

**IN THE MATTER OF**

the Resource Management Act  
1991

**AND**

**IN THE MATTER OF**

applications by Central Plains Water  
Trust to:

Canterbury Regional Council for  
resource consents to take and use  
water from the Waimakariri and  
Rakaia Rivers and for all associated  
consents required for the  
construction and operation of the  
Central Plains Water Enhancement  
Scheme

Selwyn District Council for resource  
consents to construct and operate  
the Central Plains Water  
Enhancement Scheme

**AND**

**IN THE MATTER OF**

a notice of requirement by Central  
Plains Water Limited to:

Selwyn District Council for the  
designation of land for works  
associated with the construction and  
operation of the Central Plains  
Water Enhancement Scheme

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**BRIEF OF EVIDENCE OF ANDREW MARK WHALEY**

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## **QUALIFICATIONS AND EXPERIENCE**

- 1.1 My full name is Andrew Mark Whaley.
- 1.2 I am a Civil Engineer with URS (NZ) Ltd (“URS”). I have specialised in the assessment, design and construction of civil engineering and transportation projects since 1994. This included 7 years contracting on Highways and Infrastructure works for Transit New Zealand, local authorities and the private sector. I followed this with 5 years in the provision of transportation research, design and assessment work for The Highways Agency (Transit NZ equivalent) in the United Kingdom. Most recently I have been involved in the assessment, design and construction supervision of civil engineering projects in the Canterbury Region.
- 1.3 I have the following qualifications: BE in civil engineering from University of Canterbury (1994). My studies have included specialist courses in traffic engineering and construction management. I am a member of the Institution of Civil Engineers of United Kingdom (MICE) and a Chartered Engineer (UK) (CEng).
- 1.4 I have read the code of conduct for expert witnesses set out in the Environment Court practice note, and confirm that I have complied with the code in the preparation of my evidence.

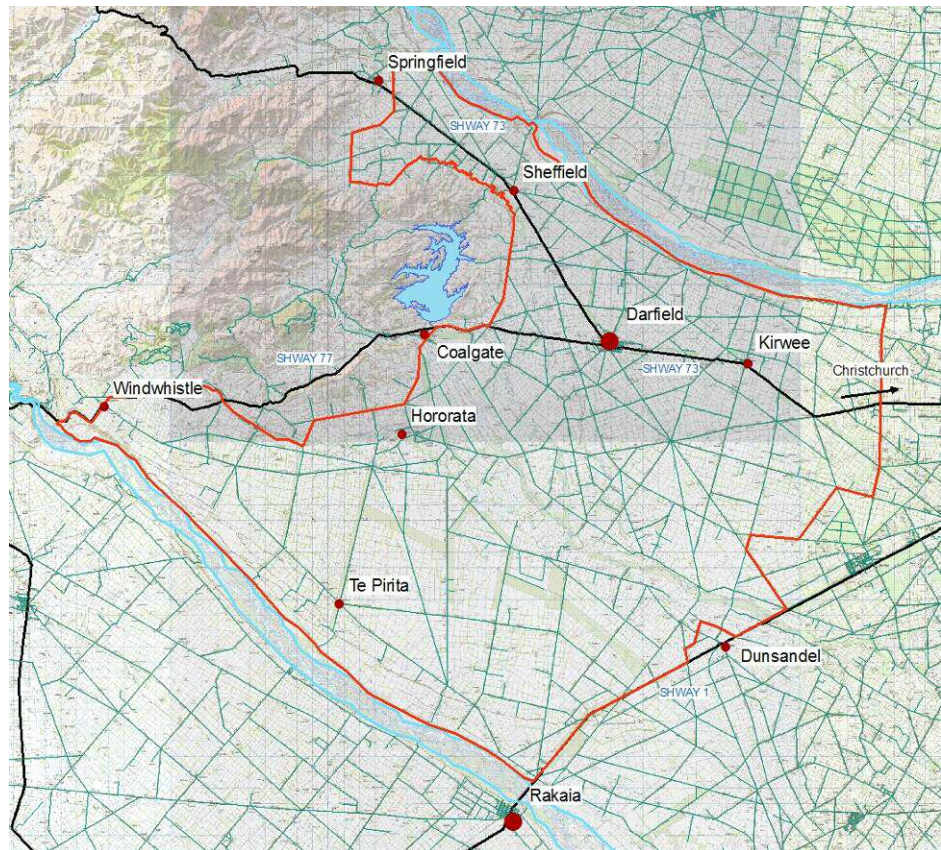
### **Scope of Evidence**

2. My evidence covers the potential traffic impacts associated with the construction and operation of the Central Plains Water Enhancement Scheme (“the Scheme”) including the anticipated trip generation arising from the Scheme introduction. My evidence will cover both the state highways and roads under the control of the Selwyn District Council. It is focused on impacts on the highway network and locations where existing public or private access may be affected. It outlines how the proposed works will affect the highway network, and the approach proposed for detailed design to accommodate the interests of concerned parties as far as possible
3. In preparing my evidence I have relied upon reports prepared by URS and information supplied by others as follows:
  - Central Plains Water Enhancement Scheme, Assessment of Environmental Effects for Resource Consent Applications to Canterbury Regional Council (‘AEE”), by URS, June 2006

- Selwyn District Council letter requesting specific information on Transportation
- Existing Traffic Count Data provided by Transit New Zealand
- Existing Traffic Count Data provided by Selwyn District Council
- Public Transport (School Bus) information in the vicinity of Malvern Hills Road provided by Selwyn District Council
- Macfarlane, A and Eaton, H (April 2007) – Central Plains Water Enhancement Scheme on Farm Profitability
- Blackmore, D and Lewthwaite, W (July 2007) – Memo to Penter, B and Watson, A – Access to Selwyn Plantation Board land in Waianiwaniwa Valley
- McMorran, T (June 2007) – URS Memo – Construction materials for proposed Waianiwaniwa Dam

#### **Effect of engineering works for the Scheme on the highway network**

4. A description of the proposed Scheme works has already been given by Mr Lewthwaite. I will not repeat that; rather I will describe the effects of these works on the relevant highways and on public and private access.
5. I have not completed a full transportation or network wide analysis as the likely impacts have been shown to be minor on the state highway network with ample spare capacity. I have instead focused on the likely construction, construction activities and associated traffic movements in order to gauge the likely impact and probable mitigation measures associated with the Scheme.
6. The affected highway network is that bounded to the south by the Waimakariri River, the north by the Rakaia River, the east by State Highway 1 and to the west along the inner margins of the Canterbury Plains. This network encompasses SH 77, SH 73 and a large portion of the Selwyn District highway network. This highway network is operating with varying degrees of spare capacity, with the busiest link, excluding SH1, being SH 73 through Darfield and on towards Christchurch with an Average Daily Traffic Count (AADT) (2005) of between 3,860 (Aylesbury Corner) and 6,950 (Yaldhurst Road east of Old West Coast Road). This compares to SH1 between Templeton and Ashburton carrying an AADT up to 18,230.



7. The engineering works affecting the highway network can be broken into 2 main activities as follows:

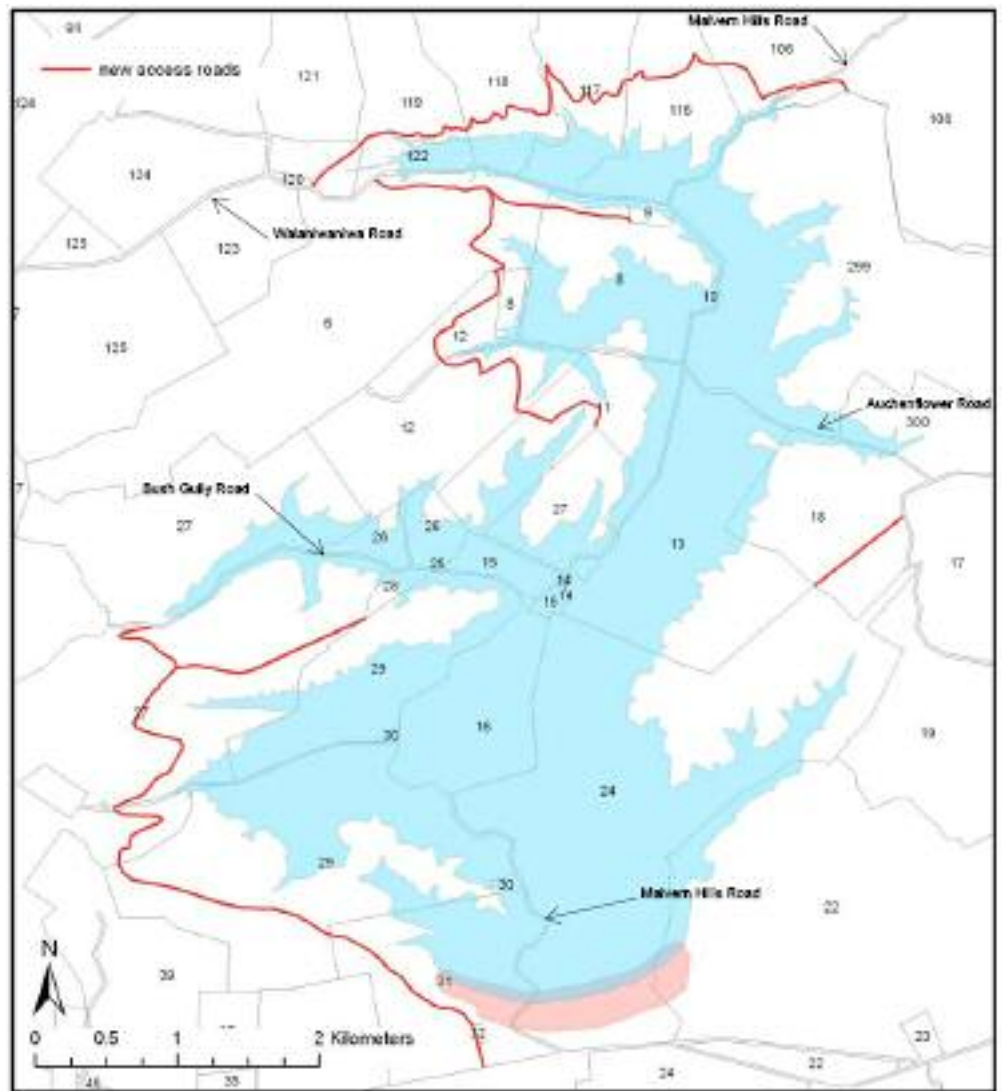
- Waianiwaniwa Reservoir, Tunnel and Dam.
- Headrace, River Intakes and the Water Distribution Network

I will describe the impacts of each on the highway network.

8. *Waianiwaniwa Reservoir, Tunnel and Dam.*

The construction of the Waianiwaniwa Valley reservoir will result in the permanent closure of several roads that will be flooded including:

- 1.7 km of Auchenflower Road (unsealed)
- 9.5 km of Malvern Hills Road (1.5 km sealed, 8km unsealed)
- Bush Gully Road (unsealed)
- 2.0 km of Waianiwaniwa Road (unsealed)



The following summarises the impact associated with these closures

- All roads through the dam site, lower parts of the reservoir area and intake tunnel portals will be closed from commencement of construction. The following table summarises the traffic effects on the immediately surrounding roads.

ROAD SECTION			Estimated 2012 AADT	CPWE effect	2012 AADT after CPWE
Malvern Hills Road	SH 77	End Of Seal	116	-75	41*
	End Of Seal	Bush Gully Rd	58	-58**	0
	Bush Gully Rd	Auchenflower Rd	32	-32**	0
	Auchenflower Rd	Waianiwaniwa Rd	55	-55***	0
	Waianiwaniwa Rd	Start Of Seal	65	25***	80

	Start Of Seal	Speed Restriction	91	25***	116
	Speed sign	Vogel St	118	25***	143
	Vogel St	SH 73	103	25***	128
Deans Road	SH77	SH73	1068	60****	1128

\* Anticipated use reflects likely need for routine operation and maintenance of the dam and reservoir.

\*\* Removal of all traffic as accessed properties inundated by the reservoir and through traffic redistributed elsewhere.

\*\*\* Level of traffic associated with removal of through traffic and properties inundated by the reservoir previously accessed from the Sheffield end of Malvern Hills Road, while allowing for traffic entering/egressing Waianiwaniwa Road via a proposed access road. (see Figure 1 above). The estimated traffic also allows for Waianiwaniwa Road/Auchenflower Road traffic entering from Sheffield that may have previously entered from the SH77 end having been diverted via Deans Road.

\*\*\*\* Through traffic and traffic previously entering Waianiwaniwa Road and Auchenflower Road redistributed onto Deans Road

- Current users of the Waianiwaniwa Valley road network will use alternative routes via the existing wider network or be required to new access routes. The main affected locations are as follows:

#### SH 77/Malvern Hills Road intersection

Once construction is complete there will be a reduction in traffic entering/egressing Malvern Hills Road from SH77.

#### SH 73/Malvern Hills Road intersection

There will be an overall increase in traffic entering/egressing Malvern Hills Road from SH73 as a result of the redistribution of through traffic on Malvern Hills Road, and an increase in traffic accessing Waianiwaniwa Road from the Sheffield end of Malvern Hills Road.

#### Waianiwaniwa Road

Traffic currently entering Waianiwaniwa Road via Malvern Hills Road will access via the proposed new access road to be constructed between Malvern Hills Road to the north of the reservoir. Traffic originating from SH77 will be required to divert along Deans Road to Sheffield and into Malvern Hills Road. This detour will add an additional travel distance of approximately 10km.

#### Malvern Hills Road to Auchenflower Road

Traffic currently entering Auchenflower Road via Malvern Hills Road will access via Deans Road.

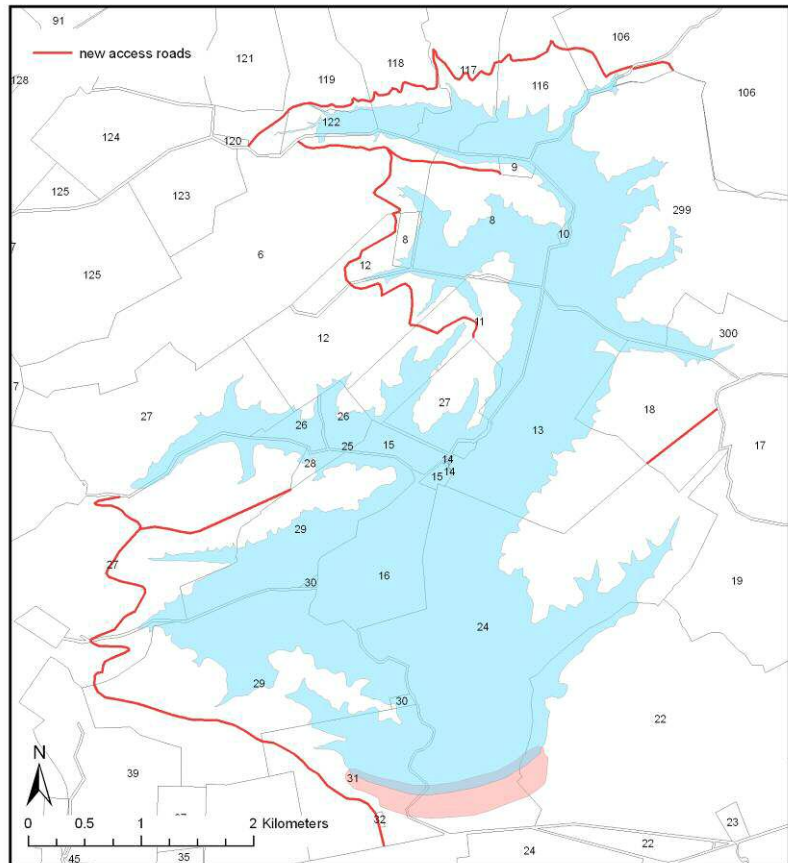
## Waianiwaniwa Road to Auchenflower Road

Traffic currently travelling from Auchenflower Road to Waianiwaniwa Road (or vice-versa) via Malvern Hills Road will be required to detour and access via Sheffield and Deans Road.

## Property Access off Roads

Where blocks, either entire or part, have had their access severed, it is proposed that new access roads will be constructed around the reservoir and this is provided for in the designation sought.

Consideration has been given, for example, to the Selwyn Plantation Board (SPB) requirements (gradient not steeper than 1 in 9.5 (6 degrees), which are higher than the minimum standard required by the SDC (gradient not steeper than 1 in 6 (9.5 degrees), with the SDC likely to require steeper grades to be sealed. The SPB requirements largely assume roads would be unsealed, and it has been acknowledged that sealing of steeper grades would make a positive difference. The road can be fitted within the 100m wide designation band to achieve the minimum SDC requirements and I expect that steeper sections will be sealed. Additionally there is scope within the designation band near the coalmine to move the road to several different positions that are likely to be suitable for the mine operations.



- The wider roading network, being SH 77, Deans Road and SH 73 has ample spare capacity for diverted traffic, being a maximum of 60 anticipated vehicle movements, and will not be adversely affected.

#### 9. Construction Access

- The primary access for the reservoir construction from the highway network off SH 77 at or near Malvern Hills Road. Other roads surrounding the Waianiwaniwa Valley will be accessed periodically, largely associated with construction of alternate access routes for property access.
- Access to the dam site for construction vehicles will typically be from SH77 and will lead at times to a significant increase in traffic at the site. This would be mitigated with upgrading of the existing intersection and standard traffic management controls. These would be constructed to standards requiring Transit NZ approval
- It is intended that the majority of construction material for the dam will be sourced and processed within the area of the dam and reservoir. This will have virtually no impact on traffic movements on the highways other than to bring vehicles to and from the site. Some

aggregates(such as concrete fines) may be sourced from further away in the Waimakariri or Selwyn River beds. If so, it is anticipated that this would require approximately 50 movements per day.

It is possible that some material may need to come from further afield. See evidence of Tim McMorran for descriptions of other material sources. If material for dam construction is borrowed from east of SH77 at Coalgate there will be a large number of heavy construction vehicles crossing SH77, possibly requiring other works in addition to upgrading of the intersection and standard traffic controls. These would be constructed to standards requiring Transit NZ approval. Options include construction of underpasses or similar on the headrace canal alignment if phasing permits in order to isolate construction traffic from highway traffic.

If material is sourced from a new quarry on the west side of Homebush Ridge to the south and west of the Selwyn River and Coalgate, temporary haul roads would be considered, again if phasing permits, along the route of the headrace in order to isolate construction traffic from highway traffic and Coalgate.

Materials such as cement for concrete batching will be imported from further afield, typically from Christchurch. These would be supplied in bulk transporters using the state highway network and would involve low numbers per day.

- Given the low traffic numbers on the State Highway network likely to be affected (SH73 1570 to 4010 vpd between Springfield and Darfield, SH77 maximum 1480 vpd), it is not anticipated that construction traffic will have a significant effect on the operation of the road network.
- It is not expected that there will be an impact public transport. No school bus routes have been identified as being affected.

#### 10. *Headrace, River Intakes and Water Distribution Network*

The construction of the headrace and river intakes will result in the construction works being within the highway boundary at several locations along the alignment of the headrace to enable permanent access to be maintained to at least its current standard. The effects during construction can be summarised as follows:

- Where the headrace crosses existing access routes, either on roads or private property, where practicable the construction of the permanent access replacement will be constructed prior to construction of the headrace. This will typically be by bridges or culverts.
- When construction disrupts roads or access to private property, temporary access will be provided around specific worksites or via agreed detours where they are available. Where it is safe to do so, access will be maintained at all times.
- Where road closure can be introduced for bridge or culvert construction without undue disruption to the network as a result of convenient detours these will be introduced following agreement with SDC and Transit NZ
- Where a road closure is not feasible due to unacceptable delay, a temporary detour road will be constructed around the location of the planned crossing with the crossing bridge or structure being constructed while the detour is in place and the detour would be removed once the road is opened over the new structure.
- Where there is a recognised impact requiring mitigation such as the road closure and temporary detour roads, these would be designed and constructed to the appropriate standards. These will typically be as follows:
  - A. State Highways – Transit New Zealand Draft Geometric Design Manual and appropriate AUSTROADS standards.
  - B. Local Authority Roads – Standards adopted will comply with Council’s standards relevant to the hierarchy and utilise accepted practices demonstrated by AUSTROADS standards.
- Where required to facilitate temporary or permanent works, temporary traffic management measures will be introduced following SDC and Transit NZ procedures. As appropriate, Traffic Management Plans will be put in place in line with Transit NZ Code of Practice for Temporary Traffic Managements. Temporary road closures will only be introduced where all other economically viable solutions have been considered and viable alternative routes are available and agreed with the SDC and Transit NZ.

- The wider roading network has ample spare capacity for diverted traffic and will not be adversely affected.
- Where safe to do so, access will be maintained to river beds and other publicly accessible recreational areas as shown in Appendix 1. Restrictions are only anticipated where temporary access facilities or staging is tied in with existing access. This would be for short durations only.
- It is not anticipated that construction traffic will have a measurable effect on the operation of the road network. Oversize and over dimension loads will be coordinated and agreed with the SDC and Transit NZ to avoid peak traffic times and minimise any disruption. It is expected that there will be an average of 75 – 100 deliveries per crossing site.

Other imported material is likely to be site concrete, bedding aggregates and filter aggregates manufactured at the screening and batching plants at the reservoir site or other agreed location. It is anticipated that this would average no more than 30-40 loads per week per crossing and thus have no material impact on the operation of the highway network.

- Rail Crossing

The headrace crosses the alignment of the west coast railway to the east of Racecourse Hill. The final design of the crossing will depend on allowable closures of the railway to facilitate construction. It is preferable for this to be a bridged crossing. However if no closure of the railway is necessary then a tunnelled siphon solution could be used. All design and construction will be subject to consultation and approval of Ontrack

Construction traffic for this is likely to be similar to that for the bridge construction although this will depend on the final design.

The operational requirements of the headrace are minimal in terms of traffic impact. The effects during operation can be summarised as follows:

- *Headrace/Distribution Network Embankment Maintenance*

Routine maintenance of the embankments will typically involve a visual inspection undertaken by suitably qualified staff from a light

4WD vehicle. This will typically be undertaken by driving along a specifically formed access track along the crest of the embankment. This will have no measurable impact on the road network.

Some routine physical works may be required resulting from the inspections. This will typically be localised repairs associated with damage to embankments similar to minor maintenance works undertaken on local road embankments. This maintenance will typically be off highway and, other than establishment of plant and material delivery, will have no measurable impact on the performance of the network.

- *Bridge Maintenance*

Bridge maintenance, given the bridge would become the responsibility of SDC or Transit NZ as appropriate, would be undertaken in conjunction with other bridge maintenance in the district. Traditionally bridge maintenance has minimal impact on the performance of a network, with most activities undertaken at off peak times.

- *Outlets, Pump Station and Intakes*

The routine operation of the pump stations and other gated facilities is likely to be undertaken remotely with only routine visual inspections and visits for planned maintenance being undertaken. It is likely that this would be no more than daily to twice weekly per outlet structure, pump station or intake. This will have no measurable affect on the operation of the road network.

In summary:

- All existing roads crossing the headrace route will be maintained to at least their current standard or as agreed with SDC or Transit NZ.
- Access to private land will be provided and maintained to a standard agreed with the relevant land owners during land negotiations.
- Scheme operational activities will not generate enough traffic to have an adverse effect on transport

## 11. General

- Over the duration of the construction there will be number of overweight or over dimension loads. These are associated with the establishment of heavy construction equipment, but will also include the delivery of large pre-cast components such as siphon box culverts, bridge beams and decks and intake gates.
- Where road crossings are being constructed to accommodate temporary or permanent works, it is proposed that the construction of temporary roads or crossings around worksites will be completed to enable works to be done without undue interruption to the travelling public.
- Access to private property and farm land will similarly be maintained with temporary facilities constructed to ensure access during construction of the works. Temporary facilities may include defined paths through construction works, temporary vehicle, stock and or stream crossing etc. This includes the construction of permanent canal crossings for the farm access, stock crossings etc.
- Issues associated with severance of property and roads will be resolved during land negotiations. It is likely that a rationalisation of some properties, mainly in the Waianiwaniwa Valley, will take place to ensure there are not isolated blocks or roads that serve no purpose. This will include the provision of alternative access as required. For this reason the location of roads shown in the AEE and on plans is liable to be amended and these amendments could require approval of Transit NZ or the SDC as appropriate.
- Discussions between Transit New Zealand and CPWL have been held with an agreement having been reached on how effects of the scheme on the State Highway network will be managed.
- All construction works within the highway reserve will be designed and constructed to industry best practice and the appropriate standards. These will typically be as follows:

State Highways – Transit New Zealand Draft Geometric Design Manual and appropriate AUSTRROADS standards.

Local Authority Roads – Standards adopted will comply with Council’s standards relevant to the hierarchy and utilise accepted practises demonstrated by AUSTRROADS standards.

All designs and subsequent handover of completed works will be subject to approval by either the Selwyn District Council or Transit New Zealand as appropriate.

## **Description of Area Wide Traffic Generation arising from the operation of scheme.**

### *12. Approach to determine traffic generation*

12.1 In order to determine the likely traffic growth associated with the CPWE scheme the following steps were undertaken

- In order to determine the likely change of agricultural use of land as a result of improved irrigation, an assessment was carried out based on the changes in irrigated areas and expected land production as indicated by Macfarlane and Eaton (2007)<sup>1</sup> for the 60,000ha
- This was followed by determining the traffic generated by various agricultural land uses, for both the irrigated, non-irrigated and post irrigated scenarios. This enables prediction of traffic generation as a result of both change of land use and increased yield for similar use post CPWE.
- Telephone surveys were carried out with a number of farmers to establish existing and likely vehicle trips in relation to the various farm types. The main split has been between typical irrigated pasture for dairy farming, irrigated and non irrigated crop/grain farm, and sheep farming on irrigated or non-irrigated land.
- Existing traffic data was obtained from Transit New Zealand and the Selwyn District Council.

### *13. Traffic Analysis*

13.1 The analysis has assumed the Scheme is fully developed, with the predicted traffic generation being 'worst case' with all available land use change being taken up and fully productive.

- Where traffic volumes in the network are high, albeit with spare capacity, the traffic increase is generally not greater than 6.5% and this change will only be slightly noticeable.

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<sup>1</sup> Macfarlane, A and Eaton, H (April 2007): Central Plains Water On Farm Profitability  
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- In some of the areas where traffic volumes are low the percentage increase is higher but the total volumes are so low that there should be no effect on the road capacity.
- The irrigation development will come on stream over a number of years so the change in normal annual traffic growth should be small if any in addition to normal traffic growth

### **Design, Construction and Maintainability**

14. As the design of the Scheme at this stage is advanced sufficiently only for the purpose of obtaining resource consent, it is impractical to discuss specific design elements or infrastructure. The design rationale that will apply to the Scheme where it affects the roading infrastructure will take into account the following:

#### 14.1 Safety

- Designs will be risk assessed in order to identify where hazards exist and to implement mitigation measures to ultimately eliminate, minimise or control any residual risk. Where there is an identified risk, or the design directly affects existing infrastructure (e.g. TNZ or SDC highways network), affected stakeholders will be notified and included in consultations undertaken to agree appropriate design and mitigation measures.
- Risks that will be assessed include:
  - Flood Risk;
  - Failure of key structures;
  - Impact of scheme on adjacent structures or network;
  - Highway Route Security (during construction and as a result of potential key structure failure).
  - Safety of required construction operations
  - Safety of required maintenance operations
- Where it is proposed to undertake temporary or permanent works that affect the existing highway network in terms of visibility, clear zones, access and or speed environment, TNZ and/or SDC will be consulted throughout the design process with their requirements addressed.

## 14.2 Environmental Impact (during construction and operation)

- The environmental impact of specific elements of the scheme associated with or mitigated during the detailed design will be assessed as appropriate. Management plans will be prepared to address the likely impacts. These will focus on the following:
- Effects during construction
  - Dust, Noise, Air Quality
  - Traffic Impact (requiring Temporary Traffic Control)
  - Final haulage routes for construction materials (temporary and permanent materials)
  - Environment (flora and fauna, water quality, rivers etc)
  - Monitoring requirements
- Effects during operation
  - Traffic impact (associated with maintenance activities)
  - Environmental (residual risks associated with failure of constructed infrastructure e.g. blocking of culverts etc that may have a consequential effect on the network and how this could be mitigated against)
  - Dust, Air and Noise (associated with maintenance activities)
  - Monitoring requirements
- Key stakeholders and regulatory bodies will be consulted on anticipated environmental impact and proposed mitigations during the development of the detailed designs. It is anticipated that the outcome of these consultations and associated regulatory processes will be to agree criteria to minimise and monitor construction activities e.g. noise limits, working hours etc.

## 14.3 Constructability/Maintainability

- Constructability of designs as they are developed will be considered in order to optimise solutions. These will take into account and balance the needs for safety and duration and magnitude of likely impact (on environment, traffic etc)

- Maintainability will be considered during design. This will include identifying during design the likely maintenance and operational requirements of detailed design options being considered. This will include the following:
  - Safety
  - Frequency and duration of maintenance activities
  - Impact of maintenance activities on the highway network
  - Responsibility for on-going maintenance
  - Development of an outline Emergency Procedures Plan and an Emergency Execution Plan

### **Design Standards**

15. The design of the Scheme, as it is developed, will take into consideration the requirements of TNZ and the SDC with respect to site access and egress. This will include consultation with both authorities as designs progress. This includes the seeking of written permission in accordance with Section 51 of the Transit NZ Act 1989 before any works are undertaken on or within the road corridor.
16. All design work will be constructed to industry best practice and the appropriate standards. These will typically be as follows:
  - State Highways -Transit New Zealand Draft Geometric Design Manual, other TNZ Design Manuals and appropriate AUSTROADS standards.
  - Local Authority Roads – Standards adopted will comply with Council's standards relevant to the hierarchy and utilise accepted practices demonstrated by AUSTROADS standards.
  - Bridges – Transit New Zealand Bridge Manual – Second Edition
17. All designs of permanent works on the highway networks will be subject to approval by either the Selwyn District Council or Transit New Zealand as appropriate.

## Summary of main conclusions

### During Construction

18. Where existing roads or access for Waianiwaniwa Valley properties is severed, new roads will be constructed to a timetable set during land and severance negotiation, but in any event to ensure continuous access is available.
19. All roads through the dam site, lower parts of the reservoir area and intake tunnel portals will be closed from commencement of construction of the dam and reservoir.
20. In the Waianiwaniwa Dam and Reservoir, the effect of the likely redistribution of traffic onto other parts of the network associated with the severance of Malvern Hills Road as a result of the construction of the dam and reservoir is minor. There would be a net reduction in the traffic on the immediate highway network, with some potential, although low in numbers, for additional traffic on the northern extent of Malvern Hills Road to access Waianiwaniwa Road. There is potential also for a slight increase in traffic using Deans Road, however all roads in the vicinity have significant spare capacity.
21. Current users of the Waianiwaniwa Valley road network will use alternative routes via the existing wider network or proposed new access routes. The proposed new routes have been indicated on the notice of requirement although they will be subject to change when the scheme is implemented, depending mainly on property boundary reconfiguration. For example, where a land parcel is amalgamated with another property because it is not considered viable on its own, there may be no need to provide independent access to it.
22. Where canals cross existing access routes, either on roads or private property, where practicable, the construction of the permanent access replacement will be constructed prior to construction of the headrace.
23. Where construction activities interrupt roads or access to private property, temporary provision will typically be provided around specific worksites or via agreed detours where they are available. It is possible to avoid closures of the railway network by adopting a tunnelled siphon option.
24. The wider roading network has ample spare capacity for diverted traffic and will not be adversely affected

25. Where safe to do so, existing access will be maintained to river beds and other publicly accessible recreational areas.
26. It is not anticipated that construction traffic will have a measurable effect on the operation of the road network.
27. The Scheme design as it is developed will conform to the requirements of TNZ and the SDC as appropriate, both informal and regulatory. This will include consultation with both authorities as designs progress. Designs will take particular account of Safety, Environmental Impact, Constructability and Maintenance.

### **During Operation**

28. All existing roads crossing the canal routes will be maintained to at least their current standard or as agreed with SDC or Transit NZ.
29. Access to private land will be provided and maintained to a standard agreed with the relevant land owners during land negotiations. This will be as a minimum 1 access crossing per property.
30. Scheme operational activities will not generate enough traffic to have an adverse effect on transport
31. The predicted area wide traffic generation associated with the potential change of land use or yield indicates a growth in traffic of up to 6.5% for higher use State Highways, with a slightly higher percentage increase where existing traffic volumes are low.
32. The irrigation development will come on stream over a number of years so the change in normal annual traffic growth should be small if any in addition to normal traffic growth.

**Andrew Whaley**

## Appendix 1 - Effects on Public Access to River Beds

The following table summarises the anticipated effects on public access to river beds.

Location	Part of CPWE Scheme	Phase	Comments	Mitigations
Waimakariri River at Rubicon Road	Upper Waimakariri intake	Construction	No effect as Rubicon Road does not provide public access to Waimakariri R	
	Upper Waimakariri intake	Operation	No effect	
Kowai River bed	Upper Waimakariri intake race	Construction	Access along river bed will be restricted for a few weeks at time of construction of scheme siphon	There is potential for staged construction of siphon to allow access around construction site within river bed subject to public safety being maintained
		Operation	No effect	
Waimakariri River at Keens Road	Upper Waimakariri intake race	Construction	Access could be restricted for about one day as a pipeline is installed across Keens Road at top of terrace; no disruption at toe of terrace as scheme works are 500m away	Timing can be arranged to suit known affected parties
		Operation	No effect	
Waimakariri River at Gorge bridge	Lower Waimakariri intake	Construction	No effect as scheme is to be tunnelled under public access routes	
		Operation	No effect	
Waimakariri River at Bleakhouse Corner	Waimakariri terrace canal	Construction	No effect, as scheme access and activities will be >500m upstream from Bleakhouse corner	
		Operation	No effect, as scheme access and activities will be >500m upstream from Bleakhouse corner	

Waimakariri River between Gorge bridge and Bleakhouse corner	Waimakariri terrace canal	Construction	Access along river bed immediately adjacent to toe of terrace could be restricted for a few months at time of construction of scheme terrace race	Alternative access is already available within river bed or could be provided a short distance away from toe of terrace subject to public safety being maintained
		Operation	No adverse effect	If agreeable with all parties additional access could be provided along scheme maintenance routes on race banks or in river bed at toe of terrace
Hawkins River at Sheffield	Upper intake canal	Construction	Access to and along river bed will be restricted for a few weeks at time of construction of scheme siphon	There may be potential for staged construction of siphon to allow access around construction site within river bed subject to public safety being maintained
		Operation	No effect	
Hawkins River near Racecourse Hill	Main headrace	Construction	Access along river bed will be restricted for a few weeks at time of construction of scheme siphon Public access to river bed not affected as site is on private land	There is potential for staged construction of siphon to allow access around construction site within river bed subject to public safety being maintained
		Operation	No effect	
Selwyn River at Sheffield	Main headrace	Construction	Access to and along river bed will be restricted for a few weeks at time of construction of scheme siphon	There is potential for staged construction of siphon to allow access around construction site within river bed subject to public safety being maintained
		Operation	No effect	

Hororata River	Main headrace	Construction	Access along river bed will be restricted for a few weeks at time of construction of scheme siphon Public access to river bed not affected as site is on private land	There is potential for staged construction of siphon to allow access around construction site within river bed subject to public safety being maintained
		Operation	No effect	
Rakaia River at Steeles Road	Rakaia terrace canal	Construction	Access along Steeles Road will be restricted for a few weeks at time of construction of scheme access bridge	There is potential for bypass around construction site subject to public safety being maintained
		Operation	No effect	
Rakaia River at Sleemans Road	Rakaia terrace canal	Construction	Access along Sleemans Road will be restricted for up to a few months at time of construction of scheme terrace race and other works	There is potential for bypass around construction site subject to public safety being maintained, or access via alternative route from Steeles Road
		Operation	No effect, depending on solution adopted	Access could be reinstated by way of a bridge on Sleemans Road or could come along canal embankment or river bed from Steeles Road
Rakaia River between Sleemans Road and gorge	Rakaia terrace canal and intake works	Construction	Access along river bed in vicinity of intake works (i.e. 3 to 6km upstream from Sleemans Road) could be restricted for up to one year at time of construction No effect further downstream	Alternative access is generally already available within river bed or could be provided a short distance away from scheme works subject to public safety being maintained
		Operation	Access will be prohibited to permanent scheme works in river bed, i.e. 3 to 6 km upstream from Sleemans Road and generally against toe of terraces	Access along other parts of river bed will be available as at present

Streams across plains	Distribution network races	Construction	At this stage only one stream bed crossing is planned for distribution races, i.e. on Hawkins River by Essendon Road. Access to and along river bed will be restricted for a few weeks at time of construction of scheme siphon	There is potential for staged construction of siphon to allow access around construction site within river bed subject to public safety being maintained
		Operation	No effect	