Appendix B

Base Line Water Level Data

Table B-1 Recorded and Expected Water Levels

Piezo ID	Recorded Levels (mRL)			Expected Levels (mRL)		Piezo Location
	Low	High	Average	Low	High	
2011/BH206 NE	4.52	4.90	4.72	4.05	5.27	Alignment
2011/BH206 SW	5.40	6.07	5.79	5.03	6.47	Alignment
2011/BH204 E	4.52	5.00	4.71	4.04	5.25	Alignment
2011/BH204 W	4.54	5.11	4.79	3.86	5.55	Alignment
2010/BH05	5.31	6.64	6.15	-	-	Alignment
2012/CPT14 E	4.59	4.93	4.75	3.01	5.96	Alignment
2012/CPT14 W	4.63	5.20	5.02	-	-	Alignment
2011/BH205	4.83	5.25	5.02	3.29	6.12	Peripheral
2010/BH04	4.44	4.77	4.61	3.93	4.99	Peripheral
2012/BH02 GW E	4.54	4.80	4.68	4.07	5.07	Alignment
2012/BH02 GW W	6.48	6.83	6.72	6.31	7.02	Alignment
2012/BH01 GW E	6.66	6.98	6.89	6.50	7.18	Raumati Manuka
2012/BH01 GW W	4.63	4.94	4.78	4.11	5.21	Raumati Manuka
2011/BH302 N	5.23	5.45	5.33	4.91	5.66	Wetland OA
2011/BH302 S	4.61	4.99	4.81	4.07	5.22	Wetland OA
2011/BH301 E	6.57	6.99	6.84	6.41	7.11	Raumati Manuka
2011/BH301 W	4.58	4.93	4.76	4.11	5.13	Raumati Manuka
2011/ HA WM02	6.81	7.20	7.08	6.73	7.31	Raumati Manuka
2007/BH-A	4.43	4.94	4.57	4.11	4.83	Alignment
2012/BH03 E	5.79	6.56	6.07	4.60	7.24	Alignment
2012/BH03 W	4.15	4.41	4.29	3.84	4.54	Alignment
2012/BH03 GW	3.29	3.82	3.54	2.70	4.02	Alignment
2012/BH04 GW	2.71	3.24	2.98	2.17	3.45	OSA 3A
2011/BH213 N	3.34	4.09	3.72	2.55	4.40	Alignment
2011/BH213 S	4.24	4.60	4.44	3.80	4.80	Alignment
2011/BH303 N	3.10	3.80	3.48	2.24	4.18	OSA 2
2011/BH303 S	3.10	3.83	3.49	2.22	4.22	OSA 2
2011/HA WM10	3.48	3.98	3.71	2.54	4.28	OSA 2

Piezo ID	Recorded Levels (mRL)			Expected Levels (mRL)		Piezo Location
	Low	High	Average	Low	High	
2011/HA WM09	dry	dry	3.95	–	–	OSA 2
2012/BH24 GW	3.36	4.06	3.73	2.62	4.35	Alignment
2012/BH06 GW	2.62	3.04	2.82	1.22	3.95	Alignment
2011/HA WM08	3.24	3.63	3.47	2.98	3.92	OSA 3A
2012/BH05 GW	2.54	3.02	2.76	0.96	4.04	Alignment
2007/BH-C	3.56	4.04	3.71	–	–	Wetland 3
2007/BH-B	4.43	4.67	4.56	4.10	5.00	Peripheral
2012/BH07 GW (N)	4.62	4.97	4.81	4.30	5.21	Alignment
2012/BH07 GW (S)	dry	dry	–	–	–	Alignment
2007/BH-U	4.20	4.50	4.32	3.79	4.77	Alignment
2007/BH-E	4.69	5.43	4.90	4.31	5.37	Alignment
2012/BH21 GW	4.37	4.69	4.52	3.95	4.96	Wetland
2007/BH-D	1.98	3.14	2.16	–	–	Peripheral
2007/BH-T	5.10	5.44	5.27	4.73	5.69	Alignment
2012/BH09 GW	5.51	5.90	5.70	4.90	6.13	Alignment
2007/BH-J	5.73	6.06	5.92	5.53	6.24	Alignment
2012/HA25	6.16	6.30	6.21	5.82	6.44	Alignment
2007/BH-I	6.25	7.47	6.41	5.87	6.83	Peripheral
2011/BH214	4.28	4.78	4.57	3.90	5.11	Peripheral
2007/BH-K	5.09	5.67	5.34	4.58	5.77	Alignment
2007/BH-L	2.68	3.27	2.98	2.03	3.51	Wetland
2011/HA WM04	1.86	2.32	2.10	1.24	2.66	Wetland
2008/BH202	3.28	3.71	3.48	–	–	Peripheral
2007/BH-M	1.59	1.82	1.73	–	–	Alignment
2012/BH14 GW	1.17	1.99	1.81	–	–	Alignment
2011/BH216	6.17	6.65	6.43	5.51	6.95	Alignment
2012/BH11 GW	6.06	6.56	6.31	5.44	6.80	Otaihanga Northern
2007/BH-V	6.24	6.68	6.48	5.72	6.91	Alignment
2012/BH10 GW	5.81	6.28	6.04	5.28	6.49	Otaihanga Southern
2011/BH307 N	6.57	7.05	6.83	6.11	7.27	Otaihanga Northern

Piezo ID	Recorded Levels (mRL)			Expected Levels (mRL)		Piezo Location
	Low	High	Average	Low	High	
2011/BH307 S	7.48	8.17	7.85	6.33	8.87	Otaihanga Northern
2011/BH306 N	7.34	7.57	7.49	7.29	7.67	Otaihanga Central
2011/BH306 S	6.26	6.66	6.46	5.79	6.86	Otaihanga Central
2011/BH305 N	6.36	6.71	6.53	5.92	6.89	Otaihanga Southern
2011/BH305 S	6.29	6.63	6.46	5.86	6.81	Otaihanga Southern
2012/BH20 N	2.38	2.68	2.51	1.99	2.81	Alignment
2012/BH20 S	2.43	2.67	2.52	-	-	Alignment
2007/BH-N(A)	2.00	2.76	2.19	-	-	Alignment
2007/BH-N	2.56	2.70	2.63	2.25	2.84	Alignment
2008/BH204	3.94	4.15	4.04	3.29	4.58	Alignment
2007/BH-O	2.28	2.77	2.60	2.21	2.86	El Rancho Wetland
2011/HA WM05	2.46	2.95	2.72	1.61	3.55	El Rancho Wetland
2011/BH215	2.83	3.00	2.90	-	-	Alignment
2012/BH15 GW (N)	2.72	2.84	2.78	-	-	El Rancho Wetland
2012/BH15 GW (S)	2.73	3.46	3.13	2.14	3.97	El Rancho Wetland
2008/BH205	2.90	3.06	3.00	2.82	3.19	Peripheral
2007/BH-R	3.21	3.49	3.30	3.04	3.48	Alignment
2012/BH25 GW (E)	2.95	3.07	3.02	-	-	Wetland 9
2012/BH25 GW (W)	3.01	3.33	3.18	2.62	3.61	Wetland 9
2012/BH16 GW (E)	2.81	2.95	2.89	2.72	3.04	Wetland 9
2012/BH16 GW (W)	2.80	3.44	3.20	2.34	3.97	Wetland 9
2012/BH22 GW (E)	2.62	2.80	2.71	2.35	3.00	Alignment
2012/BH22 GW (W)	2.67	2.83	2.75	2.39	3.04	Alignment
2010/BH07	2.31	2.75	2.49	-	-	Alignment
2012/BH26	1.69	2.16	1.94	0.79	2.84	Alignment
2011/BH207 E	2.33	2.65	2.41	-	-	Alignment
2011/BH207 W	2.27	2.69	2.46	1.63	3.11	Alignment
2007/BH-S	1.76	2.35	2.16	1.90	2.40	Peripheral
2007/BH-Q	2.13	2.32	2.23	1.97	2.50	Peripheral
2012/BH17 GW	dry	dry	-	-	-	Alignment

Piezo ID	Recorded Levels (mRL)			Expected Levels (mRL)		Piezo Location
	Low	High	Average	Low	High	
2011/BH208	4.49	4.58	4.53	4.28	4.68	Alignment
2012/BH18 GW	4.60	4.81	4.70	4.13	5.05	Wetland
2011/BH209	4.53	6.29	6.16	5.76	6.46	Wetland
2010/BH12	5.55	6.19	5.83	5.05	6.31	Alignment
2011/BH211	3.92	4.28	4.05	–	–	Alignment
2011/BH211A	4.51	5.06	4.71	4.02	5.12	Alignment
2012/BH 20 GW	5.31	5.69	5.51	4.82	6.00	Alignment
2012/BH23 GW	4.85	5.05	4.95	4.00	5.65	Alignment
2011/BH210	4.43	4.89	4.71	–	–	Alignment
2012/BH28	5.07	5.34	5.19	4.69	5.62	Ngarara Wetland
2010/BH13 N	6.61	7.09	6.87	6.16	7.51	Alignment
2010/BH13 S	6.63	7.07	6.86	6.32	7.35	Alignment
2012/BH19 GW	5.21	5.47	5.33	4.57	5.83	Wetland
2011/BH309 N	7.69	8.21	7.90	7.02	8.43	Alignment
2011/BH309 S	7.46	8.07	7.72	6.81	8.28	Alignment
2011/BH308 N	7.28	7.76	7.49	6.35	8.25	Alignment
2011/BH308 S	7.16	7.90	7.49	6.32	8.20	Alignment
2012/BH37 E	8.02	8.78	8.38	7.18	9.11	Alignment
2012/BH37 W	8.06	8.75	8.34	7.17	9.04	Alignment
2011/BH310 E	8.09	8.68	8.38	7.54	8.90	Alignment
2011/BH310 W	8.04	8.63	8.31	7.41	8.85	Alignment
2010/BH16	9.67	10.51	10.18	9.15	10.83	Alignment

*OSA: Offset Storage Area

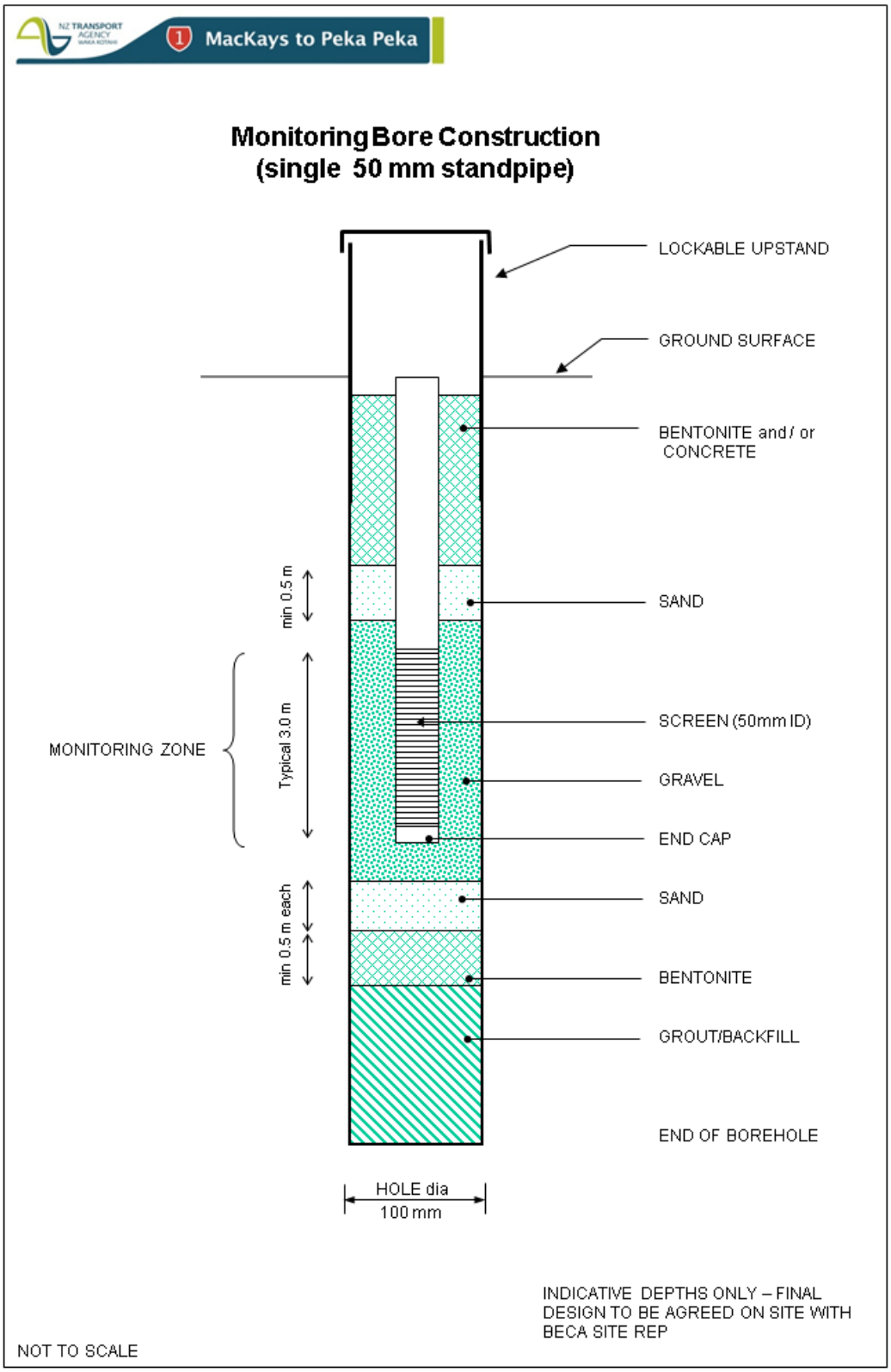
Appendix B1 – Base Line Stream Gauging Data

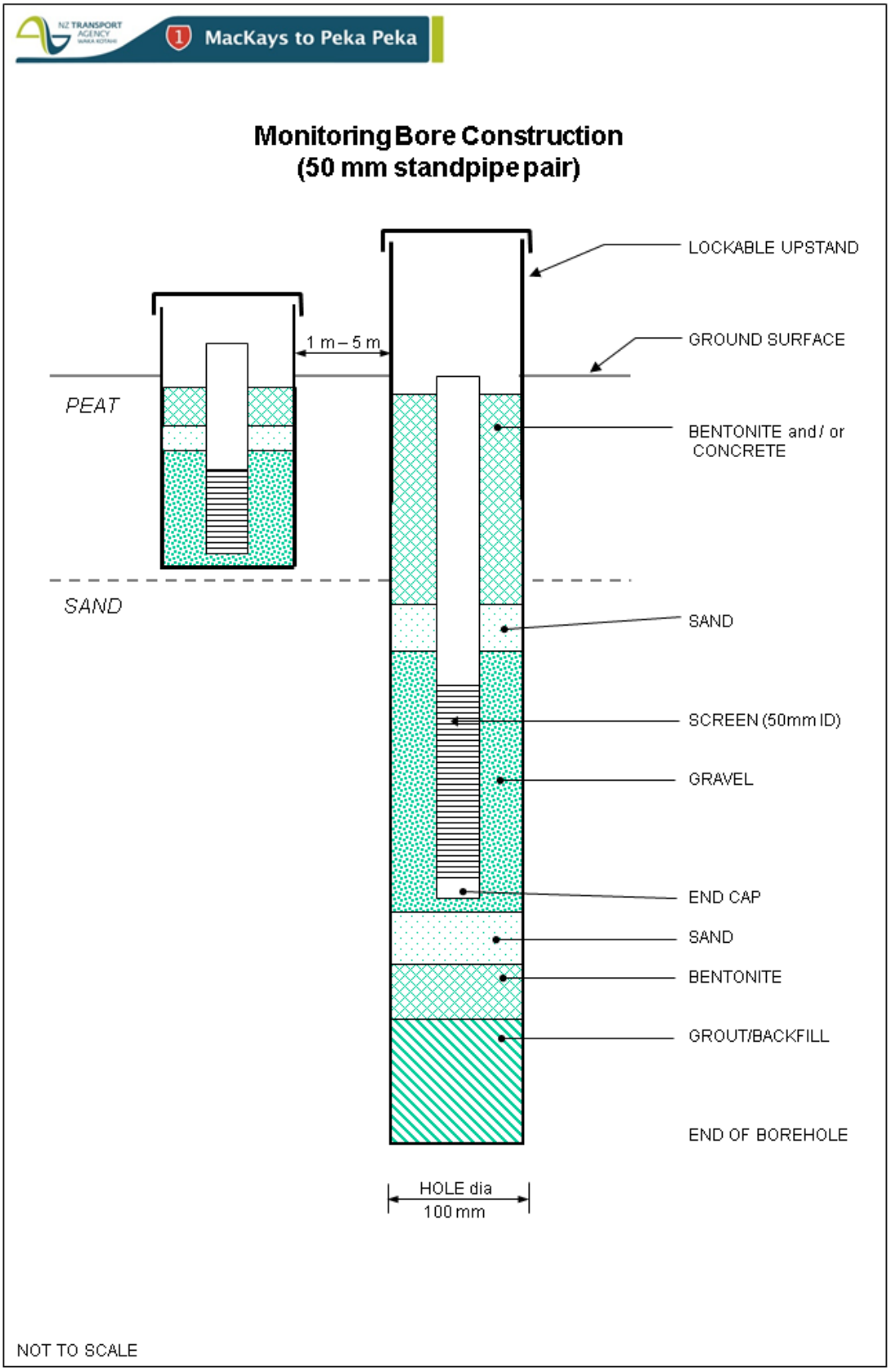
- Data will be entered once flow gauges are established

Appendix C

Monitoring Installation Details

Piezometers have been installed so that as far as possible, the screened interval targets a separate geological unit. Typical installation details
follows.




MacKays to Peka Peka
Monitoring Bore Construction
(50 mm standpipe pair)
LOCKABLE UPSTAND
GROUND SURFACE
1 m – 5 m
PEAT
BENTONITE and / or
CONCRETE
SAND
SAND
SCREEN (50mm ID)
GRAVEL
END CAP
SAND
BENTONITE
GROUT/BACKFILL
END OF BOREHOLE
HOLE dia
100 mm
NOT TO SCALE

Appendix D

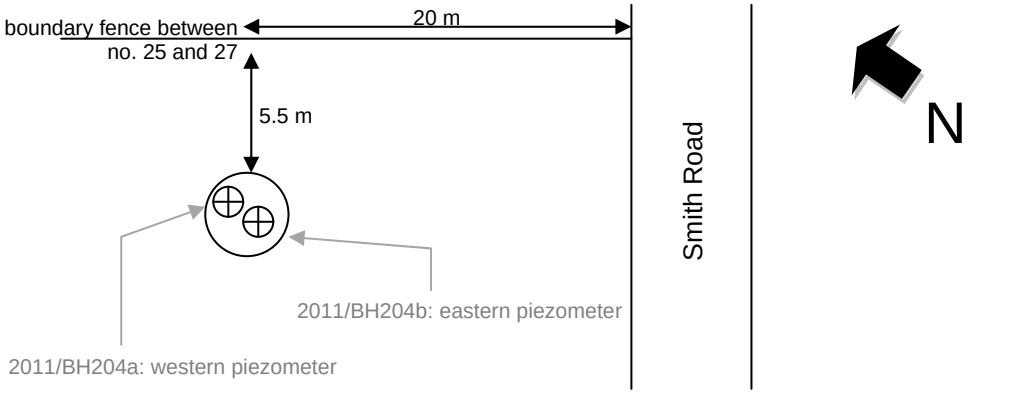
Groundwater Reporting Templates

Data collection Sheets

Water level data is collected and recorded on a data collection sheet as below or similar.

Typical Field Sheet

Groundwater Monitoring Field Sheet	
Project Name	Mackays to Peka Peka Expressway
Project No.	3320901/500
Date & Time	
Weather	fine / overcast / dry / raining / recent rainfall
Field Personnel	

2011/BH204							
Piezometer	Level (RL m)		Screened Unit	Screened Depth (m)	Time	Depth to GW (m btoc)	Depth to GW (m bgl)
	Ground	T.O.C					
2011/BH204a	4.30	4.45	Holocene Peat	1.5 – 3.0			
2011/BH204b	4.30	4.50	Holocene Sand	5.0 – 8.0			
	Location Plan						
	 NOT TO SCALE						
	Comments:						

Appendix E

Example of Response Action to Alert and Action Triggers in Wetlands

Table E-1: Example of Responses to Alert and Action Triggers in Wetlands

Wetland	Groundwater Alert Level	Groundwater Alert Action		Groundwater Action Management	Ecological Adaptive Management
Raumati Manuka	0.1 m outside of "naturally" occurring range for each piezometer (refer Section 8.1)	Notify the Alliance's Project Manager and GWRC, in writing, within 2 working days		Any activity that has the potential to cause adverse effects (such as increasing drawdown) will be ceased until mitigation measures implemented. The following people will be notified: ▪ The Project and Site Managers; ▪ GWRC; and ▪ The Environmental Management Team	Establishment of an adjustable weir to control water within the existing drain through the centre of the wetland
					Permanent infilling of the existing drain to increase groundwater levels consistent with any lowering of groundwater
		Re-check measurement over 3 consecutive days. If exceedance remains, increase frequency of groundwater level monitoring to daily for all bores within 200m radius of the affected monitoring bore and evaluate according to the methodology set out in 8.1	Recovery of the groundwater level at that monitoring bore to above the trigger level; OR Reductions in volume or outlet of flood storage wetland. A trend of increasing groundwater level over at least three (3) consecutive weeks; OR Analysis of the data indicates that adverse effects are not anticipated, in which case revised trigger levels would be set with approval of the Project Manager, Environmental Management Team and GWRC		Reductions in volume or outlet of flood storage wetland
					Control of invasive weed species that have established as a result of hydrological changes deemed to arise from the Expressway construction
				Works may recommence or recommence without mitigation once groundwater levels return to sub-Action levels Alternatively, works may recommence if written notice is received from GWRC indicating that they are satisfied that damage to buildings, structures and services or impacts on wetlands are unlikely	Replanting of any areas of die-back with suitable indigenous species
					Additional mitigation opportunities at other wetlands within the study area, including restoration of the area surrounding El Rancho wetlands

Appendix F

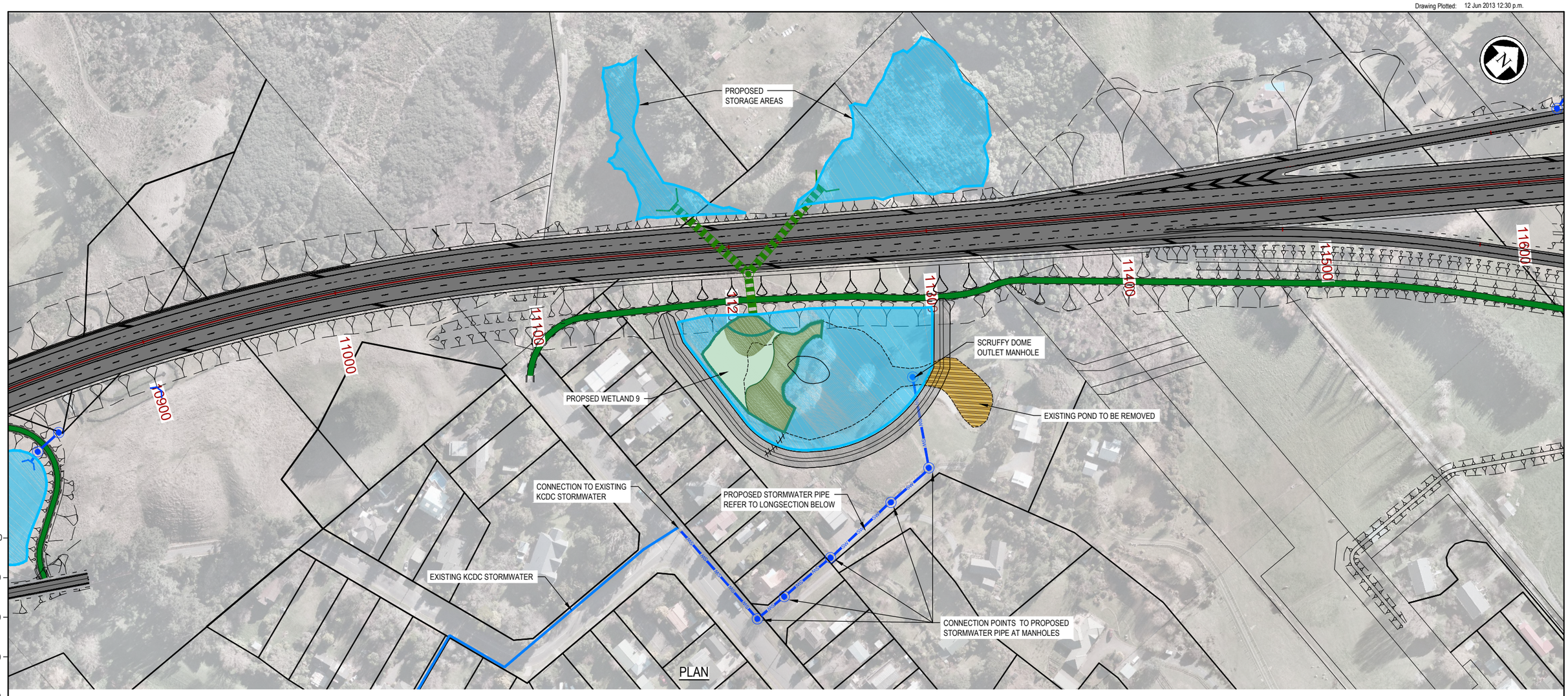
Example of Response Action to Alert and Action Triggers in Wetland 9

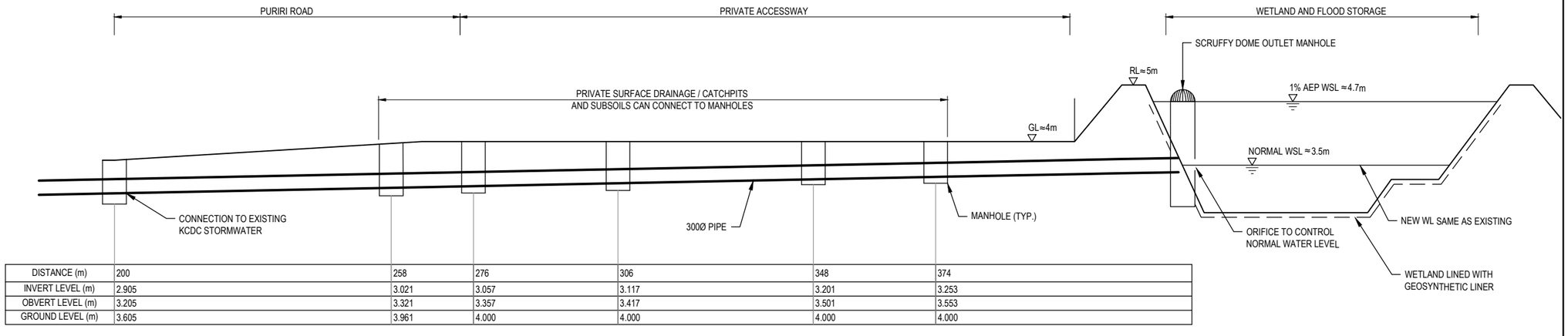
Table F-1: Example of Responses to Alert and Action Triggers in Wetland 9

Wetland	Groundwater Alert Level	Groundwater Alert Action		Groundwater Action Management	High Groundwater and Ecological Adaptive Management
Wetland 9 (El Rancho)	0.1 m outside of "naturally" occurring range for each piezometer (in accordance with the procedure set out in Section 8.1)	Notify the Alliance's Project Manager and GWRC, in writing, within 2 working days		Any activity that has the potential to cause adverse effects (such as increasing drawdown) will be ceased and mitigation measures implemented[1]. The following people will be notified: ▪ The Project and Site Managers; ▪ GWRC; ▪ Adjacent landowners; and ▪ The Environmental Management Team	Provision of private connections to the new stormwater pipe for surface runoff, to drain that ponded water
		Re-check measurement over 3 consecutive days. Increase frequency of groundwater level monitoring to daily for all bores within 200 m radius of the affected monitoring bore and evaluate according to the methodology set out in 8.1.	Recovery of the groundwater level at that monitoring bore to above the trigger level; OR Reductions in volume or outlet of flood storage wetland. A trend of increasing groundwater level over at least three (3) consecutive weeks; OR Analysis of the data indicates that adverse effects are not anticipated, in which case revised trigger levels would be set with approval of the Project Manager, Environmental Management Team and GWRC.		Allow for shallow depth private subsoil drainage to also connect to the new stormwater pipe, to assist in the management of high groundwater levels and wet ground Implement accidental artesian water interception plan if appropriate
				Works may recommence once written notice is received from GWRC indicating that it is satisfied that the risk of flooding of adjacent properties or flooding or drying out of wetlands is unlikely	Additional mitigation opportunities at other wetlands within the study area, including restoration of the surrounding El Rancho wetlands

[1] Mitigation will be implemented in accordance with the conceptual design agreed with GWRC and adjacent landowners set out on the following page

Drawing Plotted: 12 Jun 2013 12:30 p.m.





DISTANCE (m)	200	258	276	306	348	374
INVERT LEVEL (m)	2.905	3.021	3.057	3.117	3.201	3.253
OBVERT LEVEL (m)	3.205	3.321	3.357	3.417	3.501	3.553
GROUND LEVEL (m)	3.605	3.961	4.000	4.000	4.000	4.000

LEGEND:

- EXISTING STORMWATER
- SW — PROPOSED STORMWATER
- PROPOSED MANHOLE
- PROPERTY BOUNDARY
- PROPOSED CULVERT

1 / - PROPOSED STORMWATER LONG SECTION

1:500 H, 1:50 V (A1)

A1 REPRODUCTION SCALE: 100 80 60 40 20 0mm

A3 REPRODUCTION SCALE: 50 40 30 20 10 0mm

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Chk V	Appd	Date
A	FOR INFORMATION	AMcL				12.06.13

				Approved For Construction*
Original Scale (A1) 1:1000	Design	GL/AW	06.13	
	Drawn	IL	12.06.13	
Reduced Scale (A3) 1:2000	Dsg Verifier			Date
	Dwg Check			

* Refer to Revision 1 for Original Signature

NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

Project: SH1 MACKAYS TO PEKA PEKA EXPRESSWAY RP 1012/0.00 TO 1023/5.00

Title: GMP WETLAND 9 PLAN AND LONG SECTION

Drawing No: M2PP - GMP SK0001

Rev. A

Document created for NZTA by M2PP Alliance, Level 2, 17-21 Whitmore St, WELLINGTON

DO NOT SCALE IF IN DOUBT ASK.

Document No. M2PP - GMP SK0001.DWG

Appendix G

Accidental Artesian Aquifer Interception Plan

Accidental Artesian Aquifer Interception Plan

1.1 Purpose and scope

This Accidental Artesian Aquifer Interception Plan (AAAIP) forms part of the environmental controls within the Groundwater Management Plan for the construction phase of the Project. The AAAIP addresses the potential for accidental interception of artesian groundwater, during earthworks and piling construction activities between the Waikanae River and the northern side of the El Rancho wetlands.

While it is anticipated that some groundwater will be intercepted during the normal course of earthworks and consents and compliant procedures are in place to address this, the purpose of this AAAIP is to set out the activities that would need to be carried out to mitigate and remediate:

- Accidental artesian aquifer interception in an excavation;
- Accidental artesian aquifer interception during pile installation;
- Unexpected interception of large non-artesian groundwater inflow to an excavation.

The AAAIP provides an overall framework for the control of accidentally intercepted groundwater.

1.2 Construction Methods

The following subsurface construction techniques will be utilized that might result in accidental interception of aquifers:

- Driven concrete piles penetrating the underlying aquifers;
- Shallow footings founded on sandy gravels;
- Earthworks excavations.

1.3 Operating/management procedures

- Maintain adequate supplies of Portland cement, grout additives, sand bags, bentonite and geotextile. If an artesian flow is sediment laden, time is crucial.
- Understand grout mix design calculation procedure. By measuring the artesian head and knowing the depth at which the flow was encountered, a grout mix can be designed with a sufficient unit weight to arrest the flow. An underweight grout mix will not only be unsuccessful but may hinder further attempts to stop the flow.

- Emergency phone contact list. Establish an emergency phone contact list. Include phone numbers for GWRC, the Engineer, the pilling company, local suppliers, and any supporting or stand-by contractors that may be of assistance.

1.4 Observer Equipment

- Cellular phone, camera. Be prepared to communicate the artesian situation with GWRC and the Engineer and effectively document the situation.
- Water level indicator (dip meter) and tape measure. Determine the height of artesian flow. A water level indicator should be used to determine the height (additional casing stickup may need to be added).
- 1000 ml graduated cylinder or measuring cup. Allows a qualitative estimate of the turbidity of the flow or used with a timer, determination of the rate of flow.
- Grout mix design property sheets. Typical mix design details to readily establish the cement content based on the artesian head and depth encountered. Include use of additives to increase grout unit weight.

1.5 Remedial Equipment

- Non-coated bentonite chips. For sealing the annular space of bored piles to confine the flow to within the casing so a head and flow rate can be measured.
- Packers, riser pipe, pressure gauges and appropriate fittings. Artesian flow may be cut off with use of a packer system at depth within the pile hole. Pressure gauges may be used to determine the artesian head and flow meters to determine rate of flow. This equipment is needed high flow/ high volume artesian situations.
- Portland cement and necessary amendments. Portland cement is the key component of any grout mixture should the pile hole or excavation need to be immediately abandoned. Bentonite addition can be used in low flow conditions, calcium chloride additives can be used to accelerate the set time of the grout and thixotropic modifiers can be used to increase grout viscosity and limit fluid mobility.
- Portable grout plant with moyno pump. Necessary to achieve the desired grout consistency, especially if a heavier grout is needed to arrest the artesian flow.
- Geotextile and sandbags. These items can be used after grouting to filter any additional artesian flow while the grout sets and provide a normal force at the top of the hole.
- Polymer Drilling Mud. Use of a drilling mud will create a head differential to offset and suppress low artesian flows during pile advancement.

1.6 Implementation

This section outlines steps to be taken to control, stop, and seal groundwater flow during construction.

1.6.1 Piling

Avoidance of interception of artesian aquifers in piling is desirable to:

- Avoid floating of piles
- Avoid depressurisation of the aquifer
- Avoid the potential for mixing of water from different aquifers and possible spread of contaminants if depressurisation occurs.

a. Driven Piles

No remedial action should be needed.

b. Bored Piles

The following steps shall be taken in areas potentially susceptible to artesian flows: precast tremmie down centre; pot hole; redesign foundation to fit

- Install a temporary casing around the pile to 8 m below ground surface
- Complete the drilling of each pile hole using a high viscosity, dense polymer
- Once full depth is reached, complete the pile with concrete tremmied from the base up
- Recover and re-use the displaced polymer which will be pumped from the hole as the tremmie proceeds
- Have any remaining neutralized polymer trucked away by Envirowaste.

The polymer to be used should be a 1:1 mix of SC mud P System (produced by ECP Ltd, Environmental Control Products) or similar, and soda ash.

The density of the polymer must be sufficient to exceed the artesian pressure of the aquifer. The viscosity of the polymer will allow the hole to remain open until the tremmie is complete and avoid penetration of the concrete into the aquifer. The concrete will seal against the formation.

c. Artesian Pressures above the Ground Surface

In the unlikely event that artesian ground water is encountered above the ground surface, the following procedures will apply:

- Stop work
- Contact the Engineer
- Mitigation works are likely to include the following:

- a vertical pipe will be attached to the pile hole. The water inflow will be allowed to stabilise within the pipe and its level above ground measured
- if the level inside the standpipe exceeds 2 m above ground, provision will be made to hold the standpipe in place by added weight
- The hole would be grouted using 1:1 (by volume) water: cement ratio grout. Grout will be injected at the base of the hole at pressures controlled to be 2-3m above the static water level. Grouting can be done either through the extended standpipe or injected through a pipe inserted into the base of the hole
- Grouting will be discontinued at refusal
- After the grout has set, the hole will be tested to see if the hole has sealed off prior to drilling recommencing. If necessary grouting will be repeated.

Methods of addressing artesian conditions include:

- Implement an accelerated monitoring program.
- Extend the surface casing to compensate for the additional head by using platforms.
- Monitor seasonal groundwater fluctuations and perform operations when piezometric levels are lower.
- Use a higher specific gravity drilling mud to counter the higher artesian head.

1.6.2 Excavations

Avoidance of interception of artesian aquifers or large groundwater inflows to excavations is desirable to:

- Avoid piping of sands into the excavation or heave of silts;
- Avoid excessive pumping, drawdown and potential ground settlement;
- Avoid the need to discharge large volumes of sediment laden water.

a. Larger Earthworks Excavations

In the case of uncontrolled aquifer inflows to larger excavations bound by sheet piles or similar, the following steps shall be taken:

- **Assess the situation**. Determine if the flow is constant or increasing. Determine if the turbidity is constant or increasing. Determine if the flow is confined to the pile hole or excavation, and if not, take measures to confine flow.
- **Notify project engineer and/or project manager**. Be able to describe in detail the conditions and events prior to encountering artesian flow.

- **Email photos and/or video, in real-time if possible.** Consult with the Engineer and determine primary strategy and contingency plan should the primary strategy be insufficient to arrest the artesian flow.
- **Notify GWRC**. Inform GWRC and NZTA representative of the situation and planned action items.

Activities are likely to be:

- Tremmie mass concrete into the excavation until the mass of the concrete is sufficiently heavy to stem the flow; a thickness of 1.5 m to 2 m is likely to be needed
- Install a vibrating wire piezometer in the grout in a suitable location to allow monitoring of water pressure
- Control any discharge of water by established site erosion and sediment control measures
- Pump out excess water to the sediment control basin
- Leave overnight for the concrete to harden
- Pump all water from the excavation
- Replace any material lost from the breached excavation with graded granular materials
- Monitoring of the material to ensure no leakage and the aquifer is fully sealed. If the seal does not hold, notify GWRC Officer. There are two options in this case: A) Repeat the exercise, B) Excavate out and fill with site concrete.
- If the plug seals, the trench base will then be compacted with non-vibration techniques to ensure a solid bonding between the plug and the surrounding material. This material will be tested with a Scala Penetrometer to ensure sufficient bearing capacity in the soils. If the soils are too soft, the fabric wrapped granular raft will be constructed in the trench. This will be compacted and tested with a Nuclear Densometer. This will be followed with the compaction of the trench bedding and haunching. Again the material will be tested with a Nuclear Densometer. The trench will then be back filled with the prerequisite material and again compacted and tested with a Nuclear Densometer.
- If the excavation is such that it is part of a larger excavation not yet complete, proceed to progressively excavate to depth and backfill the base with mass concrete.

b. Shallow Footings or Pipe Laying

In the case of excavation of sumps or piles or the laying of pipes, the method described for larger excavations could be used or the use of concrete could be substituted with the placement of filtered gravels which will allow water to continue to flow but avoid piping.

1.7 Roles and responsibilities

All Site Staff

- Attending inductions, tool box talks and training to manage accidental artesian aquifer interception
- Responsible for reporting all incidents involving accidental artesian aquifer interception
- Ensuring processes for managing accidental artesian aquifer interception are adhered to.

Environmental or Project Manager

- Prepares, reviews and updates AAAIP
- Monitors and reports performance against the AAAIP
- Ensures sufficient resources are provided to manage accidental artesian aquifer interception in accordance with the AAAIP
- Provides leadership to the Project team in this area.

1.8 Review

This section describes how the AAAIP will be reviewed, including looking at the environmental controls and procedures to make sure that they are still applicable to the activities being carried out.

The AAAIP will be reviewed by the Principal Contractor(s) after confirmation of the resource consent and designation conditions and will be revised in accordance with those conditions. The AAAIP will be updated, with the necessary approval, throughout the course of the Project to reflect material changes associated with changes to construction techniques. Approval from the GWRC will be required for any relevant revisions of a material nature for the AAAIP.

A review of the AAAIP will be undertaken after any encounter of artesian aquifer conditions by the Principal Contractor(s). The review will be organised by the Environmental or Project Manager. The review will take into consideration:

- Any significant changes to construction activities or methods
- Key changes to roles and responsibilities within the Project
- Changes in industry best practice standards or recommended controls
- Changes in legal or other requirements (social and environmental legal requirements, consent conditions, NZTA objectives and relevant policies, plans, standards, specifications and guidelines)
- Results of inspection and maintenance programmes, logs of incidents, corrective actions, internal or external assessments
- The outcomes of implementation of the plan.

Reasons for making changes to the AAAIP will be documented. A copy of the original AAAIP document and subsequent versions will be kept for the Project records, and marked as obsolete. Each new/updated version of the AAAIP documentation will be issued with a version number and date to eliminate obsolete AAAIP documentation being used.

Appendix H

Independent Review Comments

INDEPENDENT REVIEW OF GROUNDWATER (LEVEL) MANAGEMENT PLAN
Independently Reviewed by: GWS Limited
Date of Independent Review: 21 May 2013
Signature of Independent Reviewer:

Condition Reference	*Condition*	*Independent Reviewer's comment*	*Page/paragraph/section reference within Management Plan*	*Management Plan Author's response*
G.28A a)	That there shall be no changes to the groundwater levels that shall result in a significantchange to wetland hydrological conditions	A key element in being able to identify when a 'significant change' occurs is the frequency of monitoring undertaken. Is the monthly monitoring interval in 12 months prior adequate? Given the wetland environments and potenital response to rainfall events, hourly intervals (ie. using data loggers on selected bores) should be used to to allow the undertsanding of the temporal relationships between ground and surface waters.	*5.1.3*	I concur. Propose that dataloggers are installed in all piezometers used to record changes in sensitive wetlands as listed in Table 2. Comment added to text to reflect this.
		Given the operation of the construction water supply bores, how will shallow groundwater (i.e. leakage) effects from pumping be differentiated from those due to the construction itself on the groundwater level monitoring record. Any pumping testing (Condition GT5) undertaken should be designed with this in mind.	*2.5*	Pumping testing will be carried out at each construction water supply bore site in accordance with condition GT.5 with monitoring in both shallow piezometers installed as part of the project and existing private bores that are able to be monitored . The construction works proposed in the vicinity of each bore will be considered in the pumping test design to allow identification, as far as possible, of the cause of any unacceptable drawdown that might occur in an existing bore. We anticipate that the response will be readily distinguished by comparing the timing and pattern of abstraction, the timing and nature of drawdown associated with the works and the effect recorded as compared with the pumping test data. Irrespective, if a private water supply bore is affected either by either abstraction or construction, mitigation will be implemented. Inserted the words "shallow and deeper" in 2.5.
G.29 c)	The GMP shall be finalised in consultation with Te Ati Awa ki Whakarongotai and Takamore Trust.	No evidence provided that the GMP has been developed in conjuction with / or approved by the Trust.	3.1	The GMP has been circulated to Te Ati Awa ki Whakarongotai and Takamore Trust for information and seeking feedback on what type of input these parties would like to have. On receipt of this feedback it will be incorporated in section 3.1.

G.29 d) v)	Details of how the monitoring and management, including the anticipated length of time temporary effects on existing water supply wells, may occur;	No details for managing temporary effects to supply wells provided. Deferred effects through conditions GT1-GT6 indirectly satisfy condition.	2.5	GT.1 - GT.6 require pumping testing and assessment of effects and identification of mitigation strategies at each construction water supply well site. These will be inserted in the GMP as they are completed and authorised by GW. A sentence confirming this has been added to 2.5.
G.29 d) ix)	Consultation procedures with the owners of affected existing groundwater bores, including owners of businesses reliant on bore water;	No consultation procedures with the owners of affected existing groundwater bores. Deferred effects through conditions GT1-GT6 indirectly satisfy condition.	7.1	Consultation with potentially affected existing bore owners will take place as each construction water supply bore site is confirmed to facilitate monitoring during pumping testing. A strategy is set out in 7.1. Appropriate details will be included in the GMP progressively as the bores are constructed and tested. a sentence stating this has been added at the conclusion of 7.1.
G.29 d) x)	Alert and action programmes, including the details of a range of mitigation options that can be implemented;	Mitigation options not discussed WRT groundwater bores. Deferred effects through conditions GT1-GT6 indirectly satisfy condition.	10.2	As above. Section 10.2 to be updated as this area is more fully developed and approved by GW in accordance with conditions GT.1 to GT.6.
General GMP Report Comments	If groundwater effects beyond those estimated occur then the Project team will pass on the findings and coordinate any discussions with the affected party. The Project team will implement measures to limit groundwater drawdown, effects on surface water bodies and ground settlement, and carry out remedial actions on affected buildings and services.	Any action should be provisional pending GWRC agreement.	Section 3	Statement updated to identify that such works would be with GW agreement
Accidental Artesian Aquifer Interception Plan	Required under GMP	Not provided or reviewed.		Was attached as Appendix G

Appendix I

GWRC and KCDC Review Comments

GWRC and KCDC REVIEW OF FINAL DRAFT GMP
Reviewed by: Brydon Hughes
Date of Review: 17 June 2013
Signature of Reviewer:

Condition Reference	*Condition Detail*	*GWRC Reviewer's comment*	*Page/paragraph/section reference within Management Plan*	*Management Plan Author's response*
G.28A	That there shall be no changes to the groundwater levels that shall result in a significant change to wetland hydrological conditions	The GMP does not provide any reference to the use of automated monitoring. As discussed during the expert conferencing, use of automatic groundwater level recorders at selected sites could provide useful data to characterise groundwater level response at key points along the Expressway alignment (e.g. sensitive wetlands, Wetland 9 / Tockers Pond)	Section 5.1, Page 9/10	Agree. This is addressed in section 5.1.3 a) final sentence: "Data-loggers will be installed in piezometers located in proximity to sensitive wetlands (those set out in Table 2 of Section 8.1) to allow more frequent collection of water level data (hourly as far as practicable) that might aid understanding of wetland behaviour." And at 5.1.3 b final sentence "Where data-loggers have been installed in piezometers, these will continue to record water levels at hourly intervals (as far as practicable)."
		It is recommended that the monitoring report include specific reference to the 'departure' from background for water levels monitored in sensitive wetlands (possibly in graphic form). The report should also note any updates to correlations used to establish 'background' groundwater levels (and stream flows in the case of spot gaugings being used instead of automatic flow recorders - see comment on Section 8.4)	Section 6.1.1 - Monitoring: Pre-construction and during construction	Agree. The following bullet has been inserted in 6.1.1 (now bullet 3): "'Departure' of recorded water levels from background water levels for piezometers set out in Table 2 (those located in proximity to sensitive wetlands)" and the words "(updated correlations with GWRC wells)" have been inserted in bullet 5 such that it now reads " Established alert levels and any recommended changes to these (updated correlations with GWRC wells) based on the longer monitoring record prior to works being carried out that could affect a particular area"
		The draft GMP notes that any recommended changes to alert levels will be included in the three-monthly reports. Given there is the potential for a somewhat adaptive approach to these triggers (at least during the initial monitoring period), it may be worthwhile considering the establishment of a separate process for reviewing water level triggers to enable monitoring to evolve over time in a manner which is not necessarily tied to the three monthly reporting schedule.	Section 6.1.1 - Monitoring: Pre-construction and during construction	I consider the 3-monthly interval for reporting of suggested changes to alert levels to be sufficient. That does not preclude discussion of these with GWRC at any time. As it will take a period of monitoring to determine whether any changes might be appropriate, I am comfortable with this.
		Reporting should also include documentation of actions undertaken in response to exceedence of alert or trigger levels during the reporting period	Section 6.1.1 - Monitoring: Pre-construction and during construction	Currently these are documented in the annual reports (Section 6.2 of the GMP). These can also be identified in the 3 monthly reports if relevant. A final bullet is included in 6.1.1 " Any actions undertaken in response to exceedance of alert levels during the reporting period."
		If it is not possible to establish automated flow recorders at the proposed sites, changes in stream discharge resulting from Expressway construction should be assessed by developing a correlation between gauged flows and a representative flow site in the area prior to construction commencing (most likely the GWRC Waharemauku Stream at Coastlands site). This may require gauging at a more frequent intervals during the initial monitoring period	Section 8.4, Page 20 - Monitoring of stream flows	The primary purpose of the gauging is to try to verify the modelled changes to flow in the Wharemauku. The Wharemauku is not identified as a sensitive stream of particular value. We acknowledge that the order of magnitude of change modelled might not be able to be picked up by the monitoring irrespective of difficulties such as plant growth. If flow recorders cannot be usefully established we propose to carry out a simple survey of the streambed and stream elevation at the identified locations at monthly intervals. Correlation with flows at the downstream gauge are not helpful as the purpose of the monitoring is to assess the loss and return of water to the stream in the vicinity of wetland 2/3a. A viable correlation to determine difference cannot be established with 1 year of pre-construction monitoring in the case of surface water.
		This section notes that the 'relevant model' will be updated to reflect actual ground conditions encountered in excavation of stormwater storage areas and wetlands. Does this refer to the numerical groundwater model? If so, is there a process for reporting the revised model assessment (including any changes to trigger levels in the general alignment piezometers)?	Section 8.6, Page 20 - Monitoring of ground conditions	Updating the model/s is a part of the design/construction process. Where this indicates that there should be a change to established trigger levels in piezometers, the data and revised model/s will be presented to GW and KCDC as part of evidence supporting such a proposal.
		If ponding were to be an issue, provision should be made to record the spatial extent of surface ponding at regular intervals	Section 9.3, Page 22 - Ponding groundwater indicator	Agree. Sentence added to section 9.3 that states "Should surface ponding occur in an area where monitoring indicates raised water levels in piezometers, the extent of the surface ponding will be mapped on a weekly basis until such ponding, if found to be a result of project works, is mitigated."
		This section notes that actions set out in the EMP and LMP will be initiated if relevant trigger levels are exceeded. This section would link better with the relevant plans if more details were provided in this section (including a process for establishing the 'significance' of any exceedence in terms of wetland ecology or other effects and determination of an appropriate management response(s))	Section 9.4, Page 22 - Wetlands	Actions should not be duplicated so that they appear in two different plans as there is a risk that an update in one will not be transferred accurately to another or that the base plan is not fully considered if some of the information is duplicated. For this reason, section 9.3 has been removed to section 3.3 of the SEMP, with reference in the GMP. I do however agree that it is helpful to reference specific sections in the EMP and have included these.

Appendix J

Consultation Record

CONSULTATION FOR: Groundwater (Level) Management Plan (GMP) - To be completed in accordance with consent conditions

Name of Management Plan Author: Ann Williams

Signature of M2PP Management Plan Author:

TBC

Signature of M2PP Compliance Manager:

TBC

Condition Reference No:	*Party/parties consulted*	*Consultation undertaken by*	*Date and location of consultation*	*Views of party/parties consulted*	*Have views been incorporated into the management plan?*	*Where and how views have been incorporated into the management plan?*	*If views have not been incorporated into the management plan, outline the reason/s why not*	*Has the condition been complied with?*
TBC								