejack advancing uphill from the MAGS Alternative site. For the trenched option the pipe would be set higher and would require excavation in basalt, temporary diversions of the stream and an additional connection chamber to redirect the flows across to the MAGS drop shaft.

The following points highlight the permanent works design issues associated with the MAGS Alternative site compared with Watercare' s proposed Lyon Avenue site:

1. An additional diversion chamber or drop structure is introduced with associated changes in flow direction, adding to the complexity of the hydraulics and gate configuration. If pipe jacked, the initial drop structure must be deep enough for the pipejack to pass under the basalt.
2. For the pipejack option, flows enter the main drop shaft at greater depth, adding complexity to the design of the drop structure.
3. The main CI tunnel alignment will be moved laterally at Lyon Ave. by approximately 110m resulting in a reduction in tunnel length of about 65m.
4. The alternative shaft location in the MAGS sports fields is in an area that is known to flood, and as such the shaft lids will need to be lifted to an appropriate elevation and / or made watertight. The surrounding area could also be raised so that the lids remain flush with the ground if desirable.

2.2 Construction

Connecting the Lyon Ave overflow to the MAGS Alternative site via a pipe laid in trench would require a 2.7m diameter pipe to cross Meola Creek. The envisaged method for this would entail diverting the stream to one side in a new channel, probably formed using sheet piles, and putting the stream back to its original course over the top of the laid pipe. The Roy Clements Treeway walkway would also have to be temporarily diverted. The working area to lay the pipe and accommodate the diversions has been included in the extent of the MAGS Alternative site area and required tree removal.

Two access options are shown on the attached drawings (LYON-SK1001 Rev. C & LYON-SK1101 Rev. C); it is possible to undertake construction works for the two options involving works in the MAGS site from Alberton Ave. via MAGS Gate 1 which passes beside the school hostel. This would require a bridge across the Meola Creek, likely designed as a single lane, say 3.5m wide and set high enough so as not to impede flows.

The pipejack option does not require the two work sites to be connected to undertake the works. Using Alberton Ave. to access both sites for the pipejack connection arrangement would add additional costs for a bridge and increase the size of the land needed compared with the pipejack option layout shown on LYON-SK1001 Rev. C.

The main drop shaft and access shafts for the MAGS Alternative site would be of similar size to the proposed Lyon Avenue site but are now located outside the edge of the surface layer of basalt which does not extend to the west of the Meola Creek, making them easier to construct.

Sinking of the two main shafts at the MAGS Alternative site will not require blasting as the basalt is absent here. Sheet pile cofferdams are the most likely form of construction, with associated noise generation. Installation of piles by vibration rather than hammers is likely to be needed to manage noise.

Works will be required in the stream bank immediately adjacent to the sports field fence to provide sufficient separation of the two shafts and to keep the MAGS Alternative site away from the existing cricket nets. The current access roadway through MAGS is too narrow for two way construction traffic without widening. The school dormitories are located immediately adjacent to the existing access track and the clearance between existing dormitories and the top of the stream bank ranges from 5m to 7m. Approximately 9m is preferred for a two way road.

The widening of the track will require removal of trees and installation of retaining walls on the stream side using gabions or more likely timber pole walls, possible without narrowing the watercourse. It will also need to be resurfaced. Due to the close proximity of dormitories to the road, there is risk of damage to the dormitories from heavy construction traffic impacting the walls or repeated vibrations affecting the footings.

There is insufficient space to allow a separate walkway alongside these buildings and there are a number of parking bays and side roads off the existing road. It is likely that Gate 1 access road will need to be shared with school vehicles going to the parking area by the residents, the service roads and the school

fields. As well as noise and traffic impacts, this creates a risk for pedestrians and students and would require safety measures be put in place.

It is possible to put a 2m fence alongside the road and hard up against the residence buildings on the western side of the access road. This will serve to reduce noise. Steel posts will be used to provide protection for the dormitory buildings adjacent the access road, as well as providing separation between pedestrians and the access road.

Any fencing would also need to ensure emergency vehicles can access the school buildings.

Use of the MAGS Alternative site effectively splits the construction activities into two areas for both a pipejack and a trenched option. This will make scheduling the work more difficult and lead to some increase in costs. The quantities of work for the MAGS Alternative site would take approximately 6 months longer than the preferred Lyon Avenue site works if all activities were sequential. To offset this increase in construction period more activities can be scheduled to be concurrent but this can increase costs. We would recommend that the allowed construction time for the MAGS Alternative site is increased by 2 months, to 14 to 20 months, compared with 12 to 18 months for the preferred Lyon Avenue site. The total occupation time would remain the same, 3 years.

2.3 Costs

Table 1 presents a summary of the likely cost differential for the MAGS Alternative compared with the proposed Lyon Avenue site. The unit rates for this cost comparison are taken from the current Engineer's estimate and are hence directly comparable.

Table 1: Estimated cost differential for the MAGS Alternative site compared with the proposed Lyon Avenue site

MAGS Alternative site Items	Direct costs (NZ$)
Increase to P&G's for split sites and more extensive site (+20%).	+$25,000
Additional length of connection pipeline (trenched) including stream diversions and access bridge. (60m @ $7400 + diversion @ $40,000).	+$480,000
Additional costs associated with pipejack connection. (60m @ $8900).	+$538,000
Connection chamber (trenched).	+$160,000
Intermediate drop structure (pipejack).	+$330,000
Saving on basalt excavation at main drop and access shafts.	-$60,000
Additional operational access and inspection provisions.	+$50,000
Additional costs for site and access road widening.	+$150,000
Allowance for additional hydraulic (possibly physical) modelling.	+$90,000
Cost differential for MAGS Alternative 1 – Pipe jack option.	**+$1,123,000**
Cost differential for MAGS Alternative 2 - Trenched option.	**+$895,000**
Saving from reduced length of Main tunnel (65m @ $18,000).	-$1,170,000
Additional operating costs (annual inspection would take approx. twice as long and access difficulties would require remote camera usage).	$20,000 pa

Note. Direct costs only, based on Engineers estimate Aug. 2011.

The table indicates that the additional direct costs of constructing at the MAGS Alternative site are in the range of $0.9M to $1.1M using the current estimates rates. However, this is entirely offset by the saving in length of the tunnel resulting from shifting it westwards by 110m on the inside of a curve. On this basis

Watercare may assume that cost is not a factor in comparing the proposed Lyon Avenue site to the MAGS Alternative, given the level of accuracy of cost estimating at this stage.

2.3 Operational

The introduction of a deep connection from the spillway to a drop structure in the MAGS Alternative 1 – pipe jack introduces new operational and maintenance issues for Watercare. An additional drop structure would be introduced to the arrangement requiring inspection and maintenance down to about 12m deep. It also means that the main drop shaft enters the shaft at a similar depth, well below ground level and requiring additional provisions for entry to inspect the structure. Confined space entries for drop shaft structures create an additional safety hazard.

An all-weather trafficable access road will be required across MAGS playing fields for occasional inspection and maintenance activities at the two shafts. This will need to be sufficiently large to allow a mobile crane access to remove lids and place equipment into the shafts.

3. SLGA Ground Settlement Risk Assessment

A qualitative assessment of ground movements associated with the construction works has been completed by T&T. This assessment estimates ground settlement as a result of changes in groundwater levels and associated with deformation around shafts and underground openings.

Estimating the settlement profile around the proposed Lyon Avenue site works allows the response of the existing buildings to be considered with knowledge of the types of building foundations and nature of the structures. As-built foundation drawings have been obtained from Council records for SLGA blocks A, B and C. These records are dated April 2003, and our assessment of potential ground settlement effects is made on the basis of their original condition. We have not undertaken a detailed condition assessment or inspection of the SLGA blocks as part of this assessment.

Proposed Lyon Avenue site

Table 3 of T&T's letter (Ref. 29200 19th Sept. 2013) estimates settlements generated by a combination of consolidation of the Puketoka soils, elastic deformation of the construction shaft walls and volume loss from the main tunnel below. The content of this report is not repeated here, however, the estimated settlement contours have been overlain onto the building (Blocks A to C) footprints in Figure 3 attached. The settlement estimates assume a substantially watertight shaft excavation method. These values are a worse case as the assumptions do not allow for additional mitigations measures to control groundwater levels such as groundwater recharge between the shaft location and the SLGA blocks, nor does it account for the bridging effect of the basalt which lies between the consolidating Puketoka layer and the block foundations.

Block C is the closest to the Lyon Avenue site shaft location (25m at the closest point). The building is founded on pads which support columns through the basement car park and precast concrete panels above with a lift shaft constructed from blockwork. In terms of tolerance to movements this form of construction is a less tolerant than say a concrete frame, steel frame or timber building but more flexible than a blockwork or brick structure. Areas of possibly greater sensitivity are likely to be along the join of the two legs of the L Shape configuration and at the interface with the lift shaft.

The differential movements between pads are estimated to be less than 5mm, equivalent to a distortion of less than 1:3000; well below the commonly applied limit of 1:2000 and highly unlikely to be noticeable or cause anything other than minor cosmetic effects, even at the more sensitive parts of the building. This estimated settlement would be within the limits of the proposed Consent Conditions as follows:

> "The Consent Holder shall use all reasonable endeavours to ensure that the exercise of this consent does not cause:
>
> (a) Greater (steeper) than 1:1,000 differential settlement (the Differential Settlement Limit) between any two adjacent settlement monitoring points required under this consent: or
>
> (b) Greater than 50mm total settlement (the Total Settlement Limit) at any settlement monitoring point required under this consent".

Estimated settlements of this order would, however, trigger other requirements of the consent conditions relating to the building condition assessments, detailed analysis, monitoring, the implementation of trigger levels and contingency planning all required by the proposed consent conditions.

MAGS Alternative site

The main drop shaft and access shaft on the MAGS playing fields are far enough away from the SLGA buildings so as to cause no settlement risk to SLGA buildings. Similarly construction of the diversion chambers and trenching between the outfall and the MAGS Alternative site are shallow and will have no significant impacts on the deeper groundwater or cause settlement to the SLGA buildings.

The settlement effects of constructing an intermediate drop shaft near the existing Lyon Avenue overflow for the pipejack option will be similar to the shafts on the Lyon Avenue site as discussed earlier, on page 4. Because the shaft will need to extend below the basalt it will draw down groundwater in the Puketoka Formation and give rise to contours of estimated settlement in millimetres, as shown in Figure 4. The effects of this drop structure on Block B and Block C area will be similar to the proposed Lyon Avenue site; i.e. negligible.

4. Conclusion

The design, construction, cost and operational issues associated with the MAGS Alternative site have been considered.

Construction access to the MAGS Alternative site would be via Alberton Avenue. Works will be needed to widen and surface the school access road, which passes very close to the MAGS residences, and requiring some tree removal and safety measures to ensure protection to dormitories and regulation of vehicles and school children on the access road. The additional construction cost of the MAGS Alternative site is offset by the savings in a shorter main tunnel.

The MAGS Alternative site requires a longer connection to the Lyon Avenue overflow via a trench or pipejack. Trenching would require temporary diversion of Meola Creek and the Roy Clements Treeway walkway way footway and require further tree removal. Pipejacking would require an intermediate drop structure.

The time required to construct the MAGS Alternative site would be approximately two months longer than the proposed Lyon Avenue site. Additional measure would be required to facilitate operation and maintenance access to this alternative.

The risk of settlement of the SLGA blocks as a result of the works has also been assessed. The MAGS Alternative 2 – trenched option, will not cause a settlement risk to these buildings. The current design and construction methods for both the proposed Lyon Avenue site and the MAGS Alternative 1 – pipe jack option, give rise to similar estimated settlements of the buildings footings; 5mm vertical displacement difference and 1:3000 angular distortion between adjacent footings, well below the normally accepted limit and unlikely to be noticeable.

This estimated settlement would be within the limits of the proposed Consent Conditions:

> "The Consent Holder shall use all reasonable endeavours to ensure that the exercise of this consent does not cause:
>
> (a) Greater (steeper) than 1:1,000 differential settlement (the Differential Settlement Limit) between any two adjacent settlement monitoring points required under this consent: or
>
> (b) Greater than 50mm total settlement (the Total Settlement Limit) at any settlement monitoring point required under this consent".

Estimated settlements of this order would, however, trigger other requirements of the consent conditions relating to the building condition assessments, detailed analysis, monitoring, the implementation of trigger levels and contingency planning all required by the proposed consent conditions.

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Site Plans - LYON-SK1001 Rev. C & LYON-SK1101 Rev. C, LYON-DSK401_OA Rev. B

Figures 1 and 2 - Geological Interpretation

Figure 3 and 4 - Settlement contours

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ORIGINAL IN COLOUR

INFORMATION ONLY
September 2013

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DES. CHECKED		
DRAWN	AGI	08/13
DWG. CHECKED		
REV'D P.MGR		
APP'D P.DIR		
BY		DATE

OPERATIONS

ASSET MANAGER

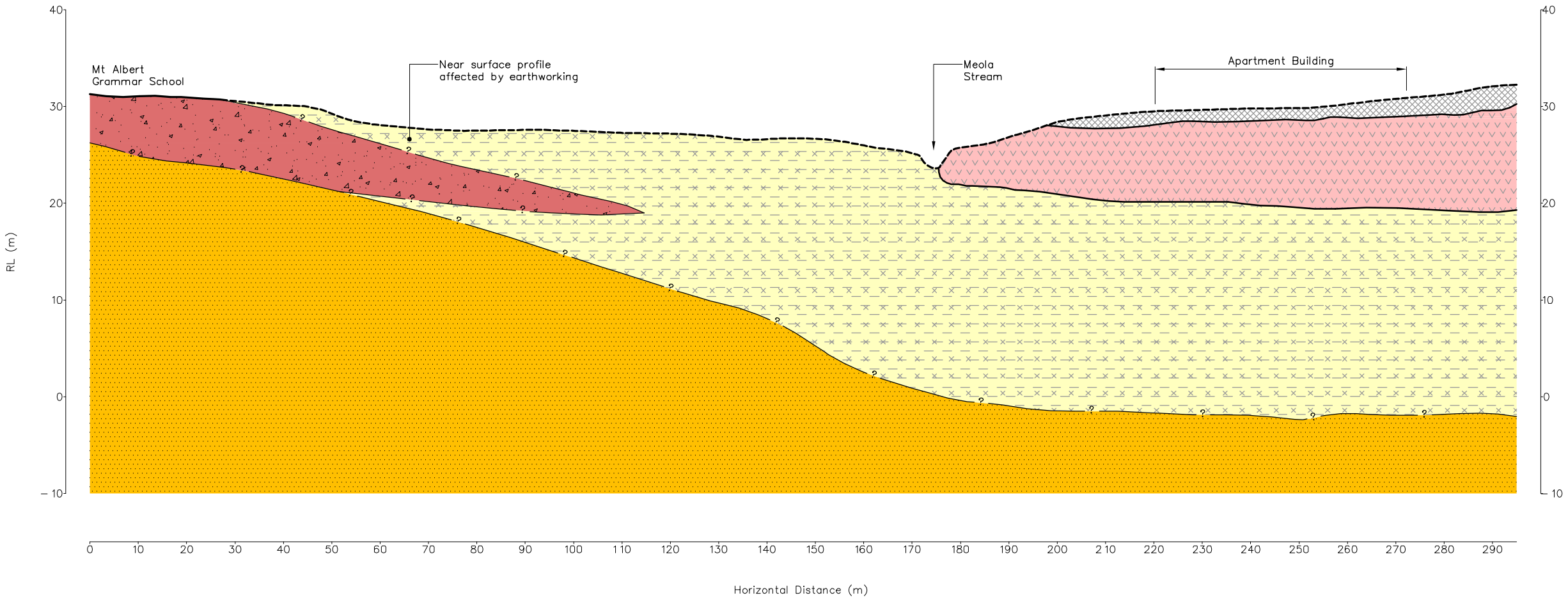
water Care services limited

CENTRAL INTERCEPTOR AND ASSOCIATED WORKS
GEOTECHNICAL CONDITIONS

CAD FILE 29200-F01 | DATE 1-Jun-12
ORIGINAL SCALE A1 1:1250 | CONTRACT No.
DRAWING No. FIGURE 1 | ISSUE

WEST
A

EAST
A'



SECTION A
SCALE 1:500(H)
1:250(V)

LEGEND

- Fill
- Basalt
- Ash
- Puketoka Formation
- East Coast Bay Formation

A3 SCALE 1:500
A1 SCALE 1:250
0 10 20 30 (m)

ORIGINAL IN COLOUR

INFORMATION ONLY
September 2013

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DRAWN	AGI	08/13	
DWG. CHECKED			
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APP'D P.DIR			ASSET MANAGER
BY		DATE	

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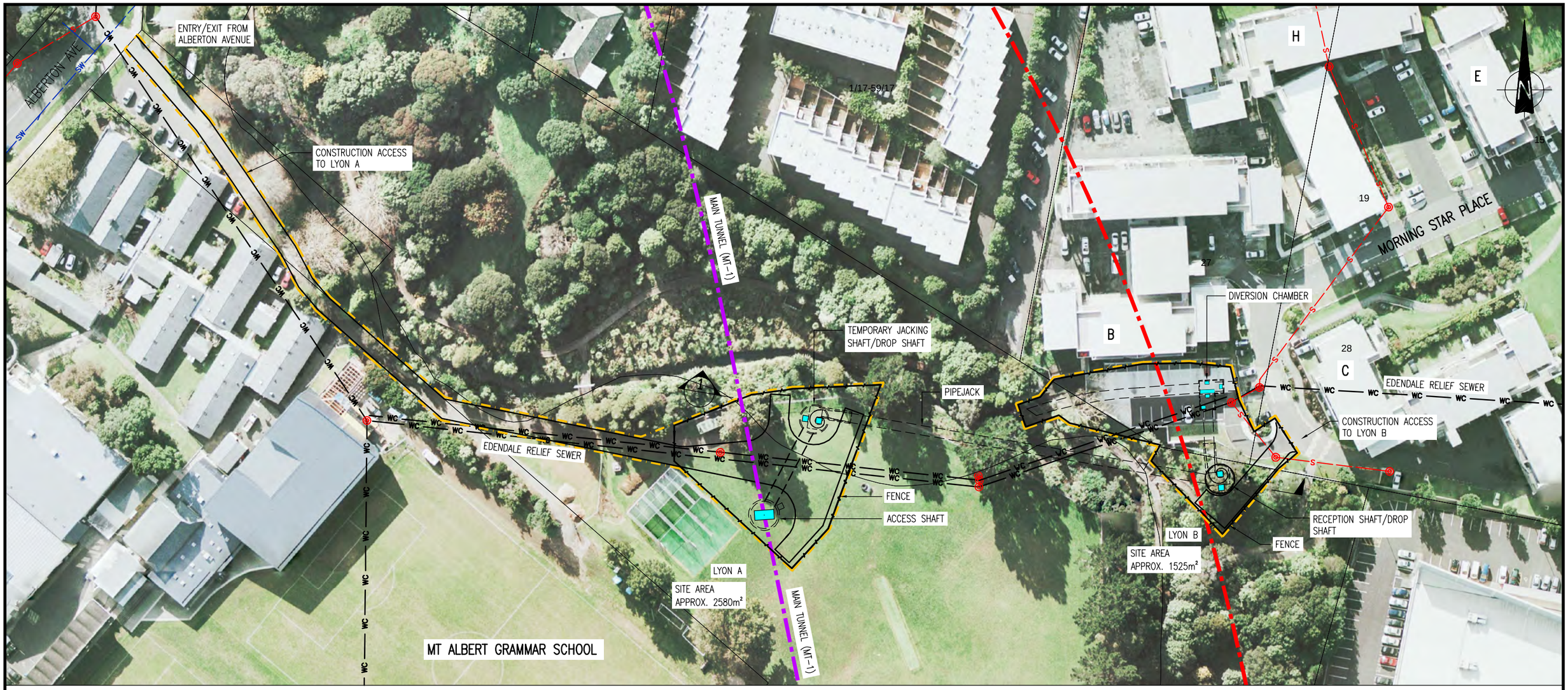
CENTRAL INTERCEPTOR AND ASSOCIATED WORKS
GEOTECHNICAL CONDITIONS

CAD FILE 29200–F02 | DATE 1–Jun–12
ORIGINAL SCALE A1 AS SHOWN | CONTRACT No.
DRAWING No. FIGURE 2 | ISSUE

FIGURE 3 – ESTIMATED SETTLEMENT CONTOURS
NOT TO SCALE PROPOSED LYON AVENUE SITE

FIGURE 4 – ESTIMATED SETTLEMENT CONTOURS
NOT TO SCALE
MAGS ALTERNATIVE SITE

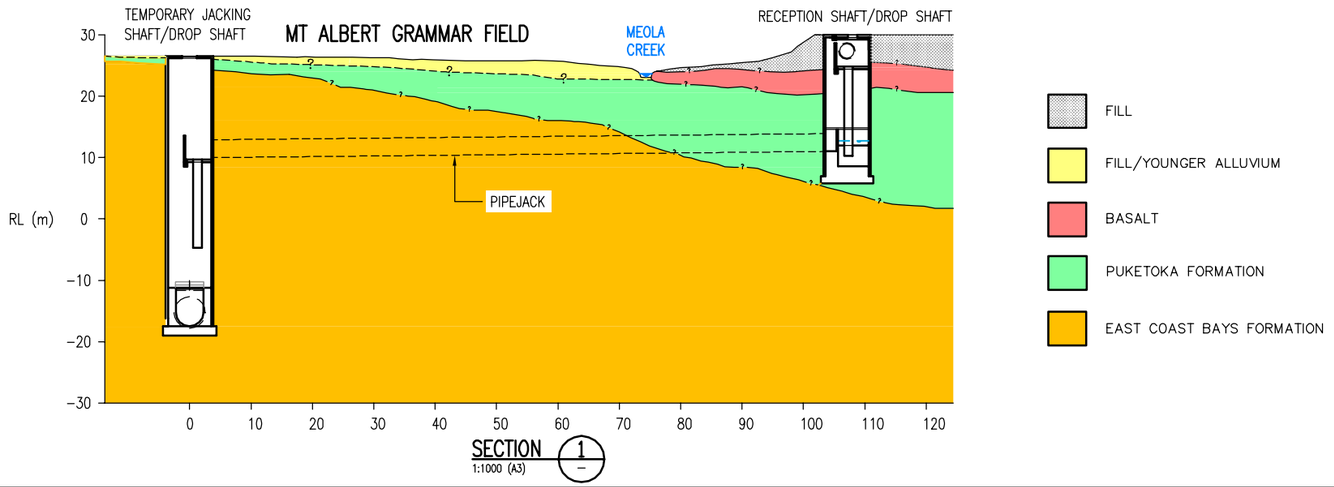


LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER (S)
- EXISTING TRUNK SEWER (WC)
- EXISTING STORMWATER (SW)
- PROPOSED SITE BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND

NOTES:

1. SEE DRAWING LYON-SK401_0A FOR PLAN OF TUNNEL ALIGNMENTS FOR LYON AVE SITE OPTIONS.



SECTION 1/– 1:1000 (A3)

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OPERATIONS

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water Care services limited

CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 1
LYON AVENUE (AS2) – SEPARATE CONSTRUCTION ACCESS (PIPEJACK OPTION)

CAD FILE LYON-SK1001	DATE 19-Sep-13
ORIGINAL SCALE A1 1:1000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK1001	ISSUE C

Project No.

Plot Date: 19-Sep-13 9:26 a.m.
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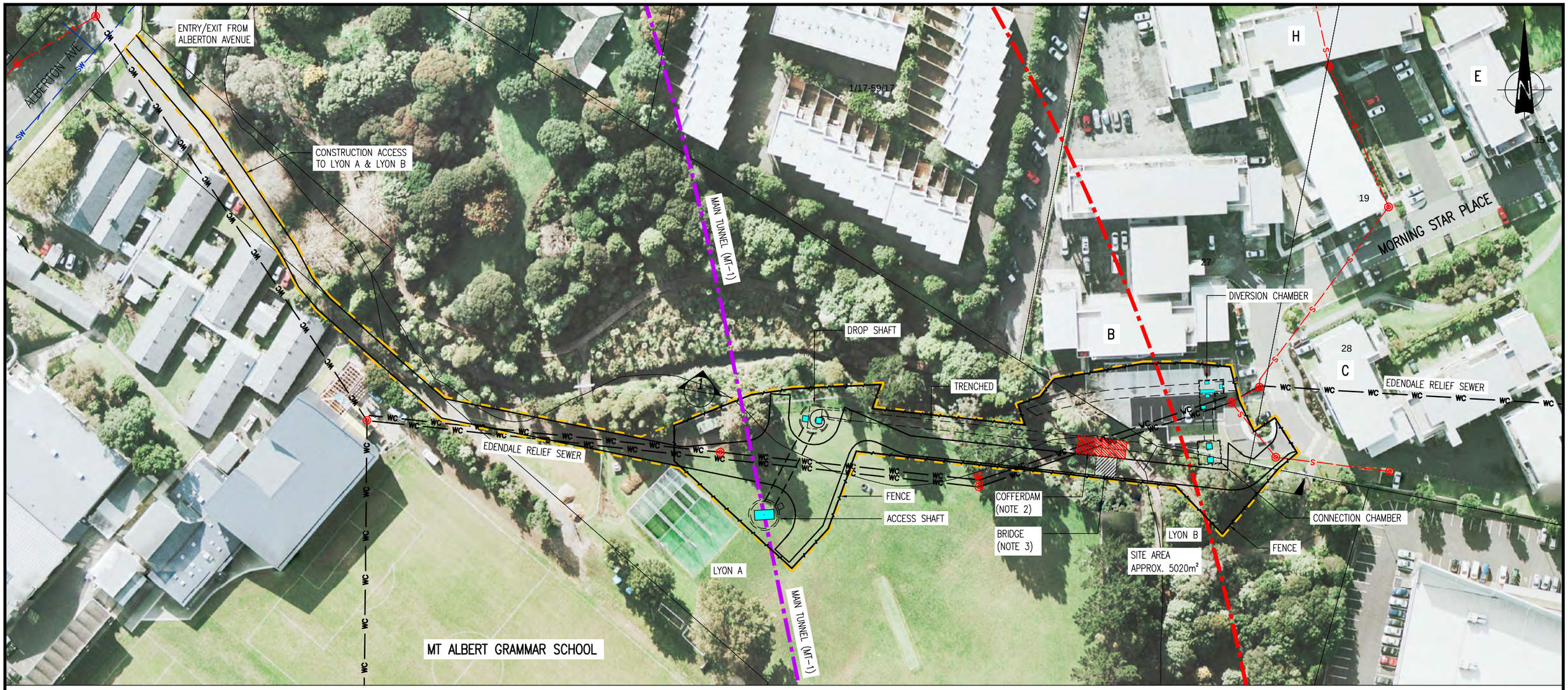

LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
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NOTES:

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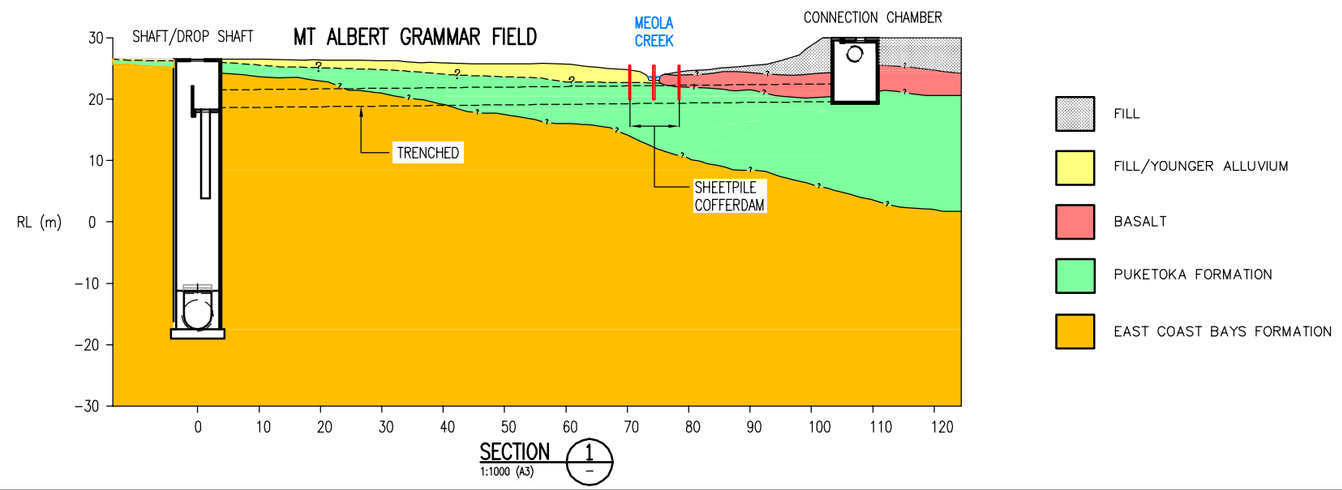

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Plot Date: 19-Sep-13 9:25 a.m.
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Project No.

DESIGNED	NL	
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DRAWN	AP	
DWG. CHECKED	NL	–
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
BY		DATE

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

water Care services limited

CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 2
LYON AVENUE (AS2) – CONSTRUCTION ACCESS FROM MAGS (TRENCHED OPTION)

CAD FILE LYON-SK1101	DATE 19-Sep-13
ORIGINAL SCALE A1 1:1000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK1101	ISSUE C

LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- CORRIDOR

Plot Date: 17-Sep-13 9:55 a.m.
File path: P:\0538 - Central Interceptor\11.0 Compiled Drawings\3_AS2_Lyon Ave\Alternatives-Options

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FOR INFORMATION

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CENTRAL INTERCEPTOR
MT ALBERT GRAMMAR SCHOOL ALTERNATIVE
LYON AVENUE (AS2) – TUNNEL DISPLACEMENT

CAD FILE LYON-SK401_0A	DATE 17-Sep-13
ORIGINAL SCALE A1 1:5000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK401_0A	ISSUE B

To:	AECOM 8 Mahuhu Crescent Auckland 1010	**Prepared by**	Andrew Benson
		Reviewed by	Andre Le Claire
Attn: **CC:**	Zahni Hefferon Alia Cederman	**Date**	19th September 2013
		Ref	19685

Subject
- **Arboricultural memornadum**
- **Lyon Avenue, St Lukes**

1. Introduction

1.1. Arborlab Consultancy Services Ltd has been requested to provide a brief arboricultural statement in relation to two options to undertake various earthworks associated with the Central Interceptor project at Lyon Avenue, Mount Albert.

1.2. Two options have been prepared which depict the possible designation and earthworks footprints; these options are depicted on the drawings LYON-SK1001 and LYON-SK1101. The various arboricultural implications of each option are briefly discussed.

1.3. The findings and comments contained herein are based on the information captured during the visual ground based assessment undertaken during a single site visit on Monday the 9th of September 2013, and the following documents and communications.

- Drawings LYON-SK1001 and LYON-SK1101
- Various communications with Zahni Hefferon of AECOM.

2. Attachments

2.1. Photoset
2.2. Drawings ARB-19685-01 and 02
2.3. Drawings LYON-SK1001 and LYON-SK1101

3. The proposal

3.1. Watercare have been asked by the Commissioners to consider the effects of the two options described above.

4. MAGS alternative 1 - Pipe jack option

4.1. The option to construct the connecting tunnel using a pipe jack method is depicted on the drawing LYON-SK1001 as well as ARB-19685-01 which shows the various vegetation plots.

4.2. The option to pipe jack the connecting tunnel negates the requirement to install the connection by open trenching, thus any adverse effects to vegetation associated with the additional earthworks would be eliminated.

4.3. Option 1 requires the removal of 46 individual trees, as well as approximately 240 square metres of mixed native vegetation. It is identified that these 240 square metres of vegetation can be described as un-managed and of low quality when considering species diversity and overall plant health.

4.4. In addition, option 1 requires that various works will need to be undertaken within the root zone of at least 19 individual trees. These works are likely to involve various excavations as well as machine tracking.

5. MAGS alternative 2 – Trenched option

5.1. The option to construct the connecting tunnel using an open trenching method is depicted on the drawing LYON-SK1101 as well as ARB-19685-02 which shows the various vegetation plots.

5.2. The option to install the connecting tunnel by means of open trenching will require a large excavation of some 5 – 8 metres deep. Excavations of this magnitude in proximity to trees can often result in the removal of multiple roots. Trees 22, 23 and 24 will be most affected by the trenching. Tree 24 is located directly within the footprint of the proposed trench alignment and so removal of this tree will be required. The excavation will pass approximately 3 metres from the base of tree 23 and 5 metres from the base of tree 22. These excavations will be on the periphery of the critical root zones of each tree, within which the structural root system is anticipated to be encountered. The removal of structural roots is likely to have an adverse effect on the stability of each tree, thus their removal will be required should the trenching option be pursued.

5.3. In addition, it is likely that trees 43 – 45 will also require removal to facilitate the various earthworks and proposed bridge structures.

5.4. In total, option 2 will require the removal of 54 individual trees and 240 square metres of mixed native vegetation, as well as works within the root zone of at least 17 individual trees.

6. Vegetation inventory

6.1. Table 1 on the following pages details the identified vegetation within and immediately adjacent to the project boundaries

Tree #	N°. Trees	Botanical name	Common name	Height (M)	No. stems at 1.4M	Aggregate girth at 1.4M (mm)	CSR (M)	Protection status	Ownership	Proposal (alt 1)	Proposal (alt 2)	CRR (M)	TPR (M)	Comments
1	1	*Quercus palustris*	Pin oak	14	1	1800	5	P	P	Remove	Remove	2.5	6.9	Mature tree approx. 1.3m from creek edge
2	1	*Metrosideros kermadecensis*	Kermadec pohutukawa	6	4	1290	3	P	P	Remove	Remove	1.6	1.6	Young tree near to creek edge
3	1	*Quercus palustris*	Pin oak	15	1	2000	7	P	P	Remove	Remove	2.7	7.6	Prominent tree approx. 6m from creek edge
4	1	*Syzygium australe*	Brush cherry	9	1	810	3	P	P	Remove	Remove	1.6	1.6	Young tree slightly supressed by adjacent ash
5	1	*Fraxinus sp.*	Ash	10	3	5100	8	P	P	Remove	Remove	2.9	11.5	Form tends to the north
6	1	*Cinnamomum camphora*	Camphor laurel	10	2	3560	5	P	P	Remove	Remove	2.9	11.5	Some canopy decline
7	1	*Cupressus sp.*	Cypress	16	1	2400	4	P	P	Remove	Remove	2.9	2.9	Densely foliated mature tree
8	1	*Cupressus sp.*	Cypress	14	1	2600	8	P	P	Remove	Remove	3.1	3.1	Heavy lean to the north
9	1	*Callistemon sp.*	Bottlebrush	5	3	2050	3	P	P	Remove	Remove	2.0	2.0	Asymmetric tree crown lifted over driveway
10	3	*Pittosporum eugenioides.*	Lemonwood	5	>1	>600	1	P	P	Remove	Remove	1.8	3.7	Young trees on bank
11	2	*Griselinia littoralis*	Puka	5	>1	>600	2	P	P	Remove	Remove	1.8	3.7	Young trees on bank

Tree #	N$^{o.}$ Trees	Botanical name	Common name	Height (M)	No. stems at 1.4M	Aggregate girth at 1.4M (mm)	CSR (M)	Protection status	Ownership	Proposal (alt 1)	Proposal (alt 2)	CRR (M)	TPR (M)	Comments
12	1	*Photinia sp.*	Photinia	6	>1	>600	2	P	P	Remove	Remove	1.8	3.7	Young trees on bank
13	1	*Alectryon excelsus*	Titoki	5	>1	>600	1	P	P	Remove	Remove	1.8	2.8	Young trees on bank
14	9	*Pittosporum eugenioides.*	Lemonwood	4	>1	>600	1	P	P	Remove	Remove	1.6	3.1	Juvenile trees
15	2	*Vitex lucens*	Puriri	4	>1	>600	1	P	P	Remove	Remove	1.6	3.1	Juvenile trees
16	1	*Dacrydium cupressinum*	Rimu	5	1	>600	1	P	P	Remove	Remove	1.6	3.1	Poor condition
17	1	*Eucalyptus cinerea*	Silver dollar gum	21	1	3600	8	P	R	Retain and protect	Retain and protect	3.7	17.2	Large prominent tree. 2M from edge of creek
18	10	*Dacrycarpus dacrydioides*	Kahikatea	12	1	>700	2	P	P	WWRZ	WWRZ	1.7	4.3	A small grove of trees in school grounds
19	9	*Cordyline australis*	Cabbage tree	7	1	>600	1	P	R	Retain and protect	Retain and protect	1.5	2.9	Small group of trees on bank of creek
20	1	*Populus yunnanensis*	Chinese poplar	19	1	1600	6	P	P	Remove	Remove	2.4	4.6	Mature tree within school grounds
21	1	*Dacrycarpus dacrydioides*	Kahikatea	10	1	900	3	P	R	Retain and protect	Retain and protect	1.7	4.3	Tree on edge of wall above creek
22	1	*Pinus radiata*	Monterey pine	13	1	2100	8	P	R	WWRZ	Remove	3.2	10.7	Growing immediately on top of the wall
23	1	*Eucalyptus sp.*	Gum	9	1	1300	6	P	R	Retain and protect	Remove	2.1	5.0	Evidence of *Paropsis.*

Tree #	N$^{o.}$ Trees	Botanical name	Common name	Height (M)	No. stems at 1.4M	Aggregate girth at 1.4M (mm)	CSR (M)	Protection status	Ownership	Proposal (alt 1)	Proposal (alt 2)	CRR (M)	TPR (M)	Comments
24	1	*Pinus radiata*	Monterey pine	14	9	>2000	9	P	R	Retain and protect	Remove	3.7	13.8	Large multi stemmed tree
25	2	*Libocedrus plumosa*	Kawaka	7	1	1140	1.5	P	R	WWRZ	WWRZ	2.0	5.4	Two trees next to boardwalk
26	1	*Podocarpus totara*	Totara	9	1	1520	3	P	R	WWRZ	WWRZ	2.3	7.3	Supressed by adjacent trees
27	1	*Podocarpus totara*	Totara	9	1	1160	3	P	R	Retain and protect	Retain and protect	2.0	5.5	Supressed by adjacent tree
28	1	*Pittosporum eugenioides.*	Lemonwood	10	6	>1000	5	P	R	Retain and protect	Retain and protect	2.4	6.1	Numerous surface roots visible
29	3	*Pittosporum eugenioides.*	Lemonwood	7	>1	>600	2	P	R	WWRZ	WWRZ	1.7	3.4	Supressed by adjacent trees
30	1	*Acer negundo*	Box elder	6	2	2280	4	P	R	Remove	Remove	2.3	2.3	Heavily pruned
31	1	*Podocarpus totara*	Totara	6	1	710	2	P	R	Remove	Remove	1.5	2.7	Some die back in the upper canopy
32	1	*Corynocarpus laevigatus*	Karaka	6	1	840	2	P	R	Remove	Remove	1.6	4.0	Large multi stemmed tree
33	1	*Casuarina cunninghamiana*	She oak	16	5	>1000	6	P	R	Remove	Remove	3.1	12.4	Juvenile trees
34	6	*Vitex lucens*	Puriri	6	1	>400	2	P	R	Remove	Remove	1.3	2.0	Manuka, karamu, karaka and lemonwood.
35	240m^2	*Various natives*	Mixed	>1	>1	>250	0	P	0	Remove	Remove	0.8	1.0	Also a smaller totara adjacent
36	1	*Podocarpus totara*	Totara	8	1	1270	4	P	R	Retain and protect	Retain and protect	2.1	6.1	Established tree near entrance to reserve
37	1	*Metrosideros excelsa*	Pohutukawa	8	7	>1200	4	P	R	Retain and protect	Retain and protect	2.7	5.7	Established tree near entrance to reserve
38	1	*Podocarpus totara*	Totara	10	1	1340	3	P	R	Remove	Remove	2.1	6.4	Semi mature tree
39	4	*Pittosporum spp.*	Pittosporums	6	>3	>1000	2	P	R	Partial removal	Partial removal	1.7	3.4	Small group of *Pittosporums*

Tree #	N°. Trees	Botanical name	Common name	Height (M)	No. stems at 1.4M	Aggregate girth at 1.4M (mm)	CSR (M)	Protection status	Ownership	Proposal (alt 1)	Proposal (alt 2)	CRR (M)	TPR (M)	Comments
40	1	*Griselinia littoralis*	Puka	5	4	>900	3	P	R	Remove	Remove	1.7	3.4	Leans over footpath
41	1	*Corynocarpus laevigatus*	Karaka	5	1	280	1	P	R	Remove	Remove	0.9	0.9	Juvenile tree
42	1	*Kunzea ericoides*	Kanuka	6	1	1130	3	P	R	WWRZ	WWRZ	1.9	5.4	Sparse canopy
43	1	*Eucalyptus sp.*	Gum	14	1	1100	4	P	R	Retain and protect	Remove	2.1	6.2	Some twiggy die back. Probably due to insect predation
44	3	*Cordyline australis*	Cabbage tree	4	>3	>900	1	P	R	Retain and protect	Remove	1.8	3.7	Group of trees growing on bank
45	1	*Vitex lucens*	Puriri	7	1	>1000	3	P	R	WWRZ	Remove	2.4	8.1	Possibly topped
46	1	*Pinus radiata*	Monterey pine	7	1	>1000	5	P	R	Retain and protect	Retain and protect	3.0	9.5	Grows on top of wall near water course
47	1	*Podocarpus totara*	Totara	6	1	1140	3	P	R	Retain and protect	Retain and protect	2.5	8.6	Also some lemonwoods
48	2	*Populus yunnanensis*	Chinese poplar	14	1	2000	5	P	P	Retain and protect	Retain and protect	2.7	5.7	Mature trees in school grounds
49	2	*Podocarpus totara*	Totara	8	1	2100	5	P	P	Retain and protect	Retain and protect	2.7	10.0	Mature trees in school grounds
50	1	*Vitex lucens*	Puriri	10	1	2100	5	P	P	Retain and protect	Retain and protect	2.7	10.0	Mature tree in school grounds

CSR – Crown Spread Radius. The greatest distance from the edge of the main stem, to the furthest distal branch tip.

CRR – Critical Root Radius – Adapted from Coder (1996) – The radial distance from the stem of the tree within which the main structural root plate is contained

TPR – Tree Protection Radius – Derived from Harris *et al* (2004). The radial distance from the trunk of the tree at which isolation fencing should be placed to adequately protect root zones from damage.

Proposal: WWRZ – Works within the root zone

Ownership: P – Private R - Reserve

Protection status: P – Protected NP – Non-protected

7. Arborist comments

7.1. It is understood that access to the site is likely to be required through the Mount Albert Grammar School (MAGS) entrance from Alberton Avenue, and that this will require modification of the existing access track/road. These modifications will involve widening of the track and the installation of retaining walls near to the stream edge. This will require the removal of vegetation in this location to undertake the physical works.

7.2. The trees in this location are currently contributing positively to the amenity at this site, particularly the mature pin oaks and the cypress.

8. Conclusions

8.1. The following table summarises the conclusions of each of the two alternatives in terms of the likely effects to vegetation.

	Lyon Ave site*	MAGS alternative 1 – Pipe jack	MAGS alternative 2 – Open trench
Number of trees removed	107	46 + 240m^2	54 + 240m^2
Number of trees WWRZ	None identified	19	17
Number of trees retained**	None identified	47	39

* Refers to June 2012 Arborlab inventory
** Total number of retained trees includes all trees with WWRZ

9. References

Coder. K. (1996) *Construction damage assessments: Trees and sites.* University of Georgia Cooperative Extension Service Forest Resources Bulletin FOR96-39.

Harris. R, Clark. J, and Mathney. P. (2004) *Arboriculture. Integrated Management of Landscape Trees, Shrubs and Vines.* 4th ed. Prentice Hall, New Jersey, USA. Pp. 262

Appendix 1: Photoset

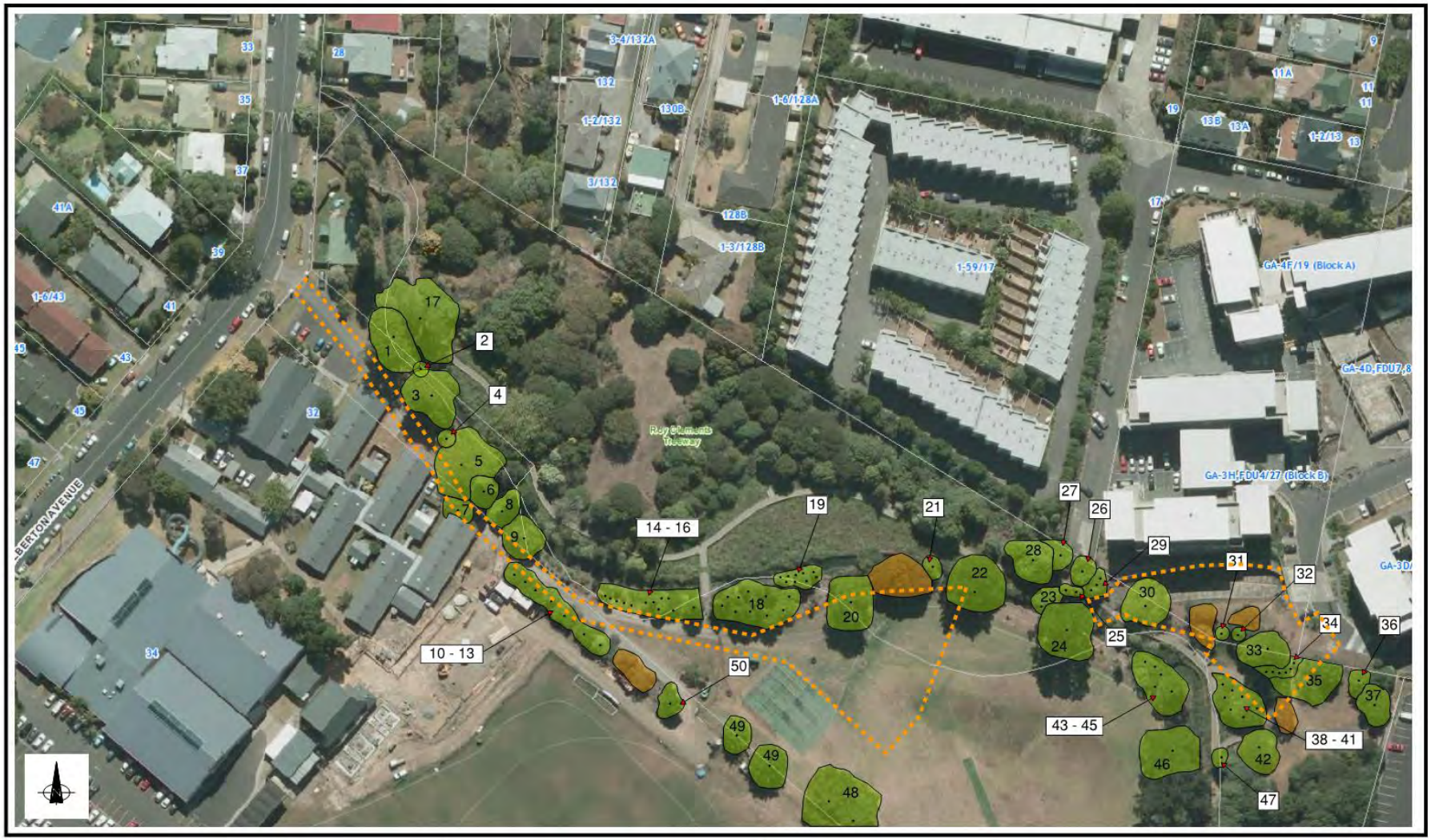
Photo 1: Tree 1. Pin oak

Photo 2: Tree 43.Gum and Tree 45. Puriri

Photo 3: Tree 36. Totara and Tree 37. Pohutukawa

Photo 4: Tree 23. Gum

Appendix 2: Drawings ARB-19685-01 and 02



Aerial images may not accurately reflect the actual vegetation cover. Vegetation is plotted as accurately as possible using existing landmarks and property boundaries. The size of the plot may not accurately represent the dimensions of the actual vegetation. Unless otherwise stated, project specific vegetation only has been plotted and captured.

Vegetation alteration/removal may be subject to resource consent requirements/conditions. It shall be the client's responsibility to determine whether or not this is the case.

Works within the root zone of any tree requires supervision from an appointed works arborist.

Legend

- Vegetation plot
- Vegetation no longer present

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09 379 3302 www.arborlab.co.nz

Lyon Avenue
Central Interceptor

VEGETATION INVENTORY

Scale 1:1000 @ A3

		Date
Requested by	Alia Cederman	
Surveyed by	ARB	09/09/13
Plotted by	ARB	10/09/13
Checked by	ALC	11/09/13
Drawing number	ARB-19685-01	Rev A

Aerial images may not accurately reflect the actual vegetation cover. Vegetation is plotted as accurately as possible using existing landmarks and property boundaries. The size of the plot may not accurately represent the dimensions of the actual vegetation. Unless otherwise stated, project specific vegetation only has been plotted and captured.

Vegetation alteration/removal may be subject to resource consent requirements/conditions. It shall be the client's responsibility to determine whether or not this is the case.

Works within the root zone of any tree requires supervision from an appointed works arborist.

Legend

- Vegetation plot
- Vegetation no longer present

waterCare services limited

ARBORLAB CONSULTANCY SERVICES LIMITED

09 379 3302 www.arborlab.co.nz

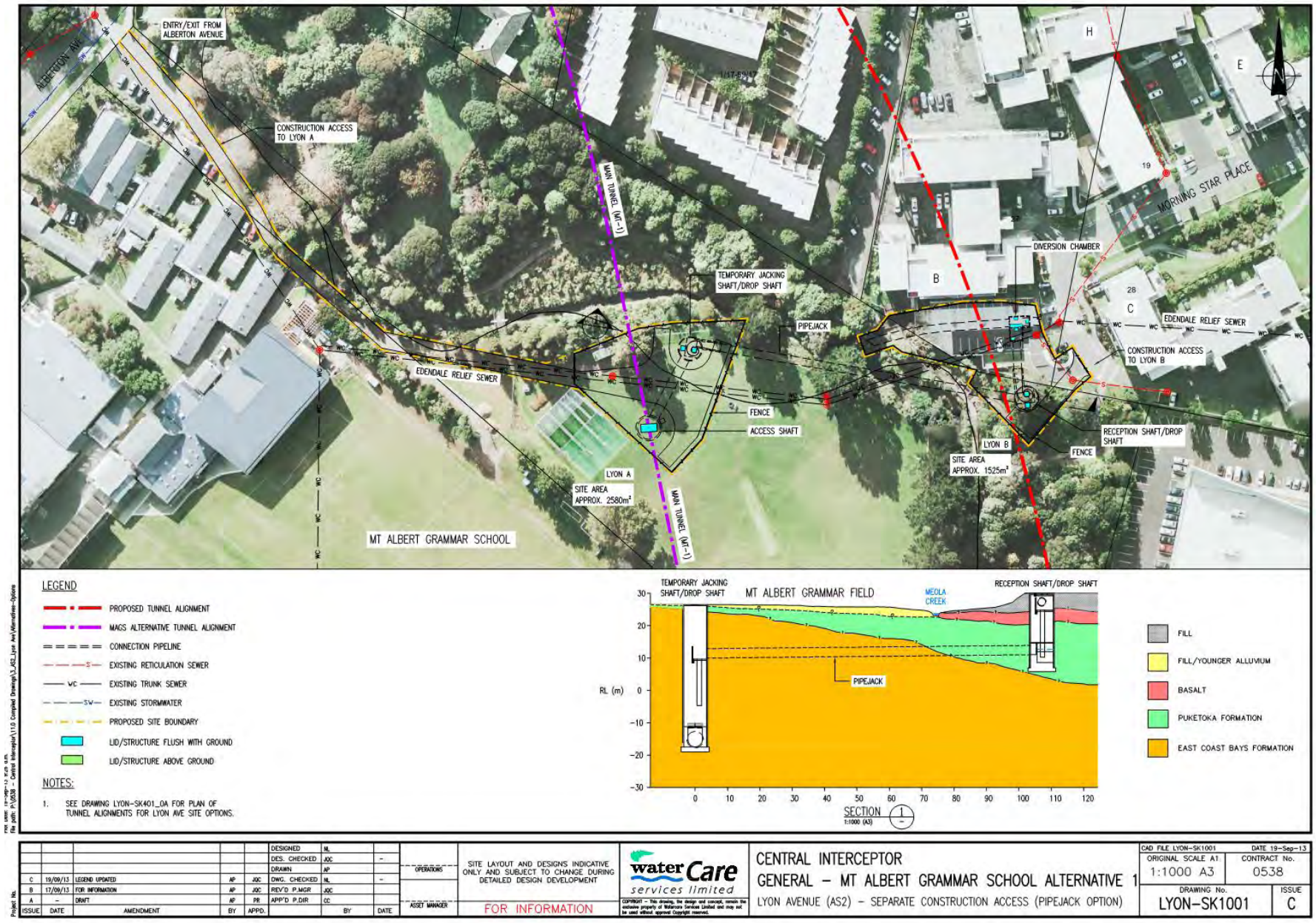
Lyon Avenue Central Interceptor

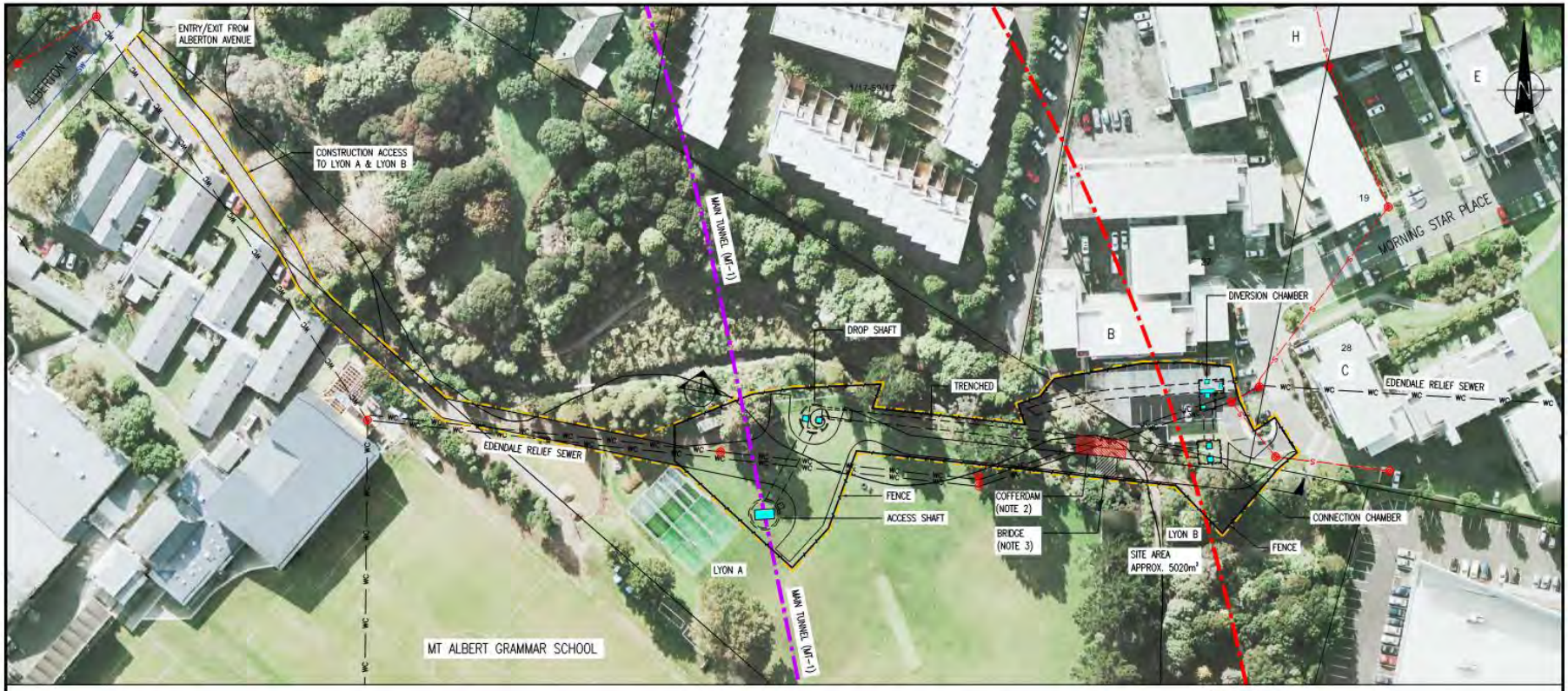
VEGETATION INVENTORY

Scale 1:1000 @ A3

		Date
Requested by	Alia Cederman	
Surveyed by	ARB	09/09/13
Plotted by	ARB	10/09/13
Checked by	ALC	11/09/13
Drawing number	ARB-19685-02	Rev A

Appendix 3: Drawings LYON-SK1001 and LYON-SK1101



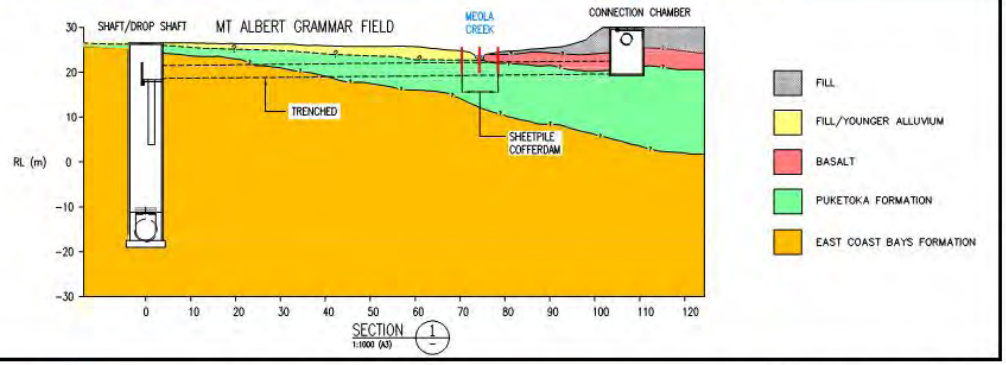


LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
- PROPOSED SITE BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND

NOTES:

1. SEE DRAWING LYON-SK401_0A FOR PLAN OF TUNNEL ALIGNMENTS FOR LYON AVE SITE OPTIONS.
2. MEAOLA STREAM TO BE DIVERTED LEFT AND THEN RIGHT WITHIN SHEETPILE COFFERDAM TO ALLOW CONSTRUCTION OF TRENCH AND PIPE LAYING. FOOTPATH TO BE DIVERTED.
3. BRIDGE REQUIRED FOR ACCESS ACROSS STREAM (EITHER PERMANENT OR TEMPORARY, DEPENDING ON ACCESS ARRANGEMENTS).



SECTION 1 (1:1000 (A3))

ISSUE	DATE	AMENDMENT	BY	APPD.
C	19/09/13	LEGEND UPDATED	AP	JQC
B	17/09/13	FOR INFORMATION	AP	JQC
A	-	DRAFT	AP	PR

DESIGNED	NL	-
DES. CHECKED	JQC	-
DRAWN	AP	
DWG. CHECKED	NL	-
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
BY	DATE	

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

water Care services limited

CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 2
LYON AVENUE (AS2) – CONSTRUCTION ACCESS FROM MAGS (TRENCHED OPTION)

CAD FILE LYON-SK1101 | DATE 19-Sep-13
ORIGINAL SCALE A1 | 1:1000 A3
CONTRACT No. 0538
DRAWING No. LYON-SK1101
ISSUE C

Plot Date: 19-Sep-13 9:25 a.m.
File path: P:\0538 - Central Interceptor\11.0 Compiled Drawings\3_AS2_Lyon Ave\Alternatives-Options
Project No.

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Watercare Services Limited
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TDG Ref: 11117-7
19 September 2013

Copy via email: **BPetersen@water.co.nz**

Dear Belinda

Central Interceptor Project - Lyon Avenue Site (AS2): Access Options

Following the adjournment of the hearing relating to the Central Interceptor Project on 13 August 2013, the Commissioners issued a direction under section 41C of the RMA inviting Watercare to provide further information on the proposed Lyon Avenue site and an alternative suggested by Mr Maddren on behalf of the St Lukes Gardens Apartments (SLGA). This letter report assesses the traffic related issues for the construction site options under consideration and potential mitigation measures of each option which are likely through the detailed Traffic Management Plan (TMP) process. In summary, these options are:

- Watercare's proposed Lyon Avenue site.
- MAGS Alternative 1 – pipe jack option with construction access via Morning Star Place and Mt Albert Grammar School (MAGS); and
- MAGS Alternative 2 – trenched option with construction access via MAGS only.

These options involve construction access via either the SLGA private road (Morning Star Place); or through Mt Albert Grammar School (MAGS) via the Gate 1 driveway entrance on Alberton Avenue (MAGS Gate 1). The assessment set out in this letter addresses the traffic issues associated with construction access via Morning Star Place (Section 1 below) and via MAGS Gate 1 (Section 2 below). Our overall consideration of the traffic issues associated with the three construction options described above is set out in Section 3.

1. Morning Star Place Access

The Morning Star Place access is the original access design proposed by Watercare for the Lyon Avenue construction site and was assessed as part of the traffic assessment and associated evidence, previously carried out by TDG, including:

- Section 4.3 of the TDG Traffic Report for Central Interceptor project.
- TDG letter to Mr Peter Roan (T&T) dated 11 June 2013 (included as Attachment I of Belinda Petersen's primary statement of evidence).
- Primary evidence of Mr Hills dated 12 July 2013 (paragraphs 5.43 and 5.52).

The following assessment summarises information which has previously been presented in those documents.

1.1 Access Description

This access involves a site access to be formed off Morning Star Place (through SLGA site), adjoining the site and opposite the residential complex at 27 Morning Star Place. Site vehicles would travel to and from the site along Morning Star Place via the St Lukes Road / Morningside Drive / Morning Star Place signalised intersection.

Morning Star Place is a private road servicing a number of residential apartment buildings. It runs in a southwest – northeast direction, connecting with St Lukes Road in the northeast and is a cul-de-sac in the southwest. The road is a two-lane, two-way street with perpendicular parking spaces on both sides of the road along the majority of its length (as shown in photograph 1 below) as well as a pedestrian footpath located along its entire length on the eastern side of the road and a partial footpath located on the western side. There are also speed tables and a small roundabout situated on Morning Star Place.

Photograph 1: Morning Star Place

1.2 Traffic Effects

1.2.1 Link to major road network

It is considered that access at this location would provide excellent access to local road network (via traffic signals).

Negligible effects at the St Lukes Road / Morning Star Place signalised intersection (with or without expansion works at Westfield St Lukes) are likely to be caused by the site traffic with approximately nine site vehicles traveling into or out of Morning Star Place during peak hours. The performance of the Morning Star Place leg of the intersection could be further improved by slightly increasing the phase length of this leg of the intersection, particularly in the morning commuter peak period.

1.2.2 Pedestrian Safety

Pedestrian access into the Roy Clements Treeway from Morning Star Place would need to be redirected during construction.

Morning Star Place is a low speed environment. The measured average and 85th percentile operating speeds were recorded to be 23km/hr and 27km/hr respectively.

This slow speed is due in part to signage (10km/hr posted speed limit) and the presence of four raised speed tables. We would expect any TMP developed for this site to emphasise and enforce truck drivers travelling at an appropriate speed.

While pedestrian footpaths exist on both sides on Morning Star Place (non-continuous on the western side) it is noted that a number of pedestrians do walk on the carriageway. At the same time, on-site observations show that these pedestrians do move out of the carriageway when vehicles approach. The low speed nature of the area allows this to occur safely. The construction trucks are likely to be even more noticeable to pedestrians which will give ample time for the pedestrians to move out of the carriageway.

Further, we note that the St Lukes Gardens Apartments were developed in stages with many of the apartment buildings being constructed while other buildings were occupied. As such, Morning Star Place has experienced significant levels of construction vehicle activity in the past while some apartments were occupied. A search of the New Zealand Transport Agency's Crash Analysis System shows no reported accidents on Morning Star Place (which is included in the database even though it is a private road) over the last 10 years.

1.2.3 Vehicle safety / capacity

Given the low speed nature of Morning Star Place, due to the presence of speed tablesand the geometry of the street, it is considered that there is adequate sight distance in both directions, at the proposed access.

Morning Star Place carries in the order of 1,100 to 1,600 vehicles per day. Traffic surveys I have undertaken show peak hours to be up to 113 vehicles per hour with traffic volumes being relatively constant throughout the day. Typically, Local Roads carry less than 1,000 vehicles per day (although many do carry more). As such, the traffic on Morning Star Place is already higher than typically experienced on Local Roads. The additional traffic generated by the Project will add between 6 - 9% in the peak hour and 4 - 6% on a daily basis. While over half this additional traffic will be single unit trucks, it does demonstrate the actual increase will be minimal.

Morning Star Place is already served by rubbish trucks on a regular basis and the largest designed vehicle proposed to access the site would be of similar size to the trucks already using Morning Star Place (single unit dump trucks). Furthermore, only five heavy vehicles are expected to travel to or from the site per hour. The probability of two trucks requiring to pass each other would be low, however, Morning Star Place is of sufficient width for two trucks to pass each other. We have measured the actual remaining width on Morning Star Place (between two parked cars on either side of the road) and found the minimum on-site dimension to be approximately 7.2m. This is considered ample width for two single unit trucks to pass each other.

It is noted that a small number of larger articulated trucks may also visit the site. This will be a rare event and only potentially relating to precast / steel delivery and can be managed to not occur at the same time as any other truck movements, and would likely only occur for short durations to match the construction scheduling. The size of this articulated truck will be limited to the site itself and the ability to turn the truck around on-site. Accordingly, we do not consider the largest semi-trailer permitted in New Zealand (19m long) will be able to access the site as it will simply be unable to turn around on-site. Rather, we would expect the semi-trailer / articulated truck to be smaller at approximately 13.5m long with 11m long flat-decks.

Of note, an entering semi-trailer can pass another semi-trailer (or any other vehicle) over the entire length of Morning Star Place except for the final 50m closest to the construction access. Given the low numbers of such trucks expected, (approximately 20 in total for the entire project) this cross-over can easily be safely accommodated by an on-site spotter as part of the final detailed TMP for this site.

1.2.4 Parking effects

The visitor car park at 27 Morning Star Place of 22 spaces would be removed during construction as it will be part of the overall works area. This removal would be required regardless of where access is from as it is needed for construction activity. The Resource Consent for the Morning Star Apartments development was approved with acknowledgments of the potential loss of these parking spaces during the construction of the Central Interceptor Project. The private car parking spaces east of the visitor car park on Morning Star Place (or any other car parks) would not be affected by the works.

1.3 Mitigation Measures

The residential nature of Morning Star Place means construction traffic would need to travel adjacent to residential housing and moderate levels of pedestrians. A TMP would therefore be required. The mitigation measures within the TMP are likely to include:

- Additional traffic calming devices at the vehicle crossing point to the construction site as well as truck speed restrictions along Morning Star Place to reinforce the existing internal speed limit and to thus make sure trucks travel at appropriate speeds.
- Fencing or barriers required to separate footpaths from the subject site around the vehicle crossing point into the construction site.
- Contractor parking associated with the construction works not permitted on Morning Star Place nor within any of the private parking areas accessed from Morning Star Place.
- Access for emergency vehicles (including fire trucks, ambulance) and service vehicles (including rubbish trucks) along Morning Star Place will need to be maintained at all times.
- A suitably qualified traffic controller will need to be available during construction works along the section of Morning Star Place that does not have footpaths on both sides of the road, to accompany pedestrians along the road to a footpath or their parked car, (as appropriate).
- Public access will need to be maintained between Morning Star Place and the Roy Clements Treeway pedestrian walkway.

1.4 Overall Assessment

It is considered that this construction access via Morning Star Place is a good option from a traffic engineering point of view, providing the above mitigation measures are implemented. The access enables excellent access onto the road network by means of a signalised intersection and is considered satisfactory with respect to traffic safety.

In terms of the effect to local residents, they are likely to experience a small increase in waiting time at St Lukes Road / Morning Star Place due to the increase in traffic, no loss in road use (two-way road will be unchanged) and a slight potential reduction in road safety due to the presence of construction trucks which will however, be controlled / mitigated by speed limit enforcement, additional traffic calming and a traffic controller (as required).

2. MAGS Gate 1 Access

TDG has previously assessed alternative construction access options for the proposed Lyon Avenue site (refer letter from TDG to Mr Peter Roan dated 11 June 2013 in Attachment I of Belinda Petersen's primary statement of evidence as well as Evidence in reply of Mr Hills dated 13 August 2013 (paragraphs 3.9-3.12) and primary Evidence of Mr Hills dated 12 July 2013 paragraphs 5.49-5.51). This included an assessment of construction access via MAGS. The following assessment incorporates that previous information, and provides further information on the potential traffic effects of the MAGS Alternatives now being assessed.

2.1 Access Description

This option involves a site access from the existing Gate 1 access to MAGS on Alberton Avenue, and along the northern edge of the sport fields to the construction site. This access is currently used to gain access to the MAGS hostel as well as maintenance and general access to the MAGS sports fields, including the rear of the sports pavilion.

The access route would be an extension (and widening) of the existing school maintenance track and would also be formed over the green fields of the school (near the existing cricket nets) via the existing maintenance track that travels past the MAGS hostel. As a new vehicle bridge across Meola Creek would also be required for the MAGS Alternative 2-trenched option.

Photograph 2: likely access location

Alberton Avenue is a two-way two-lane road with on-street parking permitted on both sides of the road. It is classified as a "local road" in the District Plan. It mainly provides access to residential properties and also provides vehicular access to MAGS, Marist College and Mt Albert Aquatic Centre. Alberton Avenue forms a give-way priority intersection with Mt Albert Road in the south and a stop priority intersection with New North Road in the north. Speed humps are situated along the length of Alberton Avenue.

2.2 Traffic Effects

2.2.1 Link to major road network

Sight distance at the existing Alberton Avenue driveway to Gate 1 access MAGS is appropriate for heavy vehicles. However given the volumes on Alberton Avenue (4,900 vpd in 2009 which is considered high for a local road) and the Alberton Avenue Gate 1 driveway is only priority controlled, only left turns would likely be permitted for heavy construction vehicles at the driveway. This restriction would restrict truck movements and route choice for the trucks.

The route choice is further restricted as each end of Alberton Avenue (New North Road and Mt Albert Road) is also priority controlled. Given these two roads are major arterials, left turn only truck restrictions would also apply. As such, overall the link to the major road network (arterials) is somewhat limited with this access.

2.2.2 Pedestrian Safety

The MAGS option would require a long narrow access route through the school, raising moderate potential for pedestrian / vehicle conflict near the School hostel and students using the school fields.

There is potential for conflict between the truck access and school student / boarders near the vehicles entrance to Alberton Avenue and on the construction access road itself, particularly immediately before and after school times. Ideally fencing would be provided to separate the entire truck access and the school users. Given however that school cars also use the access on Alberton Avenue (access to parking for hostel), and the need to maintain access for emergency vehicles, it is unlikely the trucks could be fully separated from school users near Alberton Avenue.

This would be exacerbated by the lack of footpaths / defined pedestrian areas in this area. This area is shown in Photograph 3 below:

Photograph 3: MAGS Alberton Avenue access

Consequently, pedestrian safety would be compromised if this access route were to be formed and additional mitigation would be required (eg dedicated footpaths along the access / alternative pedestrian routes).

2.2.3 Vehicle safety / capacity

Alberton Avenue has a low speed nature due to the presence of speed humps and the geometry of the street. Adequate sight distances are available in both directions from the proposed access via Gate 1.

If the MAGS Alternative 2-trenched option was considered, site vehicles would need to cross Meola Creek to gain access to the site works on the right bank of the stream. A new bridge would be required to provide this access.

As seen in the Photograph 3 above, the majority of the existing MAGS access is one-way in width but caters for two-way traffic (vehicles travelling in both directions). Given the increase in traffic volumes (especially heavy vehicles), conflict with existing school users (including maintenance vehicles and sports pavilion) and limited sight distance along the access route, the access should ideally be widened to accommodate two-way traffic and pedestrian access to the MAGS hostel. However it is recognised that providing the width needed for two-way traffic may be difficult/ impossible in places due to trees / retaining / proximity to stream bank. In these locations (likely one or two locations near the hostel) it is likely that additional traffic controls (eg: temporary traffic signals) will be required.

2.2.4 Parking effects

As previously noted, the 22 visitor spaces at 27 Morning Star Place would be removed due to physical works at the Lyon Avenue Spillway.

The construction access via MAGS will conflict with access to the parking spaces associated with the School hostel. If detailed design / mitigation shows that access can be shared between construction vehicles and existing users (with appropriate pedestrian footpaths), then no additional loss in parking would occur. However, if the detailed design / mitigation measures shows that due to safety concerns the construction access will need to be fully separated from the School site (especially near the MAGS hostel) then it is likely that alternative parking will be required for in the order of six vehicles.

2.3 Mitigation Measures

Using the MAGS Gate 1 access off Alberton Avenue means construction traffic would need to travel past residential housing / student areas, including potentially high numbers of school users/pedestrians. A TMP would therefore be required. The mitigation measures within the TMP are likely to include:

- Restrictions on truck access would likely be needed during the school peak between 8:00am and 9:00am, and 2:30pm to 3:30pm to make this option feasible.
- Within the school grounds, careful traffic management would be required including fencing between the site and school users and providing designated walking paths to the hostel outside of truck paths.
- Ideally the access track should be widened to accommodate a two-way access road. In any sections where this cannot be achieved (eg: due to trees/ retaining/pedestrian paths), additional traffic management will be required (eg: traffic signals), so that a one-way system can operate safely and efficiently.
- Access to / from Alberton Avenue would be restricted to left in / left out.
- Left turn only movements permitted at each end of Alberton Avenue (Mt Albert Road and New North Road).

- Access to School facilities including hostel (both pedestrian and parking) will need to be maintained at all times (or alternatives found including alternative parking if this is not possible).
- Speed restrictions would be required on the access past the School hostel.
- Access for emergency vehicles (including fire trucks, ambulances) along the School access route would need to be maintained at all times.

2.4 Overall Assessment

This MAGS option is considered feasible from a traffic engineering point of view subject to the above construction mitigation measures. However, the option is not preferred from a traffic engineering perspective compared to access via Morning Star Place. This is due to the option having inferior linkages to the major road network (additional turning restrictions), inferior access to the site (likely one-way sections) and potential conflict between construction vehicles and school traffic/children.

3. Consideration of proposed construction site options

We understand that three options are being reviewed relating to the site, being:

(i) Watercare's proposed Lyon Avenue site – with construction access via Morning Star Place

(ii) MAGS Alternative 1 – pipe jack option with construction access via Morning Star Place and MAGS; and

(iii) MAGS Alternative 2-trenched option with construction access via MAGS only.

These options are shown in Drawing Numbers AEE-MAIN-3.2, LYON-SK1001_B and LYON SK1101_B attached to Watercare's response to the Commissioners.

Our traffic assessment of Watercare's proposed Lyon Avenue site is set out in Section 1 above. Overall, we consider construction access via Morning Star Place is a good option from a traffic engineering point of view, providing the above mitigation measures are implemented, as the effects can be appropriately avoided or mitigated.

Our traffic assessment of Alternative 1 requires consideration of traffic effects on both Morning Star Place and in the MAGS grounds and Alberton Avenue. In this regard, we understand that the scale of works required adjacent the Lyon Avenue Spillway and in the MAGS sports fields will be similar, however, occupation at the MAGS site will be for a longer duration. The mitigation provisions identified in both Section 1 and 2 above would be required for Alternative 1; however the duration and quantity of traffic movements on Morning Star Place will be less than for Watercare's proposed Lyon Avenue site. Overall, Alternative 1 results in traffic effects at two locations and, other than reducing the number and duration of traffic movements on Morning Star Place, does not appear to offer benefits that would outweigh Watercare's proposed Lyon Avenue site.

Our traffic assessment of Alternative 2 is set out in Section 2. Overall, our assessment is that access via MAGS Gate 1 is not preferred from a traffic engineering perspective compared to access via Morning Star Place due to the option having inferior links to the major road network (additional turning restrictions), inferior access to the site (likely one-way sections) and potential conflict between construction vehicles and school children. However, with the mitigation measures proposed for this option, including restricting truck hours, traffic signals, additional footpaths/fencing and potential relocation of parking spaces, it could be made viable.

4. Summary

The following table summarises the results of our analysis of traffic issues associated with construction access via either Morning Star Place or MAGS Gate 1.

	Traffic Issues			
OPTION	**Link to major road network**	**Pedestrian safety**	**Vehicle safety / capacity**	**Parking effects**
1. Watercare's Lyon Ave option: access via Morning Star Place	**Excellent**, via signalised intersection to major arterial road	**Good**, a number of resident pedestrians but separate footpaths provided. A traffic controller be available to improve safety to residents as required Management of trucks speeds would be required.	**Excellent**. Two-way road, good sight distance.	No additional loss above the 22 visitor spaces which are lost for all construction site options due to work area.
2. MAGS Alternative 1: Access via Morning Star Place AND MAGS	**Acceptable**, access from MAGS site restricted to left turns as well as intersection with arterial roads at either end of Alberton Avenue. Access via Lyon Avenue via signalised intersection.	**Good**, providing fencing/footpath is provided to separate the construction access from pedestrians near MAGS hostel, and speed restrictions are put in place. Traffic controller and speed restrictions required on Morning Star Place.	**Good.** Separation of site traffic from school traffic for MAGS access required in confined area, eg: signage/fencing. Access likely to be restricted to one-way in places with signals required. Morning Star Place provides two-way road.	No additional loss providing access maintained to hostel in MAGS. If separation of the access road by fencing is required (which also restricts access to cars associated with the hostel) then alternative parking would be required
3. MAGS Alternative 2: Access via MAGS	**Acceptable**, access restricted to left turns as well as intersection with arterial roads at either end of Alberton Avenue	**Good**, providing fencing/footpath is provided to separate the construction access from pedestrians especially near MAGS hostel, and speed restrictions are put in place.	**Good.** Separation of site traffic from school traffic required in confined area, eg: signage/fencing. Access likely to be restricted to one-way with signals required.	No additional loss, providing access maintained to hostel. If separation of the access road by fencing is required (which also restricts access to cars associated with the hostel) then alternative parking would be required

Overall, we consider all of the construction site options are viable; however, our assessment is that Watercare's proposed Lyon Avenue site and access via Morning Star Place is the best access option from an overall traffic engineering perspective. In terms of permanent access post construction, either Morning Star Place or MAGS options are acceptable from a traffic engineer perspective, as traffic volumes associated with routine maintenance will be low, and safe access/egress to the wider public road network can be provided for both options.

If you require any further clarification please do not hesitate in contacting us.

Yours sincerely
Traffic Design Group Ltd

Leo Hills
Associate

leo.hills@tdg.co.nz

MINISTRY OF EDUCATION
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16 July 2013

Watercare Services Ltd
Private Bag 94 010
AUCKLAND 2241

Attention: David Ward – Central Interceptor Project Manager

Dear David

RE: CENTRAL INTERCEPTOR MAIN PROJECT WORKS – LYON AVE

We write with reference to your letter dated 19th June 2013.

We have reviewed the information received from Watercare with respect to the above proposed site, proposed alternative site and construction access options being considered. We have also reviewed WaterCare's Central *Interceptor Main Project Works, Notice of Requirement 1* (August 2012) included with the notified Plan Modification 332 to the *Auckland Council Operative District Plan – Isthmus Section.*

In the absence of file or meeting notes confirming the Ministry's views from our site meeting of the 8th May 2012 and with reference to relevant planning documents such as the above District Plan (Isthmus Section) and the *Draft Auckland Unitary Plan*, the Ministry of Education considers that Option AS2 (proposed Lyon Ave site) as shown on maps AEE-MAIN-3.1 and AEE-MAIN-3.1, remains the preferred option with respect to construction and permanent works for the Central Interceptor.

The reasons for the Ministry's view are that:

(i) The alternative option on the Mt Albert Grammar School (MAGS) bottom playing fields compromises a larger area of land than that of the preferred option which is specifically designated and required for the school's continued use.

In light of the *Auckland Plan* and the *Draft Unitary Plan*, the Ministry is currently considering the future growth options for this school site and other central city Auckland schools. The alternative option on the MAGs playing fields pre-empts any reasonable outcomes for the school and the Ministry in terms of accommodating future school population growth and therefore rolls.

(ii) The Ministry are comfortable that with an appropriate mitigation plan and/or conditions of the Watercare NoR for replanting of the Roy Clements Treeway in consultation with the St Lukes Enviromental Protection Society (SLEPS) and any other interested community groups; any temporary adverse effect on the Treeway will be minimised and/or avoided.

It is noted that the Treeway currently exists on Crown land used and designated for school purposes and that the Operative District Plan, does not provide any additional limitations or controls or specific protection of the Treeway (for example, through scheduling of any single or groups of trees).

Further, the confirmed conditions of the existing E06/24 Designation of the MAGS school require an Outline Plan of Works to be submitted prior to undertaking any works on or in the vicinity of notable trees on the site, which may or may not include trees and vegetation in the Treeway.

We trust these comments provided by the Ministry, sufficiently assists Watercare as per your letter of 19 June 2013.

Please do not hesitate to contact me should you have any further questions or queries.

Yours sincerely

Sandra Orr
Acting Regional Property Manager

Cc: Dale Burden, Mt Albert Grammar School

BPetersen (Belinda)

From: Anthea Morell <Anthea.Morell@minedu.govt.nz>
Sent: Tuesday, 3 September 2013 5:03 p.m.
To: BPetersen (Belinda)
Subject: RE: Central Interceptor project - works at proposed Lyon Avenue site

Hi Belinda,

I have spoken to the principal today. Our position is the same as the previous letter. The school and Ministry would not want to agree to a proposal which uses any of the school site except for the initial proposal and we do not want construction traffic using the school site for access. The "Fraser Thomas option" would have a considerable impact on the school operation and use of their playing fields in the short and long term. As I mentioned the school is experiencing significant roll growth so we need to retain all the playing fields.
Do you want me to get another letter with this same information or is there something else you require?

Regards
Anthea

From: BPetersen (Belinda) [mailto:BPetersen@water.co.nz]
Sent: Tuesday, 3 September 2013 10:36 a.m.
To: Anthea Morell
Subject: FW: Central Interceptor project - works at proposed Lyon Avenue site

Hi Anthea,

Just wondering if you had the opportunity to look at this information yet?
I'll try calling you this afternoon to discuss.

Regards,
Belinda

From: BPetersen (Belinda)
Sent: Tuesday, 27 August 2013 3:32 p.m.
To: paheadmaster@mags.school.nz; dburden@mags.school.nz; anthea.morell@minedu.govt.nz
Cc: BChiam (Bernice); DWard (David)
Subject: Central Interceptor project - works at proposed Lyon Avenue site

Hello Dale and Anthea,

We met with you earlier this year and exchanged correspondence during June & July.

One of the main objectors to Watercare's proposed Lyon Avenue site, the St Lukes Gardens Apartments, has suggested another option in the MAGS playing fields. As a consequence, we now need to undertake further assessment of this option, including the effects of that option on school activities.

The background information is set out below. Apologies in advance for the length of this e-mail and the number of attachments. As you can appreciate, we would like to ensure that the potential effects of Watercare's works on school (and other) activities are properly considered – your input is a key component of this.

1. Watercare's proposed construction site layout for the "Lyon Avenue site" is shown on the attached Drawing Number AEE-MAIN-3.2 Issue D.

2. The resource consent hearing for the Central Interceptor project took place between 29 July and 13 August. Watercare presented evidence at the hearing explaining why the "Lyon Avenue site" is the preferred location for the works in this vicinity.

3. The hearing has not yet formally closed as the Commissioners have requested further information on the options in this vicinity – specifically, a further option involving works in MAGS.

4. This further option was suggested by the St Lukes Gardens Apartments. The option is shown on attached Drawing Number 32218/SK02 prepared by engineers Fraser Thomas.

5. The "Fraser Thomas option" is a variation of an option we previously discussed with you and reported on in a summary assessment table in May 2013 – attached.

6. The Commissioners have now asked for further information on the "Fraser Thomas option". Their request for further information is attached. In particular, Item 4 (a) (iii) (c) on page 2 requests an assessment of "the potential for disruptions to school functioning under the MAGS option both during construction and long term …"

7. Our engineers are now looking at the feasibility of this option and the technical issues associated with it.

8. In order to report back to the Commissioners, we would like to meet with MAGS and MOE if possible to discuss the "Fraser Thomas option", the potential effects on the school, and potential options to mitigate those effects.

Please can you let me know if you are available to meet with us sometime over the next two weeks (preferably before 6 Sept) to discuss the project and the "Fraser Thomas option" in the MAGS playing fields. If this is not possible, an alternative would be for us to include (with your agreement) the 16 July letter from MoE in our report back to the Commissioners, along with any additional response you have on the new "Fraser Thomas option".

Thanks again for your consideration of this.
We look forward to hearing from you.

Regards,
Belinda

Belinda Petersen
Resource Consent Manager

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MEMO

MARSHALL DAY Acoustics

Project:	Central Interceptor	**Document No.:**	Mm 006 (GFW Rev)		
To:	Watercare Services Limited	**Date:**	18 September 2013		
Attention:	C/- Aecom	**Cross Reference:**			
Delivery:		**Project No.:**	2011153A		
From:	Graham Warren	**No. Pages:**	6	**Attachments:**	No
CC:					
SUBJECT	Lyon Ave site options assessment				

The Commissioners for the Central Interceptor Hearing have requested further information to assist their deliberations. This memo details Marshall Day Acoustics' response to the request and provides further information as follows:

- A review of the acoustic assessment for the two Mt Albert Grammar School alternative ("MAGS Alternative") site options, namely the pipe-jacked and trenched options. A conclusion as to the preferred option from a noise effects perspective.
- A brief effects comparison of the MAGS Alternative site option with the proposed Lyon Avenue site.

Description of Site Options

The following options form the basis of the assessment:

- MAGS Alternative 1 ("pipe-jack option"): pipe-jacked micro-tunnel with construction and operational access via Morning Star Place and MAGS access road
- MAGS Alternative 2 ("trenched option"): cut and cover trench with construction access via MAGS site access road only, and operational access via MAGS and Morning Star Place to the permanent facilities remaining at each of those sites
- Watercare's proposed Lyon Avenue site ("proposed site"): the details of this assessment are contained in the existing application documents with the relevant results summarised therein.

MAGS Alternative Option Review

Significant noise generating activities have been compared for each option as follows.

Access and Drop Shafts

Both options locate the access and drop shafts at the northern end of the MAGS playing fields. The shafts would be excavated into East Coast Bay Formation (sandstone) typically using sheet piling cofferdams, with shaft excavation and muck-out by excavator/crane. Therefore, similar activity noise levels would be received for St Lukes Garden Apartments (SLGA) and MAGS receivers under each option.

From an acoustic perspective there is no significant difference between the options.

Connection Sewer

The trenched option would employ a "cut and cover" trench that would connect the drop shaft to the connection chamber and would be formed primarily using excavators and sheet piles for trench wall retention and the coffer dam. Trench excavation would encounter basalt from Meola Creek eastwards to the connection chamber (approximately 35 metres) therefore requiring rock-breaking/excavation or controlled blasting/excavation to remove spoil.

Under the pipe-jack option the connecting sewer would be formed and lined using a micro-tunnel boring machine utilising the pipe-jacking method. The tunnel would be bored below the basalt layer (RL circa 10-15 metres) therefore no rock-breaking or controlled blasting would be required for its construction.

From a noise generating perspective, construction of the cut and cover trench would emit higher noise levels, particularly where basalt is broken up using rock breaking, for a longer duration than the pipe-jack option.

Therefore, the pipe-jack method is preferred for this activity.

Diversion Chamber

For both MAGS Alternatives and the proposed Lyon Avenue site, the diversion chamber is located in a similar position, adjacent to 27 Morning Star Place, therefore construction and operational activity noise levels would be the same.

From an acoustic perspective there is no significant difference between the options.

Connection Chamber and Reception/Drop Shaft

The connection chamber (trenched option) and reception/drop shaft (pipe-jack option) are located in similar positions therefore both would require rock-breaking/excavation or controlled blasting/excavation to break up the basalt layer. The reception/drop shaft would require longer excavation time (approximately 2 months) due to its greater depth (RL 6 metres versus RL 21 metres) however the deeper section of the shaft would be constructed through more forgiving ground once the basalt layer was penetrated and would therefore employ conventional excavation rather than rock-breaking or controlled blasting.

As similar methods would be employed to break through the basalt layer for each site option, the associated noise levels from basalt excavation would be comparable.

From an acoustic perspective there is no significant difference between the options.

Cut and cover trench vs Pipe-jacked tunnel

MDA considers that the pipe-jack option, even after taking into account the longer duration to construct the deeper reception/drop shaft, would have less noise impact when compared to the cut and cover trench.

For the MAG Alternative 2 – trenched option, construction noise levels would be higher as noted above, because the trench excavation and pipe installation activities being the open rather than underground as

for the pipe-jack option. The noise levels generated by these activities are predicted to be 70 to 78 dB L_{Aeq} for the nearest apartments in Lyon Avenue and Morning Star Place respectively, without mitigation.

The 78 dB L_{Aeq} predicted for the nearest apartments in Morning Star Place slightly exceeds the construction noise limit of 75 dBA L_{eq}. However, with the use of temporary noise barriers this could be mitigated by 5 to 8 decibels thus achieving a compliant level.

Therefore, from a noise perspective, the pipe-jack method is preferred for this activity.

Site Access

For the trenched option, access to the site would be solely via Alberton Avenue whereas for the pipe-jack option vehicle access would be split between Alberton Avenue, for drop/access shaft construction, and Morning Star Place, for diversion chamber and reception/drop shaft construction works. The pipe-jack option is considered to be the preferred of the tow MAGS Alternatives as it involves less daily heavy traffic noise exposure for SLGA receivers, particularly at sensitive times such as early morning and Saturdays, and would involve less traffic movements adjacent to the MAGS dormitory compared to the trenched option which only incorporates access via Alberton Avenue.

MDA considers that the noise effects from heavy vehicle and other traffic on the access road from the Alberton Avenue site entrance and adjacent to the MAGS dormitory could be mitigated by using a two metre high noise barrier achieving an acceptable level of 47 dB L_{Aeq}. However, installation of such a barrier would prevent access to the School House parking areas and would also restrict access for emergency and service vehicles. If a noise barrier was not used the noise level at the closest façades of the school dormitory would be up to 13 decibels higher and up to 60 dB L_{Aeq} based on the maximum anticipated vehicle flow of 56 truck and 14 standard vehicles per day.

The apartments and residences to the north of the access road are approximately 80 metres distant. The noise generated by the anticipated maximum of 70 vehicle movements per day is predicted to be 45 dB L_{Aeq} at the façades of the nearest dwellings without any noise barriers. This level is readily compliant with all relevant noise criteria and likely to have little appreciable impact on occupiers.

Therefore, from a noise perspective, and taking all the above factors into consideration, the pipe-jack option is preferred for this activity.

Overall Assessment

In conclusion, MDA considers the pipe-jack option to be the preferred option overall based on the balance of facts detailed above, provided that a noise barrier could be erected to provide screening for the MAGS dormitories.

Noise Level Predictions and Assessment of Effects – Pipe-jack Options vs Preferred Site

Construction noise emissions have been predicted for the pipe-jack option[1] and compared to Watercare's proposed Lyon Avenue site. It should be noted that additional source positions and receiver locations

[1] Based on drawing LYON –SK1001 Issue A dated 3 September 2013

have been added to the proposed Lyon Avenue site for comparative purposes. Refer to the attached Tables 1 and 2, which details the predicted noise levels for each site option.

Based on the predicted noise levels given in the attached tables, the following conclusions are made:

- Noise effects from diversion chamber construction will be similar for both options. Break-up of the existing concrete chamber would be by rock-breaker and occur intermittently for a period of approximately one month.

- Construction of the reception shaft/drop shaft under the pipe-jack option is closer to SLGA receivers than the drop shaft in the proposed Lyon Avenue site, therefore receivers would experience higher noise levels over a similar duration. Controlled blasting would reduce the duration of effects from four months down to two months, for both options.

- For the pipe-jack option, noise effects on SLGA receivers from the construction of drop and access shafts on the MAGS sports-field would reduce appreciably by 10 decibels or more and would be readily compliant with NZS 6803:1999.

- For the pipe-jack option, noise effects on MAGS receivers associated with drop and access shaft construction on the MAGS sports-field, would increase by 6 decibels but would remain readily compliant with NZS 6803:1999.

MDA notes that where controlled blasting is used, similar noise levels to those detailed in the attached Tables 1 and 2 would likely occur from blast hole preparation work using rock drills, and rock breakers to tidy up the shaft faces. It is the duration of noise and its associated effects which can be significantly reduced with the use of blasting. Tables 1 and 2 detail the estimated reduction in duration of effects based on current estimated construction time frames for controlled blasting, as supplied by AECOM[2]

Overall, in terms of noise impact, it is considered that Watercare's proposed Lyon Avenue site is preferred over the two MAGS alternatives, as the predicted construction noise levels for the apartments in Morning Star Place and the MAGS sports-field are lower. Also, with the proposed Lyon Avenue site there would be no need for the access road from Alberton Avenue thus reducing the construction noise impact from its widening and from the passage of trucks on the MAGS dormitories.

For operational noise, it is considered that there would be no appreciable difference in received noise levels. For both options compliance with the recommended project noise criteria will be achieved thus ensuring that any noise effects would be no more than minor.

[2] John Cooper (Aecom) via email dated 12 September 2013

PREDICTED NOISE LEVELS FROM ROCK-BREAKING

Table 1: MAGS Alternative 1: Pipe-jack option

Affected Receiver	Activity	Duration of Effects (months)	Predicted Noise Level Without Mitigation (dB L_{Aeq})	Mitigation Options where non-compliant with NZS6803: 1999	Duration of Effects After Mitigation (weeks)	Predicted Noise Level with Mitigation (dB L_{Aeq})
27 Morning Star Place	Diversion chamber rock-breaking/drilling	<1	75- 80	Management through CNMP	<1	Up to 73
	Connection chamber rock-breaking/drilling	4	72-75	Controlled blasting	2	-
	Drop shaft and access shaft	<1	61-63[3]	Controlled blasting	<1	-
28 Morning Star Place	Diversion chamber rock-breaking/drilling	<1	75-78	Management through CNMP	<1	Up to 80
	Connection chamber rock-breaking/drilling	4	72-74	Controlled blasting	2	-
	Drop shaft and access shaft	<1	59-60[3]	Controlled blasting	<1	-
MAGS classrooms adj access road	Diversion chamber rock-breaking/drilling	<1	54-57	Not required	<1	-
	Connection chamber rock-breaking/drilling	4	59-62	Not required	2	-
	Drop shaft and access shaft	<1	59-60[3]	Not required	<1	-
	Vehicles on access road		61 – 63	Not required		47 - 49[4]

[3] Excavation in ECBF
[4] dB L_{Aeq} 12 hrs

Table 2: Proposed Lyon Avenue site

Affected Receiver	Activities	Duration of Effects (months)	Predicted Noise Level without mitigation (dB L_{Aeq})	Mitigation Options where non-compliant with NZS6803: 1999	Duration of Effects After Mitigation (weeks)	Predicted Noise level with mitigation (dB L_{Aeq})
27 Morning Star Place	Diversion chamber rock-breaking/drilling	<1	Up to 73	Management through CNMP	<1	Up to 73
	Connection chamber rock-breaking/drilling	4	-	-	-2	-
	Drop shaft and access shaft	4	-	Controlled blasting	2	-
28 Morning Star Place	Diversion chamber rock-breaking/drilling	<1	Up to 80	Management through CNMP	<1	Up to 80
	Connection chamber rock-breaking/drilling	4	-	-	-2	-
	Drop shaft and access shaft	4	77-80	Controlled blasting	2	-
MAGS classrooms adj access road	Diversion chamber rock-breaking/drilling	<1	23 - 45	Not required	<1	-
	Connection chamber rock-breaking/drilling	4	-	-	2	-
	Drop shaft and access shaft	4	22 - 42	Not required	2	-

Tonkin & Taylor

T&T Ref: 29200
19 September 2013

Watercare Services Limited
Private Bag 92 521
Wellesley Street
Auckland 1141

Attention: Belinda Petersen

Dear Belinda

Central Interceptor Project
Technical report on settlement for site AS2 - S41C RMA Direction

1 Introduction

This technical report has been prepared for Watercare Services Limited (WSL) at their request to assist them in preparing a response to a S41C RMA Direction from the Auckland Council Hearing Panel.

It provides information specific to the S41C RMA Direction under item 4 (a) (v), which requests:

"A quantified risk assessment of the potential for ground settlement adversely affecting the SGLA buildings during construction of the tunnel and shaft for both alternatives."

The S42C identifies that the alternatives are the Lyon Avenue site proposed by WSL and the Mt Albert Grammar School option (MAGS), presented by Mr Maddren at the Hearing.

2 Scope

Given the potential extent of work and timeframe required to undertake a quantitative risk assessment, a qualitative risk assessment has been undertaken. This assessment is based on inference from existing analysis and available information including Auckland Council's property files for the St Lukes Gardens Apartments (SLGA). The geological conditions and shaft configurations studied in the existing analyses are sufficiently similar to those in this study, that the findings and conclusions presented here can be considered appropriate for this stage of the project.

This report provides estimates of potential settlement that might arise as a result of construction activities for the Proposed Lyon Avenue site and the Mt Albert Grammar School (MAGS) Alternative site. Based on these estimates AECOM have separately prepared an assessment of the potential for the settlement to adversely affect the SGLA buildings.

3 Assumptions

The assessments made here are based on the attached geological information and the layouts for each of the alternatives provided by AECOM, (AEE-MAIN-3.1 issue D, LYON-SK1101 issue C and LYON-SK1001 issue Included in Appendix C).

Watercare's Proposed Lyon Avenue site is shown on AEE-MAIN-3.1 issue D, with all the shafts located on the eastern side of Meola Creek.

The MAGS Alternative site is shown on LYON-SK1101 issue C and LYON-SK1001 issue C. These two drawings identify a layout with shafts constructed on both sides of Meola Creek, connected by either pipeline constructed by trenching, or a deeper pipeline constructed by pipe jacking.

3.1 Existing analyses utilised in this study

The geological information (Figure 1 and Figure 2 in Appendix A) identifies that the conditions at the Proposed Lyon Avenue site and the MAGS Alternative site are similar to those previously studied at the Mt Albert War Memorial Reserve site and at the Whitney Street site respectively.

Example construction methodologies were developed for both those sites during settlement studies as part of S92 settlement studies pre Hearing. Those studies will be utilised here to provide qualitative assessments of potential settlement.

In utilising those studies, we have adopted the same assumptions around the construction methodologies used as examples for those sites. Those methodologies were developed to specifically address the conditions at those sites.

4 Geology of sites for AS2

In the vicinity of the Proposed Lyon Avenue site and the MAGS Alternative site, Meola Creek demarcates a change in the geological ground profile. Basalt flows dominate surface geology to the east and north overlying Puketoka Formation, and East Coast Bays Formation (ECBF) rock at depth. To the south and west surface geology is air fall ash deposits or Puketoka Formation deposits, overlying ECBF rock.

For the purposes of this comparative study, these two geological environments are considered similar to the geology at the Mt Albert War Memorial Reserve site and the Whitney Street site respectively. The qualitative study of potential surface effects, completed for those two sites during S92 responses, have been utilised here to provide a basis for assessing the potential settlement effects at the two alternative locations for site AS2.

Table 1 and Table 2 provide a direct comparison of general geological conditions at the two alternative AS2 locations with the corresponding existing analyses.

Table 1 – Proposed Lyon Avenue Site – Typical main shaft (drop shaft and access shaft) geology comparison

Geological Unit	Proposed Lyon Avenue Site thickness	Comparative Mt Albert War Memorial Reserve site thickness
Basalt rock	5 to 7 m	11 m
Puketoka Formation	22 to 24 m	19 m
ECBF	18 m+	20 m+

Table 2 – MAGS Alternative – Typical main shaft (drop shaft and access shaft) geology comparison

Geological Unit	MAGS Alternative site thickness	Comparative Whitney Street site thickness
Ash	2 to 5 m	NIL
Puketoka Formation	NIL	8 m
ECBF	40 m+	60 m+

The Mt Albert War Memorial Reserve analyses provide a reasonable comparison to the Proposed Lyon Avenue site. The basalt rock is considered incompressible in terms of direct settlement arising from groundwater drawdown, so the difference in overlying thickness is of little importance in this comparison. The Puketoka Formation is mostly likely to contribute the majority of settlement that might arise from groundwater drawdown. The Proposed Lyon Avenue site has Puketoka Formation about 25% thicker than the Mt Albert War Memorial Reserve site. Drawdown effects, i.e. settlement estimates are likely to be proportional to the thickness of the compressible layer. Therefore the estimates of settlement that were made using numerical analysis techniques for the Mt Albert War Memorial Reserve site can be extrapolated to the MAGs Alternative site without significant loss in accuracy.

The Whitney Street site provides a relatively good geotechnical match to the MAGS Alternative site, despite a difference in surface geology. The ash is likely to be slightly less compressible than the Puketoka Formation, meaning that the assessments of settlement at the MAGS Alternative site based on the Whitney Street analyses are likely to be conservative (over estimates of settlement that might arise).

5 Settlement estimates

Estimates have been adopted directly from the S92 work for the Whitney Street site and the Mt Albert War Memorial site.

5.1 Proposed Lyon Avenue site shafts

The Whitney Street site settlement estimates have been factored up by 25% to estimate settlement at the Proposed Lyon Avenue site to allow for the greater thickness of compressible material potentially present at this site.

These estimates are considered appropriate for assessing the effects of the access shaft and drop shafts.

Table 3 – Proposed Lyon Avenue site estimated settlement with distance from edge of single shaft

Distance from Shaft	0 m	5 m	10 m	20 m	30 m	40 m	50 m	100 m
Estimated settlement	60 mm	55 mm	55 mm	50 mm	45 mm	40 mm	35 mm	20 mm

Settlement differentials are estimated to be 1:2,000 or flatter in all cases.

5.2 MAGS Alternative site shafts

The Whitney Street site settlement estimates have been adopted directly as estimates of settlement for the MAGS Alternative site.

These estimates are considered appropriate for assessing the effects of the access shaft and drop shafts.

Table 4 – MAGS Alternative site estimated settlement with distance from edge of single shaft

Distance from Shaft	0 m	5 m	10 m	20 m	30 m	40 m	50 m	100 m
Estimated settlement	30 mm	30 mm	30 mm	30 mm	30 mm	30 mm	30 mm	20 mm

Settlement differentials are estimated to be flatter than 1:2,000 in all cases.

For the drop shaft on the eastern side of Meola Creek associated with this option, the settlement is expected to similar to that estimated for the access shaft and drop shafts in the Proposed Lyon Avenue site, repeated here in Table 5.

Table 5 – MAGS Alternative estimated settlement for drop shaft on eastern side of Meola Creek (refer LYON-SK1001 issue C)

Distance from Shaft	0 m	5 m	10 m	20 m	30 m	40 m	50 m	100 m
Estimated settlement	60 mm	55 mm	55 mm	50 mm	45 mm	40 mm	35 mm	20 mm

Settlement differentials are estimated to be 1:2,000 or flatter in all cases.

5.3 MAGS Alternative site – connection across Meola Creek

For the MAGS Alternative site, there are two options for connecting the flows from the diversion chamber to the drop shaft:

- A trench excavation, and,
- A pipe jacked connection some 10-15 m depth to invert below ground level.

In both cases, AECOM advises the connection will be via a pipe some 2.7 m in diameter.

5.3.1 Open trench installation (LYON-SK1101)

The trench will be excavated through basalt and Puketoka formation on the eastern side of Meola Creek, and Puketoka Formation and ECBF rock.

The trench will mostly likely be excavated progressively in small sections, within a support shield. This construction methodology is not likely to result in significant surface settlement away from the immediate excavation area.

5.3.2 Pipe jacking installation (LYON-SK1001)

A nominally 2.7 m diameter pipe is shown with installation from the drop shaft on the western side of Meola Creek to the reception shaft/drop shaft on the eastern side.

The pipe jack will start within ECBF rock, before transitioning into Puketoka Formation material some 2/3 of the way along the run.

This is a similar construction methodology to much of the proposed combined sewer overflow network, as reported in "Central Interceptor Project, CSO Settlement Study", Tonkin & Taylor Ltd, July 2012.

In that study, estimates of potential surface settlement that could arise from construction were presented. Those estimates indicate that when the pipe jack is entirely within the ECBF, little if any surface settlement would be expected. This is the situation for most of the pipeline on the western side of Meola Creek. On the eastern side, where the pipeline is constructed with approximately 10 m cover to the pipe crown in Puketoka Formation some 10-20 mm of settlement is estimated immediately above the pipeline, reducing away from the centreline such that settlement is expected to be close to zero 20 m from the pipe centreline. Maximum differentials associated with the settlement are estimated to be in the order of 1:1,000 some 6 m from the pipe centreline.

6 Conclusions

A qualitative assessment has been undertaken of the potential for settlement arising from the Proposed Lyon Avenue site and the MAGS Alternative site. This assessment is based on inference from existing analysis where the geological conditions and shaft are sufficiently similar to those in this study, such that the findings and conclusions presented here can be considered appropriate for this stage of the project.

This report provides estimates of potential settlement that might arise as a result of construction activities for the Proposed Lyon Avenue site and the MAGS Alternative site. Based on these estimates AECOM have separately prepared an assessment of the potential for the settlement to adversely affect the SGLA buildings.

For the Proposed Lyon Avenue site, settlement associated with shaft construction is estimated to be 60 mm immediately adjacent to the shaft, reducing to some 20 mm approximately 100 m from the shaft.

For the MAGS Alternative site settlement associated with shaft construction is estimated to be 30 mm immediately adjacent to the shaft, reducing to some 20 mm approximately 100 m from the shaft.

Construction of the drop shaft on the eastern side of Meola Creek associated with the MAGS Alternative site is estimated to result in 60 mm of settlement immediately adjacent to the shaft, reducing to some 20 mm approximately 100 mm from the shaft.

An additional feature of the MAGS Alternative site is the need to connect flows from the diversion chamber on the eastern side of Meola Creek to the shafts on the western side: two options are considered;

- A trenched option is not expected to result in significant surface settlement away from the immediate excavation area.
- The alternative pipe jacked option could result some 10-20 mm of settlement immediately above the pipeline, reducing away from the centreline such that settlement is expected to be

close to zero 20 m from the pipe centreline. Maximum differentials associated with the settlement are estimated to be in the order of 1:1,000 some 6 m from the pipe centreline.

7 Applicability

This report has been prepared for the benefit of Watercare Service Limited with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
pp	.....
Graeme Twose	Robert Hillier
Senior Geotechnical Engineer	Geotechnical Group Manager

19-Sep-13
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Appendix A: Geological information

ORIGINAL IN COLOUR

INFORMATION ONLY
September 2013

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DES. CHECKED		
DRAWN	AGI	08/13
DWG. CHECKED		
REV'D P.MGR		
APP'D P.DIR		
BY		DATE

OPERATIONS

ASSET MANAGER

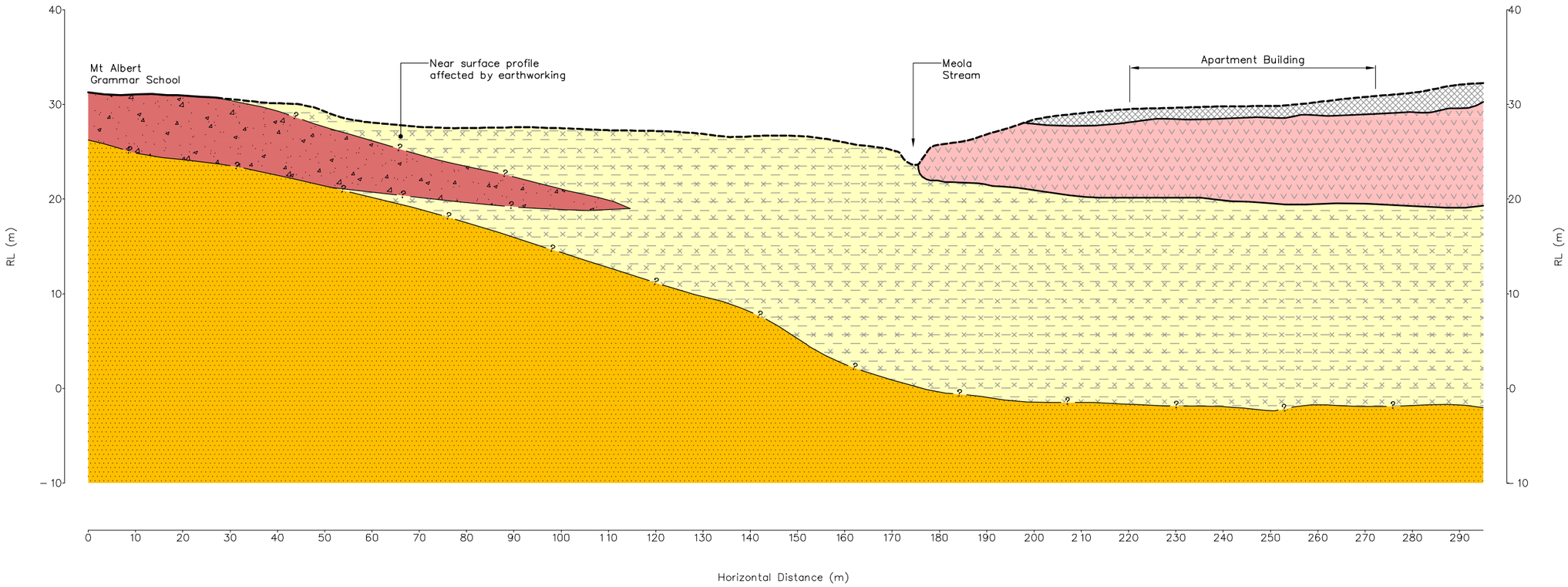
water Care services limited

CENTRAL INTERCEPTOR AND ASSOCIATED WORKS
GEOTECHNICAL CONDITIONS

CAD FILE 29200-F01	DATE 1-Jun-12
ORIGINAL SCALE A1 1:1250	CONTRACT No.
DRAWING No. FIGURE 1	ISSUE

WEST
A

EAST
A'



SECTION A
SCALE 1:500(H)
1:250(V)

LEGEND

- Fill
- Basalt
- Ash
- Puketoka Formation
- East Coast Bay Formation

A3 SCALE 1:500
A1 SCALE 1:250
0 10 20 30 (m)

ORIGINAL IN COLOUR

INFORMATION ONLY
September 2013

L:\29200\Working Material\CAD\29200-F02.dwg, F2, 19/09/2013 10:13:33 a.m., amm, 1:2

ISSUE	DATE	AMENDMENT	BY	APPD.

DESIGNED	KJH	08/13
DES. CHECKED		
DRAWN	AGI	08/13
DWG. CHECKED		
REV'D P.MGR		
APP'D P.DIR		
BY		DATE

OPERATIONS

ASSET MANAGER

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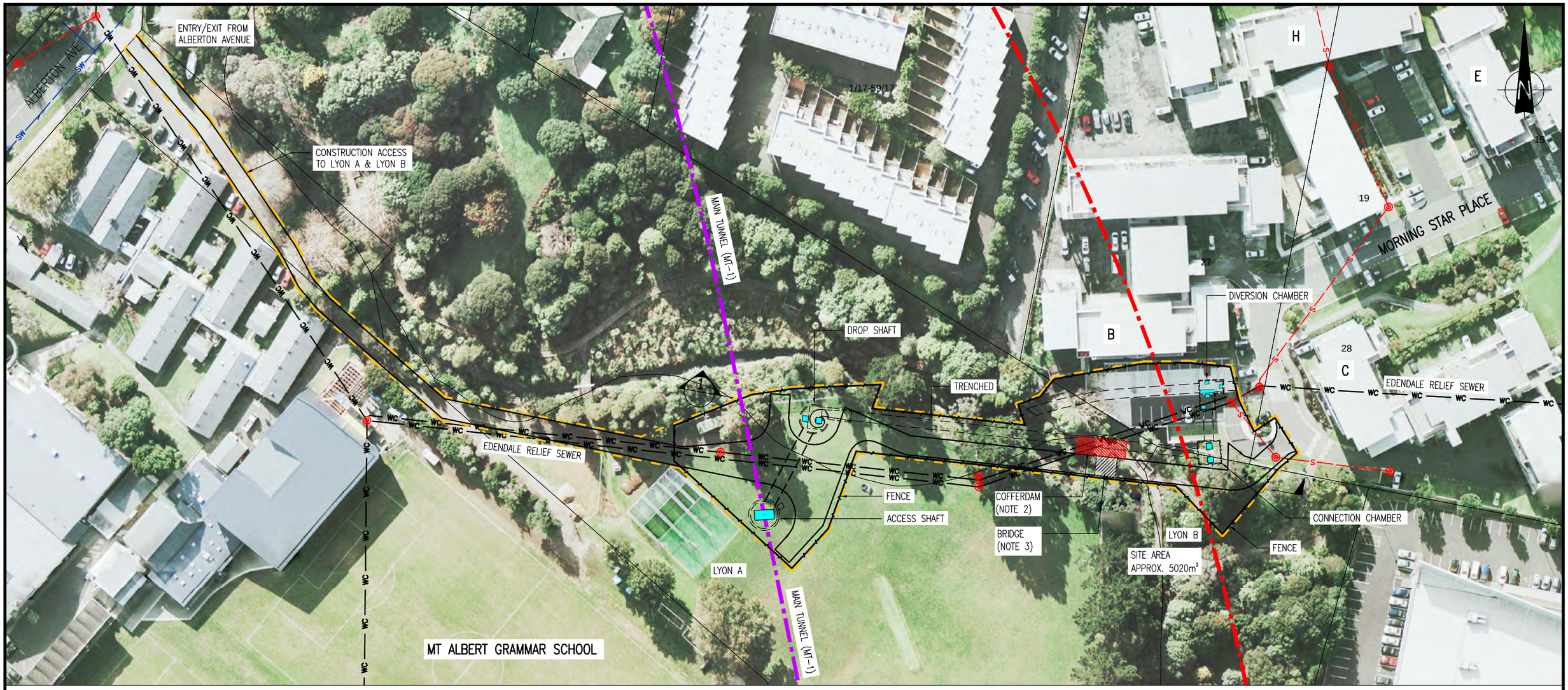
CENTRAL INTERCEPTOR AND ASSOCIATED WORKS
GEOTECHNICAL CONDITIONS

CAD FILE 29200-F02	DATE 1-Jun-12
ORIGINAL SCALE A1 AS SHOWN	CONTRACT No.
DRAWING No. FIGURE 2	ISSUE

Appendix B: Layout drawings from AECOM

- **LYON-SK1101**
- **LYON-SK1001**
- **AEE-MAIN-3.1_D**

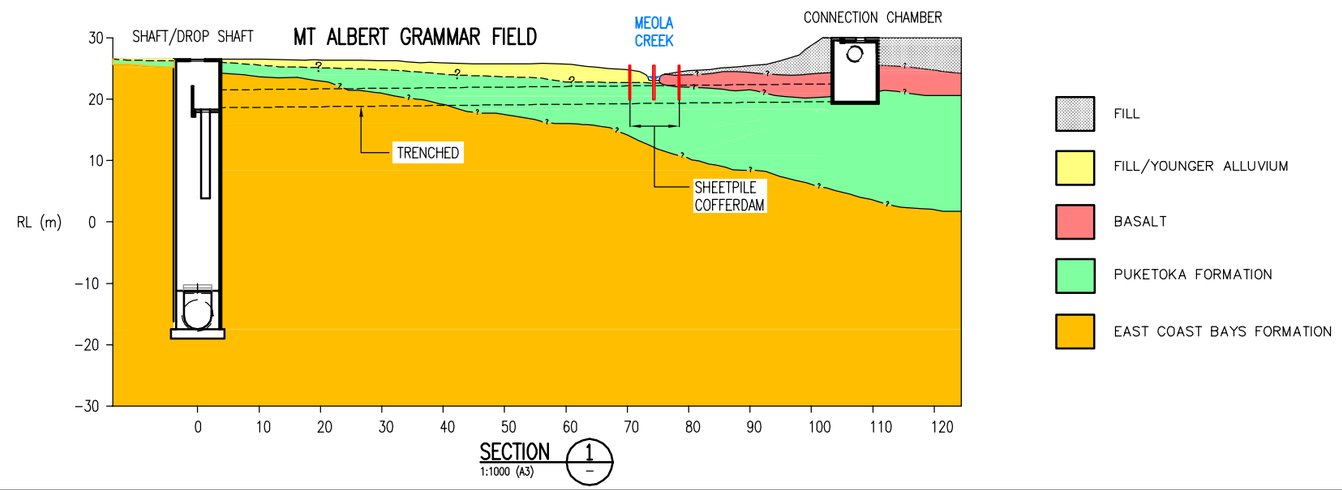


LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
- PROPOSED SITE BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND

NOTES:

1. SEE DRAWING LYON-SK401_0A FOR PLAN OF TUNNEL ALIGNMENTS FOR LYON AVE SITE OPTIONS.
2. MEAOLA STREAM TO BE DIVERTED LEFT AND THEN RIGHT WITHIN SHEETPILE COFFERDAM TO ALLOW CONSTRUCTION OF TRENCH AND PIPE LAYING. FOOTPATH TO BE DIVERTED.
3. BRIDGE REQUIRED FOR ACCESS ACROSS STREAM (EITHER PERMANENT OR TEMPORARY, DEPENDING ON ACCESS ARRANGEMENTS).



SECTION 1 — 1:1000 (A3)

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C	19/09/13	LEGEND UPDATED	AP	JQC
B	17/09/13	FOR INFORMATION	AP	JQC
A	–	DRAFT	AP	PR

Project No.

DESIGNED	NL	
DES. CHECKED	JQC	–
DRAWN	AP	
DWG. CHECKED	NL	–
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
BY		DATE

OPERATIONS

ASSET MANAGER

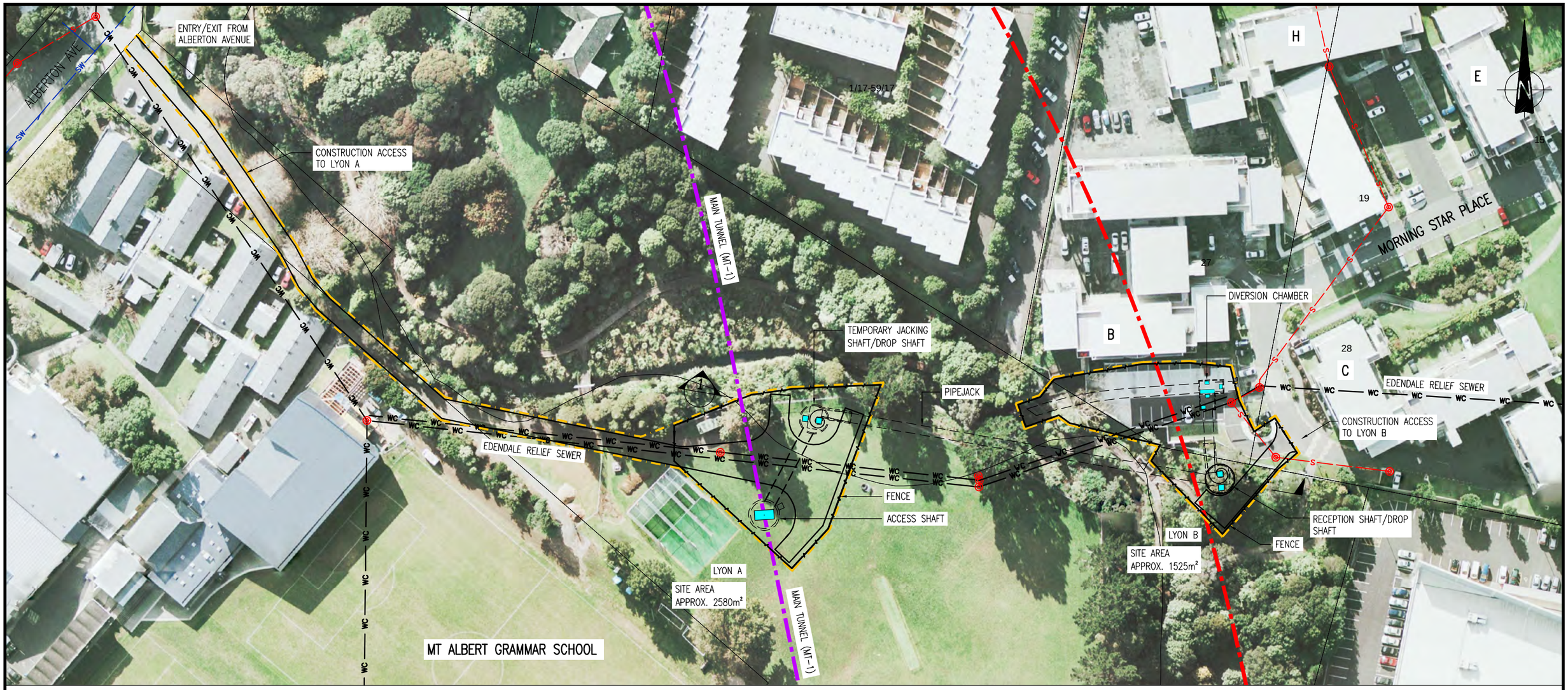
SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

water Care services limited

CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 2
LYON AVENUE (AS2) – CONSTRUCTION ACCESS FROM MAGS (TRENCHED OPTION)

CAD FILE LYON-SK1101	DATE 19-Sep-13
ORIGINAL SCALE A1 1:1000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK1101	ISSUE C

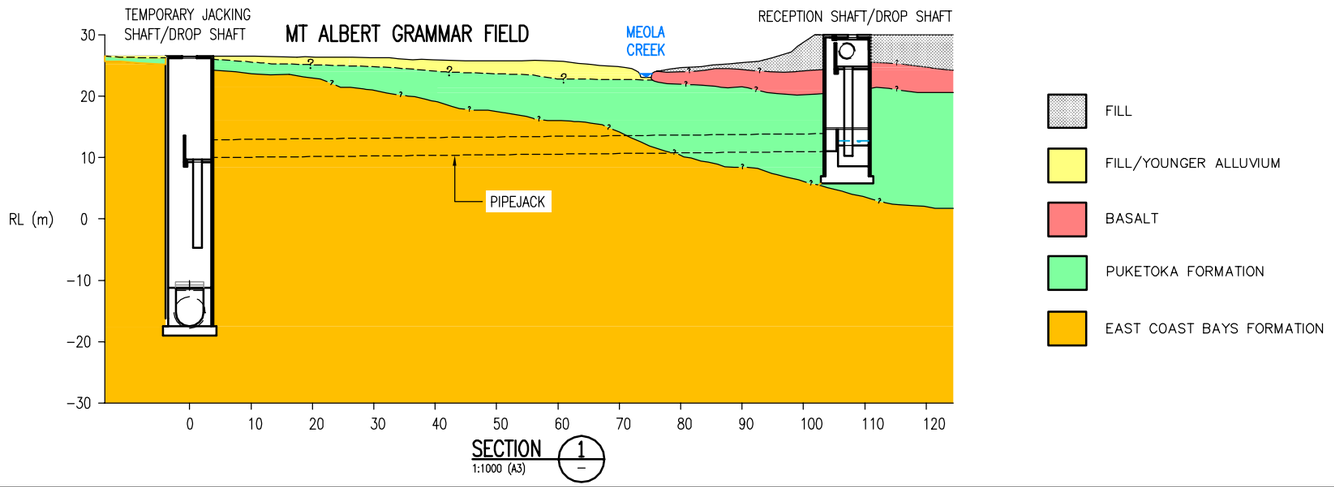


LEGEND

- PROPOSED TUNNEL ALIGNMENT
- MAGS ALTERNATIVE TUNNEL ALIGNMENT
- CONNECTION PIPELINE
- EXISTING RETICULATION SEWER (S)
- EXISTING TRUNK SEWER (WC)
- EXISTING STORMWATER (SW)
- PROPOSED SITE BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND

NOTES:

1. SEE DRAWING LYON-SK401_0A FOR PLAN OF TUNNEL ALIGNMENTS FOR LYON AVE SITE OPTIONS.



SECTION 1/– 1:1000 (A3)

ISSUE	DATE	AMENDMENT	BY	APPD.
C	19/09/13	LEGEND UPDATED	AP	JQC
B	17/09/13	FOR INFORMATION	AP	JQC
A	–	DRAFT	AP	PR

DESIGNED	NL	
DES. CHECKED	JQC	–
DRAWN	AP	
DWG. CHECKED	NL	–
REV'D P.MGR	JQC	
APP'D P.DIR	CC	
	BY	DATE

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

FOR INFORMATION

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CENTRAL INTERCEPTOR
GENERAL – MT ALBERT GRAMMAR SCHOOL ALTERNATIVE 1
LYON AVENUE (AS2) – SEPARATE CONSTRUCTION ACCESS (PIPEJACK OPTION)

CAD FILE LYON-SK1001	DATE 19-Sep-13
ORIGINAL SCALE A1 1:1000 A3	CONTRACT No. 0538
DRAWING No. LYON-SK1001	ISSUE C

Project No.

Plot Date: 19-Sep-13 9:26 a.m.
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Plot Date: 18-Jul-13 3:03 p.m.
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Project No.

ISSUE	DATE	AMENDMENT	BY	APPD.
D	18/7/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
C	12/07/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
B	28/05/13	CONSENT ISSUE - DESIGNATION BOUNDARY/ACCESS REVISED	AP	PR
A	17/08/12	CONSENT ISSUE	AP	PR

DESIGNED	NL		
DES. CHECKED	JS	-	
DRAWN	AP		
DWG. CHECKED	NL	-	
REV'D P.MGR	JS		
APP'D P.DIR	CC		
BY		DATE	

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

AEE JULY 2013

water Care services limited

CENTRAL INTERCEPTOR
GENERAL
LYON AVENUE (AS2) - PERMANENT WORKS PLAN

CAD FILE AEE-MAIN-3.1_D | DATE 18-Jul-13

ORIGINAL SCALE A1 1:1000 A3 | CONTRACT No. 0538

DRAWING No. AEE-MAIN-3.1 | ISSUE D

Central Interceptor Main Project Works – Comparative assessment of proposed Lyon Avenue site and MAGS Alternative sites

Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	**MAGS Alternative 1 - Pipe Jacked** Drawing Number LYON-SK1001 Issue C	**MAGS Alternative 2 – Trenched** Drawing Number LYON-SK1101 Issue C
LAND OWNERSHIP		
Crown (Ministry of Education) Multiple unit owners (St Lukes Garden Apartments (SLGA)), St Lukes Holdings Ltd	Crown (Ministry of Education) Multiple unit owners (St Lukes Garden Apartments (SLGA)), St Lukes Holdings Ltd	Crown (Ministry of Education) Multiple unit owners (St Lukes Garden Apartments (SLGA)), St Lukes Holdings Ltd
DESIGN CONSIDERATIONS		
Optimal location for connection of Edendale Branch Sewer to main Central Interceptor tunnel. Least physical works and design required to achieve objective.	Additional intermediate drop structure required at Lyon Avenue overflow (connection of Edendale Branch Sewer) results in more complex hydraulics design and additional safety considerations (additional confined space operation). As the site location in MAGS is known to flood, the shaft lids would need to be raised by approximately 1 metre and / or made watertight. Should the lids be raised, the surrounding land area could be raised to tie in with the lid levels and prevent pooling of water at that location. Consideration would need to be given to prevent diversion of water exacerbating flooding in other areas of the playing fields.	Additional connection chamber required at Lyon Avenue overflow (connection of Edendale Branch Sewer) results in additional design considerations, such as deep trench design, access bridge design, flow diversion and upstream and downstream effects on Meola Creek. As the site location in MAGS is known to flood, the shaft lids would need to be raised by approximately 1 metre and / or made watertight. Should the lids be raised, the surrounding land area could be raised to tie with the raised lid and prevent pooling of water at that location. Consideration would need to be given to prevent diversion of water causing flooding in other areas of the playing fields.
CONSTRUCTION CONSIDERATIONS		
<u>Approximate construction site area</u>	<u>Approximate construction site area</u>	<u>Approximate construction site area</u>
4050m^2	4105m^2	5020m^2 Significantly larger construction site area due to trenching activities, construction access across Meola Creek, flow diversion and silt control measures.
<u>Geotechnical conditions at site</u>	<u>Geotechnical conditions at site</u>	<u>Geotechnical conditions at site</u>
Main drop shaft location – presence of basalt requiring blasting or rock breaking for excavation.	Main drop shaft location – basalt is absent resulting in less complex excavation methodology. Intermediate drop shaft location – presence of basalt requiring blasting or rock breaking for excavation. Pipe jacking has to set at about 12 metres below ground level, under the basalt layer.	Main drop shaft location – basalt is absent resulting in less complex excavation methodology. Connection chamber location – presence of basalt requiring blasting or rock breaking for excavation. The trench is located in basalt east of Meola Creek which would also require blasting or rock breaking until it crosses Meola Creek.
<u>Construction site layout</u>	<u>Construction site layout</u>	<u>Construction site layout</u>
Connection of Edendale Branch Sewer via diversion chamber and drop shaft to main Central Interceptor tunnel. Shafts constructed at 9 metres diameter, finished at 7 metres diameter. Work is contained within one site.	Connection of Edendale Branch Sewer via diversion chamber and intermediate drop shaft east of Meola Creek, and pipe jacking under Meola Creek to main drop shaft in MAGS. Access shaft to main Central Interceptor tunnel approximately 8 metres in diameter. Shafts constructed at 8.5 metres diameter, finished at 7 metres diameter. Work is divided into two sites:	Connection of Edendale Branch Sewer via diversion chamber and connection chamber east of Meola Creek, and trenching across Meola Creek to main drop shaft in MAGS. Access shaft to main Central Interceptor tunnel approximately 8 metres in diameter. Shafts constructed at 8.5 metres diameter, finished at 7 metres diameter. Work is contained within one extended site. Trenching across Meola Creek would require associated stream diversion. Potential trench depth of up to 5 to 8 metres, requiring shoring or batters. Trench depth is close to limits for this construction method resulting in heightened safety concerns. Access between Lyon Avenue and MAGS would require temporary (or permanent) bridge over Meola Creek.

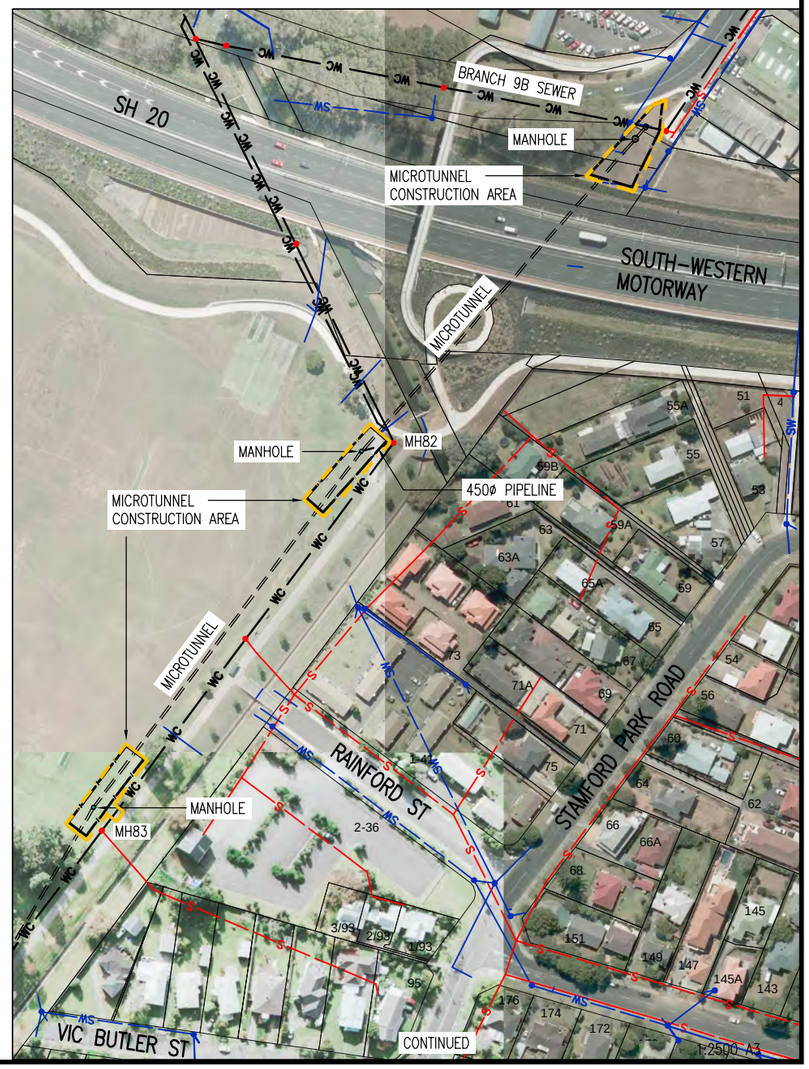
Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	**MAGS Alternative 1 - Pipe Jacked** Drawing Number LYON-SK1001 Issue C	**MAGS Alternative 2 – Trenched** Drawing Number LYON-SK1101 Issue C
Construction access	Construction access	Construction access
Construction access via Morning Star Place. As this is an existing residential road, no additional construction works required to provide access to proposed construction site.	Two separate construction access routes, some additional safety controls required. Construction access via Morning Star Place to construction area east of Meola Creek and via Alberton Avenue and MAGS Gate 1 to construction area west of Meola Creek. Existing MAGS access road via Gate 1 would need to be widened in part using gabions or timber pole walls on the stream banks, with associated tree removals, and resurfaced.	Construction access via Alberton Avenue and MAGS Gate 1 to construction area east of Meola Creek and via access road and bridge across Meola Creek to construction area in Crown and SLGA land west of Meola Creek. Existing MAGS access road via Gate 1 would need to be widened in part using gabions or timber pole walls on the stream banks, with associated tree removals, and resurfaced. Access bridge over Meola Creek would need to be substantial to accommodate construction trucks and heavy machinery and designed to not impede flood flows.
OPERATIONAL CONSIDERATIONS		
Permanent access	Permanent access	Permanent access
Permanent access via Morning Star Place.	Permanent access via Morning Star Place to permanent facilities east of Meola Creek and via Alberton Avenue and MAGS Gate 1 to permanent facilities west of Meola Creek.	Permanent access via Morning Star Place to permanent facilities east of Meola Creek and via Alberton Avenue and MAGS Gate 1 to permanent facilities west of Meola Creek. OR If temporary construction bridge is retained for permanent use, permanent access could be solely via Morning Star Place or solely via MAGS. Retention of the temporary construction bridge for permanent use has not been assessed further as the bridge and associated access road would result in significant additional long term impact on the Crown land, MAGS activities, and Roy Clements Treeway.
Permanent access required to diversion chamber and other facilities in SLGA land (within existing Watercare easement area). All weather trafficable access also required in area of Roy Clements Treeway (Crown land) for occasional inspection and maintenance activities. Easement would need to be established to secure access in Crown land.	Permanent access required to diversion chamber and other facilities in SLGA land (within existing Watercare easement area). All weather trafficable access also required in area of Roy Clements Treeway (Crown land) for occasional inspection and maintenance activities; area required is much less than for Watercare's proposed Lyon Avenue site. Permanent all-weather trafficable access required via MAGS and north of cricket nets to drop shaft and tunnel access shaft for occasional inspection and maintenance activities. Easement would need to be established to secure access in Crown land.	Permanent access required to diversion chamber and other facilities in SLGA land (within existing Watercare easement area). All weather trafficable access also required in area of Roy Clements Treeway (Crown land) for occasional inspection and maintenance activities; area required is much less than for Watercare's proposed Lyon Avenue site. Permanent all-weather trafficable access required via MAGS and north of cricket nets to drop shaft and tunnel access shaft for occasional inspection and maintenance activities. Easement would need to be established to provide access in Crown land.
Operations and maintenance	Operations and maintenance	Operations and maintenance
Connection of Lyon Avenue overflow enters main drop shaft close to ground level and is readily inspected from the surface.	Additional structure (intermediate drop shaft) at Lyon Avenue overflow requires additional maintenance access facilities. Connecting pipeline from intermediate drop shaft enters the main drop shaft at depth adding further complexity for inspection and maintenance. Longer length of access road would increase potential road maintenance requirements.	Additional structure (connection chamber) at Lyon Avenue overflow requires additional maintenance access facilities. Connecting pipeline between connection chamber and the main drop shaft requires further maintenance. Longer length of access road would increase potential road maintenance requirements.

Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	**MAGS Alternative 1 - Pipe Jacked** Drawing Number LYON-SK1001 Issue C	**MAGS Alternative 2 – Trenched** Drawing Number LYON-SK1101 Issue C
COSTS		
Cost comparison relative to Lyon Avenue site	Cost comparison relative to Lyon Avenue site	Cost comparison relative to Lyon Avenue site
N/A	Additional costs of around $1.12M associated with construction site activities. Main tunnel length shortened by approximately 65 metres with potential cost reduction of $1.17M. Overall cost neutral. Note that this excludes costs associated with securing property access rights.	Additional costs of around $895,000 associated with construction site activities. Main tunnel length shortened by approximately 65 metres with potential cost reduction of $1.17M. Overall, potential cost reduction of approximately $275,000 compared to proposed Lyon Avenue site. Note that this excludes costs associated with securing property access rights.
POTENTIAL EFFECTS		
Land use effects	**Land use effects**	**Land use effects**
Residential activities:	Residential activities:	Residential activities:
Limited separation from residential neighbours (approximately 15 metres to closest), with associated noise and vibration construction effects and loss of amenity.	Limited separation from residential neighbours (approximately 15 metres to closest) at the diversion chamber and intermediate drop shaft, with associated noise and vibration construction effects and loss of amenity. Construction of the main drop shaft and access shaft in MAGS would occur further away from SLGA apartments but nearer to residential townhouses at 17 Lyon Avenue (located approximately 50m north of the construction area, across Meola Creek).	Limited separation from residential neighbours (approximately 15 metres to closest) at the diversion chamber and connection chamber, with associated noise and vibration construction effects and loss of amenity. Construction of the main drop shaft and access shaft in MAGS would occur further away from SLGA apartments but nearer to residential townhouses at 17 Lyon Avenue (located approximately 50m north of the construction area, across Meola Creek).
Construction access via Morning Star Place passes through residential area, with associated noise effects from heavy vehicles. Traffic management measures to be implemented to minimise potential effects on pedestrian access and safety.	Construction access road passes immediately adjacent to the dormitories of the MAGS School House boarding hostel ("School House"). At some points, the access is only a couple of metres or less from the buildings. Potential for adverse noise effects if no acoustic barrier (fence) is implemented. Depending on the location and nature of fencing and traffic management, the construction access has the potential to impact on pedestrian safety and on access to and parking at School House. As the heavy vehicle traffic volumes for this option would be slightly less than for the trenched option (which involves access only via MAGS), the potential effects on School House would be slightly less, but not significantly so as the same issues of pedestrian safety, noise and access would apply.	Construction access road passes immediately adjacent to the dormitories of the School House boarding hostel ("School House"). At some points, the access is only a couple of metres from the buildings. Potential for adverse noise effects if no acoustic barrier (fence) is implemented. Depending on the location and nature of fencing and traffic management, the construction access has the potential to impact on pedestrian safety and on access to and parking at School House.
Permanent access requirements would have little effect on residential activity at SLGA as the normal access requirements would be infrequent (around one vehicle per month) and via an established residential access road.	Permanent access requirements would have little effect on residential activity at School House as the normal access requirements would be infrequent (around one vehicle per month) and via the school access road. Security arrangements for access through the school and locked fence gates would need to be agreed with MAGS.	Permanent access requirements would have little effect on residential activity at School House as the normal access requirements would be infrequent (around one vehicle per month) and via the school access road. Security arrangements for access through the school and locked fence gates would need to be agreed with MAGS.
School activities:	School activities:	School activities:
No adverse effects on school activities as the construction site is located east of Meola Creek in an area that is not used for school activities.	Construction access via MAGS Gate 1 would conflict with existing use of access road for school activities including access to School House, playing fields and sports pavilion. Potential effects on residential activities at School House are noted above. Construction area adjacent to cricket nets would impact on use of playing fields for summer and winter sports and training activities.	Construction access via MAGS Gate 1 would conflict with existing use of access road for school activities including access to School House, playing fields and sports pavilion. Potential effects on residential activities at School House are noted above. Construction area adjacent to cricket nets would impact on use of playing fields for summer and winter sports and training activities. The construction impacts of this option would be greater than the pipe-jack option due to the additional land requirements for trenching activities and access.

Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	**MAGS Alternative 1 - Pipe Jacked** Drawing Number LYON-SK1001 Issue C	**MAGS Alternative 2 – Trenched** Drawing Number LYON-SK1101 Issue C
No impact on school activities arising from permanent works.	Shaft lids and permanent all-weather access road would remain at the site. Permanent works could be designed to minimise impacts on school playing fields (e.g. surfacing and ground levels to tie in with surrounding land, but noting need to consider consequential effects of overland stormwater flows in other areas). Main impact is that no buildings could be constructed in the area of the shafts and access road, potentially affecting future school development options.	Shaft lids and permanent all-weather access road would remain at the site. Permanent works could be designed to minimise impacts on school playing fields (e.g. surfacing and ground levels to tie in with surrounding land, but noting need to consider consequential effects of overland stormwater flows in other areas). Main impact is that no buildings could be constructed in the area of the shafts and access road, potentially affecting future school development options. Building development on land above the connection pipe may also be restricted depending on final depth.
Recreational activities:	Recreational activities:	Recreational activities:
Local effect on recreation and amenity values during construction due to proximity of works to public walkway and need for temporary diversion of the walkway between the Roy Clements Treeway and SLGA and the St Lukes commercial centre.	Local effect on recreation and amenity values during construction due to proximity of works to public walkway. Effects on school recreational activities noted above.	Local effect on recreation and amenity values during construction due to proximity of works to public walkway and temporary closure of the boardwalk along Meola Creek during construction works. Effects on school recreational activities noted above.
Traffic effects	**Traffic effects**	**Traffic effects**
Traffic:	Traffic:	Traffic:
Morning Star Place represents good option for traffic and pedestrian safety during construction. Additional construction traffic would be well within capacity of Morning Star Place and St Lukes Road.	Morning Star Place represents good option for traffic and pedestrian safety during construction. Additional construction traffic would be well within capacity of Morning Star Place and St Lukes Road. This option would result in lower construction traffic volumes on Morning Star Place compared to the proposed Lyon Avenue site (less than half). Construction access via MAGS would require operating restrictions and associated traffic management measures to avoid peak school hours and minimise adverse traffic and pedestrian safety effects of construction traffic on Alberton Avenue. Additional construction traffic is well within capacity of Alberton Avenue. Construction access via MAGS would conflict with school activities - including parking and access for School House, service access to the sports pavilion and maintenance access to the playing fields.	No traffic effects on Morning Star Place if all construction access is via MAGS. Construction access via MAGS would require operating restrictions and associated traffic management measures to avoid peak school hours and minimise adverse traffic and pedestrian safety effects of construction traffic on Alberton Avenue. Additional construction traffic is well within capacity of Alberton Avenue. Construction access via MAGS would conflict with school activities - including parking and access for School House, service access to the sports pavilion and maintenance access to the playing fields.
Parking:	Parking:	Parking:
Temporary loss of 22 visitor car parks at the western end of Morning Star Place during construction. This is anticipated in existing resource consents for SLGA.	Temporary loss of 22 visitor car parks at the western end of Morning Star Place during construction. This is anticipated in existing resource consents for SLGA. Construction access road via MAGS Gate 1 would conflict with access to parking areas at School House. If construction access is fenced with acoustic barrier to mitigate potential noise effects, access to informal parking areas around the dormitories would be lost for the duration of the construction works.	Temporary loss of 22 visitor car parks at the western end of Morning Star Place during construction. This is anticipated in existing resource consents for SLGA. Construction access road via MAGS Gate 1 would conflict with access to parking areas at School House. If construction access is fenced with acoustic barrier to mitigate potential noise effects, access to informal parking areas around the dormitories would be lost for the duration of the construction works.

Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	**MAGS Alternative 1 - Pipe Jacked** Drawing Number LYON-SK1001 Issue C	**MAGS Alternative 2 – Trenched** Drawing Number LYON-SK1101 Issue C
Effects on pedestrians	**Effects on pedestrians**	**Effects on pedestrians**
Access via existing boardwalk along Meola Creek would be maintained during construction. A temporary pedestrian access to the south of the construction area would be established to provide access between the Roy Clements Treeway and St Lukes commercial area.	Access via existing boardwalk along Meola Creek and access to the south of the construction area (and east of Meola Creek) would be maintained during construction. Existing pedestrian access via MAGS access road to School House and to rear of sports pavilion would be affected during construction. Pedestrian management measures or alternative pedestrian access would need to be established.	Access via existing boardwalk along Meola Creek would require closure during construction due to access road and temporary bridge and trenching activities. Alternative pedestrian route around the site could be long. Existing pedestrian access via MAGS access road to School House and to rear of sports pavilion would be affected during construction. Pedestrian management measures or alternative pedestrian access would need to be established.
Effects on vegetation and ecology	**Effects on vegetation and ecology**	**Effects on vegetation and ecology**
Much of the vegetation within the proposed designation area would require removal. This includes 107 individual trees of varying types, size and age. Wider Roy Clements Treeway area is identified as an area of ecological significance in draft Unitary Plan. Construction site is assessed as being of moderate ecological value by project ecologist. Reduction in value associated with vegetation removal, but noting reinstatement landscaping and ecological mitigation plantings proposed to offset effect.	Requires the removal of around 46 individual trees and an area of approximately 240m^2 of generally low quality mixed native vegetation. Work required to establish construction access through MAGS may also impact on adjacent trees. Wider Roy Clements Treeway area is identified as an area of ecological significance in draft Unitary Plan. This area extends across Meola Creek, to include riparian vegetation on left bank of stream. Vegetated part of construction site is assessed as being of moderate ecological value by ecologist. Open area of MAGS field would hold little ecological value. Reduction in value associated with vegetation removal, but noting reinstatement landscaping and ecological mitigation plantings could be undertaken to offset effect.	Requires the removal of around 54 individual trees and an area of approximately 240m^2 of generally low quality mixed native vegetation. Work required to establish construction access through MAGS may also impact on adjacent trees. Wider Roy Clements Treeway area is identified as an area of ecological significance in draft Unitary Plan. This area extends across Meola Creek, to include riparian vegetation on left bank of stream. Vegetated part of construction site is assessed as being of moderate ecological value by ecologist. Open area of MAGS field would hold little ecological value. Trenching works would affect greater area of riparian vegetation compared to pipe jacked option. Reduction in value associated with vegetation removal, but noting reinstatement landscaping and ecological mitigation plantings could be undertaken to offset effect.
Effects on landscape	**Effects on landscape**	**Effects on landscape**
Removal of mature vegetation, construction site screening and construction activities would have more than minor effects on visual amenity and landscape character of Roy Clements Treeway. Mitigation of effects on-site would be required through design and landscape plantings, but this would take time to achieve.	Works required for construction of shafts and access roads both west and east of Meola Creek would require removal of mature vegetation. These works, along with construction site screening would have more than minor effects on existing visual amenity and landscape character. Mitigation of effects would be required through design and landscape plantings on both sides of Meola Creek, but this would take time to achieve. The overall area of vegetation affected is less than for the proposed Lyon Avenue site.	Works required for construction of shafts and access roads both west and east of Meola Creek and trenching across Meola Creek would require removal of mature vegetation. These works, along with construction site screening would have more than minor effects on existing visual amenity and landscape character. Mitigation of effects would be required through design and landscape plantings on both sides of Meola Creek, but this would take time to achieve. The overall area of vegetation affected is less than for the proposed Lyon Avenue site.
Effects on Meola Creek	**Effects on Meola Creek**	**Effects on Meola Creek**
Minor potential for effects associated with surface construction works. Erosion and sediment control measures would be established on site to minimise potential for discharge of sediment laden water to Meola Creek during construction.	Minor potential for effects associated with surface construction works. Erosion and sediment control measures would be established on site to minimise potential for discharge of sediment laden water to Meola Creek during construction.	Minor potential for effects associated with surface construction works. Erosion and sediment control measures would be established on site to minimise potential for discharge of sediment laden water to Meola Creek during construction. Effects on Meola Creek during trenching works with temporary stream diversion required, and associated risks with flood events. Temporary access bridge over Meola Creek would need to be designed so that it does not impede flood flows or result in erosion around bridge footings.

Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	**MAGS Alternative 1 - Pipe Jacked** Drawing Number LYON-SK1001 Issue C	**MAGS Alternative 2 – Trenched** Drawing Number LYON-SK1101 Issue C
Cultural heritage effects	**Cultural heritage effects**	**Cultural heritage effects**
Site in modified area with no recorded archaeological evidence.	Site in modified area with no recorded archaeological evidence.	Site in modified area with no recorded archaeological evidence.
Noise effects	**Noise effects**	**Noise effects**
Works would generally comply with construction noise standards at adjacent apartments, except for period during excavations through basalt and during shaft construction, and would require management measures. Construction access via Morning Star Place would generate additional noise from heavy vehicles. This aspect of the work is expected to comply with the construction noise standards.	Works would generally comply with construction noise standards at adjacent apartments, except for period during excavations through basalt and during shaft construction. Would not be significantly different to effects of proposed Lyon Avenue site, due to works required for intermediate drop shaft and to make connections. From a noise perspective, the MAGS Alternative - pipe jacked option is preferred over the trenched option. Construction access road via MAGS Gate 1 would generate noise effects from heavy vehicles. A two metre high acoustic barrier would be required to achieve acceptable noise levels at School House. The design and location of this would need to take into account requirements for access to and amenity of the dormitories of School House.	Works would generally comply with construction noise standards at adjacent apartments, except for period during excavations through basalt for trench and connection chamber construction. Rock breaking for trenching works would extend duration of noisy site activities compared to proposed Lyon Avenue site, due to works required for connection chamber and to make connections. Construction access road via MAGS Gate 1 would generate noise effects from heavy vehicles. A two metre high acoustic barrier would be required to achieve acceptable noise levels at School House. The design and location of this would need to take into account requirements for access to and amenity of the dormitories at School House.
Vibration effects	**Vibration effects**	**Vibration effects**
Excavation in basalt, either by mechanical rock breaker or blasting, would result in some short term disturbance at adjacent SLGA apartments.	Excavation in basalt, either by mechanical rock breaker or blasting, would result in some short term disturbance at adjacent SLGA apartments. Would not be significantly different to effects of the proposed Lyon Avenue site due to works required for construction of intermediate drop shaft.	Excavation in basalt, either by mechanical rock breaker or blasting, would result in some short term disturbance at adjacent SLGA apartments. Would not be significantly different to effects of the proposed Lyon Avenue site due to works required for construction of connection chamber and trenching through basalt on the eastern side of Meola Creek.
Groundwater and settlement effects	**Groundwater and settlement effects**	**Groundwater and settlement effects**
Not expected to cause adverse effects on adjacent buildings or structures. The differential movements between building pads of SLGA are estimated to be less than 5mm, equivalent to a distortion of less than 1:3000; well below the commonly applied limit of 1:2000 and highly unlikely to be noticeable or cause anything other than minor cosmetic effects, even at the more sensitive parts of the building. The estimated settlement levels would be within the limits of the proposed consent conditions, but would trigger other requirements of the consent conditions relating to building condition surveys, analysis, monitoring, implementation of trigger levels and contingency planning.	Not expected to cause adverse effects on adjacent buildings or structures. The main drop shaft and access shaft on the MAGS playing fields are far enough away from the SLGA buildings so as to cause no settlement risk to SLGA buildings. Similarly construction of the diversion chamber and trenching between the diversion chamber and intermediate drop shaft are relatively shallow and will have no significant impacts on the deeper groundwater or cause settlement to the SLGA buildings. Because the intermediate drop shaft will need to extend below the basalt it will draw down groundwater in the Puketoka Formation. The potential settlement effects of constructing an intermediate drop shaft near the existing Lyon Avenue overflow for the pipe jacked option will be similar to the effects of shaft construction for the proposed Lyon Avenue site. The effects of this drop structure on the Block B and Block C areas will be similar to the proposed Lyon Avenue site; i.e. negligible.	Not expected to cause adverse effects on adjacent buildings or structures. The main drop shaft and access shaft on the MAGS playing fields are far enough away from the SLGA buildings so as to cause no settlement risk to SLGA buildings. Similarly construction of the diversion chamber and trenching between the diversion chamber and connection chamber are relatively shallow and will have no significant impacts on the deeper groundwater or cause settlement to the SLGA buildings.



LEGEND

- MAIN TUNNEL
- LINK SEWER
- CSO COLLECTOR
- CONNECTION PIPELINE
- VENTILATION DUCTS
- EXISTING RETICULATION SEWER
- EXISTING TRUNK SEWER
- EXISTING STORMWATER
- PROPOSED DESIGNATION BOUNDARY
- LID/STRUCTURE FLUSH WITH GROUND
- LID/STRUCTURE ABOVE GROUND
- PROPOSED NOISE BARRIER

Plot Date: 06-Sep-13 11:55 a.m.
File path: P:\0538 - Central Interceptor\04. Drawings\4.3 Working\AEE\AEE_Consent\General\Dwg

Project No.

ISSUE	DATE	AMENDMENT	BY	APPD.
D	06/09/13	NOISE WALL RELOCATED	AP	JQC
C	18/07/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
B	12/07/13	ADDRESS NUMBERS ADDED AND AERIAL IMAGE REVISED	AP	JQC
A	17/08/12	CONSENT ISSUE	AP	PR

DESIGNED	NL		
DES. CHECKED	JS		
DRAWN	AP		
DWG. CHECKED	NL		
REV'D P.MGR	JS		
APP'D P.DIR	CC		

OPERATIONS

ASSET MANAGER

SITE LAYOUT AND DESIGNS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN DEVELOPMENT

AEE SEPTEMBER 2013

water Care services limited

CENTRAL INTERCEPTOR
GENERAL
KEITH HAY PARK (AS5) - CONSTRUCTION WORKS PLAN

CAD FILE AEE-MAIN-7.2_D — DATE 6-Sep-13

ORIGINAL SCALE A1 1:1000 A3 — CONTRACT No. 0538

DRAWING No. AEE-MAIN-7.2 — ISSUE D

1:2500 A3