From: Official Information
Sent: Friday, 9 March 2018 4:54 p.m.
To: '[redacted]@fairfaxmedia.co.nz'
Subject: LGOIMA 18/029 response - wellheads material

Dear [redacted],

Thank you for your email, received on 24 January. You requested the following information, under the Local Government Official Information and Meetings Act 1987 (LGOIMA):

"- Can we please get copies of the report(s) / communication from the engineers who carried out the Christchurch well assessments, resulting in Canterbury Water Assessor removing the city's secure status. The report was delivered, according to Mayor Lianne Dalziel in yesterday's media briefing, on December 22. I understand they were City Care contractors.

- Can we please get copies of all correspondence relating to the city's drinking water (including the aforementioned report) on December 22, 2017 involving Mayor Lianne Dalziel, the mayor's office, CEO Karleen Edwards, any members of the communication team, John Mackie and city councillors. This would include any emails, documents, text messages and any other methods of communication.

- All correspondence involving the same individuals regarding or relating to the water status between December 22 and January 23.

- The Canterbury Water Assessor's correspondence about the engineer's well assessments and decision to remove the city's secure water status.

- When were city councillors advised of the results of the engineers' well assessments / the city's loss of secure water status? Please provide information in relation to that."

You subsequently expanded your request as follows:

"Can we please make a tiny amendment to the below LGOIMA/OIA, to extend the request in question three to include all correspondence up to and including the council meeting on January 25."

Refinement sought
On 2 February we asked that you refine your request, if possible, due to the extremely large amount of information involved, and the lack of due particularity inherent in parts of your request:

"Regarding point 3, I wonder if you are able to refine your request? As it stands this encompasses a very large amount of information, which will take quite some time to find and collate. For example, it would be helpful if you could specify a more particular topic (i.e. not only 'water status' or 'drinking water'), or limiting the individuals and groups included in the request. It would be very helpful for us to understand the particular information it is that you are seeking."

We did not receive a response from you regarding our refinement request.

Extension of timeframe

On 2 March, we extended the timeframe on our response to you by an additional 5 working days.

Release of information
We have decided to release information in response to the first, fourth and fifth points in your request. This includes:

- **Engineers' reports:**
  - All nine reports on the 25 wellheads inspected by engineers from BECA, which were finalised in January 2018. We have released to you the final reports on ShareFile, as sent by the BECA to the Council (please advise if you are unable to access these and we will organise an alternative means of releasing the information). The draft reports were received by the Council on 14 December 2017.
  - Correspondence between the engineers who carried out the assessments of the wellheads, and Council staff members.
- **CityCare report** dated 22 December, concerning the assessment of the below ground wellheads, and the works undertaken as part of the project to repair the wellheads.
- **Correspondence from the Canterbury Water Assessor** related to the wellheads assessments and the decision to remove Christchurch's secure water status, including the letter of 22 December, which constituted formal notification of this decision.
- An email sent by the Council Secretary to Elected Members to advise them of the Recess Committee Meeting of Tuesday 16 January, at which the Councillors present were first briefed about the loss of Christchurch's secure water status.

The Council has decided to withhold some information under section 7(2)(a) of the LGOIMA – to protect the privacy of natural persons. In the Council's view the reasons for withholding these details are not outweighed by public interest considerations in section 7(1) favouring their release.

We are currently finalising this information, and we will be releasing this to you on Monday.

Decision to refuse information under section 17(f) of the LGOIMA
After careful consideration, the Council has decided to refuse points two and three of your request under section 17(f) of the LGOIMA – the information requested cannot be made available without substantial collation or research. In all, the information you have requested under these points constitutes at least 400 items of correspondence, which would take a number of days for staff to collate and organise. This is an unreasonable amount of time.

As outlined to you in our email of 2 February, if you were able to identify more specifically the correspondence you are seeking, we would be happy to consider the release of these documents. In this instance, however, the request for 'all correspondence' is simply too broad.

Under the LGOIMA and the Council's policy for charging for official information (https://ccc.govt.nz/the-council/plans-strategies-policies-and-bylaws/policies/council-organisational-policies/charging-for-official-information-policy), the Council can impose a charge for the supply of official information. Please advise if you are willing to pay for the provision of this information. If this is the case, we will reconsider our decision.

Subsequent information
On 25 January, Council resolved to ask the CE to undertake an overarching independent external review of the situation that arose regarding the wellheads, to be reported back to Council. The review, along with its findings and recommendations, is intended to assist the Council to provide assurance for the future of

Christchurch's unchlorinated water supply. It is envisaged that the review will provide conclusions and recommendations including:

- An assessment of how the matter arose and was handled
- An assessment of existing practices, monitoring and assessment, and reporting
- Any recommendations for improvements in procedure, practice, levels of service, reporting or otherwise.

The draft Terms of Reference for the Below Ground Well Heads and Drinking Water Supply Status Review were considered and endorsed by Council on 8 February. You can find these on the Council's website (http://christchurch.infocouncil.biz/Open/2018/02/CNCL_20180208_ATT_2267_EXCLUDED.PDF).

You have the right to ask the Ombudsman to investigate and review our decision. Complaints can be sent by email to info@ombudsman.parliament.nz, by fax to (04) 471 2254, or by post to The Ombudsman, PO Box 10152, Wellington 6143.

Publication of responses to LGOIMA requests

Please note: our LGOIMA responses may be published on the Christchurch City Council website a month after they have been responded to, with requesters' personal details withheld. If you have any concerns about this please contact the Official Information team on officialinformation@ccc.govt.nz.

Yours sincerely,

Katie McFadden

Information Advisor
Office of the Chief Executive

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73016, Christchurch, 8154

Please consider the environment before printing this email

From: Official Information
Sent: Friday, 2 February 2018 11:36 a.m.
To: '[redacted]@fairfaxmedia.co.nz'
Subject: RE: LGOIMA request from The Press

Hi [redacted]

Thanks for your amendment – I have forwarded this on to staff. We will provide a response or update within 20 working days of the date we received your amendment.

Regarding point 3, I wonder if you are able to refine your request? As it stands this encompasses a very large amount of information, which will take quite some time to find and collate. For example, it would be helpful if you could specify a more particular topic (i.e. not only 'water status' or 'drinking water'), or limiting the individuals and groups included in the request. It would be very helpful for us to understand the particular information it is that you are seeking.

If you're unable to refine your request, we will consider what information we can reasonably supply. For example, we may need to omit supplying all administrative emails due to the time it would take to research and collate these.

Yours sincerely,

Katie McFadden

Information Advisor
Office of the Chief Executive

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73016, Christchurch, 8154

Please consider the environment before printing this email

From: [redacted] [mailto:[redacted]@stuff.co.nz]
Sent: Thursday, 1 February 2018 12:42 p.m.
To: Media Enquiries <MediaEnquiries@ccc.govt.nz>; Ritchie, Jocelyn <Jocelyn.Ritchie@ccc.govt.nz>
Subject: Fwd: LGOIMA request from The Press

Hi all,
Can we please make a tiny amendment to the below LGOIMA/OIA, to extend the request in question three to include all correspondence up to and including the council meeting on January 25.
Many thanks,
[redacted]

Hi Joss,

Request from news desk, as per below.

Please can you action these LGOIMAs / OIAs please:

- Can we please get copies of the report(s) / communication from the engineers who carried out the Christchurch well assessments, resulting in Canterbury Water Assessor removing the

city's secure status. The report was delivered, according to Mayor Lianne Dalziel in yesterday's media briefing, on December 22. I understand they were City Care contractors.

- Can we please get copies of all correspondence relating to the city's drinking water (including the aforementioned report) on December 22, 2017 involving Mayor Lianne Dalziel, the mayor's office, CEO Karleen Edwards, any members of the communication team, John Mackie and city councillors. This would include any emails, documents, text messages and any other methods of communication.

- All correspondence involving the same individuals regarding or relating to the water status between December 22 and January 23.

- The Canterbury Water Assessor's correspondence about the engineer's well assessments and decision to remove the city's secure water status.

- When were city councillors advised of the results of the engineers' well assessments / the city's loss of secure water status? Please provide information in relation to that.

Many thanks,

[redacted]
Senior reporter

[redacted]
Fairfax Media, 158 Gloucester Street, Christchurch, 8011, New Zealand

[redacted]

--

[redacted]
Senior reporter - environment and defence

[redacted]

The Press, 158 Gloucester Street, Christchurch, 8011, New Zealand

From: Judy Williamson <[redacted]>
Sent: Wednesday, 20 December 2017 12:17 p.m.
To: Mackie, John; Murugesh, Daniela
Cc: CPH Drinking Water Unit; Ramon Pink
Subject: forfiling_GEN_1_Concerns re Christchurch supplies

Hi John and Daniela
Ramon and I have had a discussion this morning and would ideally like to meet with you before we close for Christmas on Friday or early in the new year (week of 8-12th Jan).
Our main area of concern is the ongoing 'Provisionally' secure status that has been given to the Christchurch sources since the earthquakes in 2011, recently PDP's refusal to sign off security criteria two for several well heads and recent findings by BECA indicate that there are a number of wells that currently do not meet criteria 2. We are aware that the council has a comprehensive programme started to 'encase' and remediate several of the below ground chambers and that findings from the BECA reports for 25wells are planned to be addressed, but are concerned that the timeframe for when all Christchurch sources meet criteria 2 is still some time away.
Do you have any time slots available that we could meet to discuss further?
Regards
Judy

Judy Williamson
Drinking Water Assessor
Community & Public Health
PO Box 1475
Christchurch
[redacted]

From: Judy Williamson <[redacted]>
Sent: Friday, 22 December 2017 2:07 p.m.
To: Mackie, John; Murugesh, Daniela
Cc: CPH Drinking Water Unit; Helen Graham; Ramon Pink; Alistair Humphrey; Cheryl Brunton
Subject: forfiling_CWS_1_CHR001+BRO012_Removal of Security Status
Attachments: 171222_CWS_1_CHR001+BRO012_RemovalOfSecurityStatus.pdf

Hi
Seemed sensible to just get this letter written after our meeting this morning.
I have not included Lyttelton as I know the bore is being worked on at present so would anticipate that it would be inspected with criteria 2 in mind before being put back into service.
Hope you have good breaks over Christmas.
Regards
Judy

Judy Williamson
Drinking Water Assessor
Community & Public Health
PO Box 1475
Christchurch
[redacted]

Canterbury
District Health Board
Te Poari Hauora ō Waitaha

File: CWS_1_CHR001+BRO012

22nd December 2017

Head of 3 Waters and Waste
Christchurch City Council
PO Box 73014
CHRISTCHURCH 8154

Attention: John Mackie

Dear John

Removal of Provisional Security Status for Christchurch and Brooklands/Kainga sources (CHR001+BRO012)

Following the Christchurch earthquakes in 2011 the security status for Christchurch (CHR001) and Brooklands Kainga (BRO012) was changed from 'Full' security to 'Provisional'. This was in recognition that a number of bores were damaged but none of the transgressions recorded in the period following the earthquakes were associated with the individual bores or pump stations.

This provisional status has continued as the remediation/new bore work programme has been rolled out.

Security criteria 2 (bore head security) is required "…*to be judged by a person recognised as an expert in the field..."* (Section 4.5.2.2) when initially established and then reviewed at least every five years as part of the requirements for ongoing demonstration of secure bore water. As such, in accordance with this requirement the Drinking Water Assessor (DWA) has been provided each year with reports for approximately one fifth of the bores, confirming that criteria two is continuing to be met.

The reports from the bores inspected recently this year show that some bore heads do not meet the security criteria and therefore the security status for Christchurch and Brooklands Kainga is removed. This means that the supplies now are not able to demonstrate the protozoa requirements of section 5 of the Drinking Water Standards for New Zealand (DWSNZ) through demonstrating secure sources.

It is acknowledged that while in some instances the bore heads may have deteriorated, the assessment and acceptance of risk are the more likely drivers that have meant that

engineering experts are no longer willing to confirm the security of the bore head installations.

Christchurch City Council are also acknowledged for reacting swiftly as the findings from the Havelock North enquiry have emerged. This includes the programme for rehabilitation of below ground well heads and fast tracking of the new deep bores for Northwest Christchurch.

Yours sincerely

Judy Williamson
Drinking Water Assessor
SIDWAU
Community & Public Health
A division of Canterbury District Health Board

Dr Ramon Pink
Medical Officer of Health

From: Lisa Mace <[redacted]>
Sent: Thursday, 14 December 2017 9:54 a.m.
To: Murugesh, Daniela
Cc: Mike Thorley; Paul Reed
Subject: Assistance with DWSNZ Wellhead Security Assessments - Draft Reports
Attachments: NZ1-14947565-Well Head Protection Assessments - Discussion about Most Recent Assessments.pdf

Hi Daniela,

I have just sent through the draft reports for each site through ShareFile. Please confirm that they have come through.

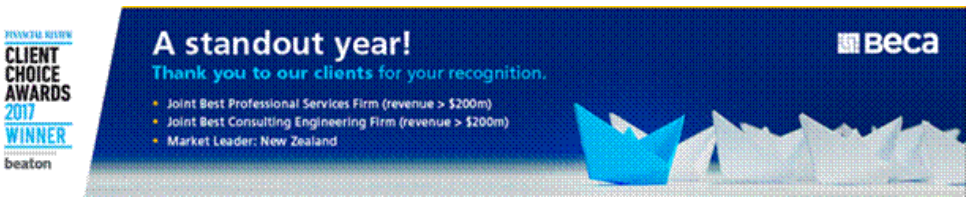
Note that these reports have not been formally reviewed and so there are likely to be changes (including to the recommendations) before we finalise them. Regardless, they will give you an idea of what the final product will look like. Comments are welcome. I haven't attached the bore logs at this stage.

Also attached is an agenda for our discussion on Tuesday. I have provided Judy with this agenda.

When I sent through the Dunbars report template I also sent through a list of additional information (copy and pasted below). This information would be useful if it exists in a form that is easy for you to send to us. If it doesn't, then don't worry.

- Water Safety Plan - I remember you saying that it is currently being updated. If the new version isn't in a state to be issued to us, can we please have a look at the previous version?
- Well Head Management Document - referred to in the previous
- Sump Pump Testing records – CityCare mentioned they were currently doing an overhaul of sump pumps and that there might be a list of those tested.
- List of bore pumps with backflow devices at the pump - this may not exist but I thought I would ask just in case
- List of bores that have had E. coli transgressions - the annual compliance reports may be a good source
- Can you confirm that SCADA receives on/off signals from all bore pumps?

Regards,
Lisa Mace
Process Engineer
Beca
Phone: [redacted] Fax: [redacted]
DDI: [redacted] Cell: [redacted]
www.beca.com



Agenda

Well Head Protection Assessments - Discussion about Most Recent Assessments

To be held 19 December 2017 at 10am

at Christchurch City Council

Invitees:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca

Item	Action
1 Project Summary ■ Scope ■ Results so far including common issues	
2 Health, safety and Environment	
3 Discussion Points ■ Below ground installations ■ Not fenced, or fence at less than 5m ■ No record of grout seals ■ Check valve said to be on the pump with no record of this or single check valve rather than dual ■ Duty/standby sump pumps ■ No air vent ■ Time frames for remedial works ■ Any changes as a result of Havelock North Stage 2 Inquiry	

Citycare Group

Citycare Water

Below Ground Wellheads Benchmark

22/12/2017

1. Summary

Works carried out at Main Pumps Station Well 2 as a part of the repairing of below ground wellhead project are:

1. External grouting
2. Internal sealing and lining of the well
3. Sealing of glands and ducts
4. Cable relocation
5. Installation of a new sump pump
6. Floor regrading and sump deepening
7. Installation of a secure, accessible well cover
8. Construction of a 2m apron around welll cover

The work undertaken on each component is considered to be the benchmark level required to minimise or elimnate water contamination from ground water and rainfall (or both).

Following are pictures of the finished works corresponding to the above list at Well 2 Main Pumps:

1.External Grouting 	2/3.Internal Sealing and Lining of the Well 	4.Cable Relocation 
5/6. Floor Regrading (in progress) 	7. Installation of Secure, Accessible Well cover 	9.Construction of a 2m Apron around Well 

2. External Grouting

Ideal Well Picture (Main pumps Well 2)

3. Cable Relocation

Ideal Picture (Main Pumps Well 2)

5. Install Secure Accessible Well Cover

Ideal picture (Main Pumps Well 2)

6. Construction of 2m Apron around well cover

Ideal picture (Main Pumps Well 2)

Timelines

The following high priority works will be completed by June 2018 – as these sites were assessed as having the highest potential risk of water contamination. There are 25 wells in this group. Of this, 16 wells require all eight (8) components of work to be undertaken. The remainder (nine) require lesser work in particular cable relocation.

In total 102 wells have been assessed, with the remainder (77) considered to be lower risk but still requiring remedial works. It is anticipated that this work will be completed by December 2018.

The table below identifies 25 wells, some with two work streams

Part 1: Cable Relocation where non External Grouting Require

Part 2: All other works

Site	Well Number	Estimated Start Date	Estimated Finish Date
Main Pumps Station	Well 1	26/10/2017	13/11/2017
	Well 2	12/09/2017	3/10/2017
	Well 4	7/11/2017	23/11/2017
	Well 5	15/01/2018	26/01/2018
	Well 6	29/01/2018	2/02/2018
Grampian	Well 5	5/02/2018	23/02/2018
Farrington (Part 1)	Well 4	17/11/2017	27/11/2017
Grassmere (Part 1)	Well 3	4/12/2018	15/12/2017
Farrington (Part 2)	Well 4	26/02/2018	9/03/2018
Palantine	Well 1	12/03/2018	30/03/2018
Thompsons (Part 1)	Well 2	15/01/2018	24/01/2018
Sydenham (Part 1)	Well 5	26/01/2018	2/02/2018
Sydenham (Part 2)	Well 5	2/04/2018	6/04/2018
	Well 6	209/04/2018	20/04/2018
Thompsons (Part 2)	Well 2	23/04/2018	27/04/2018
Burnside (Part 1)	Well 5	5/02/2018	14/02/2018
Belfast (Part 1)	Well 1	15/02/2018	22/02/2018
	Well 2	26/02/2018	6/03/2018
Grassmere (Part 1)	Well 2	12/03/2018	16/03/2018
Mays (Part 1)	Well 2	19/03/2018	27/03/2018
	Well 4	26/03/208	3/04/2018
Redwood (Part 1)	Well 1	5/04/2018	12/04/2018
Burnside (Part 2)	Well 5	30/04/2018	9/05/2018
Belfast (Part 2)	Well 1	10/05/2018	18/05/2018
	Well 2	21/05/2018	29/05/2018
Blighs	Well 1	30/05/2018	13/06/2018
Grassmere (Part 2)	Well 1	14/06/2018	22/06/2018
	Well 2	25/06/2018	29/06/2018
	Well 3	2/06/2018	7/07/2018
Thorrington (Part 1)	Well 1	16/04/2018	24/04/2018
Bexley (Part 1)	Well 1	26/04/2018	2/05/2018
	Well 2	7/05/2018	15/05/2018
Brooklands (Part 1)	Well 1	16/05/2018	22/05/2018
Montreal (Part 1)	Well 1	23/05/2018	31/05/2018
	Well 2	4/06/2018	12/06/2018
St John (Part 1)	Well 1	14/06/2018	20/06/2018
Trafalgar (Part 1)	Well 1	21/06/2018	28/06/2018
	Well 2	29/06/2018	5/07/2018

From: Mike Thorley <[redacted]>
Sent: Friday, 19 January 2018 2:34 p.m.
To: Murugesh, Daniela; Mace, Lisa (BECA)
Cc: Meek, Rob; O'Brien, Bridget; Davison, Keith
Subject: RE: Wellhead Inspections

Hi Daniela,

The well chamber now appears clear of rubbish and debris, and the cable entry points into the well head appear to be sealed now. These were our primary concerns about the continued operation of the well at this location.

Other issues relating to the below ground chamber will likely need to be addressed via the WSP process as per the recommendations in the Havelock North enquiry.

Please contact me if you have any further questions or comments.

Kind regards,
Mike

From: Murugesh, Daniela [mailto:[redacted]]
Sent: Friday, 19 January 2018 11:48 a.m.
To: Mike Thorley <[redacted]>; Lisa Mace <[redacted]>
Cc: Meek, Rob <[redacted]>; O'Brien, Bridget <[redacted]>; Davison, Keith <[redacted]>
Subject: FW: Wellhead Inspections

Hi Mike and Lisa,
Attached are 2 photos of Denton Well 3. Can you please review them and advise if you are happy to close out the concerns you raised in your email from 9 November?

Regards,
Daniela

From: Wardman, Graham
Sent: Thursday, 18 January 2018 1:56 p.m.
To: Murugesh, Daniela <[redacted]>
Subject: FW: Wellhead Inspections

Hope this is ok for today for Denton Well 3 ?

Graham Wardman

Reticulation Maintenance Contracts Supervisor (Pumps)
City Water & Waste

DDI [redacted]

Fax [redacted]

Mobile [redacted]

Email [redacted]

Web www.ccc.govt.nz

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73014, Christchurch, 8154

From: Andrew Trinnaman [mailto:[redacted]]
Sent: Thursday, 18 January 2018 1:24 p.m.
To: Wardman, Graham <[redacted]>
Cc: Huddlestone, Kevin (CityCare) <[redacted]>; Skevington, Tony (CityCare) <[redacted]>; Barron, Chris (CityCare) <[redacted]>
Subject: Re: Wellhead Inspections

Hey Graham,

See attached photo of Denton well3 today

Sent from my Samsung Galaxy smartphone.

-------- Original message --------
From: "Wardman, Graham" <[redacted]>
Date: 18/01/18 1:15 PM (GMT+12:00)

To: Andrew Trinnaman <[redacted]>
Subject: FW: Wellhead Inspections

Graham Wardman

Reticulation Maintenance Contracts Supervisor (Pumps)
City Water & Waste

DDI [redacted]

Fax [redacted]

Mobile [redacted]

Email [redacted]

Web www.ccc.govt.nz

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73014, Christchurch, 8154

From: Wardman, Graham
Sent: Thursday, 18 January 2018 1:05 p.m.
To: Huddlestone, Kevin (CityCare) <[redacted]>
Subject: FW: Wellhead Inspections

Hi Kev

These are the photo's I already have with Chris's coments below.

Daniela would just like a few photo's from today and making sure the sump pump is working.

Thanks for your help AGAIN !!!

Well-deserved holiday next week.

Cheers

Graham

Graham Wardman

Reticulation Maintenance Contracts Supervisor (Pumps)
City Water & Waste

DDI [redacted]

Fax [redacted]

Mobile [redacted]

Email [redacted]

Web www.ccc.govt.nz

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73014, Christchurch, 8154

Please consider the environment before printing this email

From: Wardman, Graham
Sent: Thursday, 18 January 2018 12:54 p.m.
To: Murugesh, Daniela <[redacted]>
Subject: FW: Wellhead Inspections

FYI

Graham Wardman

Reticulation Maintenance Contracts Supervisor (Pumps)
City Water & Waste

DDI [redacted]

Fax [redacted]

Mobile [redacted]

Email [redacted]

Web www.ccc.govt.nz

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73014, Christchurch, 8154

Please consider the environment before printing this email

From: Chris Barron [mailto:[redacted]]
Sent: Friday, 10 November 2017 4:29 p.m.
To: Wardman, Graham <[redacted]>
Subject: RE: Wellhead Inspections

Hi Graham,

Update on well head repairs.

Denton Well 1 The cable glands were checked and are not leaking.

Denton Well 3 The rubbish has been removed and cable entries have been sealed.

Denton Well 5 The cable glands were checked and are not leaking.

Dunbars Well 1 The leaking cable gland was tightened to stop the leak.

Dunbars Well 3 The cable entries are sealed with RTV.

Dunbars Well 4 New sump pump was installed yesterday cable glands are sealed and are not leaking

Regards
Chris

Chris Barron
Manager Pumps and Storage
[redacted]
Shuttle Drive. Bromley. Christchurch
PO Box 7669 Sydenham Christchurch 8240
citycarewater.co.nz

From: Wardman, Graham [mailto:[redacted]]
Sent: Friday, 10 November 2017 12:30 p.m.
To: Chris Barron
Subject: Wellhead Inspections
Importance: High

Hi Chris

See comments below, please can you action the Dunbars and Denton issues immediately.

Cheers

Graham

Graham Wardman

Reticulation Maintenance Contracts Supervisor (Pumps)
City Water & Waste

DDI [redacted]

Fax [redacted]

Mobile [redacted]

Email [redacted]

Web www.ccc.govt.nz

Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73014, Christchurch, 8154

Please consider the environment before printing this email

From: Murugesh, Daniela
Sent: Friday, 10 November 2017 12:09 p.m.
To: Collins, Les <[redacted]>; Wardman, Graham <[redacted]>; Meek, Rob <[redacted]>
Cc: Johnson, Mark <[redacted]>
Subject: FW: Wellhead Inspections
Importance: High

Hi Les / Graham / Rob,

Beca carried out some wellhead inspections this week (required under the DWSNZ every 5 years).
They identified some issues at Dunbars Well 4 and Denton Well 3 that they feel need to be rectified immediately, please see below.

There are also wells where the sump pumps weren't working and some wells where cable gland seals were non-existent.

Can the issues at Dunbars Well 4 and Denton Well 3 please be addressed immediately, the sump pumps at the wells listed below be checked and the cable glands be checked.
It would be great to check where these wells are on the City Care wellhead improvement priority list.

Many thanks,
Daniela

From: Lisa Mace [mailto:[redacted]]
Sent: Thursday, 9 November 2017 4:01 p.m.
To: Murugesh, Daniela <[redacted]>
Cc: Paul Reed <[redacted]>; Andrew Watson <[redacted]>; Mike Thorley <[redacted]>
Subject: Wellhead Inspections

Hi Daniela,

Mike and I had a successful few days with Paul joining for some of the sites. We made it around all the locations including Wainui.

Unfortunately, we could not inspect Brooklands Well 2 due to safety concerns. A new chamber segment has recently been added making the total height about 3m without railing (see the first photo). I understand that CityCare have already planned to install fall protection railing but I will leave that with you to follow up.

Also, there are two wells which have immediate public health risks. We recommended taking these out of service and isolating until the issues can be rectified:

- Dunbars Well 4 – significant amounts of water in the chamber, the sump pump was not running, and water was leaking out of the cable gland. This well is in a driveway/footpath and has a level entry unsealed chamber lid (see photos);
- Denton Well 3 – garbage and vandalism in the chamber and its vicinity, open cable entry point (no cable glands), no sump pump (although dry), a bellow that looked to be sucked inwards indicating that the valve on the pump might need to be checked (see photos). If this chamber was inundated with water it would directly enter the well head.

Also we found a few wells with water sitting in them and no sump pumps. We recommend that you carry out an urgent review of all sump pumps and clear water out of the wet well chambers. We noticed water in:

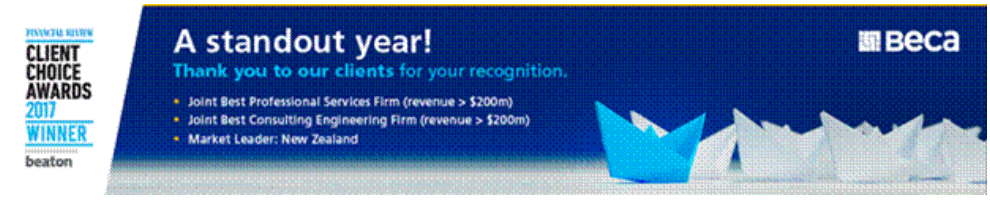
- Tara
- Sockburn Well 3
- Picton Well 1
- Picton Well 3
- Kainga

And we noticed the following wells without cable gland seals:

- Wainui
- Denton Well 1
- Denton Well 3
- Denton Well 5
- Dunbars Well 1
- Dunbars Well 3
- Dunbars Well 4

We will include this information in our reports but I thought it would be best for you to have it earlier.

Regards,
Lisa Mace
Process Engineer
Beca
[redacted]
www.beca.com



From: Daly, Jo
Sent: Monday, 15 January 2018 5:03 p.m.
To: Councillors and Mayor; Edwards, Karleen; Adamson, David
Cc: Bruorton, Adair
Subject: Recess Committee Meeting - Tuesday 16 January 3.30pm - Availability

Importance: High

Good afternoon

To advise that a Council Recess Committee meeting has been called for tomorrow, Tuesday 16 January 3.30pm in the Council Chamber, Civic Offices.

The purpose of this meeting is to receive a public excluded report on **below ground well heads**. The report will be considered in public excluded session.

Members are asked to confirm their availability to attend this Recess Committee meeting to me **by 9am tomorrow**, Tuesday 16 January. An appointment will shortly be sent to all members.

The agenda for this meeting will be distributed to all Councillors and available on the Hub tomorrow morning.
Kind regards
Jo

Jo Daly
Council Secretary and Electoral Officer
Christchurch City Council

DDI: [redacted]
Mobile: [redacted]
Email: [redacted]
Web: www.ccc.govt.nz

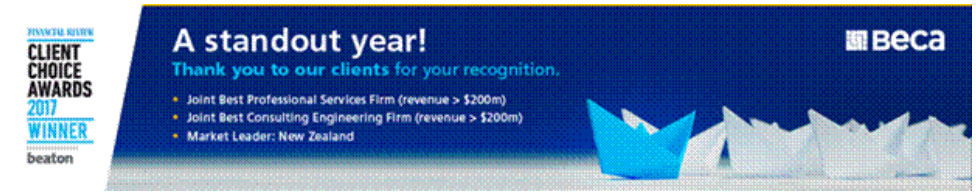
From: Lisa Mace <[redacted]>
Sent: Thursday, 21 December 2017 11:24 a.m.
To: Murugesh, Daniela; 'Judy Williamson'; Mike Thorley; Paul Reed
Subject: Well Head Protection Assessments - Discussion Minutes
Attachments: NZ1-14974786-Well Head Protection Assessments - Discussion about Recent Assessments - Minutes.pdf

Hi all,

Attached is minutes from our meeting of Tuesday. Daniela, can you please distribute to Kenton, Rob and Graham?

Happy holidays all!

Regards,
Lisa Mace
Process Engineer
Beca
[redacted]
www.beca.com



Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

CH2M Beca

www.ch2mbeca.com

Report

Dunbars Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

22 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Template for Client Review	22 November 2017
B	Lisa Mace / Mike Thorley	Draft for Client Review	14 December 2017
C	Lisa Mace / Mike Thorley	Final version	19 January 2018
D	Lisa Mace / Mike Thorley	Incorporating final changes	22 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		22 January 2018
Reviewed by	**Andrew Watson**		22 January 2018
Approved by	**Paul Reed**		22 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the wells supplying Dunbars Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used in this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Dunbars Pumping Station (West Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore logs (Wells 1, 2, 3 and 5) as included in Appendix C
- Bore logs from ECan's website (Well 4) as included in Appendix C - https://www.ecan.govt.nz/gis-mapping/
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Dunbars Pumping Station is supplied by five wells; Dunbars Wells 1 – 5. Each well feeds into a combined suction tank which then goes to the Pumping Station pump set. Dunbars Pumping Station and Wells are located near the corner of Halswell Road and Dunbars Road. The station supplies part of the West Pressure Zone. Table 2-1 summarises key information about the five wells.

Table 2-1: Dunbars Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M36/4053	48.6 – 53.6	2
Well 2	M36/4052	48.3 – 54.3	2
Well 3	M36/4333	46.57 – 52.57	2

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 4	M36/3060	45.9 – 51.9	2
Well 5	M36/8019	106 - 110	4

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The wells at Dunbars Pumping Station are screened within moderately-deep (Aquifer 2 – Linwood Gravel Aquifer) and deep (Aquifer 4 – Wainoni Gravel Aquifer) leaky (semi)-confined aquifers within the Christchurch Artesian Aquifer System.

4 Well Inspections

An inspections of each well was carried out on 8 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Matthew Thomas (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Dunbars Wells 1 – 5 do not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 2 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 2: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Locate source of leak and seal. The source is potentially the sample tap. ■ Seal chamber floor to prevent inundation of	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled		

	First Priority	Second Priority	Third Priority	Ongoing
	chamber from groundwater and install a sump pump with level sensor and alarms ■ Seal cable entry points	outside the chamber when samples are collected ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.		
Well 2	■ Seal the hole in the top of the chamber ■ Seal chamber floor to prevent inundation and include a sump ■ Install a sump pump (with a level sensor that alarms to an operator)	■ Modify the sample tap connection point to prevent the collection of debris. This may be either a cap or the installation of a permanent sample tap connection device. The sample tap should allow collection outside of the chamber to avoid spilling water in the chamber. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.	■ Mitigation works to prevent inundation and contamination risk from adjacent drain	
Well 3	■ Seal cabling ■ Seal the chamber floor to prevent water inundation and either install a sump pump, or install drainage holes at the base of the chamber Ensure that the drainage holes have vermin protection, probably in the form of mesh.	■ Modify the sample tap connection point to prevent the collection of debris. This may be either a cap or the installation of a permanent sample tap connection device. The sample tap should allow collection outside of the chamber to avoid spilling water in the chamber.	■ Mitigation works to prevent inundation and contamination risk from adjacent drain	
Well 4	■ Install a level sensor and a chamber level alarm ■ Seal the chamber lids	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled		■ Regular monitoring of this well should be carried out because of the high risk to public health. We recommend weekly and during

	First Priority	Second Priority	Third Priority	Ongoing
	■ Seal cables, pipework and casing if not already sealed (could not assess due to water in chamber) ■ Replace lid and form an apron with a fall away from the lid	outside the chamber when samples are collected ■ Consider decommissioning this well and replacing with an above ground well in a new location ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.		heavy rain inspections to check that there is no water in the chamber and that there are no signs of it leakage. The sump pump should also be tested regularly.
Well 5	■ Seal cabling at chamber side wall ■ Ensure that casing-chamber connection is sealed ■ Check casing integrity, treat rust and seal chamber/floor ■ Install a sump pump (with a level sensor that alarms to an operator)	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Form an apron with a fall away from the chamber ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.		
All wells	■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the	■ For the as-built records, confirm backflow prevention on the well pump has been installed.	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

	First Priority	Second Priority	Third Priority	Ongoing
		next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.		

7 Conclusion

The information reviewed and the inspections carried out indicate that none of the Dunbars wells meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Dunbars
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2017
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Dunbars Wells 1 – 4 draw from Aquifer 2 (leaky-confined) Dunbars Well 5 draws from Aquifer 4 (leaky-confined)
Surface Water Ways, Drains, etc	Dunbars Drain
4. Photo Record and Comments	
Photo	Comment

	Suction tank which all Dunbars wells feed
	Reticulation pumps within the pump station

5. Risks from Surrounding Environment

a) Within the site:				
Diesel/Chemical Storage	None	☐ Underground ☐ Aboveground	Fuel lines	☐ Underground ☐ Aboveground
Access by Animals	Not a fenced site but a locked and alarmed building			
Protection from vandalism, signs of vandalism	As above, no signs of vandalism			
Other Activities	N/A			
b) Immediate Neighbouring Land Use:				
Current Neighbouring Land Use	Residential			
Significant Changes Since Previous Inspection	None identified			
Zoning of Neighbouring Land	Residential Suburban Zone			
c) Wider Environment:				

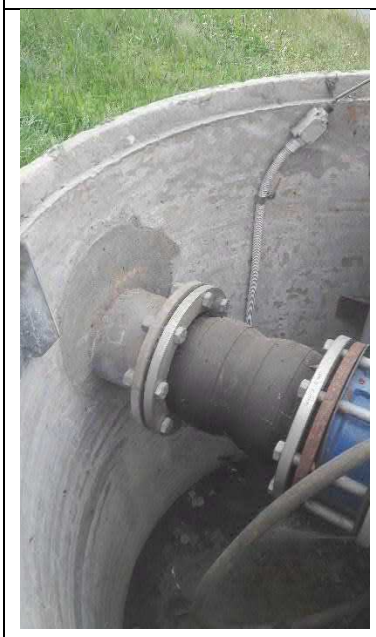
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Gas station located across the street. Risk from potential spills of petrol or diesel fuel from the gas station could enter underground pipework and potentially the wells. One active stormwater discharge to land consent within 400m Sewer nearby
Risk of flood inundation	Pump station is below ground but within a building
Potential sources of young water	No sources specific to the pumping station identified. See well assessments
General land use in catchment (LLUR)	As below
Contaminated sites (HAIL status)	None identified at the addresses of the wells Gas station across the road
Status and condition of surrounding wells (within 400 m radius)	Multiple wells
Landfill	None identified
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
Immediate Action Required	Refer well assessments
Action Required within 12 Months	Refer well assessments
Future	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

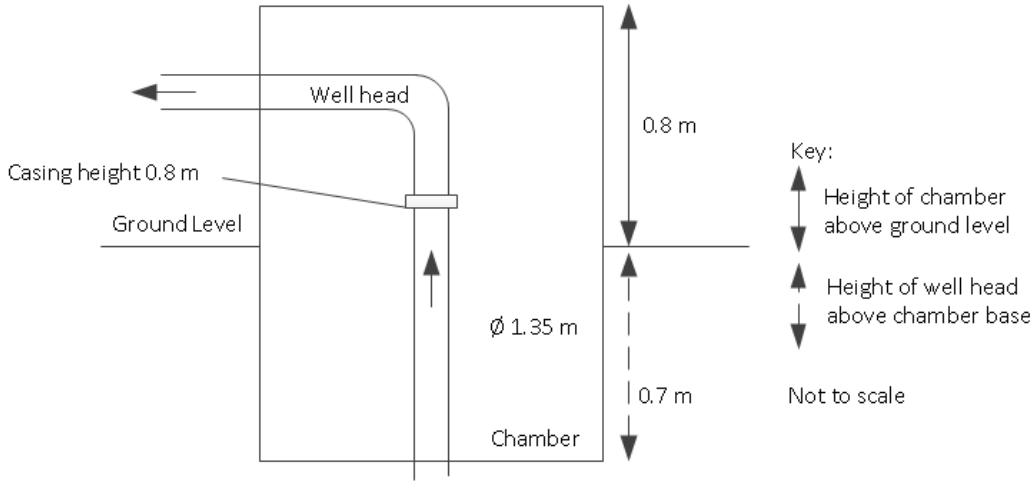
Dunbars Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Dunbars Well 1
ECan Well No.	M36/4053
Aquifer No.	2
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	48.6 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	48.6 – 53.6
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	28 December 1989
Control System/Alarms	Well pump on/off, lid opening alarm

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well chamber is located adjacent to the road with a gas station across the street.
	Chamber is located in a slight low point. Ponding may occur around the exterior.

	Water present on top of casing to pipe flange. The source of the water is unknown. It may be the pipe or it may be the sample tap.
	Pipe sealed at chamber connection.
	Chamber floor is gravel and so is not sealed from below. Casing is not sealed to chamber.

	Signs of groundwater entering the chamber through the floor from outside.
	Flow meter chamber near Dunbars Well 1 with water in the base and no sump pump
5. Diagram with Well Measurements	



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection		
a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Power cable joint not sealed
	Pipework	Sealed with sidewall of chamber. Some leaking on top of flange in chamber which may be a result of a pipework leak or from the sample tap.
	Well casing	No concrete seal, minor pitting
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good condition
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No, slight low point
100mm step above ground level?		No

<table>
<tr><td>Signs of ponding?</td><td>Not at time of inspection</td></tr>
<tr><td>Access by animals</td><td>No fence to prevent access, in a residential area where cats and dogs would be common but livestock would be less likely</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Lid access alarm installed. Lid locked with padlock</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – check valve installed (not tested)

Note that a single check valve provides a low degree of protection. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel with minor pitting</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
</table>
</td></tr>
</table>

	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	3m from edge of busy road. There is the potential for a spill of gas or other liquid to enter the well. Gas station across the street. Sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	Base of chamber was damp at the time of inspection and there was some water on top of the casing to pipe flange	
Is there a sump pump?	No pump or sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Locate source of leak and seal. The source is potentially the sample tap. ■ Seal chamber floor to prevent inundation of chamber from groundwater and install a sump pump with level sensor and alarms ■ Seal cable entry points ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected	

	■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced and the local contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

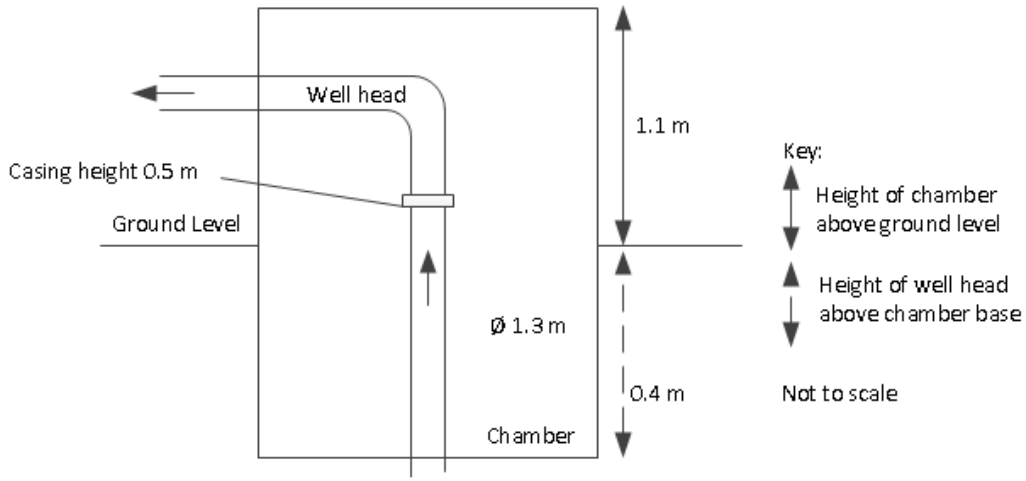
Dunbars Well 2

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Dunbars Well 2
ECan Well No.	M36/3052
Aquifer No.	2
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	48.3 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	48.3 – 54.3
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	16 May 1990
Control System/Alarms	Well pump on/off, lid opening alarm

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well chamber is 1.1m above ground. Located on the side of the road.
	Well is adjacent to sidewalk and road. A creek is on the other side of the well.

	Pipework in reasonable condition with some rust. Bottom of chamber is gravel. Sample tap not installed but connection point is present.
	Cables appear to be sealed
	A hole in the top of the chamber was seen. This is a possible source or water, or vermin, ingress

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Sealed
	Pipework	Sealed
	Well casing	No concrete seal
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good
Raw Water sample port?		Connection point is chamber, sample tap attachment must be brought to site
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		No
Signs of ponding?		No

<table>
<tr><td>Access by animals</td><td>No fence around well, in a residential area where cats and dogs would be common but livestock would be less likely</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Lid access alarm installed. Padlock on lid</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – check valve installed (not tested)

Note that a single check valve provides a low degree of protection. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel, good condition</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
</table>

c) Contamination Sources:	
Does the WSP address contaminant sources and contaminant migration pathways?	Not received
Any localised well specific sources of contamination?	Adjacent sidewalk and road Sewers in close proximity.
d) Below Ground Chambers:	
Water level of chamber	None at time of visit
Is there a sump pump?	No pump or sump
Are there duty/standby sump pumps?	No
Sump pump testing, include date a method	N/A
Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the bore head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal the hole in the top of the chamber ■ Seal chamber floor to prevent inundation and include a sump ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify the sample tap connection point to prevent the collection of debris. This may be either a cap or the installation of a permanent sample tap connection device. The sample tap should allow collection outside of the chamber to avoid spilling water in the chamber. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA.

	■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced and the local contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	■ Mitigation works to prevent inundation and contamination risk from adjacent drain ■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

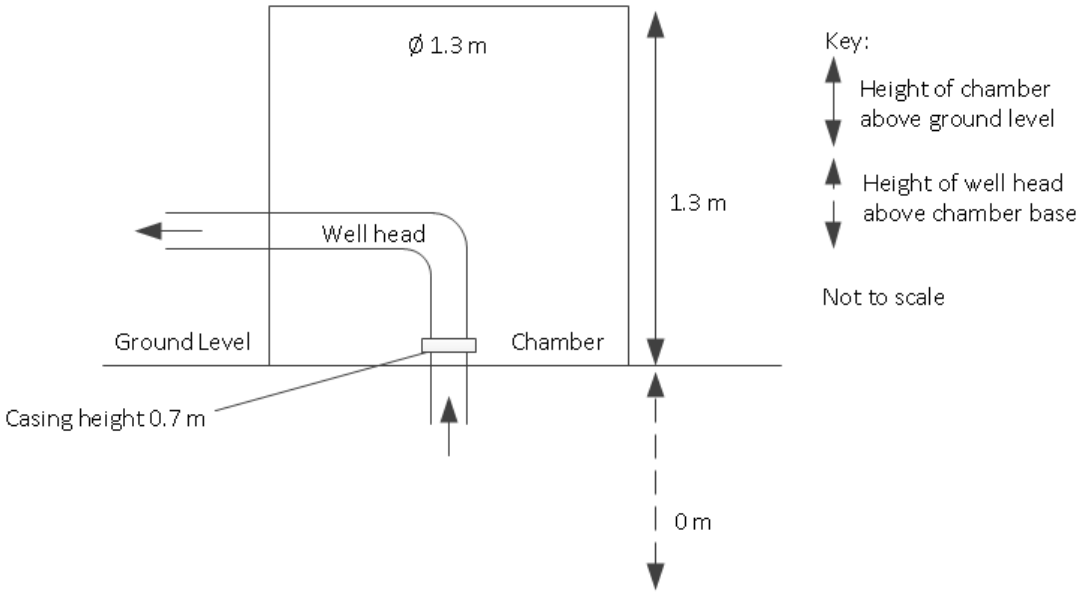
Dunbars Well 3

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Dunbars Well 3
ECan Well No.	M36/4333
Aquifer No.	2
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Above
Casing Depth (mbgl)	46.57 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	46.57 – 52.57
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	1 October 1990
Control System/Alarms	Well pump on/off, lid opening alarm

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Chamber sits on ground (not a below ground installation)
	Pipework sealed with the chamber sidewalls. Sample connection point on top of pipework. A sample tap is brought to site for sampling. Gravel in bottom of chamber which allows water to come up through the ground and into the chamber.

	Adjacent creek
	Adjacent road

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
	Cabling	Not sealed

Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Pipework	Sealed
	Well casing	No concrete seal
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		Not sealed, not floor Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good
Raw Water sample port?		Connection point is chamber, sample tap attachment must be brought to site
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		No
Signs of ponding?		No, near a drain
Access by animals		No fence around well, in a residential area where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism		Lid access alarm installed. Padlock on lid
b) Drilling Standard:		
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?		Yes – check valve installed (not tested) Note that a single check valve provides a low degree of protection. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?		N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?		Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)		Steel, good condition

<table>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td><table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table></td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Adjacent sidewalk, road and creek.

Sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>None at time of visit</td></tr>
<tr><td>Is there a sump pump?</td><td>N/A – above ground</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>N/A</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>N/A</td></tr>
<tr><td>Does the bore head meet the requirements of Criteria 2</td><td>No, see actions below</td></tr>
<tr><td colspan="2">7. Actions Arising</td></tr>
</table>

Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal cabling ■ Seal the chamber floor to prevent water inundation and either install a sump pump, or install drainage holes at the base of the chamber Ensure that the drainage holes have vermin protection, probably in the form of mesh. ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify the sample tap connection point to prevent the collection of debris. This may be either a cap or the installation of a permanent sample tap connection device. The sample tap should allow collection outside of the chamber to avoid spilling water in the chamber. ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced and the local contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	■ Mitigation works to prevent inundation and contamination risk from adjacent drain ■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

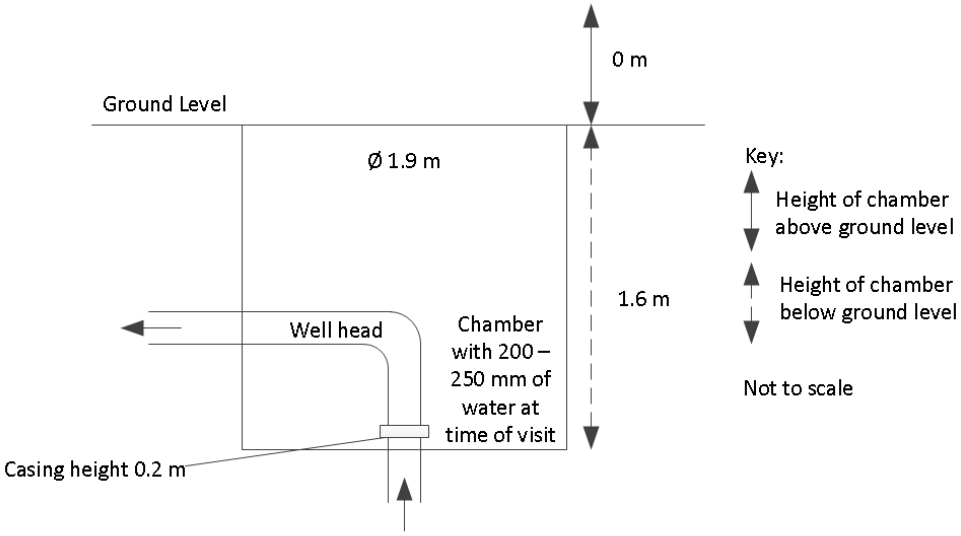
Dunbars Well 4

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Dunbars Well 4
ECan Well No.	M36/3060
Aquifer No.	2
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	45.9 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	45.9 – 51.9
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	21 March 1985
Control System/Alarms	Well pump on/off, lid opening alarm
Type of Pump	Submersible

Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well is located at the end of a driveway, on the sidewalk and adjacent to a busy road.
	Stormwater drain on road approximately 2m away
	Drain from driveway directed towards well.
	Well with water in chamber and evidence that the lid is not water tight. Poor pipe condition can also be seen. Note that the lid has a security alarm. Sample point drains into chamber.

	Water in bottom of chamber. Sump pump outside of sump. Ripples in water imply that there is a leak from the side of the casing near the cable duct.
	A photo of a new sump pump in the chamber that was received after the site visit (19 January 2018). The photo shows a small amount of water in the chamber.

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Could not inspect due to water in chamber but ripples in the water implied that there was a leak from the cable ducting or adjacent casing

	Pipework	Could not inspect due to water in chamber
	Well casing	Could not inspect due to water in chamber
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Site is above the 50 year flood level and so flooding potential is low
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Surface rust
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No, driveway sloped into chamber
100mm step above ground level?		No
Signs of ponding?		Yes, some ponding on surrounding driveway. The adjacent driveway has a stormwater drain directed towards the chamber.
Access by animals		No fence, in a residential area where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism		Lid access alarm installed. Lid tools required to access but no lock
b) Drilling Standard:		
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?		Yes – check valve installed (not tested) Note that a single check valve provides a low degree of protection. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?		N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?		Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)		Could not assess due to water in chamber

<table>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Adjacent driveway, sidewalk and road.

Sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>200 – 250 mm at time of visit</td></tr>
<tr><td>Is there a sump pump?</td><td>Yes, but it was not running at the time of inspection despite the 200 – 250 mm of water in the bottom. Also not sitting in sump.</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>None</td></tr>
</table>

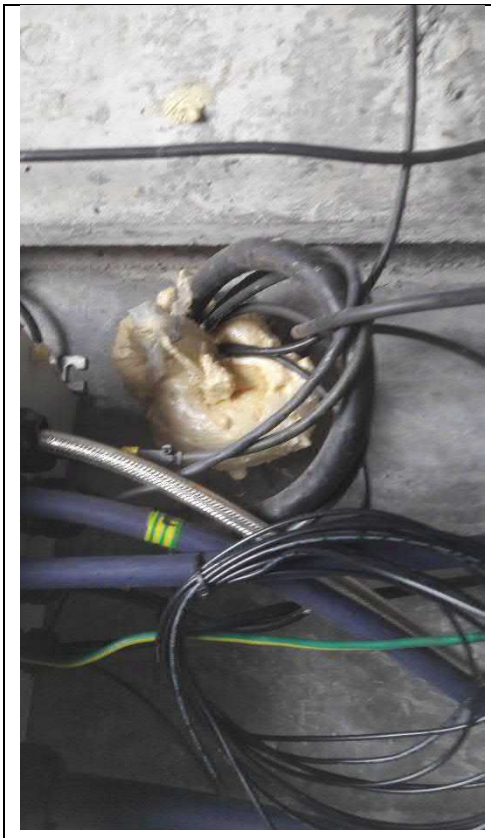
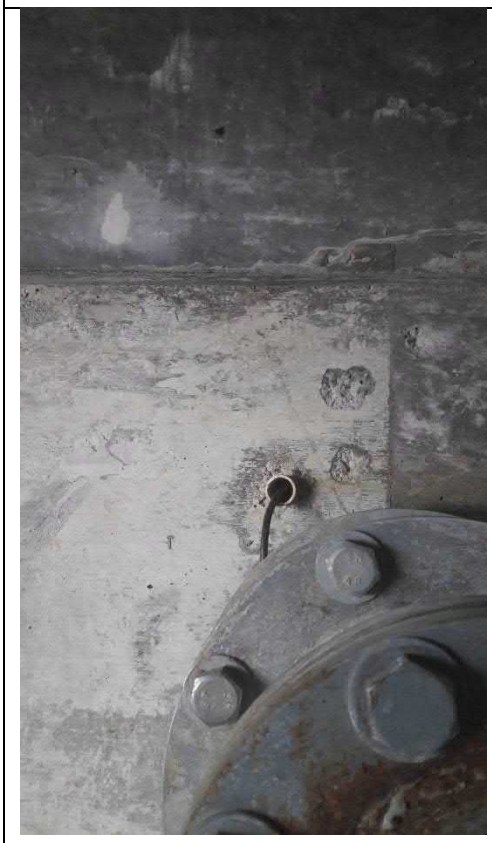
Does the bore head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Install a level sensor and a chamber level alarm ■ Seal the chamber lids ■ Seal cables, pipework and casing if not already sealed (could not assess due to water in chamber) ■ Replace lid and form an apron with a fall away from the lid ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Consider decommissioning this well and replacing with an above ground well in a new location ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced and the local contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ Regular monitoring of this well should be carried out because of the high risk to public health. We recommend weekly and during heavy rain inspections to check that there is no water in the chamber and that there are no signs of it leakage. The sump pump should also be tested regularly.

Dunbars Well 5

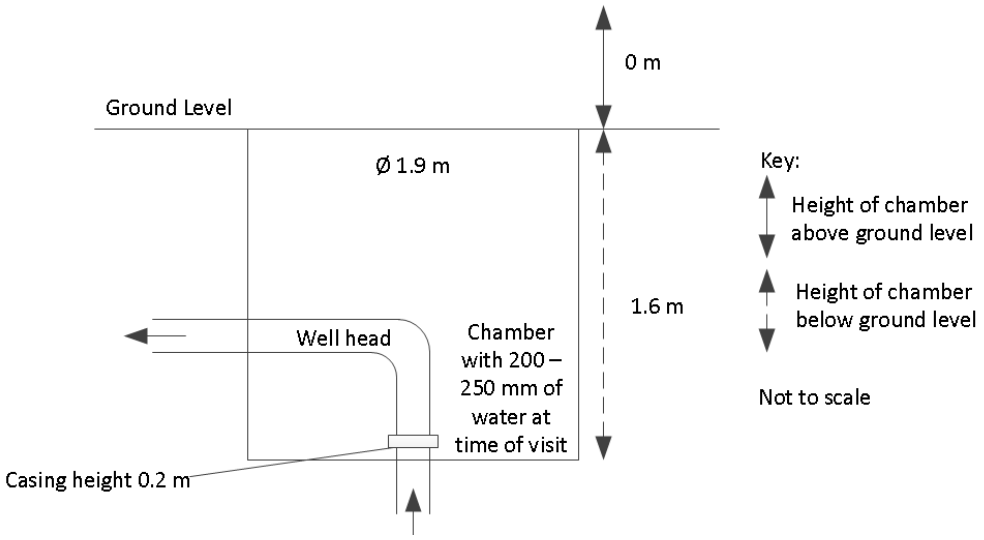
1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Dunbars Well 5
ECan Well No.	M36/8019
Aquifer No.	4
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	106 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	106 - 110
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	10 May 2006
Control System/Alarms	Well pump on/off, lid opening alarm

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Ground surrounding chamber is slightly lower

	Chamber has a sump but no pump Some pipe rust
	Pitting and rust on casing

	Untidy cable seals
	Cable entry at side wall is not sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection		
a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Sealed at well, not at chamber side wall
	Pipework	Sealed
	Well casing	Reasonable rust at casing-chamber connection. This may no longer be sealed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Minor surface rust
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		No
Signs of ponding?		Not at time of inspection

<table>
<tr><td>Access by animals</td><td>No fence, in a residential area where cats and dogs would be common but livestock would be less likely</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Lid access alarm installed. Lid locked with padlock</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – check valve installed (not tested)

Note that a single check valve provides a low degree of protection. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Significant rust</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
</table>

c) Contamination Sources:	
Does the WSP address contaminant sources and contaminant migration pathways?	Not received
Any localised well specific sources of contamination?	Adjacent sidewalk and road Sewers in close proximity.
d) Below Ground Chambers:	
Water level of chamber	None at time of visit
Is there a sump pump?	No pump but there is a sump
Are there duty/standby sump pumps?	No
Sump pump testing, include date a method	N/A
Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the bore head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal cabling at chamber side wall ■ Ensure that casing-chamber connection is sealed ■ Check casing integrity, treat rust and seal chamber/floor ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Form an apron with a fall away from the chamber ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area) ■ DWA to confirm that a single check valve in the headworks meets the backflow prevention

	requirements. Backflow prevention on the well pump may be installed but has not been confirmed. ■ Agree with the DWA whether or not grout seals must be retrofitted requirements based on how soon the well will be replaced ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced and the local contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

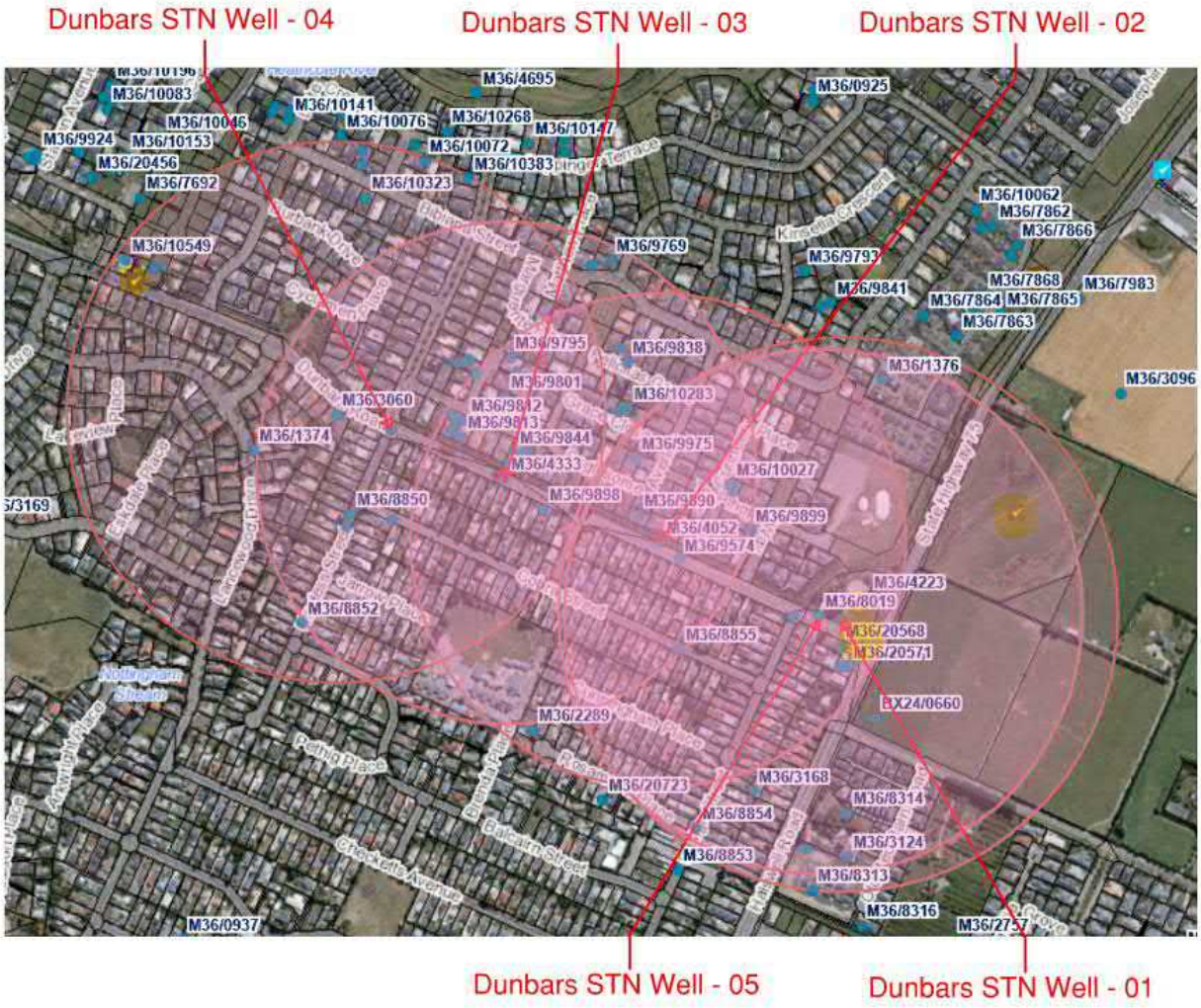


Figure 1: Summary of wells and consents within 400m of Dunbars Wells

Table 3: Summary of consents within 400m of Dunbars Wells:

Dunbars Well Sites

Well Number:	M36/3060			
	Type	*Consent Number*	*Consent Status*	*Feature Type*
	Discharge to Land	CRC092609	Issued - Active	Stormwater Residential
Well Number:	M36/4052			
	Type	*Consent Number*	*Consent Status*	*Feature Type*

	Discharge to Water	CRC092047	Terminated-Surrendered	Stormwater Industrial

Well Number: M36/8019

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC092047	Terminated-Surrendered	Stormwater Industrial
Discharge to Land	CRC092611	Terminated--Surrendered	Stormwater Industrial

Well Number: M36/4053

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC092047	Terminated-Surrendered	Stormwater Industrial
Discharge to Land	CRC092611	Terminated--Surrendered	Stormwater Industrial

Appendix C

Bore Logs

J

M36/4053
permit
1573

N.Z.D.F.
member

CLEMENCE DRILLING CONTRACTOR

Mill Road OHOKA Phone Ohoka 525

WELL-OWNER Papanui County Council
ADDRESS 149 Main South Rd
Sockburn
DRILLER D Clemence
DRILLING DATE 28 - 12 - 89
LOCALITY Cor Dunbars / Halswell Rd.

No 1. well

MAP SHEET No.
GRID REFERENCE*
N.Z.G.S. WELL No.
WATER RIGHT No. Reduced Level

STRATA				DETAILS OF AQUIFERS		
DEPTH FROM SURFACE (m)		COLOUR		DEPTH FROM SURFACE (m)		STATIC WATER LEVEL
Top	Bottom			Top	Bottom	(m)
0	6		Blue silts Top soil			
6	9.3		Big blue gravel			
13	13.8		Blue pug			
13.8	15.4		Peat			
15.4	18		Big blue gr		1.930	BGL
18	19.4		Big brown sandy gravel			
19.4	20.2		Wellsorted br gravel			
20.2	20.5		Yellow clay			
20.5	21.7		Good clean wellsorted gr			
21.7	24.7		Br stained " "			
24.7	24.9		Br/blue gravel			
24.9	25.1		Blue clay			
25.1	26		Peat			
26	26.15		Tight greeny blue clay			
26.15	26.4		Bl/Br gravel			
.4	26.65		Yellow clay			
.65	27.7		clean loose gravel			
27.7	30.7		Sandy gravel (br)			1.1 BGL
30.7	31.2		Yellow clay			
31.2	34		Blue Pug			
34	37.1		Yellow clay			
37.1	43		Brown sand saturated with heavy clay content.			

CASING DIAMETER (cm) DEPTH (m)
SCREEN TYPE SET AT
SCREEN LENGTH (m)‡ STATIC WATER LEVEL
DRAWDOWN (m) AFTER HOURS PUMPING AT (LITRES SEC/MIN)

REMARKS (INCLUDING NOTES ON CORES AND SAMPLES TAKEN)—

(2)

No1 Well

N.Z.D.F.
member

CLEMENCE DRILLING CONTRACTOR

Mill Road OHOKA Phone Ohoka

WELL-OWNER Papanui County Council (No. 1)
ADDRESS 149 Main South Rd
Sockburn
DRILLER D Clemence
DRILLING DATE 28-12-89
LOCALITY Cnr Dunbars / Halswell Rd

MAP SHEET No.
GRID REFERENCE*
N.Z.G.S. WELL No.
WATER RIGHT No. Reduced Level

DEPTH FROM SURFACE (m) Top	Bottom	COLOUR	STRATA	DETAILS OF AQUIFERS: DEPTH FROM SURFACE (m) Top	Bottom	STATIC WATER LEVEL (m)
3	43.4		Grey clay & Peat			
43.4	44.5		Yellow clay			
44.5	45		Claybound gravel			
45	47.25		Sandy br gravel			
47.25	47.8		clayboand gravel			
47.8	48.4		Hellsorted gravels			
48.4	50.8		Good hellsorted gravels			
50.8	51.8		sandier gravels			
51.8	54.1		Good clean gravel			
54.1	54.6		Very sandy V Stained			

CASING DIAMETER (cm) 300mm DEPTH (m) 53.6 Mtrs
SCREEN TYPE Hardson wedge wire SET AT 48.6 – 53.6
SCREEN LENGTH (m)‡ 5 Mtr header 720 STATIC WATER LEVEL +200
DRAWDOWN (m) 3 Mtrs AFTER 1 HOURS PUMPING AT 64 (LITRES SEC/MIN)
3.3 Mtrs 2 68 4/Sec

REMARKS (INCLUDING NOTES ON CORES AND SAMPLES TAKEN)– Pulled back 1mtr and gravel packed

N.Z.D.F.
member

CLEMENCE DRILLING CONTRACTOR

Mill Road OHOKA Phone Ohoka 528

WELL-OWNER Papanui County Council
ADDRESS C/o Rayds & Carolen.
P.O Box 870

DRILLER D Clemence

DRILLING DATE 16.5.90

LOCALITY Dunbars Rd No2 Bore.

MAP SHEET No.

GRID REFERENCE*

N.Z.G.S. WELL No.

WATER RIGHT No. Reduced Level

DEPTH FROM SURFACE (m) Top	Bottom	COLOUR	STRATA	DETAILS OF AQUIFERS: DEPTH FROM SURFACE (m) Top	Bottom	STATIC WATER LEVEL (m)
0	5.6		Top soil - Blue Pug			
5.6	8.8		clean blue gravel			
8.8	15		Blue pug			
15	16.1		Silty blue pug			
16.1	20.8		Rust stained loose gravel			
20.8	24.3		Good brown gravel			
24.3	26.1		Peat			
26.1	26.2		Yellow clay			
26.2	28		Br gravel clay seams			
28	28.6		Solid yellow clay			
28.6	31.7		Big wellsorted sandy gr			
31.7	34.4		Good loose gravel			
34.4	44		sandy brown gravel.			
44	46		Yellow clay			
46	47		clean br gravel			
47	48.1		Rust stained sandier gr			
48.1	49.3		Good clean gravel			
49.3	50		sandier big gravel			
50	51.7		Ex gravel			
51.7	52.9		Tight brown gravel			
52.9	53.6		Good WB seam			
53.6	54.3		loose pea gravel			
54			sandy			

CASING DIAMETER (cm) 300 mm DEPTH (m) 54.3 Mtrs

SCREEN TYPE Houston stainless steel SET AT 48.3 - 54.3 Mtrs

SCREEN LENGTH (m)‡ 6 Mtrs. STATIC WATER LEVEL .720 B GL.

DRAWDOWN (m) 2.030 AFTER 3 HOURS PUMPING AT 56.5 L (LITRES SEC/MIN)

REMARKS (INCLUDING NOTES ON CORES AND SAMPLES TAKEN)—

Bore No 3

N.Z.D.F. member

CLEMENCE DRILLING CONTRACTOR

Mill Road OHOKA Phone Ohoka 528

WELL OWNER Christchurch City Council

ADDRESS P O Box 237
CH-CH.

DRILLER J Blundell - T Watson

DRILLING DATE 1-10th-1990

LOCALITY Dunbars Rd Halswell

MAP SHEET No.

GRID REFERENCE*

N.Z.G.S. WELL No.

WATER RIGHT No. Reduced Level

STRATA				DETAILS OF AQUIFERS		
DEPTH FROM SURFACE (m)		COLOUR		DEPTH FROM SURFACE (m)		STATIC WATER LEVEL
Top	Bottom			Top	Bottom	(m)
0	2·5		Br silty clay			
2·5	7·6		Blue pug & timber			
7·6	7·75		claybound gr			
7·75	10·2		Good clean blue gr			
10·2	13·4		Blue pug & timber			
13·4	13·7		Peat			
13·7	15·3		Blue pug & Timber			
13·3	15·45		Peat			
15·45	17·7		Good wellsorted gr			
17·7	21·7		Stained br gravel			4·4
21·7	22·4		sandy gravel			
22·4	22·6		Yellow clay & gravel			
22·6	24·0		stained br sandy gravel			
24	31·5		Brown gravel / lenses yellow clay			
31·5	38·4		Sandy stained gravel			
38·4	39·8		Sand			
39·8	41·85		sandy gravel			
41·85	42·5		Yellow clay claybound gr			
42·5	44·77		Blue Pug			
44·77	45·77		Yellow claybound gr			
45·77	52·57		Good clean gravel			
52·57			Yellow clay			

CASING DIAMETER (cm) 300 mm DEPTH (m) 52·57 mtrs

SCREEN TYPE Houston wedge wire SET AT 46·57 - 52·57

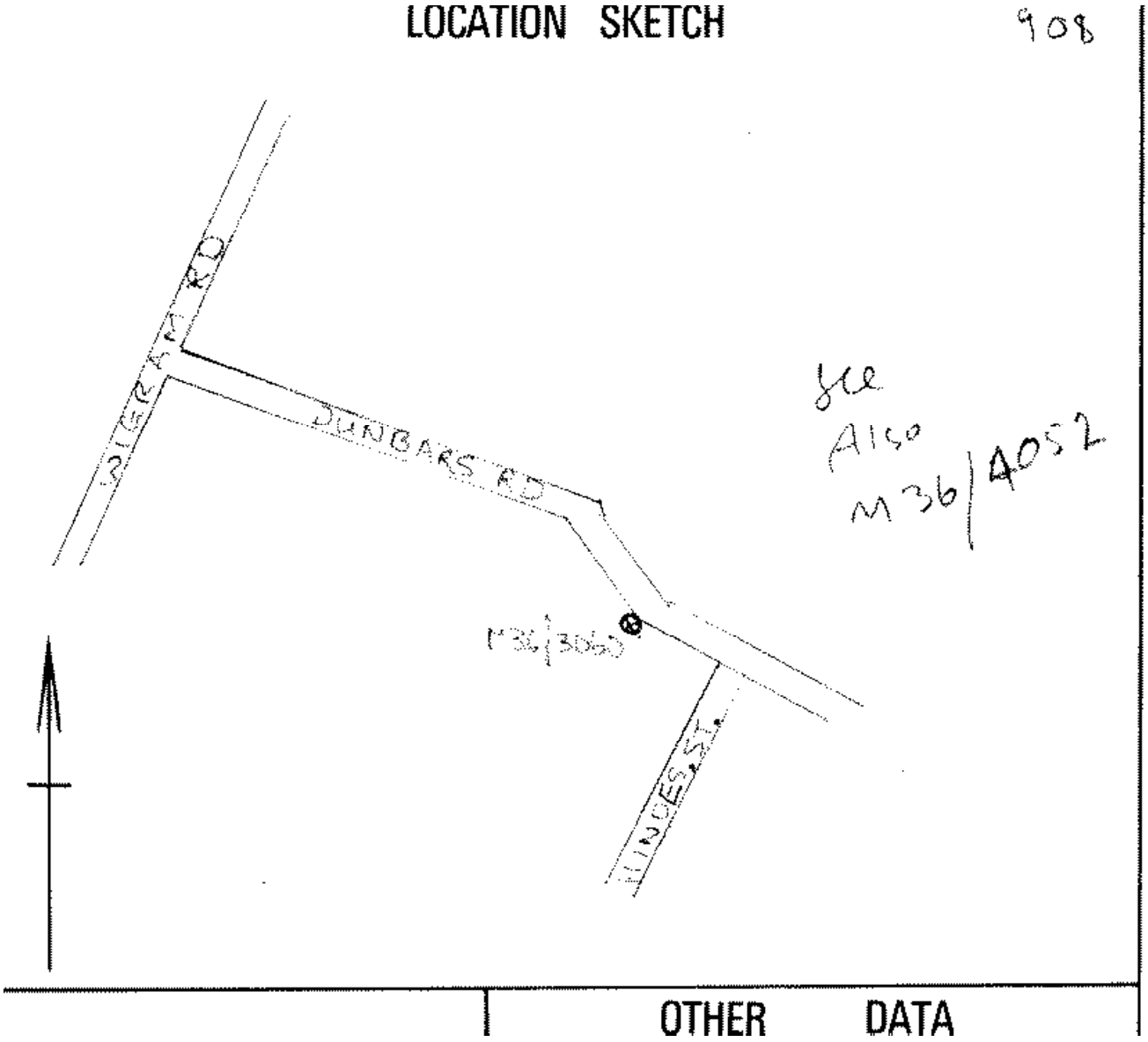
SCREEN LENGTH (m)‡ 6 mtrs STATIC WATER LEVEL 1·3 B.P.T

DRAWDOWN (m) 3·7 AFTER 2 HOURS PUMPING AT 100 (LITRES SEC/~~MIN~~)

REMARKS (INCLUDING NOTES ON CORES AND SAMPLES TAKEN)—

Bore or Well No	M36/3060
Well Name	DUNBARS ROAD
Owner	Christchurch City Council

Well Number	M36/3060	**File Number**	CO6C/03078
Owner	Christchurch City Council	**Well Status**	Active (exist, present)
Street/Road	DUNBARS ROAD	**NZTM Grid Reference**	BX24:64622-75939
Locality	OAKLANDS	**NZTM X and Y**	1564622 - 5175939
Location Description	SEE M36/4052	**Location Accuracy**	2 - 15m
CWMS Zone	Christchurch - West Melton	**Use**	Small Community Supply,
Groundwater Allocation Zone	Christchurch/West Melton	**Water Level Monitoring**	–
Depth	51.90m	**Water Level Count**	0
Diameter	300mm	**Initial Water Level**	
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	16.30m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 0.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	18	**Calc Min 95%**	1.00m above MP
Aquifer Name	Linwood Gravel	**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	0
Drill Date	21 Mar 1985	**Max Tested Yield**	0 l/s
Driller	A M Bisley & Co	**Drawdown at Max Tested Yield**	0 m
Drilling Method	Cable Tool	**Specific Capacity**	
Casing Material	STEEL	**Last Updated**	22 Dec 2015
Pump Type	Unknown	**Last Field Check**	
Water Use Data	Yes		



Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	45.9	51.9				

No step tests for this well

Comments

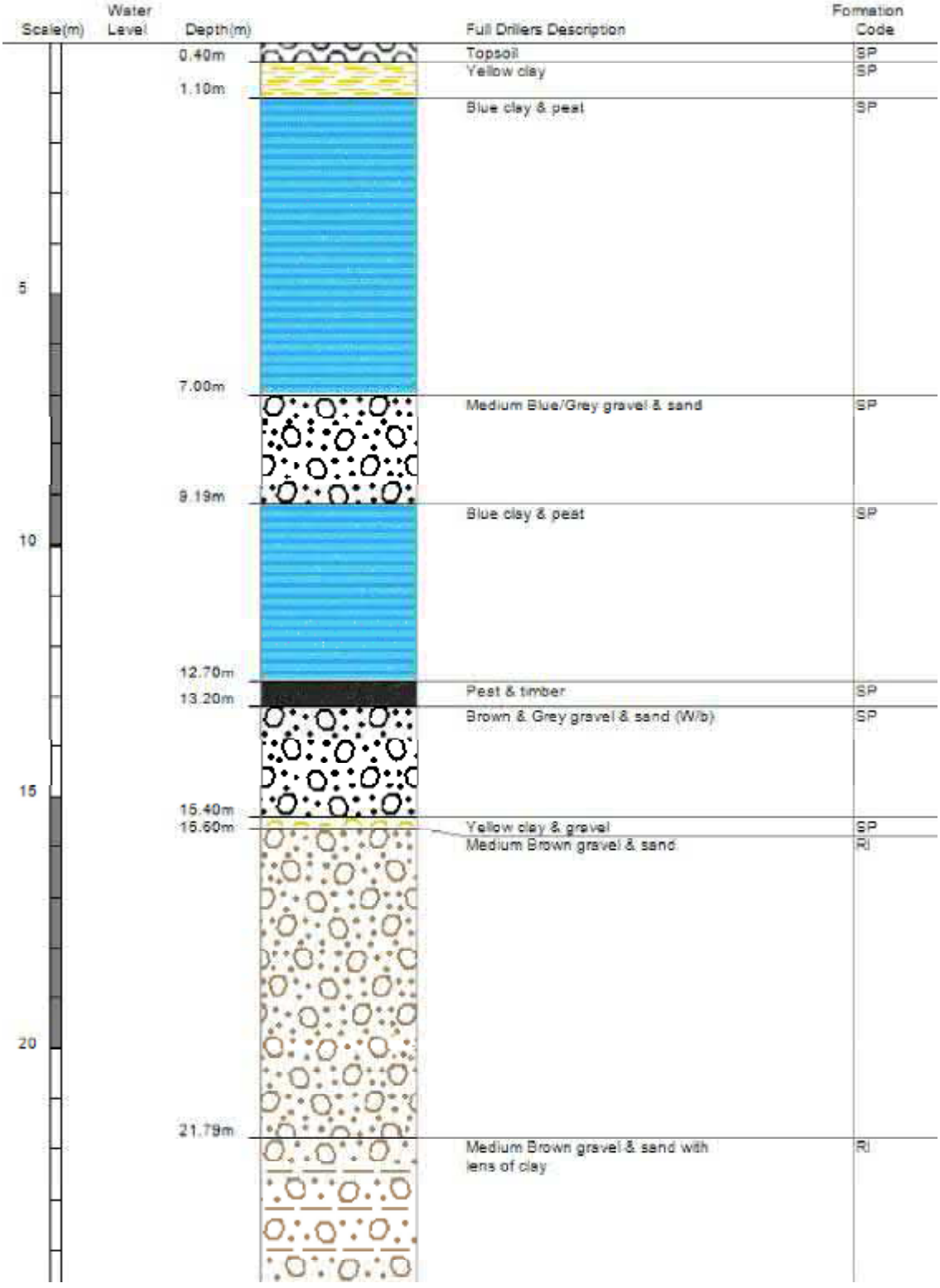
Comment Date	Comment
	FROM OLD CWS DB On Dunbars Rd near the corner of Halswell Rd. M36/3060 is on the south side of Dunbars Rd, approx. 240 m from M36/4333. Is in front of driveway for 83 Dunbars Red under a metal plate on footpath.
07 Oct 1998	Ex Paparua County Council
10 Feb 2000	FROM OLD CWS DB Surrounding area residential, paddocks used to graze horses & for cropping & is a BP petrol station on the south corner of Halswell & Dunbars Rd. GRID REF: M36:7462-3755.
13 Sep 2002	On the same consent as Dunbar P.S.
13 Jan 2004	Gridref changed from: M36:746-375 (from fieldwork 2000 Community Supply dtb)
17 Feb 2006	West Pressure Zone
28 Aug 2009	CCC advised taking from aquifer 2
06 May 2010	MfE source code added

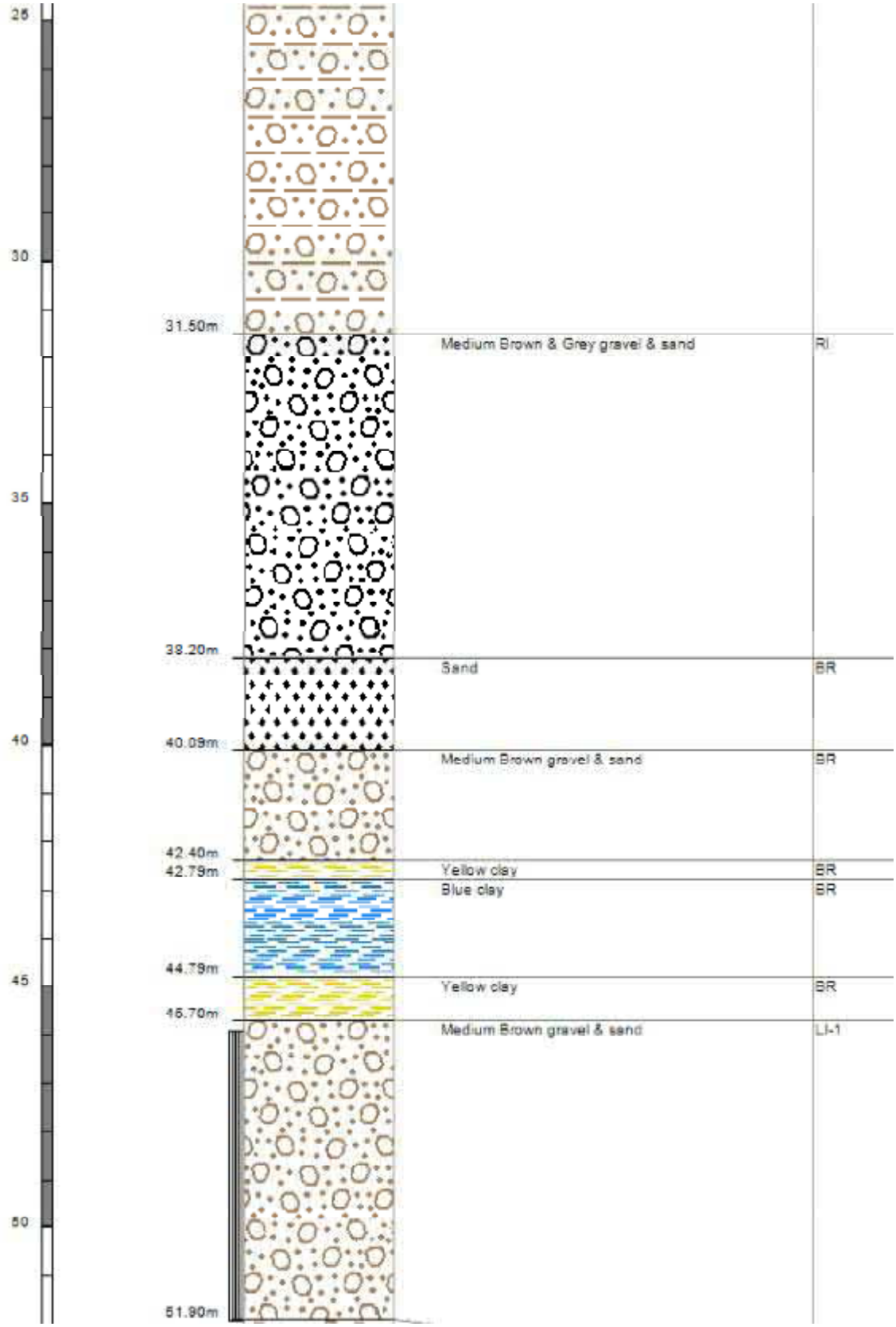
Bore Log

Borelog for well M36/3060

Grid Reference (NZTM): 1564622 mE, 5175940 mN
Location Accuracy: 2 - 15m
Ground Level Altitude: 16.3 m +MSD Accuracy: < 0.5 m
Driller: A M Bisley & Co
Drill Method: Cable Tool
Borelog Depth: 52.0 m Drill Date: 21-Mar-1985

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




25
30
35
40
45
50
31.50m
Medium Brown & Grey gravel & sand
RI
38.20m
Sand
BR
40.09m
Medium Brown gravel & sand
BR
42.40m
42.79m
Yellow clay
BR
Blue clay
BR
44.79m
Yellow clay
BR
46.70m
Medium Brown gravel & sand
LI-1
51.90m

Clemence Drilling Contractors Ltd

65 Main North Road • Kaiapoi • Canterbury • New Zealand • Phone 64 3 327 4300 • Fax 64 3 327 7799

BORELOG

WELL OWNER	Christchurch City Council	*CONSENT NUMBER*	CRC061480
ADDRESS	Dunbars Road, Halswell	*BORE NUMBER*	M36/8019
	Christchurch	*GRID REFERENCE*	
LOCALITY	Dunbars Road, Halswell, Christchurch		
DRILLER	Tony Smith/Ira Leech	*DRILLING DATE*	10-May-06

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	*Bottom*				
0.000	0.100	Topsoil			
0.100	0.600	Yellow clay and pit run			
0.600	4.000	Hard yellow clay - some gravel			
4.000	7.200	Grey puggy sand			
7.200	10.700	Medium - large blue grey gravel			
10.700	11.000	Grey pug and peat			
11.000	14.300	Soft grey pug			
14.300	15.000	Peat and timber			
15.000	15.700	Grey pug			
15.700	16.300	Peat and timber			
16.300	17.600	Tight grey gravel			
17.600	26.300	Loose brown sandy gravel			
26.300	28.300	Peat			
28.300	29.000	Yellow clay			
29.000	30.900	Loose grey/brown gravel			
30.900	31.100	Blue gravel			
31.100	31.300	Timber			
31.300	31.900	Hard yellow clay			
31.900	32.700	Brown water bearing sand			
32.700	37.200	Grey pug			
37.200	38.700	Brown clay			
38.700	42.000	Clay bound sand			
42.000	42.400	Yellow clay			
42.400	44.800	Clay bound sand			
44.800	46.300	Grey pug			
46.300	46.600	Peat			

Casing Diameter(mm)	300mm		Static water level	.63 AGL	Depth(M)	110.000
Screen Type	Aqua Link			Set At	106.000	110.000
Screen Length (m)	4 mtrs				Leader	1.200
Drawdown (m)	8.5 mtrs	Pumping	4	Hours @	70	Ltrs/sec

REMARKS * Well is on a mound approximately 1.5 metres high *
** Well should not be pumped at over 70 L/sec **

HOUSTON GRUNDFOS DAVEY N.Z.D.F

Clemence Drilling Contractors Ltd

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BORELOG

WELL OWNER	Christchurch City Council	*CONSENT NUMBER*	CRC061480
ADDRESS	Dunbars Road, Halswell	*BORE NUMBER*	M36/8019
	Christchurch	*GRID REFERENCE*	
LOCALITY	Dunbars Road, Halswell, Christchurch		
DRILLER	Tony Smith/Ira Leech	*DRILLING DATE*	10-May-06

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	*Bottom*				
46.600	47.100	Yellow clay			
47.100	48.700	Clay bound gravel			
48.700	54.200	Sandy brown gravel			
54.200	54.300	Clay seam			
54.300	56.700	Loose sandy brown gravel			
56.700	57.900	Brown sand			
57.900	58.100	Blue/green pug			
58.100	59.800	Peat and timber			
59.800	61.600	Loose blue gravel			
61.600	64.300	Grey pug and peat			
64.300	66.500	Blue pug/peat traces			
66.500	67.400	Blue clay bound gravel			
67.400	67.600	Brown clay bound gravel			
67.600	68.300	Brown gravel			
68.300	68.900	Yellow clay			
68.900	69.800	Tight water bearing gravel			
69.800	69.900	Clay seam			
69.900	70.800	Loose brown sandy gravel			
70.800	72.700	Very sandy gravel			
72.700	72.800	Yellow clay			
72.800	73.300	Very sandy gravel			
73.300	73.600	Yellow clay			
73.600	75.100	Grey pug			
75.100	76.300	Yellow clay			
76.300	78.200	Brown sand			
78.200	79.000	Yellow/brown clay			

Casing Diameter(mm)	300mm	Static water level	.63 AGL	Depth(M)	110.000
Screen Type	Aqua Link		Set At	106.000	110.000
Screen Length (m)	4 mtrs			Leader	1.200
Drawdown (m)	8.5 mtrs Pumping	4	Hours @	70	Ltrs/sec

REMARKS * Well is on a mound approximately 1.5 metres high *
** Well should not be pumped at over 70 L/sec **

Clemence Drilling Contractors Ltd

65 Main North Road • Kaiapoi • Canterbury • New Zealand • Phone 64 3 327 4300 • Fax 64 3 327 7799

BORELOG

WELL OWNER	Christchurch City Council	*CONSENT NUMBER*	CRC061480
ADDRESS	Dunbars Road, Halswell	*BORE NUMBER*	M36/8019
	Christchurch	*GRID REFERENCE*	
LOCALITY	Dunbars Road, Halswell, Christchurch		
DRILLER	Tony Smith/Ira Leech	*DRILLING DATE*	10-May-06

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	*Bottom*				
79.000	80.300	Brown clay			
80.300	81.400	Yellow clay			
81.400	81.700	Clay bound gravel			
81.700	87.000	Very sandy water bearing gravel			
87.000	88.000	Yellow clay			
88.000	89.400	Very sandy gravel			
89.400	90.500	Sand			
90.500	92.900	Sandy stained gravel			
92.900	93.400	Yellow clay			
93.400	93.900	Blue pug			
93.900	94.400	Grey pug			
94.400	94.800	Peat			
94.800	99.800	Grey pug			
99.800	100.000	Peat			
100.000	100.400	Grey pug			
100.400	100.800	Peat and timber			
100.800	102.300	Grey pug			
102.300	103.000	Peat			
103.000	103.300	Yellow clay			
103.300	105.000	Clay bound gravel			
105.000	105.900	Loose stained sandy gravel			
105.900	106.000	Clay bound seam			
106.000	110.000	Tight sandy water bearing gravel			
110.000	111.100	Very loose very sandy gravel			
111.100	111.800	Hard yellow clay			

Casing Diameter(mm)	300mm		Static water level	.63 AGL	Depth(M)	110.000
Screen Type	Aqua Link			Set At	106.000	110.000
Screen Length (m)	4 mtrs				Leader	1.200
Drawdown (m)	8.5 mtrs	Pumping	4	Hours @	70	Ltrs/sec

REMARKS * Well is on a mound approximately 1.5 metres high *
** Well should not be pumped at over 70 L/sec **

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

CH2M Beca

www.ch2mbeca.com

Report

Brooklands Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the wells supplying Brooklands Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used throughout this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Brooklands Pumping Station (Brooklands/Kainga Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Bore logs from ECan's website (Well 1 and 2) as included in Appendix C - https://www.ecan.govt.nz/gis-mapping/
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Brooklands Pumping Station is supplied by two wells; Brooklands Wells 1 and 2. The station supplies the Brooklands/Kainga pressure zone. Table 2-1 summarises key information about the two wells.

Table 2-1: Brooklands Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M 35/7180	78.6 – 82.6	2
Well 2	M35/7291	78.75 – 81.75	2

Brookland Well 2 could not be accessed due to safety concerns. The chamber height has recently been increased to approximately 3 m above ground level and there is no railing or a permanent ladder. This report

includes some information and recommendation for this well, but it is important to note that a full inspection could not take place and is recommended once the safety concerns are addressed.

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The wells suppling Brooklands Pumping Station are screened within moderately-deep (Aquifer 2 – Linwood Gravel Aquifer) leaky (semi)-confined aquifers within the Christchurch Artesian Aquifer System.

4 Well Inspections

An inspection of each well was carried out on 7 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Andrew Batchelor (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Brooklands Wells 1 and 2 do not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Seal cabling at wall penetration ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5m above 100 year flood level			

	First Priority	Second Priority	Third Priority	Ongoing
Well 2	■ Ensure that safe access to the bore is available without bringing temporary equipment to site. This includes installation of a permeant ladder and railings ■ Re-inspect well once access is available ■ Seal leaks in chamber			
All wells		■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.	■ For the as-built records, confirm backflow prevention on the well pump has been installed.	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

7 Conclusion

The information reviewed and the inspections carried out indicate that neither of the Brooklands wells meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether

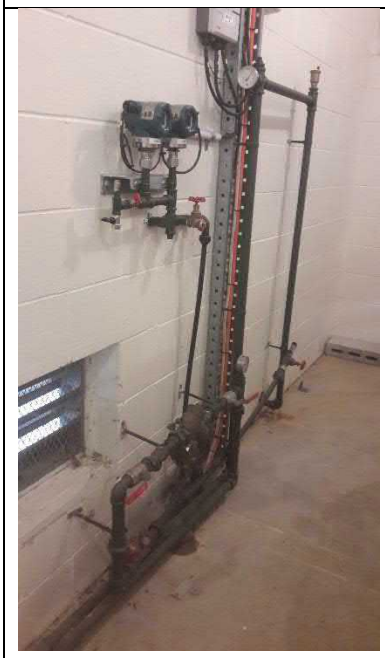
Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2. A re-inspection of Brooklands Well 2 is also required as access could not be gained during the initial visit.

Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Brooklands
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Brooklands Wells 1 and 2 draw from Aquifer 2 (leaky (semi)-confined)
Surface Water Ways, Drains, etc	Styx River/Brooklands Lagoon
4. Photo Record and Comments	
Photo	Comment
	Step up into Brooklands Pump Station. Note that some of the site is below the 100 year flood level and so there is the potential for flooding

<table>
<tr><td>  </td><td>Small diesel storage tank within a bund</td></tr>
<tr><td>  </td><td>Pipework inside pump house</td></tr>
<tr><td colspan="2">5. Risks from Surrounding Environment</td></tr>
<tr><td>a) Within the site:</td><td></td></tr>
<tr><td>Diesel/Chemical Storage</td><td colspan="2">Small bunded tank ☐ Underground √ Aboveground</td><td>Fuel lines ☐ Underground √ Aboveground</td></tr>
<tr><td>Access by Animals</td><td colspan="2">Not a fenced site but building is locked</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td colspan="2">As above, no signs of vandalism</td></tr>
</table>

Other Activities	N/A
b) Immediate Neighbouring Land Use:	
Current Neighbouring Land Use	Some residential and rural, mostly red zoned property unused
Significant Changes Since Previous Inspection	None identified
Zoning of Neighbouring Land	Not available on CCC's Zones and Designation Map
c) Wider Environment:	
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Agriculture Sewer nearby
Risk of flood inundation	Some of the site is below the 100 year flood level and so there is the potential for flooding. Step up to pump station to minimise this risk
Potential sources of young water	No sources specific to the pumping station identified. See well assessments
General land use in catchment (LLUR)	As below
Contaminated sites (HAIL status)	At well and pump station address (1001 Lower Styx Road): ACT 10714 A17 - Storage tanks or drums for fuel, chemicals or liquid waste
Status and condition of surrounding wells (within 400 m radius)	Multiple wells
Landfill	None identified
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

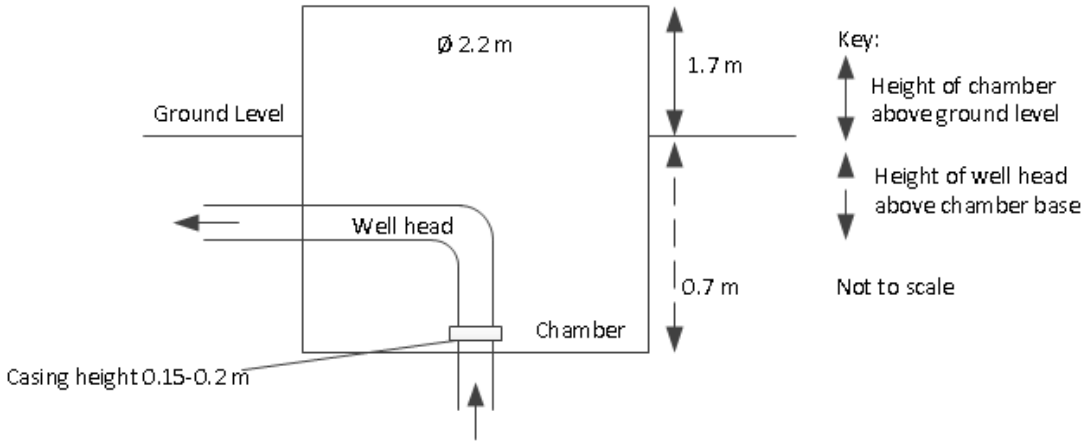
Brooklands Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Brooklands Well 1
ECan Well No.	M 35/7180
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	78.6 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	78.6 – 82.6
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	24 February 1995
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Approximately twice a week
4. Photo Record and Comments	
Photo	Comment
	Deep chamber where access is not possible without meeting confined space requirements. Therefore, inspection was from above and by photo only.
	Cable glands appear sealed
	
	

	Well casing appears to be sealed to the chamber floor from the photos collected
	Not obvious whether or not the cable penetrations through the chamber side wall are sealed
	Sample tap in cabinet on the outside of the chamber

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Cabling appears sealed at bore entry but it is not clear if it is sealed at the wall penetration
	Pipework	Sealed with sidewall of chamber
	Well casing	Sealed with floor (from photos)
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No – casing is below ground level and the cabling penetrations through the wall may not be sealed Some of the site is below the 100 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good condition
Raw Water sample port?		Yes, on the outside of the chamber in a cabinet
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		No
Signs of ponding?		Not at time of inspection
Access by animals		5m fence from boundary installed. Chickens outside fence.
Protection from vandalism, signs of vandalism		Lid locked with padlock. No signs of vandalism.
b) Drilling Standard:		
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?		Yes –butterfly valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?		N/A

<table>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Good condition</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Diesel storage close by. Small tank with bunding to minimise the risk</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>Dry at the time of inspection</td></tr>
<tr><td>Is there a sump pump?</td><td>No pump or sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
</table>

Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the well head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal cabling at wall penetration ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Brooklands Well 2

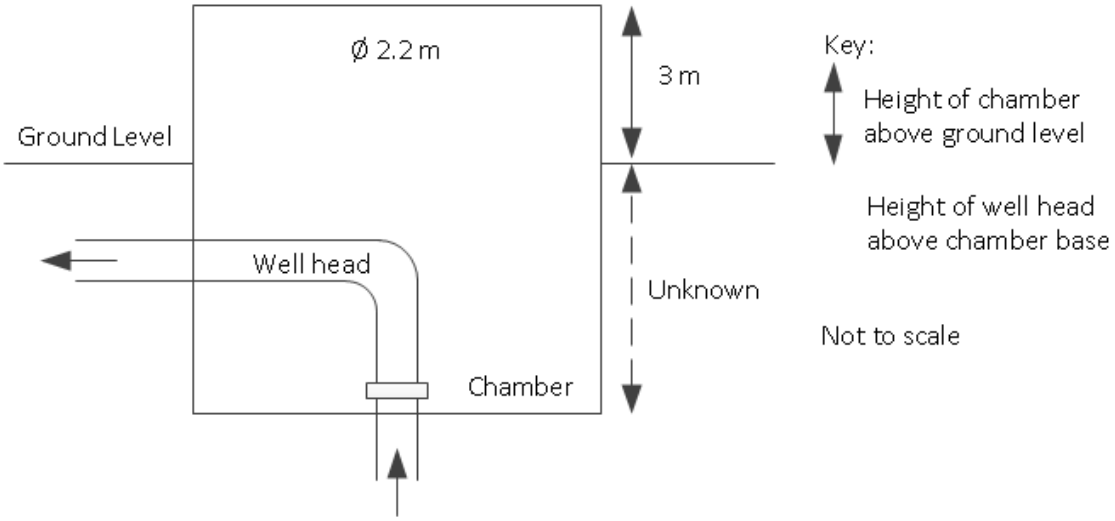
Note: this is not a full inspection. The well could not be accessed due to safety concerns.

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Brooklands Well 2
ECan Well No.	M 35/7291
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl) (assume top of screen)	78.75
Casing Diameter (mm)	300
Screen Interval (mbgl)	78.75 – 81.75
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown

Date Drilled	12 September 1995
Control System/Alarms	Pump failure
Type of Pump	Submersible
Frequency of Pump Use	Approximately twice a week
4. Photo Record and Comments	
Photo	Comment
	Brookland Well 2 could not be accessed due to safety concerns. The chamber has recently been increase to ~3m above ground level and there is no railing or a permanent ladder
	Signs of leaking from inside the chamber

	Evidence of ponding in the area

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Unknown
	Pipework	Unknown
	Well casing	Unknown
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No – leaking from the chamber could be seen from the outside

	Some of the site is below the 100 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level	Unknown
Type and condition of borehead pipework (above ground)	Unknown
Raw Water sample port?	Yes, outside the chamber
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	No
Signs of ponding?	Yes, leaking from chamber and in adjacent path
Access by animals	5m fence from boundary installed. Chickens outside fence.
Protection from vandalism, signs of vandalism	Lid locked with padlock. No signs of vandalism.
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Unknown
If not, has this been agreed with the DWA?	Unknown
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Unknown
Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No
Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?	No

<table>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required if not already installed</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Diesel storage close by. Small tank with bunding to minimise the risk.

Roads and sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>Unknown</td></tr>
<tr><td>Is there a sump pump?</td><td>Unknown</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>Unknown</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>Unknown</td></tr>
<tr><td>Sump pump operation method including start level</td><td>Unknown</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>Unknown</td></tr>
<tr><td>Does the bore head meet the requirements of Criteria 2</td><td>Unknown</td></tr>
<tr><td colspan="2">7. Actions Arising</td></tr>
<tr><td colspan="2">Identify issues and rank them in terms of whether they require:</td></tr>
<tr><td>First Priority</td><td>■ Ensure that safe access to the bore is available without bringing temporary equipment to site. This includes installation of a permeant ladder and railings
■ Re-inspect well once access is available</td></tr>
</table>

	▪ Seal leaks in chamber
Second Priority	▪ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ▪ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	▪ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	▪ A sanitary inspection of the well should take place on a regular basis ▪ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

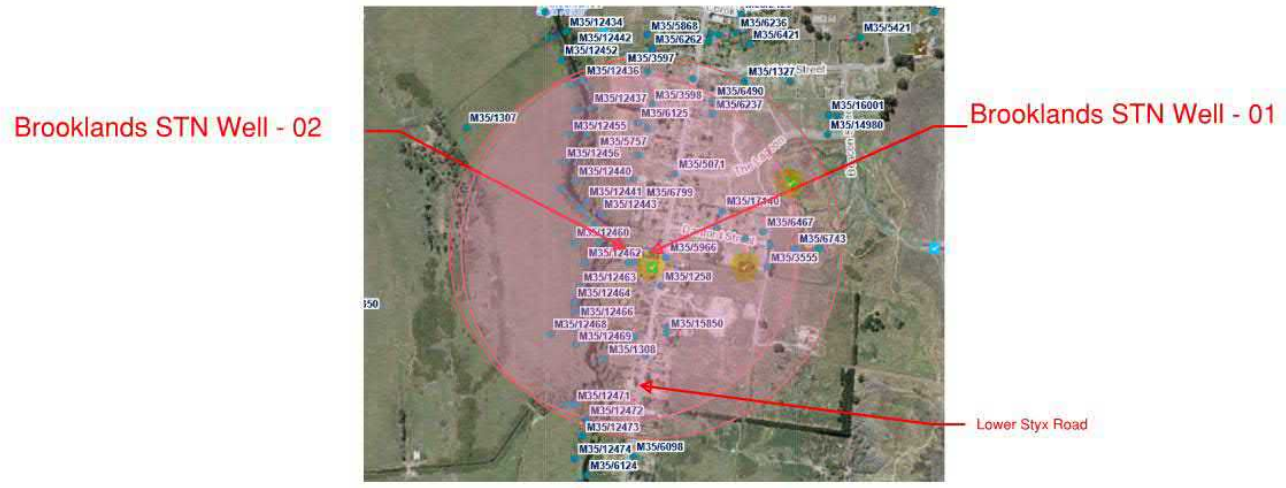


Figure 1: Summary of wells and consents within 400m of Brooklands Wells

Table 2: Summary of consents within 400m of Brooklands Wells

Brooklands Well Sites

Well Number: M35/7180

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	NCY880584	Terminated - Expired	Stormwater Residential
Discharge to Water	CRC080874	Application withdrawn	Stormwater Residential
Discharge to Water	NCY880526C	Terminated- Surrendered	Stormwater Residential

Well Number: M35/7291

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	NCY880584	Terminated - Expired	Stormwater Residential
Discharge to Water	NCY880526C	Terminated- Surrendered	Stormwater Residential

Appendix C

Bore Logs

Bore or Well No	M35/7180
Well Name	1001 LOWER STYX ROAD
Owner	Christchurch City Council

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M35/7180	**File Number**	CO6C/09665
Owner	Christchurch City Council	**Well Status**	Active (exist, present)
Street/Road	1001 LOWER STYX ROAD	**NZTM Grid Reference**	BW24:75198-93914
Locality	BROOKLANDS	**NZTM X and Y**	1575198 - 5193914
Location Description		**Location Accuracy**	< 50m
CWMS Zone	Christchurch - West Melton	**Use**	Public Water Supply,
Groundwater Allocation Zone	Christchurch/West Melton	**Water Level Monitoring**	--
Depth	82.60m	**Water Level Count**	0
Diameter	300mm	**Initial Water Level**	5.90m above MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	2.10m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	33	**Calc Min 95%**	0.60m below MP
Aquifer Name	Linwood Gravel	**Aquifer Tests**	2
Aquifer Type	Flowing Artesian	**Yield Drawdown Tests**	7
Drill Date	24 Feb 1995	**Max Tested Yield**	76 l/s
Driller	McMillan Drilling Ltd	**Drawdown at Max Tested Yield**	5 m
Drilling Method	Cable Tool	**Specific Capacity**	11.52 l/s/m
Casing Material	STEEL	**Last Updated**	08 Oct 2015
Pump Type	Unknown	**Last Field Check**	
Water Use Data	Yes		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	78.6	82.6				

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
24 Feb 1995	1	76	1003.06195	4.8	24
01 Jan 1996	1	19	250.765488	1.65	0.266666681
01 Jan 1996	2	34	448.738251	3.36	0.25
01 Jan 1996	3	43	567.5219	4.57	0.316666663
01 Jan 1996	4	51	673.107361	5.18	0.05
01 Jan 1996	5	60	791.891	6.7	0.0833333358
01 Jan 1996	6	75	989.8638	9.61	0

Comments

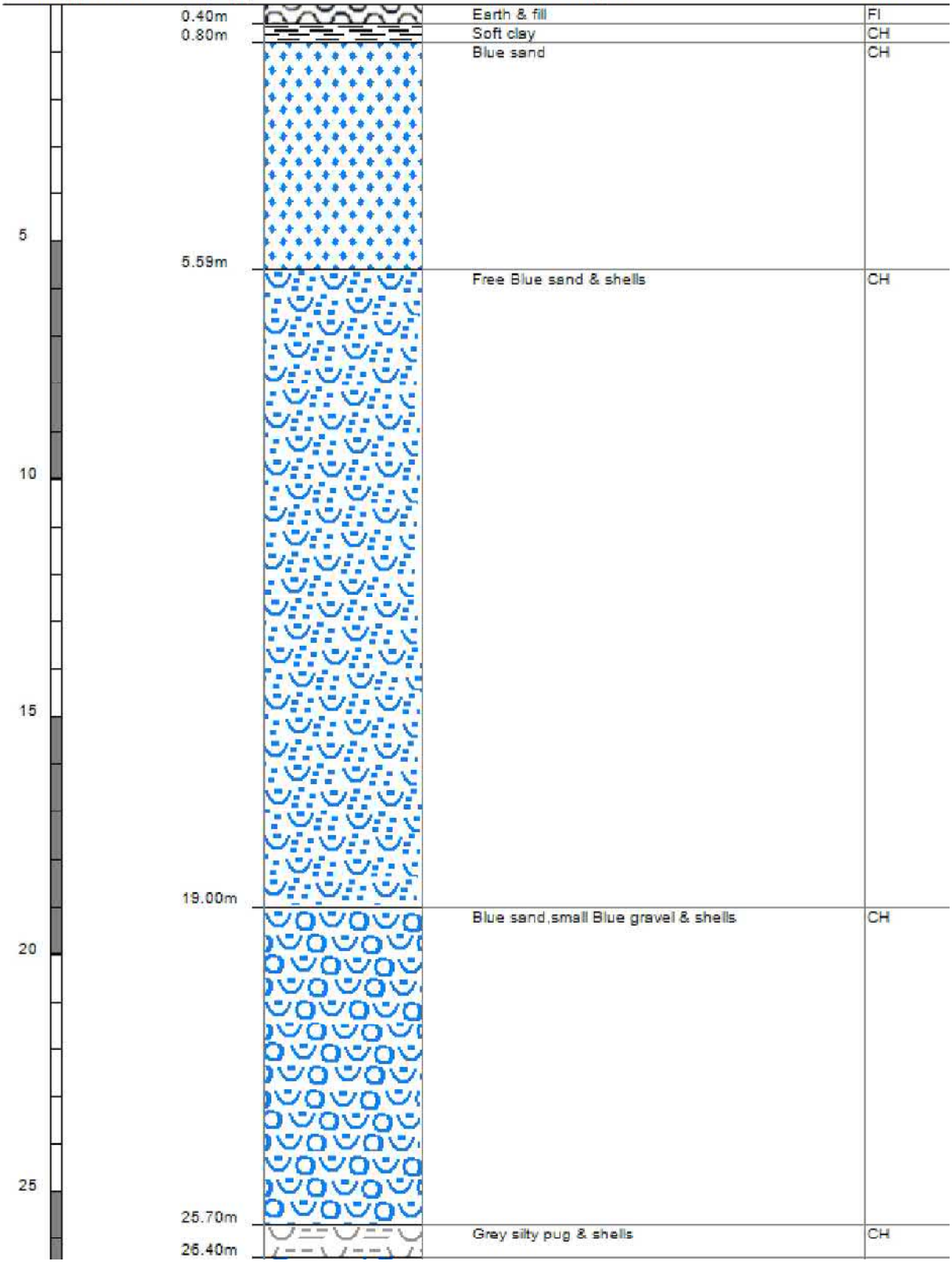
Comment Date	Comment
	NO.1 WELL.ALSO M35/7291
	FROM OLD CWS DB Located at Brooklands pumpstation, 1001 Lower Styx Rd (on west side of the rd). Situated in front of the pump room in the garden. Is enclosed in a 1 m tall round concrete tank with a metal lid (padlocked).
15 Oct 1998	Brooklands pressure zone.
11 Feb 2000	FROM OLD CWS DB Surrounding area residential, across rd is empty paddock & rear of pumpstation, west boundary, is the Styx River. GRID REF: M35:85203-55528.
06 Oct 2005	Step test data entered under 1/1/1996, actual date unknown.
26 Sep 2007	Gridref changed from: M35:8520-5553

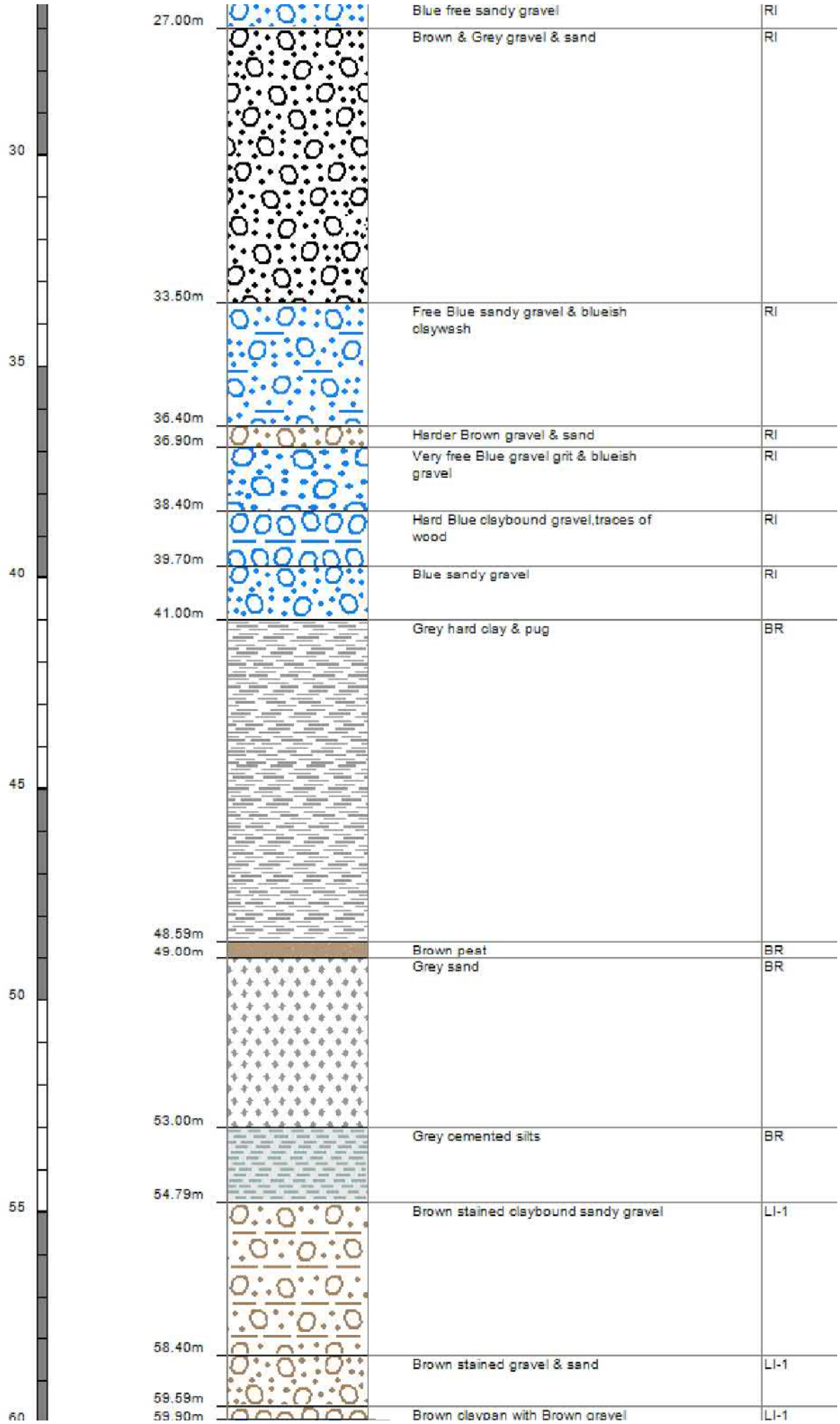
Bore Log

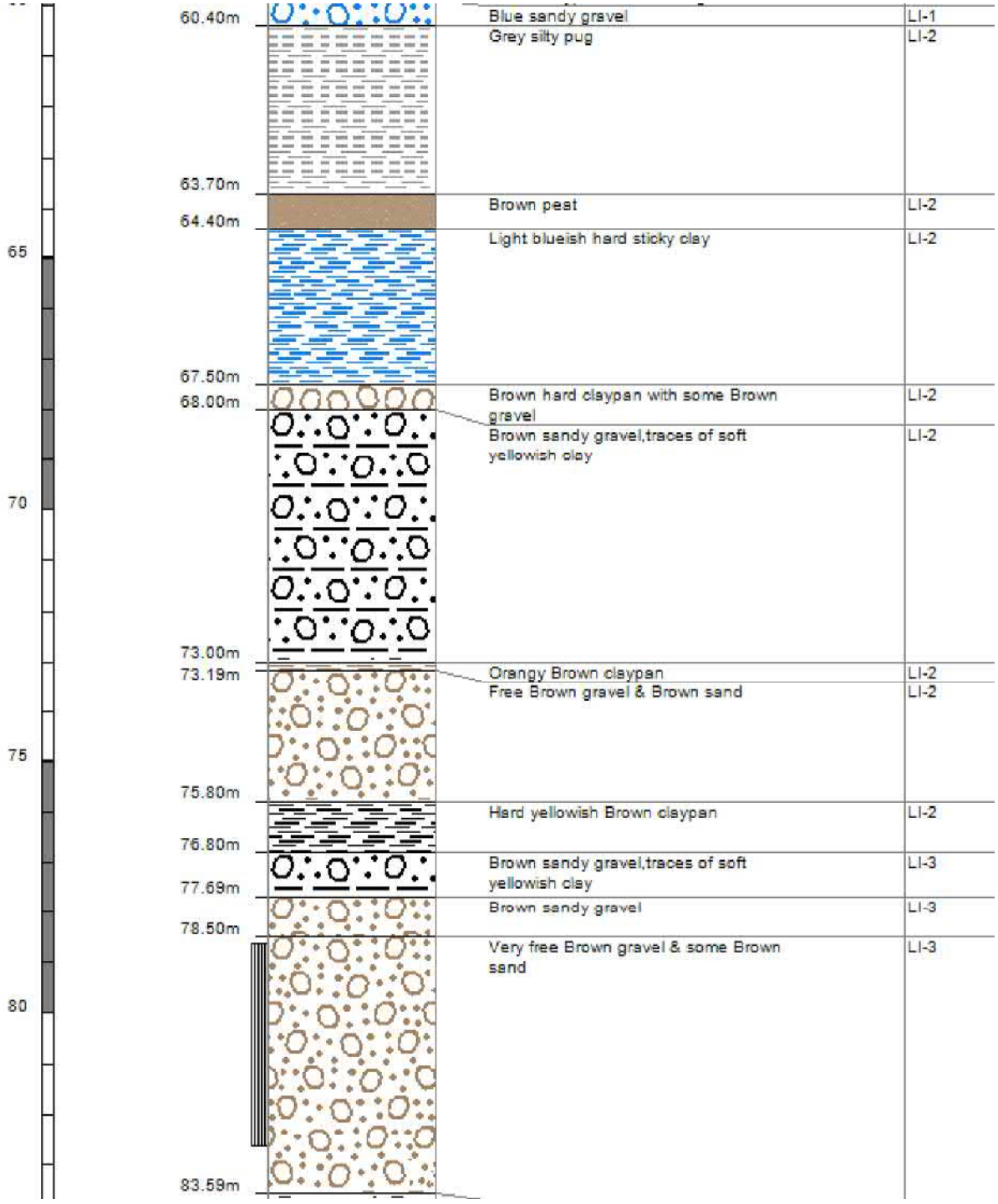
Borelog for well M35/7180

Grid Reference (NZTM): 1575199 mE, 5193915 mN
Location Accuracy: < 50m
Ground Level Altitude: 2.1 m +MSD Accuracy: < 2.5 m
Driller: McMillan Drilling Ltd
Drill Method: Cable Tool
Borelog Depth: 83.7 m Drill Date: 24-Feb-1995

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




30
35
40
45
50
55
60
27.00m
33.50m
36.40m
36.90m
38.40m
39.70m
41.00m
48.59m
49.00m
53.00m
54.79m
58.40m
59.59m
59.90m
Blue free sandy gravel
RI
Brown & Grey gravel & sand
RI
Free Blue sandy gravel & blueish claywash
RI
Harder Brown gravel & sand
RI
Very free Blue gravel grit & blueish gravel
RI
Hard Blue claybound gravel,traces of wood
RI
Blue sandy gravel
RI
Grey hard clay & pug
BR
Brown peat
BR
Grey sand
BR
Grey cemented silts
BR
Brown stained claybound sandy gravel
LI-1
Brown stained gravel & sand
LI-1
Brown claypan with Brown gravel
LI-1


60.40m
Blue sandy gravel
LI-1
Grey silty pug
LI-2
63.70m
Brown peat
LI-2
64.40m
Light blueish hard sticky clay
LI-2
65
67.50m
68.00m
Brown hard claypan with some Brown gravel
LI-2
Brown sandy gravel,traces of soft yellowish clay
LI-2
70
73.00m
73.19m
Orangy Brown claypan
LI-2
Free Brown gravel & Brown sand
LI-2
75
75.80m
Hard yellowish Brown claypan
LI-2
76.80m
Brown sandy gravel,traces of soft yellowish clay
LI-3
77.69m
Brown sandy gravel
LI-3
78.50m
Very free Brown gravel & some Brown sand
LI-3
80
83.59m

Bore or Well No	M35/7291
Well Name	1001 LOWER STYX ROAD
Owner	Christchurch City Council

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M35/7291	**File Number**	CO6C/09445
Owner	Christchurch City Council	**Well Status**	Not Used
Street/Road	1001 LOWER STYX ROAD	**NZTM Grid Reference**	BW24:75139-93923
Locality	BROOKLANDS	**NZTM X and Y**	1575139 - 5193923
Location Description	2 BORES ON SAME BLOCK, LOT 134	**Location Accuracy**	2 - 15m
CWMS Zone	Christchurch - West Melton	**Use**	Small Community Supply,
Groundwater Allocation Zone	Christchurch/West Melton	**Water Level Monitoring**	--
Depth	83.00m	**Water Level Count**	0
Diameter	300mm	**Initial Water Level**	6.09m above MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	1.40m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	17	**Calc Min 95%**	0.40m below MP
Aquifer Name	Linwood Gravel	**Aquifer Tests**	1
Aquifer Type	Flowing Artesian	**Yield Drawdown Tests**	1
Drill Date	12 Sep 1995	**Max Tested Yield**	76 l/s
Driller	McMillan Drilling Ltd	**Drawdown at Max Tested Yield**	2 m
Drilling Method	Unknown	**Specific Capacity**	48.10 l/s/m
Casing Material	Steel	**Last Updated**	30 Mar 2016
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	78.75	81.75				

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
12 Sep 1995	1	76	1003.06195	1.58	24

Comments

Comment Date	Comment
	NO.2 WELL. ALSO M35/7180
	FROM OLD CWS DB Located at Brooklands pumpstation, 1001 Lower Styx Rd (on west side of the rd). Situated at the back of the pumpstation section, in a small reserve by the Styx River. Is enclosed in a 1.5 m tall concrete tank with a metal lid.
15 Oct 1998	Brooklands pressure zone.
11 Feb 2000	FROM OLD CWS DB Surrounding area residential, across rd is empty paddock & rear of pumpstation, west boundary, is the Styx River. GRID REF: M35:85140-55541.
05 Feb 2008	Gridref changed from: M35:8514-5554
26 Aug 2011	Unservicable as a result of earthquake activity. Will be replaced.
14 Apr 2016	Small monitoring piezo in front of well. Approx 3.8m deep. See picture. FROM WAIMAK PIEZO QA SUMMER 2015/16.
20 May 2016	Visited for Waimakariri Piezo QA Summer 2015/2016. Well details updated.

Bore Log

Borelog for well M35/7291

Grid Reference (NZTM): 1575140 mE, 5193924 mN
Location Accuracy: 2 - 15m
Ground Level Altitude: 1.4 m +MSD Accuracy: < 2.5 m
Driller: McMillan Drilling Ltd
Drill Method: Unknown
Borelog Depth: 83.0 m Drill Date: 12-Sep-1995

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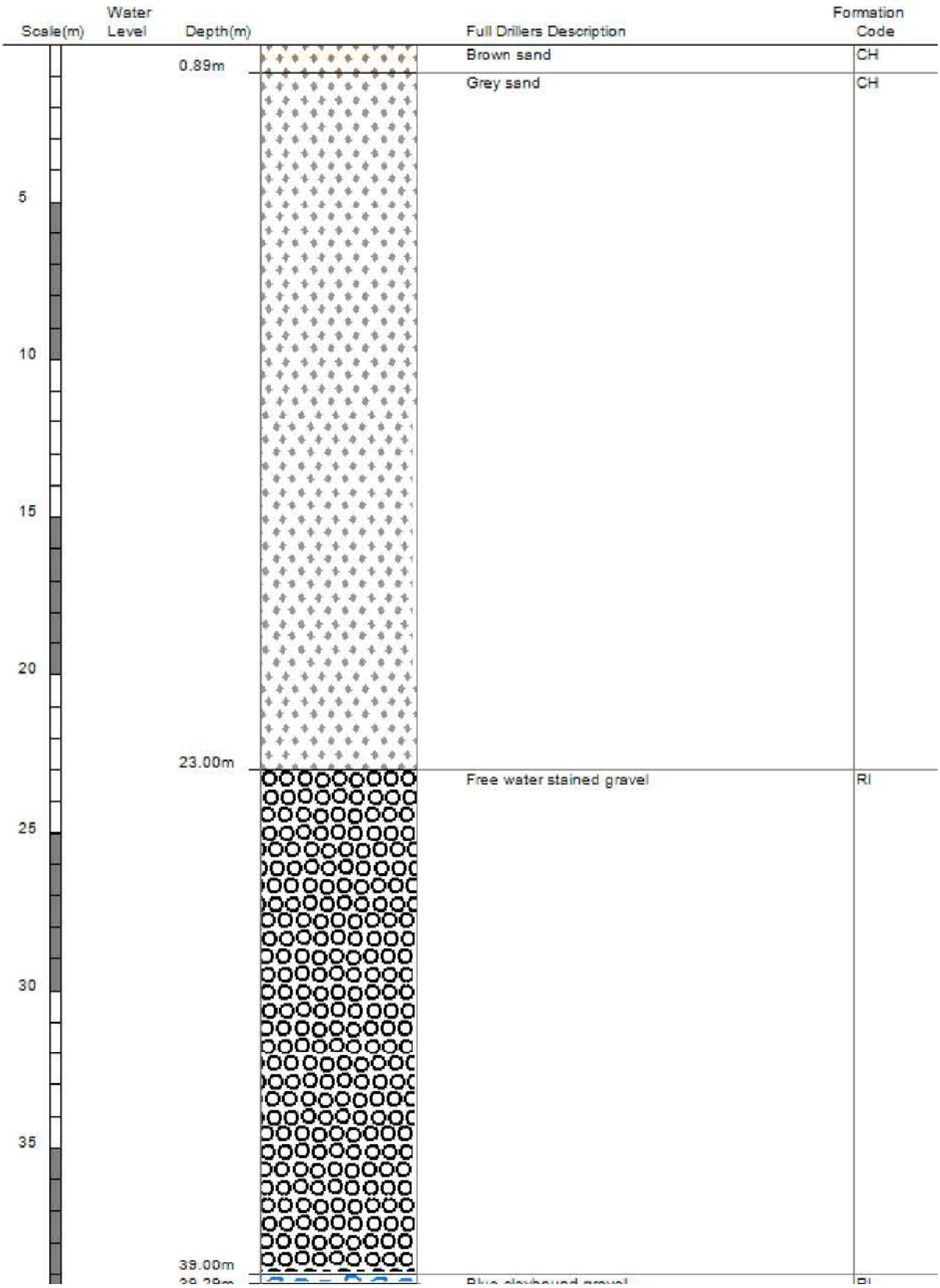

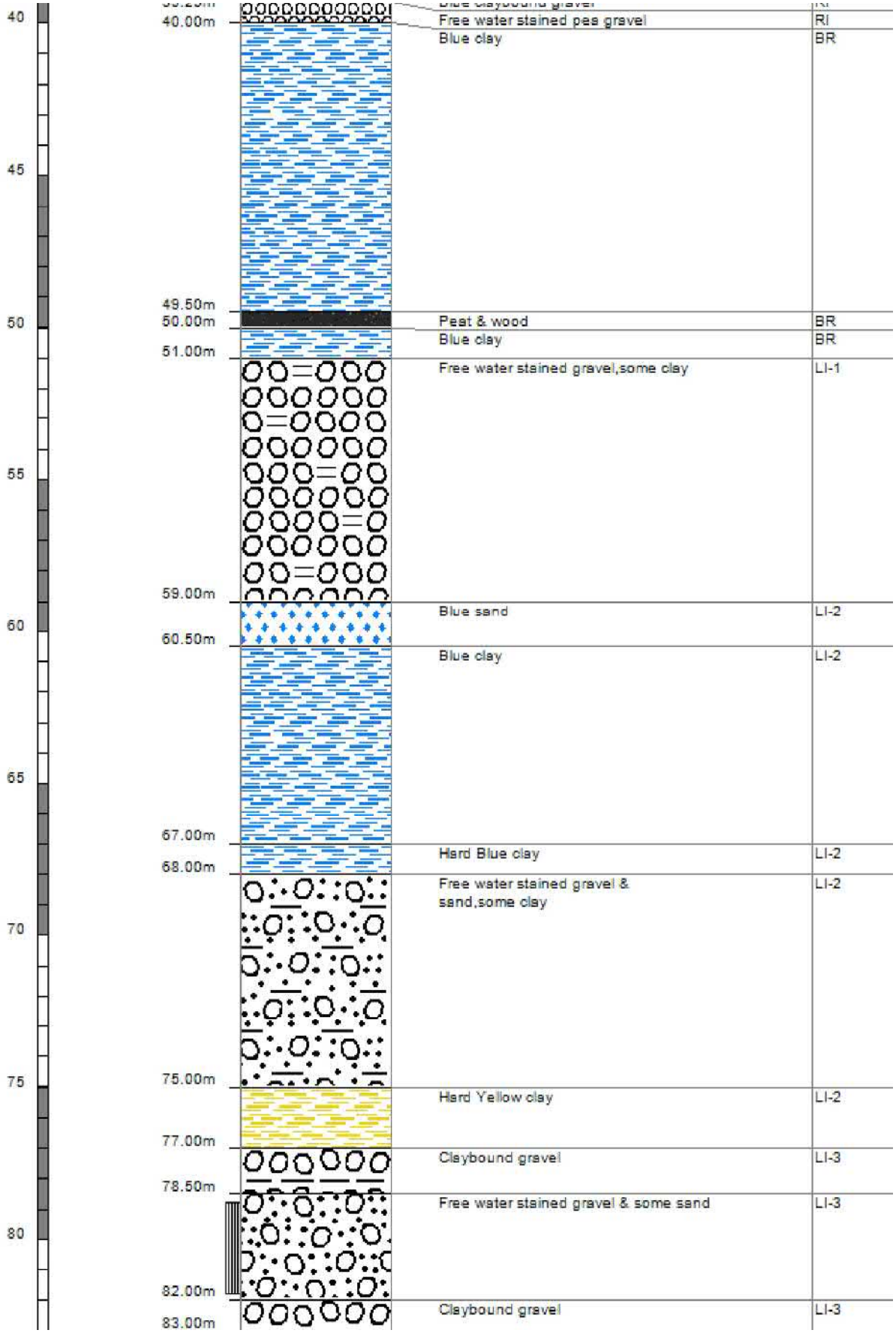
40
45
50
55
60
65
70
75
80
40.00m
49.50m
50.00m
51.00m
59.00m
60.50m
67.00m
68.00m
75.00m
77.00m
78.50m
82.00m
83.00m
Free water stained pea gravel
RI
Blue clay
BR
Peat & wood
BR
Blue clay
BR
Free water stained gravel,some clay
LI-1
Blue sand
LI-2
Blue clay
LI-2
Hard Blue clay
LI-2
Free water stained gravel & sand,some clay
LI-2
Hard Yellow clay
LI-2
Claybound gravel
LI-3
Free water stained gravel & some sand
LI-3
Claybound gravel
LI-3

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

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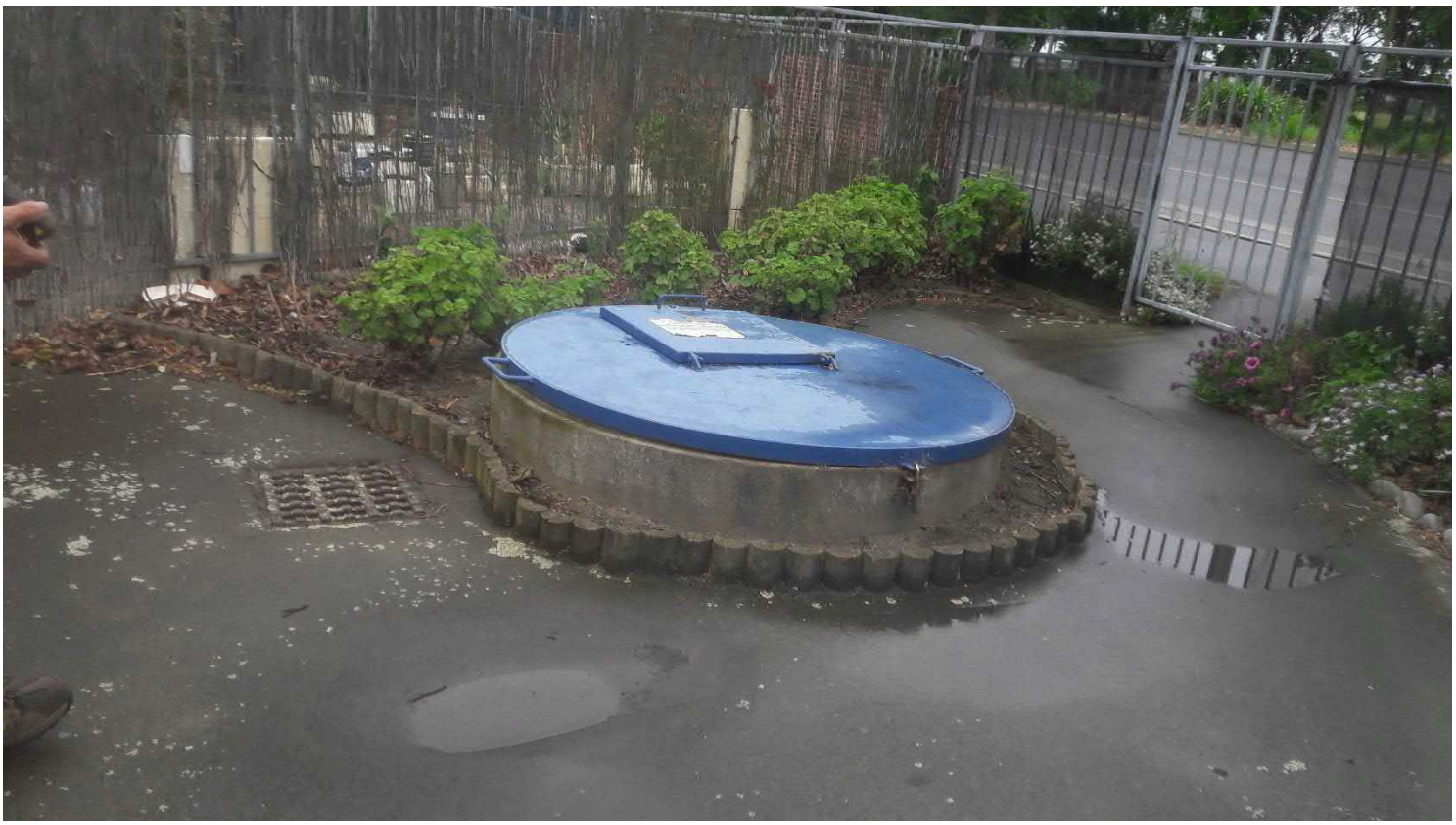
Report

Denton Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018



Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	**Lisa Mace / Mike Thorley**	Final version	22 January 2018
C	**Lisa Mace / Mike Thorley**	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the wells supplying Denton Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used throughout this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Denton Pumping Station (West Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore logs (Wells 2, 3, 4 and 5) as included in Appendix C
- Bore logs from ECan's website (Well 1) as included in Appendix C - https://www.ecan.govt.nz/gis-mapping/
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Denton Pumping Station is supplied by five wells; Denton Wells 1 – 5. The station supplies part of the West Pressure Zone. Table 1 summarises key information about the five wells.

Table 1: Denton Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M35/7291	No Screen Data	3
Well 2	M35/1866	90.23 – 96.28	3
Well 3	M35/1865	94.3 – 102.4	3
Well 4	M35/3546	89.75 – 95.85	3

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 5	M35/1864	63.4 – 72.8	3

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The wells supplying Denton Pumping Station are generally from Aquifer 3 and source groundwater from a leaky-confined aquifer.

4 Well Inspections

An inspection of each well was carried out on 8 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Matthew Thomas (City Care). The Inspection Reports in Appendix A include a complete list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Denton Wells 1 – 5 do not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 2 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 2: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Check seal between chamber floor and well casing and seal as required ■ Check pipework penetrations through chamber sidewall and seal if required			

	First Priority	Second Priority	Third Priority	Ongoing
	■ Check cable entry points and seal if required			
Well 2	■ Seal side entry to chamber ■ Replace chamber lid so the chamber is protected from rainfall and runoff			
Well 3	■ Install and seal cable glands ■ Check that pipe wall penetrations are sealed ■ Investigate bellows collapse and mitigate ■ Investigate source of graffiti and trash. Mitigate likelihood of vandal access ■ Seal chamber floor to prevent inundation from below. Ensure that casing is sealed to floor. ■ Install a fence 5m away from well to minimise the likelihood of vandalism	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected		
Well 4	■ Seal pipe penetration through chamber wall ■ Seal casing and chamber floor	■ Move sample tap to make lid removal easier. Sample tap should not drain in the well. ■ Re-landscape so that water is not contained around well		
Well 5	■ Seal cable glands ■ Seal pipework penetrations through wall ■ Check casing seal with chamber floor and seal if required ■ Seal chamber floor to prevent inundation	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected		
All wells	■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This	■ For the as-built records, confirm backflow prevention on the well pump has been installed.	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification

	First Priority	Second Priority	Third Priority	Ongoing
	above 100 year flood level (unless the well is not located in a flood prone area)	should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.		of backflow prevention device

7 Conclusion

The information reviewed and the inspections carried out indicate that none of the Denton wells meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Denton
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	All Denton Wells draw from Aquifer 3. Leaky (semi)-confined.
Surface Water Ways, Drains, etc	Stormwater detention in adjacent park.
4. Photo Record and Comments	
Photo	Comment
	Pump station is within fenced area

	Double skinned and bunded diesel storage tank inside the pump station
	Pump room (underground) Water leaking through the ceiling was noticed
	Pump room access not sealed. Source of leaking into the pump room. This should be sealed.

5. Risks from Surrounding Environment

a) Within the site:				
Diesel/Chemical Storage	Yes	☐ Underground √ Aboveground	Fuel lines	☐ Underground √ Aboveground
Access by Animals	Fenced site and locked building			

Protection from vandalism, signs of vandalism	As above, no signs of vandalism
Other Activities	N/A
b) Immediate Neighbouring Land Use:	
Current Neighbouring Land Use	Park, train track adjacent
Significant Changes Since Previous Inspection	None identified
Zoning of Neighbouring Land	Open Space Metropolitan Facilities Zone
c) Wider Environment:	
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	A number of stormwater consents and other bores within 400m Sewer nearby
Risk of flood inundation	Some of the site is below the 50 year flood level and so there is the potential for flooding
Potential sources of young water	No sources specific to the pumping station identified. See well assessments.
General land use in catchment (LLUR)	As below
Contaminated sites (HAIL status)	At well and pump station address (442 Main South Road): ACT 27077 A10 - Persistent pesticide bulk storage or use Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds ACT 3417 A17 - Storage tanks or drums for fuel, chemicals or liquid waste ACT 4313 B2 - Electrical transformers ACT 27067 A10 - Persistent pesticide bulk storage or use
Status and condition of surrounding wells (within 400 m radius)	Multiple wells
Landfill	None identified
6. Actions Arising	

Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

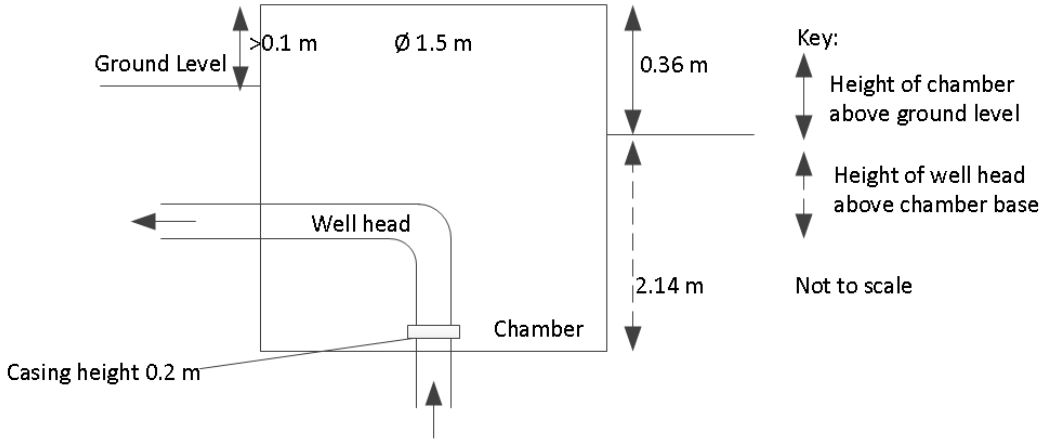
Denton Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Denton Well 1
ECan Well No.	M 35/3547
Aquifer No.	3
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Depth (mbgl)	96.3 (casing depth unknown)
Casing Diameter (mm)	250
Screen Interval (mbgl)	No Screen Data
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	11 June 1982
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well chamber is located adjacent to the pump station
	Well chamber is within a fenced area
	Pipework is in reasonable condition. Chamber was reasonably dry at the time of inspection.
	Sump installed with no sump pump. Some water in sump.

	Some corrosion on the inside of the chamber. The source is unknown

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Could not be checked as chamber entry was not possible
	Pipework	From above the pipework looks to be sealed with sidewall of chamber. Cannot see if it is sealed at the bottom.
	Well casing	Could not be seen in person or with a camera
Any history of E. coli transgressions? Historical and current levels of total coliforms?		20 distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). The source is unknown and may not be this well. Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No

	Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level	Not installed
Type and condition of borehead pipework (above ground)	Steel in good condition, some surface rust
Raw Water sample port?	Yes, outside chamber
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	Not on one side of the well chamber
Signs of ponding?	Not at time of inspection
Access by animals	Fenced site with only 4m on one side
Protection from vandalism, signs of vandalism	Locked areas with barbed wire fence. No signs of vandalism
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – check valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Could not be viewed
Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No

<table>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced (4m fence)</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Railway track 8m away. A spill could enter the wellhead chamber.

Roads and sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>Water only in sump at the time of inspection</td></tr>
<tr><td>Is there a sump pump?</td><td>No sump pump but there is a sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>N/A</td></tr>
<tr><td>Does the well head meet the requirements of Criteria 2</td><td>No, see actions below</td></tr>
<tr><td colspan="2">7. Actions Arising</td></tr>
<tr><td colspan="2">Identify issues and rank them in terms of whether they require:</td></tr>
</table>

First Priority	■ Check seal between chamber floor and well casing and seal as required ■ Check pipework penetrations through chamber sidewall and seal if required ■ Check cable entry points and seal if required ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

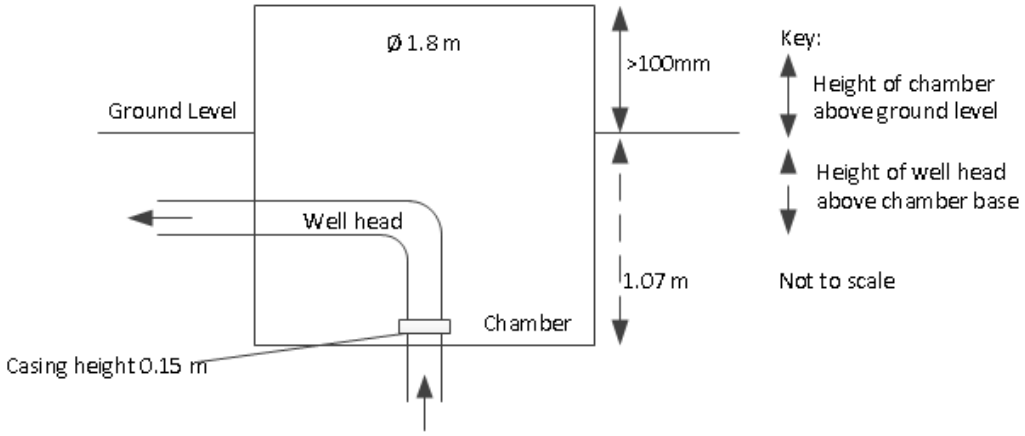
Denton Well 2

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Denton Well 2
ECan Well No.	M35/1866
Aquifer No.	3
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl) (assume top of screen)	90.23
Casing Diameter (mm)	250
Screen Interval (mbgl)	90.23 – 96.28
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	14 June 1982
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well chamber lid flush with the ground and covered in bark and debris
	Well chamber is located on the edge of a park, close to the road
	Bark can be seen in the bottom of the chamber

	Sealing on side entry to chamber has deteriorated
	Casing appears to be sealed to floor from photos

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Sealed
	Pipework	Side entry to chamber not sealed
	Well casing	Sealed
Any history of E. coli transgressions?		20 distribution system E. coli transgressions have been recorded in the data received (dating back to

Historical and current levels of total coliforms?	2012-13 FY). The source is unknown and may not be this well. Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level	No Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level	Not installed
Type and condition of borehead pipework (above ground)	Steel, good condition
Raw Water sample port?	Yes, outside of chamber in a cabinet
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	No
Signs of ponding?	Not close to the well at the time of inspection. Ponding on the road further downhill
Access by animals	No fence around well, in a residential area where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism	Padlock on lid. No signs of vandalism
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – check valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Steel, some rust

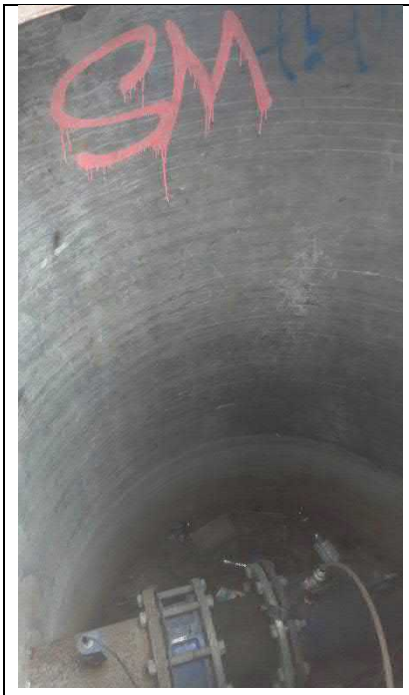
<table>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Adjacent sidewalk and road</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>None at time of visit</td></tr>
<tr><td>Is there a sump pump?</td><td>No sump pump but there is a sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>N/A</td></tr>
</table>

Does the bore head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal side entry to chamber ■ Replace chamber lid so the chamber is protected from rainfall and runoff ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Denton Well 3

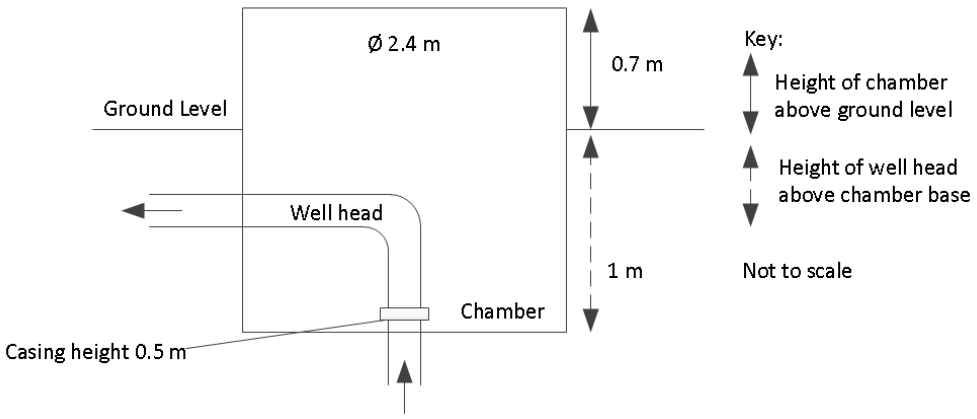
1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Denton Well 3
ECan Well No.	M 35/1865
Aquifer No.	3
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl) (assume top of screen)	94.3
Casing Diameter (mm)	250
Screen Interval (mbgl)	94.3 – 102.4
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	February 1976
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well is located in a small park, adjacent to a car park, surrounded by trash
	Sample tap is located in chamber

	Graffiti in chamber implying that vandals have gained access
	Trash and debris in the bottom of the chamber
	Rebar showing through the chamber wall

	Cable penetrations through wall are sealed
	Photo received 19 January 2018 following a clean-up of the well. The well chamber now appears clear of rubbish and debris, and the cable entry points into the well head appear to be sealed now.

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection		
a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Not sealed – no glands, open holes at time of inspection. Have since received photos from CCC showing the cable entry points have been sealed.
	Pipework	Rebar showing through seal point. Can't be sure that penetration is sealed.
	Well casing	Could not access, not clear that there is a concrete floor, may be just soil
Any history of E. coli transgressions? Historical and current levels of total coliforms?		20 distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). The source is unknown and may not be this well. Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Bellows have partially collapsed inwards likely due to back pressure
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		N/A
Signs of ponding?		Not at time of inspection. Well is at a low point so ponding is possible
Access by animals		No fence around well, in a residential area where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism		Padlock on lid, no lid alarm. Graffiti in chamber implying vandal access has occurred in the past
b) Drilling Standard:		

<table>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – check valve installed (not tested)

Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel, minor surface rust</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Fence or other device to prevent vandalism is required</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
</table>

Does the WSP address contaminant sources and contaminant migration pathways?	Not received
Any localised well specific sources of contamination?	Adjacent footpath and road. Lots of trash in the area and in the chamber
d) Below Ground Chambers:	
Water level of chamber	None present at time of visit
Is there a sump pump?	No pump or sump
Are there duty/standby sump pumps?	No
Sump pump testing, include date a method	N/A
Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the bore head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Install and seal cable glands ■ Check that pipe wall penetrations are sealed ■ Investigate bellows collapse and mitigate ■ Investigate source of graffiti and trash. Mitigate likelihood of vandal access ■ Seal chamber floor to prevent inundation from below. Ensure that casing is sealed to floor. ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a fence 5m away from well to minimise the likelihood of vandalism ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced

	(i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

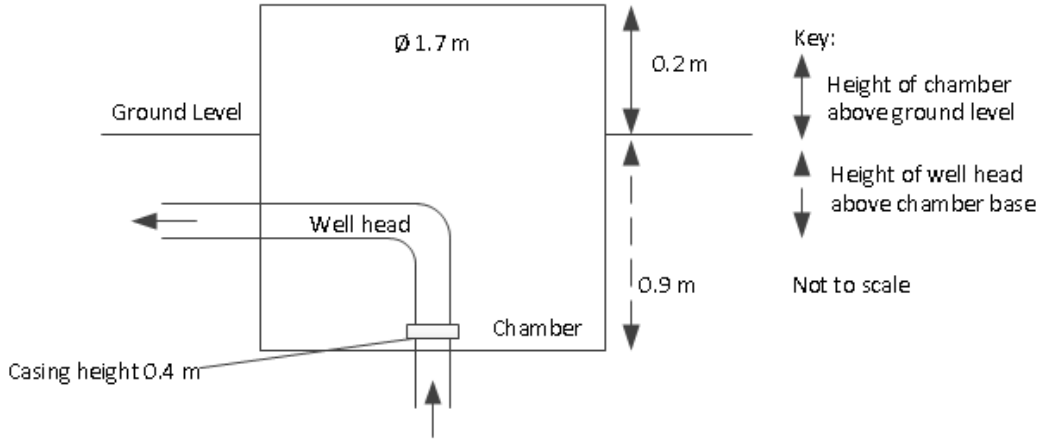
Denton Well 4

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Denton Well 4
ECan Well No.	M35/3546
Aquifer No.	3
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl) (assume top of screen)	89.75
Casing Diameter (mm)	300
Screen Interval (mbgl)	89.75 – 95.85
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	29 March 1982
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	Well chamber within a partially fenced area, part of a residential community. Signs on ponding on footpath adjacent to well
	Pipework in reasonable condition
	Pipe penetrations through wall are not sealed
	Casing sealed to chamber floor

	Cable glands sealed
	Sump without a sump pump installed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection		
a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Sealed
	Pipework	Not sealed
	Well casing	Sealed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		20 distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). The source is unknown and may not be this well. Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Air vent not installed above floor level
Type and condition of borehead pipework (above ground)		Good
Raw Water sample port?		Yes, on lid which makes lid removal difficult
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		Yes
Signs of ponding?		Yes, on path nearby. Landscaping also may keep water contained
Access by animals		Not fully fenced, in a residential area where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism		Padlock on lid. No signs of vandalism
b) Drilling Standard:		
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?		Yes – check valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The

<table>
<tr><td></td><td>well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel, good condition</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Adjacent to footpath and road

Roads and sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
</table>

Water level of chamber	None present at time of visit
Is there a sump pump?	No pump or sump
Are there duty/standby sump pumps?	No
Sump pump testing, include date a method	N/A
Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the bore head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal pipe penetration through chamber wall ■ Seal casing and chamber floor ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Move sample tap to make lid removal easier. Sample tap should not drain in the well. ■ Re-landscape so that water is not contained around well ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis

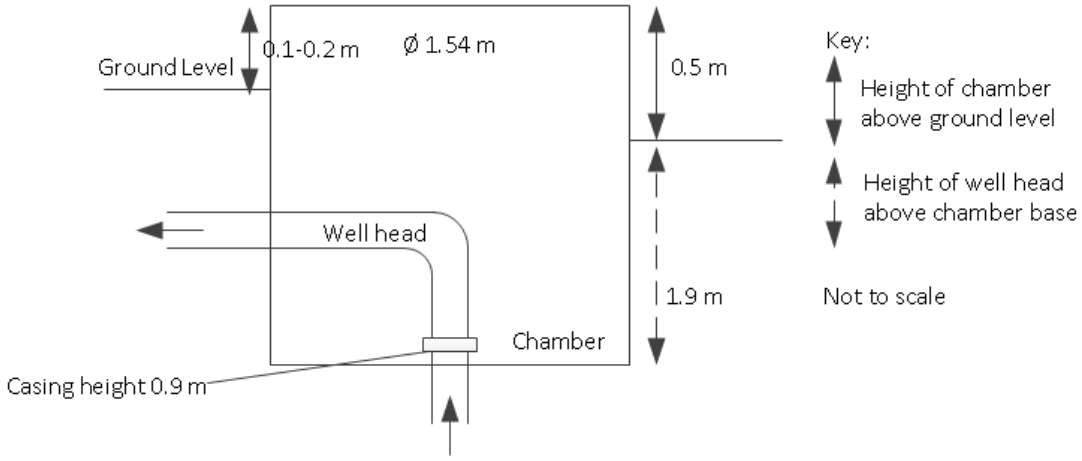
	■ Establish routine testing and verification of backflow prevention device

Denton Well 5

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Denton Well 5
ECan Well No.	M35/1864
Aquifer No.	3
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl) (assume top of screen)	63.4
Casing Diameter (mm)	254
Screen Interval (mbgl)	63.4 – 72.8
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	1973
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Generally runs about once a day
4. Photo Record and Comments	
Photo	Comment
	
	Sample tap drains into chamber. Some chamber corrosion behind sample tap.
	Pipe penetration through chamber wall not sealed. Dirt floor, not sealed
	Cable penetration through chamber wall not sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Glands not sealed
	Pipework	Not sealed
	Well casing	Could not be viewed in person or with a camera
Any history of E. coli transgressions? Historical and current levels of total coliforms?		20 distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). The source is unknown and may not be this well. Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		N/A

<table>
<tr><td>Signs of ponding?</td><td>Not at time of inspection</td></tr>
<tr><td>Access by animals</td><td>Not fenced</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Padlock on lid. No signs of vandalism</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – check valve installed (not tested)

Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Could not be viewed</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
</table>
</td></tr>
</table>

	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Adjacent to rail line and arterial road Roads and sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	None present at time of visit	
Is there a sump pump?	No pump or sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the bore head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Seal cable glands ■ Seal pipework penetrations through wall ■ Check casing seal with chamber floor and seal if required ■ Seal chamber floor to prevent inundation ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA.	

	■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

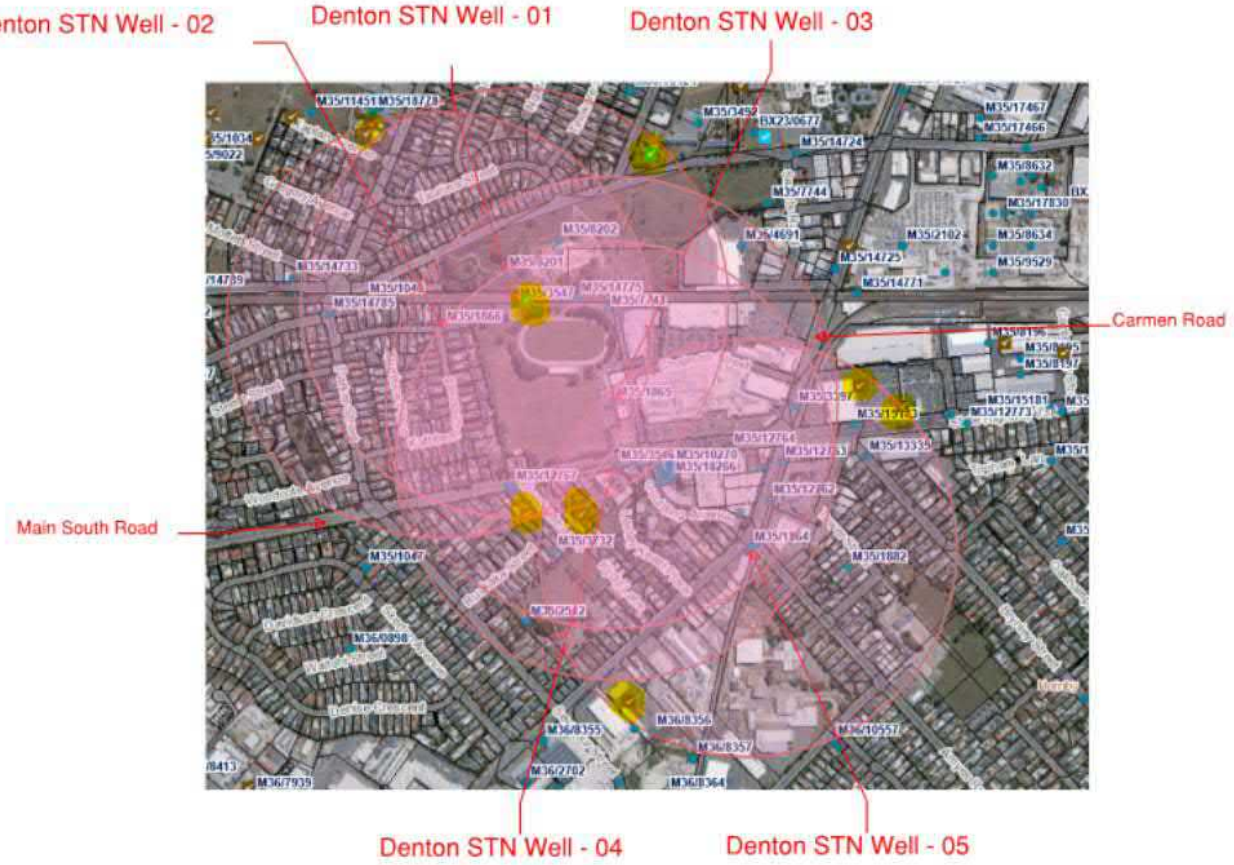


Figure 1: Summary of wells and consents within 400m of Denton Wells

Table 3: Summary of consents within 400m of Denton Wells

Denton Well Sites

Well Number: M35/3547

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC101944	Issued - Active	Stormwater Residential
Discharge to Water	CRC990260	Terminated - Surrendered	Stormwater Residential
Discharge to Land	CRC960782	Issued - Active	Stormwater Residential

Well Number: M35/1866

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	CRC122386	Terminated - Replaced	Stormwater Industrial

Discharge to Land	CRC121736	Terminated - Replaced	Stormwater Industrial
Discharge to Land	CRC960782	Issued - Active	Stormwater Residential
Discharge to Water	CRC990260	Terminated - Surrendered	Stormwater Residential

Well Number: M35/1865

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	CRC960782	Issued - Active	Stormwater Residential
Discharge to Land	CRC952722	Terminated - Replaced	Stormwater Residential
Discharge to Water	CRC990260	Terminated - Surrendered	Stormwater Residential

Well Number: M35/3546

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	CRC960782	Issued - Active	Stormwater Residential
Discharge to Land	CRC952722	Terminated - Replaced	Stormwater Residential
Discharge to Water	CRC990260	Terminated - Surrendered	Stormwater Residential

Well Number: M35/1864

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	CRC110523	Issued - Active	Stormwater Industrial
Discharge to Land	CRC952722	Terminated - Replaced	Stormwater Residential
Discharge to Land	CRC101848	Issued - Active	Stormwater Industrial
Discharge to Land	CRC952110	Application Returned	Stormwater Residential

Appendix C

Bore Logs

Bore or Well No	M35/3547
Well Name	442 Main South Rd
Owner	Christchurch City Council

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M35/3547	**File Number**	CO6C/03077
Owner	Christchurch City Council	**Well Status**	Active (exist, present)
Street/Road	442 Main South Rd	**NZTM Grid Reference**	BX23:61181-78980
Locality	HORNBY	**NZTM X and Y**	1561181 - 5178980
Location Description	Located on the north side of the Reservoir, by the access road	**Location Accuracy**	2 - 15m
CWMS Zone	Christchurch - West Melton	**Use**	Small Community Supply,
Groundwater Allocation Zone	Christchurch/West Melton	**Water Level Monitoring**	--
Depth	96.30m	**Water Level Count**	0
Diameter	250mm	**Initial Water Level**	9.00m below MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	31.40m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	17	**Calc Min 95%**	15.50m below MP
Aquifer Name	Burwood Gravel	**Aquifer Tests**	0
Aquifer Type	Non-Flowing Artesian	**Yield Drawdown Tests**	1
Drill Date	11 Jun 1982	**Max Tested Yield**	28 l/s
Driller	A M Bisley & Co	**Drawdown at Max Tested Yield**	6 m
Drilling Method	Cable Tool	**Specific Capacity**	5.07 l/s/m
Casing Material		**Last Updated**	22 Dec 2015
Pump Type	Unknown	**Last Field Check**	30 Jan 2008
Water Use Data	Yes		

No screen data for this well

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
11 Jun 1982	1	28.4	374.8284	5.6	0

Comments

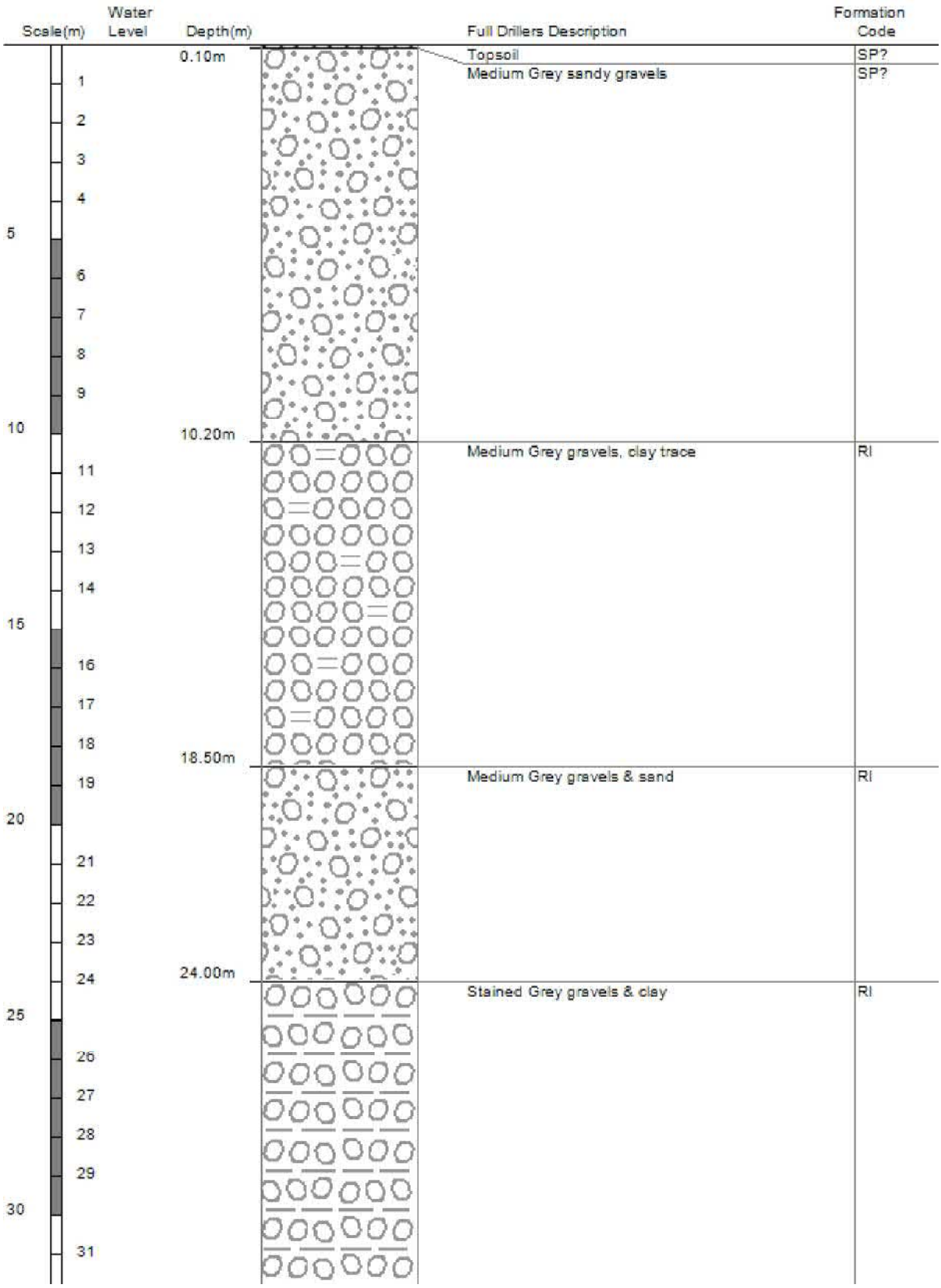
Comment Date	Comment
	WELL NO.2 = ONE OF 5 WELLS PUMPING TO DENTON PARK RESERVOIR Grid ref amended from M35:710-406 to M35:7105-4055, more accurate.
	FROM OLD CWS DB Located in Denton Park, Main South Rd near Carmen Rd & Shands Rd. Located on the west side of the park, at the Kathleen Cresent entrance, on the south side of the path. Is in the garden covered by a green round lid (padlocked).
15 Oct 1998	West pressure zone.
08 Feb 2000	FROM OLD CWS DB Surrounding area a sports ground, with several clubrooms. Park borders residential properties, railway line, a main road & a shopping centre on east boundary. GRID REF: M35:71045-40543.
03 Dec 2007	Screen length 9.0m, information form CCC
06 Dec 2007	FROM OLD CWS DB CCC Notation: Denton Stn Well-01=M35/3547
01 Feb 2008	From information supplied form CCC this well is Denton Well-01 not Well-02
01 Feb 2008	Gridref changed from: M35:7105-4055
01 Feb 2008	CCC PUB SUPPLY,KATHLEEN CRES,HORNBY PREV. PCC,ONE OF 5 DEEP BORES SUPPLING DENTON PARK PUMP STATION Updated Squalarc gridreference from Wells database 1-May-08
04 Sep 2009	Gridref changed from: M35:71177-40593 photo added
06 May 2010	MfE source code added

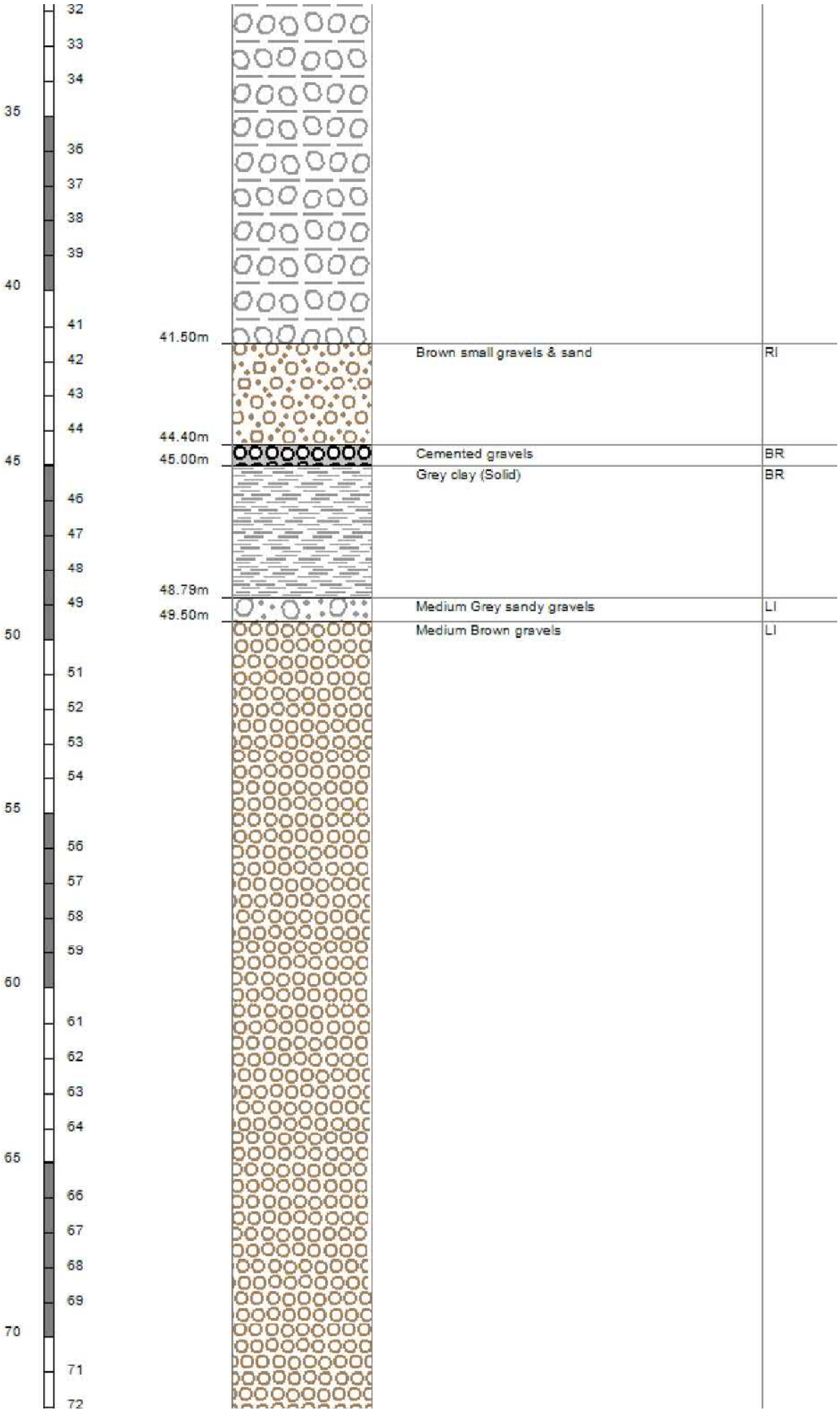
Bore Log

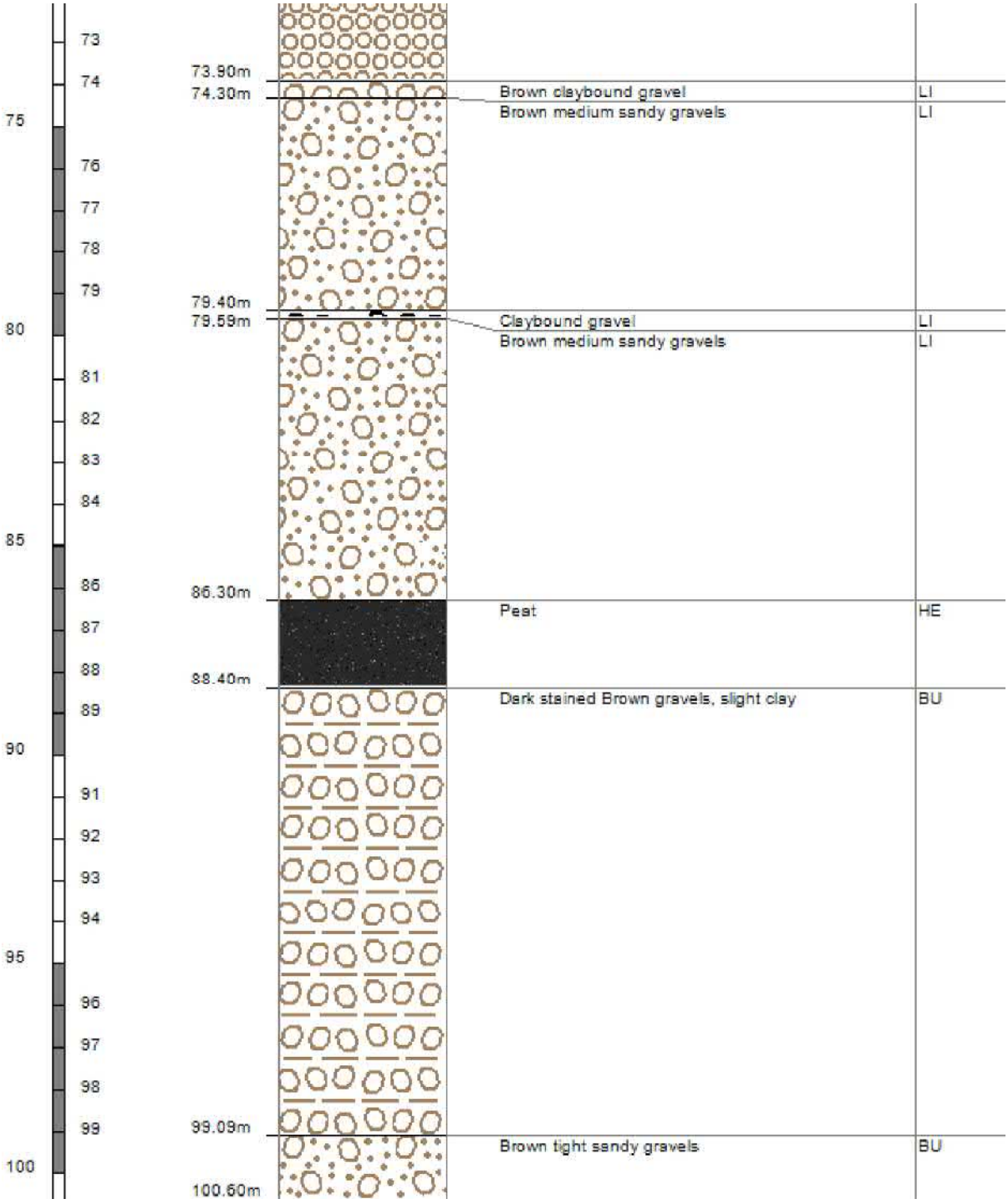
Borelog for well M35/3547

Grid Reference (NZTM): 1561181 mE, 5178980 mN
Location Accuracy: 2 - 15m
Ground Level Altitude: 31.4 m +MSD Accuracy: < 2.5 m
Driller: A M Bisley & Co
Drill Method: Cable Tool
Borelog Depth: 100.6 m Drill Date: 11-Jun-1982

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




41.50m
Brown small gravels & sand
RI
44.40m
Cemented gravels
BR
45.00m
Grey clay (Solid)
BR
48.79m
Medium Grey sandy gravels
LI
49.50m
Medium Brown gravels
LI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95
96
97
98
99
100
73.90m
74.30m
Brown claybound gravel
LI
Brown medium sandy gravels
LI
79.40m
79.59m
Claybound gravel
LI
Brown medium sandy gravels
LI
86.30m
Peat
HE
88.40m
Dark stained Brown gravels, slight clay
BU
99.09m
Brown tight sandy gravels
BU
100.60m

A. M. BISLEY & CO. LTD.

WELL DRILLING DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

February 1976

NAME: PAPARUA COUNTY COUNCIL c/o Royds Sutherland & McLeay

LOCATION: Denton Park - N.W. Corner by rail line

DIA. OF WELL: 250 STATIC WATER LEVEL: 6.5m

CASING: 94.3m Spiralweld SHOE: Rolled steel

TOTAL DEPTH: 102.4m

SCREEN: 9.35m of 10" s/s 80 slot

LEADER: .72m of 230mm I.D.

PACKER: Nil

PUMPING TEST: 40.2 ℓ/s for 19.4m

SPECIFIC CAPACITY: 2.08 ℓ/m
(approx. 8 gals/foot)

LITHOLOGY

.0 - 1.00	Shingle fill
1.0 - 6.0	fine coarse grey gravel & sand
6.0 - 10.0	medium grey gravel and sand
10.0 - 21.0	fine-coarse stained gravel and sand
21.0 - 22.0	Tight grey gravel and yellow clay
22.0 - 23.5	Medium grey gravel - sand - trace yellow clay (WB)
23.5 - 26.0	Tight grey gravel and clay
26.0 - 43.0	Sandy greyish brown gravel - stained - trace clay
43.0 - 49.5	Blue and grey clay - trace peat
49.5 - 50.0	Tight blue gravel and clay
50.0 - 52.0	Tight blue gravel - sandy
52.0 - 54.0	Small-medium brown gravel stained lenses & clay
54.0 - 74.00	" " " " " trace clay
74.0 - 74.5	Yellow clay & brown gravel
74.5 - 84.0	Medium brown gravel - sandy
84.0 - 86.0	Medium blue gravel - sandy
86.0 - 88.0	Peat
88.0 - 88.5	Tight clays & gravel
88.5 - 94.0	Grey brown gravel - sandy
94.0 - 102.0	Tight grey brown gravel - sandy - some yellow clay

RIG NO. 5 DRILLER K.A. GRANT

ELEC05/5121

A. M. BISLEY & CO. LTD

WATER SUPPLY DIVISION Denton well 2

HAMILTON and CHRISTCHURCH

WELL LOG

June 14 1962

CLARITY PRESS LTD

NAME: Paparua County Council
LOCATION: Kathleen Crescent

DIA. OF WELL: 250mm STATIC WATER LEVEL: 9metres

CASING: 90.23 metres SHOE: 1 rolled

TOTAL DEPTH: 96.28metres drilled to 100.63metres

SCREEN: 6.10metres s/s Johnscreen 250mm T.S. 80 slot

LEADER: 1.21metres rolled

PACKER:

PUMPING TEST: 374gpm at 5.60m D.D. or 28.42l/sec at 5.60 M.D.D.
5.07l/sec/metre

SPECIFIC CAPACITY: 66.78gals/m/D.D.

LITHOLOGY

.00-0.10 metres	Top Soil
0.10-10.20 metres	Sandy med grey gravels
10.20-10.50 metres	Stained med grey gravel and clay trace
10.50-24.00 metres	Med grey gravels and sand
24.00-41.50 metres	St. grey gravels and clay
41.50-44.40 metres	Small brown gravels and sand
44.40-45.00 metres	Cemented gravels
45.00-48.80 metres	Grey clay (solid)
48.80-49.50 metres	Sandy med grey gravels
49.50-73.90 metres	Med brown gravels
73.90-74.30 metres	Clay bound brown gravel
74.30-79.40 metres	Med sandy brown gravels
79.40-79.80 metres	Clay bound gravel
79.80-86.30 metres	Med sandy brown gravels (some clay trace)
86.30-86.38 metres	Peat
86.38-97.13 metres	Dark stained brown gravels slight clay
97.13-100.63metres	Sandy brown gravels (tight)

RIG No. 3 Cable 10-96 DRILLER P. Sinclair

A. M. BISLEY & CO. LTD

4

WATER SUPPLY DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

March 29 1982

CLARITY PRESS LTD

NAME: Paparua County Council

LOCATION: Main South Road Opp. Denton Park

DIA. OF WELL: 300mm

STATIC WATER LEVEL:

CASING: 89.75m Spiral

SHOE: 1

TOTAL DEPTH: 95.85m

SCREEN: 250mm Johnson St. St. 80 slots length 6.10m

LEADER: 0.60m 290mm O.D. Rolled Pipe.

PACKER: Screened between 65.4-71.5m

PUMPING TEST: G.W.L. 10.64m Pumped 19.1ℓ/sec DR.D. 13.83m 27.38ℓ/sec

SPECIFIC CAPACITY: 3.78ℓ/sec/m

DRAWDOWN: 7.25m

LITHOLOGY

[illegible].3	Filling
0.3-3.9	Silt
3.9-11.7	Grey Gravel Sand
11.7-15.6	Black and Brown stained gravel and sand
15.6-22.1	Grey Gravel - Sand
22.1-24.8	Grey-Brown Gravel- Sand some Yellow Clay
24.8-26.5	Tight Sandy Grey-Brown Gravel
26.5-28.9	Grey-Brown Gravel-Sand
28.9-29.6	Grey- Brown Gravel - Yellow Clay - Sand
29.6-40.5	Grey-Brown Gravel - Sand
40.5-41.3	Blue Clay - Blue Gravel
41.3-49.5	Blue Clay - Peat
49.5-51.8	Tight Blue Gravel - Sand - Some Blue Clay
51.8-57.8	Tight Blue Clay-Sandy Brown Gravel
57.8-61.1	Brown Gravel - Sand
61.1-61.3	Brown Gravel - Yellow Clay
61.3-71.5	Sandy Brown Gravel some stained gravel
71.5-72.6	Tight Sandy Brown Gravel
72.6-74.1	Brown Stained Gravel - Sand - Yellow Clay
74.1-77.2	Tight Sandy Brown stained gravel
77.2-82.8	Tight Sandy Brown stained gravel some Yellow Clay
82.8-82.9	Yellow Clay

RIG No. 4

DRILLER B. Lagendyk

PTO

82.9-85.4 Tight Sandy Grey-Brown stained Gravel
85.4-86.6 Sandy Brown Stained Gravel
86.6-87.5 Hard Yellow Clay
87.5-87.8 Hard Gravel-Sand-Clay
87.8-95.8 Sandy Brown Stained Gravel

Denton? Amyes Rd but details dont match well 6

A. M. BISLEY & CO. LTD.

WELL DRILLING DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

19....

NAME: Feparua County Council

LOCATION: Corner Amyes & Shands Roads

DIA. OF WELL: 10" Spirocoin STATIC WATER LEVEL: 33' - 4"

CASING: 208' - 6 1/2" SHOE: 10 rolled

TOTAL DEPTH: 239' - 0"

SCREEN: 30'-9" of 8" x 100 Slot Johnsnn S/S

LEADER: 1'-8" of 7" + 4" of Cone + 1'-8" of 9"

PACKER: Figure K 10" x 3"

PUMPING TEST: 500 gpm from 39.4 D.D.

SPECIFIC CAPACITY: 12.8

LITHOLOGY

0	- 1	Top Soil
1	- 18	Yellow Sandy Silt
18	- 27	Grey & Brown Gravel (tight)
27	- 29	Black stained gravel - so d
29	- 56	Grey gravel & sand
56	- 65	Sandy grey gravels
65	- 128	Grey Brown Gravels & Clay
128	- 134	Grey & blue Clay - some wood fibre
134	- 152	Sandy blue gravel
152	- 160	Stiff grey clay, timber & peat
160	- 162	Blue sandy gravel & clay
162	- 169	Brown gravel & Yellow clay
169	- 174	Medium to small grey & brown gravel
174	- 178	Rough sandy clay bound gravels
178	- 188	Sandy brown gravel, some clay
188	- 188.6"	Yellow sandy clay
188.6"	- 193	Brown gravel & sand
193	- 198	Sandy clay bound gravels
198	- 222	Sandy brown gravels
222	- 238	Grey & Brown gravels
238	- 242	Yellow sandy clay & brown stained gravels
242	- 250	Grey & Brown gravels (tight)

RIG NO. ONE DRILLER J.S. HAWKINS

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

CH2M Beca

www.ch2mbeca.com

Report

Kainga Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the wells supplying Kainga Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used in this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Kainga Pumping Station (Brooklands/Kainga Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore log as included in Appendix C
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Kainga Pumping Station is supplied by one well; Kainga Well 1. Kainga Pumping Station is one of the two pump stations that service the Brooklands/Kainga pressure zone. Table 2-1 summarises key information about the five wells.

Table 2-1: Kainga Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M 35/6213	87.0-92.0	2

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from

both alpine river and rainfall to land surface recharge. The wells at Kainga Pumping Station are screened within moderately-deep (Aquifer 2 – Linwood Gravel Aquifer) leaky (semi)-confined aquifers within the Christchurch Artesian Aquifer System.

4 Well Inspections

An inspection of the well was carried out on 7 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Andrew Batchelor (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Kainga Well 1 does not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 6-1 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Seal casing at ground of well shed ■ Regrade the land around the well-house to promote draining away from the well. ■ Regrade the concrete floor within the well-house to promote draining away from the casing ■ Tighten the connection on the cooling tube as this is likely causing a leak in the well-shed ■ Install backflow prevention device ■ Install a downward facing air vent 0.5 m	■ Pipe and casing tidy ups including removing rust and peeling paint and resealing ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses	■ For the as-built records, confirm backflow prevention on the well pump has been installed.	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

	First Priority	Second Priority	Third Priority	Ongoing
	above 100 year flood level (unless the well is not located in a flood prone area)	contaminant sources and contaminant migration pathways		

7 Conclusion

The information reviewed and the inspections carried out indicate that Kainga Well 1 does not meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix B

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Kainga
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Draws from Aquifer 2 (leaky (semi)-confined)
Surface Water Ways, Drains, etc	Unnamed drain adjacent to pumping station building and close to the well, Waimakariri River nearby
4. Photo Record and Comments	
Photo	Comment

	Step up into the pump station for flood protection Note that the site is above the 100 year flood level and so flooding potential is low
	Flow meter in underground chamber with stagnant water and a sump pump. About 50mm of water at the time of inspection. There has been up to 250-300mm in the past. This line is under pressure so entry of stagnant water from the chamber into the pipe is unlikely. Pipe is rusty. Chamber does not have cable seals.

	As above
	Above ground diesel storage tank adjacent to well shed
	Diesel pipework in pump station is located above a trench for collection of leaks

	Stormwater collection drain with stagnant water

5. Risks from Surrounding Environment				
a) Within the site:				
Diesel/Chemical Storage	2m from well	☐ Underground √ Aboveground	Fuel lines	☐ Underground √ Aboveground
Access by Animals	Locked site but low fence at road frontage Pump station door has an alarm			
Protection from vandalism, signs of vandalism	As above, no signs of vandalism			
Other Activities	N/A			
b) Immediate Neighbouring Land Use:				
Current Neighbouring Land Use	Residential/rural			
Significant Changes Since Previous Inspection	None identified			
Zoning of Neighbouring Land	Residential Small Settlement Zone			
c) Wider Environment:				
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Agricultural area, stormwater discharges in the area, drain within pump station site Sewer nearby			
Risk of flood inundation	Low risk as the site is above the 100 year flood level			
Potential sources of young water	Stormwater collection creek with stagnant drain adjacent to pump station			
General land use in catchment (LLUR)	As below			
Contaminated sites (HAIL status)	None identified at the address of the well and pump station			

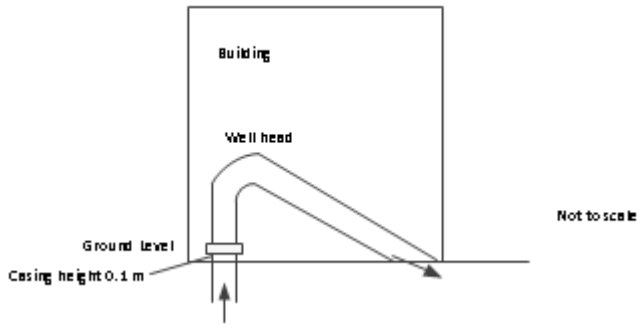
Status and condition of surrounding wells (within 400 m radius)	Multiple wells
Landfill	None identified
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

Kainga Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Kainga Well 1
ECan Well No.	M 35/6213
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Above
Casing Depth (mbgl)	87.0 (assume top of screen)
Casing Diameter (mm)	304.8
Screen Interval (mbgl)	87.0-92.0
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	26 October 1989
Control System/Alarms	Pump failure alarm

Type of Pump	Submersible
Frequency of Pump Use	Continuous
4. Photo Record and Comments	
Photo	Comment
	Concrete floor is flat and does not slope away from the casing. Water can be seen on the floor surrounding the casing
	Well casing not sealed to concrete floor
5. Diagram with Well Measurements	



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Good seal
	Pipework	Good seal
	Well casing	Not sealed – 1-2mm gap around casing
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No – casing to floor not sealed Site is above the 100 year flood level and so flooding potential is low
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Some rust, peeling paint
Raw Water sample port?		Yes, on opposite side of building and on the wellhead
Concrete apron sloped to drain away from well?		No, floor flat and not sloped away from wellhead
100mm step above ground level?		Yes, ground has been dug away and directed to drain
Signs of ponding?		Yes, inside the shed. The floor is not sloped away from wellhead
Access by animals		Fence is only 3m to west and 3.5m to south

<table>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Fence with a low gate that could be climbed. No signs of vandalism</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>None seen – there may be one on the pump but this could not be confirmed</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>Unknown</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Minor rust on casing. Leakage from direct supply to generator, pooling on floor.</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>No 5m fence to prevent animal access</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>No confirmed backflow prevention device</td><td>To be agreed</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Diesel storage tank adjacent to well

Roads and sewers in close proximity</td></tr>
</table>

d) Below Ground Chambers:	
Water level of chamber	N/A
Is there a sump pump?	N/A
Are there duty/standby sump pumps?	N/A
Sump pump testing, include date a method	N/A
Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the well head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal casing and concrete in well shed ■ Regrade the land around the well-house to promote draining away from the well. ■ Regrade the concrete floor within the well-house to promote draining away from the casing ■ Tighten the connection on the cooling tube as this is likely causing a leak in the well-shed ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Pipe and casing tidy ups including removing rust and peeling paint and resealing ■ Install backflow prevention device ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

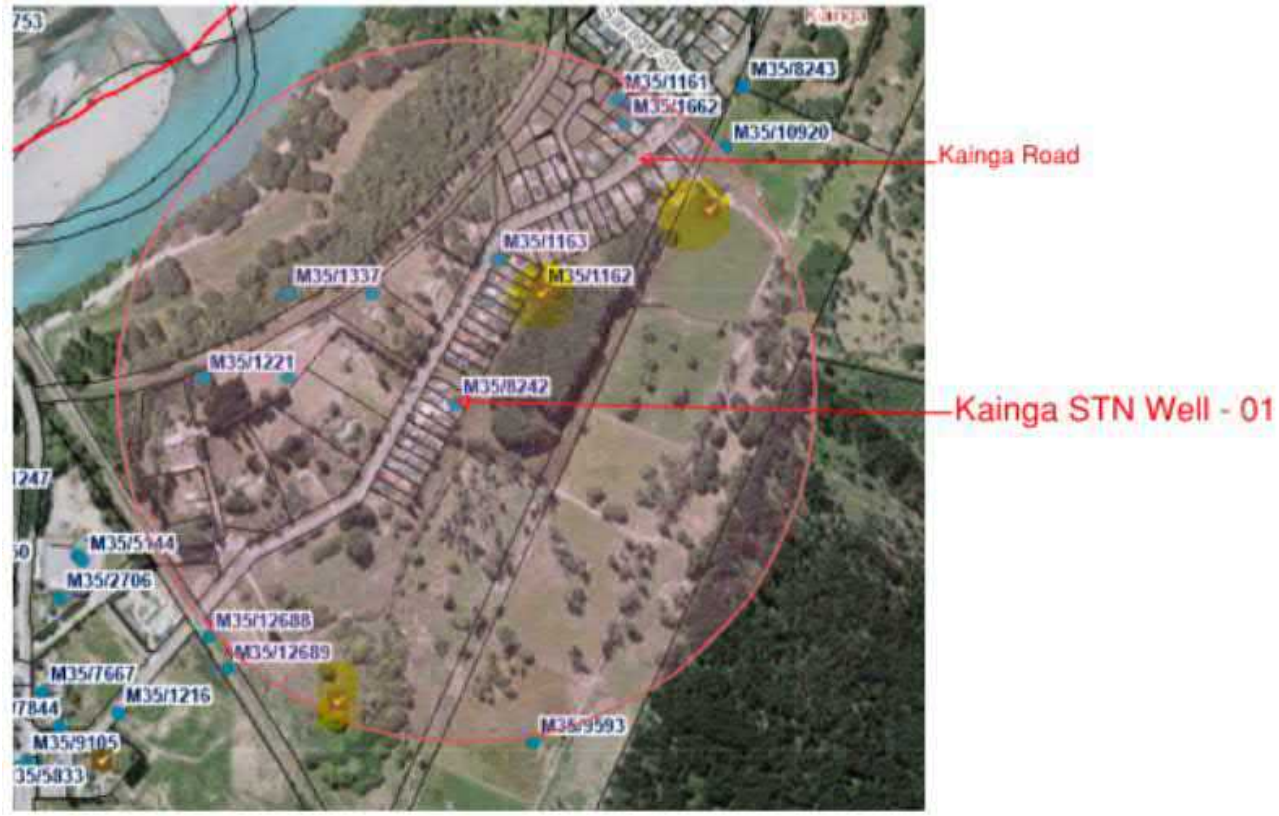


Figure 1: Summary of wells and consents within 400m of Kainga Well

Table 2: Summary of consents within 400m of Kainga Well

Kainga Well Site

Well Number: M35/6213

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	CRC900856	Terminated - Expired	Stormwater Residential
Discharge to Land	CRC900826	Terminated - Expired	Stormwater Residential
Discharge to Land	NCY790413	Terminated - Surrendered	Stormwater Residential

Appendix C

Bore Logs

McMILLAN WATER WELLS LTD

PH. 242-571 PH. 242-530 A.H. Fax (03) 242 431

WELL OWNER. Waimairi District Council

ADDRESS. Private Bag, FENDALTON

LOCALITY. Kaianga

DRILLER. C Weaver

DRILLING DATE. Completed 26 October 1989

GRID REFERENCE. 824546

DEPTH FROM SURFACE (m) TOP	BOTTOM	STATIC WATER LEVEL.	DESCRIPTION
.000	.400		Topsoil
.400	2.650		Brown sand
2.650	3.100		Brown sand and small brown gravel
3.100	5.100		Very sandy small brown gravel
5.100	11.600		Sandy blue/grey pea gravel
11.600	12.100		Small/med sandy blue/grey gravel, trace blue silt
12.100	16.800		Small very sandy blue/grey gravel, trace shells
16.800	17.400		Very sandy grey gravel, shells and grey organic clay
17.400	22.800		Small/med grey sandy clay
22.800	26.350		Med grey/brown sandy gravel, trace brown clay
26.350	26.600		Brown sandy clay
26.600	35.200		Med grey/brown sandy gravel
35.200	35.450		Brown sandy gravel and brown clay
35.450	37.200		Small brown sandy gravel
37.200	42.950		Brown sand, trace very small brown gravel
42.950	48.100		Brown sand, rare brown pebbles
48.100	56.550		Med/some large grey/brown sandy gravel

CASING DIAMETER

WELL DEPTH

FINAL WATER LEVEL

SCREEN TYPE

SLOT SIZE

SCREEN LENGTH

LEADER & DIAMETER

SET AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

REMARKS (INCLUDE NOTES ON CORES AND SAMPLES TAKEN)

McMILLAN WATER WELLS LTD

PH. 242-571 PH. 242-530 A.H. FAX (03) 242 431

WELL OWNER. Waimairi District Council

ADDRESS. Private Bag, FENDALTON

LOCALITY. Kaianga

DRILLER. C Weaver

DRILLING DATE. Completed 26 October 1989

GRID REFERENCE. 824546

DEPTH FROM SURFACE (m) TOP	BOTTOM	STATIC WATER LEVEL.	DESCRIPTION
56.550	57.000		Med brown, some grey sandy gravel, trace grey clay
57.000	57.550		Med grey sandy gravel with grey clay (tight)
57.550	59.050		Grey sandy clay
59.050	61.500		Very fine grey clayey sand, rare grey and brown pebbles
61.500	62.000		Grey sandy organic clay
62.000	62.750		Peat and grey sand
62.750	63.300		Grey sandy gravel, trace grey clay and peat (tight)
			Patches claybound
63.300	63.500		Brown and grey claybound gravel (tight)
63.500	64.200		Brown stained sandy gravel with brown clay
64.200	65.800		Med grey/brown sandy gravel, some black stained
65.800	66.800		Med/some large grey/brown sandy gravel, trace brown claybound gravel
66.800	67.900		Med grey/brown sandy gravel, trace brown clay
67.900	68.500		Med grey/brown sandy gravel
68.500	70.300		Very sandy med grey/brown gravel
70.300	71.300		Brown/grey clay, brown sand, trace brown gravel

CASING DIAMETER

WELL DEPTH

FINAL WATER LEVEL

SCREEN TYPE

SLOT SIZE

SCREEN LENGTH

LEADER & DIAMETER

SET AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

REMARKS (INCLUDE NOTES ON CORES AND SAMPLES TAKEN)

Samples taken at 61.500 - 62.000 metres and at 62.000 - 62.750 metres.

McMILLAN WATER WELLS LTD

PH. 242-571 PH. 242-530 A.H. FAX (03) 242 431

WELL OWNER. Waimairi District Council

ADDRESS. Private Bag, FENDALTON

LOCALITY. Kaisnga

DRILLER. C Weaver

DRILLING DATE. Completed 26 October 1989

GRID REFERENCE. 824546

DEPTH FROM SURFACE (m) TOP	BOTTOM	STATIC WATER LEVEL.	DESCRIPTION
71.300	71.600		Grey claybound grey gravel, very tight
71.600	72.000		Med grey sandy gravel, trace grey clay
72.000	72.200		Brown organic clay and peat
72.200	72.500		Grey clay and grey sand
72.500	73.200		Grey sand and clay, trace grey pebbles
73.200	73.800		Brown sandy claybound gravel
73.800	80.600		Brown very sandy gravel
80.600	84.100		Small/med grey/brown sandy gravel, some black stained gravel
84.100	89.000		Small/med grey/brown sandy gravel
89.000	89.300		Grey/brown sandy gravel with brown clay
89.300	90.600		Grey/brown sandy gravel
90.600	91.800		Small brown stained and black stained sandy gravel
91.800	92.000		Grey/brown sandy gravel

CASING DIAMETER 12"

WELL DEPTH 92.000 metres

FINAL WATER LEVEL 4.500m Pos Head

SCREEN TYPE Stainless Steel

SLOT SIZE .80 slot

SCREEN LENGTH 5.150 metres

LEADER & DIAMETER 6.77m x 260mm ID

SET AT 87.000 - 92.000 metres

DRAWDOWN

AFTER ___ HOURS PUMPING AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

DRAWDOWN

AFTER ___ HOURS PUMPING AT

REMARKS (INCLUDE NOTES ON CORES AND SAMPLES TAKEN)

Sample taken at 72.000 - 72.200 metres

McMILLAN WATER WELLS LTD

PH. 242-571 PH. 242-530 A.H. FAX (03) 242 431

WELL OWNER. Waimairi District Council

ADDRESS. Private Bag, FENDALTON

LOCALITY. Kaianga

DRILLER. C Weaver

DRILLING DATE. Completed 26 October 1989

GRID REFERENCE. 824546

DEPTH FROM SURFACE (m) TOP	BOTTOM	STATIC WATER LEVEL.	DESCRIPTION	DEVELOPING AND PUMPING HOURS PUMPING	DEVELOPING
			11-10-89	½	3 ¼
			12-10-89	2	3
			13-10-89	½	5 ½
			16-10-89		7
			17-10-89	2	5 3/4
			18-10-89	1 ¼	6 ¼
			"	? 3/4	1 ½
			20-10-89	4	2
			24-10-89	2 ¼	2 ¼
			25-10-89 Test Pump	2 ½	
				17 3/4	36 ½

CASING DIAMETER

WELL DEPTH

FINAL WATER LEVEL

SCREEN TYPE

SLOT SIZE

SCREEN LENGTH

LEADER & DIAMETER

SET AT

DRAWDOWN 0.900m

AFTER ½ HOURS PUMPING AT 200 gpm

DRAWDOWN 4.05m

AFTER 1½ HOURS PUMPING AT 300 gpm

DRAWDOWN 6.000m

AFTER 2½ HOURS PUMPING AT 400 gpm (30 l/sec)

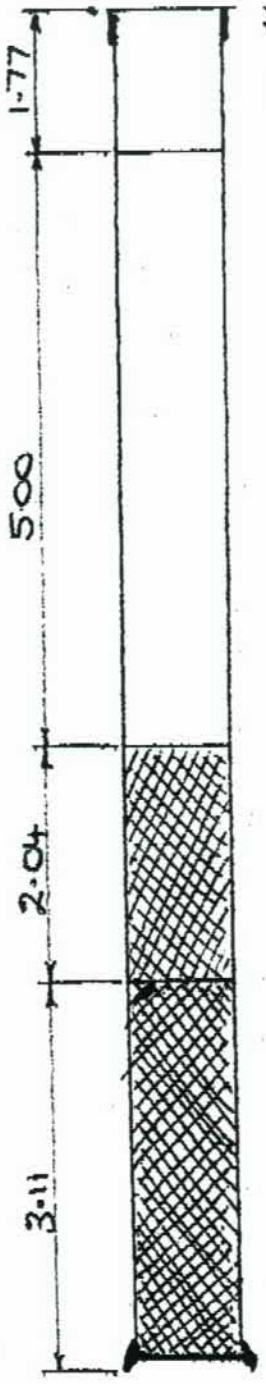
REMARKS (INCLUDE NOTES ON CORES AND SAMPLES TAKEN)

Pumping Results

37 l/sec 500 gpm - 13.000m Drawdown

62 l/s 830 gpm - 28.500m Darwdown

SCREEN.



DRIVE RING, 290mm OD

LEADER. 260mm ID
275mm OD

BLANK. 260mm ID
275mm OD

JOHNSON STAINLESS
80 SLOT 265mm ID

SURESCREEN STAINLESS
80 SLOT. 265mm ID

DRIVE SHOE. 290mm OD.

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

Report

Mairehau Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace/ Mike Thorley**	Template for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the well that supplies Mairehau Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminant s, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used in this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore log as included in Appendix C
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)
- Note that the previous inspection report was not received

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Mairehau Pumping Station is supplied by one well; Mairehau Well 1. The well and pump station are located within Burwood Hospital. Table 2-1 summarises key information about the well.

Table 2-1: Mairehau Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M 35/5830	147.8-153.8	4

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The well at Mairehau Pumping Station is screened

within the deep (Aquifer 4 – Wainoni Gravel Aquifer) leaky (semi)-confined aquifer within the Christchurch Artesian Aquifer System.

4 Well Inspections

An inspection of the well was carried out on 7 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Andrew Batchelor (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Mairehau Well 1 do not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 6-1 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Seal chamber floor to prevent inundation of chamber from groundwater from the local near-surface groundwater ■ Seal pipework at chamber sidewall ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced		■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

	First Priority	Second Priority	Third Priority	Ongoing
		(i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.		

7 Conclusion

The information reviewed and the inspections carried out indicate that Mairehau Well 1 does not meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Mairehau
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	8 February 2013
2. Modifications since Previous Assessment	
Upgrade of VSD and other electrics including a flowmeter. Occurred in ~2010 so before previous inspection.	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Draws from Aquifer 4 (leaky (semi)-confined)
Surface Water Ways, Drains, etc	Stormwater detention basins at Hospital, Travis Wetland ~500 m away
4. Photo Record and Comments	
Photo	Comment
	Reticulation pump room. Diesel generator is shown in the background.

<table>
<tr><td>  </td><td>Above ground diesel storage tank outside the pump station</td></tr>
<tr><td>  </td><td>The pump station is located between two roads</td></tr>
<tr><td colspan="2">5. Risks from Surrounding Environment</td></tr>
<tr><td>a) Within the site:</td><td></td></tr>
<tr><td>Diesel/Chemical Storage</td><td>8 – 10 m from bore ☐ Underground ☑ Aboveground
Fuel lines ☑ Underground ☑ Aboveground</td></tr>
<tr><td>Access by Animals</td><td>Locked and alarmed building</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>As above, no signs of vandalism</td></tr>
<tr><td>Other Activities</td><td>N/A</td></tr>
<tr><td>b) Immediate Neighbouring Land Use:</td><td></td></tr>
<tr><td>Current Neighbouring Land Use</td><td>Hospital</td></tr>
<tr><td>Significant Changes Since Previous Inspection</td><td>None identified</td></tr>
<tr><td>Zoning of Neighbouring Land</td><td>SHP</td></tr>
<tr><td>c) Wider Environment:</td><td></td></tr>
<tr><td>Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks</td><td>Hospital, boiler, discharge of stormwater to ground

There is an active stormwater discharge consent within 400m</td></tr>
</table>

	Sewer nearby
Risk of flood inundation	Unknown – no flood level data was available
Potential sources of young water	No sources specific to the pumping station identified. See well assessments
General land use in catchment (LLUR)	As below
Contaminated sites (HAIL status)	Unknown
Status and condition of surrounding wells (within 400 m radius)	An unused well (probably shallower), close by Multiple wells within 400m
Landfill	None identified
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

Mairehau Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Mairehau Well 1
ECan Well No.	M 35/5830
Aquifer No.	4
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	8 February 2013
2. Modifications since Previous Assessment	
Recently refurbished including a new bellow on the pipework	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	147.8 (assume top of screen)
Casing Diameter (mm)	305
Screen Interval (mbgl)	147.8-153.8
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	1988
Control System/Alarms	Alarm in pump station for no flow

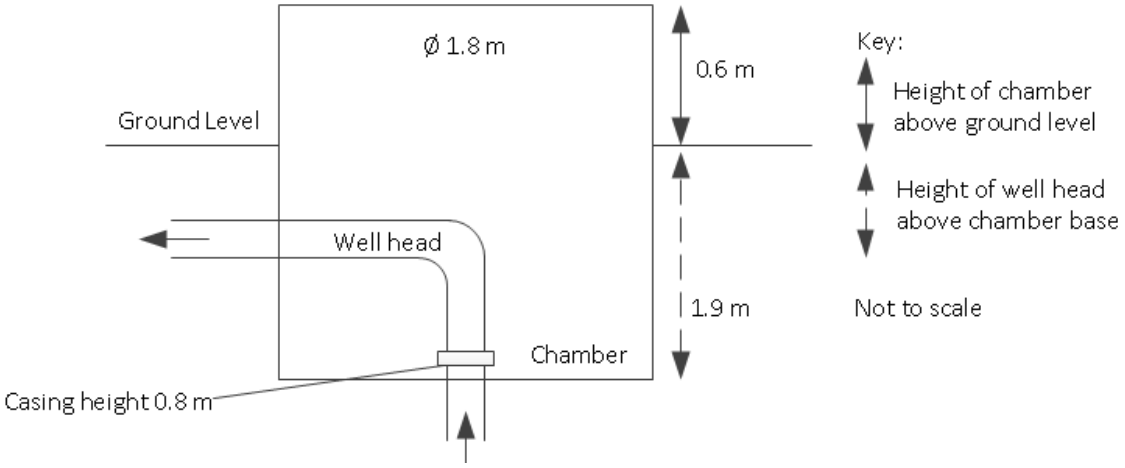
Type of Pump	Surface pumped
Frequency of Pump Use	Generally runs about once a day in summer and less frequent in winter
4. Photo Record and Comments	
Photo	Comment
	The well is located adjacent to the pump station and on the side of the road
	

	Pipework in reasonable condition
	Surface rust on casing and pitting at the gravel level Floor is gravel rather than concrete
	Chamber floor not sealed

	Chamber side wall may not be sealed
	Old suction tank now disconnected
	Old well nearby

	The well is close to the side of the road

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	None
	Pipework	May not be sealed
	Well casing	No concrete seal
Any history of E. coli transgressions?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY).

Historical and current levels of total coliforms?	Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level	No, no concrete seal at the base of the chamber (gravel) No flood level data available
Downward facing air vent 0.5m above 100 year flood level	Not installed, artesian
Type and condition of borehead pipework (above ground)	Good condition
Raw Water sample port?	Yes, discharges in chamber
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	Yes, chamber is 600mm above ground
Signs of ponding?	Not at time of inspection
Access by animals	No fence to prevent access, within hospital grounds where cats and dogs may be found but livestock would be less likely
Protection from vandalism, signs of vandalism	Lid locked with padlock, no signs of vandalism
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – in pump station. Each of the two pumps have a reflux valve. Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Casing has surface rust and pitting in the casing at the gravel level
Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing	Unknown

<table>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Check valve at pumping station</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent (but artesian)</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Diesel storage on the other side of the pump station (8 – 10m away).

Boiler at hospital nearby.

Close to road where spills are possible.

Sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>Dry at the time of inspection but sample tap discharges into the chamber</td></tr>
<tr><td>Is there a sump pump?</td><td>No pump or sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
</table>

Sump pump and/or level alarms	N/A
Does the well head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Seal chamber floor to prevent inundation of chamber from groundwater from the local near-surface groundwater ■ Seal pipework at chamber sidewall ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

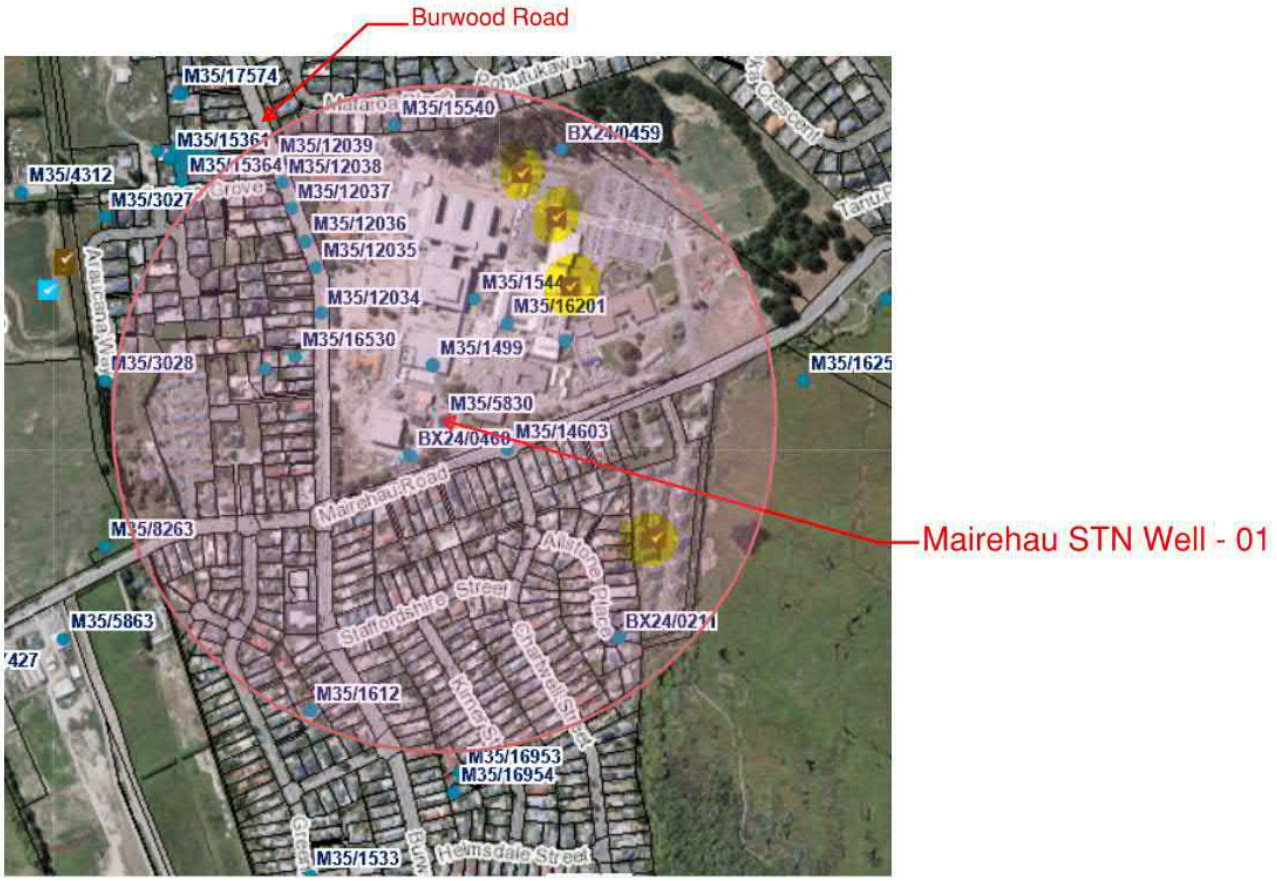


Figure 1: Summary of wells and consents within 400m of Mairehau Well

Table 2: Summary of consents within 400m of Mairehau Well

Mairehau Well Site

Well Number: M35/5830

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to land	CRC063313	Terminated - Replaced	Stormwater Residential
Discharge to land	CRC137035	Issued - Active	Stormwater Industrial
Discharge to land	CRC030243	Terminated - Surrendered	Stormwater Residential

Appendix C

Bore Logs

2762

McMILLAN WATER WELLS LTD

No. 1

PH. 242-571 PH. 242-530 A.H.

WELL OWNER. Waimairi District Council

ADDRESS. Jeffreys & Clyde Rd, Fendalton, Christchurch 5

LOCALITY. Burwood Hospital

DRILLER. G Campbell

DRILLING DATE. _____

GRID REFERENCE. _____

Mairehau 1

DEPTH FROM SURFACE (m) TOP	BOTTOM	STATIC WATER LEVEL.	DESCRIPTION
0	8		Brown sand
8	16.2		Traces of peat mostly grey sand
[illegible]	30		Grey sand with some shells
30	32		Blue sand & some blue clay
32	34		Blue clay
34	35		Peat
35	38		Small free gravels
38	45		Free medium sized gravels
45	51		Grey clay & some gravels
51	62		Fine brown running sands
62	63.5		Yellow clay
63.5	66		Brown sand & some gravels
66	73		Free medium sized gravels
73	74.5		Hard yellow clay
[illegible]	81		Blue clay & wood
81	87		Free gravels & sand
87	91.6		Blue clay

CASING DIAMETER _____

WELL DEPTH _____

FINAL WATER LEVEL _____

SCREEN TYPE _____

SLOT SIZE _____

SCREEN LENGTH _____

LEADER & DIAMETER _____

SET AT _____

DRAWDOWN _____

AFTER ___ HOURS PUMPING AT _____

DRAWDOWN _____

AFTER ___ HOURS PUMPING AT _____

DRAWDOWN _____

AFTER ___ HOURS PUMPING AT _____

REMARKS (INCLUDE NOTES ON CORES AND SAMPLES TAKEN)

McMILLAN WATER WELLS LTD

No. 2

PH. 242-571 PH. 242-530 A.H.

WELL OWNER. Waimairi District Council

ADDRESS. Jeffreys & Clyde Rd, Fendalton, Christchurch 5

LOCALITY. Burwood Hospital

DRILLER. G Campbell

DRILLING DATE. _____

GRID REFERENCE. _____

DEPTH FROM SURFACE (m) TOP	BOTTOM	STATIC WATER LEVEL.	DESCRIPTION
91.6	91.7		Brown peat
91.7	92.5		Hard brown clay
92.5	101.4		Free brown stained grevels
101.4	110.6		Brown sand
110.6	113.7		Very sandy grey gravels
113.7	119.4		Brown clay
119.4	120.9		Free grey sandy gravels
120.9	125.3		Brown claybound gravels & sand
125.3	131.6		Brown very course sand & peagravels, traces of soft yellow clay
131.6	138		Free brown gravel
138	138.45		Hard whitish claypan
138.45	140.8		Grey pug
140.8	142.7		Whitish yellow claypan
142.7	145.9		Hard orangey clay
145.9	146.2		Whitish silty clay
146.2	146.5		Brown claybound gravels
146.5	153.8		Free grey & brown sandy gravels & traces of orangey clay

CASING DIAMETER 305 mm

WELL DEPTH 153.8 m

FINAL WATER LEVEL Flowing 750 gpm

SCREEN TYPE stainless steel

SLOT SIZE _____

SCREEN LENGTH 6.3 m x 10"

LEADER & DIAMETER 2.770 x 10"

SET AT 147.8 to 153.8 m

DRAWDOWN 4.080 m

AFTER 7 HOURS PUMPING AT 970 gpm

DRAWDOWN _____

AFTER ___ HOURS PUMPING AT _____

DRAWDOWN _____

AFTER ___ HOURS PUMPING AT _____

REMARKS (INCLUDE NOTES ON CORES AND SAMPLES TAKEN)

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

www.ch2mbeca.com

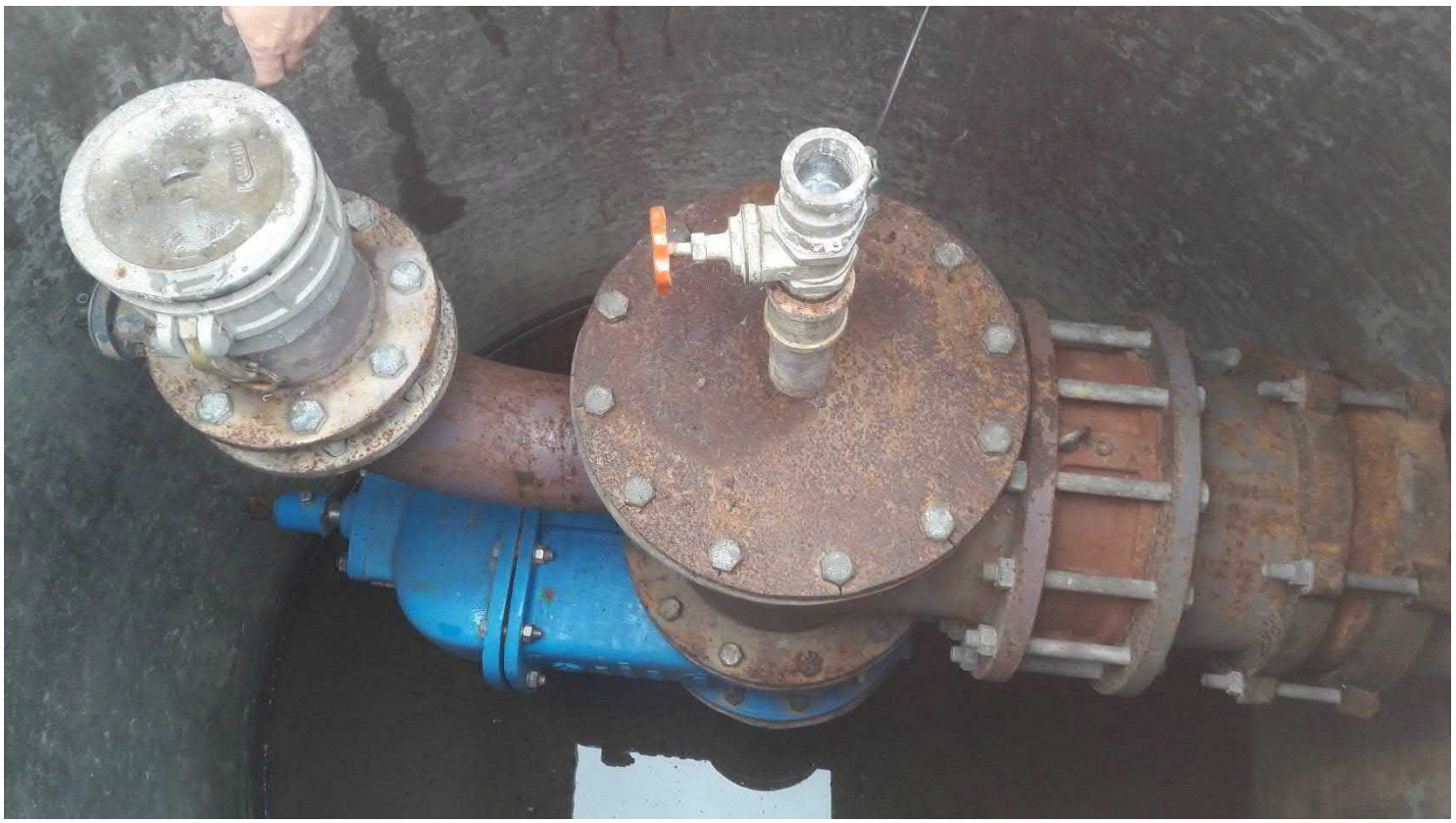
Report

Picton Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018



Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the wells supplying Picton Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used in this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Picton Pumping Station (Riccarton Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore logs as included in Appendix C
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Picton Pumping Station is supplied by three wells; Picton Wells 1 – 3. Each well feeds into a combined suction tank which then goes to the Pumping Station pump set. Table 2-1 summarises key information about the five wells.

Table 2-1: Picton Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M 35/8897	118-126	4
Well 2	M 35/8896	118-126	4
Well 3	M 35/8898	52.5-60.5	2

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The wells at Picton Pumping Station are screened within moderately-deep (Aquifer 2 – Linwood Gravel Aquifer) and deep (Aquifer 4 – Wainoni Gravel Aquifer) leaky (semi)-confined aquifers within the Christchurch Artesian Aquifer System.

4 Well Inspections

An inspections of each well was carried out on 7 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Andrew Batchelor (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Picton Wells 1 – 3 do not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 6-1 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Locate source of water in chamber and seal. The source is potentially the sample tap. ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	■ Cut back vegetation covering edge of well chamber		
Well 2	■ Install a downward facing air vent 0.5 m above 100 year flood level			

	First Priority	Second Priority	Third Priority	Ongoing
Well 3	■ Seal cable glands			
All wells	■ Install a sump pump (with a level sensor that alarms to an operator)	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.		■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device
General	■ Seal the cooling water line that is leaking on the diesel line. Fix any corrosion of the			

	First Priority	Second Priority	Third Priority	Ongoing
	diesel line that has already been caused.			

7 Conclusion

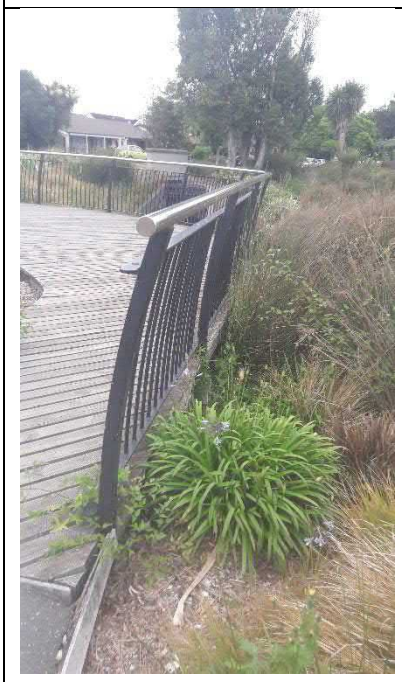
The information reviewed and the inspections carried out indicate that none of the Picton wells meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

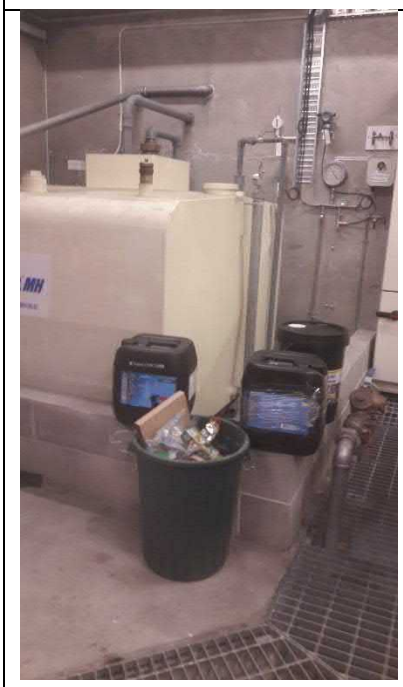
Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Picton
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
New filter wheels recently installed to make opening and closing filter trains easier	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Picton Wells 1 and 2 draw from Aquifer 4 (leaky (semi)-confined) Picton Well 3 draws from Aquifer 2 (leaky (semi)-confined)
Surface Water Ways, Drains, etc	Avon River tributaries
4. Photo Record and Comments	
Photo	Comment

	Pump station is located within a park
	Waterways designed for stormwater drainage are within the park

	Pump room
	Diesel storage tank within a bunded area

	Diesel lines within bunded concrete channel with sump pump installed
	Cooling water leaking on diesel line causing corrosion
	Four filters installed

5. Risks from Surrounding Environment

a) Within the site:				
Diesel/Chemical Storage	In pump station	☐ Underground √ Aboveground	Fuel lines	√ Underground √ Aboveground
Access by Animals	Locked building within a park. Filters are in a fenced area.			
Protection from vandalism, signs of vandalism	As above, no signs of vandalism			
Other Activities	N/A			
b) Immediate Neighbouring Land Use:				
Current Neighbouring Land Use	Park			
Significant Changes Since Previous Inspection	None identified			
Zoning of Neighbouring Land	Could not be confirmed on CCC's Planning Map			
c) Wider Environment:				
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Active consents for discharge of contaminated water and de-watering water within 400m Stormwater, diesel leak, animals Sewer nearby			
Risk of flood inundation	Some of the site is below the 50 year flood level and so there is the potential for flooding			
Potential sources of young water	No sources specific to the pumping station identified. See well assessments			
General land use in catchment (LLUR)	As below			
Contaminated sites (HAIL status)	None identified at the address of the wells			
Status and condition of surrounding wells (within 400 m radius)	Multiple wells			
Landfill	None identified			
6. Actions Arising				
Identify issues and rank them in terms of whether they require:				

First Priority	■ Seal the cooling water line that is leaking on the diesel line. Fix any corrosion of the diesel line that has already been caused.
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

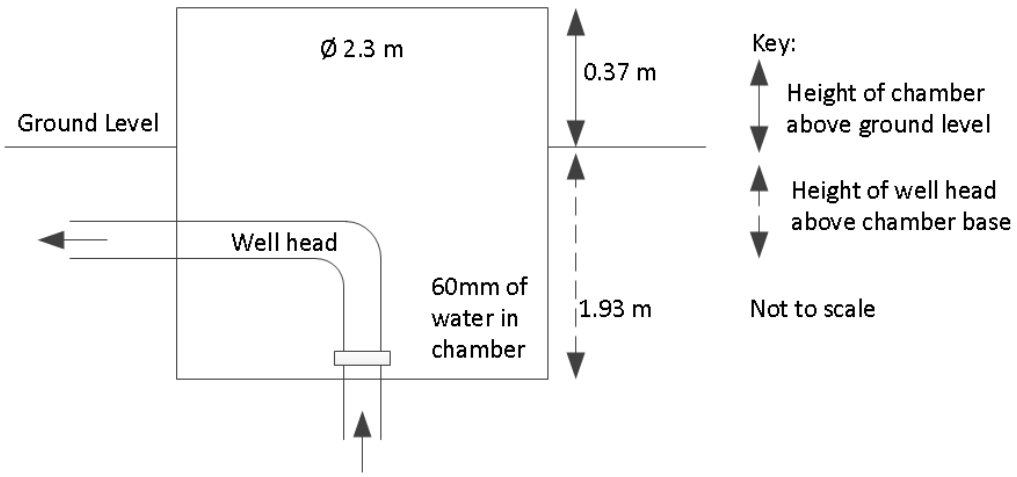
Picton Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Picton Well 1
ECan Well No.	M 35/8897
Aquifer No.	4
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	118 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	118-126
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	9 March 2001
Control System/Alarms	Pump failure

Type of Pump	None, artesian
Frequency of Pump Use	Runs everyday
4. Photo Record and Comments	
Photo	Comment
	Chamber is within a park and partially covered by vegetation
	Pipework has surface rust. Approximately 60mm of water in bottom of chamber.

	Sample tap discharges into chamber. This may be the source of the water in the bottom
	Surface rust on casing. Sump installed but no sump pump.
	Pipe penetration through chamber appears to be sealed.

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	No cables
	Pipework	Sealed with sidewall of chamber
	Well casing	Appears to be sealed from photos. Chamber could not be accessed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		Unknown Some of the site is below the 50 year flood level and so there is the potential for flooding. The flood level at this bore is not known
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Surface rust
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		No
Signs of ponding?		Only in the chamber

<table>
<tr><td>Access by animals</td><td>No fence to prevent access, in a park where cats and dogs would be common but livestock would be less likely</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Lid locked with padlock</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – butterfly valve installed (not tested)

Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel with minor pitting</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
</table>
</td></tr>
</table>

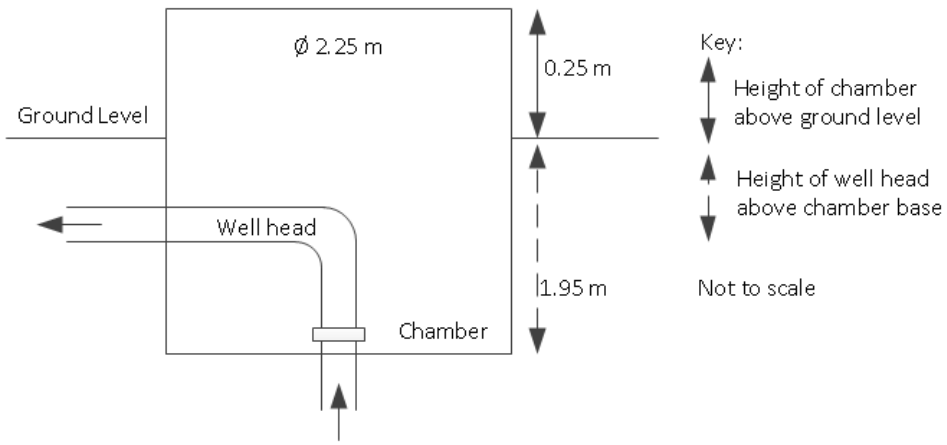
	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Roads and sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	60mm of water in chamber at time of inspection	
Is there a sump pump?	No sump pump but there is a sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Locate source of water in chamber and seal. The source is potentially the sample tap. ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the	

	contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Cut back vegetation covering edge of well chamber
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Picton Well 2

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Picton Well 2
ECan Well No.	M 35/8896
Aquifer No.	4
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	118 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	118-126
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	27 April 2001
Control System/Alarms	Pump failure
Type of Pump	None, artesian
Frequency of Pump Use	Runs everyday

4. Photo Record and Comments	
Photo	Comment
	Pipe work has some surface rust. Chamber is dry.
	Bore casing has some surface rust. Casing appears to be sealed with chamber floor.
	Pipe penetrations through chamber side wall are sealed
5. Diagram with Well Measurements	



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection		
a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	No cables
	Pipework	Sealed with sidewall of chamber
	Well casing	Appears to be sealed from photos. Chamber could not be accessed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		Unknown Some of the site is below the 50 year flood level and so there is the potential for flooding. The flood level at this bore is not known
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Surface rust
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		Yes

<table>
<tr><td>Signs of ponding?</td><td>Not at time of inspection. Waterway/drain is less than 1m away</td></tr>
<tr><td>Access by animals</td><td>No fence to prevent access, in a park where cats and dogs would be common but livestock would be less likely</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Lid locked with padlock. No signs of vandalism</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – butterfly valve installed (not tested)

Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel with minor pitting</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
</table>
</td></tr>
</table>

	No sump pump	Sump pump required
	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Roads and sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	None at the time of inspection	
Is there a sump pump?	No sump pump , but there is a sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the	

	contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

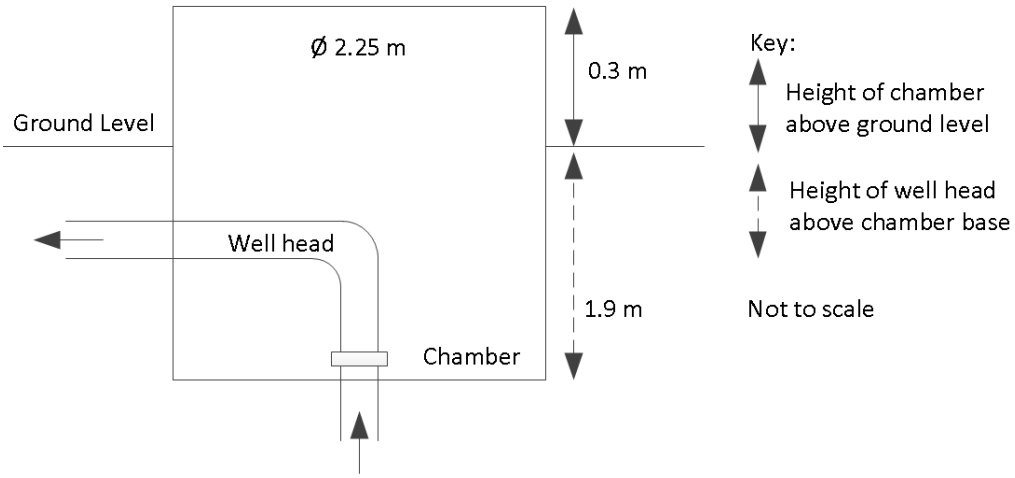
Picton Well 3

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Picton Well 3
ECan Well No.	M 35/8898
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	52.5 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	52.5-60.5
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	6 June 2001
Control System/Alarms	Pump failure
Type of Pump	Submersible
Frequency of Pump Use	Runs everyday

4. Photo Record and Comments	
Photo	Comment
	Condensation from the top of the chamber. Sump without a pump. Sump has water in it. Sample tap within chamber
	Cable entry at side wall is sealed
	Pipe penetration through side wall is sealed

	Casing appears to be sealed to chamber floor from photo.

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Cable gland not sealed
	Pipework	Sealed with sidewall of chamber
	Well casing	Appears to be sealed from photos. Chamber could not be accessed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		Unknown Some of the site is below the 50 year flood level and so there is the potential for flooding. The flood level at this bore is not known

Downward facing air vent 0.5m above 100 year flood level	Installed at lid level. Exact flood level at the well is unknown.
Type and condition of borehead pipework (above ground)	Surface rust
Raw Water sample port?	Yes, in chamber
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	Yes
Signs of ponding?	Not at time of inspection. Drain is less than 1m away
Access by animals	No fence to prevent access, in a park where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism	Lid locked with padlock. No signs of vandalism
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – butterfly valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Steel with minor pitting
Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No
Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?	No

<table>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Roads and sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>None at the time of inspection</td></tr>
<tr><td>Is there a sump pump?</td><td>No sump pump , but there is a sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>N/A</td></tr>
<tr><td>Does the well head meet the requirements of Criteria 2</td><td>No, see actions below</td></tr>
<tr><td colspan="2">7. Actions Arising</td></tr>
<tr><td colspan="2">Identify issues and rank them in terms of whether they require:</td></tr>
<tr><td>First Priority</td><td>■ Seal cable glands
■ Install a sump pump (with a level sensor that alarms to an operator)</td></tr>
<tr><td>Second Priority</td><td>■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected</td></tr>
</table>

	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable.
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

Figure 1: Summary of wells and consents within 400m of Picton Wells

Table 2: Summary of consents within 400m of Picton Wells

Picton Well Sites

Well Number:	M35/8897			
	Type	*Consent Number*	*Consent Status*	*Feature Type*
	Discharge to Water	NCY880140	Terminated - Replaced	Contaminated Water
	Discharge to Water	CRC971563	Terminated - Surrendered	Contaminated Water
	Discharge to Water	NCY730262	Terminated - Expired	Human Effluent
	Discharge to Water	CRC090465	Issued - Active	Contaminated Water
	Discharge to Water	NCY730263	Terminated - Surrendered	Human Effluent
	Discharge to Water	CRC147597	Issued - Active	De-watering Water
Well Number:	M35/8896			
	Type	*Consent Number*	*Consent Status*	*Feature Type*

Discharge to Water	NCY880140	Terminated - Replaced	Contaminated Water
Discharge to Water	CRC971563	Terminated - Surrendered	Contaminated Water
Discharge to Water	NCY730262	Terminated - Expired	Human Effluent
Discharge to Water	CRC090465	Issued - Active	Contaminated Water
Discharge to Water	NCY730263	Terminated - Surrendered	Human Effluent
Discharge to Water	CRC147597	Issued - Active	De-watering Water
Discharge to Water	NCY730264	Terminated - Surrendered	Human Effluent

Well Number: M35/8898

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	NCY880140	Terminated - Replaced	Contaminated Water
Discharge to Water	CRC971563	Terminated - Surrendered	Contaminated Water
Discharge to Water	NCY730262	Terminated - Expired	Human Effluent
Discharge to Water	CRC090465	Issued - Active	Contaminated Water
Discharge to Water	NCY730263	Terminated - Surrendered	Human Effluent
Discharge to Water	CRC147597	Issued - Active	De-watering Water

Appendix C

Bore Logs

65 Main North Road • Kaiapoi • Canterbury • New Zealand • Phone 64 3 327 4300 • Fax 64 3 327 7799

BORELOG

WELL OWNER	Christchurch City Council	PERMIT NUMBER	CRC010770
ADDRESS		BORE NUMBER	Bore 1
		GRID REFERENCE	M35/8897
LOCALITY	Picton Avenue		
DRILLER	T Smith	DRILLING DATE	9-MAR-01

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
0	0.5	Top Soil			
0.5	6.8	Grey Pug (some peat & timber)			
6.8	10.9	Loose Brown Stained Gravel			
10.9	18.3	Soft Grey Pug			
18.3	18.6	Peat & Timber			
18.6	22.7	Very loose Heavily Stained Brown Gravel			
22.7	25.2	Very Loose Clean Gravel (some heavy staining)			
25.2	28.9	Tight Sandy Gravel			
28.9	29.3	Very Loose Brown Stained Gravel			
29.3	30.3	Tight Sandy Gravel			
30.3	31.4	Very Loose Brown Stained Gravel			
31.4	32.4	Tight Sandy Gravel (yello clay seams)			
32.4	34.1	Tight Sandy Gravel Some Claybound			
34.1	38.3	Very Loose Stained Sandy Gravel			
38.3	40.3	Brown Sand (some gravel)			
40.3	41.4	Peat & Timber			
41.4	45.5	Grey Puggy W/B Sand			
45.5	47.6	Hard Silty Grey Pug			
47.6	49.4	Hard Sticky Orange/Yellow Clay			
49.4	51.0	Very Loose Brown Stained Gravel			
51.0	51.7	Loose Heavly Stained Brown Gravel			
51.7	52.3	Tight Sandy Gravel (traces of clay)			
52.3	56.8	Very Loose Stained Gravel			
56.8	57.3	Tight Gravel (traces of clay)			
57.3	58.4	Very Loose heavy Stained Gravel			
58.4	58.9	Tight Gravel with Hard Clay Seams			
58.3	61.2	Loose Brown Stained Gravel			
61.2	63.3	Water Bearing Gravel			
63.3	65.0	Tight Large Blue Gravel With Traces of Blue Pug			
65.0	65.3	Hard Dry Green Clay			
65.3	66.5	Large Blue Water Bearing Gravels with Traces of Green Clay			
66.5	71.0	Loose Blue Sandy Gravek			
71.0	71.3	Peat			
71.3	72.4	Grey Pug and Peat			
72.4	72.8	Clay Bound Gravel			

CLEMENCE DRILLING
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BORELOG

WELL OWNER	Christchurch City Council	PERMIT NUMBER	CRC010770
ADDRESS		BORE NUMBER	Bore 1
		GRID REFERENCE	M35/8897
LOCALITY	Picton Avenue		
DRILLER	T Smith	DRILLING DATE	9-MAR-01

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
72.8	78.2	Loose Brown Sandy Gravel			
78.2	78.6	Pale Yellow Clay			
78.6	79.5	Loose Brown Gravel			
79.5	80.6	Hard Yellow Clay			
80.6	81.2	Hard Blue Pug			
81.2	83.6	Soft Grey Pug			
83.6	86.2	Hard Silty Grey Pug			
86.2	89.2	Hard Silty Yellow Clay			
89.2	89.8	Hard Silty Grey Pug			
89.8	92.0	Hard Yellow Clay			
92.0	92.6	Claybound Gravel			
92.6	93.3	Brown Stained Gravel			
93.3	93.5	Yellow Clay Seam			
93.5	97.4	Brown Stained Gravel (very sandy)			
97.4	98.4	Loose Lightly Stained Sandy Gravel			
98.4	100.0	Tight Large Sandy Gravel			
100.0	102.1	Loose Heavily Stained Sandy Gravel			
102.1	102.3	Blue Cemented Gravels			
102.3	102.9	Grey Pug (traces of peat)			
102.9	107.6	Very Hard Silty Grey Pug			
107.6	108.7	Grey Pug			
108.7	109.0	Hard Dry Peat			
109.0	110.6	Hard Grey Pug			
110.6	110.8	Peat			
110.8	114.4	Hard Grey Pug			
114.4	116.0	Hard Yellow Clay			
116.0	117.4	Hard Clay Bound Gravel			
117.4	122.2	Tight Grey/Brown Sandy Gravel			
122.2	124.8	Small Grey/Brown Sandy Gravels			
124.8	125.6	Loose Lightly Stained Sandy Gravel			
125.6	126.5	Loose Brown Gravel (some dark staining)			
126.5	127.9	Tight brown Graqvel (traces of clay bound)			
127.9	128.3	Loose Rusty Brown Gravel			
128.3	128.7	Tight Grey Gravel			

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BORELOG

WELL OWNER	Christchurch City Council	PERMIT NUMBER	CRC010770
ADDRESS		BORE NUMBER	Bore 1
		GRID REFERENCE	M35/8897
LOCALITY	Picton Avenue		
DRILLER	T Smith	DRILLING DATE	9-Mar-01

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
128.7	128.9	Yellow Clay Seam			
128.9	129.1	Rusty Brown Gravel			
129.1	129.3	Clay & Gravel			
129.3	130.0	Yellow Clay Bound Sand			

Casing Diameter(mm)	300mm	Static Water Level +	4.1	Depth (m)	126.895
Screen Type	Houston Stainless Steel Wedge Wire		Set At	118	126
Screen Length (m)	8 mtrs	Sump .895mm		Leader	.825mm
Drawdown (m)		Pumping Hours at		Litres-Minute/Second	

Remarks	Freeflow at 9-3-01 52 Litres/Second
	Drawdown 1.380mm from static
	Oriface Height 1 mtr above groud

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BORELOG

WELL OWNER	Christchurch City Council	CONSENT NUMBER	CRC 010770
ADDRESS	P O Box 237	BORE NUMBER	Bore 2
	Christchurch	GRID REFERENCE	M35 | 8896
LOCALITY	Picton Avenue		
DRILLER	Tony Smith	DRILLING DATE	27-4-01

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
0	0.5	Soil			
0.5	6.35	Pug and peat			
6.4	10.5	Loose large gravel			
10.5	16.3	Grey pug			
16.3	17.5	Blue/grey gravel			
17.5	20.3	Loose brown gravel			
20.3	20.8	Heavily stained gravel (clay traces)			
20.8	27.9	Brown gravel			
27.8	30.5	Loose heavily stained gravel			
30.5	31.3	Tight heavily stained gravel (clay lumps)			
31.3	32.6	Loose stained gravel			
32.6	38.5	Brown water bearing gravel and sand			
38.5	39.7	Grey sand (some blue gravel)			
39.7	41.4	Grey pug and peat (some timber)			
41.4	43.9	Grey puggy sand (some shells)			
43.9	48.0	Silty grey pug			
48.0	48.9	Soft sticky yellow clay			
48.9	52.6	Tight large grey gravel			
52.6	56.3	Loose brown stained gravel			
56.3	57.5	Large sandy gravel			
57.5	60.9	Loose stained gravel			
60.9	63.2	Loose heavily stained gravel			
63.2	64.4	Hard yellow clay			
64.4	64.9	Hard blue pug			
64.9	68.3	Loose blue gravel			
68.3	71.0	Soft silty blue/grey pug (traces of peat)			
71.0	71.8	Peat			
71.8	72.0	Blue gravel seam			
72.0	72.4	Peat			
72.4	73.0	Clay bound gravel			
73.0	75.7	Very loose brown stained gravel			
75.7	75.9	Yellow clay seam			

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BORELOG

WELL OWNER	Christchurch City Council	CONSENT NUMBER	CRC010770
ADDRESS	P O Box 237	BORE NUMBER	Bore 2
	Christchurch City Council	GRID REFERENCE	M35 | 8896
LOCALITY	Picton Ave		
DRILLER		DRILLING DATE	

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
75.9	79.8	Loose brown gravel			
79.8	81.3	Hard sticky yellow clay			
81.3	84.6	Hard slity grey pug			
84.6	86.3	Sticky grey pug			
86.3	88.3	Hard sticky yellow clay			
88.3	89.9	Hard silty grey pug			
89.9	92.3	Hard sticky yellow clay			
92.3	94.1	Claybound gravel			
94.1	95.4	Loose stained gravel			
95.4	96.4	Med/ Large grey gravel			
96.4	96.6	Yellow clay seam			
96.6	100.2	Loose Med/Large stained gravel			
100.2	100.9	Loose Med/large grave (traces of claybound)			
100.9	101.4	Loosely claybound large gravel			
101.4	101.8	Tight blue gravel (blue clay traces)			
101.8	102.6	Tight large claybound gravel			
102.6	103.3	Hard silty blue pug			
103.3	104.2	Cemented blue claybound gravel			
104.2	104.9	Loose blue gravel (traces blue clay)			
104.9	108.2	Hard silty blue pug			
108.2	108.8	Peat			
108.8	114.2	Hard grey pug			
114.2	116.5	Hard yellow clay			
116.5	118.0	Cemented claybound gravel			

Casing Diameter(mm)		Static Water Level		Depth (m)	
Screen Type			Set At		
Screen Length (m)				Leader	
Drawdown (m)					

REMARKS _____

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BORELOG

WELL OWNER	Christchurch City Council	CONSENT NUMBER	CRC010770
ADDRESS	P O Box 237	BORE NUMBER	Bore 2
	Christchurch	GRID REFERENCE	M35|8896
LOCALITY	Picton Ave		
DRILLER		DRILLING DATE	

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
118.0	122.8	Loose lightly stained gravel with traces of clay			
122.8	124.1	Very loose lightly stained gravel			
124.1	125.8	Loose lightly stained gravel			
125.8	126.4	Very loose lightly stained gravel			
126.4	126.8	Very loose gravel progressively heavier staining			
126.8	127.0	Tight blue gravel			

Casing Diameter(mm)	.300mm	Static Water Level	4.380mtrPT	Depth (m)	127.mtrsPT
Screen Type	Houston Stainless Steel		Set At	118-126 mtrs	
Screen Length (m)	8 Mtrs Sump 1.035mtrs			Leader	.940mm
Drawdown (m)	4.95mtrs	Pumping @	6 Hours	80	Ltrs/Sec

REMARKS

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BORELOG

WELL OWNER	CHCH City Council	CONSENT NUMBER	CRC010770
ADDRESS	Tuam Street	BORE NUMBER	Number 3
		GRID REFERENCE	M35 8898
LOCALITY	Picton Avenue		
DRILLER	Tony Smith / Daniel Rodgers	DRILLING DATE	06-Jun-01

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from surface (m)		S/W Level
Top	Bottom				
0.0	0.4	Top soil			
4.0	6.5	Grey Pug / Lenses Peat & Timber			
6.5	13.8	Loose W/B Stained Gravel			
13.8	14.0	Yellow Clay Seam			
14.0	14.4	Loose Blue Gravel (Traces of Blue Pug)			
14.4	17.9	Soft Siltty Grey Pug & Sand (Some Timber)			
17.9	18.0	Sticky Blue Pug			
18.0	18.4	Peat			
18.4	30.4	Loose Stained Gravel			
30.4	31.0	Loose Stained Gravel (Traces of Clay)			
31.0	35.7	Loose Stained Sandy Gravel			
35.7	36.0	Hard Yellow Clay (Some Gravel)			
36.0	38.6	Loose Heavily Stained Sandy Gravel			
38.6	39.5	Very Loose Heavily Stained Gavel With Seams of Yellow Clay			
39.5	39.8	Grey Pug & Peat			
39.8	45.5	Grey Puggy Sand (Some Blue Gravel)			
45.5	48.8	Grey Pug (Traces of Peat)			
48.8	49.5	Yellow / Orange Clay			
49.5	51.4	Loose Lightly Stained Gravel (Some Large)			
51.4	52.7	Heavily Stained Loose Gravel			
52.7	55.5	Loose Lightly Stained Gravel			
55.5	55..7	Yellow Clay Seam			
55.7	60.5	Loose Gravel			

Casing Diameter(mm)	300 mls	Static water level	1.81	Depth(M	60.5 Meters
Screen Type	Houston Stainless Steel 120 Slot Wedge Wire		Set At		52.5 to 60.5
Screen Length (m)	8 Meters			Leader	.720
Drawdown (m)	2.12	Pumping 3 Hours	Hours @	50	Ltrs/Sec

REMARKS

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

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Report

Tara Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the well supplying Tara Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used in this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Tara Pumping Station (Riccarton Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore logs as included in Appendix C
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Tara Pumping Station is supplied by one well; Tara Well 4. Table 2-1 summarises key information about the well.

Table 2-1: Tara Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 4	M 35/6945	164.8-169.3	4

3 Hydrogeological Settling

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The well supplying Tara Pumping Station is screened

within deep (Aquifer 4 – Wainoni Gravel Aquifer) leaky (semi)-confined aquifer within the Christchurch Artesian Aquifer System.

4 Well Inspections

An inspection the well was carried out on 7 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Andrew Batchelor (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that the Tara Well does not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 6-1 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 4	■ Locate source of leak and seal. The source is potentially the sample tap, the ducts, from a hole behind the electrical cable, a leak from the lid or a leak at the chamber floor. ■ Seal chamber floor to prevent inundation of chamber from groundwater from the local near-surface groundwater ■ Seal cable entry points ■ Install backflow prevention device ■ Move sump pump to sit in sump and install	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Regrade site to promote flow of water away from chamber ■ Grout seals must be retrofitted.		■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

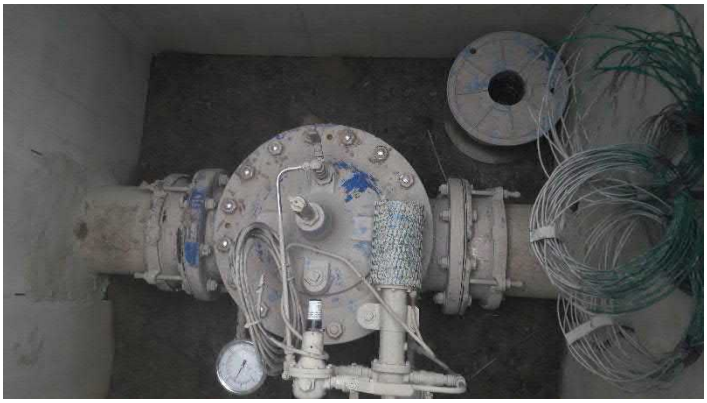
	First Priority	Second Priority	Third Priority	Ongoing
	level sensor with alarm to operator ■ Unblock the sump pump outlet ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways		
General		■ Clean up and seal valve chamber including sealing the chamber floor		

7 Conclusion

The information reviewed and the inspections carried out indicate that the Tara well does not meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix A

Inspection Reports



Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Tara
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Well draws from Aquifer 4 (leaky confined)
Surface Water Ways, Drains, etc	Avon River tributary flows through reserve
4. Photo Record and Comments	
Photo	Comment
	Valve chamber without a sealed floor

	Cable penetration in valve chamber appear to be unsealed from photos. Chamber could not be accessed
	Unsealed holes in valve chamber
	A second valve chamber

	New wastewater wet well being installed within the park
5. Risks from Surrounding Environment	
a) Within the site:	
Diesel/Chemical Storage	None ☐ Underground ☐ Aboveground; Fuel lines ☐ Underground ☐ Aboveground
Access by Animals	Usually not a fenced site, within a park. However at the time of inspection the park was closed and the area was fenced off for construction works. Locked building.
Protection from vandalism, signs of vandalism	As above, no signs of vandalism
Other Activities	N/A
b) Immediate Neighbouring Land Use:	
Current Neighbouring Land Use	Park
Significant Changes Since Previous Inspection	None identified
Zoning of Neighbouring Land	Open Space Community Parks Zone, Residential Suburban Density Transition Zone
c) Wider Environment:	

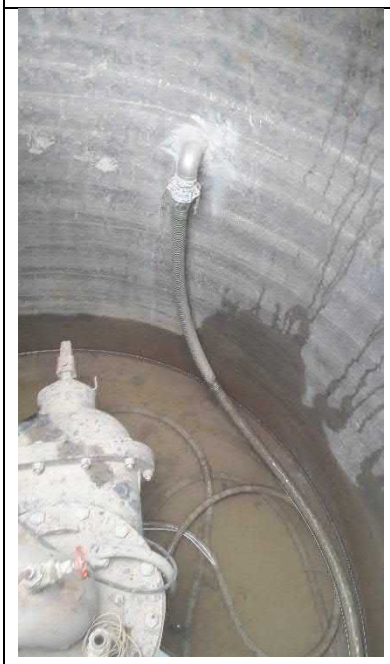
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Sewage main with air vents less that 100m away. Drains into creek. Deep wet well. Sewer nearby
Risk of flood inundation	Some of the site is below the 100 year flood level and so there is the potential for flooding
Potential sources of young water	No sources specific to the pumping station identified. See well assessments
General land use in catchment (LLUR)	As below
Contaminated sites (HAIL status)	None identified at the well and pump station address
Status and condition of surrounding wells (within 400 m radius)	Multiple wells
Landfill	None identified
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	■ Clean up and seal valve chamber including sealing the chamber floor
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

Tara Well 4

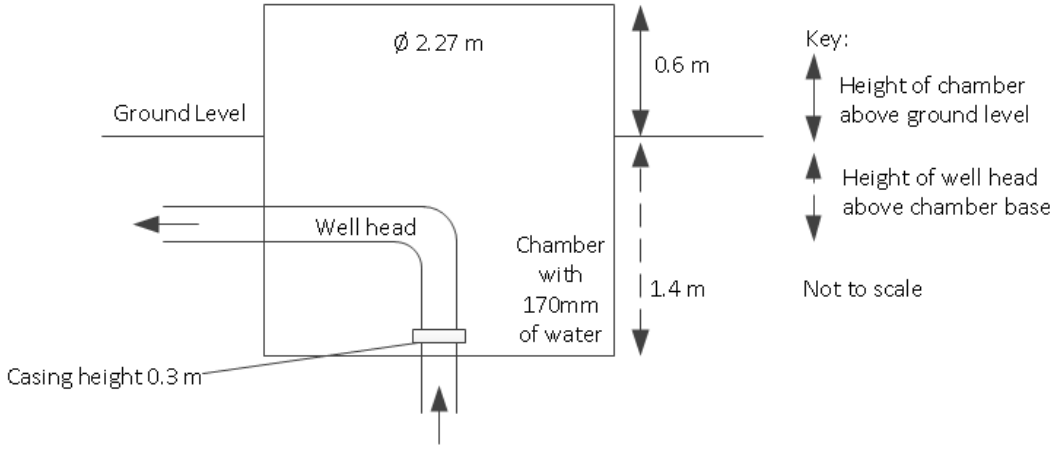
1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Tara Well 4
ECan Well No.	M 35/6945
Aquifer No.	4
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	164.8 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	164.8-169.3
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	1994
Control System/Alarms	Pump failure

Type of Pump	Submersible
Frequency of Pump Use	Daily in summer, weekly in winter
4. Photo Record and Comments	
Photo	Comment
	Well chamber is located on the side of the road within a park. Park was closed due to construction works at the time of inspection. Site grading does not promote the flow of water away from the chamber.
	Sample tap drains into chamber.
	Water in the bottom of the chamber (~170mm) which may be from the sample tap, the ducts, from a hole behind the electrical cable, lid or chamber floor. It is possible that the nearby construction work has had an effect on this.

	Pipe penetration through chamber wall is sealed. Leaking down from the top of the chamber
	Chamber wall penetration sealed
	Potential leak from behind the electrical cabinet. Note that the sump pump is not sitting in the sump.

	Casing may not be sealed to chamber floor. It appears that sediment is coming up from the ground below the chamber.
	Cable glands may not be sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
	Cabling	Cable gland not sealed
	Pipework	Sealed with sidewall of chamber

Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Well casing	Not sealed. It appears that sediment from the ground below is coming up into the chamber.
Any history of E. coli transgressions? Historical and current levels of total coliforms?		No E. coli transgressions recorded in the data received (dating back to 2012-13 FY). Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No – leaks described above Some of the site is below the 100 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed Air vent has been removed, this might be for the construction works
Type and condition of borehead pipework (above ground)		Good condition – minor rust
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		Yes
Signs of ponding?		Not at time of inspection
Access by animals		Usually not a fenced site, within a park. However at the time of inspection the park was closed and the area was fenced off for construction works. Locked building.
Protection from vandalism, signs of vandalism		As above, lid locked with padlock, no signs of vandalism
b) Drilling Standard:		
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?		No – unless on the pump (not confirmed) A pressure reducing valve is installed to reduce shock wave to the delicate Riccarton system, but no backflow prevention unless on the pump.
If not, has this been agreed with the DWA?		N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?		Yes – bore logs attached

<table>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Surface rust</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>No confirmed backflow prevention device</td><td>To be agreed</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Spills from road, animals and vandalism</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>~170mm of water at the time of inspection</td></tr>
<tr><td>Is there a sump pump?</td><td>Yes – but not working at the time of arrival despite the water in the chamber

Sump outlet is blocked due to construction works</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>Unknown</td></tr>
</table>

Sump pump operation method including start level	Unknown
Sump pump and/or level alarms	Unknown
Does the well head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Locate source of leak and seal. The source is potentially the sample tap, the ducts, from a hole behind the electrical cable, a leak from the lid or a leak at the chamber floor. ■ Seal chamber floor to prevent inundation of chamber from groundwater from the local near-surface groundwater ■ Seal cable entry points ■ Install backflow prevention device ■ Move sump pump to sit in sump and install level sensor with alarm to operator ■ Unblock the sump pump outlet ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Regrade site to promote flow of water away from chamber ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis

	■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

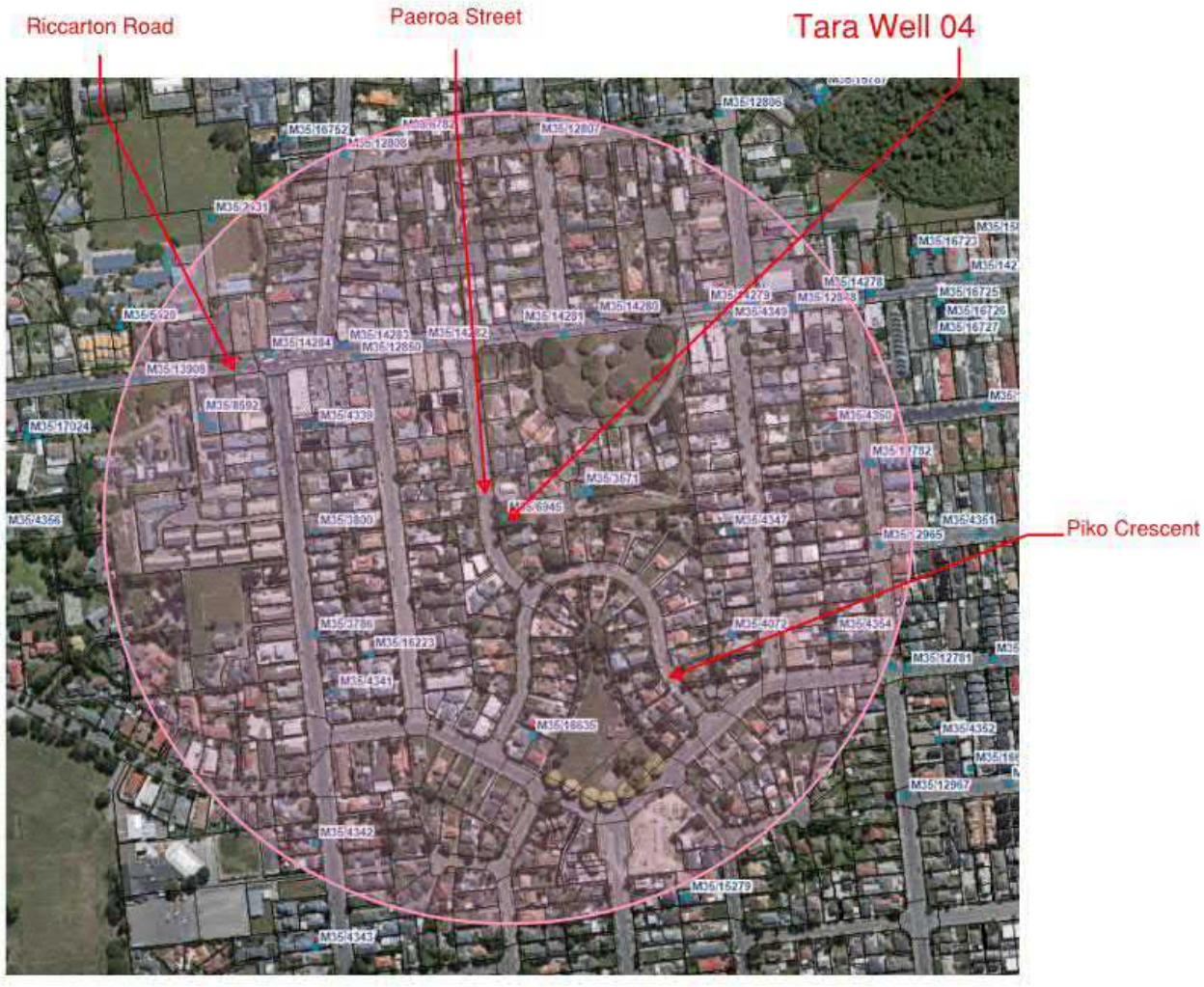


Figure 1: Summary of wells and consents within 400m of Tara Well

Table 2: Summary of consents within 400m of Tara Well

Tara Well Site

Well Number: M35/6945

Type	*Consent Number*	*Consent Status*	*Feature Type*
NO CONSENTS			

Appendix C

Bore Logs

P.O. Box 191
Kaiapoi
New Zealand

N.Z.D.F. member

Clemence Drilling Contractors Ltd

Mill Road, Ohoka, Canterbury, New Zealand

☎ (03) 312 6528
Fax (03) 312 6528
Mobile 025 320 147

Well Owner Christchurch City Council
Address Cambridge House
CHRISTCHURCH

Driller D.Clemence
Locality Paeroa Street Riccarton.

Permit Number
Bore Number Well 4
Water Right Number
Grid Reference
Drilling Date 1994

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from Surface (m)		Static water level
Top	Bottom		Top	Bottom	
0	0.3	Top soil and fill			
0.3	2.0	Yellow clay			
2.0	6.4	Blue clay streaked with peat			
6.4	7.1	Sloppy blue pug			
7.1	9.9	Hard blue/green clay			
9.9	11.8	clean stained gravel			
11.8	14.9	Big clean gravel			
14.9	17.0	Blue pug with peat and timber			
17.0	17.3	Blue pug with green sandy lenses			
17.3	17.5	Gravel and blue silt			
17.5	20.6	Loose brown stained gravel			
20.6	25.3	Good clean loose gravel			
25.3	26.8	Sandier large gravels heavy staining			
26.8	27.6	Tighter rough clay washed gravel			
27.6	30.9	Good loose gravel			
30.9	32.0	Yellow clay bound gravel			
32.0	33.4	Brown stained gravel			
33.4	33.8	Brown sand			
33.8	34.0	Yellow clay			
34.0	34.4	Peat impregnated with gravel			
34.4	36.0	Clean loose grey gravel			
36.0	36.7	Sandy rough broken gravel			
36.7	37.0	Blue clay			
37.0	37.4	Blue loose gravel			
37.4	37.8	Peat and timber			
37.8	40.0	Hard blue clay			
40.0	49.9	Tight sand heavy clay content			
49.9	50.5	Very tight silty blue pug			
50.5	51.4	Very tight yellow clay peat and gravel mixed			
51.4	56.0	Sandy stained clay washed gravel			
56.0	58.1	Very sandy stained gravel			

Casing Diameter (cm) Depth (m)
Screen type Set at
Screen Length (m) Static Water Level
Drawdown (m) After Hours Pumping at (litres sec/min)

Remarks (including notes on core samples taken)

P.O. Box 191
Kaiapoi
New Zealand

Clemence Drilling Contractors Ltd

☎ (03) 312 6528
Fax (03) 312 6528
Mobile 025 320 147

N.Z.D.F. member

Mill Road, Ohoka, Canterbury, New Zealand

Well Owner Christchurch City Council
Address Cambridge House
Christchurch

Driller D Clemence
Locality Paeroa St Riccarton

Permit Number
Bore Number
Water Right Number
Grid Reference
Drilling Date 20-5-94

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from Surface (m)		Static water level
Top	Bottom		Top	Bottom	
58.1	58.5	Yellow clay bound gravel			
58	59.5	Clean clay washed gravel			
59.5	59.9	Sand and gravel			
59.9	61.0	Brown sand			
61.0	62.4	Sandy loose stained gravel			
62.4	63.4	sandy well sorted gravel			
63.4	64.8	Yellow clay			
64.8	65.8	Loose small gravel and sand			
65.8	66.1	Very light sandy gravel			
66.1	67.0	Good loose gravel			
67.0	68.1	Brown tight stained gravel			
68.1	68.9	Blue gravel and clay			
68.9	71.9	Peat			
71.9	72.3	Blue clay bound gravel			
72.3	74.8	Loose sand and stained gravel			
74.8	79.0	Tight clay bound gravel			
79.0	80.4	Good loose well sorted gravel			
80.4	81.4	Loose gravel with clay seams			
81.4	82.4	Good loose gravel			
82.4	83.5	Yellow clay			
83	90.0	Blue pug / clay			
90.0	90.4	Blue and yellow clay			
90.4	91.2	Yellow clay bound gravel			
91.2	93.5	Good clean gravel			
93.5	93.9	Sandy gravel and clay seams			
93.9	94.8	Silty claybound gravel			
94.8	95.4	Clean gravel			
95.4	96.2	Very sandy tight gravel			
96.2	98.6	Progressivly more stained gravel/sticky clay seams			
98.6	99.1	Rough silty claybound stained gravel			
99.1	101.5	Brown gravel and sand			

Casing Diameter (cm) Depth (m)
Screen type Set at
Screen Length (m) Static Water Level
Drawdown (m) After Hours Pumping at (litres sec/min)

Remarks (including notes on core samples taken)

P.O. Box 191
Kaiapoi
New Zealand

N.Z.D.F. member

Clemence Drilling Contractors Ltd

Mill Road, Ohoka, Canterbury, New Zealand

☎ (03) 312 6528
Fax (03) 312 6528
Mobile 025 320 147

Well Owner Christchurch City Council
Address Cambridge House
CHRISTCHURCH

Driller D Clemence
Locality Paeroa ST Riccarton

Permit Number
Bore Number
Water Right Number
Grid Reference
Drilling Date 20-5-94

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from Surface (m)		Static water level
Top	Bottom		Top	Bottom	
101.5	102.1	Sandy stained gravel			
102.1	102.6	Good loose gravel			
102.6	104.0	Tight sandy stained gravel			
104.0	104.7	Blue clay bound gravel			
104.7	104.9	Blue clay and peat			
104.9	106.2	Yellow clay			
106.2	107.5	Rust stained gravel			
107.5	108.8	Tight sandy clay washed gravel			
108.8	112.0	Good gravel			
112.0	112.2	Clay bound stained gravel			
112.2	113.8	Yellow clay and timber			
113.8	114.2	Blue pug			
114.2	115.0	Yellow clay bound gravel			
115.0	115.6	Yellow clay and timber			
115.6	116.1	Very tight clay bound gravel			
116.1	116.4	Good grey gravel			
116.4	117.3	Sandy gravel lots of fragmented timber			
117.3	117.6	Very tight clay bound gravel			
117.6	119.2	Stained sandy gravel			
119.2	122.5	Good clean gravel			
122.5	125.0	Sandy gravel stained			
125.0	125.6	Cleaner stained gravel			
125.6	126.3	Rust stained sandy gravel			
126.3	126.8	Good loose stained gravel			
126.8	127.1	Rough sandy gravel			
127.1	127.6	Good clean stained gravel			
127.6	127.8	Yellow clay			
127.8	128.1	Blue gravel			
128.1	128.5	Blue clay bound gravel			
128.5	129.8	Dry grey silt/organic material			
129.8	130.7	Blue/grey clay			

Casing Diameter (cm) Depth (m)
Screen type Set at
Screen Length (m) Static Water Level
Drawdown (m) After Hours Pumping at (litres sec/min)

Remarks (including notes on core samples taken)

P.O. Box 191
Kaiapoi
New Zealand

N.Z.D.F. member

Clemence Drilling Contractors Ltd

Mill Road, Ohoka, Canterbury, New Zealand

☎ (03) 312 6528
Fax (03) 312 6528
Mobile 025 320 147

Well Owner Christchurch City Council
Address Cambridge House

Driller D Clemence
Locality Paeroa St Riccarton

Permit Number
Bore Number
Water Right Number
Grid Reference
Drilling Date 20-5-94

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from Surface (m)		Static water level
Top	Bottom		Top	Bottom	
13[illegible]7	133.4	Peat			
133.4	135.0	Grey soft clay			
135.0	135.6	Peat			
135.6	136.1	Blue clay			
136.1	136.3	Very tight clay bound gravel			
136.3	136.6	Clean loose gravel			
136.6	136.9	Tighter gravel some clay			
136.9	137.5	Good loose gravel			
137.5	137.8	Sandy claywashed gravel			
137.8	140.3	Good reasonably clean gravel			
140.3	140.8	Good clean gravel clay lense			
140.8	142.0	Good gravel			
142.0	142.5	Sandier gravel			
142.5	143.0	Sandier gravel			
143.0	143.7	Brown gravel stained and sand			
143.7	144.8	Yellow clay			

deepened further
Refer Next Page

Casing Diameter (cm) 300mm Depth (m) ~~143mtrs~~
Screen type Houston stainless steel wedgewire Set at ~~137-143~~
Screen Length (m) 6mtrs 2.6mm slot 950mm leader Static Water Level +3.210
Drawdown (m) After ~~Hours~~ Pumping at (litres sec/min)

Remarks (including notes on core samples taken)

CLEMENCE DRILLING CONTRACTORS LIMITED

Mill Road, Ohoka
P.O. Box 191, Kaiapoi, Canterbury, New Zealand
Tel 0064-033126528 Fax 0064-033126528

HOUSTON
HOUSTON WELL SCREEN CO

N.Z.D.F.
Member

Well Owner Christchurch City Council
Address Cambridge House
Christchurch

Driller D. Clemence
Locality Paeroa Street, Riccarton
Christchurch

Permit Number
Bore Number
Water Right Number
Grid Reference
Drilling Date 8-11-94

Strata			Details of Aquifers		
Depth from Surface (m)			Depth from Surface (m)		Static water level
	Bottom		Top	Bottom	
142.0	144.4	Brown gravel			
144.4	145.2	Tight claybound gravel mainly clay			
145.2	147.0	Tight yellow clay			
147.0	148.0	Brown stained gravel			
148.0	149.2	Tight silty claybound gravel			
149.2	149.6	Silty loose claybound gravel white clay seam			
149.6	150.5	Very sandy claywashed gravel			
150.5	151.0	Loose claywashed stained gravel			
151.0	159.6	Yellow clay			
159.6	160.7	Good loose gravel			
169.7	161.2	Sandy grey gravel			
161.2	162.8	Yellow clay			
162.8	163.4	Very tight claybound gravel			
163.4	164.8	Good loose gravel small lense clay (yellow)			
164.8	165.7	Sandy gravel			
165.7	167.7	Sandy gravel			
167.7	170.3	Good clean gravel			
170.3	171.9	Sandy gravel			
[illegible].9	174.0	yellow/blue clay bands peat			
174.0	174.7	yellow clay			
174.7	175.8	Yellow claybound gravel			
175.8	176.4	Loose stained gravel			
176.4	178.0	Loose clean gravel			
178.0	178.3	Loose blue gravel			
178.3	180.9	Blue pug and peat			

Casing Diameter (cm) 300mm Depth (m) 169.3m
Screen type Houston Stainless steel wedgewire Set at 164.8 - 169.3m
Screen Length (m) 4.5m 2.6mm slot 950mm leader 500 sump Static Water Level 4.3m above ground level
Drawdown (m) See attached page After Hours Pumping at (litres sec/min)

Remarks (including notes on core samples taken) Withdrew casing to 169.3m. Gravel packed and grouted. Installed screen.

CLEMENCE DRILLING CONTRACTORS LIMITED

HOUSTON
HOUSTON WELL SCREEN CO

Mill Road, Ohoka
P.O. Box 191, Kaiapoi, Canterbury, New Zealand
Tel 0064-033126528 Fax 0064-033126528

N.Z.D.F.
Member

17th February 1995

Bruce Henderson
Headworks Manager
Water Supply Unit
Cambridge House
CHRISTCHURCH

PAEROA/TARA STREET WELL
TEST PUMP AND FREE FLOW

Pumped using surface pump. 8 x 6 Ajax. Static water level + 4.3metres.

FLOW	DRAWDOWN	FREEFLOW	DRAWDOWN FROM STATIC + 4.3 METRES A.G.L.
38 l/sec	4 metres	7 l/sec	.3metres
45 l/sec	5 metres	9 l/sec	.9 metres
52 l/sec	6 metres	15 l/sec	1.35 metres
57 l/sec	7 metres	21 l/sec	2.00 metres
62 l/sec	8 metres	24 l/sec	2.50 metres
65 l/sec	9 metres	32 l/sec	3.20 metres
68 l/sec	9.5 metres		

Constant testpump after 5.5 hours at 68 l/sec, drawdown 9.1metres.
Freeflow at wellhead - 38 l/sec

Freeflow test - 24 hours.
At start of test: 32 l/sec drawdown 3.0 metres
After 24 hours: 30 l/sec drawdown 3.2 metres

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

www.ch2mbeca.com

Report

Wainui Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the well supplying Wainui Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
  - Hydrogeological Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Risks from Surrounding Environment
  - Actions Arising
- Individual Well Head Inspection Reports – Appendix A
  - Well Details
  - Photo Record, made at the time of inspection unless otherwise indicated
  - Diagram with measurements
  - Assessment of DWSNZ Criterion 2
  - Actions Arising

The following acronyms are used in this report:

- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Wainui Pumping Station (Banks Peninsula)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Bore log from ECan's website as included in Appendix C - https://www.ecan.govt.nz/gis-mapping/
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Wainui Pumping Station is supplied by a single well. This well, Wainui Well, services the Wainui Pressure Zone. The pump station is approximately 1km from Akaroa Harbour.

Table 2-1:Wainui Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Wainui Well	N 36/0048	No Screen Data	BPS

3 Hydrogeological Setting

The aquifer system at Wainui consists of fractured Akaroa Volcanics which is likely to be an unconfined to leaky (semi)-confined aquifer.

4 Well Inspections

An inspection of the well was carried out on 8 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Matthew Thomas (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Wainui Well does not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 6-1 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 6-1: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Wainui Well	■ Check to see if the pump has a compliant backflow prevention device, otherwise agree requirements with the DWA and install a device if required ■ Seal cable glands and penetration through wall ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area) ■ Install mesh on drain hole for vermin control ■ Add additional drainage holes (or enlarge existing) with mesh for vermin control	■ Rust prevention and tidy up of pipework ■ Regrade concrete around chamber to promote drainage ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways		■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

7 Conclusion

The information reviewed and the inspections carried out indicate that the Wainui well does not meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Wainui
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2017
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	Draws from a fractured volcanic aquifer. Unconfined to leaky (semi)-confined.
Surface Water Ways, Drains, etc	Wainui Stream
4. Photo Record and Comments	
Photo	Comment
	Pump station and wellhead are located adjacent to the road in a park

	One cartridge filter in the pump station building. No information on how often it is maintained.
5. Risks from Surrounding Environment	
a) Within the site:	
Diesel/Chemical Storage	None ☐ Underground ☐ Aboveground; Fuel lines ☐ Underground ☐ Aboveground
Access by Animals	Not a fenced site but a locked and alarmed building
Protection from vandalism, signs of vandalism	As above, no signs of vandalism
Other Activities	N/A
b) Immediate Neighbouring Land Use:	
Current Neighbouring Land Use	Playground and carpark
Significant Changes Since Previous Inspection	None identified
Zoning of Neighbouring Land	Rural Banks Peninsula Zone
c) Wider Environment:	
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Young Men's Christian Association has a consent to discharge human effluent to land ~100m away
Risk of flood inundation	No detailed flood modelling in area. Unlikely to flood from visual inspection of site grading.

Potential sources of young water	No sources specific to the pumping station identified. See well assessment
General land use in catchment (LLUR)	As below
Contaminated sites (HAIL status)	None identified at the address of the well and pump station
Status and condition of surrounding wells (within 400 m radius)	None identified
Landfill	None identified
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

Well Head Protection Assessment – Individual Well Heads

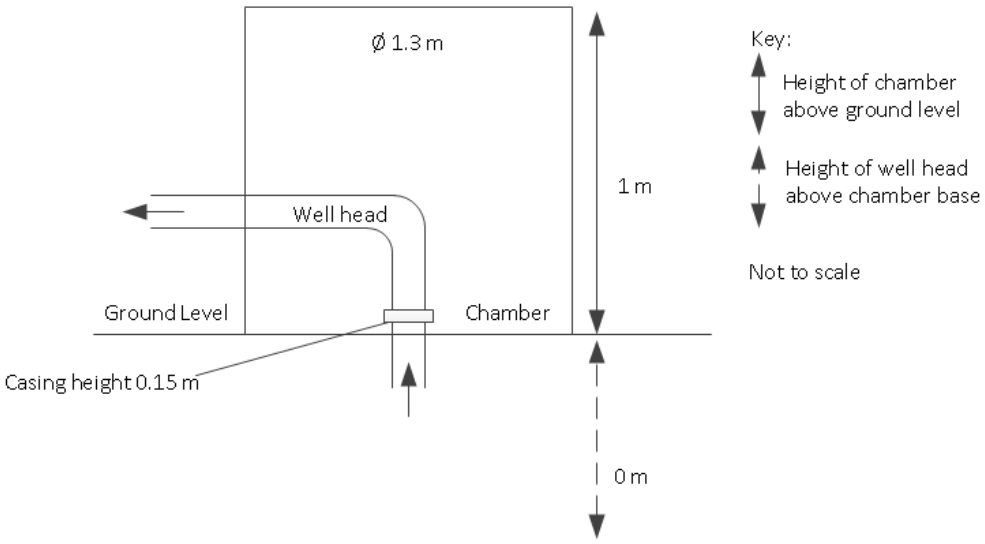
Wainui Well

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Wainui Well
ECan Well No.	N 36/0048
Aquifer No.	BPS
Date of Inspection/Assessment	8 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Matthew Thomas
Date of Previous Inspection/Assessment	2 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Above
Depth (mbgl)	91.7 (depth from bore log, casing depth unknown)
Casing Diameter (mm)	200
Screen Interval (mbgl)	No Screen Data
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	14 August 1996
Control System/Alarms	Well pump on/off, lid opening alarm

Type of Pump	Submersible
Frequency of Pump Use	Continuous
4. Photo Record and Comments	
Photo	Comment
	200mm casing and bore head. Headworks is rusty (especially cap)
	Drain on chamber, no mesh for vermin control
	Cable penetration through wall not sealed
	Cable gland not sealed

	Well casing has some surface rust. Appears to be sealed with chamber floor
	No vermin control on drain hole

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection		
a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Cable gland not sealed
	Pipework	Appears to be sealed with sidewall of chamber
	Well casing	Appears to be sealed with chamber floor
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions at the well. Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Steel, rusty
Raw Water sample port?		Yes, in cabinet of building
Concrete apron sloped to drain away from well?		No, well and building are not at a low point
100mm step above ground level?		Yes
Signs of ponding?		Not at time of inspection
Access by animals		No fence to prevent access, in a park where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism		Lid access alarm installed. Lid locked with padlock. No signs of vandalism
b) Drilling Standard:		
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?		No – possible installed on the pump but this has not been confirmed Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.

<table>
<tr><td>If not, has this been agreed with the DWA?</td><td>Unknown</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Steel with surface rust</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>No 5m fence to prevent animal access</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>No confirmed backflow prevention device</td><td>To be agreed</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Well and pump station are in a park near a parking lot. There is the potential for a spill of gas or other liquid to enter the well.

Roads and sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>None present at the time of inspection. A drain hole is installed</td></tr>
<tr><td>Is there a sump pump?</td><td>No pump or sump</td></tr>
</table>

Are there duty/standby sump pumps?	No
Sump pump testing, include date a method	N/A
Sump pump operation method including start level	N/A
Sump pump and/or level alarms	N/A
Does the well head meet the requirements of Criteria 2	No, see actions below
7. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	■ Check to see if the pump has a compliant backflow prevention device, otherwise agree requirements with the DWA and install a device if required ■ Seal cable glands and penetration through wall ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area) ■ Install mesh on drain hole for vermin control ■ Add additional drainage holes (or enlarge existing) with mesh for vermin control
Second Priority	■ Rust prevention and tidy up of pipework ■ Regrade concrete around chamber to promote drainage ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

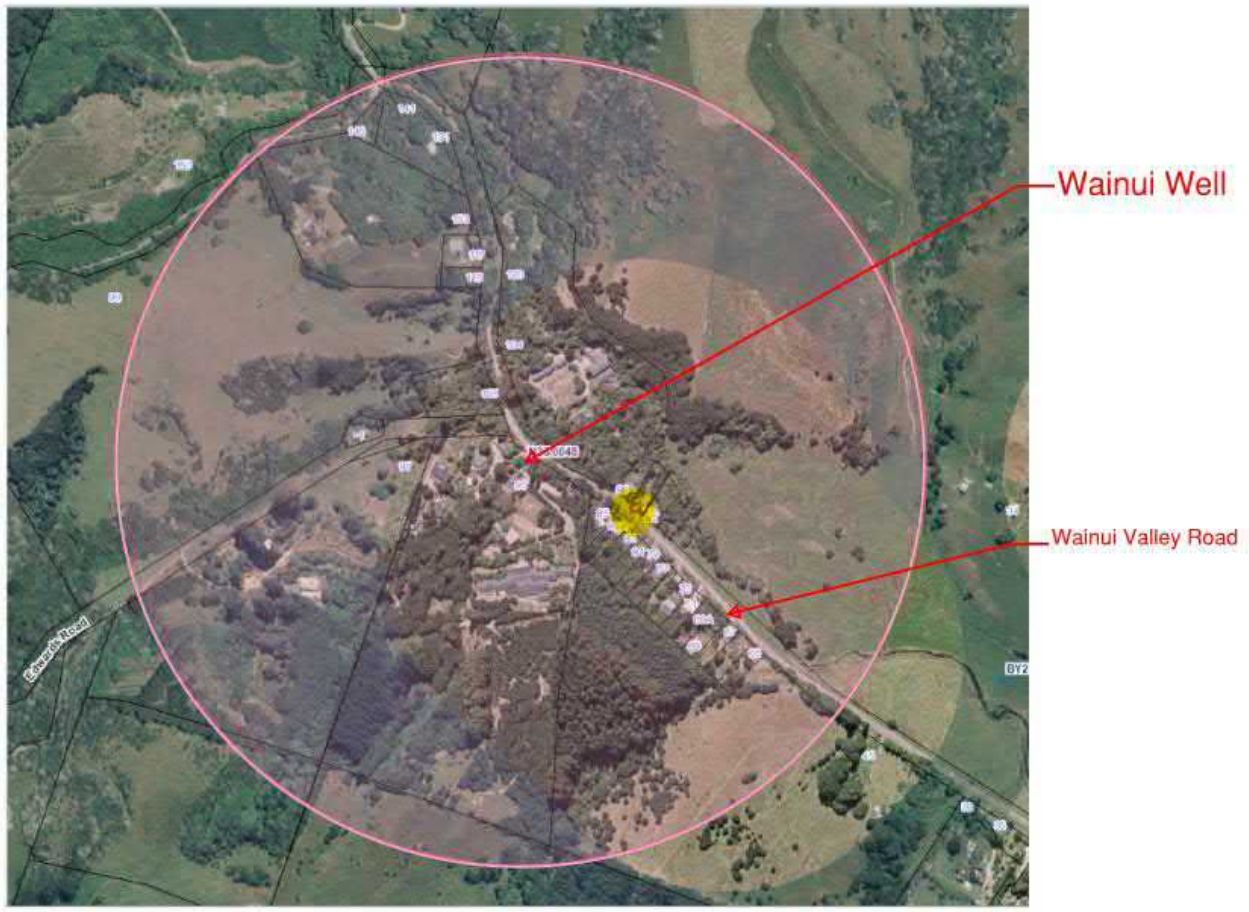


Figure 1: Summary of wells and consents within 400m of Wainui Well

Table 2: Summary of wells and consents within 400m of Wainui Well

Wainui Well Site

Well Number: N36/0048

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Land	CRC950353	Issued - Active	Human Effluent

Appendix C

Bore Logs

Bore or Well No	N36/0048
Well Name	WAINUI VALLEY ROAD
Owner	Christchurch City Council

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	N36/0048	**File Number**	CO6C/12030
Owner	Christchurch City Council	**Well Status**	Active (exist, present)
Street/Road	WAINUI VALLEY ROAD	**NZTM Grid Reference**	BY25:91479-48947
Locality	WAINUI	**NZTM X and Y**	1591479 - 5148947
Location Description		**Location Accuracy**	1 - 2m
CWMS Zone	Banks Peninsula	**Use**	Public Water Supply,
Groundwater Allocation Zone	Outside	**Water Level Monitoring**	--
Depth	91.70m	**Water Level Count**	0
Diameter	200mm	**Initial Water Level**	2.50m below MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	31.63m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	12	**Calc Min 95%**	
Aquifer Name	Banks Peninsula Volcanics	**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	1
Drill Date	14 Aug 1996	**Max Tested Yield**	6 l/s
Driller	McMillan Drilling Ltd	**Drawdown at Max Tested Yield**	77 m
Drilling Method	Rotary Rig	**Specific Capacity**	0.07 l/s/m
Casing Material	STEEL	**Last Updated**	08 Nov 2013
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

No screen data for this well

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
14 Aug 1996	1	5.7	75.2296448	76.85	26

Comments

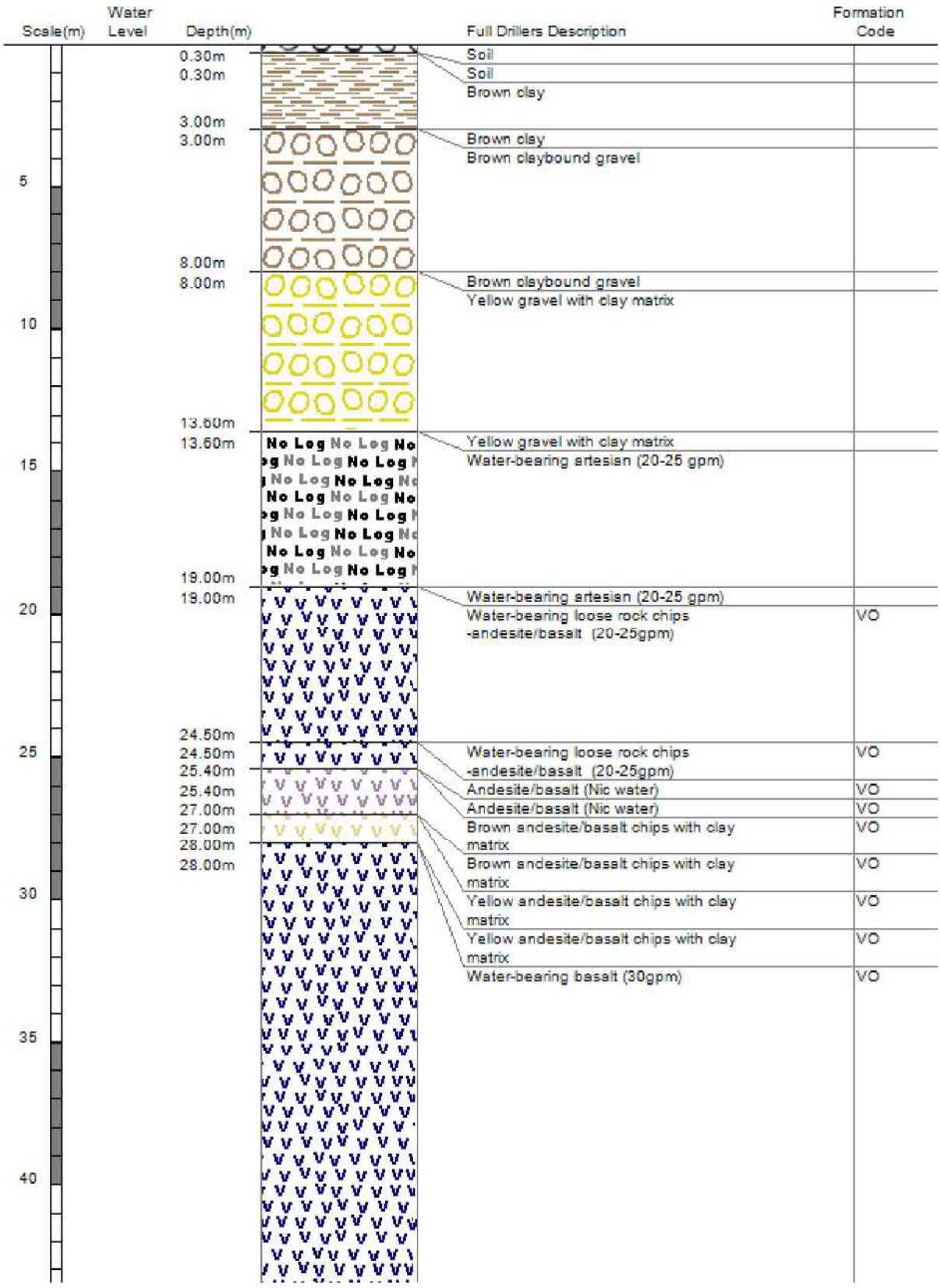
Comment Date	Comment
	FROM OLD CWS DB Located on Wainui Valley Rd, at entrance to the YMCA camp, on south side of the rd. Next to well is a pump shed & small water storage tank. Well not enclosed or fenced.
21 Mar 2000	FROM OLD CWS DB Surrounding area grassed with trees & above land used for camping facilities, cabins etc. GRID REF: N36:01487-10545. CCC Wn Wainui Valley 1 Stn Well-01
10 Dec 2001	css 193
10 Dec 2001	200mm casing to 13.65m & 100mm casing to 28.82m.
19 May 2010	Added well to CCC large water user

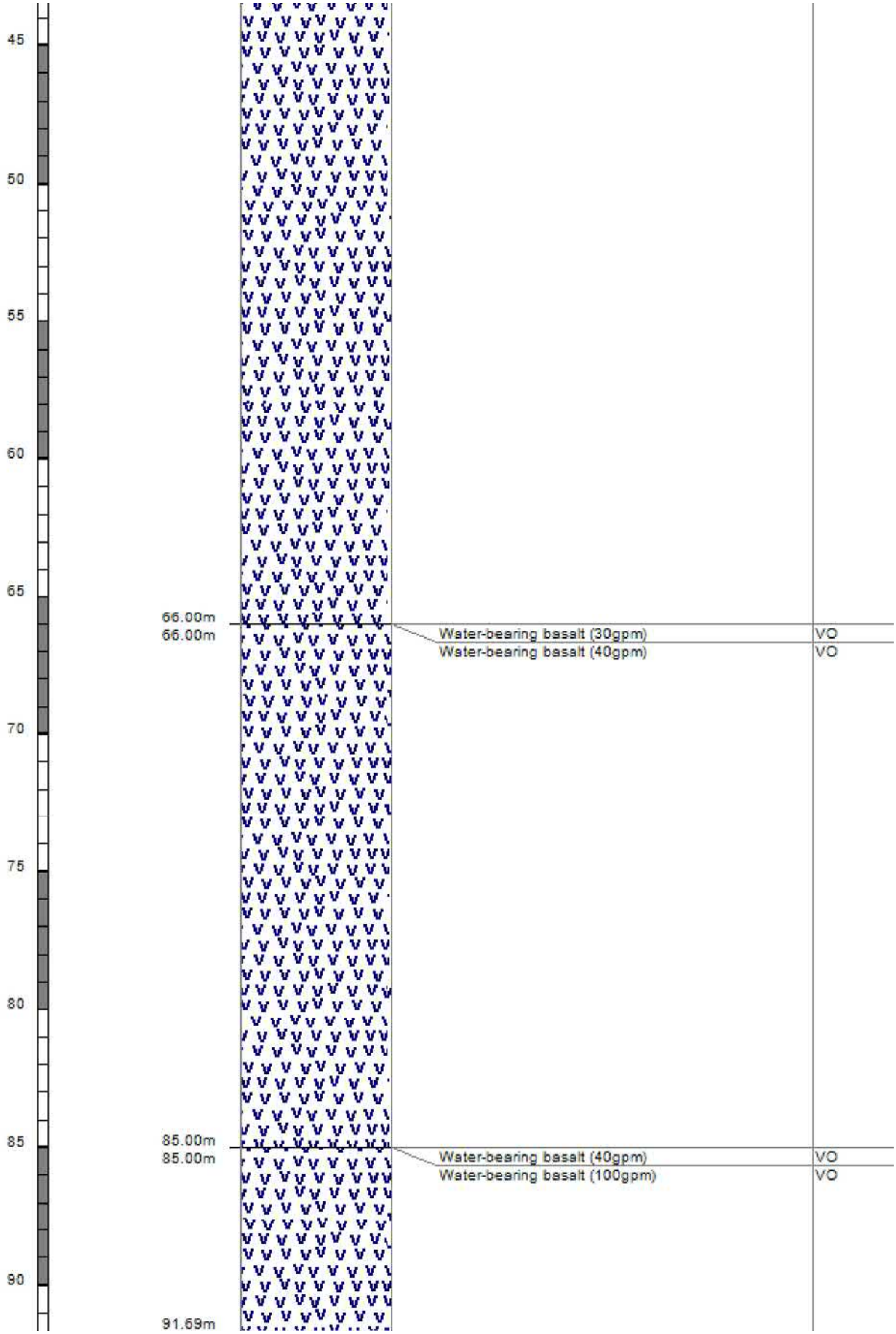
Bore Log

Borelog for well N36/0048

Grid Reference (NZTM): 1591479 mE, 5148948 mN
Location Accuracy: 1 - 2m
Ground Level Altitude: 31.6 m +MSD Accuracy: < 0.5 m
Driller: McMillan Drilling Ltd
Drill Method: Rotary Rig
Borelog Depth: 91.7 m Drill Date: 14-Aug-1996

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




45
50
55
60
65
66.00m
66.00m
Water-bearing basalt (30gpm)
VO
Water-bearing basalt (40gpm)
VO
70
75
80
85
85.00m
85.00m
Water-bearing basalt (40gpm)
VO
Water-bearing basalt (100gpm)
VO
90
91.69m

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace

Report

Sockburn Well Head Protection Assessment

Prepared for Christchurch City Council

Prepared by CH2M Beca Ltd

23 January 2018

Revision History

Revision Nº	Prepared By	Description	Date
A	**Lisa Mace / Mike Thorley**	Draft for Client Review	14 December 2017
B	Lisa Mace / Mike Thorley	Final version	22 January 2018
C	Lisa Mace / Mike Thorley	Incorporating final changes	23 January 2018

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Lisa Mace / Mike Thorley**		23 January 2018
Reviewed by	**Andrew Watson**		23 January 2018
Approved by	**Paul Reed**		23 January 2018
on behalf of	CH2M Beca Ltd		

Contents

Appendices

1 Preamble

Christchurch City Council (CCC) commissioned CH2M Beca Ltd (CH2M Beca) to carry out a review of 25 water supply wells at 9 primary water supply pump stations against *Bore Water Security Criterion 2 (bore head must provide satisfactory protection)* of the Drinking Water Standards New Zealand 2005 (revised 2008) (DWSNZ). The scope of works included inspecting the bores and determining their compliance with Criterion 2, recommending upgrades to improve bore head protection and DWSNZ compliance, and summarising the findings with one report per water scheme. This report summarises the findings for the wells supplying Sockburn Pumping Station.

Criterion 2 from section 4.5 of DWSNZ states:

> ***4.5.2.2 Bore water security criterion 2: bore head must provide satisfactory protection***
>
> *The bore head must be judged to provide satisfactory protection by a person recognised as an expert in the field.*
>
> *The bore head must be sealed at the surface to prevent the ingress of surface water and contaminants, and the casing must not allow ingress of shallow groundwater. Animals must be excluded from within 5 m of the bore head.*
>
> *The bore construction must comply with the environmental standard for drilling soil and rock (NZS 4411, Standards New Zealand (2001)), including providing an effective backflow prevention mechanism, unless agreed by the DWA.*
>
> *The supply's PHRMP must address contaminant sources and contaminant migration pathways.*
>
> *Potential sources of contamination such as septic tanks or other waste discharges must be situated sufficiently far from the bore so contamination of the groundwater cannot occur (for further discussion, see the Guidelines, section 3.2.3).*

Note that in order to be classified as "secure", a groundwater supply must show compliance with the DWSNZ Criterion 1, 2 and 3. This assessment only includes findings associated with Criterion 2.

The assessment contains the following sections:

- Body of report
  - This is a summary of information from the Inspection Reports located in Appendix A. It includes a summary of recommendations.
- Location maps – Appendix B
- Pumping Station Inspection Report – Appendix A
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- WSP – Water Safety Plan
- DWA – Drinking Water Assessor
- ADWCRs – Annual Drinking Water Compliance Reports
- WTP – Water Treatment Plant

In addition to information collected during the site visits, the following documents were used to prepare this report:

- The previous inspection report – "Well Head Security Report for Christchurch City Council Sockburn Pumping Station (West Pressure Zone)"
- A summary sheet of the wells to be inspected including information such as the ECan Well ID – "FY 2017 – 18 Wellhead Security Assessments"
- Original bore logs (Wells 1, 3,4, 5 and 6) as included in Appendix C
  - Note that that bore log labelled Well 2 has been assumed to be mislabelled and should actually be Well 1. This correction aligns the bore logs with the summary sheet
- Bore logs from ECan's website (Well 2) as included in Appendix C - https://www.ecan.govt.nz/gis-mapping/
- Canterbury maps website - https://mapviewer.canterburymaps.govt.nz/
- WSP (requested from CCC)
- ADWCRs (requested from CCC)

We note that the Stage 2 report from the Havelock North Drinking Water Inquiry was published on 6 December 2017. Its recommendations include abolishing the secure classification system forthwith. Given that the Government's formal response to the recommendations is not expected until February, we have not taken into account the Inquiry's specific recommendations. However, Recommendation 50 is of particular relevance. It states:

"DWA should ensure special attention is given to the risk of existing bores with below-ground headworks in future WSPs. Appropriate mitigation measures should be implemented, including treatment and raising them where practicable."

This recommendation has been considered in this report. We note that the Inquiry also recommends that treatment is mandated but this is beyond our current scope.

2 General Details

Sockburn Pumping Station is supplied by six wells; Sockburn Wells 1 – 6. Each well feeds into a combined suction tank which then goes to the Pumping Station pump set. Sockburn Pumping Station and Wells are located on Main South Road, Weaver Place and Blenheim Road. The station supplies part of the West Pressure Zone. Table 1 summarises key information about the six wells.

Table 1: Sockburn Wells Summary

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
Well 1	M 35/1859	No Screen Data	2
Well 2	M 35/1860	Screen 1: 65.5 – 68.5	2

CCC Well No	ECan Well No	Screen Depth (mbgl)	Aquifer No
		Screen 2: 75.5 – 78.5	
Well 3	M 35/2272	63.05 – 77.17	2
Well 4	M 35/2273	61.2 – 68.4	2
Well 5	M 35/2274	Screen 1 : 64.8 – 67.8 Screen 2: 73.3 – 76.3	2
Well 6	M 35/2275	63.64 – 76.75	2

3 Hydrogeological Setting

The Christchurch Artesian Aquifer System is made up of a series of interbedded gravel, sand and silt deposits derived from marine or terrestrial sources which contain groundwater of varying ages sourced from both alpine river and rainfall to land surface recharge. The wells supplying Sockburn Pumping Station are screened within moderately-deep (Aquifer 2 – Linwood Gravel Aquifer) leaky (semi)-confined aquifers within the Christchurch Artesian Aquifer System.

4 Risks

An inspections of each well was carried out on 7 November 2017 by Mike Thorley (CH2M Beca), Lisa Mace (CH2M Beca), Richard McCracken (CCC) and Andrew Batchelor (City Care). The Inspection Reports in Appendix A include a list of the risks identified with regards to DWSNZ Criterion 2.

5 Status / Compliance with DWSNZ Criterion 2

The information reviewed and the inspections carried out indicate that Sockburn Wells 1 – 6 do not meet DWSNZ Criterion 2. Recommendations to improve bore head protection are listed below.

6 Recommendations

Table 2 summarises that recommendations from the Inspection Reports. These recommendations are divided into priority rankings. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection.

The recommendations included below have been modified since Revision A of this report. Some of these modifications are a result of discussion with the DWA. See Appendix D for the minutes from this discussion.

Table 2: Summary of Recommendations

	First Priority	Second Priority	Third Priority	Ongoing
Well 1	■ Seal cable penetration through chamber			
Well 2	■ Check that the cable entries are sealed and seal if required ■ Seal side entry points to chamber	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Tidy up well casing including removing rust from above ground area		
Well 3	■ Locate source of leak and seal. ■ Seal cable entry points ■ Seal water supply pipe and sample tap pipe entry points to chamber			
Well 4	■ Seal pipework with side chamber wall. ■ Seal cable entry points	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected		
Well 5	■ Seal casing to chamber floor if required (could not be accessed during visit) ■ Seal cable entry points to the bore and at the chamber wall ■ Install backflow prevention device	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Rust removal and prevention for the pipework and casing		

	First Priority	Second Priority	Third Priority	Ongoing
Well 6	■ Check that the cable glands into the bore are sealed. Seal if required. ■ Seal cable entry point of chamber sidewall	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected		
All wells	■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.	■ For the as-built records, confirm backflow prevention on the well pump has been installed.	■ A sanitary inspection of the well (and flow meter chamber if applicable) should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

7 Conclusion

The information reviewed and the inspections carried out indicate that none of the Sockburn wells meet DWSNZ Criterion 2. The recommendations listed above should be carried out according to the priority

rankings shown. Those listed in the *First Priority* column should be completed as soon as possible as they will reduce immediate risks to human health and also satisfy the requirements for Well Head Protection. A follow-up inspection should take place within one month of the works being completed to review whether Criterion 2 is met, or seek the DWA agreement on those items that do not meet Criterion 2.

Appendix A

Inspection Reports

Well Head Protection Assessment – General

1. General	
Water Supplier	Christchurch City Council
Pumping Station	Sockburn
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2017
2. Modifications since Previous Assessment	
No known modifications	
3. Hydrogeological Details	
Aquifer Details (geology, un/confined, etc)	All wells draw from Aquifer 2 (leaky (semi)-confined)
Surface Water Ways, Drains, etc	Stormwater detention in park
4. Photo Record and Comments	
Photo	Comment
	Reticulation pumps

	Diesel storage tank outside. Above ground fuel lines and storage			
5. Risks from Surrounding Environment				
a) Within the site:				
Diesel/Chemical Storage	Yes, away from wells	☐ Underground √ Aboveground	Fuel lines	☐ Underground √ Aboveground
Access by Animals	No, locked building			
Protection from vandalism, signs of vandalism	As above, no signs of vandalism			
Other Activities	N/A			
b) Immediate Neighbouring Land Use:				
Current Neighbouring Land Use	Industrial and roading			
Significant Changes Since Previous Inspection	None identified			
Zoning of Neighbouring Land	Commercial Mixed Use Zone			
c) Wider Environment:				
Potential sources of contamination such as septic tanks or other waste discharges, sewage pump stations, sewage pumping mains, gravity sewers, agricultural risks	Active consents for stormwater discharge within 400m Sewer nearby			
Risk of flood inundation	Pump station is below ground but within a building			
Potential sources of young water	No sources specific to the pumping station identified. See well assessments			
General land use in catchment (LLUR)	As below			
Contaminated sites (HAIL status)	At well and pump station address (149 Main South Road):			

	ACT 3632 G3 - Landfill sites ACT 77 A17 - Storage tanks or drums for fuel, chemicals or liquid waste
Status and condition of surrounding wells (within 400 m radius)	Multiple wells
Landfill	At Well 1 location (149 Main South Road)
6. Actions Arising	
Identify issues and rank them in terms of whether they require:	
First Priority	Refer well assessments
Second Priority	Refer well assessments
Third Priority	Refer well assessments
Ongoing	Refer well assessments

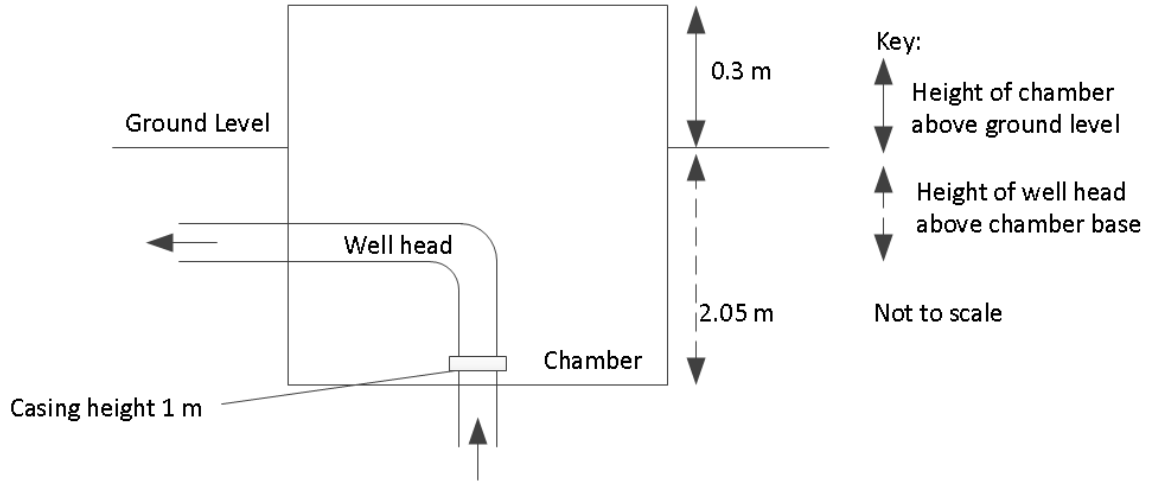
Well Head Protection Assessment – Individual Well Heads

Sockburn Well 1

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Sockburn Well 1
ECan Well No.	M 35/1859
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached (Assumed to be “No 2 Well”)
Borehead type (above or below ground)	Below
Depth (mbgl)	81.66 (casing depth unknown)
Casing Diameter (mm)	300
Screen Interval (mbgl)	No Screen Data
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	30 August 1976
Control System/Alarms	Well pump on/off

Type of Pump	Submersible
Frequency of Pump Use	Generally runs every day or two to maintain level in suction tank
4. Photo Record and Comments	
Photo	Comment
	Well chamber and sample cabinet
	

	Pipe penetration through chamber wall is sealed
	Casing approximately 1m above the chamber floor. Casing appears to be sealed to chamber from photos taken. Chamber could not be entered
	Cable entry to chamber not sealed
5. Diagram with Well Measurements	



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Sealed at casing entry but not at chamber wall
	Pipework	Sealed with chamber wall
	Well casing	Sealed with chamber floor
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions have been recorded at the well in this data Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No – cabling entry at chamber wall not sealed Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good condition
Raw Water sample port?		Yes, in cabinet next to chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		Mostly, slightly less than 100mm at one side

<table>
<tr><td>Signs of ponding?</td><td>Not at time of inspection but the well is located at a slight low point</td></tr>
<tr><td>Access by animals</td><td>No fence to prevent access, near a road where cats and dogs would be common but livestock would be less likely</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>No lid alarm but there is a padlock on the hatch. No signs of vandalism.</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>Yes – check valve installed (not tested)

Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>N/A</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Good condition</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
</table>
</td></tr>
</table>

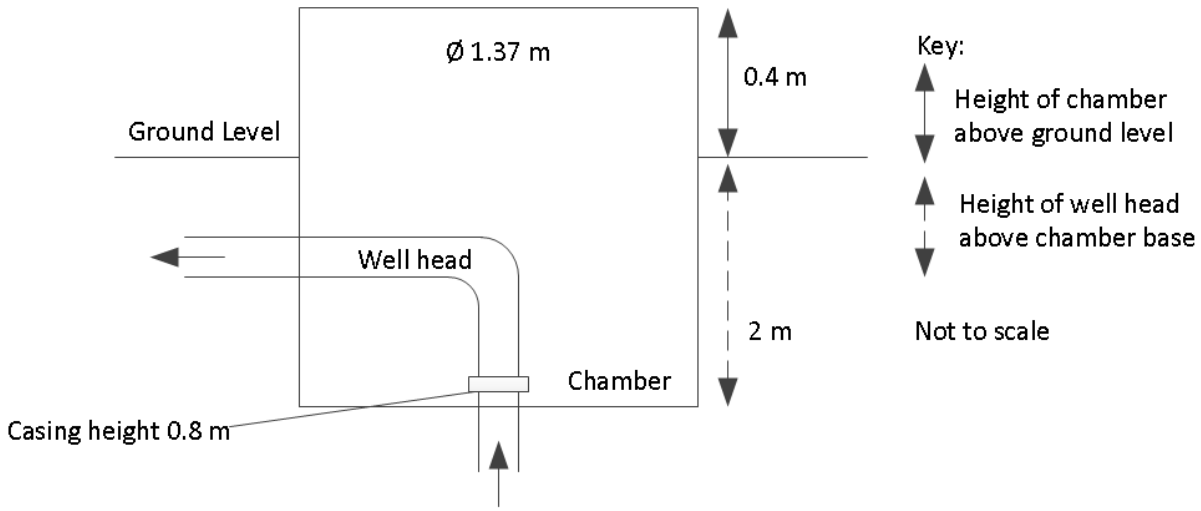
	Single check valve in headworks	To be agreed
	No sump pump	Sump pump required
	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Close to edge of busy road. There is the potential for a spill of gas or other liquid to enter the well. Gas station across the street. Sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	None at the time of inspection	
Is there a sump pump?	No pump or sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Seal cable penetration through chamber ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA.	

	■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Sockburn Well 2

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Sockburn Well 2
ECan Well No.	M 35/1860
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	65.5 (assume top of screen)
Casing Diameter (mm)	300
Screen Interval (mbgl)	Screen 1 : 65.5 – 68.5 Screen 2 : 75.5 – 78.5
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	30 August 1976
Control System/Alarms	Well pump on/off
Type of Pump	Submersible

Frequency of Pump Use	Generally runs every day or two to maintain level in suction tank
4. Photo Record and Comments	
Photo	Comment
	Well location
	Casing condition – some surface rust
	Casing and chamber connection appears to be sealed from photos although the chamber could not be entered.
	Well chamber
5. Diagram with Well Measurements	



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Cable entries appear to be sealed (although chamber could not be entered)
	Pipework	Sealed with sidewall of chamber
	Well casing	Casing to chamber appear to be sealed (although chamber could not be entered)
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions have been recorded at the well in this data Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		Yes Some of the site is below the 50 year flood level and so there is the potential for flooding
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Good condition
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No

100mm step above ground level?	Yes
Signs of ponding?	Not at time of inspection
Access by animals	No fence to prevent access, in a residential area where cats and dogs would be common but livestock would be less likely
Protection from vandalism, signs of vandalism	Lid locked with padlock, no signs of vandalism but well is adjacent to footpath
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – check valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Some surface rust
Bore casing grouted (see the definitions section of the DWSNZ, "bore head protection" and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No
Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?	No
If no, what non-compliances require agreement with the DWA?	**Non-Compliance** / **Agreed with DWA? (see Appendix D)** Below ground installation / Agreed ok No 5m fenced / Agreed ok Casing not grout sealed / To be agreed

	Single check valve in headworks	To be agreed
	No sump pump	Sump pump required
	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Close to busy road. There is the potential for a spill of gas or other liquid to enter the well. Sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	None at the time of inspection	
Is there a sump pump?	No pump, but there is a sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Check that the cable entries are sealed and seal if required ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Tidy up well casing including removing rust from above ground area	

	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

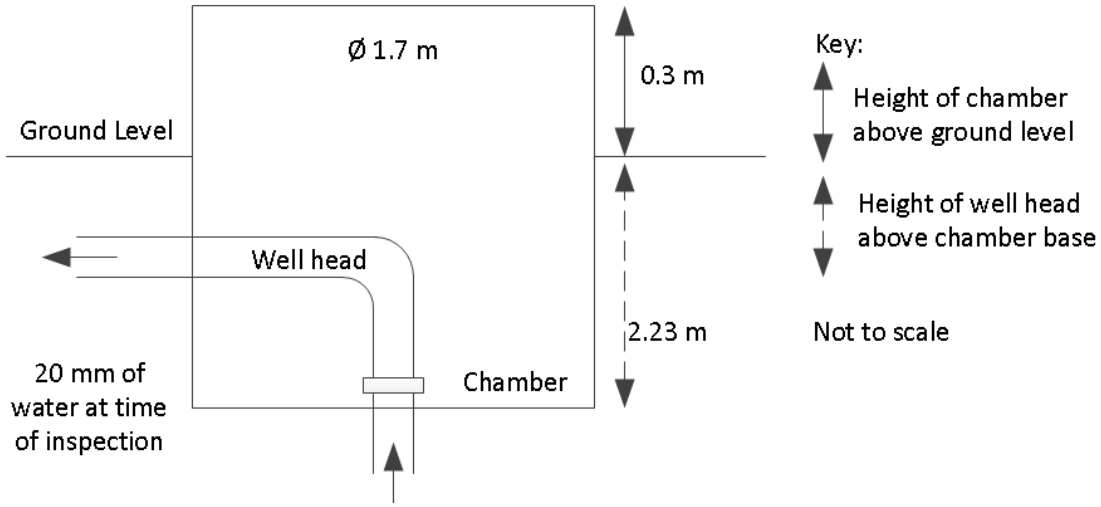
Sockburn Well 3

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Sockburn Well 3
ECan Well No.	M 35/2272
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
New wellhead as part of earthquake repairs	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	63.05 (assume top of screen)
Casing Diameter (mm)	305
Screen Interval (mbgl)	63.05 – 77.17
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	18 September 1978
Control System/Alarms	Well pump on/off, lid alarm
Type of Pump	Submersible

Frequency of Pump Use	Generally runs every day or two to maintain level in suction tank
4. Photo Record and Comments	
Photo	Comment
	Well chamber locked with padlock
	Approximately 20 mm of water in the bottom of the chamber
	Chamber penetrations appear to be sealed
	Cable entries have minor leaks and need sealing

	Sample tap entry to chamber not sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Minor leaks, needs sealing
	Pipework	Not sealed (water supply pipe and sample tap pipe)
	Well casing	Sealed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions have been recorded at the well in this data Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Site is above the 50 year flood level and so flooding potential is low

Downward facing air vent 0.5m above 100 year flood level	Not installed
Type and condition of borehead pipework (above ground)	Good condition
Raw Water sample port?	Yes, in cabinet next to chamber
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	Yes
Signs of ponding?	Not at time of inspection, it was noted that this site has flooded in the past
Access by animals	No fence to prevent access, in a park
Protection from vandalism, signs of vandalism	Lid access alarm installed. Lid locked with padlock. No signs of vandalism.
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – check valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Good condition
Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No
Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?	No

<table>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Close to busy road. There is the potential for a spill of gas or other liquid to enter the well.

Sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>~20mm of water at the time of inspection</td></tr>
<tr><td>Is there a sump pump?</td><td>No pump or sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>N/A</td></tr>
<tr><td>Does the well head meet the requirements of Criteria 2</td><td>No, see actions below</td></tr>
<tr><td colspan="2">7. Actions Arising</td></tr>
<tr><td colspan="2">Identify issues and rank them in terms of whether they require:</td></tr>
<tr><td>First Priority</td><td>■ Locate source of leak and seal.
■ Seal cable entry points
■ Seal water supply pipe and sample tap pipe entry points to chamber</td></tr>
</table>

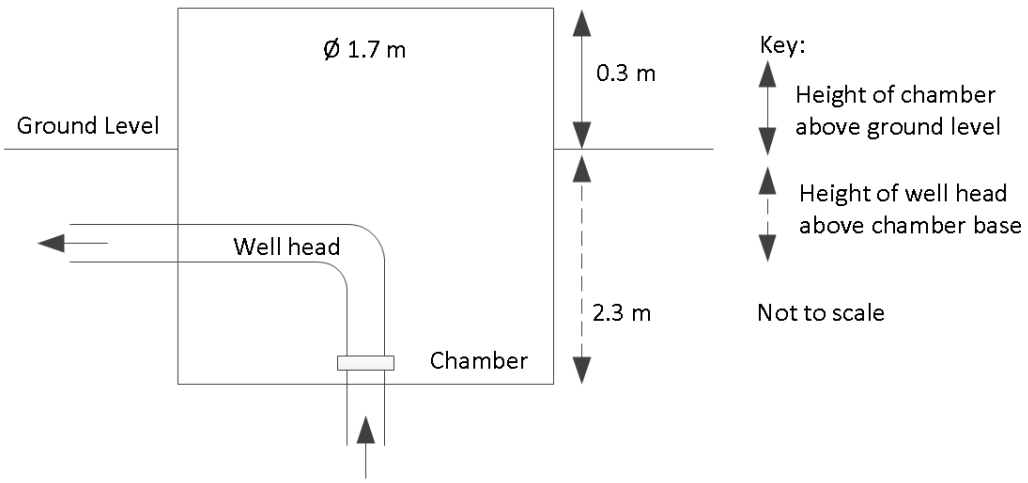
	■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Sockburn Well 4

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Sockburn Well 4
ECan Well No.	M 35/2273
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	61.2 (assume top of screen)
Casing Diameter (mm)	305
Screen Interval (mbgl)	61.2 – 68.4
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	29 August 1978
Control System/Alarms	Well pump on/off, lid opening alarm
Type of Pump	Submersible

Frequency of Pump Use	Generally runs every day or two to maintain level in suction tank
4. Photo Record and Comments	
Photo	Comment
	Well location
	Bore head – pipe glands not sealed
	Casing in reasonable condition with some rust
	Pipe to wall entry not sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Power cable joint not sealed
	Pipework	Not sealed with sidewall of chamber
	Well casing	Sealed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions have been recorded at the well in this data Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No Site is above the 50 year flood level and so flooding potential is low
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Steel, reasonable condition
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No

100mm step above ground level?	Yes
Signs of ponding?	Not at time of inspection
Access by animals	No fence to prevent access, near road
Protection from vandalism, signs of vandalism	Lid access alarm installed. Lid locked with padlock. No signs of vandalism
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	No – possible installed on the pump but this has not been confirmed Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	Unknown
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Steel, ok condition
Bore casing grouted (see the definitions section of the DWSNZ, "bore head protection" and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No
Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?	No
If no, what non-compliances require agreement with the DWA?	**Non-Compliance** / **Agreed with DWA? (see Appendix D)** Below ground installation / Agreed ok No 5m fenced / Agreed ok Casing not grout sealed / To be agreed

	No confirmed backflow prevention device	To be agreed
	No sump pump	Sump pump required
	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Close to busy road. There is the potential for a spill of gas or other liquid to enter the well. Sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	None at the time of inspection	
Is there a sump pump?	No pump or sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Seal pipework with side chamber wall. ■ Seal cable entry points ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention	

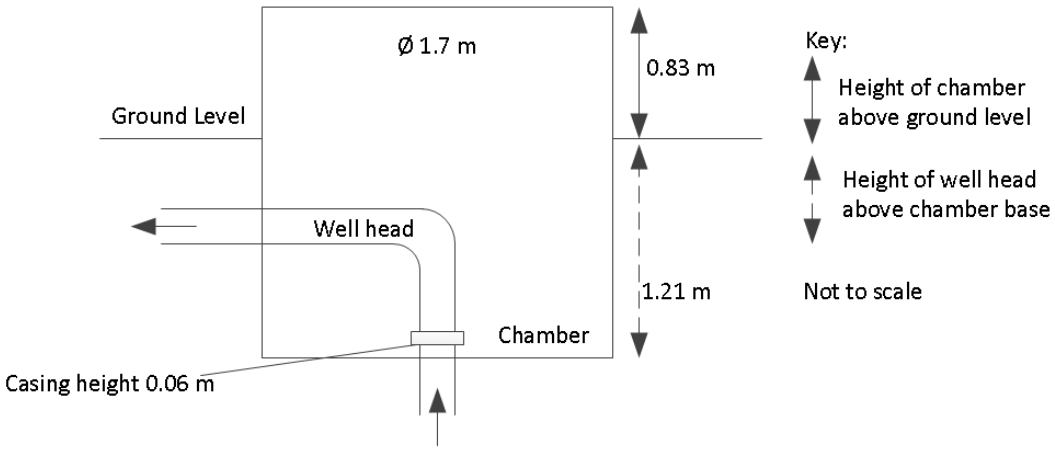
	requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well and the flow meter chamber should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Sockburn Well 5

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Sockburn Well 5
ECan Well No.	M35/2274
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
No known modifications	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	64.8 (assume top of screen)
Casing Diameter (mm)	305
Screen Interval (mbgl)	Screen 1: 64.8 – 67.8 Screen 2: 73.3 – 76.3
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	5 April 1979
Control System/Alarms	Well pump on/off, lid opening alarm
Type of Pump	Submersible

Frequency of Pump Use	Generally runs every day or two to maintain level in suction tank
4. Photo Record and Comments	
Photo	Comment
	Well chamber floor. Casing to floor connection could not be viewed as the chamber could not be accessed.
	Pipework is rusty Chamber floor appears to be damp but on closer inspection it was found that sparkling spider webs cause the damp look.
	Pipework to chamber sidewall connection appears to be sealed.
	Cable penetrations through the chamber sidewall are not sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Cable entry not sealed
	Pipework	Sealed with sidewall of chamber
	Well casing	Cannot be seen as the chamber cannot be accessed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions have been recorded at the well in this data Total coliform levels are unknown
Sanitary well seal watertight or elevated 0.5m above 100 year flood level		No
Downward facing air vent 0.5m above 100 year flood level		Not installed
Type and condition of borehead pipework (above ground)		Rusty pipework
Raw Water sample port?		Yes, in chamber
Concrete apron sloped to drain away from well?		No
100mm step above ground level?		Yes
Signs of ponding?		Yes

<table>
<tr><td>Access by animals</td><td>No fence to prevent access, in a commercial and construction area</td></tr>
<tr><td>Protection from vandalism, signs of vandalism</td><td>Lid access alarm installed. Lid locked with padlock. No signs of vandalism</td></tr>
<tr><td>b) Drilling Standard:</td><td></td></tr>
<tr><td>Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?</td><td>No – possible installed on the pump but this has not been confirmed

Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.</td></tr>
<tr><td>If not, has this been agreed with the DWA?</td><td>Unknown</td></tr>
<tr><td>Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?</td><td>Yes – bore logs attached</td></tr>
<tr><td>Bore casing type and condition (see NZS:4411 2.4.2)</td><td>Rusty well casing</td></tr>
<tr><td>Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing</td><td>Unknown</td></tr>
<tr><td>Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1</td><td>Unknown</td></tr>
<tr><td>Does the well comply with NZS:4411?</td><td>No</td></tr>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>No confirmed backflow prevention device</td><td>To be agreed</td></tr>
</table>
</td></tr>
</table>

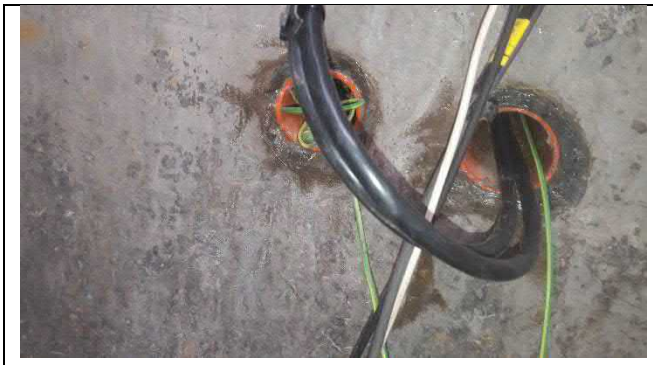
	No sump pump	Sump pump required
	No air vent	Air vent required
c) Contamination Sources:		
Does the WSP address contaminant sources and contaminant migration pathways?	Not received	
Any localised well specific sources of contamination?	Close to busy road. There is the potential for a spill of gas or other liquid to enter the well. Sewers in close proximity.	
d) Below Ground Chambers:		
Water level of chamber	None at the time of inspection	
Is there a sump pump?	No pump or sump	
Are there duty/standby sump pumps?	No	
Sump pump testing, include date a method	N/A	
Sump pump operation method including start level	N/A	
Sump pump and/or level alarms	N/A	
Does the well head meet the requirements of Criteria 2	No, see actions below	
7. Actions Arising		
Identify issues and rank them in terms of whether they require:		
First Priority	■ Seal casing to chamber floor if required (could not be accessed during visit) ■ Seal cable entry points to the bore and at the chamber wall ■ Install backflow prevention device ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)	
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ Rust removal and prevention for the pipework and casing	

	■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways.
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

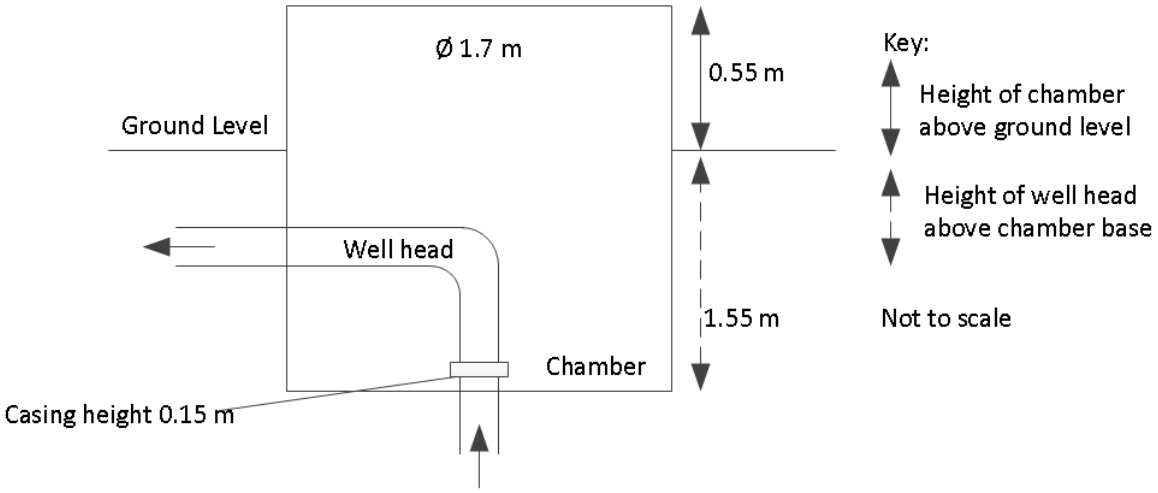
Sockburn Well 6

1. General	
Water Supplier	Christchurch City Council
CCC Well No.	Sockburn Well 6
ECan Well No.	M 35/2275
Aquifer No.	2
Date of Inspection/Assessment	7 November 2017
Inspection Team	CH2M Beca: Mike Thorley, Lisa Mace CCC: Richard McCracken City Care: Andrew Batchelor
Date of Previous Inspection/Assessment	3 October 2012
2. Modifications since Previous Assessment	
New top riser that has increased the level	
3. Bore Details	
Bore log	Attached
Borehead type (above or below ground)	Below
Casing Depth (mbgl)	63.64 (assume top of screen)
Casing Diameter (mm)	305
Screen Interval (mbgl)	63.64 – 76.75
Thickness of grout seal (mm) from the outside of the casing diameter	Unknown
Depth of grout seal (mbgl)	Unknown
Date Drilled	15 May 1979
Control System/Alarms	Well pump on/off, lid opening alarm
Type of Pump	Submersible

Frequency of Pump Use	Generally runs every day or two to maintain level in suction tank
4. Photo Record and Comments	
Photo	Comment
	Well chamber location
	Borehead pipework, in reasonable condition
	Casing to chamber floor connection. Some debris build-up but appears to be sealed
	Rust and casing flaking

	Cable chamber penetrations not sealed

5. Diagram with Well Measurements



6. Assessment of Bore Water Security Criterion 2 – Bore head must provide satisfactory protection

a) Water Ingress:		
Condition of seals (see NZS:4411 2.5.5.3 & 2.5.5.4)	Cabling	Cable penetration through chamber not sealed. Cable glands into bore appeared to be sealed but the chamber could not be accessed so they could not be properly checked
	Pipework	Sealed with sidewall of chamber.
	Well casing	Appears to be sealed from photo collected, chamber could not be accessed
Any history of E. coli transgressions? Historical and current levels of total coliforms?		Only distribution system E. coli transgressions have been recorded in the data received (dating back to 2012-13 FY). No transgressions have been recorded at the well in this data Total coliform levels are unknown

Sanitary well seal watertight or elevated 0.5m above 100 year flood level	No
Downward facing air vent 0.5m above 100 year flood level	Not installed
Type and condition of borehead pipework (above ground)	Good condition
Raw Water sample port?	Yes, in chamber
Concrete apron sloped to drain away from well?	No
100mm step above ground level?	Yes
Signs of ponding?	Not at time of inspection, next to carpark
Access by animals	No fence to prevent access, near a road and a carpark
Protection from vandalism, signs of vandalism	Lid access alarm installed. Lid locked with padlock. No signs of vandalism
b) Drilling Standard:	
Does the bore have backflow prevention complying with Backflow Mechanism (NZS:4411 2.5.5.8)?	Yes – check valve installed (not tested) Note that dual check valves are often used to provide a higher degree of protection, however we consider a single check valve at the headworks meets the backflow prevention requirements. The well pump may also have a check valve but this is not known.
If not, has this been agreed with the DWA?	N/A
Does the bore drilling and well construction record keeping meet NZS:4411 (Section 4)?	Yes – bore logs attached
Bore casing type and condition (see NZS:4411 2.4.2)	Some rust
Bore casing grouted (see the definitions section of the DWSNZ, “bore head protection” and NZS:4411 2.5.2.1 Grouting/sealing	Unknown
Does the bore construction meet casing and jointing requirements of NZS4411 2.5.1	Unknown
Does the well comply with NZS:4411?	No

<table>
<tr><td>Does the well comply with Minimum Construction Requirements for water bore in Australia 3rd ed?</td><td>No</td></tr>
<tr><td>If no, what non-compliances require agreement with the DWA?</td><td>
<table>
<tr><th>Non-Compliance</th><th>Agreed with DWA? (see Appendix D)</th></tr>
<tr><td>Below ground installation</td><td>Agreed ok</td></tr>
<tr><td>No 5m fenced</td><td>Agreed ok</td></tr>
<tr><td>Casing not grout sealed</td><td>To be agreed</td></tr>
<tr><td>Single check valve in headworks</td><td>To be agreed</td></tr>
<tr><td>No sump pump</td><td>Sump pump required</td></tr>
<tr><td>No air vent</td><td>Air vent required</td></tr>
</table>
</td></tr>
<tr><td>c) Contamination Sources:</td><td></td></tr>
<tr><td>Does the WSP address contaminant sources and contaminant migration pathways?</td><td>Not received</td></tr>
<tr><td>Any localised well specific sources of contamination?</td><td>Close to busy road and carpark. There is the potential for a spill of gas or other liquid to enter the well.

Sewers in close proximity.</td></tr>
<tr><td>d) Below Ground Chambers:</td><td></td></tr>
<tr><td>Water level of chamber</td><td>None at the time of inspection</td></tr>
<tr><td>Is there a sump pump?</td><td>No pump or sump</td></tr>
<tr><td>Are there duty/standby sump pumps?</td><td>No</td></tr>
<tr><td>Sump pump testing, include date a method</td><td>N/A</td></tr>
<tr><td>Sump pump operation method including start level</td><td>N/A</td></tr>
<tr><td>Sump pump and/or level alarms</td><td>N/A</td></tr>
<tr><td>Does the well head meet the requirements of Criteria 2</td><td>No, see actions below</td></tr>
<tr><td colspan="2">7. Actions Arising</td></tr>
<tr><td colspan="2">Identify issues and rank them in terms of whether they require:</td></tr>
</table>

First Priority	■ Check that the cable glands into the bore are sealed. Seal if required. ■ Seal cable entry point of chamber sidewall ■ Install a sump pump (with a level sensor that alarms to an operator) ■ Install a downward facing air vent 0.5 m above 100 year flood level (unless the well is not located in a flood prone area)
Second Priority	■ Modify sample tap so that it is either outside the chamber, or so that it contains a length of flexible hose that can be pulled outside the chamber when samples are collected ■ We consider a single check valve at the headworks meets the backflow prevention requirements. This should be confirmed with the DWA. ■ Grout seals must be retrofitted. Requirements will be based on how soon the well will be replaced (i.e. if the well is due for replacement within the next two years, then undertake grout sealing as part of new well construction), and the contamination risks in the immediate vicinity of the well. ■ Address the risks associated with the below ground bore in the WSP. This includes treatment and raising above ground where practicable. ■ Ensure that the WSP addresses contaminant sources and contaminant migration pathways
Third Priority	■ For the as-built records, confirm backflow prevention on the well pump has been installed.
Ongoing	■ A sanitary inspection of the well should take place on a regular basis ■ Establish routine testing and verification of backflow prevention device

Appendix B

Maps

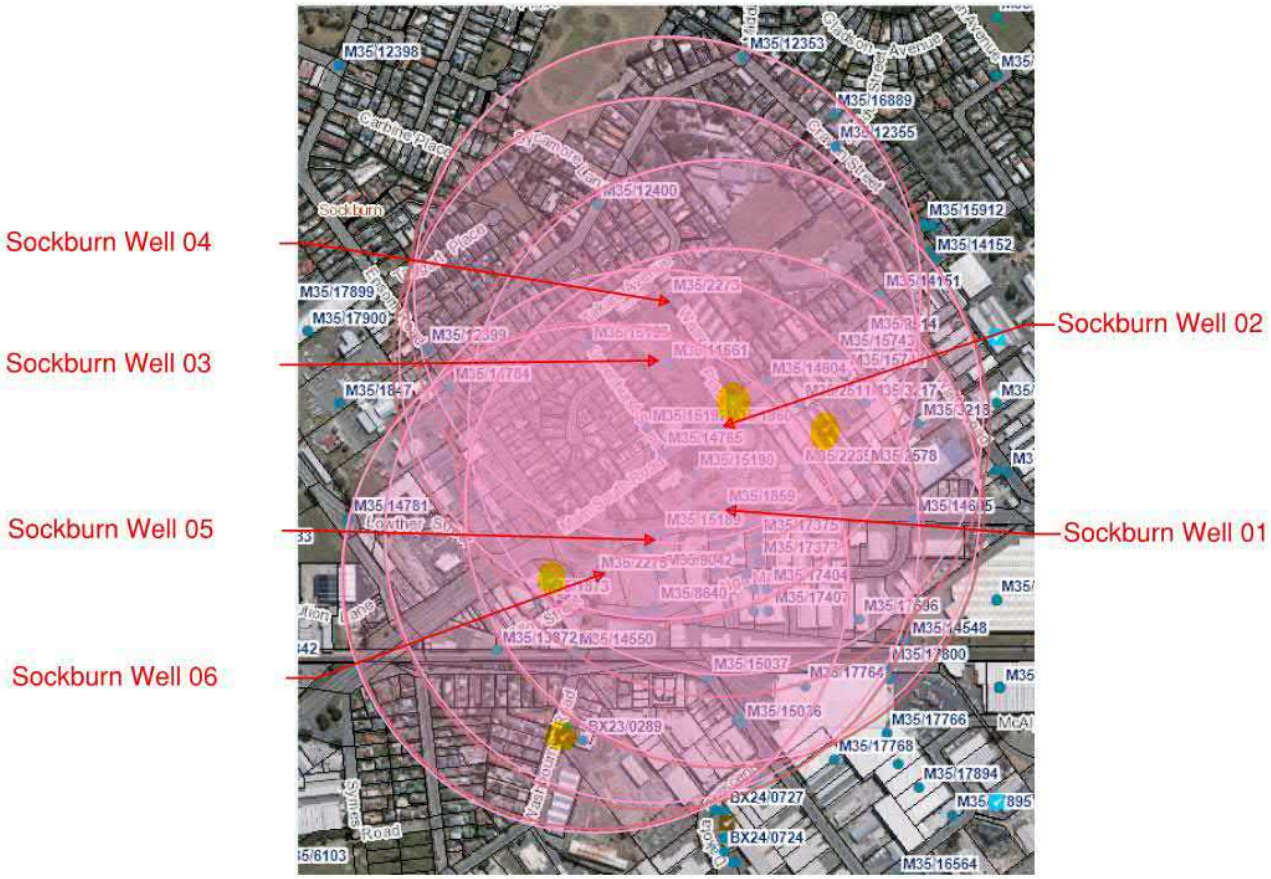


Figure 1: Summary of wells and consents within 400m of Sockburn Wells

Table 3: Summary of consents within 400m of Sockburn Wells

Sockburn Well Sites

Well Number: M35/1859

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC091739	Issued - Active	Stormwater Industrial
Discharge to Water	CRC010280	Terminated - Replaced	Cooling Water
Discharge to Land	CRC030353	Issued - Active	Stormwater Residential

Well Number: M35/1860

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC091739	Issued - Active	Stormwater Industrial
Discharge to Water	CRC010280	Terminated - Replaced	Cooling Water
Discharge to Land	CRC030353	Issued - Active	Stormwater Residential

Well Number: M35/2272

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC091739	Issued - Active	Stormwater Industrial

Discharge to Water	CRC010280	Terminated - Replaced	Cooling Water
Discharge to Land	CRC030353	Issued - Active	Stormwater Residential

Well Number: M35/2273

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC010280	Terminated - Replaced	Cooling Water
Discharge to Land	CRC030353	Issued - Active	Stormwater Residential

Well Number: M35/2274

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC091739	Issued - Active	Stormwater Industrial
Discharge to Water	CRC010280	Terminated - Replaced	Cooling Water
Discharge to Land	CRC030353	Issued - Active	Stormwater Residential
Discharge to Land	CRC130324	Issued - Inactive	Stormwater Residential

Well Number: M35/2275

Type	*Consent Number*	*Consent Status*	*Feature Type*
Discharge to Water	CRC091739	Issued - Active	Stormwater Industrial
Discharge to Water	CRC010280	Terminated - Replaced	Cooling Water
Discharge to Land	CRC130324	Issued - Inactive	Stormwater Residential

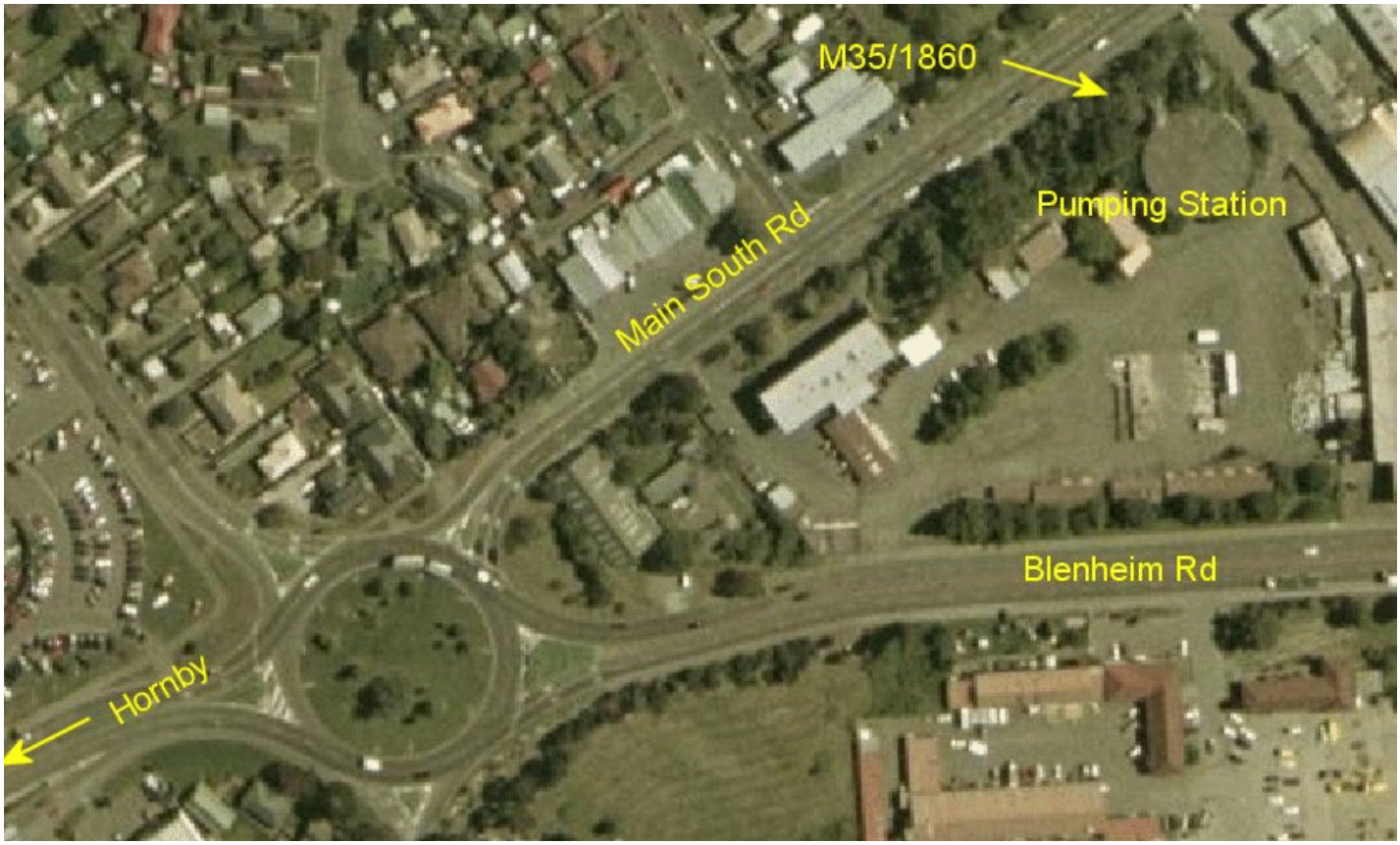
Appendix C

Bore Logs

Bore or Well No	M35/1860
Well Name	149 MAIN SOUTH ROAD
Owner	Christchurch City Council

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M35/1860	**File Number**	CO6C/10597
Owner	Christchurch City Council	**Well Status**	Active (exist, present)
Street/Road	149 MAIN SOUTH ROAD	**NZTM Grid Reference**	BX24:64183-79350
Locality	SOCKBURN	**NZTM X and Y**	1564183 - 5179350
Location Description	Sth side Main South Rd - in reserve	**Location Accuracy**	2 - 15m
CWMS Zone	Christchurch - West Melton	**Use**	Small Community Supply,
Groundwater Allocation Zone	Christchurch/West Melton	**Water Level Monitoring**	--
Depth	78.50m	**Water Level Count**	0
Diameter	300mm	**Initial Water Level**	
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	21.30m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	39	**Calc Min 95%**	3.10m below MP
Aquifer Name	Linwood Gravel	**Aquifer Tests**	0
Aquifer Type	Non-Flowing Artesian	**Yield Drawdown Tests**	0
Drill Date	30 Aug 1976	**Max Tested Yield**	0 l/s
Driller	A M Bisley & Co	**Drawdown at Max Tested Yield**	0 m
Drilling Method	Cable Tool	**Specific Capacity**	
Casing Material		**Last Updated**	25 Jul 2017
Pump Type	Unknown	**Last Field Check**	30 Jan 2008
Water Use Data	No		



Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	65.5	68.5				
2	Stainless steel	75.5	78.5				

No step tests for this well

Comments

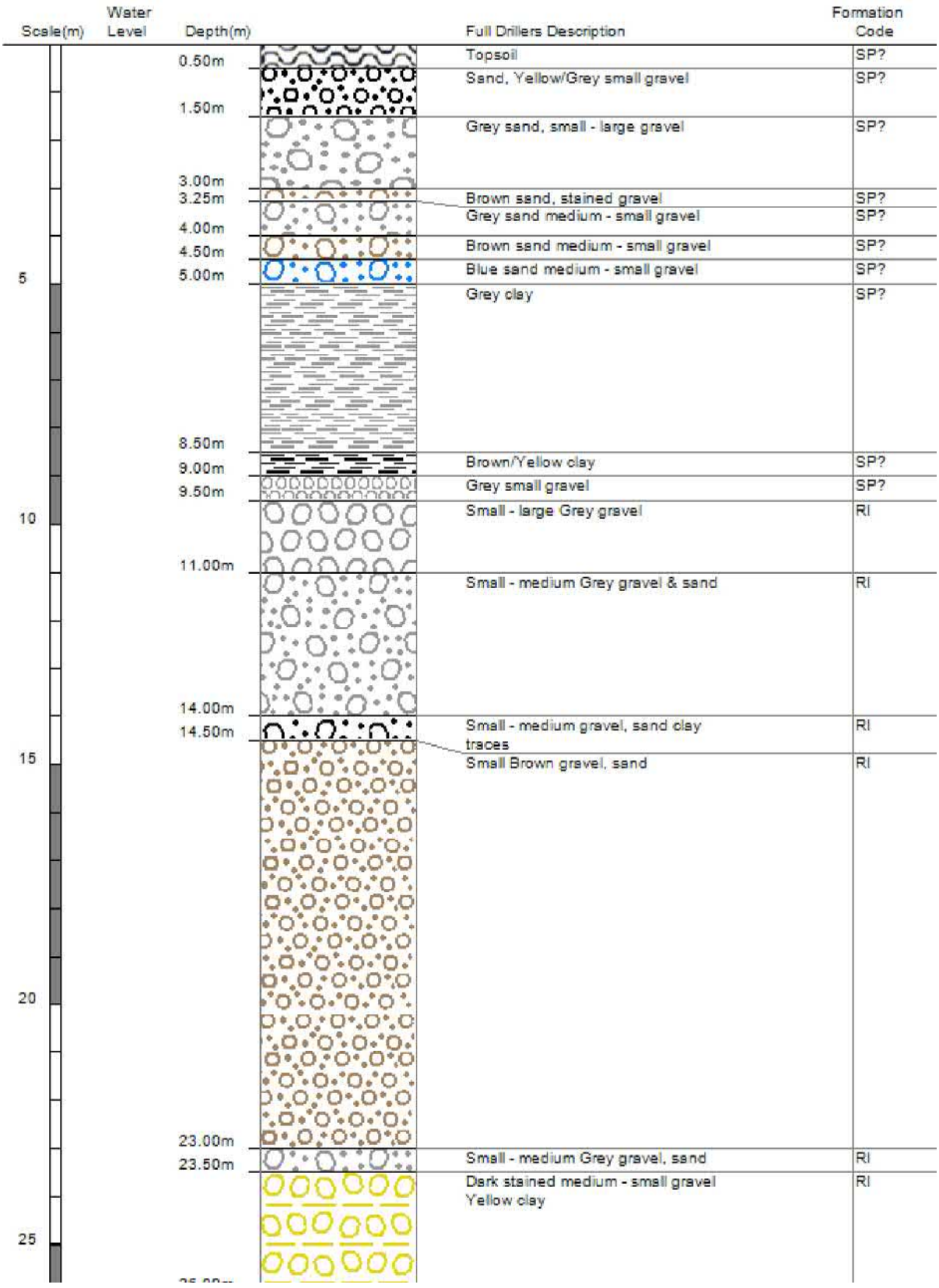
Comment Date	Comment
	FROM OLD CWS DB M35/1859, M35/1860, M35/2272, M35/2273, M35/2274 & M35/2275. All supply Sockburn pumpstation but some not in use. M35/1860 located in garden in front of storage tank & pumpstation on Main South Rd, opp. entrance to Sockburn Pool & Weaver Place. Is enclos
15 Oct 1998	West pressure zone.
14 Feb 2000	FROM OLD CWS DB Surrounding area Sockburn pumpstation & CCC service centre, a vehicle testing station, a swimming pool & recreation centre & all wells are adjacent to main rds. GRID REF: M35:74164-40953.
25 Aug 2008	NZMG update from air photo Aug 2008, gridref changed from M35:74177-40961
06 May 2010	MfE source code added

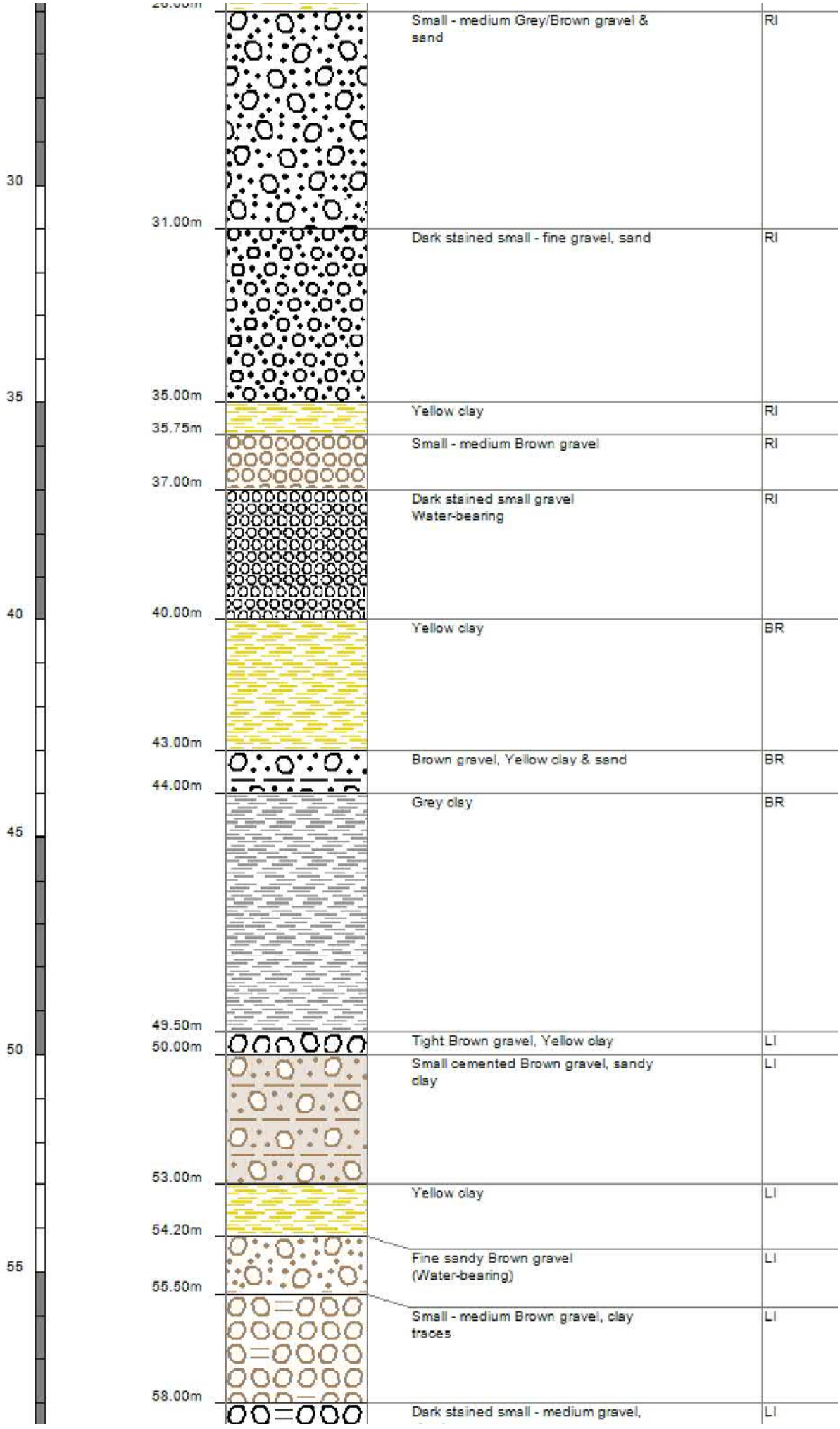
Bore Log

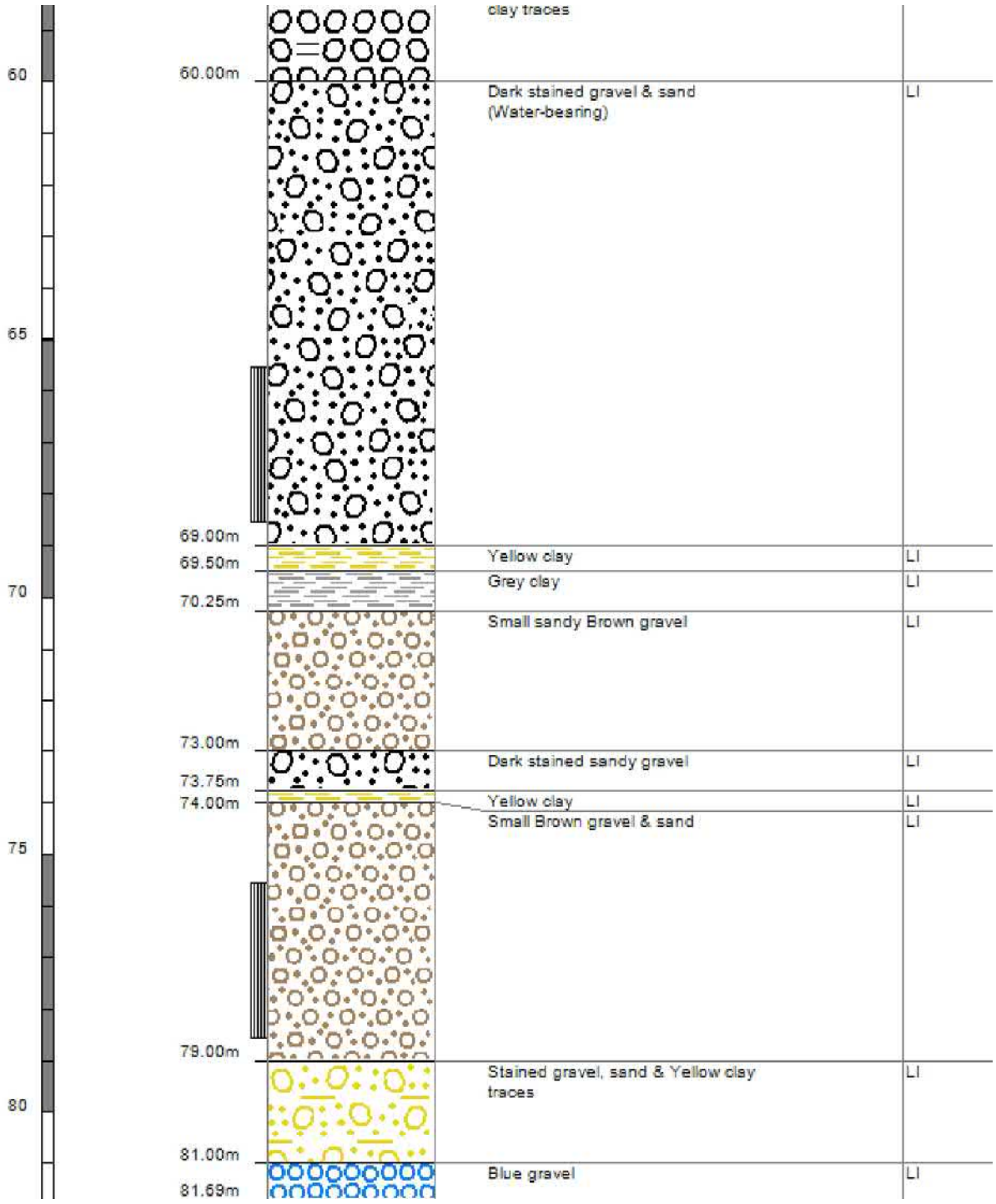
Borelog for well M35/1860

Grid Reference (NZTM): 1564183 mE, 5179350 mN
Location Accuracy: 2 - 15m
Ground Level Altitude: 21.3 m +MSD Accuracy: < 2.5 m
Driller: A M Bisley & Co
Drill Method: Cable Tool
Borelog Depth: 81.7 m Drill Date: 30-Aug-1976

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha




30
35
40
45
50
55
31.00m
35.00m
35.75m
37.00m
40.00m
43.00m
44.00m
49.50m
50.00m
53.00m
54.20m
55.50m
58.00m
Small - medium Grey/Brown gravel & sand
RI
Dark stained small - fine gravel, sand
RI
Yellow clay
RI
Small - medium Brown gravel
RI
Dark stained small gravel
Water-bearing
RI
Yellow clay
BR
Brown gravel, Yellow clay & sand
BR
Grey clay
BR
Tight Brown gravel, Yellow clay
LI
Small cemented Brown gravel, sandy clay
LI
Yellow clay
LI
Fine sandy Brown gravel
(Water-bearing)
LI
Small - medium Brown gravel, clay traces
LI
Dark stained small - medium gravel,
LI


clay traces
60
60.00m
Dark stained gravel & sand
(Water-bearing)
LI
65
69.00m
69.50m
Yellow clay
LI
70
Grey clay
LI
70.25m
Small sandy Brown gravel
LI
73.00m
Dark stained sandy gravel
LI
73.75m
74.00m
Yellow clay
LI
Small Brown gravel & sand
LI
75
79.00m
Stained gravel, sand & Yellow clay
traces
LI
80
81.00m
Blue gravel
LI
81.69m

N02 Well

A. M. BISLEY & CO. LTD.

WELL DRILLING DIVISION NO 1028/29

HAMILTON and CHRISTCHURCH

WELL LOG

30/8 19.76

NAME: Paparua County Council

LOCATION: Main South Rd, Opp Sockburn Park.

DIA. OF WELL: 300 mm STATIC WATER LEVEL:

CASING: Spiral Weld SHOE: Rolled Steel

TOTAL DEPTH: 81.66

SCREEN: S/S 3.11m x 250 ID (80 slot) .7m x 10" spiral weld blank
S/S 3.11 x 250 ID (80 slot)

LEADER: 600mm x 292mm OD (Sump 1.46 x 10" spiral weld)

PACKER: Nil

PUMPING TEST:

SPECIFIC CAPACITY:

LITHOLOGY

0 - .5	Top Soil
.5 - 1.5	Sand, yellow grey small gr
1.5 - 3	Sand grey small to larger gr
3-3.25	Sand brown stain gr
3.25-4	Sand grey Medi to small gr
4-4.50	Sand Brown " " " "
4.50-5	Sand Blue " " " "
5-8.5	Grey Clay
8.5-9	Browny Yellow Clay
9-9.5	Gray Gravel small
9.5-11	Gray gravel small to large
11-14	Gray gravel small to Medi sand
14-14.5	Grey gr small to medi sand trace clay
14.5 - 23	Brown gr small sand
23-23.5	Grey gr small to medi sand
23.5-26	Dark stain gr small to fine yellow clay
26-31	Grey brown gr small to medi sand
31 - 35	Dark Stain gr small to fine sand
35 -35.75	Yellow Clay
35.75-37	Brown gr small to Medi
37 - 40	Dark stain gr small (WB)
40-43	Yellow Clay
43-44	Brown gr yellow clay sand
44-49.5	Grey clay
49.5-50	Tight brown gr yellow clay
50-53	Small brown cemented gr sandy clay
53-54.2	Yellow Clay
54.2-55.5	Fine brown sandy gr (WB)

RIG NO. 5 DRILLER J. Beardsley

A. M. BISLEY & CO. LTD.

WELL DRILLING DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

30.8. 19.76

NAME: Paparua County Council

LOCATION: Main South Rd, Opp Sockburn Park

DIA. OF WELL: 300mm

STATIC WATER LEVEL:

CASING: Spiral Weld

SHOE: Rolled Steel

TOTAL DEPTH: 81.66

SCREEN: S/S 3.11m x 250 ID (80 slot) .7m x 10'' spiral weld blank
S/S 3.11 x 250 ID (80 slot) (Sump 1.46 x 10" spiral weld)

LEADER:

PACKER: Nil

PUMPING TEST:

SPECIFIC CAPACITY:

LITHOLOGY

55.5 - 58	Brown gr small to medi trace clay
58 - 60	Dark stain small to medi trace clay
60 - 69	Dark stain small sand (WB)
69 - 69.5	Yellow Clay
69.5 -70.25	Grey Clay
70.25-73	Brown gr small sandy
73 - 73.75	Dark stain gr sandy
73.75 -74	Yellow Clay
74 - 79	Brown gr small sand
79 - 81	Stain gr sand yellow clay trace
81 - 81.66	Blue gr.

RIG NO. 5

DRILLER J. Beardsley

A. M. BISLEY & CO. LTD

WATER SUPPLY DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

April 5 1979

CLARITY PRESS LTD

NAME: Paparua County Council.

LOCATION: Sockburn Round About (Opp Council Yard) ~~NOS~~ ~~NOT~~ NOS

DIA. OF WELL: 305mm

STATIC WATER LEVEL: 4.5m from G.L.

CASING: 63.3m

SHOE: 1.

TOTAL DEPTH: 76m

SCREEN: 1m 250mm Black Pipe 3.10m 225mm I.D. Johnson St.St. 100 Slot.
5.5m 250mm " " 3.10m 225mm " " " " 100 Slot.

LEADER: 0.61m 280I.D. Rolled Pipe.

PACKER: -

PUMPING TEST: 28.1 ℓ/sec.

SPECIFIC CAPACITY: 15 ℓ/sec/m

DR.D: 1.87m

Screen 64.8 → 67.8.
73.3 → 76.3.

LITHOLOGY

0	-	6	Backfill and Grey Gravel.
6	-	6.1	Large Grey Gravel.
6.1	-	9.3	Blue Clay.
9.3	-	12.3	Small Grey Brown Gravel.
12.3	-	15.0	Medium Grey Brown Gravel.
15.0	-	16.4	Medium Grey Brown Gravel and Sand.
16.4	-	18.4	Grey Medium Brown Gravel.
18.4	-	21.5	Medium Grey Brown Gravel and Sand.
21.5	-	24.5	Medium Grey Gravel.
24.5	-	29.0	Medium Grey Brown Gravel and Brown Clay.
29.0	-	30.8	Brown Clay.
30.8	-	33.5	Medium to Small Grey Brown Gravel.
33.5	-	37.0	Sandy Brown Medium Gravel.
37.0	-	38.0	Large Sandy Brown Gravel.
38.0	-	40.1	Brown Clay and Some Gravel.
40.1	-	45.0	Brown Stained Sandy Gravel.
45.0	-	46.2	Medium Brown Gravel and Some Yellow Clay.
46.2	-	48.0	Medium to Small Brown Sandy Gravel.
48.0	-	48.5	Brown Sandy Clay.
48.5	-	49.3	Blue Clay.

RIG No. 4.

DRILLER B. Lagendyk.

Continued

A. M. BISLEY & CO. LTD

WATER SUPPLY DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

April 5 1979

CLARITY PRESS LTD

NAME: Paparua County Council.

LOCATION: Sockburn Round About (Opp Council Yard)

DIA. OF WELL: STATIC WATER LEVEL:

CASING: SHOE:

TOTAL DEPTH:

SCREEN:

LEADER:

PACKER:

PUMPING TEST:

SPECIFIC CAPACITY:

LITHOLOGY

49.3	-	50.0	Brown Clay.
50.0	-	55.0	Grey Gravel.
55.0	-	57.2	Medium to Small Brown Stained Gravel.
57.2	-	63.0	Large to Small Brown Gravel, Sand and Some Yellow Clay.
63.0	-	66.8	Large to Small Brown Stained Gravel and Fine Sand.
66.8	-	67.0	Yellow Clay and Gravel.
67.0	-	69.6	Sandy Brown Gravel.
69.6	-	71.1	Hard Blue Clay.
71.1	-	71.4	Hard Yellow Clay.
71.4	-	76.0	Sandy Brown Gravel and Some Yellow Clay.

RIG No. 4. DRILLER B. Lagendyk.

A. M. BISLEY & CO. LTD

WATER SUPPLY DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

15 May 1979

CLARITY PRESS LTD

No 6. Well

NAME: Paparua County Council,

LOCATION: Sockburn Round About (Near Alloy Steel)

DIA. OF WELL: 305mm

STATIC WATER LEVEL: 4.40m From G.L.

CASING: 63.64m

SHOE: 1.

TOTAL DEPTH: 76.75m

SCREEN: 1m 250mm Black pipe 3.10m 225mm I.D. Johnson S.S. 100 slot
5.84 250mm Black pipe 3.10m 225mm I.D. Johnson S.S. 100 slot
LEADER: 0.60m 220 I.D. Rolled pipe

PACKER: -

PUMPING TEST: 31.5 ℓ/sec.

SPECIFIC CAPACITY: 9.78 ℓ/sec/m

DR.D.: 3.22m

LITHOLOGY

0.0	-	4	Filling.
4.0	-	6.5	Grey Gravel & Sand.
6.5	-	9.3	Grey Clay & Roots.
9.3	-	12.0	Brown Stained Gravel.
12.0	-	12.5	Fine Brown Stained Gravel.
12.5	-	29.0	Grey Brown Gravel & Sand.
29.0	-	33.4	Brown Sandy Gravel.
33.4	-	33.9	Brown Gravel. Yellow Clay, and Sand.
33.9	-	35.0	Brown Stained Gravel & Sand.
35.0	-	37.2	Sandy Brown Gravel-
37.2	-	37.8	Yellow Clay.
37.8	-	42.0	Brown Stained Sandy Gravel.
42.0	-	46.2	Brown Stained Sandy Gravel Some Clay.
46.2	-	48.1	Fine Sand Some Gravel.
48.1	-	48.4	Brown Gravel. Yellow Clay & Sand.
48.4	-	48.9	Yellow Clay, Peat Timber.
48.9	-	50.3	Blue Clay.
50.3	-	51.7	Grey Gravel, Grey & Yellow Clay, Peat.
51.7	-	52.4	Grey Brown Gravel.
52.4	-	53.0	Sandy Brown Stained Gravel.
53.0	-	53.2	Tight Blue Gravel, Yellow Clay.

RIG No. 4

DRILLER B. Lagendyk.

PACKER:

PUMPING TEST: No 6 Well.

SPECIFIC CAPACITY:

415 G.P.M.

Pumped 31.5 ℓ/sec W.L. 4,40m from G.L.

LITHOLOGY

5 min	Draw Down		2.46m
30 "	"	"	2.69m
60 "	"	"	3.00m
90 "	"	"	3.07m
120 "	"	"	3.12m
150 "	"	"	3.15m
180 "	"	"	3.18m
210 "	"	"	3.19m
240 "	"	"	3.21m
300 "	"	"	3.22m

RIG No.

DRILLER

53.2	-	53.5	Tight Brown Gravel & Yellow Clay.
53.5	-	63.0	Sandy Brown Stained Gravel.
63.0	-	66.5	Brown Stained Gravel & Sand.
66.5	-	66.7	Sandy Brown Gravel Some Yellow Clay,
66.7	-	69.4	Sandy Brown Gravel.
69.4	-	69.8	Sandy Blue Gravel.
69.8	-	70.9	Hard Blue Clay & Peat.
70.9	-	71.4	Hard Yellow Clay.
71.4	-	75.0	Very Sandy Brown Gravel.
75.0	-	75.2	Sandy Brown Gravel & Yellow Clay.
75.2	-	76.65	Very Sandy Brown Gravel.

RIG No. 4.

DRILLER B. Lagendyk.

A. M. BISLEY & CO. LTD.

WELL DRILLING DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

18th September 19 78

NAME: PAPRUA COUNTY COUNCIL

LOCATION: BEAVER PLACE/IN FRONT OF SOCKBURN POOL

DIA. OF WELL: 305mm

STATIC WATER LEVEL: 2.85m FROM G.L.

CASING: 63.05m

SHOE: 1

TOTAL DEPTH: 77.17m

SCREEN: 1m 225mm Black Pipe 3.06m 225mm I.D. Johnson SS 100 slot
1.98m 225mm Black Pipe 2.08m 225mm I.D. Johnson SS 100 slot

LEADER: 0.61m 280mm I.D. Rolled Pipe

PACKER: -

PUMPING TEST: 24.3ℓ/sec

SPECIFIC CAPACITY: 6.9 ℓ/sec/m

DR.D 3.50m

LITHOLOGY

0	- 5	Filling (Rubbish Dump)	
5	- 7.30	Grey Gravel & Sand	
7.30	- 8.30	Grey Clay	
8.30	- 8.80	Yellow Clay	
8.80	- 28.2	Grey Brown Gravel some dark stained and sand	
28.2	- 32.7	Brown Gravel some dark stained and sand.	
32.7	- 36.7	Sandy brown Gravel	
36.7	- 37.5	Brown Gravel and yellow clay	
37.5	- 38.7	Sandy brown gravel	
38.7	- 44	Yellow Clay	
44	- 44.9	Sandy Yellow Clay and gravel	
44.9	- 50.7	Grey clay, sand timber & some gravel	
50.7	- 52	Brown gravel and fine sand	
52.0	- 55.6	Tight sandy brown gravel	
55.6	- 64.5	Sandy brown and dark stained gravel	
64.5	- 67.5	Sandy brown and dark stained gravel and some yellow clay.	
67.5	- 70.3	Very sandy brown and dark stained gravel	
70.3	- 71.5	Hard Yellow Clay	
71.5	- 72	Brown Gravel, fine sand and some clay	
72	- 77	Sandy brown gravel	

RIG NO. 4

DRILLER G. LAGENDYK

A. M. BISLEY & CO. LTD

WATER SUPPLY DIVISION

HAMILTON and CHRISTCHURCH

WELL LOG

29/8/ 1978

No 4 Well

NAME: Taupiri County Council

LOCATION: Beaver Place (Beside Sockburn Pool)

DIA. OF WELL: 305mm

STATIC WATER LEVEL: 3.2m From G.L.

CASING: 01.20m

SHOE: 1

TOTAL DEPTH: 68.40m

SCREEN: 1m 225mm Black pipe.

LEADER: 0.20m 225mm I.D. Johnson ST.ST. 100 slots
0.60m 200mm I.D. Rolled pipe

PACKER: -

PUMPING TEST: 25.25 l/sec

SPECIFIC CAPACITY: 5 l/sec/m

DR. D: 5.2m

LITHOLOGY

0	-	0.5	Filling
0.5	-	5	Grey Gravel & Sand
5	-	6.7	Grey Clay & Timber
6.7	-	12	Grey Sand Clay, Timber & Some Gravel
12	-	27.3	Grey - Brown Gravel Some Dark Stained & Sand
27.3	-	34.2	Brown Gravel Some Dark Stained & Sand
34.2	-	37.2	Sandy Brown Gravel
37.2	-	38.7	Yellow Clay & Some Gravel
38.7	-	39	Brown Gravel & Sand
39	-	42	Sandy Grey Clay
42	-	46	Grey Clay & Timber
46	-	48.10	Grey Sand Some Gravel & Timber
48.10	-	52.2	Grey Clay
52.2	-	57.6	Sansy Brown Gravel & Some Clay
57.6	-	57.9	Yellow Clay & Gravel
57.9	-	60.4	Brown Gravel & Fine Sand
60.4	-	63.5	Sandy Brown & Dark Stained Gravel
63.5	-	67	Brown Gravel Some Dark Stained & Fine Sand
67	-	68	Sandy Brown Gravel and Yellow Clay

RIG No. 4

DRILLER B. Legendyk

Appendix D

DWA Discussion Minutes

Minutes of Meeting

Well Head Protection Assessments - Discussion about Recent Assessments - Minutes

Held 19 December 2017 at 10am

at CCC

Present:	Daniela Murugesh	CCC
	Kenton Winckles	CCC
	Rob Meek	CCC
	Graham Wardman	CCC
	Judy Williamson	CDHB
	Mike Thorley	CH2M Beca
	Lisa Mace	CH2M Beca
	Paul Reed	CH2M Beca
Apologies:	None	
Distribution:	All of the above	

Item	Action
1 General ■ Inspections of 25 wells have been carried out ■ The purpose of the meeting was to discuss eight common items that are non-compliant with Criteria 2 the Drinking Water Standard New Zealand (DWSNZ) or are not considered best practice and to come to a conclusion on which items can be signed off by the Drinking Water Assessor (DWA) and which items require upgrades.	
2 Cable glands ■ CCC forwarded CityCare the list of sites where Beca identified that cable glands were not sealed. ■ CityCare has since been around to inspect the cable glands and has said that they are ok ■ Beca made the point that cable glands can appear to be sealed from above, but on closer inspection that may be loose (move when touched) which mean that sealant is required	
3 Below ground installations ■ **Decision:** DWA agreed that existing below ground installations can meet Criteria 2 (so long as the chamber is sealed) of the DWA but new wells should be installed above ground	
4 Not fenced, or fence at less than 5m ■ **Decision:** DWA agreed that wells without fences (or fences at less than 5m) can meet Criteria 2 of the DWA when they are not located in an area with livestock ■ One possible exception is wells that have been seen to have issues with vandalism and rubbish although fencing still may not be the best solution.	
5 No record of grout seals	

■ CCC is currently retrofitting grout seals on some wells ■ Grout seals are more important for non-artesian wells ■ Daniela to email Judy with a list of which wells don't have confirmed grout seals (all of the wells inspected) and the planned upgrade dates in CityCare's schedule ■ **Decision:** Judy will respond with which wells are acceptable based on how soon the grout seals will be installed and which should be retrofitted ■ Note that the Australian drilling standard provides depths that grout seals should go down to ■ Note that wells drilled after ~2014 are likely to have grout seals as the CCC standards required them.	**Daniela** **Judy**
6 Backflow Prevention ■ DWA indicated that there must be a testable backflow preventer at all sites however this could be substituted with an air gap on the inlet to the suction tank or a backflow preventer on the outlet of the pump station ■ Lisa to send Daniela a list of wells without a check valve in the well headworks (*post meeting note: completed*) ■ Daniela to confirm that these wells have check valves at the well pumps (ie foot valves) ■ **Decision:** Beca to include which bores have check valves in the bore headworks in each report for DWA approval	**Lisa** **Daniela**
7 Sump pumps ■ **Decision:** A single sump pump and a level sensor that alarms to an operator should be included on all below ground wells ■ In some cases this involves modification, or installation, of the floor to include a sump ■ In some cases low voltage power may be difficult to install in the well. Battery operated sump pumps may be considered ■ It was agreed a duty/standby sump pump is not required. ■ The sump pumps need to be on a regular testing programme	
8 No air vent ■ **Decision:** Air vents should be installed on all wells with a priority for non-artesian wells. The air vents need to be 500mm above the 100 year flood level.	
9 Miscellaneous ■ Some flowmeter chambers were found to be flooded but it was agreed that this was simply a maintenance item. That is, there'll be a programme to pump them out.	
10 Going Forward ■ Daniela to send Lisa report comments ■ Beca to finalise reports based on this meeting and CCC comments ■ Reports to include a table of discretionary items for sign off by DWA	**Daniela** **Beca** **Beca**

Minuted by: Lisa Mace