Investigating the use of resource condition trigger levels for groundwater management in the Adelaide Plains Water Allocation Plan

Department for Environment and Water

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Foreword

The Department for Environment and Water (DEW) is responsible for the management of the State's natural resources, ranging from policy leadership to on-ground delivery in consultation with government, industry and communities.

High-quality science and effective monitoring provides the foundation for the successful management of our environment and natural resources. This is achieved through undertaking appropriate research, investigations, assessments, monitoring and evaluation.

DEW's strong partnerships with educational and research institutions, industries, government agencies, regional boards and the community ensures that there is continual capacity building across the sector, and that the best skills and expertise are used to inform decision making.

John Schutz
CHIEF EXECUTIVE
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Acknowledgements

This work has been supported by Adelaide and Mount Lofty Ranges and Green Adelaide Boards, who have facilitated the approach taken by DEW to evaluate the groundwater management within the Plan that support the achievement of the Plan's objectives. In addition, we would like to thank Stuart Richardson (CDM Smith Pty Ltd) for his external review of work that supported this report, with constructive and targeted comments that have improved the focus and clarity of this report.

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Executive summary

The Adelaide Plains Water Allocation Plan (the Plan) sets out the management arrangements for the allocation and use of groundwater within the Northern Adelaide Plains and Central Adelaide Prescribed Wells Areas.

This document summarises the investigations that were undertaken to determine the groundwater management approaches (use of recommended extraction limits and resource condition trigger levels) within the Plan that support the achievement of the Plan's objectives.

Key objectives relevant to this work (as set out in the Plan) are:

- Provides for the flexible and variable use of groundwater at times and in areas where needed to maximise economic and social outcomes.
- Ensures that groundwater resources are managed within acceptable resource condition limits.
- Provides security of water access entitlements to users of the resource.

This is the primary document with respect to the groundwater science supporting the Plan and its management responses. Related reports have been summarised within this document, including the Resource Capacity Report (Watt et al., 2017) and the work that supported the development of the proposed groundwater management responses.

The objectives of the Resource Capacity Report were to determine the groundwater resource capacity and based on that capacity, develop recommended extraction limits for the Northern Adelaide Plains and Central Adelaide Prescribed Wells Areas, to be used in the development of the Plan. The Resource Capacity Report establishes a system of 20 groundwater management zones (GMZs) with recommended extraction limits for each. Of the 20 GMZs, 16 are at less than 100% allocation and the T2 NAP (4595 ML/y) is at 102% allocation. Monitoring will continue in these GMZs to enable continued assessment of resource condition; however, no management response is currently required as both the allocation and extraction from within these GWMZs is at, near or less than 100%.

There are three GMZ where the sum of proposed Water Access Entitlements, and therefore initial allocations exceed the recommended extraction limit:

- T2 Kangaroo Flat (2,058 ML/y allocation, 137% of recommended extraction limit); and
- T2 Virginia (13,862 ML/y allocation, 125% of recommended extraction limit);
- T1 NAP (4,685 ML/y allocation, 113% of recommended extraction limit).

Although these GMZ's are over-allocated, they are not considered over-used, as the current extraction is less than the total volume allocated. However, the risk to the resource should the full allocation volumes be extracted is significant.

The management responses set out in the Plan are:

- a reduction scheme for licensees in the T2 Kangaroo Flat GMZ – this is underway as directed by the Minister whereby the sum of entitlement shares within the GMZ will reduce from 2,058 ML/y to the recommended extraction limit of 1,500 ML/y by 1 July 2022.
- adjusting pumped volumes for the T2 Virginia and T1 NAP GMZ's – whereby groundwater monitoring enables assessment against a set of trigger levels, with a management response of adjusting pumped volumes as required. An initial breach of triggers results in a notification of the breach to licensees, but no

allocation reductions. This allows licensees to voluntarily adjust pumped volumes to potentially avoid a second consecutive breach that would result in a management response being required.

The groundwater trigger levels are designed to address the risks to the aquifers from excessive water take via pumping. The Resource Capacity Report identifies resource condition limits that are considered the point beyond which unacceptable risk to the resource could occur.

For the T1 aquifer, these risks include:

- vertical leakage of higher-salinity groundwater from the overlying Quaternary aquifer; and
- the horizontal encroachment of higher-salinity groundwater from surrounding areas of the aquifer

For the T2 aquifer, the risk is depressurisation of the aquifer and changing the aquifer from a confined aquifer to an unconfined aquifer.

The trigger levels were developed by assessing historical water level data at times when the aquifers were under stress as well as considering the previously developed resource condition limits. From this, a set of trigger levels were derived as an early warning system for a management response to mitigate the risk of reaching the resource condition limits. To ensure that the trigger for management was not unduly sensitive, a number of wells in each GMZ have to breach trigger levels before the management process is initiated.

The pumping volume applied during the management response is based on the recommended extraction limits that represent the maximum volume that can be extracted before there is a potential for risk to the resource. These volumes are not volumes designed to assist in the recovery of an already stressed resource.

Groundwater modelling was used throughout the development of the recommended extraction limits and the proposed management to inform and test recommendations. The groundwater model used for this analysis (and in the Resource Capacity Report) is the Adelaide Plains groundwater flow and solute transport model, version AP2013 (Peat V and Yan W, 2014). The key scenarios relevant to the process of developing trigger levels and proposed management response are:

- Scenario 1 – 2006 to 2013 average use for T1 NAP and T2 Virginia over 30 years
- Scenario 2 – Full allocation for T1 NAP and T2 Virginia over 30 years
    - Note that the full allocation reflects the understanding of the current entitlement volume at the time the modelling was undertaken. Recent revisions of this data mean that there are differences between the volumes used in the modelling and the volumes in the Plan.
- Scenario 10 – Recommended extraction limit (REL) for T1 NAP and T2 Virginia over 30 years
- Management scenario – Full allocation plus applied management over 40 years
- Testing of managed pumping volumes over 40 years:
    - 90% of the recommended extraction limit – 3,743 ML/y for T1 NAP and 9,965 ML/y for T2 Virginia
    - 50% of the recommended extraction limit – 2,080 ML/y for T1 NAP and 5,536 ML/y for T2 Virginia.

These scenarios enable examination of a range of constant pumping volumes set out in the Plan (that is, the same pumping rate is applied over the full duration of the scenario). The exception to this is the management scenario, where the pumping rate is changed when the conditions have been met for managed pumping rates to be applied.

The use of a constant pumping rate is limited in its ability to represent the variations in pumping that have historically been observed. However, the scenarios undertaken allow for exploration of what is allowed for under the Plan, whether the management proposed is effective in a worst case scenario and some understanding of the implications for changing managed pumping volumes. Table 0.1 is a summary of key outcomes from the modelling and should be considered in conjunction with the modelling limitations outlined in section 4.1.3.

Scenario results are expressed in terms of years, where the scenario started in 2010. This is done for simplicity in the discussion and should not be taken to imply that in any given year the water levels will be as the model specified. Rather, the model represents a generic 40 year period and the results provided below should be interpreted as being indicative of the time frames over which actions and responses may occur.

Evidence suggests the resource in T2 Virginia GMZ can sustain short-term increased extraction, of one to two years, whereas the resource in T1 NAP can sustain increased extraction for a longer period, possibly in the order 10 to 20 years. However in both GMZ's sustained extraction of the water resource at a higher rate is likely to result in adverse impacts to the resource.

The modelling analysis demonstrates that under the full allocations permitted under the Plan, the proposed management response is not effective at protecting the resource. This is particularly true for T1 NAP, where ongoing pumping of management volumes results in breaching the resource condition limit. Resource condition limits in T2 Virginia are only breached if full allocation pumping continues without management intervention. When management intervention does occur, trigger levels are likely to be breached in the long term, however the resource condition limits are not breached

Some limitations are noted in the modelling that is the basis for this assessment. In addition to recommending a number of improvements to the model, ongoing monitoring is also recommended to support assessment of whether further reductions in allocations should be pursued in a future update to the Plan to protect the resource, particularly in the face of projections for a drier and hotter climate.

Table 0.1 Summary of key outcomes from scenario modelling

Scenario	T1 NAP		T2 Virginia		Other key results
	Management activated	RCLs breached	Management activated	RCLs breached	
1 - Average use	No	No	No	No	T1 NAP modelled water levels show a declining trend over the 30 years. T2 Virginia modelled water levels show a predominately flat trend over the 30 years of the modelled simulation.
2 - Full allocation	After 13 years	All bar one (PTA111)	After 3 years	All group 3 wells* No group 4 wells*	This scenario is considered a worst case, as the likelihood of continual pumping at full allocations in the GMZ's is small. All monitoring wells show continuous decline in water level over the 30 year period.
10 – Recommended extraction limit (REL)	After 30 years	No	After 21 years	No	All monitoring wells show continuous decline in water level over the 30 year period, although less so than under full allocation.
Management	After 18 years	PTA093 after 29 years PTA111 after 31 years	After 3 years Recovery after 3 years of managed pumping After 9 years	No	For T1 NAP the applied management applied fails to allow the system to recover or prevent the breaching of resource condition limits in two wells. However, management is not required until after 18 years of full allocation pumping, which may represent an unrealistically long time for full allocation pumping to occur. For T2 Virginia, trigger levels are breached after one year of full allocation pumping. While long term pumping at full allocation rates is likely to be unrealistic, one or two years of full or close to full allocation pumping in response to adverse climatic conditions is possible and this scenario is intended to highlight the associated risks. The management response allows the resource to recover from the first trigger level breach, however it does not allow the system to recover after the second breach, which occurred after 9 years. The management proposed also does not prevent the long term declining trend in water levels.

Scenario	T1 NAP		T2 Virginia		Other key results
	Management activated	**RCLs breached**	**Management activated**	**RCLs breached**	
Managed pumping 90% of recommended extraction limit	After 31 years	PTA093 after 38 years	After 3 years	No	For T1 NAP the rate of decline in winter water levels is between 30 to 50% less for the 50% scenario compared to the 90% REL scenario. This suggests that adjusting the managed pumping volumes has the potential to significantly change the effectiveness of management. For T2 Virginia the rate of decline in winter water levels is between 10 to 15% less for the 50% scenario compared to the 90% REL scenario. This suggests that adjusting the managed pumping volumes may be less successful in changing effectiveness of management.
Managed pumping 50% of recommended extraction limit	No	No	After 4 years	No	

* For well groupings see Table 2.4

1 Introduction

1.1 Aim

The Adelaide Plains Water Allocation Plan (the Plan) sets out the management arrangements for the allocation and use of prescribed groundwater within the Adelaide Plains. It replaces the existing Water Allocation Plan for the Northern Adelaide Plains Prescribed Wells Area (2000) and is the first water allocation plan for the Dry Creek and Central Adelaide Prescribed Wells Areas. The objectives as set out in the Plan) are:

- **Provides for the flexible and variable use of groundwater at times and in areas where needed to maximise economic and social outcomes.**
- **Ensures that groundwater resources are managed within acceptable resource condition limits.**
- Maintains groundwater-dependent ecosystems at a low level of risk.
- **Provides security of water access entitlements to users of the resource.**
- Supports the Managed Aquifer Recharge industry by maximising security and certainty of access to recharged water and establishes a flexible, case-by-case approach to Managed Aquifer Recharge without compromising other water users.
- Ensures the use of effluent or imported water only presents a low level of risk to groundwater dependent ecosystems or the productive capacity of the land.

The investigation summarised in this report addresses whether the proposed groundwater management response achieves the three objectives in bold above. The remaining objectives are met through principles in the Plan, which were developed outside of this work specifically address these issues. The analysis undertaken uses historical climatic conditions, trend and statistical analysis of historical groundwater level data, and groundwater modelling to investigate the trigger levels and management approaches. Social and economic factors were also considered during the development of the Plan, however these are outside of the scope of this document that is focused primarily on groundwater science and modelling.

1.2 Background

The Plan outlines GMZs (Figures 1.1 and 1.2) and a management approach that includes trigger levels for over-allocated GMZs (Table 1.1). It also documents the management response for those GMZs that are likely to be at risk of adverse impacts, due to increased groundwater extraction from currently extracted averages up to the full volumes authorised for taking within the area. Table 1.2 documents the principles from the Plan that govern the allocation of groundwater for licensed use. These form the evaluation criteria to determine whether the Plan objectives are met. The analysis undertaken in this document assesses the ability for the management approach to effectively manage the resource in a manner which should result in the objectives of the plan being met.

The Resource Capacity Report (Watt et al., 2017), the findings of which are summarised in section 1.3.1, outlined a resource condition limit for each GMZ. The resource condition limits represent a state beyond which the impact on the physical condition of the resource becomes unacceptable, for example encroachment of higher-salinity groundwater or aquifer depressurisation (see section 1.3.3 for the rationale in each GMZ). Once the resource condition limits were defined, it was possible to determine resource extraction limits, being the volume of extraction that can be sustained over time while minimising the risk of exceeding these resource condition limits.

In two GMZs (the T1 NAP and the T2 Virginia consumptive pools), the total of currently-held authorisations to take water exceeds the resource extraction limits. An adaptive trigger-level management approach is considered appropriate to manage these GMZs. The adaptive approach works by limiting the volume of water that can be extracted (allocation) within a GMZ during periods when the resource is at higher risk. In order to do this, resource condition triggers have been developed for these GMZs, where a resource condition trigger acts as an early warning system that the resource condition limit is at risk of being breached and initiates a management response that minimises the risk of this occurring. T2 Kangaroo Flat consumptive pool also has currently-held authorisations to take water exceeding the resource extraction limits, however this is being addressed through a reduction scheme as directed by the Minister for Environment and Water. The intention is to reduce the volume of the sum of entitlement shares within the zone to the resource extraction limit of 1,500 ML/y by July 1 2022.

Note that the T2 Northern Adelaide Plains GMZ and the T2 Virginia GMZ as discussed in this report have been combined into a single consumptive pool (the T2 Northern Adelaide Plains) under the Plan to enable effective management of the resource.

Table 1.1 GMZs and triggers

GMZ	Trigger Level	Resource Condition Limit
T1 Northern Adelaide Plains	1-3 m below the Millennium Drought low	5 m below sea level
T2 Virginia	3-5 m below the Millennium Drought low	Top of the T2 aquifer

Table 1.2 Principles for water allocation

Principle	Description
2	The value of entitlement shares in the following consumptive pools are subject to variation in accordance with the processes outlined in section 7.5 (principles 24 - 29) of this Plan: a. The T1 Northern Adelaide Plains consumptive pool, and b. The T2 Northern Adelaide Plains consumptive pool
18	Subject to principles 22 and 23 a water allocation obtained on account of an entitlement share will be determined at the rate of 1 share = 1 kilolitre.
21	With respect to principles 22 and 23, the Minister may, from time to time, by notice in the South Australian Government Gazette, determine the volume of water that is to be made available for allocation from the T1 Northern Adelaide Plains consumptive pool and the T2 Northern Adelaide Plains consumptive pool.
22	The value of the entitlement shares in the T1 Northern Adelaide Plains consumptive pool are subject to variation in relation to the trigger management approach outlined in section 7.5 of this Plan (principles 24 – 29).
23	The value of the entitlement shares in the T2 Northern Adelaide Plains consumptive pool are subject to variation in relation to the trigger management approach outlined in section 7.5 of this Plan (principles 24 – 29).
24	With respect to principles 22 and 23, the first year that the end of winter groundwater pressure level does not rise to a level above the resource condition trigger in relation to the triggered condition as defined in Table 6.3 for the relevant consumptive pool, the triggered condition is met

Principle	Description
	and a notice will be issued to all licensees within the consumptive pool advising that future allocations may be reduced, subject to principles 25, 26 and 27.
25	If the winter groundwater pressure level recovery in the second year remains below the resource condition trigger, to minimise the risk of breaching the resource condition limit, restrictions to the volume of water, which can be extracted will be announced for the relevant consumptive pool commencing 1 July of the next (third) water-use year.
26	If restrictions have been announced pursuant to principle 25, in the third water use-year, the value of the entitlement shares will not be determined at the rate of 1 share = 1 kL and will instead be reduced proportionally to a value that results in the total volume of allocations issued for the consumptive pool not exceeding the resource extraction limit for the consumptive pool as defined in Table 7.1.
27	Whilst the winter groundwater pressure level recovery remains below the resource condition trigger, the value of share remains reduced. However, when the winter groundwater pressure level recovers to above the resource condition trigger, the value of share will revert to 1 share = 1 kL for the following water-use year.
28	With regard to principle 25, the Minister shall announce the restrictions to the volume of water which can be extracted from the relevant consumptive pool by publishing a notice in *The South Australian Government Gazette* determining the value of an individual entitlement share for the relevant consumptive pool.
29	Principles 24 – 28 do not apply to water allocated for stock and domestic purposes and registered in the State Water Register as such.

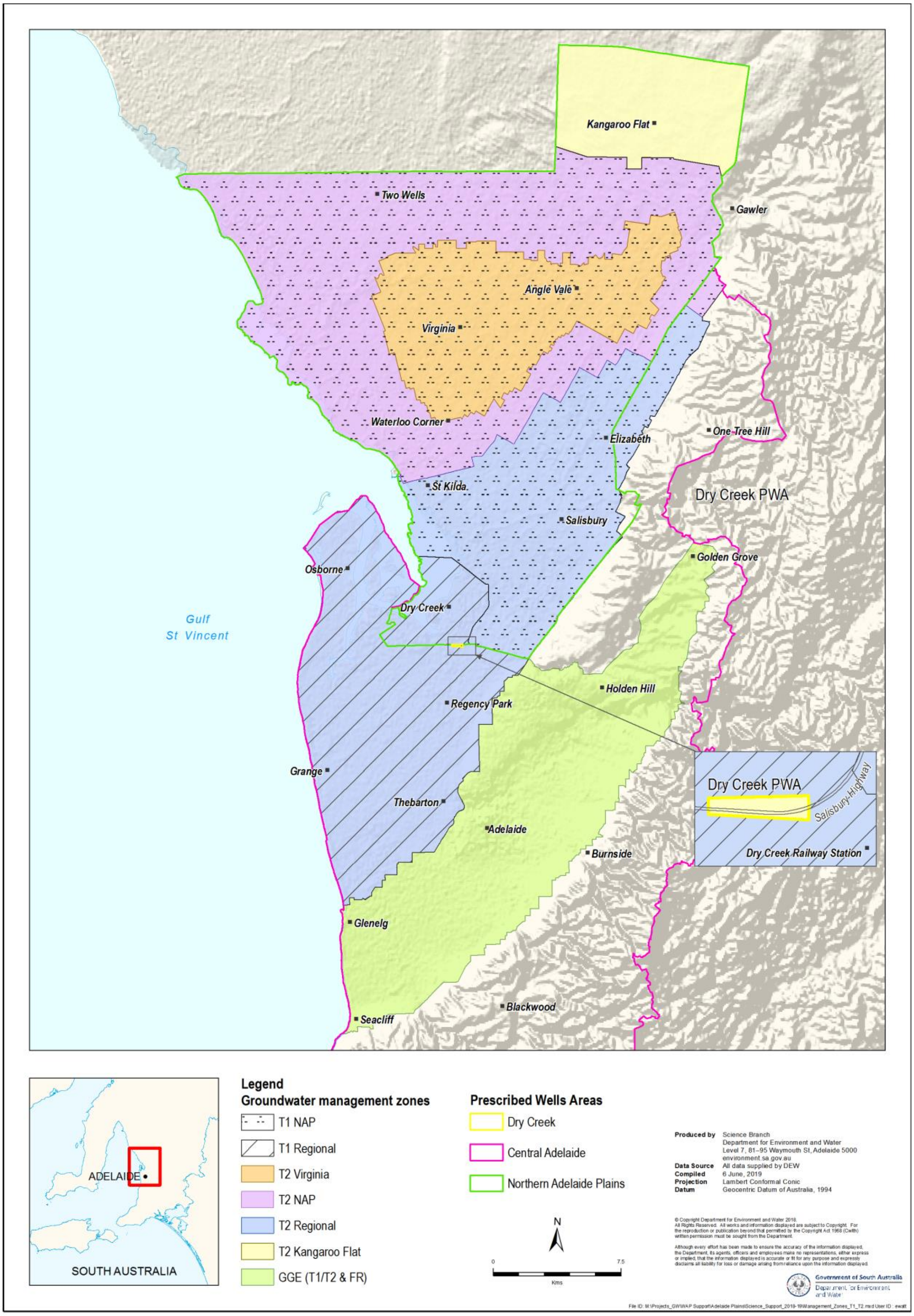

Figure 1.1 GMZs (T1/T2 aquifers)

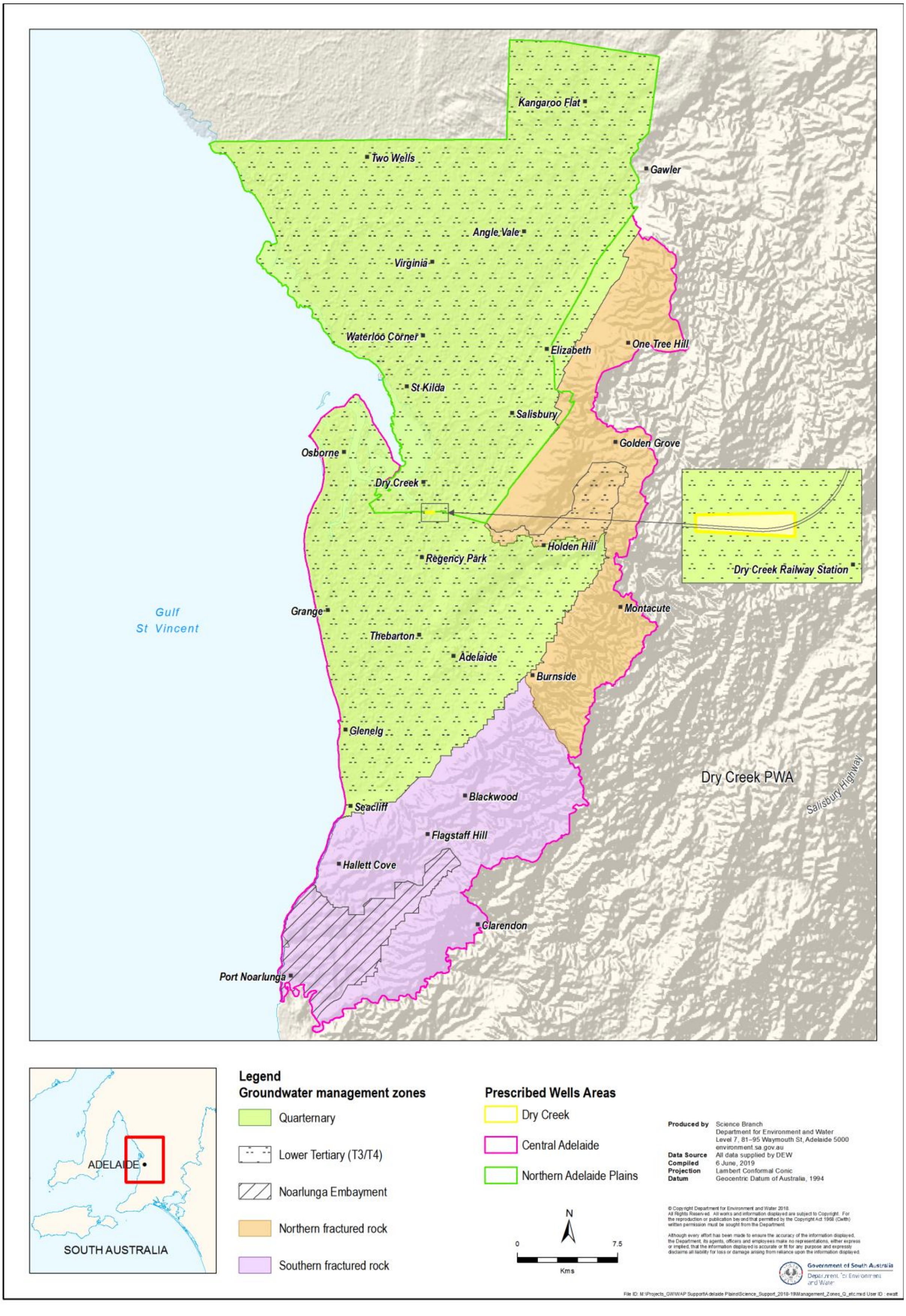

Figure 1.2 GMZs (Quaternary, Lower Tertiary and fractured rock aquifers)

1.3 Previous work

Key documents that have directly informed this investigation are:

- The Resource Capacity Report (Watt E, Peat V and Barnett S (2017): Estimation of groundwater resource capacity and recommended extraction limits for the Adelaide Plains Water Allocation Plan, DEWNR Technical Report 2017/03, Government of South Australia through Department of Environment, Water and Natural Resources, Adelaide.)
- The Addendum to the Resource Capacity Report (Department for Environment and Water (2020): Estimation of groundwater resource capacity and recommended extraction limits for the Adelaide Plains Water Allocation Plan: Addendum 2020, DEW Technical report 2020/17, Government of South Australia, Adelaide)

1.3.1 Resource Capacity Report

The broad objectives were to:

- delineate GMZs
- determine of the resource capacity and recommended extraction limits (excluding non-licensed water use and licensed stock and domestic allocations in the NAP PWA) to inform the issuing of new allocations in the CA Prescribed Wells Area (PWA) and the development of principles for the draft WAP about any future approval of new or increased allocations
- determine levels of extraction in some zones of the NAP PWA (which is considered to be over-allocated) that would trigger a management response to prevent unacceptable impacts on the resource.

Ranges of recommended extraction limits for the proposed GMZs in the CA and NAP prescribed areas were estimated by using either a water balance approach or scenario modelling in combination with an assessment of resource condition indicators and limits:

- volume of water extracted annually from the Quaternary aquifers must not result in unacceptable impacts to GDEs or existing users
- winter drawdown in the T1 aquifer should not drop below –5 m AHD in the Waterloo Corner area and –15 m AHD in the Central Adelaide PWA by 2040. This is to mitigate the salinity threat from increased downward leakage of salty water from the Q4 aquifer and the encroachment of higher-salinity water from surrounding areas
- winter drawdown in the T2 aquifer should not drop below the base of the confining layer separating the T1 and T2 aquifers by 2040 to avoid continued dewatering of the T2 aquifer that could compromise the integrity of the aquifer material
- annual volume of baseflow from the fractured rock aquifers is maintained within the range of historical observations
- volume of annual extraction from the Quaternary and Tertiary aquifers in the Noarlunga Embayment must not result in unacceptable impacts to GDEs or existing users.

Once the resource condition limits (RCLs) were defined, it was possible to determine recommended extraction limits—the volume of extraction for licensed consumptive use (excluding stock and domestic water allocations) that can be sustained without breaching the resource condition limits. The recommended extraction limits for each GMZ reflect the capacity of the resource to meet various demands (Table 1.3).

Within the T1 and T2 aquifers, a recommended extraction limit equal to a 20–30% increase from the current average extraction is proposed for most GMZs. This range of limits was derived from modelling that show increases in the amount of drawdown were within the resource condition limits set for the aquifers and any unacceptable impacts on existing users should be limited. These volumes still allow some development of the aquifers.

The recommended extraction limit for the proposed T2 Virginia GMZ has been kept at the lower range of 10–20% increase on current average extractions to limit major increases in the existing cone of depression in this area of intensive extraction.

The recommended extraction limit for the proposed T2 NAP GMZ is the current allocation volume of 4,483 ML/y. The risk of structural damage to the confining layer above the T2 aquifer under this scenario is considered acceptable.

An assessment of the T2 aquifer in the Kangaroo Flat region of the NAP PWA confirmed 1,500 ML/y as the recommended extraction limit.

Table 1.3 Recommended extraction limit and current extraction and allocation volumes by GMZ (all volumes in ML/y) (Table 6.1 in Resource Capacity report)

GMZ	Current licensed extraction[1]	Current allocation[2]	Recommended extraction limit
Quaternary aquifers	964	1526	1600–2000
T1 NAP	3199	5081	3839–4159
T1 Dry Creek	2972	2972	3566–3864
T1 Grange	1940	1940	2328–2522
T1 Thebarton	1383	1383	1660–1798
T1 Central Adelaide	1777	1777	2132–2310
T2 NAP	1994	4483	2592–4483
T2 Kangaroo Flat	1321	1321	≤1500
T2 Virginia	9227	14,940	10,150–11,072
T2 Regional	73	212	≤2212
T2 Osborne	1199	1199	1439–1559
T2 Regency Park	1732	1732	2078–2252
T1 and T2 GGE*	1526	1526	3052–4052
T3 and T4 aquifers	0	2300	2300–4000
FRA GGE*	14	14	≤500
FRA Northern	960	960	960–3479
FRA Torrens	539	539	539–1637
FRA Patawalonga	464	464	464
FRA Southern	155	155	155
Noarlunga Embayment	0	0	≤1717

1. Licensed extraction is the average extraction from metered wells in the NAP PWA for the years 2006 to 2013 inclusive. For the CA PWA extraction was estimated based on the license applications from existing users.

2. Allocation volumes are sourced from a dataset prepared by the AMLR NRM Board and provided to RPS-Aquaterra in 2013 and represent allocation volumes for year 2011 for the NAP PWA and equals the extraction estimated for the CA PWA.

*GGE – Golden Grove Embayment

1.3.2 Addendum to the Resource Capacity Report

The addendum represents changes to the Resource Capacity Report (Watt et al., 2017), a supporting document to the WAP. Since the publication of the Resource Capacity Report, changes have been made to some GMZ boundaries, resulting in a reduction of the number of proposed GMZs. Additionally, DEW was preparing to issue existing user water licences in the CA PWA and required separate recommended extraction limits, which required some recommended extraction limits to be recalculated. The addendum documents these changes.

During the drafting of the WAP, it became apparent that amendments needed to be made to some of the GMZs proposed earlier in the Resource Capacity Report. These changes are summarised in Table 1.4.

Note that other changes documented in the Addendum relate to GMZs that are not investigated as part of this report.

Table 1.4 Amendments made to the GMZ proposed in the Resource Capacity Report (Table 2.1 in Addendum to Resource Capacity Report)

<table>
<tr><th>Proposed GMZ in Resource Capacity Report</th><th>New proposed GMZ</th></tr>
<tr><td>Quaternary aquifers</td><td>No change</td></tr>
<tr><td>T1 NAP</td><td>Top right boundary cropped</td></tr>
<tr><td>T1 Dry Creek</td><td rowspan="4">T1 Regional</td></tr>
<tr><td>T1 Grange</td></tr>
<tr><td>T1 Thebarton</td></tr>
<tr><td>T1 Central Adelaide</td></tr>
<tr><td>T2 NAP</td><td rowspan="2">The two separate GMZs remain, with a small change to the shared boundary</td></tr>
<tr><td>T2 Kangaroo Flat</td></tr>
<tr><td>T2 Virginia</td><td>No change</td></tr>
<tr><td>T2 Regional</td><td rowspan="3">T2 Regional</td></tr>
<tr><td>T2 Osborne</td></tr>
<tr><td>T2 Regency Park</td></tr>
<tr><td>T1 and T2 GGE</td><td rowspan="2">T1, T2 and FRA GGE</td></tr>
<tr><td>FRA GGE</td></tr>
<tr><td>T3 and T4 aquifers</td><td>No change</td></tr>
<tr><td>FRA Northern</td><td rowspan="2">Northern FRA</td></tr>
<tr><td>FRA Torrens</td></tr>
<tr><td>FRA Patawalonga</td><td rowspan="2">Southern FRA</td></tr>
<tr><td>FRA Southern</td></tr>
<tr><td>Noarlunga Embayment</td><td>No change</td></tr>
</table>

1.3.3 Adelaide Plains Water Allocation Plan: policy options for groundwater management

A number of different groundwater management options were considered. The selected approach is management via ‘consecutive winter trigger levels’. This involves: (1) when the winter groundwater pressure level recovers to a level less than the trigger level, a warning is issued to licensees and resource managers; and (2) if the trigger level is breached again the following winter season, then to minimise the risk of breaching the RCL, reductions in allocation will be imposed commencing 1 July of the next water-use year. The reductions in allocation will be no greater than that required such that aggregate allocation is equal to the REL for the GMZs affected and remains in place until the resource recovers to above the trigger level again. This management option is explained in greater detail in section 2.

At the time of writing this report, there were three GMZ where the sum of proposed Water Access Entitlements, and therefore initial allocations, exceed the recommended extraction limit:

- T2 Virginia (13,862 ML allocation, 125% of recommended extraction limit);
- T2 Kangaroo Flat (2,058 ML allocation, 137% of recommended extraction limit);
- T1 NAP (4,685 ML allocation, 113% of recommended extraction limit).

These zones have a total of 20.6 GL of allocation and are over allocated by 3.87 GL in total. However current extraction by licensees in these zones is 7.5 GL less than the full allocation. Should the full allocation be extracted there is a significant risk that the resource condition limits will be exceeded and the condition of the resource will decline.

There were three additional GMZs where the maximum volume of water authorised to be extracted from the GWMZ is equal to, or slightly exceeds the recommended extraction limit: T2 NAP, Southern Fractured Rock and Lower Tertiary. Given the low utilisation of the lower tertiary aquifer and the self-limiting nature of the fractured rock aquifers, a trigger management approach was not deemed necessary for the Southern Fractured Rock and Lower Tertiary aquifers. T2 NAP was further investigated as part of this work.

Within the remaining 6 GMZs, the existing allocations were not within 20% of the recommended extraction limit (i.e. full allocation is less than the recommended extraction limit) and as such, the risk of the resource being adversely impacted by extraction of the full allocation volumes is anticipated to be low. Based on this, the work undertaken in this document focused on these four GMZ's:

- T2 Virginia;
- T2 Kangaroo Flat;
- T2 NAP; and
- T1 NAP.

While the currently-held allocations in the T2 Kangaroo Flat GMZ exceed the REL, the area is currently undergoing a reduction scheme as directed by the Minister whereby the sum of entitlement shares within the zone will reduce from an equivalent volume totalling 2,058 ML/y to the resource extraction limit of 1,500 ML/y by July 1 2022. Therefore, as allocations will no longer exceed the recommended extraction limit by 2022, groundwater management was no longer required for this GMZ. However, monitoring (Table 2.5) will assist in providing ongoing overview of the status of the resource in this GMZ.

In addition, analysis of groundwater levels and extraction data in the T2 NAP GMZ suggested that risk to the resource within the T2 NAP GMZ is minimal (see Section 3.4). Risk to the resource in this instance is defined as groundwater levels dropping below the top of the T2 aquifer within the T2 NAP GMZ. No groundwater management response is proposed for this GMZ. There is the potential for extraction within T2 NAP GMZ to impact groundwater levels within T2 Virginia, subject to further monitoring and investigation.

Beyond the addendum report, refinements were made to the recommended extraction limits as a result of data analysis undertaken following the roll out licences in the Central Adelaide PWA. This modified the current allocated volumes (and hence resource extraction limits where the limit is based on allocated volumes) for some of the GMZs from those in Table 1.4, particularly the Southern Fractured Rock. Table 1.5 outlines the recommended extraction limits as documented in the Plan.

Table 1.5 Groundwater management area recommended extraction limits defined in the draft Plan

Consumptive Pool	Resource Extraction Limit ML/y	Rationale for Resource Extraction Limit
Quaternary	6,762	This limit covers existing licensed holders, allows some further development of the aquifers, and reserves some water for aquifer maintenance and groundwater-dependent ecosystems. This limit was determined based on a water balance calculation and consideration of the environmental water provisions.
T1 Northern Adelaide Plains	4,159	The limit is based on a 30% increase on current average annual extractions. Modelling suggests this does not result in unacceptable drawdown.
T1 Regional	10,494	The limit is based on a 30% increase on current average annual extractions. Modelling suggests this does not result in unacceptable drawdown.
T2 Virginia	11,072	The limit is based on a 20% increase on current average annual extractions, to limit major increases in the existing cone of depression in this area of intensive extraction.
T2 Northern Adelaide Plains	4,483	The limit is equal to the allocation volume in this zone under the previous Northern Adelaide Plains water allocation plan. The risk of structural damage to the confining layer above the T2 aquifer under this scenario is low.
T2 Regional	6,023	This limit is subject to the proviso that for any application to increase extraction by more than 250 ML/y from a well or group of wells, a hydrogeological investigation should be conducted to determine the impact on the resource and other users.
T2 Kangaroo Flat	1,500	Based on an assessment of the T2 aquifer in the Kangaroo Flat region of the Northern Adelaide Plains Prescribed Wells Area.
Lower Tertiary (T3/T4)	2,385	Based on current volumes allocated in relation to these aquifers. Further development is likely to be limited by the depth of the aquifers and high salinities.
Golden Grove Embayment	4,552	As increased extraction may be sought in this zone, a scenario was modelled by doubling the estimated existing user demand plus 1,000 ML/y. Modelling results suggests the risk of reaching the RCL is low, with drawdown of up to 3 m compared to the current conditions. This limit is subject to the proviso that for any application to increase extraction by more than 250 ML/y from a well or group of wells, a hydrogeological investigation should be conducted to determine the impact on the resource and other users.
Noarlunga Embayment	1,717	The extraction limit is a based on a conservative estimate of the capacity of this resource based on previous scientific studies.
Northern Fractured Rock	5,116	The volume of groundwater available for licensed extraction from this part of the fractured rock aquifer was derived using a water balance approach, calculated as the recharge minus the sum of baseflow and non-licensed extraction.
Southern Fractured Rock	1,409	Due to the uncertainties in the water balance calculations for this part of the fractured rock aquifers, the recommended extraction limits are based on maintaining current level of extractions.

1.4 Scope

The work presented in this report is designed to test the feasibility of using resource condition trigger levels to control the volume of groundwater extraction in the T2 Virginia and T1 NAP. These trigger levels may then be considered and refined during the development of the new WAP.

Locations for ongoing monitoring have been recommended for the T2 NAP and T2 Kangaroo Flat GMZs. The nominated monitoring wells and specific groundwater levels that would trigger changes in extraction presented in this report are suggestions for consideration. The triggers have been developed drawing on the perspective of groundwater resource management.

The scope of this report is to:

- identify key monitoring wells that can be used as trigger level monitoring points
- propose trigger levels that could be used to initiate management responses in each 'high-risk' GMZ
- test the applicability and limitations of the proposed trigger levels under current climatic conditions, as well as current and potential groundwater extraction and allocation volumes using the Adelaide Plains groundwater flow model
- test the effectiveness of the proposed management strategies under the full extent that is allowed for in the Plan, using the Adelaide Plains groundwater flow model.

2 Management approach

As discussed in Section 0, the proposed management approach is informed by the Resource Capacity Report (Watt et al., 2017). The outcome from this process is documented here as the proposed management approach. It should be noted that this management approach is intended to apply only to T1 Northern Adelaide Plains and T2 Virginia GMZs.

The investigation undertaken in this report looks at a management approach that has three key components:

1. Timing – when is the management applied or removed related to the water-use year
2. Volume – what is the volume of water available during management
3. Triggers – what conditions (groundwater pressure level) trigger a management response

The following sections outline each of these components. The investigation as to how the trigger levels were developed is covered in Section 3.

2.1 Timing of management

As stated in Section 1.3.3, the proposed management approach is a double winter trigger level approach (Figure 2.1):

1. the first year that the winter groundwater pressure level recovers to a level less than the trigger level, a warning is issued to licensees and resource managers; and
2. if the trigger level is breached again the following winter season, then to minimise the risk of breaching the resource condition limits (RCL), reductions in extraction will be imposed commencing 1 July of the next water-use year.

The proposed timing of the management approach is explained visually in Tables 2.1 and 2.2.

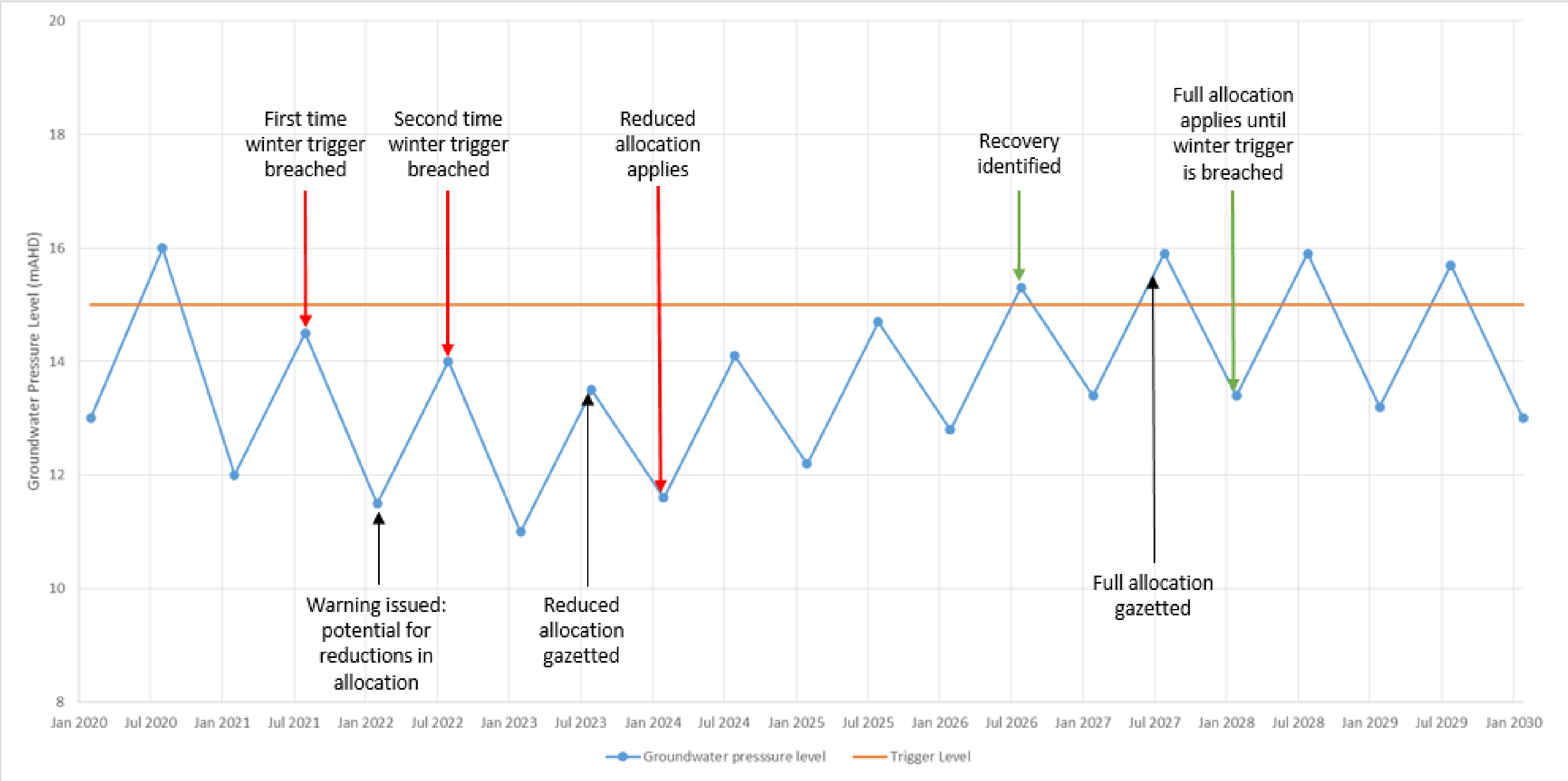

Figure 2.1 Conceptual trigger management level approach

Table 2.1 Timing of management actions for management being applied

Year	Month	Management Trigger Identified	Water take restricted	Irrigation
1	June			
	July			
	August	First time winter trigger breached		
	September			
	October			Warning issued to licensees and resource managers: potential for reductions in allocation
	November			
	December			
2	January			
	February			
	March			
	April			
	May			
	June			
	July			
	August	Second time winter trigger breached		
	September			
	October			Warning issued to licensees and resource managers: reductions in allocation are imminent
	November			
	December			
3	January			
	February			
	March			
	April			
	May		Reduced allocations gazetted	
	June			
	July			
	August			
	September			

Year	Month	Management Trigger Identified	Water take restricted	Irrigation
	October			Reduced allocation applies
	November			
	December			
4	January			
	February			
	March			
	April			
	May			
	June			

Table 2.2 Timing of management actions for management being removed

Year	Month	Management Trigger Identified	Water take restricted	Irrigation
1	June			
	July			
	August	Recovery identified		
	September			
	October			Reduced allocation applies
	November			
	December			
2	January			
	February			
	March			
	April			
	May		Full allocation gazetted	
	June			
	July			
	August			
	September			

<table>
<tr><th>Year</th><th>Month</th><th>Management Trigger Identified</th><th>Water take restricted</th><th>Irrigation</th></tr>
<tr><td rowspan="3"></td><td>October</td><td></td><td></td><td rowspan="5">Full allocation applies until winter trigger is breached</td></tr>
<tr><td>November</td><td></td><td></td></tr>
<tr><td>December</td><td></td><td></td></tr>
<tr><td rowspan="6">3</td><td>January</td><td></td><td></td></tr>
<tr><td>February</td><td></td><td></td></tr>
<tr><td>March</td><td></td><td></td><td></td></tr>
<tr><td>April</td><td></td><td></td><td></td></tr>
<tr><td>May</td><td></td><td></td><td></td></tr>
<tr><td>June</td><td></td><td></td><td></td></tr>
</table>

2.2 Management of pumping volumes

When management is implemented, the proposed reductions in allocations are such that aggregate extraction is equal to the recommended extraction limits (REL) for the GMZs affected (Table 2.3). These RELs are based on the work documented in the Resource Capacity Report, however the main rationale is included in Table 2.3.

Table 2.3 Groundwater management area recommended extraction limits defined in the draft Plan

GMZ	Recommended extraction limits ML/y	Rationale for recommended acceptable extraction limit
T1 Northern Adelaide Plains	4,159	The limit is based on a 30% increase on current average annual extractions. Modelling suggests this does not result in unacceptable drawdown.
T2 Virginia	11,072	The limit is based on a 20% increase on current average annual extractions, to limit unacceptable increases in the existing cone of depression in this area of intensive extraction, which would result in a breach of the resource condition limits.

2.3 Trigger levels

Trigger levels were developed for four GMZ that were of concern, with two GMZ targeted for management and assigned specific trigger levels and a triggered condition (Table 2.4). Trigger levels for T2 NAP have been included (Table 2.5) as proposed monitoring sites such that if trigger levels are breached in these wells, further investigations may be warranted. Monitoring sites have also been proposed for T2 Kangaroo Flat, however no trigger levels were required for this site (see section 3.5 for further detail).

The winter trigger level is breached when:

1. Winter groundwater pressure levels do not rise above the trigger level for the number of wells specified in the ‘triggered condition’ field (Table 2.4) for the associated monitoring group; and

2. Either monitoring group is triggered.

For example in T2 Virginia, if both Group 3 bores, or two out of three Group 4 bores failed to recover above winter trigger levels, then the GMZ would be considered to have breached the trigger levels. This would then need to occur in two consecutive winters for active management (reduced allocations) to be implemented.

Table 2.4 Groundwater monitoring wells in managed GMZs

GMZ	Monitoring group	Monitoring well	Winter trigger level (m AHD)	Resource Condition Limit (m AHD)	Triggered condition
T1 NAP	Group 1	PTA161	-2.5	-5	Two out of four
		PTA095	-3.59	-5	
		PTA111	-4	-5	
		MPA152	-0.62	-5	
	Group 2	PTA051	-4.29	-5	Both
		PTA093	-4.2	-5	
T2 Virginia	Group 3	MPA144	-33.2	-46.1	Both
		MPA158	-27.95	-42.93	
	Group 4	PTA091	-26.7	-57.5	Two out of three
		PTA082	-18.4	-46.3	
		MPA159	-22.1	-65	

Table 2.5 Groundwater monitoring wells in monitored GMZs

GMZ	Monitoring group	Monitoring well	Trigger level (m AHD)*	Resource Condition Limit (m AHD)
T2 NAP	Group 5	PTG031	-4.36	-44.7
		PTG085	2.15	-28.44
		PTG060	1.25	-76.59
		MUW034	10.04	-12.23
	Group 6	PTA094	-6.2	-90
		MPA081	9.29	-80.76
T2 Kangaroo Flat	Group 7	MUW029	N/A	-3.8
		MUW030	N/A	-7

3 Trigger level development

3.1 Background

Groundwater risks include over-extraction, degradation in water quality and in multi-layered sedimentary aquifers, a decrease in the structural integrity of confining layers that separate aquifers. Groundwater management is a tool that can be used to maintain the longevity of the resource for all users. Therefore management needs to consider the risk that is specific to the resource being managed, as well as the ongoing condition of the resource. Groundwater monitoring and comparison to pre-determined trigger levels is the mechanism that provides insight into the condition of the resource, relative to the risks faced by the resource. It is also the mechanism that is intended to prompt action, whether that be further investigation, warnings provided to licensees or a reduction in the volume of water available to licensees.

The proposed management approach in the Plan includes groundwater trigger levels to restrict the volume licensees can extract in response to a decline in resource condition. The trigger levels refer to a defined state of the resource that represents an intermediate stage before the resource condition limits are breached. Resource condition limits (RCLs) for the T1 and T2 aquifers of the Adelaide Plains are documented in the Resource Capacity Report and represent quantifiable limits that are used to define a state beyond which the risk of impacts on the physical condition of the resource are unacceptably high.

The trigger-level management approach works as an early warning system for a management response and thereby mitigates the risk of reaching the resource condition limits. Successful application of trigger-level management involves a degree of flexibility, such that trigger levels can be fine-tuned based on historical performance of the trigger-level management regime (Nation, Werner and Habermehl 2008).

The risks identified in the Resource Capacity Report are different for the different aquifers and associated GMZs. For the T1 Aquifer and for the T2 Kangaroo Flat GMZ, the risk identified is one of water quality, such that overuse could lead to increased salinity within the aquifer. For the T2 aquifer, particularly in the T2 Virginia GMZ, the risk is that overuse could lead to a compromise in the structural integrity of the confining layer overlying the aquifer. The trigger levels described here have been developed to consider these specific risks and the mechanisms that drive them.

While the triggers needs to reflect the risk to the resource, they also need to consider the practicality of implementation. Trigger levels that are overly sensitive or produce a large variability in outcome, that is they cause management actions to be repeatedly switched off and on, are likely to be ineffective. For this reason, consideration has been given to the likely stability of the outcomes that could be produced by the triggers developed.

The four GMZ's that are recommended to be either managed or monitored cover both the T1 and T2 aquifers (Table 3.1). GMZ's that have been nominated for management are those where the historical data and/or modelling suggests that the RCL within that GMZ may be at risk of being breached. This includes T1 NAP and T2 Virginia. In addition, two GMZ's have been nominated for ongoing monitoring, T2 NAP and T2 Kangaroo Flat. T2 NAP has been nominated as requiring ongoing monitoring, in part due to the extraction approaching the water access entitlements, but also because there may be the potential for extraction within the T2 aquifer in this GMZ to influence levels in the T2 aquifer within the T2 Virginia GMZ. Therefore "trigger levels" for the T2 NAP that are proposed in this report are designed to prompt further investigation into the influence of the pumping in the T2 NAP GMZ on the T2 aquifer within the adjacent T2 Virginia GMZ. T2 Kangaroo Flat has been nominated for ongoing monitoring to assess the impacts and potential recovery in the aquifer as a result of changes to licensed allocations as well as monitor the ongoing salinity concerns in the area.

The remaining under-allocated GMZs are the least likely to experience resource condition stress. It is proposed that in these areas, six-monthly monitoring of the resources and assessments via annual reports will identify any impacts. Should the resource show unexpected stress throughout the life of the Plan, the source of the stress be investigated and if required, a management response could be enacted and included in future Plans.

3.1.1 T1 Aquifer (T1 NAP GMZ)

The risk to the T1 aquifer is that higher salinity groundwater may be drawn into the areas that have lower salinity groundwater, reducing the quality of the water and its suitability for some licensees. The mechanisms by which this can occur include:

- the vertical leakage of higher-salinity groundwater from the overlying Quaternary aquifer
- the horizontal encroachment (induced lateral groundwater flow) of higher-salinity groundwater from surrounding areas of the aquifer.

From the Resource Capacity Report, the resource condition limit for the T1 aquifer is -5 m AHD. This is not an absolute value beyond which a tipping point or a change in state immediately occurs, but rather a level beyond which there is an increased risk of salinity increasing. It is therefore preferable to use a point above the resource condition limit as the trigger level.

The trigger levels developed for the T1 NAP need to consider the mechanisms through which the risk to the resource work. The overall risk of inducing the lateral or vertical ingress of saline groundwater is highest during summer when groundwater levels are at their lowest. However, the summer drawdown can have large variations from year to year and is likely to be too unstable to use as a reliable trigger level. Over the past 20 years, salinity has generally been stable in the T1 aquifer, except for a small number of irrigator’s wells, which have recorded significant increases in salinity due to corroded casing. Winter recovery levels have also been relatively stable. Therefore, the winter recovery level is used as the trigger level. Maintained winter recovery is important for mitigating salinity increases as the amount of winter recovery can mitigate the leakage or encroachment of higher-salinity groundwater.

The trigger levels for the T1 aquifer will therefore be defined as a winter groundwater pressure level, above which the pressure level must recover to prevent a management response from being implemented.

3.1.2 T2 Aquifer (T2 Virginia and T2 NAP GMZs)

The resource condition limit for the T2 aquifer is the top of the T2 aquifer. This is an absolute value beyond which the aquifer changes from being confined to unconfined; this has the potential to compromise the structural integrity of the confining layer above the T2 aquifer. This value varies for each of the monitoring wells included, based on the top of the T2 aquifer at that location.

Groundwater use is highest and groundwater pressure levels are lowest in summer, with recovery occurring during the winter months. Therefore summer groundwater pressure levels are the most likely to breach the resource condition limit. Similar to the T1 aquifer, these levels can have a large degree of variation from year to year. In addition, short duration breaches (i.e. one or two months) are unlikely to represent a significant risk to the resource with respect to the structural integrity. Therefore, the winter recovery groundwater pressure levels are used as the basis for the trigger levels for this aquifer.

3.1.3 T2 Aquifer (T2 Kangaroo Flat GMZ)

Similar to the to the T1 Aquifer, the risk to the T2 aquifer in the Kangaroo Flat GMZ is that higher salinity groundwater may be drawn into the areas which currently have lower salinity groundwater, reducing the quality of the water and its suitability for some licensees. Specifically, there is a risk of increased downward leakage of saline water from the Q4 aquifer.

Significant increases in salinity in the Kangaroo Flat area have been observed in the past when extraction levels have risen above 1,500 ML/y. As a reduction plan is underway to reduce allocations to 1,500 ML/y or lower, there are no trigger levels identified for this GMZ. Groundwater (salinity) monitoring will occur to assess the effectiveness of the reductions.

3.1.4 Trigger level monitoring wells and development of levels

The primary objective of the trigger-level management approach is to protect the recovered winter groundwater levels. Winter groundwater levels (i.e. the groundwater level at the start of irrigation period) will be compared against the proposed trigger levels. If the trigger level is breached in the majority of nominated monitoring wells within a designated group or GMZ (as outlined in section 3.1.1), a management response will be enacted per the process described in Section 2.

Suitable trigger levels need to be at reasonable points above the resource condition limits. When determining trigger levels, previous conditions, current conditions and preventing potentially undesirable impacts in the future need to be considered. As groundwater levels have been monitored in the NAP for nearly sixty years, past recoveries in winter groundwater levels helped identify the trigger level options including (Table 3.1):

- the lowest winter groundwater level recorded during the Millennium Drought (2001 to 2009)
- the lowest winter groundwater level on record.

The lowest winter groundwater level recorded during the Millennium Drought represents the lowest the groundwater level has reached in recent times under unusually dry climatic conditions. The extraction rate from the T1 and T2 aquifers during the Millennium Drought ranged from 11,984 ML/y (2005–06) to 16,466 ML/y (2007–08). The 16,466 ML extracted in 2007–08 is the most groundwater extracted from the T1 and T2 aquifers since verified metered extraction data became available. This has been used to inform the trigger levels as it represents a time where extraction increased in response to climatic drivers.

Historically, the lowest winter groundwater level was recorded during the mid to late-1990s when intensive pumping in the NAP PWA continued all year round prior to the distribution of treated waste water becoming available in the region. The Virginia Pipeline Scheme was established in 1997 and provides around 20 GL of recycled water from the Bolivar Wastewater Treatment Plant for horticultural irrigation to around 360 customers in Virginia and surrounding areas. This did not allow the groundwater level to fully recover during the winter months and it dropped below the top of the T2 aquifer at the centre of the cone of depression. Away from the centre of the cone of depression, the decline resulted in groundwater levels from 25–90 m above the top of the T2 aquifer. These levels represent a snapshot of when the T2 aquifer was at risk. This has been used to inform the trigger levels, as allowing the groundwater level to decline by these amounts before a management response is enacted would risk not meeting objectives of the Plan.

Trigger levels have generally been set between these two historical levels (the lowest winter groundwater level recorded during the Millennium Drought and lowest winter groundwater level). This allows licensees the capacity to respond to adverse climatic conditions represented by the levels associated with the millennium drought, while still protecting the resource based on the historic information from when it was most at risk. This takes a holistic approach to mitigating the risk of breaching the resource condition limit at the centre of the cone of depression.

Table 3.1 Trigger level development in key GMZs

GMZ	Managed or Monitored	Basis of Trigger Level	Trigger level	Resource condition limit
T1 NAP	Managed	Millennium Drought low	1 m below the Millennium Drought low	-5 m AHD

GMZ	Managed or Monitored	Basis of Trigger Level	Trigger level	Resource condition limit
T2 Virginia	Managed	Millennium Drought low and historic lows	3–5 m below the Millennium Drought low	Top of T2 aquifer
T2 NAP	Monitored	Millennium Drought low and historic lows	1–2 m below the Millennium Drought low	Top of T2 aquifer
T2 Kangaroo Flat	Monitored	N/A	N/A	Top of T2 aquifer

Existing monitoring wells in the statewide monitoring network are nominated as trigger level monitoring sites (Tables 3.2 and 3.3, and Figures 3.1 and 3.2). The nominated wells were selected based on their location within the GMZ or cone of depression, and the quality and length of their historical groundwater level data. Due to the concentration of pumping wells in the high-risk GMZs, particularly the T2 Virginia GMZ, several wells have been nominated for each zone and the trigger levels would need to be breached in a majority of the zone's wells before a management response occurs. Additionally, the nominated monitoring wells have been classed into groups that would dictate when a management response is enacted (Table 2.4). This is to alleviate concerns regarding the potential impacts of short-term fluctuations in pumping rates, as well as the possibility of having, for example, groundwater levels in two out of the five monitoring wells within a GMZ continually breaching the trigger levels and no management response being enacted. For instance, the T2 Virginia GMZ has been split into two groups with Group 3 concentrated at the centre of the cone of depression. Both wells in Group 3 would need to breach their trigger levels before a management response is enacted. In Group 4, at least two out of the three wells would need to breach their trigger levels before a management response is enacted.

Note that MPA109 was originally nominated for a monitoring well when this work was started in 2017. Since that time, this well has been decommissioned. MPA158 has been recommended as a replacement monitoring well. For completeness both wells have been presented in this analysis.

Table 3.2 Groundwater monitoring wells in managed GMZs

<table>
<tr><th>GMZ</th><th>Monitoring group</th><th>Monitoring well</th><th>Winter trigger level (m AHD)</th><th>Resource Condition Limit (m AHD)</th><th>Triggered condition</th></tr>
<tr><td rowspan="6">T1 NAP</td><td rowspan="4">Group 1</td><td>PTA161</td><td>-2.5</td><td>-5</td><td rowspan="4">Two out of four</td></tr>
<tr><td>PTA095</td><td>-3.59</td><td>-5</td></tr>
<tr><td>PTA111</td><td>-4</td><td>-5</td></tr>
<tr><td>MPA152</td><td>-0.62</td><td>-5</td></tr>
<tr><td rowspan="2">Group 2</td><td>PTA051</td><td>-4.29</td><td>-5</td><td rowspan="2">Both</td></tr>
<tr><td>PTA093</td><td>-4.2</td><td>-5</td></tr>
<tr><td rowspan="4">T2 Virginia</td><td rowspan="3">Group 3</td><td>MPA144</td><td>-33.2</td><td>-46.1</td><td rowspan="3">Both</td></tr>
<tr><td>MPA158</td><td>-27.95</td><td>-42.93</td></tr>
<tr><td>MPA109*</td><td>-29.6</td><td>-35.5</td></tr>
<tr><td>Group 4</td><td>PTA091</td><td>-26.7</td><td>-57.5</td><td>Two out of three</td></tr>
</table>

		PTA082	-18.4	-46.3	
		MPA159	-22.1	-65	

*Monitoring well no longer active. Replaced with MPA158.

Table 3.3 Groundwater monitoring wells by GMZs

GMZ	Monitoring group	Monitoring well	Trigger level (m AHD)	Resource Condition Limit (m AHD)
T2 Virginia	Group 5	PTG031	-4.36	-44.7
		PTG085	2.15	-28.44
		PTG060	1.25	-76.59
		MUW034	10.04	-12.23
	Group 6	PTA094	-6.2	-90
		MPA081	9.29	-80.76
T2 Kangaroo Flat	Group 7	MUW029	N/A	-3.8
		MUW030	N/A	-7

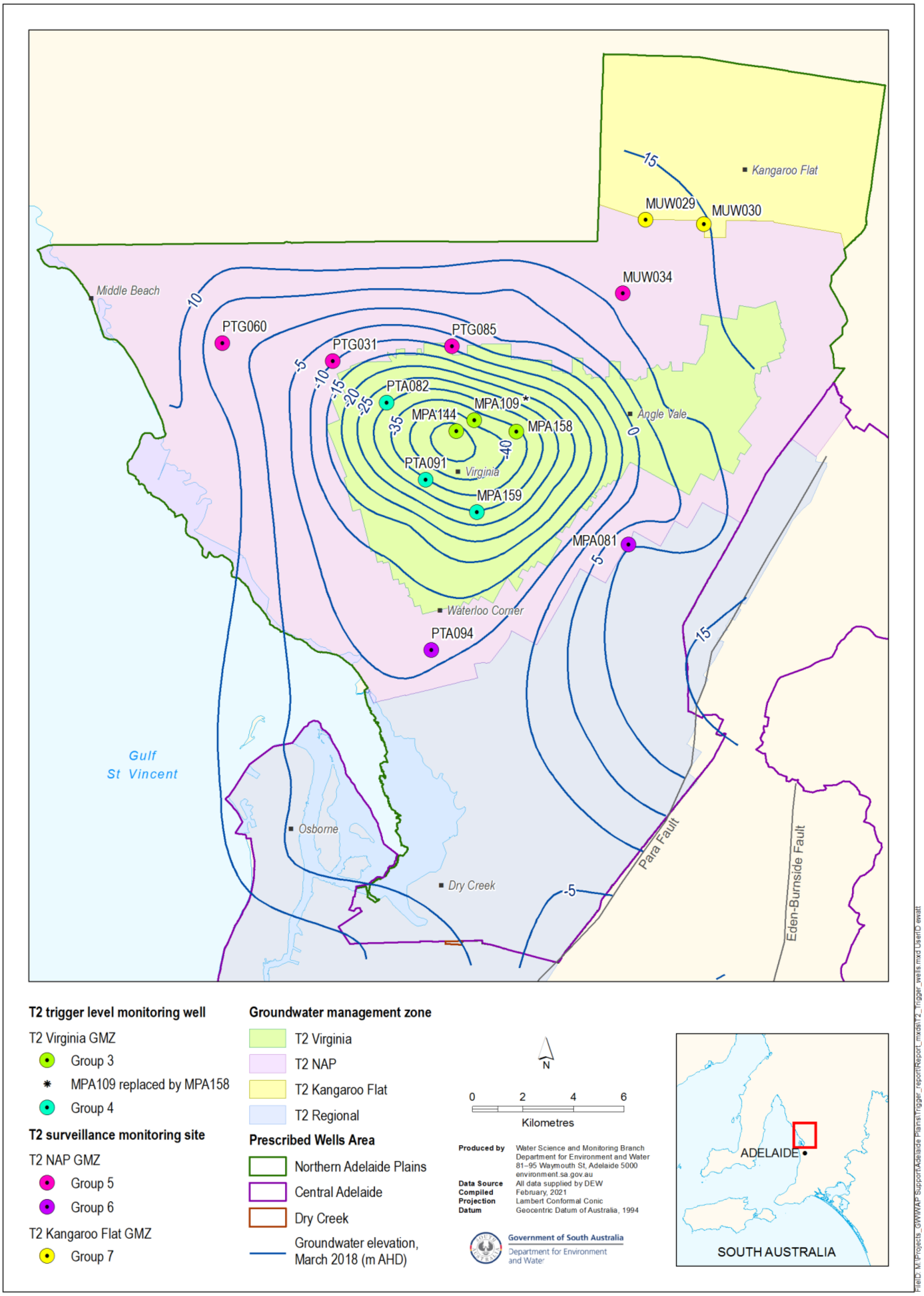

Figure 3.1 Location of proposed trigger level monitoring sites in the T2 Virginia, T2 NAP and T2 Kangaroo Flat GMZs

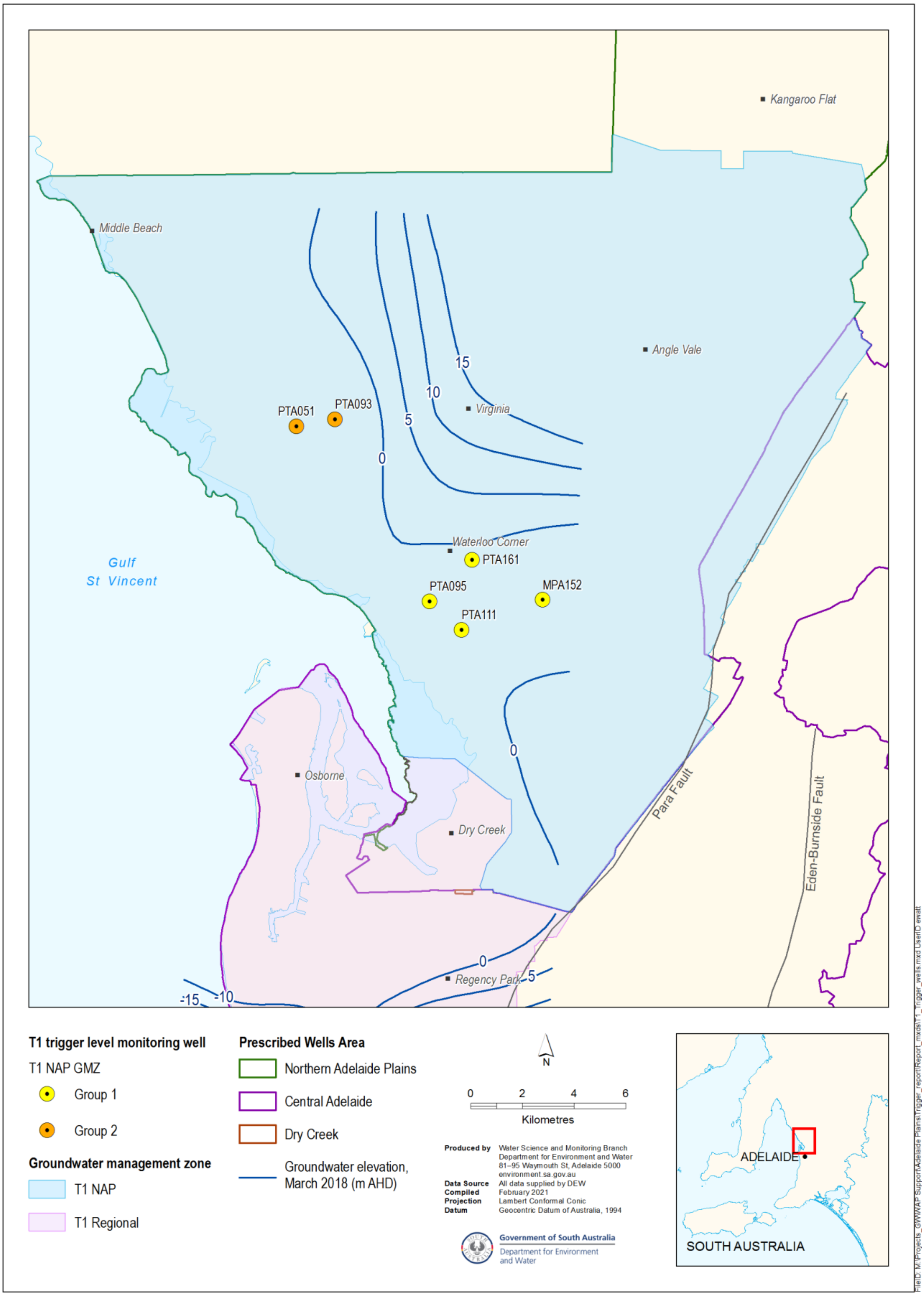

Figure 3.2 Location of proposed trigger level monitoring wells in the T1 NAP GMZ

3.2 T1 NAP aquifer GMZ

The resource condition limit for the T1 aquifer is -5 m AHD. Trigger levels have been developed that consider both millennium drought low and the resource condition limit. The highest winter groundwater level, generally from between June and September was used in the analysis.

3.2.1 Group 1

3.2.1.1 PTA161

The key levels, including the trigger level, for well PTA161 in the T1 NAP GMZ are presented in Table 3.4, and Figure 3.3. Figure 3.3 also presents the historical groundwater level data and the maximum winter groundwater level. PTA161 is located in Waterloo Corner, where the most intensive extraction occurs from the T1 aquifer (Figure 3.2). It has been monitored since 1999, thus there is limited data from the mid to late-1990s when low pressure levels were experienced in the area due to excessive pumping and extraction. However, the winter groundwater level recorded in 1999 does provide a reasonable measure for the historical winter low, which is 1.5 metres above the resource condition limit of -5 m AHD, so is too low to be used as the trigger level. The lowest winter recovery during the Millennium Drought is approximately 0 m AHD, five metres above the resource condition limit. It is therefore proposed that the trigger level is -2.5 m AHD, 2.5 m below the Millennium Drought low.

Table 3.4 Key levels of interest for PTA161

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-0.01
Trigger level	2.5 m below the Millennium Drought low	-2.5
Resource condition limit (RCL)	-5 m AHD	-5

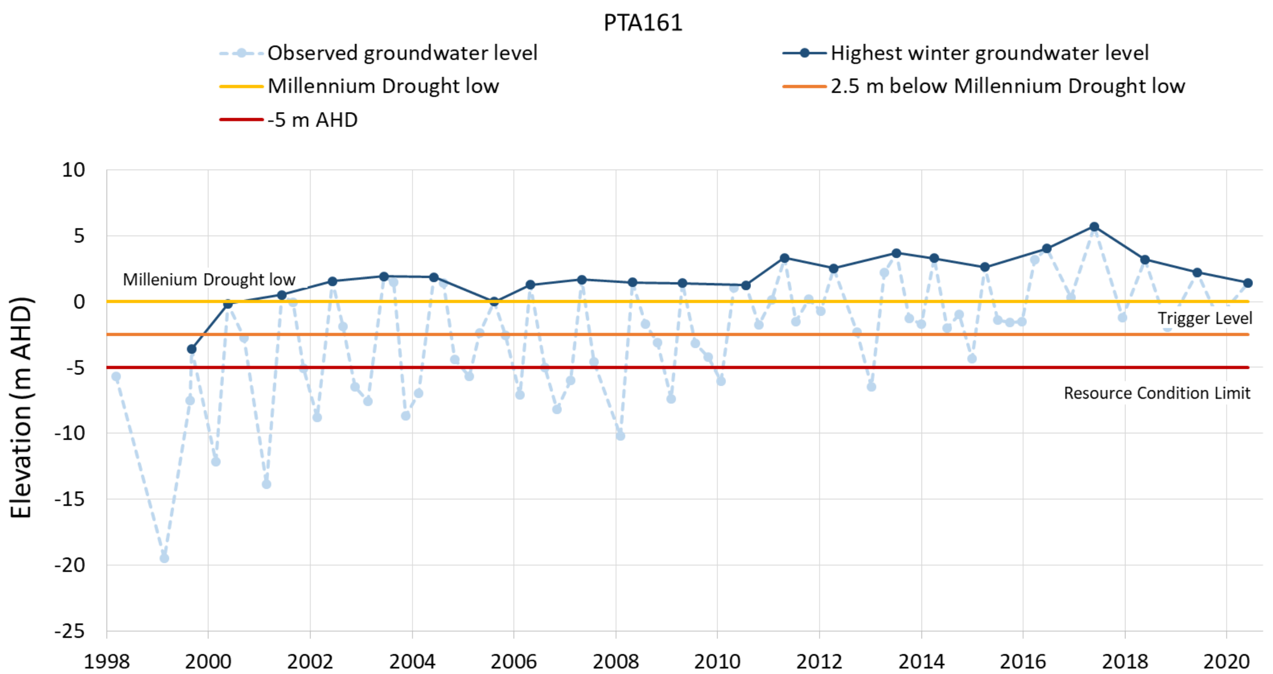

Figure 3.3 Groundwater levels and key levels of interest for PTA161

3.2.1.2 PTA095

The key levels, including the trigger level, for well PTA095 in the T1 NAP GMZ are presented in Table 3.5 and Figure 3.4. Figure 3.4 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. PTA095 is also located in Waterloo Corner, where the most intensive extraction occurs from the T1 aquifer (Figure 3.2). Monitoring of PTA095 began in 2000, but this well replaced the monitoring well PTA049, which is located about 12 m north of PTA095 and has monitoring data as far back as 1972. Therefore, the groundwater level data from PTA049 can be used as the historical data for PTA095 pre-2000.

The lowest winter recovery during the Millennium Drought is about 2.5 m above the resource condition limit. This is too sensitive (meaning that management is likely to be triggered too frequently) to use as the trigger level. The lowest winter recovery in the entire time series (August 1978) is about 0.5 m above the resource condition limit, which is too close to the resource condition limit to use as a trigger level. Therefore, a trigger level one metre below the Millennium Drought low is proposed.

Table 3.5 Key levels of interest for PTA095

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-2.59
Trigger level	1 m below the Millennium Drought low	-3.59
Resource condition limit (RCL)	-5 m AHD	-5

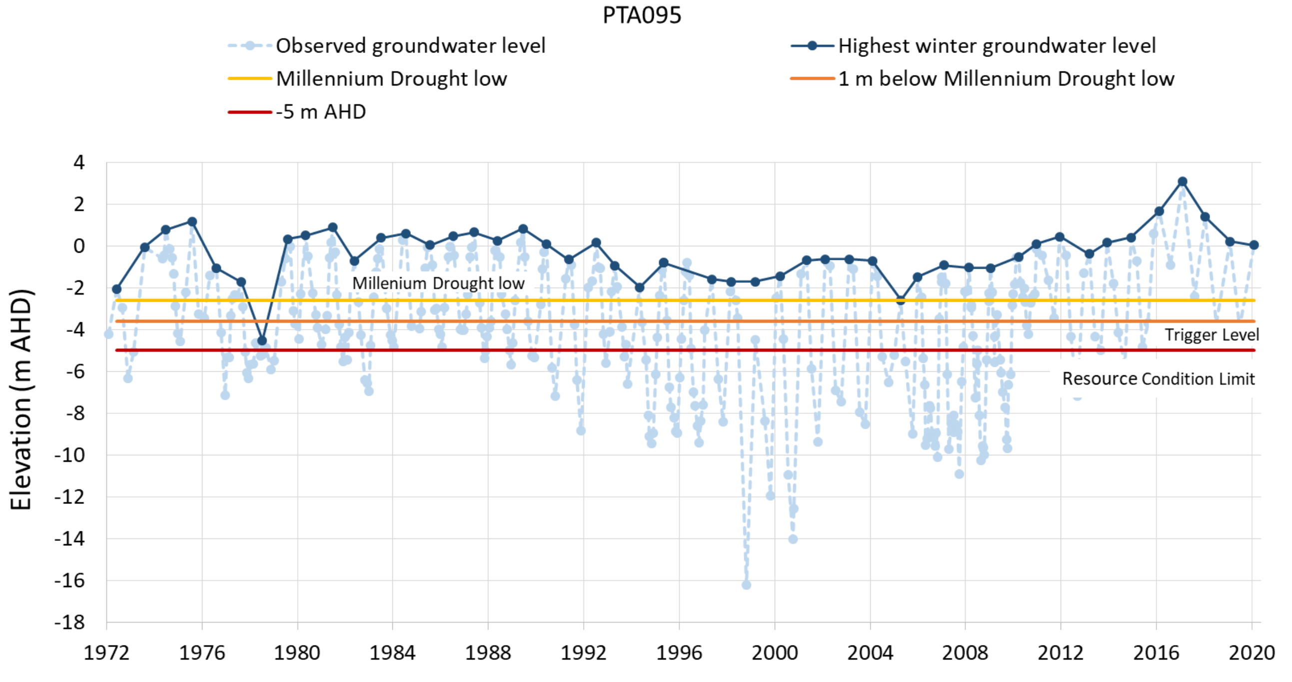

Figure 3.4 Groundwater levels and key levels of interest for PTA095

3.2.1.3 PTA111

The key levels, including the trigger level, for well PTA111 in the T1 NAP GMZ are presented in Table 3.6, and Figure 3.5. Figure 3.5 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. PTA111 is also located in Waterloo Corner, where the most intensive extraction occurs from the T1 aquifer (Figure 3.2).

Monitoring of PTA111 began in 2000, so the lowest winter recovery during the Millennium Drought is also the historical winter low and is two metres above the resource condition limit. Therefore, one metre below the Millennium Drought low is proposed as the trigger level.

Table 3.6 Key levels of interest for PTA111

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-3
Trigger level	1 m below the Millennium Drought low	-4
Resource condition limit (RCL)	-5 m AHD	-5

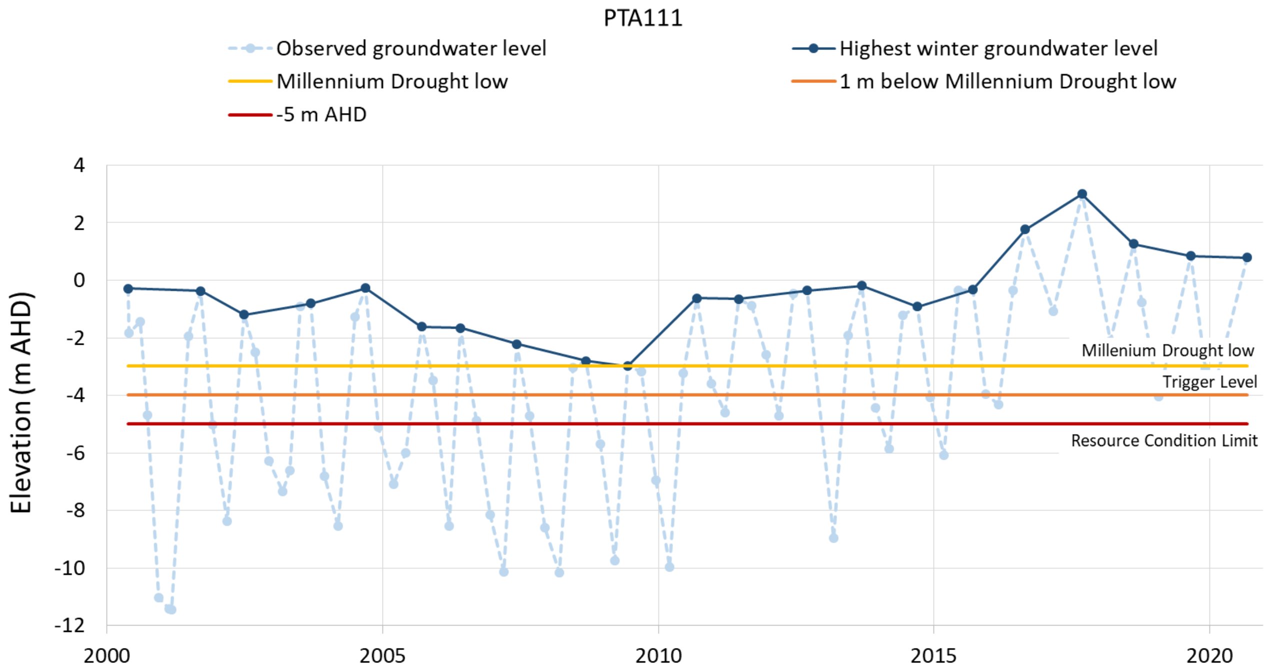

Figure 3.5 Groundwater levels and key levels of interest for PTA111

3.2.1.4 MPA152

The key levels, including the trigger level, for well MPA152 in the T1 NAP GMZ are presented in Table 3.7 and Figure 3.6. Figure 3.6 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. MPA152 is also located in Waterloo Corner, where the most intensive extraction occurs from the T1 aquifer (Figure 3.2).

Monitoring of MPA152 began in 2000, so the lowest winter recovery during the Millennium Drought is also the historical winter low and is about seven metres above the resource condition limit. Therefore, three metres below the Millennium Drought low is proposed as the trigger level.

Table 3.7 Key levels of interest for MPA152

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	2.38
Trigger level	3 m below the Millennium Drought low	-0.62
Resource condition limit (RCL)	-5 m AHD	-5

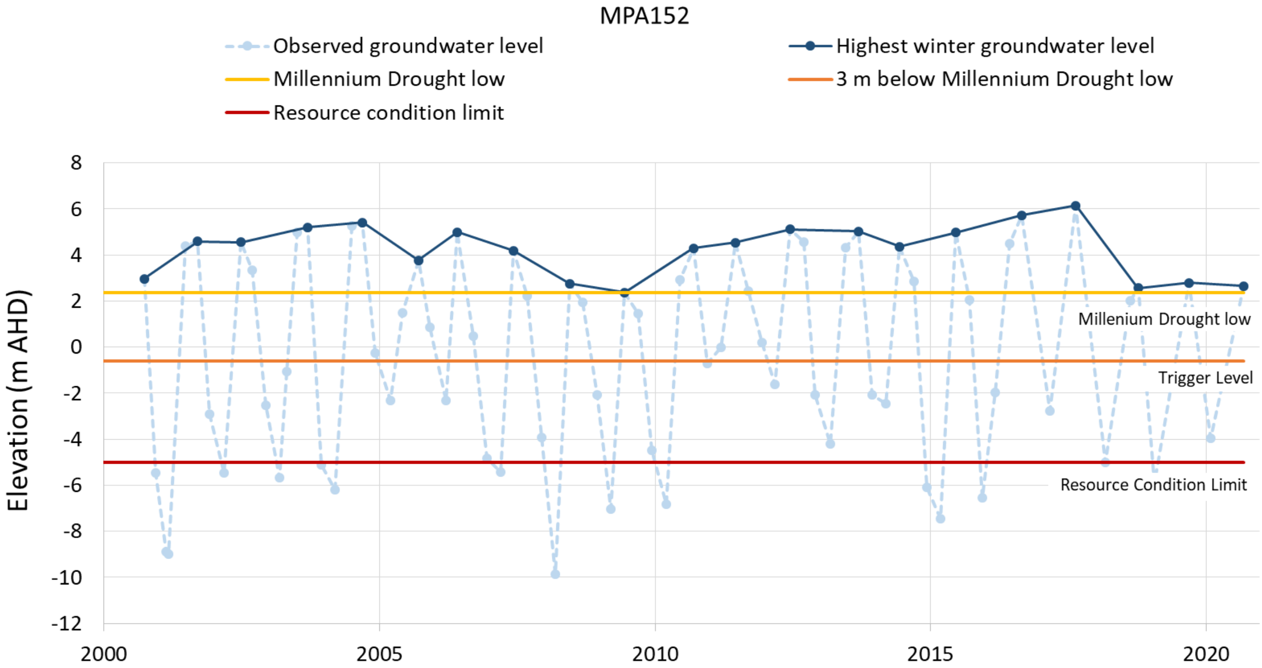

Figure 3.6 Groundwater levels and key levels of interest for MPA152

3.2.2 Group 2

3.2.2.1 PTA051

The key levels, including the trigger level, for well PTA051 in the T1 NAP GMZ are presented in Table 3.8, and Figure 3.7. Figure 3.7 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. PTA051 is located west of Virginia where intensive extraction occurs (Figure 3.2). Despite being monitored since 1972, limited data was collected during the mid-1990s when pressure levels were at their lowest in other wells due to excessive pumping and extraction. However, the winter groundwater level recorded in 1999 does provide a reasonable measure for the historical winter low.

The historical winter low is below the resource condition limit so is unsuitable as the trigger level. There is about two metres between the historical winter low and the lowest winter level during the Millennium Drought, therefore, one metre below the Millennium Drought low is proposed as the trigger level.

Table 3.8 Key levels of interest for PTA051

Key levels	Basis	Elevation (m AHD)

Informing the trigger level	Lowest winter recovery during the Millennium Drought	-3.29
Trigger level	1 m below the Millennium Drought low	-4.29
Resource condition limit (RCL)	-5 m AHD	-5

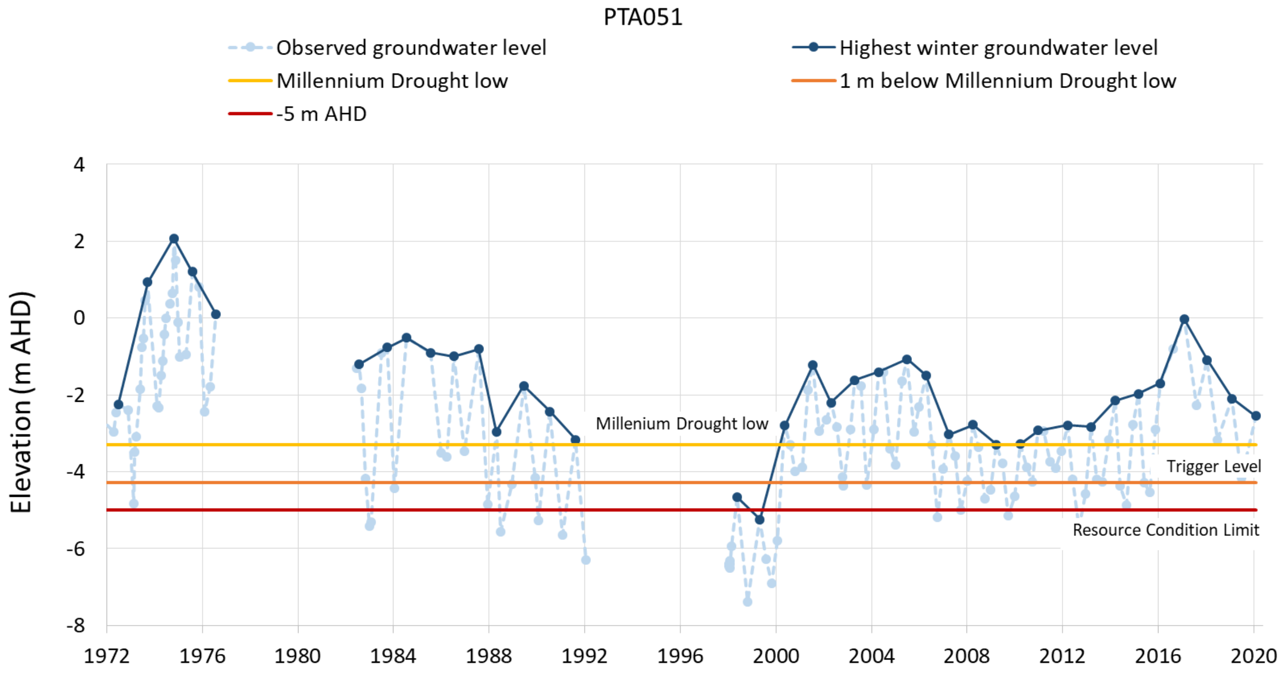

Figure 3.7 Groundwater levels and key levels of interest for PTA051

3.2.2.2 PTA093

The key levels, including the trigger level, for well PTA093 in the T1 NAP GMZ are presented in Table 3.9, and Figure 3.8. Figure 3.8 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. PTA093 is located west of Virginia where intensive extraction occurs (Figure 3.2). It has been monitored since 1998, thus there is limited data from the mid to late-1990s when low pressure levels were experienced in the area due to excessive pumping and extraction.. However, the winter groundwater level recorded in 1999 does provide a reasonable measure for the lowest winter recovery.

The historical winter low is at the resource condition limit, so is unsuitable as the trigger level. There is about two metres between the historical winter low and the Millennium Drought low, therefore one meter below the Millennium Drought low is proposed as the trigger level.

Table 3.9 Key levels of interest for PTA093

Key levels	**Basis**	**Elevation (m AHD)**
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-3.2
Trigger level	1 m below the Millennium Drought low	-4.2
Resource condition limit (RCL)	-5 m AHD	-5

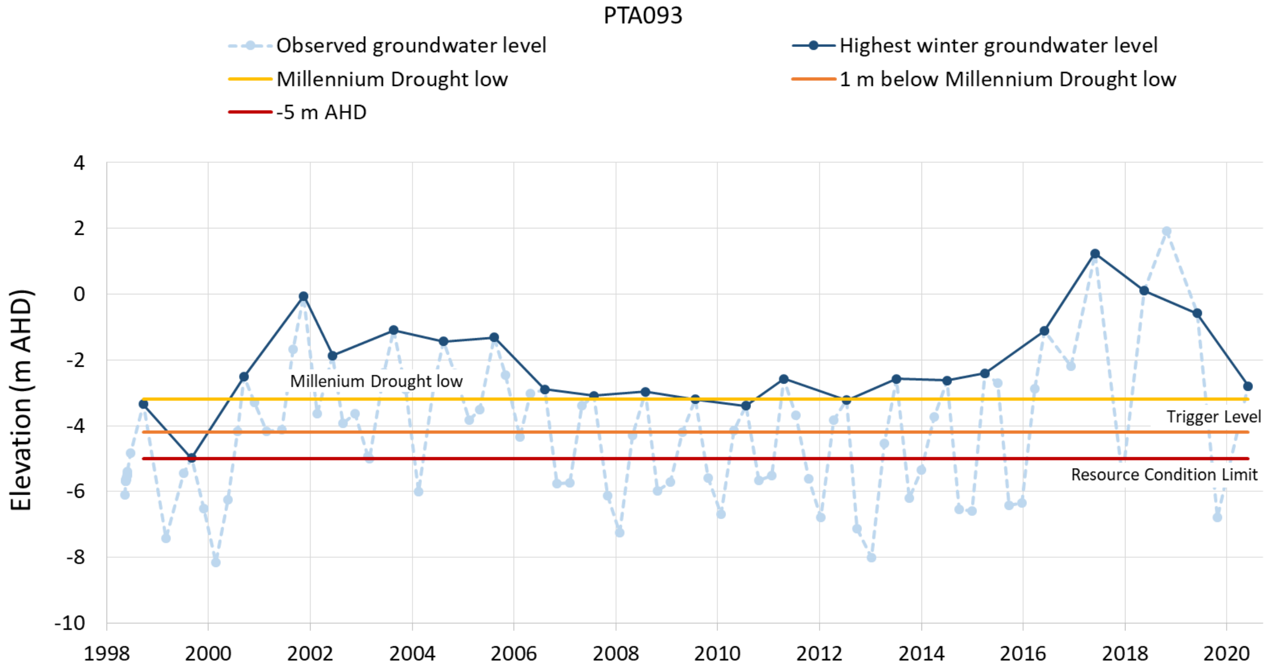

Figure 3.8 Groundwater levels and key levels of interest for PTA093

3.3 T2 Virginia GMZ

The T2 Virginia GMZ has management proposed as historical extraction has breached the resource condition limit and the current allocation exceeds the recommended extraction limit. The resource condition limit for the T2 aquifer is the top of the T2 aquifer. Trigger levels have been developed that consider the Millennium Drought low, the historical low and the resource condition limit. The highest winter groundwater level, generally from June, July, August or September were highlighted in the analysis as it is this level that would be compared to the trigger level.

3.3.1 Group 3

3.3.1.1 MPA144

The key levels, including the trigger level, for well MPA144 in the T2 Virginia GMZ are presented in Table 3.10 and Figure 3.9. Figure 3.9 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. Data for this well is not available pre-1999 so cannot inform historical low that predates the Millennium Drought period, however it is noted that the winter recovery level in 1999 is lower than the Millennium Drought level and possibly represents the impact at the tail end of a period of intensive pumping and extraction. MPA144 is in the centre of the cone of depression at Virginia (Figure 3.1). The lowest winter recovery during the Millennium Drought has been used to inform the trigger level which is set five metres below this level. While there is a difference of nearly 18 metres between the top of the T2 aquifer and the Millennium Drought low, setting the trigger level of five metres below the Millennium Drought low is proposed as this is still above the level seen in 1999.

Table 3.10 Key levels of interest for MPA144

Key levels	Basis	Elevation (m AHD)

Informing the trigger level	Lowest winter recovery during the Millennium Drought	-28.2
Trigger level	5 m below the Millennium Drought low	-33.2
Resource condition limit (RCL)	Top of the T2 aquifer	-46.1

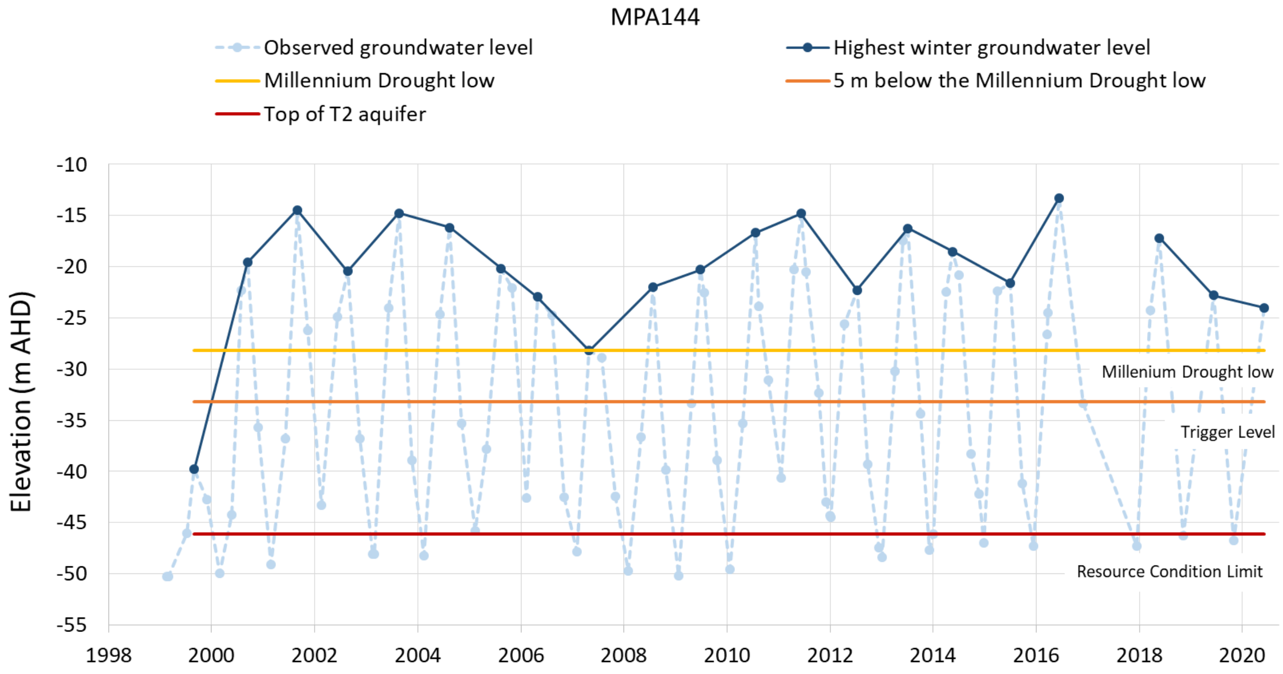

Figure 3.9 Groundwater levels and key levels of interest for MPA144

3.3.1.2 MPA109

MPA109 was removed in 2019 and MPA158 has been recommended as a replacement monitoring well. For completeness both wells have been presented in this analysis.

The key levels, including the trigger level, for well MPA109 in the T2 Virginia GMZ are presented in Table 3.11 and Figure 3.10. Figure 3.10 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. MPA109 is located close to the centre of the cone of depression (Figure 3.1). The winter groundwater level fell below the top of the T2 aquifer during the 1990s. The lowest winter recovery during the Millennium Drought has been used to inform the trigger level which is set five metres below this level. There is a difference of nearly 11 metres between the top of the T2 aquifer and the Millennium Drought low, therefore setting the trigger level of five metres below the Millennium Drought low is proposed as a point of middle ground.

Table 3.11 Key levels of interest for MPA109

Key levels	**Basis**	**Elevation (m AHD)**
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-24.6
Trigger level	5 m below the Millennium Drought low	-29.6
Resource condition limit (RCL)	Top of the T2 aquifer	-35.5

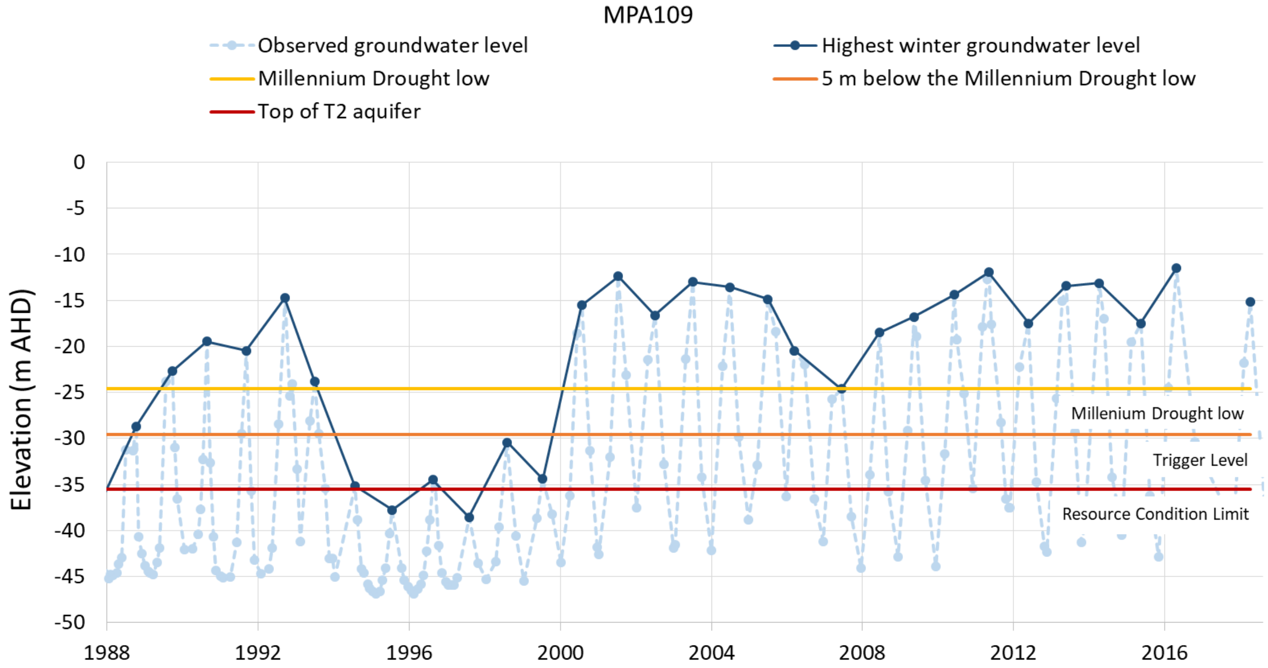

Figure 3.10 Groundwater levels and key levels of interest for MPA109

3.3.1.3 MPA158

The key levels, including the trigger level, for well MPA158 in the T2 Virginia GMZ are presented in Table 3.12 and Figure 3.11. Figure 3.11 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. Data for this well, data is not available pre 1999 and thus there is not enough data to inform historic low that predates the millennium drought period. MPA158 is located close to the centre of the cone of depression (Figure 3.1), although further away than MPA109. The lowest winter recovery during the Millennium Drought has been used to inform the trigger level which is set five metres below this level. There is a difference of nearly 15 metres between the top of the T2 aquifer and the Millennium Drought low. Setting the trigger level of five metres below the Millennium Drought low is proposed as being consistent with the approach taken for the other wells in this group as well as the well it is replacing (MPA109).

Table 3.12 Key levels of interest for MPA158

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-22.95
Trigger level	5 m below the Millennium Drought low	-27.95
Resource condition limit (RCL)	Top of the T2 aquifer	-42.93

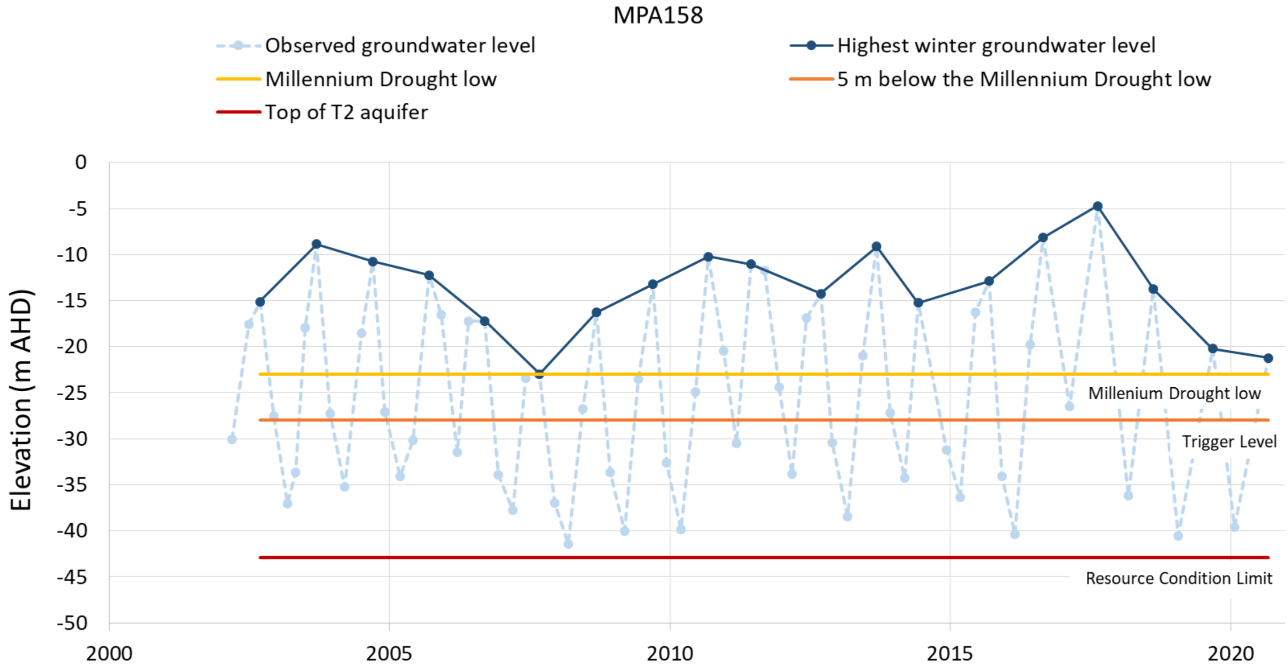

Figure 3.11 Groundwater levels and key levels of interest for MPA158

3.3.2 Group 4

3.3.2.1 PTA091

The key levels, including the trigger level, for well PTA091 in the T2 Virginia GMZ are presented in Table 3.13 and Figure 3.12. Figure 3.12 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. PTA091 is located close to the centre of the cone of depression (Figure 3.1).

During the 1990s when extraction was highest and the lowest winter recovery breached the top of the T2 aquifer at the centre of the cone of depression, the level was about 26 m above the top of the T2 aquifer in this well. Therefore the lowest winter recovery for PTA091 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. There is a nearly ten metre difference between the historical low and the Millennium Drought low. Therefore, the lowest winter recovery during the Millennium Drought has been used to inform the trigger level which is set five metres below this level.

Table 3.13 Key levels of interest for PTA091

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-21.7
Trigger level	5 m below the Millennium Drought low	-26.7
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	-31.26
Resource condition limit (RCL)	Top of the T2 aquifer	-57.5

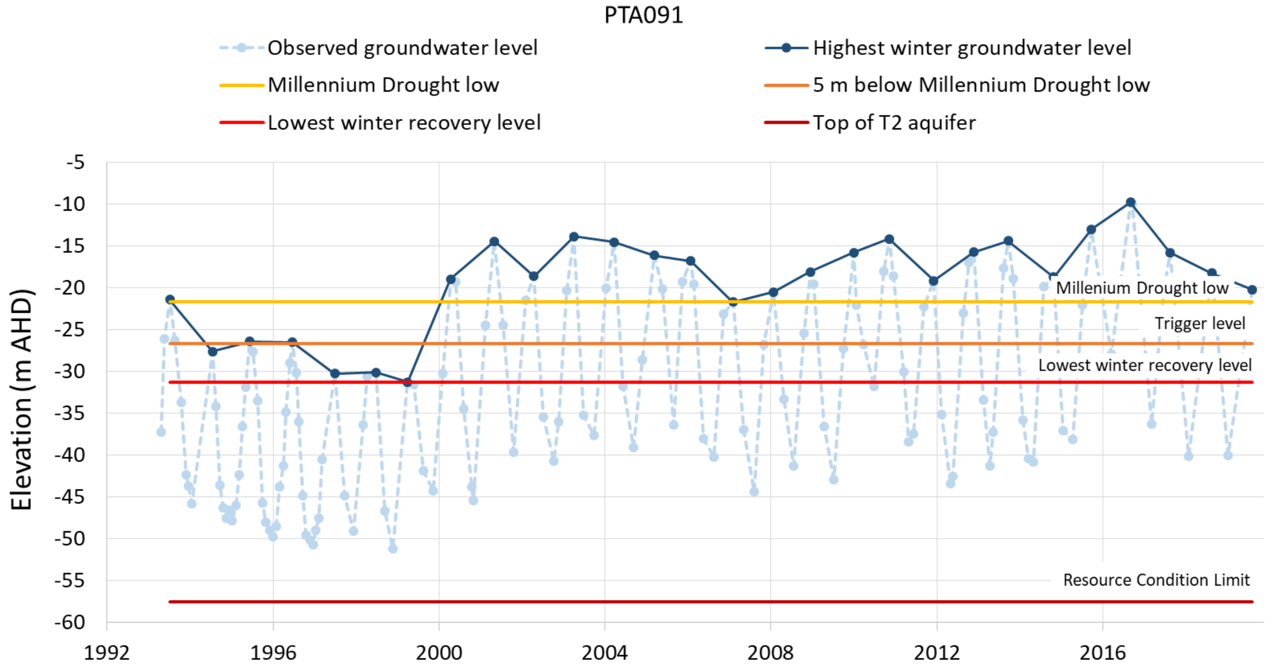

Figure 3.12 Groundwater levels and key levels of interest for PTA091

3.3.2.2 PTA082

The key levels, including the trigger level, for well PTA082 in the T2 Virginia GMZ are presented in Table 3.14 and Figure 3.13. Figure 3.13 also presents the historical groundwater level data and the maximum winter groundwater level. PTA082 is located to the northwest of the centre of the cone of depression (Figure 3.1).

During the 1990s when extraction was highest and the lowest winter recovery breached the top of the T2 aquifer in the centre of the cone of depression, the groundwater (pressure) level was about 25 m above the top of the T2 aquifer in this well. Therefore the lowest winter recovery for PTA082 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is about six metres lower than the Millennium Drought low, therefore a trigger level of three metres below the Millennium Drought low is proposed.

Table 3.14 Key levels of interest for PTA082

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-15.4
Trigger level	3 m below the Millennium Drought low	-18.4
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	-21.8
Resource condition limit (RCL)	Top of the T2 aquifer	-46.3

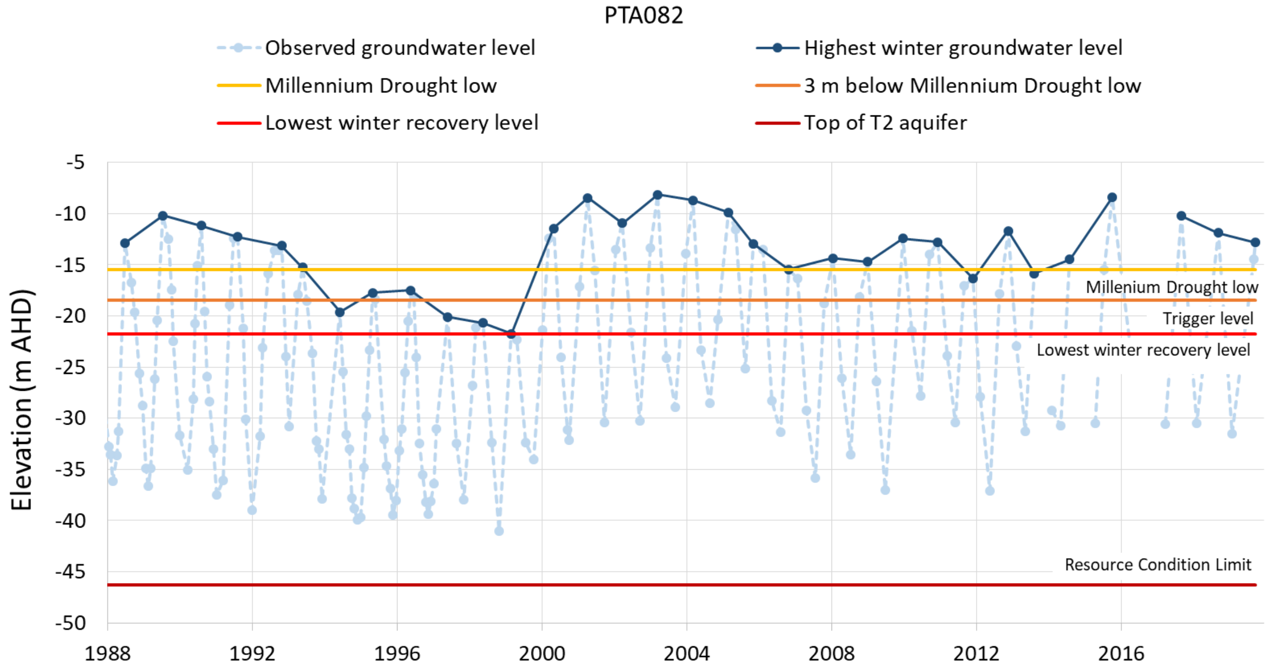

Figure 3.13 Groundwater levels and key levels of interest for PTA082

3.3.2.3 MPA159

The key levels, including the trigger level, for well MPA159 in the T2 Virginia GMZ are presented in Table 3.15, and Figure 3.14. Figure 3.14 also presents the historic groundwater (pressure) level data and the maximum winter groundwater level. MPA159 is located south of the centre of the cone of depression (Figure 3.1). Monitoring of MPA159 did not begin until 2002, but this well replaced the monitoring well MPA064, which is located about 100 m north of MPA159. Therefore, the groundwater level data from MPA064 can be used as the historical data for MPA159 pre-2002.

During the 1990s when extraction was highest, the lowest winter recovery breached the top of the T2 aquifer in the centre of the cone of depression. The groundwater level in this well at that time was about 39 m above the top of the T2 aquifer. Therefore the lowest winter recovery for MPA159 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is about nine metres lower than the Millennium Drought low, therefore a trigger level of five metres below the Millennium Drought low is proposed.

Table 3.15 Key levels of interest for MPA159

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-17.1
Trigger level	5 m below the Millennium Drought low	-22.1
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	-26.4
Resource condition limit (RCL)	Top of the T2 aquifer	-65.0

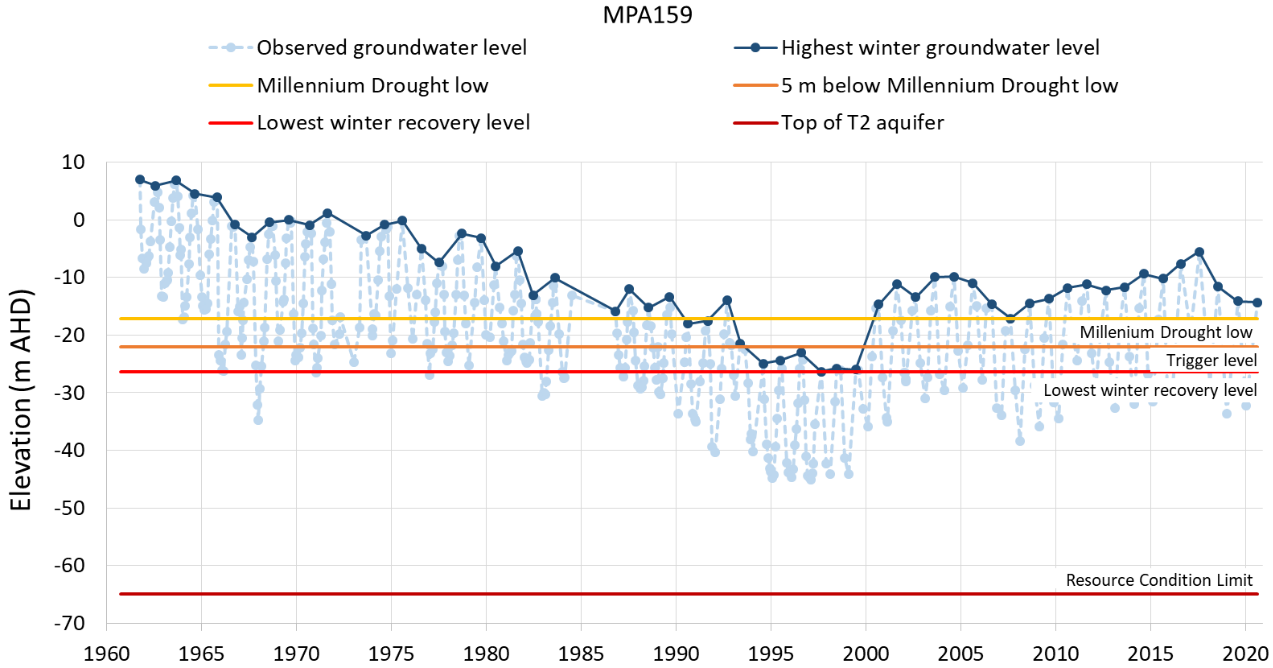

Figure 3.14 Groundwater levels and key levels of interest for MPA159

3.4 T2 NAP GMZ

Monitoring is proposed for the T2 NAP GMZ as the current allocation slightly exceeds the recommended extraction limit. In addition, there is the potential for extraction in this GMZ to influence the level in the adjacent T2 Virginia GMZ, which has historically breached the resource condition limit. The highest winter groundwater level (generally from June, July, August or September) was highlighted in the analysis as it is this level that would be compared to the trigger level. Where triggers are breached, further investigatory work should occur.

3.4.1 Group 5

3.4.1.1 PTG060

The key levels, including the trigger level, for well PTG060 in the T2 NAP GMZ are presented in Table 3.16, and Figure 3.15. Figure 3.15 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. For reasons of scale, this figure does not show the resource condition limit (the top of the T2 aquifer) however this value is given in Table 3.16. PTG060 is located northwest of Virginia in the outer reaches of the cone of depression (Figure 3.1).

During the 1990s when extraction was highest and the lowest winter recovery breached the top of the T2 aquifer in the centre of the cone of depression, the groundwater level was about 77 m above the top of the T2 aquifer in this well. Therefore the lowest winter recovery for PTG060 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is only one metre lower than the Millennium Drought low, so a trigger level of half a metre below the Millennium Drought low is proposed.

Table 3.16 Key levels of interest for PTG060

Key levels	Basis	Elevation (m AHD)

Informing the trigger level	Lowest winter recovery during the Millennium Drought	1.75
Trigger level	0.5 m below the Millennium Drought low	1.25
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	0.63
Resource condition limit (RCL)	Top of the T2 aquifer	-76.59

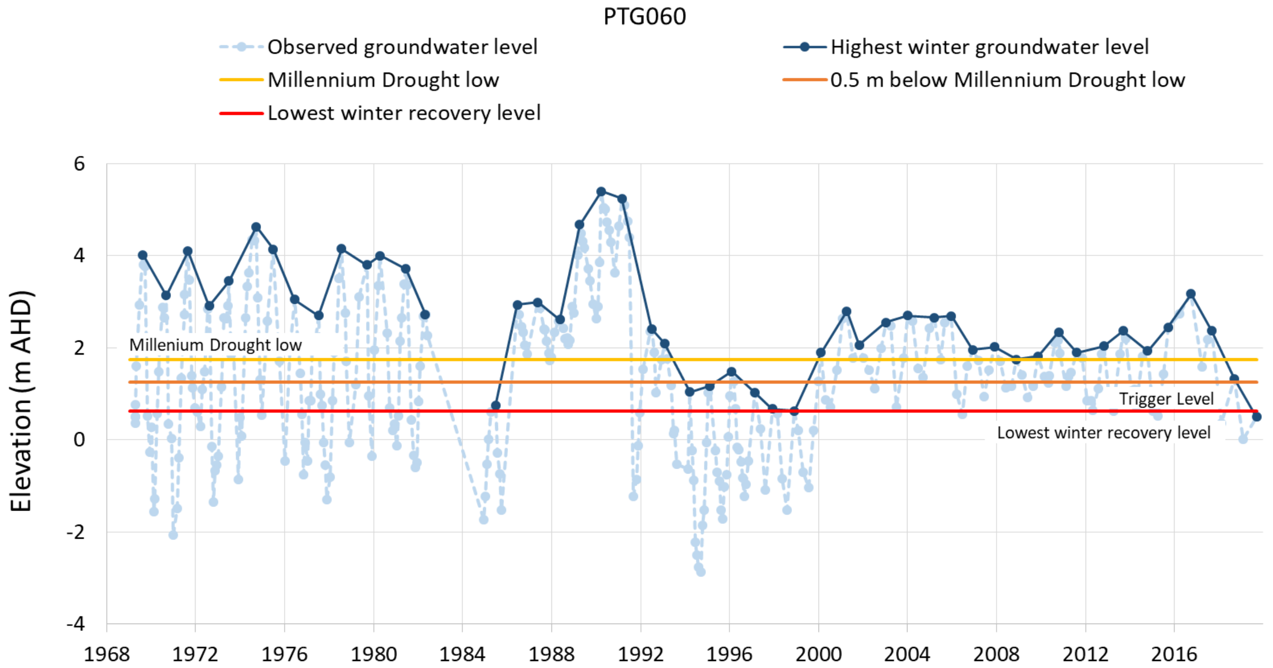

Figure 3.15 Groundwater levels and key levels of interest for PTG060

3.4.1.2 PTG031

The key levels, including the trigger level, for well PTG031 in the T2 NAP GMZ are presented in Table 3.17 and Figure 3.16. Figure 3.16 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. For reasons of scale, this figure does not show the resource condition limit (the top of the T2 aquifer) however this value is given in Table 3.17. PTG031 is located to the northwest of the T2 Virginia GMZ, in the outer reaches of the cone of depression (Figure 3.1).

Despite being monitored since 1982, no data was collected for most of the 1990s, thus there is limited data from the mid to late-1990s when low pressure levels were experienced in the area due to excessive pumping. However, the winter groundwater level recorded in 1999 does provide a reasonable measure for the historical winter low, which was about 38 m above the top of the T2 aquifer in this well. Therefore the lowest winter recovery for PTG031 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is about four metres lower than the Millennium Drought low, so a trigger level of two metres below the Millennium Drought low is proposed.

Table 3.17 Key levels of interest for PTG031

Key levels	**Basis**	**Elevation (m AHD)**

Informing the trigger level	Lowest winter recovery during the Millennium Drought	-2.36
Trigger level	2 m below the Millennium Drought low	-4.36
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	-6.82
Resource condition limit (RCL)	Top of the T2 aquifer	-44.7

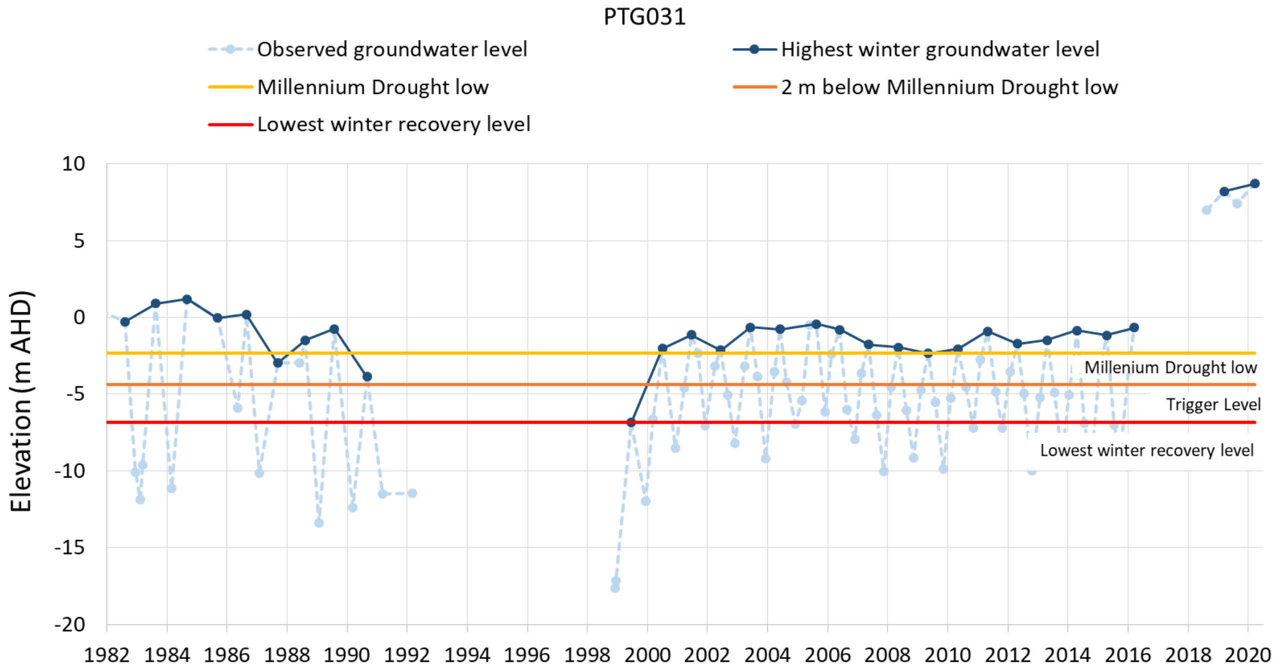

Figure 3.16 Groundwater levels and key levels of interest for PTG031

3.4.1.3 PTG085

The key levels, including the trigger level, for well PTG085 in the T2 NAP GMZ are presented in Table 3.18 and Figure 3.17. Figure 3.17 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. For reasons of scale, this figure does not show the resource condition limit (the top of the T2 aquifer) however this value is given in Table 3.18. PTG085 is located north of Virginia in the outer reaches of the cone of depression (Figure 3.1). Monitoring of PTG085 began in 2003 and replaced the monitoring well PTG062, which is located about five metres away. Therefore, the groundwater level data from PTG062 is used as the historical data for PTG085 pre-2003.

During the 1990s when extraction was highest and the lowest winter recovery breached the top of the T2 aquifer in the centre of the cone of depression, the groundwater level was about 30 m above the top of the T2 aquifer in this well. Therefore the lowest winter recovery for PTG085 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is about two metres lower than the Millennium Drought low, so a trigger level of one metre below the Millennium Drought low is proposed.

Table 3.18 Key levels of interest for PTG085

Key levels	Basis	Elevation (m AHD)

Informing the trigger level	Lowest winter recovery during the Millennium Drought	3.15
Trigger level	1 m below the Millennium Drought low	2.15
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	1.12
Resource condition limit (RCL)	Top of the T2 aquifer	-28.44

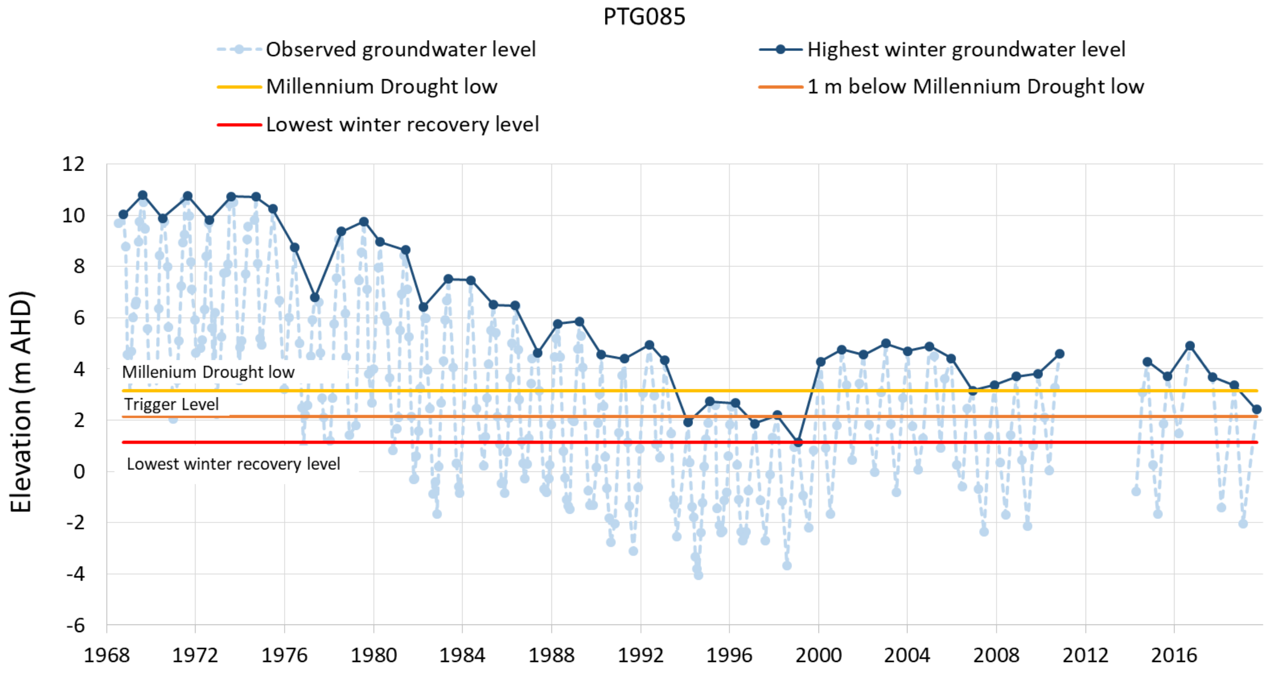

Figure 3.17 Groundwater levels and key levels of interest for PTG085

3.4.1.4 MUW034

The key levels, including the trigger level, for well MUW034 in the T2 NAP GMZ are presented in Table 3.19 and Figure 3.18. Figure 3.18 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. For reasons of scale, this figure does not show the resource condition limit (the top of the T2 aquifer) however this value is given in Table 3.19. MUW034 is located northeast of Virginia in the outer reaches of the cone of depression (Figure 3.1).

Monitoring since 1987 shows that while the groundwater level declined steadily throughout the 1990s, the lowest winter recovery during the Millennium Drought is lower than any time previous. Recent data also shows a decline since 2017, with the lowest historic recovery level occurring in 2019. The top of the T2 aquifer is about 22 metres below the lowest winter recovery. A trigger level of one metre below the Millennium Drought low is proposed based on the magnitude of change in groundwater level from year to year and between 1988 and 2009. This trigger may need to be revised based on future data, given the downwards trend in the groundwater level.

Table 3.19 Key levels of interest for MUW034

Key levels	**Basis**	**Elevation (m AHD)**
Informing the trigger level	Lowest winter recovery during the Millennium Drought	11.04
Trigger level	1 m below the Millennium Drought low	10.04

Lowest winter recovery level	Lowest winter groundwater recovery level	9.63
Resource condition limit (RCL)	Top of the T2 aquifer	-12.23

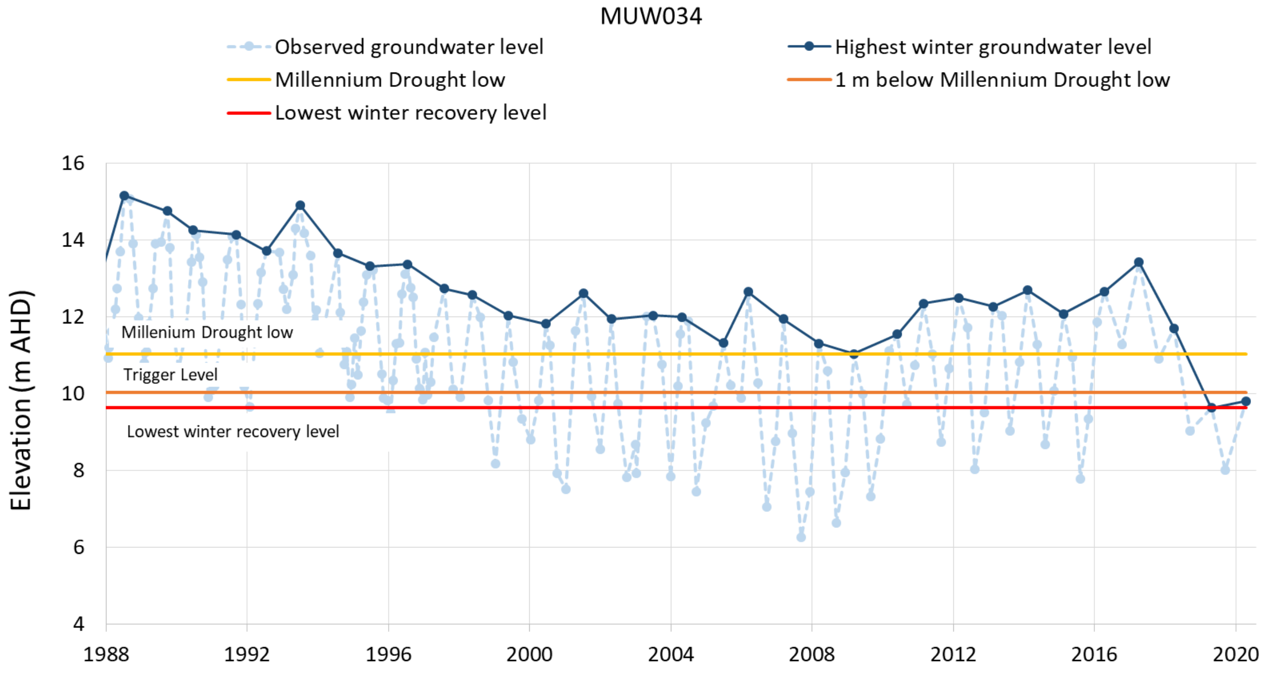

Figure 3.18 Groundwater levels and key levels of interest for MUW034

3.4.2 Group 6

3.4.2.1 PTA094

The key levels, including the trigger level, for well PTGA094 in the T2 NAP GMZ are presented in Table 3.20 and Figure 3.19. Figure 3.19 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. For reasons of scale, this figure does not show the resource condition limit (the top of the T2 aquifer) however this value is given in Table 3.20. PTA094 is located at Waterloo Corner, south of the T2 Virginia GMZ (Figure 3.1).

In the mid to late-1990s, low pressure levels were experienced in the area due to excessive pumping. Monitoring commenced in 1998 and the winter groundwater level recorded in 1999 provides a reasonable basis for the historical winter low, which was about 82 m above the top of the T2 aquifer in this well. Therefore the lowest winter recovery for PTG094 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is about three metres lower than the Millennium Drought low, so a trigger level of 1.5 m below the Millennium Drought low is proposed.

Table 3.20 Key levels of interest for PTA094

Key levels	Basis	Elevation (m AHD)
Informing the trigger level	Lowest winter recovery during the Millennium Drought	-4.7
Trigger level	1.5 m below the Millennium Drought low	-6.2

Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	-7.75
Resource condition limit (RCL)	Top of the T2 aquifer	-90

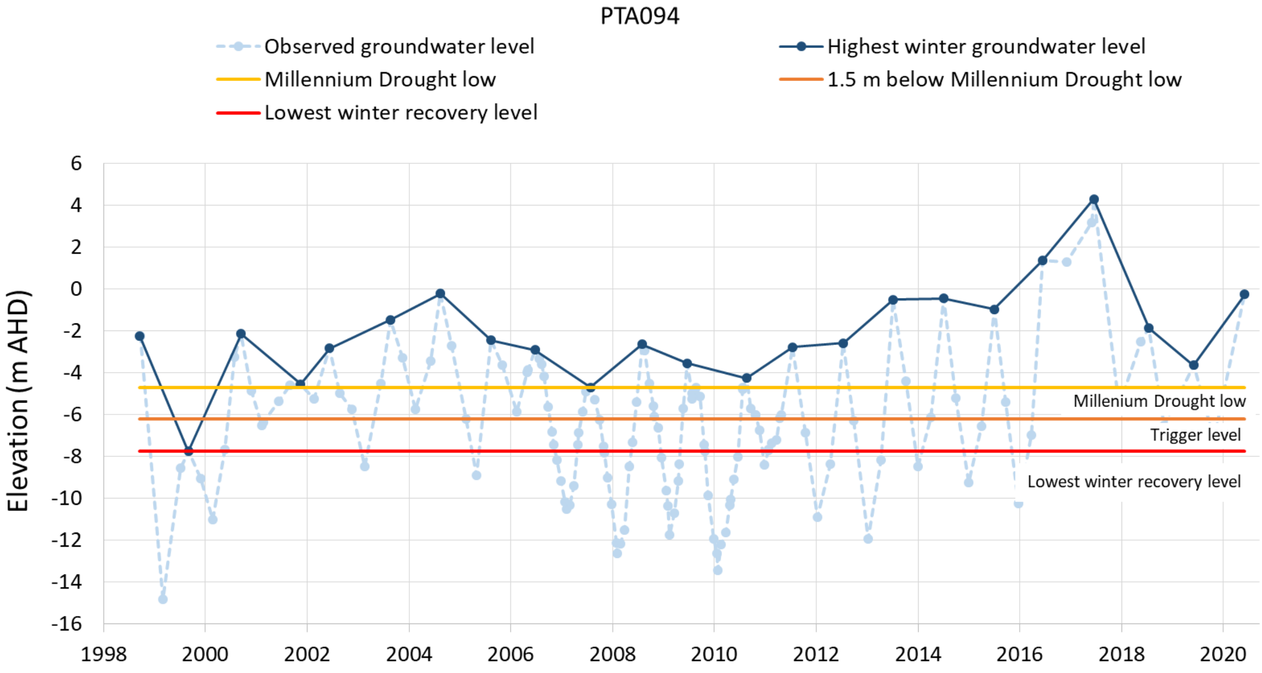

Figure 3.19 Groundwater levels and key levels of interest for PTA094

3.4.2.2 MPA081

The key levels, including the trigger level, for well MPA081 in the T2 NAP GMZ are presented in Table 3.21 and Figure 3.20. Figure 3.20 also presents the historical groundwater (pressure) level data and the maximum winter groundwater level. For reasons of scale, this figure does not show the resource condition limit (the top of the T2 aquifer) however this value is given in Table 3.21. MPA081 is located southeast of Virginia on the outskirts of the T2 NAP GMZ (Figure 3.1).

During the 1990s when extraction was highest and the winter recovery breached the top of the T2 aquifer in the centre of the cone of depression, the lowest winter recovery in MPA081 was around 90 m above the top of the T2 aquifer. Therefore the lowest winter recovery for PTG094 is considered to be representative of the groundwater level when the T2 aquifer breached the RCL within the T2 Virginia GMZ, even though the T2 aquifer was not breached at this location. The historical winter low is about one metre below the Millennium Drought low, so a trigger level of 0.5 m below the Millennium Drought low is proposed.

Table 3.21 Key levels of interest for MPA081

Key Levels	**Based on**	**Elevation (m AHD)**
Informing the trigger level	Lowest winter recovery during the Millennium Drought	9.79
Trigger level	0.5 m below the Millennium Drought low	9.29
Lowest winter recovery level	Lowest winter groundwater recovery level pre 2000	8.74
Resource condition limit (RCL)	Top of the T2 aquifer	-80.76

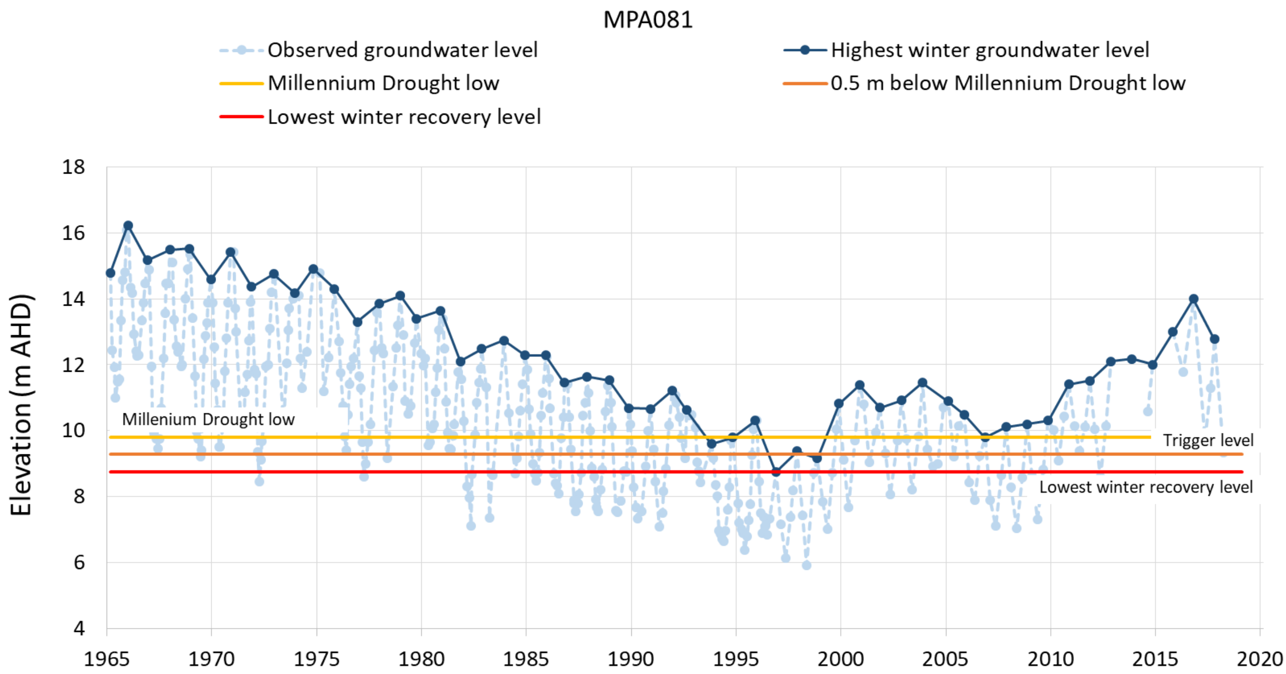

Figure 3.20 Groundwater levels and key levels of interest for MPA081

3.5 T2 Kangaroo Flat GMZ

Monitoring is proposed for the T2 Kangaroo Flat GMZ as significant increases in salinity in the Kangaroo Flat area have been observed. Figures 3.21 and 3.22 show the relationship between historic extraction and groundwater salinity for two key wells. Increases in salinity have been observed, particularly in well MUW029, when extraction levels have risen above 1,500 ML/y per year. Unlike the previous GMZ's, there is no relationship between the groundwater level with respect to the top of the aquifer and the issue requiring management (groundwater salinity). As such, there are no trigger levels proposed, however ongoing monitoring of the groundwater salinity in the two wells shown below is recommended.

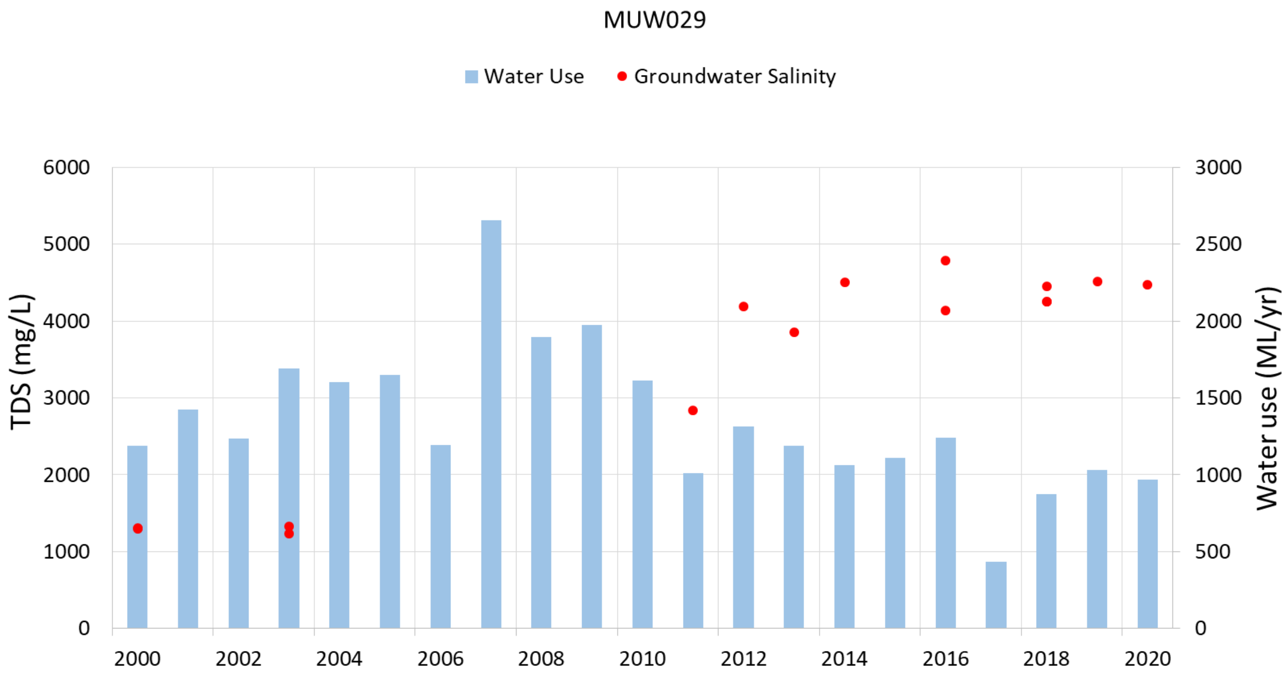

Figure 3.21 Groundwater salinity and extraction for MUW029

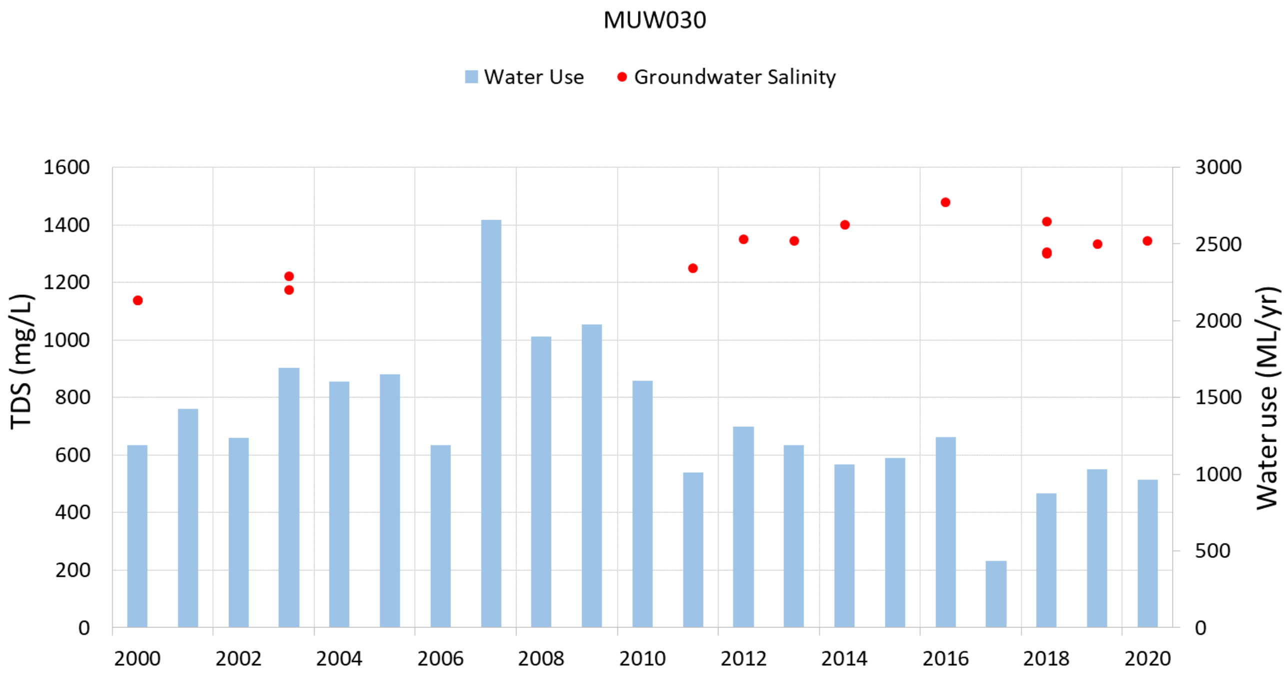

Figure 3.22 Groundwater salinity and extraction for MUW030

4 Modelling Analysis

Groundwater modelling has been used in developing the recommended extraction limits and the trigger levels to inform and test recommendations. In the Resource Capacity Report scenarios were developed to determine the impact of various rates of extraction on the groundwater resource. This report builds on this work by re-analysing the output from those scenarios with respect to the recommended trigger levels. Additional model scenarios were undertaken by consultants (Groundwater Science), which extended these scenarios to examine the impact of applying the recommended management approach where management would be triggered. The full consultant report is included in Appendix A with key results consolidated in this section.

4.1 Adelaide Plains groundwater flow and solute transport model

The groundwater model used for this analysis (and in the Resource Capacity Report) is the Adelaide Plains groundwater flow and solute transport model, version AP2013 (Peat V and Yan W, 2014). This model version is an updated version of AP2011. Only the flow model has been used in this work. An outline of the model development is given below.

RPS Aquaterra worked closely with the DEW (Department for Water at the time) Technical Reference Panel to develop the Adelaide Plains Groundwater Flow and Solute Transport Model 2011, known as the AP2011 model (RPS Aquaterra 2011). They develop a history-matched model that is calibrated to observed groundwater levels and salinity trends from 1950 to 2010. Where long-term and complete abstraction data exists (such as the abstraction bores located in the central region of the NAP), good calibration was demonstrated. However, the unmetered abstraction across CA required assumptions to be made about the historical abstraction data and thus good calibration was not always achieved everywhere across the CA area, especially in terms of short-term water level responses.

The AP2011 model consists of 7 layers representing the following hydrostratigraphic units: Shallow unconfined Quaternary, Quaternary silts and clay, Carisbrooke Sands, T1 aquifer, Munno Para Clay and T2 aquifer. The model was designed to simulate the following hydrological processes: diffuse recharge from rainfall, evapotranspiration, groundwater interaction with the major rivers and creeks, groundwater abstraction and injection, regional inflow from the Mount Lofty Ranges and discharge to Gulf St Vincent. The model domain is bounded to the north by the Light River, to the east and south by the Eden-Burnside Fault, and to the west 5 km off-shore from Gulf St Vincent. The model was constructed using the MODFLOW 96 code. AP2011 was calibrated to historical groundwater level data dating from March 1950 to March 2010.

The AP2011 model was updated by DEW in 2013 and is referred to as the AP2013 model. It was based on AP2011 and has the following modifications:

- the General Head Boundary (GHB) was adjusted to increase the volume of lateral inflow into the plains area from the Mount Lofty Ranges (MLR)
- rainfall recharge in the plains area was simplified to represents a long-term average condition
- Munno Para Clay was extended to the western model boundary under the coast, which is supported by borehole data

These changes improve the model to simulate the Adelaide Plains groundwater system, whilst still achieving an adequate match to groundwater levels within the CA and NAP areas as per AP2011 model.

4.1.1 Modelling undertaken to support the Resource Capacity Report

To support the Resource Capacity Report, the AP2013 model was used to conduct a series of groundwater extraction pumping scenarios (for the purpose of determining recommended extraction limits in the context of resource capacity). A summary of these scenarios is given in Table 4.1.

The input data used in these scenarios included metered groundwater extraction data, groundwater allocation data, MAR scheme data and groundwater level data (Watt et al., 2017). The metered groundwater extraction data was sourced from WILMA (DEW groundwater licensing database); MAR scheme data from DEW; and groundwater level data were sourced from the DEW WaterConnect website. This data was updated by DEW in 2017 and a summary of the pumping data used in the scenarios is given in Table 4.2.

At the time this modelling was undertaken, the trigger levels were in an earlier stage of development and the analysis of the model output was conducted based on these preliminary triggers. Further development of the trigger levels resulted in the analysis that was undertaken at that time being no longer relevant to the Plan. For that reason, the model output from these scenarios has been reanalysed with respect to the trigger levels documented in this report (Tables 3.2 and 3.3).

Table 4.1 Summary of modelled scenarios

Modelled scenario	**Description of scenario**
Scenario 1 – Base case	Extraction of average metered extraction from 2006 to 2013 for the NAP PWA; existing user demand for the CA PWA
Scenario 2 – Worst case	Extraction of full allocation volumes for the NAP PWA; existing user demand for the CA PWA
Scenario 3 – Mid case	Extraction of volumes midway between the average metered extraction from 2006 to 2013 and full allocations for the NAP PWA; existing user demand for the CA PWA
Scenario 4 – Base case + 10%	Same as Scenario 1 with an additional 10% extraction from every well west of the Para Fault
Scenario 5 – Base case + 20%	Same as Scenario 1 with an additional 20% extraction from every well west of the Para Fault
Scenario 6 – Base case + double in GGE	Same as Scenario 1, with double the existing user demand extracted from the GGE
Scenario 7 – Scenario 6 + extra 2,000 ML/y in GGE	Same as Scenario 6 with an additional 2,000 ML/y extracted from the GGE
Scenario 8 – Scenario 6 + extra 1,000 ML/y in GGE	Same as Scenario 6 with an additional 1,000 ML/y extracted from the GGE
Scenario 9 – Scenario 1, Scenario 2 in T2 NAP and T2 Regional + extra 2,000 ML/y in T2 Regional	Same as Scenario 1 for all GMZs, except same as Scenario 2 for the T2 NAP and T2 Regional GMZs, with an additional 2,000 ML/y extracted from the T2 Regional GMZ
Scenario 10 – Base case + 30%, Scenario 1 for T2 Kangaroo Flat, Scenario 5 for T2 Virginia, Scenario 9 for T2 Regional and Scenario 8 for T1 and T2 GGE	Same as Scenario 1 with an additional 30% extraction from every well west of the Para Fault, except same as Scenario 1 for the T2 Kangaroo Flat GMZ, same as Scenario 5 for the T2 Virginia GMZ, same as

	Scenario 9 for the T2 Regional GMZ and the same as Scenario 8 for the T1 and T2 GGE GMZ

Table 4.2 Pumping volumes for each GMZ per scenario

GMZ	Current entitlement volume ML/y^	Resource Extraction Limit ML/y*	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
T1 NAP	4601	4159	3199	5091	3953	3519	3839	3199	3199	3199	3199	4159
T1 Dry Creek	8327	10,494	2972	2972	2972	3270	3567	2972	2972	2972	2972	3864
T1 Grange			1940	1940	1940	2134	2328	1940	1940	1940	1940	2522
T1 Thebarton			1383	1383	1383	1521	1660	1383	1383	1383	1383	1798
T1 Central Adelaide			1777	1777	1777	1955	2132	1777	1777	1777	1777	2310
T2 NAP	18,378	4251	2230	4483	3322	2453	2676	2230	2230	2230	4483	2899
T2 Virginia		11,072	9224	14,917	11921	10,146	11,068	9224	9224	9224	9224	11,068
T2 Kangaroo Flat	2057	1500	1321	1321	1321	1453	1585	1321	1321	1321	1321	1321
T2 Regional	3424	6023	103	212	157	113	124	103	103	103	2212	2212
T2 Osborne			1199	1199	1199	1319	1439	1199	1199	1199	1199	1559
T2 Regency Park			1732	1732	1732	1905	2078	1732	1732	1732	1732	2252
T1 and T2 GGE	1517	4552	1526	1526	1526	1526	1526	3052	5052	4052	1526	4052
Total			**28,606**	**38,554**	**33,204**	**31,315**	**34,023**	**30,132**	**32,132**	**31,132**	**32,968**	**40,016**

^From Plan (Table 7.1: Entitlement shares and resource extraction limits at the date of adoption of this Plan)

*From Table 1.5, noting that some GMZ's have been combined since this modelling was undertaken. Highlights show in which scenario the modelled extraction pumping volumes are closest to the current Resource Extraction Limit for the GMZ's of interest.

4.1.2 Modelling undertaken to investigate proposed management

The modelling undertaken to support the Resource Capacity Report did not examine the impact management approach, in part because the approach was still under discussion at the time that work was being completed. Therefore, the proposed management approach requires testing as to whether it successfully protects the resource. This work was undertaken by Groundwater Science. In addition to testing the effectiveness of management, the analysis provides some understanding on the frequency and duration of management actions under the different scenarios examined. This modelling was undertaken based on an earlier version of the trigger levels, with minor difference to those documented in this report. Commentary has been included where these differences may have impacted how the modelling was undertaken. However, the results presented here are presented with respect to the trigger levels documented in this report.

The scenarios undertaken by Groundwater Science examine how the system responds once management is triggered. They were assessed over a 40 year timescale and management was applied to T1 NAP and T2 Virginia as per the management approach documented in Section 2. Modelled extraction pumping volumes are given in Table 4.3, along with the equivalent volumes from the Plan. Current entitlement volume is derived from the current entitlement shares in Table 7.1 in the Plan, where one share equals one kilolitre. It is representative of the full volume available to licensees at the time of writing, noting that Kangaroo Flat is undergoing a reduction. It may not match the full allocation used in the modelling as the process of reconciling licenses has led to revisions in the current entitlement volume that post-date the modelling.

The initial, unmanaged extraction pumping rate (full allocation volume) is based on Scenario 2 (Table 4.2), with adjustments made to the rates in the T2 NAP and T2 Kangaroo Flat GMZs. This was done as to better align the scenario with the understanding of what the full allocation of each of the GMZ was at the time this modelling was undertaken. There have been further refinements to this since that time, and the current entitlement volume reflects the full allocation volume at the time of writing.

The extraction pumping rate when management is applied (managed aquifer volume) is given in Table 4.3 and is based on the recommended extraction limit. The only GMZs that are managed are T1 NAP and T2 Virginia, all other zones remain at full allocation volume.

Table 4.3 Pumping volumes for each GMZ for management scenario modelling

GMZ	Current entitlement volume ML/y^ From Plan	Resource Extraction Limit ML/y* From Plan	Full allocation volume (FAV) ML/y Modelled	Managed aquifer volume (MAV) ML/y Modelled	MAV percentage of FAV
T1 NAP	4601	4159	5091	4,159	81.7%
T1 Dry Creek			2972	2972	
T1 Grange	8327	10,494	1940	1940	
T1 Thebarton			1383	1383	
T1 Central Adelaide			1777	1777	
T2 NAP	18,378	4251	4304	4304	

T2 Virginia		11,072	14,917	11,072	74.2%
T2 Kangaroo Flat	2057	1500	1500	1500	
T2 Regional			212	212	
T2 Osborne	3424	6023	1199	1199	
T2 Regency Park			1732	1732	
T1 and T2 GGE	1517	4552	1526	1526	
Total			**40,673**	**35,843**	

^ From Plan, (Table 7.1: Entitlement shares and resource extraction limits at the date of adoption of this Plan)

*From Table 1.5, noting that some GMZ's have been combined since this modelling was undertaken.

Following the management scenario investigation, further work was undertaken to investigate variations in managed extraction pumping volumes. Due to time constraints, this was not done as a response to management being triggered, like the previous scenario, but as a flat pumping rate over 40 years. These are not documented in the consultant report as they were run after that report was complete. However the results from these scenarios have been incorporated into this report.

4.1.3 Key model and scenario limitation

At the time of the Plan's development, the AP2013 model is the most appropriate tool for assessing the proposed management approaches. There are other more recent models that look at a similar area but these do not have the necessary spatial resolution to sufficiently answer the questions being addressed. However, it is important to acknowledge the limitations associated with this model that may be pertinent to the information being examined.

A thorough description of the limitations of the AP2011 model has been carried out by RPS Aquaterra (2011), noting that these limitations reflect the knowledge at that time. In the past 10 years, significant work has been done in furthering the understanding of the Adelaide Plains region and this knowledge creates some additional limitations, which need to be considered.

4.1.3.1 Structure surfaces

Since the development of the model in 2010, significant work has been undertaken to improve the understanding of the hydrogeological surfaces that define the different aquifers/aquitards. Comparison of the layering in the AP2011 to updated surfaces and bore data show that the top of the T2 aquifer in the model can be significantly different to the current level data. As the top of the T2 aquifer is the resource condition limit for that aquifer, this represents a limitation in the model's capability to inform management questions that relate to this boundary. It also may cause an issue where the groundwater level is near that boundary as there is the potential for unconfined conditions (i.e. groundwater level dropping below the top of the aquifer) to occur in reality but not in the model, or vice versa. Given that unconfined and confined flow respond differently to pumping, this is a significant limitation of the model and it is recommended that this is remedied as a priority.

4.1.3.2 Model result adjustments

AP2011 was calibrated to groundwater level data that ended in 2010. As part of the 2017 update, model scenario 1 (base case) was compared to measured groundwater data. Where levels did not match in wells used for the trigger level analysis, an adjustment was made. This was to allow direct comparison between simulated levels and proposed trigger levels. These adjustments (Table 4.4) were made to all further modelled scenario results.

These adjustments likely represent some degree of poor calibration of the model to more recent data. It is therefore recommended that the model be recalibrated to the latest data as a priority.

Table 4.4 Adjustments to modelled groundwater level

GMZ	Monitoring group	Monitoring well	Winter trigger level (m AHD)	Resource Condition Limit (m AHD)	Adjustment to modelled groundwater level (m)
T1 NAP	Group 1	PTA161	-2.5	-5	-1.5
		PTA095	-3.6	-5	-2.5
		PTA111	-4	-5	-4.1
		MPA152	-0.62	-5	-4.3
	Group 2	PTA051	-4.3	-5	-4.8
		PTA093	-4.2	-5	-5.3
T2 Virginia	Group 3	MPA144	-33.2	-46.1	5
		MPA158	-27.95	-42.93	5
	Group 4	PTA091	-26.72	-57.5	7
		PTA082	-18.4	-46.3	4.5
		MPA159	-22.09	-65	7

4.1.3.3 Scenario design

Model scenarios are often described as "predictions", however that is a misnomer as predicting future conditions and extraction is not possible. Two approaches are considered.

Firstly, historic conditions and extraction can be used as the basis for scenarios. This allows a degree of variability representative of how extraction responds to conditions. However there is a risk with a changing climate that the historic conditions (such as changes in annual rainfall) are no longer representative of what may occur in the future and how that may need to be managed. Estimates of climate change can be used, but it is difficult to predict water extraction in response to different climate drivers.

Another approach is to test the limits proposed within the Plan, regardless of how they compare to historic data. This does not capture the variability of extraction from year to year and assumes that all water extractions are the same every year (the volume being dependent on the particular scenario being run). Also the Plan limits on extraction are higher than long term observed water extraction. This method can be viewed as testing whether the management proposed is capable of protecting the resource under the worst possible conditions allowed for in a policy setting, regardless of the likelihood of these conditions occurring. The risk of using this approach is that it may result in management being designed in an overly restrictive manner to address a worst case scenario that may never occur. However this approach allows for a relatively small (compared to the previous approach) number of scenarios to be examined and gives confidence that the worst case conditions have been examined.

As outlined, both scenario design options have advantages and disadvantages. To ensure that the worst case scenario was covered, the scenario approach was designed to test the limits proposed within the Plan.

Management responses were designed to not be overly restrictive, provide water users with flexibility and provide significant forewarning of any changes that may occur, while still protecting the resource. Should the management require further refinement in future, then it is recommended that scenarios be designed to be more representative of the historic (and likely future) variability in water extraction from year to year.

4.2 Scenario results from the Resource Capacity Modelling

There are a number of scenarios that were undertaken as part of, or subsequent to the Resource Capacity Report that are relevant to the volumes in the Plan. These scenarios look at a constant volume pumped for each GMZ over a 30 year period. Different combinations of pumping rates for different GMZs were examined (Table 4.2). The scenarios relevant to the current Plan include:

- Scenario 1 – 2006 to 2013 average use for T1 NAP and T2 Virginia
- Scenario 2 – Full allocation for T1 NAP and T2 Virginia
    - Note that the full allocation reflects the understanding of the current entitlement volume at the time the modelling was undertaken. Recent revisions of this data mean that there are differences between the volumes used in the modelling and the volumes in the Plan.
- Scenario 10 – Recommended extraction limit for T1 NAP and T2 Virginia.

The output from these scenarios has been re-analysed against the trigger level approach outlined in Section 2. This provides insight into when management would have been triggered based on the consistent pumping of the volumes outlined in Table 4.2.

4.2.1 Scenario 1

This scenario assumes that extraction in the NAP PWA over 30 years (2010–40) is the average extraction over the eight years from 2006 to 2013, which includes wet and dry climatic periods. In the NAP PWA, it was assumed that 80% of the annual extraction is taken in summer and 20% is taken in winter to meet agricultural and horticultural demand. Existing user demand in the CA PWA was applied for the 30 years in both the T1 and T2 aquifers. Extraction in the CA PWA was non-seasonal as the largest users are industrial.

The results from this scenario have been re-analysed against the triggers outlined in Section 2. The results for individual wells have been included in Section 4.2.1.1 for T1 NAP and Section 4.2.1.2 for T2 Virginia. Because the key output of this re-analysis is to examine whether management would be triggered, individual wells are not discussed in these sections. Rather an overview is presented here as well as relevant comments on individual wells. A summary of the modelled results is given in Table 4.5.

The modelled response in the T1 NAP indicates that under this pumping regime, no wells breach their trigger levels. Also, no wells breach the resource condition limit. All modelled water levels show a declining trend over the 30 years of the modelled simulation.

The modelled response in the T2 Virginia indicates that under this pumping regime, no wells breach their triggered level. Also, no wells breach the resource condition limit. Modelled water levels show a predominately flat trend over the 30 years of the modelled simulation. Group 3 wells (MPA144 and MPA109) show a slight decline over the 30 year period, however it is in the order of 1 m or less.

Table 4.5 Summary of modelled bore response – Scenario 1

GMZ	Monitoring group	Monitoring well	Winter trigger level (m AHD)	Resource Condition Limit (m AHD)	Triggered condition	Trigger breached	Resource condition breached
T1 NAP	Group 1	PTA161	-2.5	-5	2 out of 4	No	No
		PTA095	-3.6	-5		No	No
		PTA111	-4	-5		No	No
		MPA152	-0.62	-5		No	No
	Group 2	PTA051	-4.3	-5	Both	No	No
		PTA093	-4.2	-5		No	No
T2 Virginia	Group 3	MPA144	-33.2	-46.1	Both	No	No
		MPA158*	-27.95	-42.93		N/A	N/A
		MPA109	-26.72	-57.5		No	No
	Group 4	PTA091	-18.4	-46.3	2 out of 3	No	No
		PTA082	-22.09	-65		No	No
		MPA159	-2.5	-5		No	No

*This modelling was undertaken prior to the issues with MPA109 being identified and results were provided for MPA109 rather than MPA158.

4.2.1.1 T1 NAP aquifer GMZ

4.2.1.1.1 Group 1

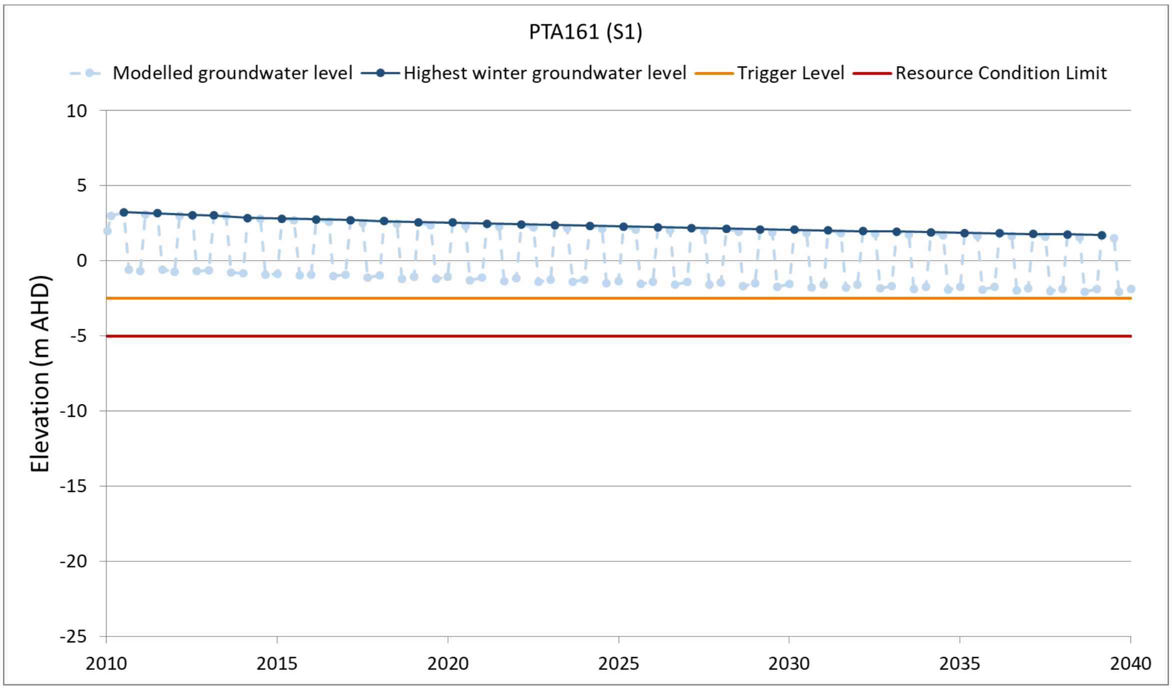

Figure 4.1 Modelled groundwater levels and key levels of interest for PTA161 – Scenario 1

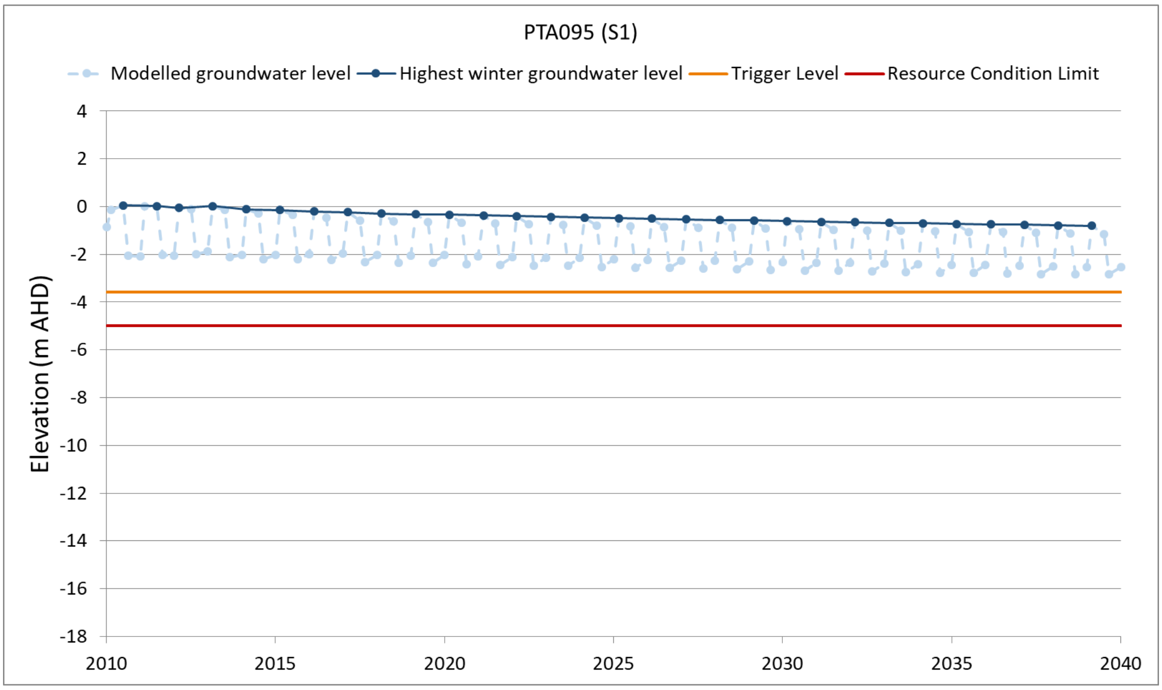

Figure 4.2 Modelled groundwater levels and key levels of interest for PTA095 – Scenario 1

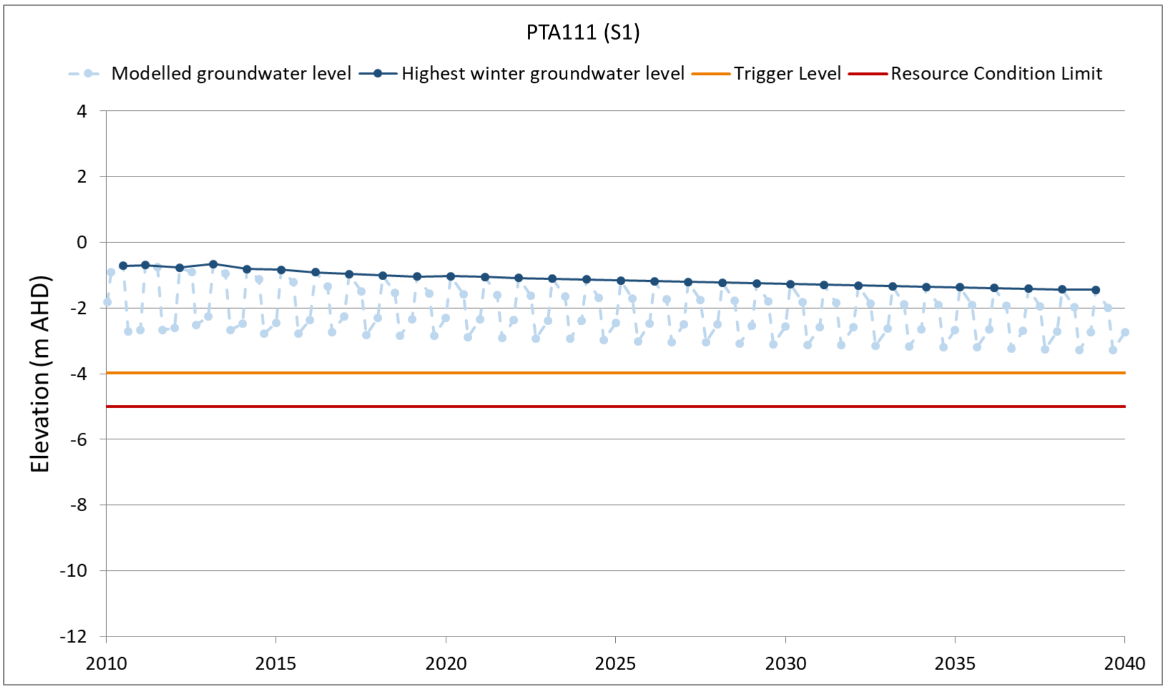

Figure 4.3 Modelled groundwater levels and key levels of interest for PTA011 – Scenario 1

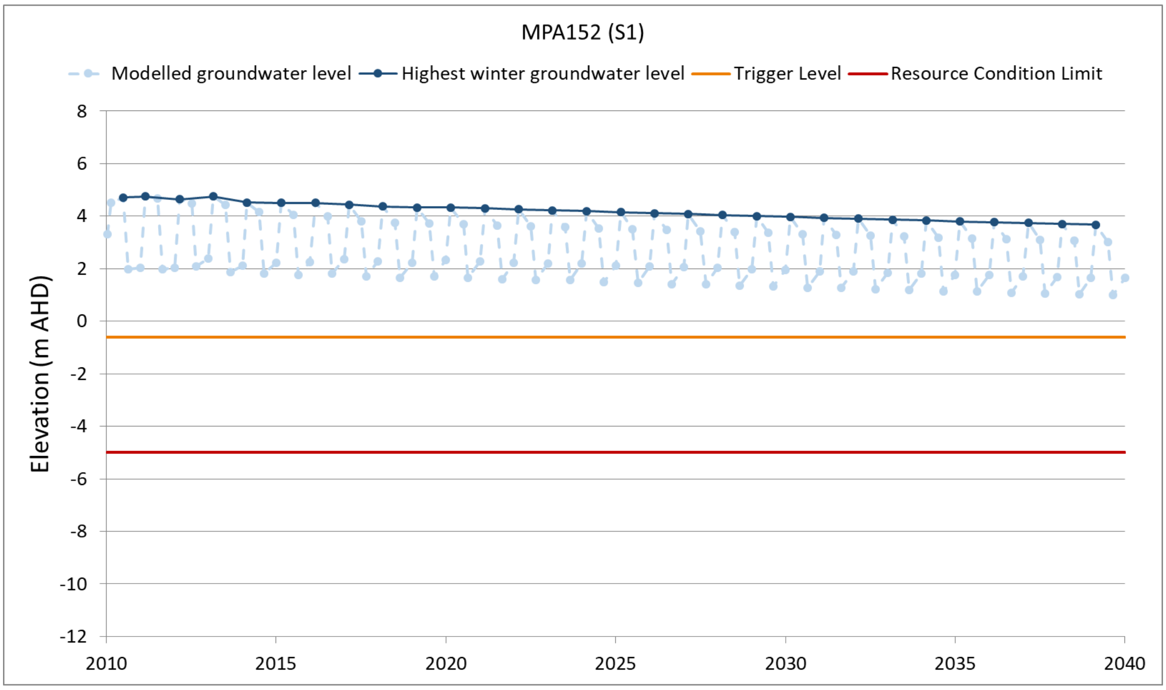

Figure 4.4 Modelled groundwater levels and key levels of interest for MPA152 – Scenario 1

4.2.1.1.2 Group 2

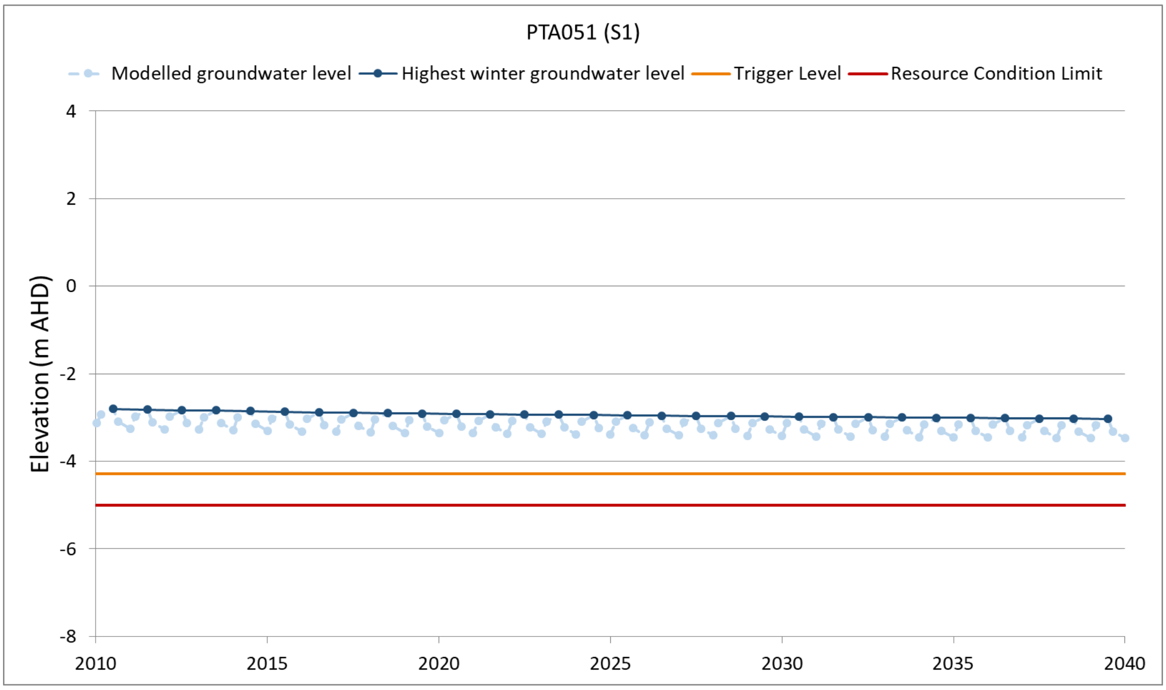

Figure 4.5 Modelled groundwater levels and key levels of interest for PTA051 – Scenario 1

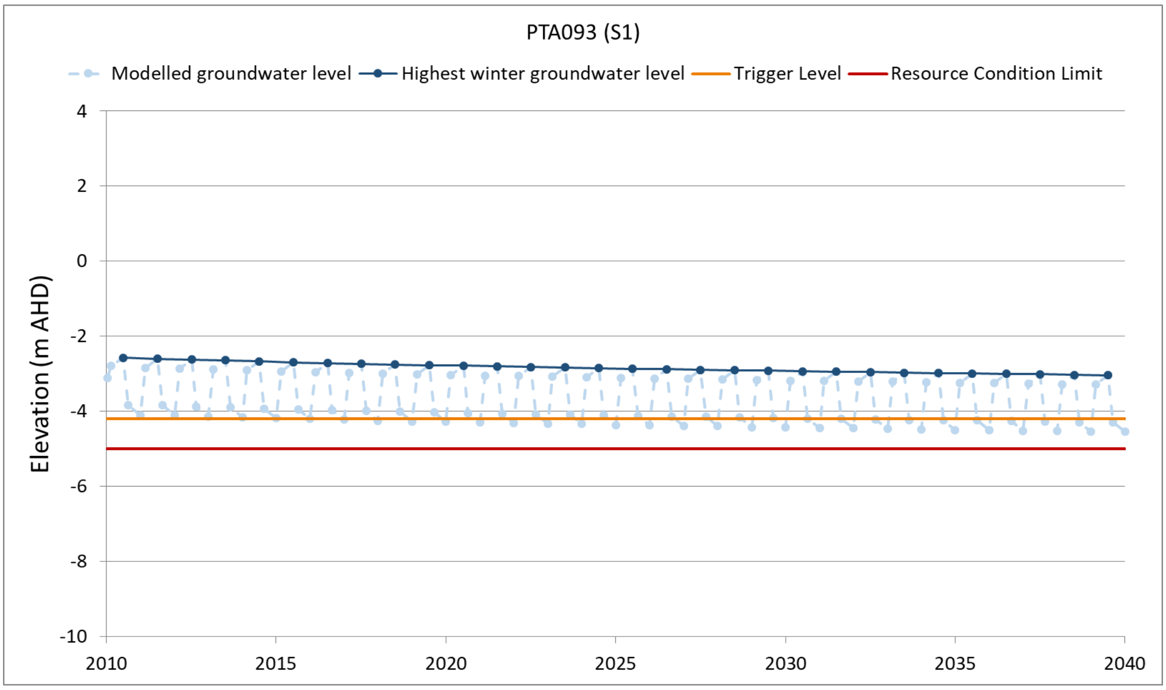

Figure 4.6 Modelled groundwater levels and key levels of interest for PTA093 – Scenario 1

4.2.1.2 T2 Virginia GMZ

4.2.1.2.1 Group 3

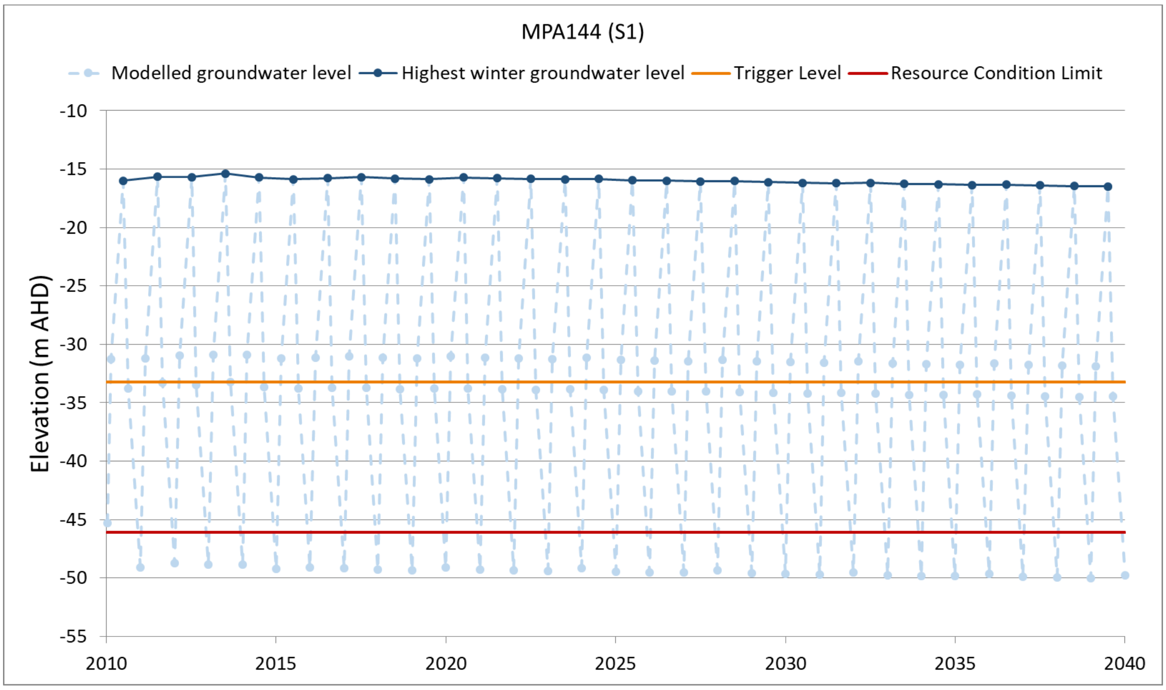

Figure 4.7 Modelled groundwater levels and key levels of interest for MPA144 – Scenario 1

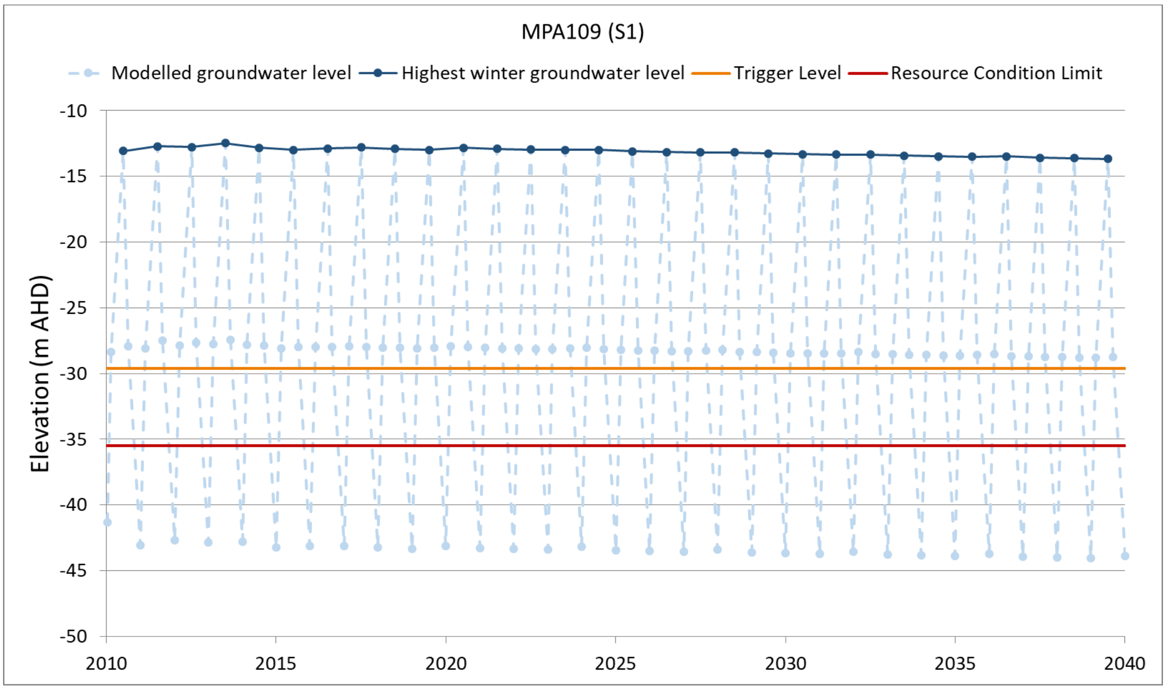

Figure 4.8 Modelled groundwater levels and key levels of interest for MPA109 – Scenario 1

4.2.1.2.2 Group 4

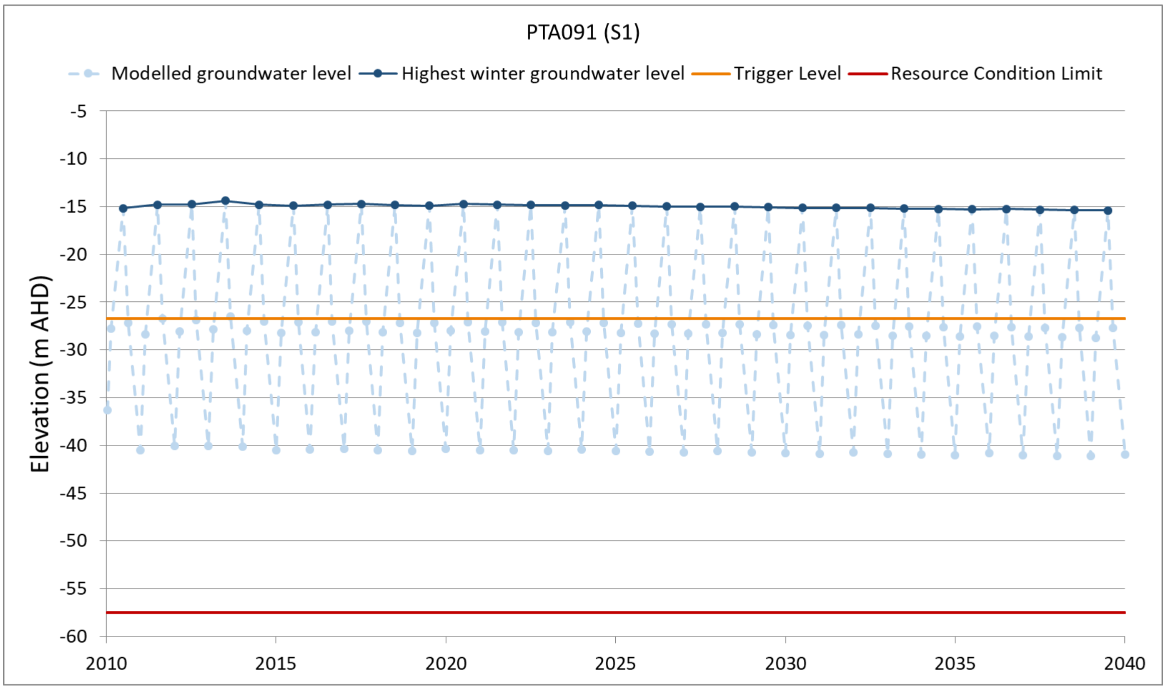

Figure 4.9 Modelled groundwater levels and key levels of interest for PTA091 – Scenario 1

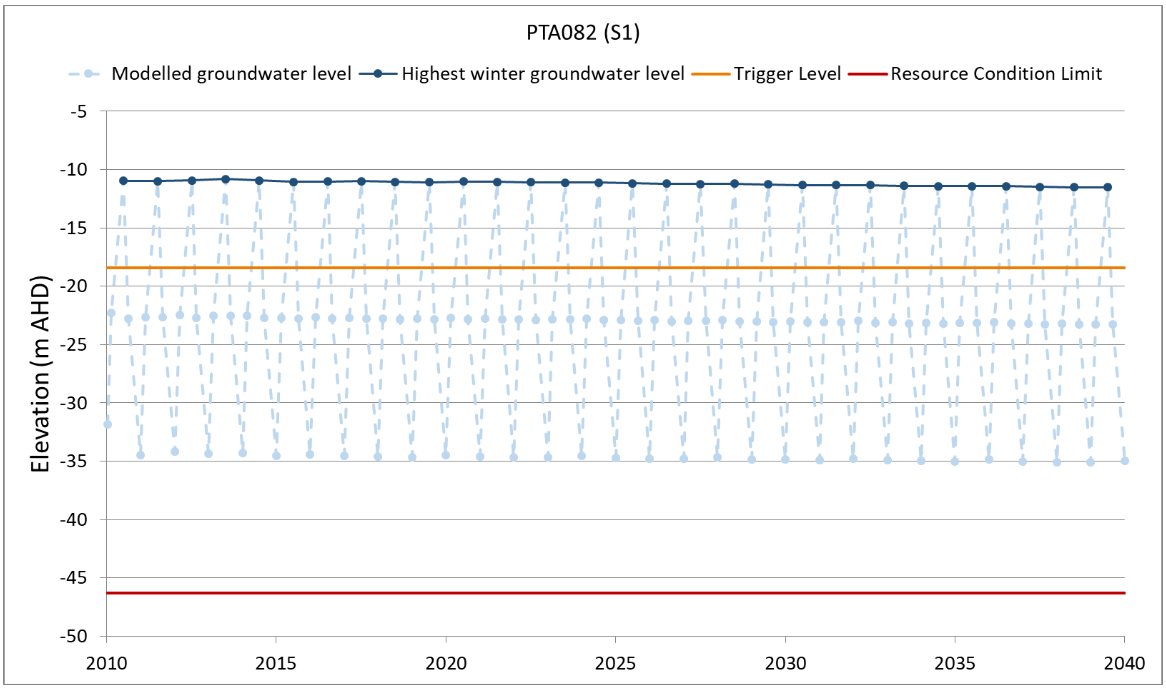

Figure 4.10 Modelled groundwater levels and key levels of interest for PTA082 – Scenario 1

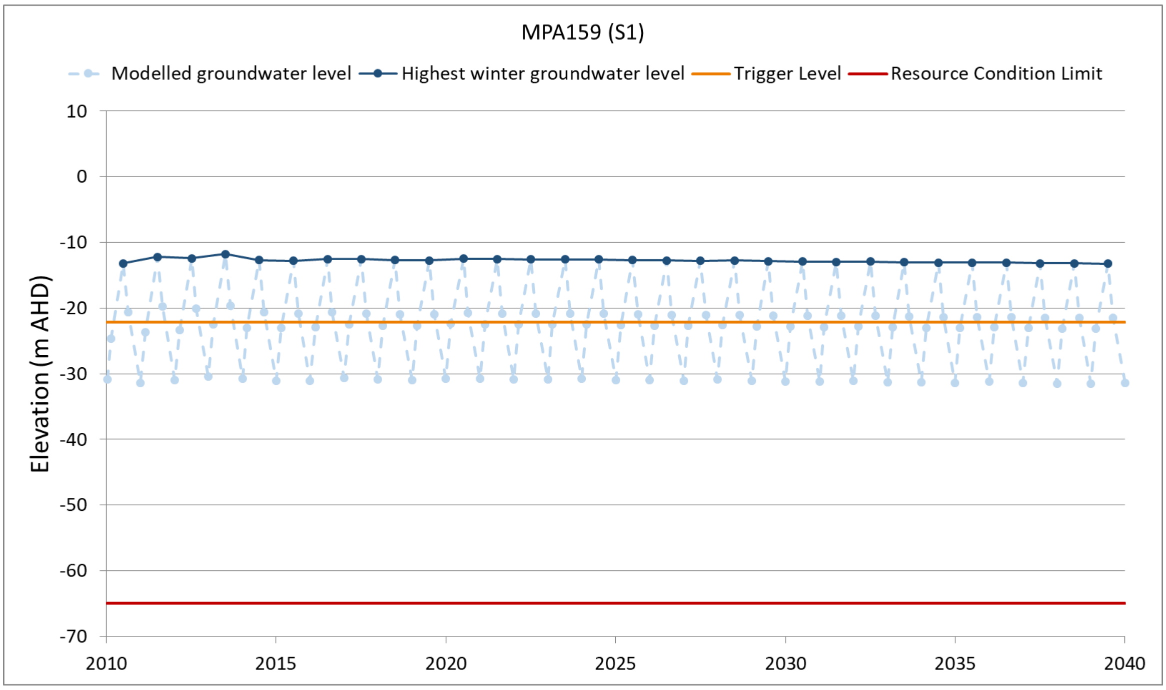

Figure 4.11 Modelled groundwater levels and key levels of interest for MPA159 – Scenario 1

4.2.2 Scenario 2

This scenario is based on the assumption that within the NAP region, all licensees will extract their full allocation over a 30 year period (2010–40). This scenario is considered to be the 'worst case' in terms of relative impact on the groundwater resources. It is assumed that 80% of the annual volume is extracted in summer and 20% is extracted in winter. There is no change in extraction in the CA PWA.

The results from this scenario have been re-analysed against the triggers outlined in Section 2. The results for individual wells have been included in Section 4.2.2.1 for T1 NAP and Section 4.2.2.2 for T2 Virginia. Because the key output of this reanalysis is to examine whether management would be triggered, individual wells are not discussed in these sections. Rather an overview is presented here as well as relevant comments on individual wells. A summary of the modelled results is given in Table 4.6.

The modelled response in the T1 NAP indicates that under this pumping regime, the trigger level is breached in all wells. Also, all wells except PTA111 breach the resource condition limit by the end of the 30 year modelled run time. All modelled water levels show a declining trend over the 30 years of the modelled simulation. These results suggest that under this extraction pumping scenario, 13 years of pumping at full allocation every year would trigger management actions. In addition, if this continued, resource condition limits would be breached in PTA093 after 14 years, with all wells except PTA111 breaching their resource condition limits within the 30 year period.

The modelled response in the T2 Virginia indicates that under this extraction pumping regime, all wells breach their trigger level after a year of pumping. Both wells in Group 3 breach the resource condition limit after 6 years of pumping, however wells in Group 4 do not breach their resource condition limits during the 30 years of the modelled scenario. This likely reflects the locations of the groups, with Group 3 bores located closer to the cone of depression than Group 4 bores. Modelled water levels show an initial steep decline, followed by a continual decline over the 30 years of the modelled simulation. These results suggest that under this extraction pumping scenario, management actions would be triggered after 3 years. In addition, if this continued, resource condition limits would be breached in MPA109 after 2 years, with MPA144 breaching their resource condition limits after 6 years.

These scenarios results should be considered an extremely worst case scenario as the likelihood of continual pumping at full allocations in the GMZ's is small.

Table 4.6 Summary of modelled bore response – Scenario 2

GMZ	Monitoring group	Monitoring well	Winter trigger level (m AHD)	Resource Condition Limit (m AHD)	Triggered condition	Trigger breached	Resource condition breached
T1 NAP	Group 1	PTA161	-2.5	-5	2 out of 4	2022	2032
		PTA095	-3.6	-5		2024	2032
		PTA111	-4	-5		2022	2028
		MPA152	-0.62	-5		2029	No
	Group 2	PTA051	-4.3	-5	Both	2021	2032
		PTA093	-4.2	-5		2017	2024
T2 Virginia	Group 3	MPA144	-33.2	-46.1	Both	2011	2016
		MPA158*	-27.95	-42.93		N/A	N/A
		MPA109	-26.72	-57.5		2011	2012
	Group 4	PTA091	-18.4	-46.3	2 out of 3	2011	No
		PTA082	-22.09	-65		2011	No
		MPA159	-2.5	-5		2011	No

*This modelling was undertaken prior to the issues with MPA109 being identified and results were provided for MPA109 rather than MPA158.

4.2.2.1 T1 NAP aquifer GMZ

4.2.2.1.1 Group 1

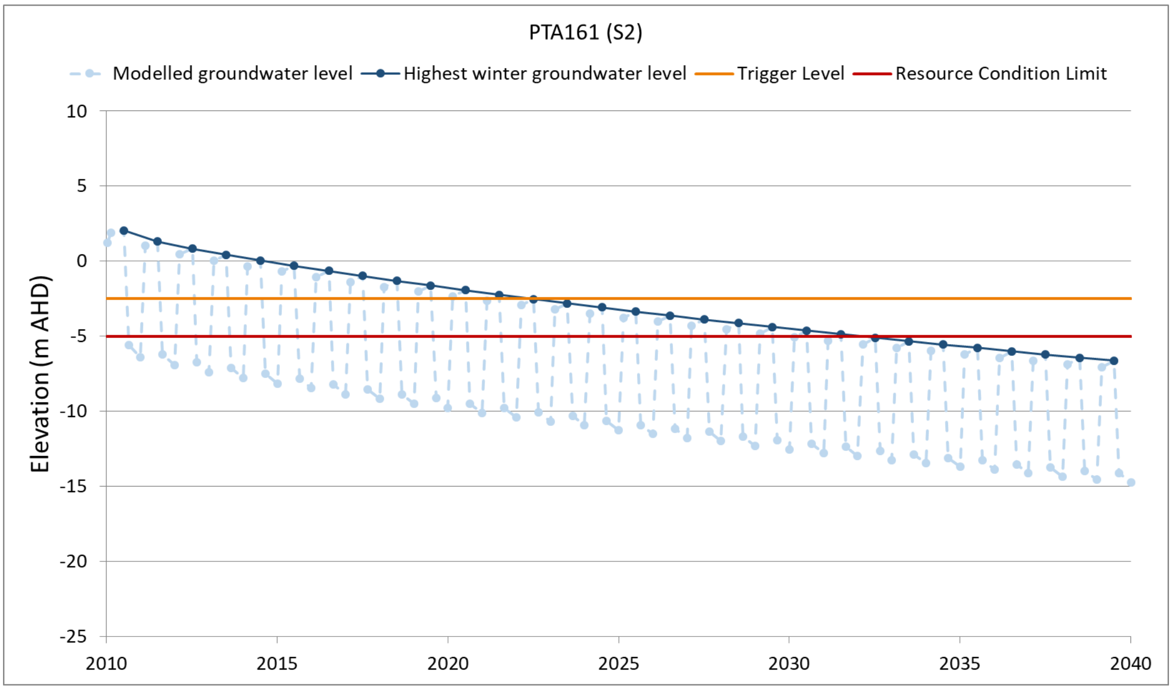

Figure 4.12 Modelled groundwater levels and key levels of interest for PTA161 – Scenario 2

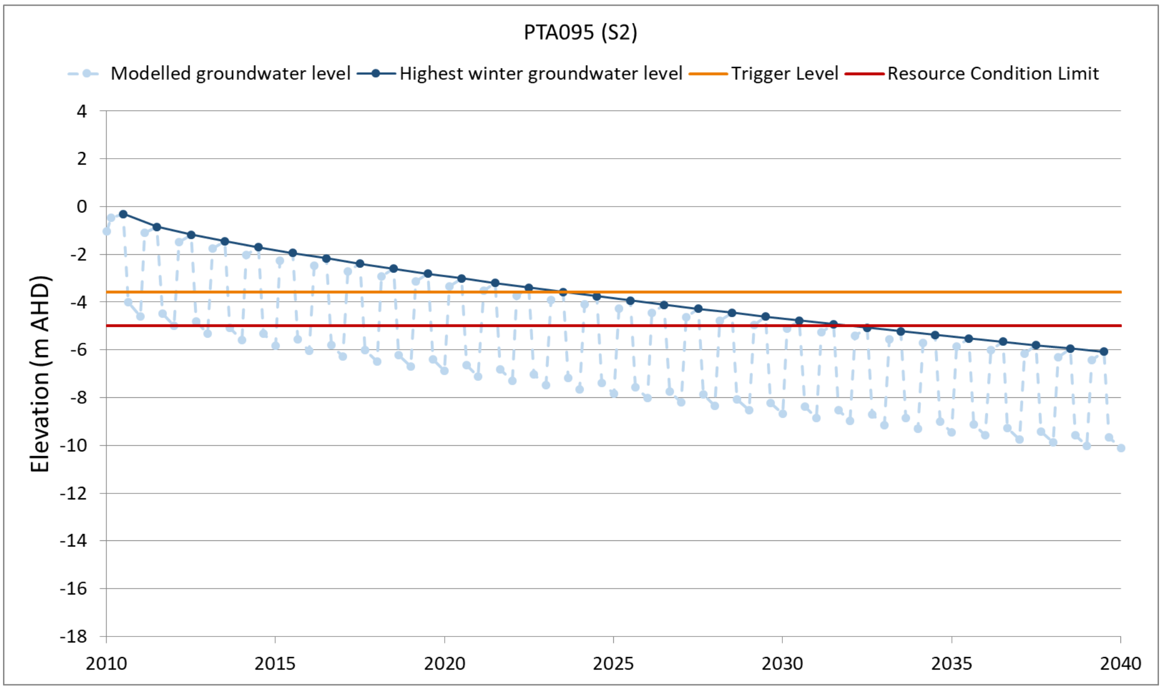

Figure 4.13 Modelled groundwater levels and key levels of interest for PTA095 – Scenario 2

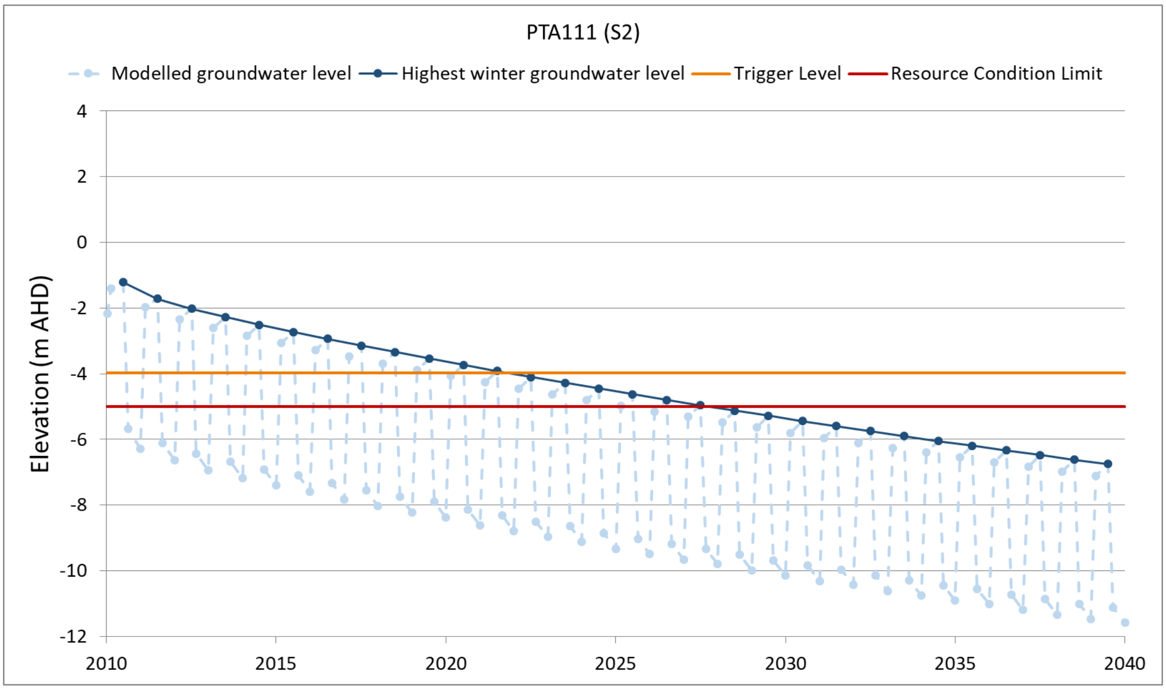

Figure 4.14 Modelled groundwater levels and key levels of interest for PTA011 – Scenario 2

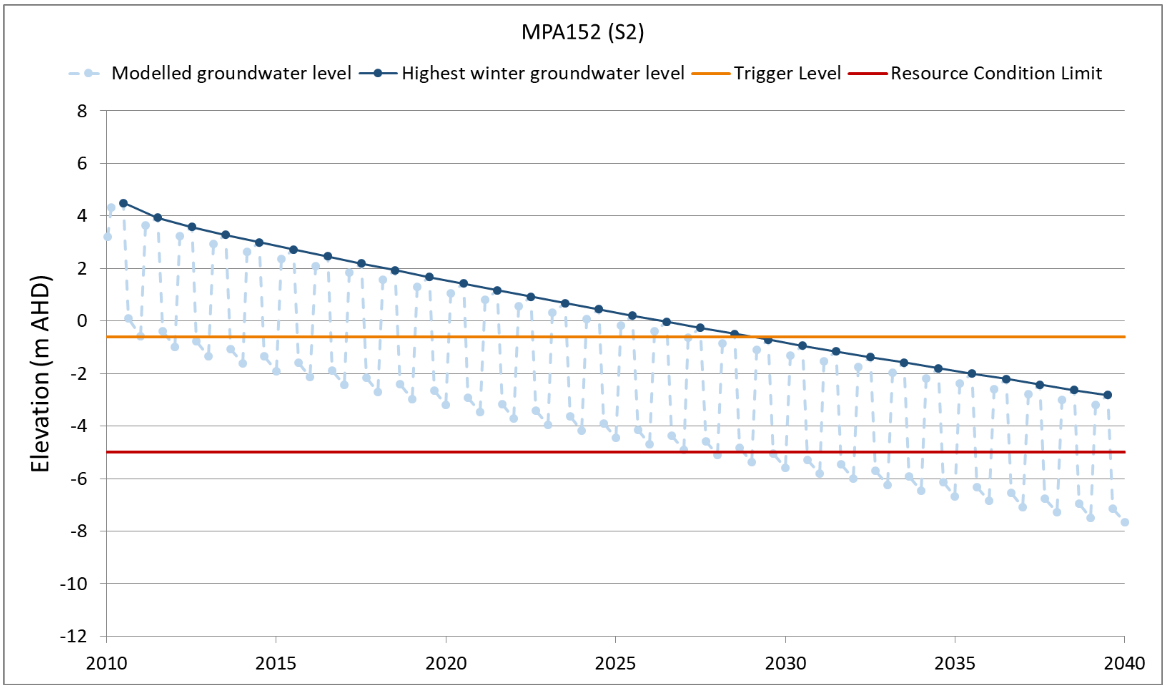

Figure 4.15 Modelled groundwater levels and key levels of interest for MPA152 – Scenario 2

4.2.2.1.2 Group 2

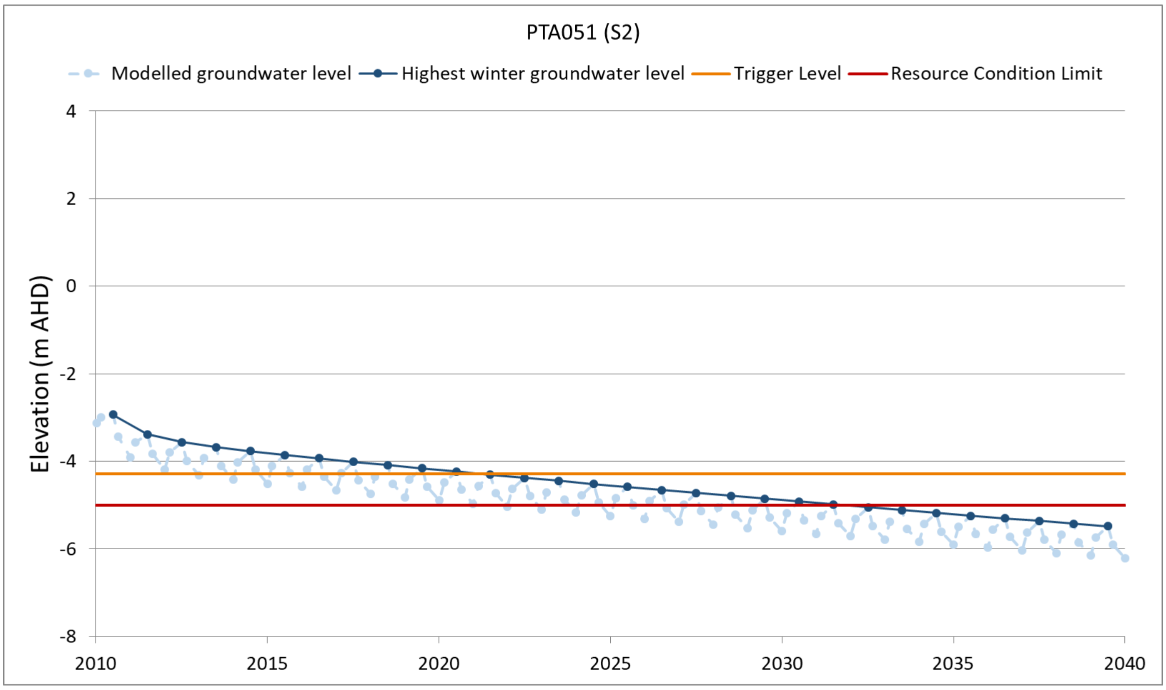

Figure 4.16 Modelled groundwater levels and key levels of interest for PTA051 – Scenario 2

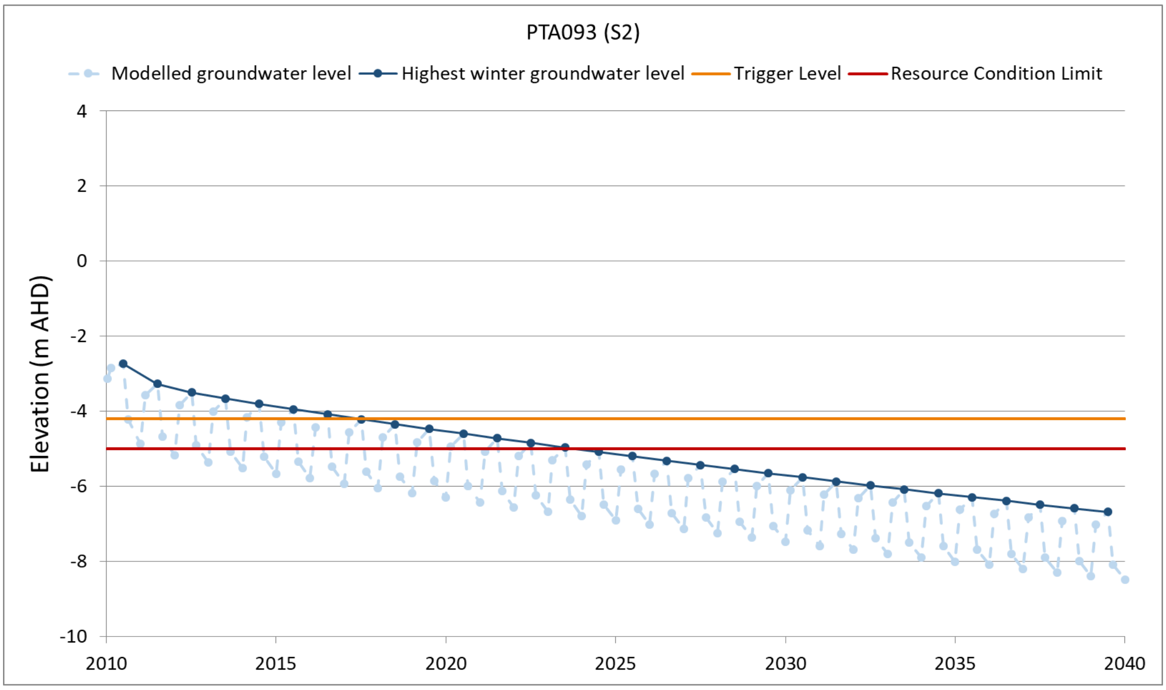

Figure 4.17 Modelled groundwater levels and key levels of interest for PTA093 – Scenario 2

4.2.2.2 T2 Virginia GMZ

4.2.2.2.1 Group 3

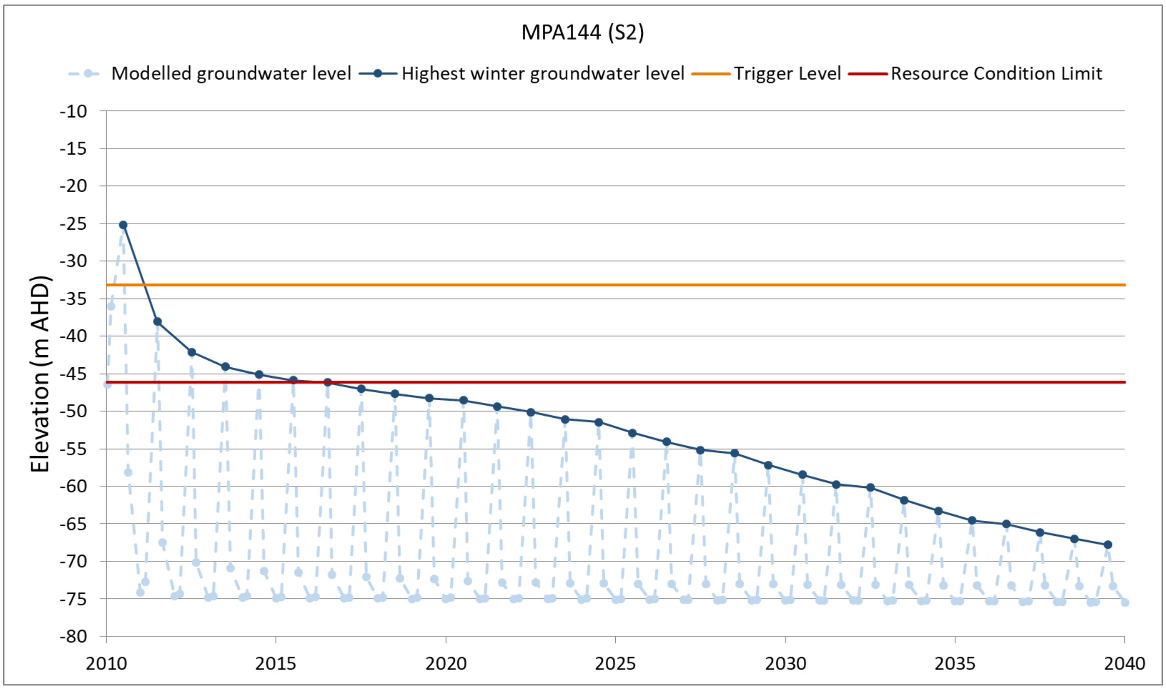

Figure 4.18 Modelled groundwater levels and key levels of interest for MPA144 – Scenario 2

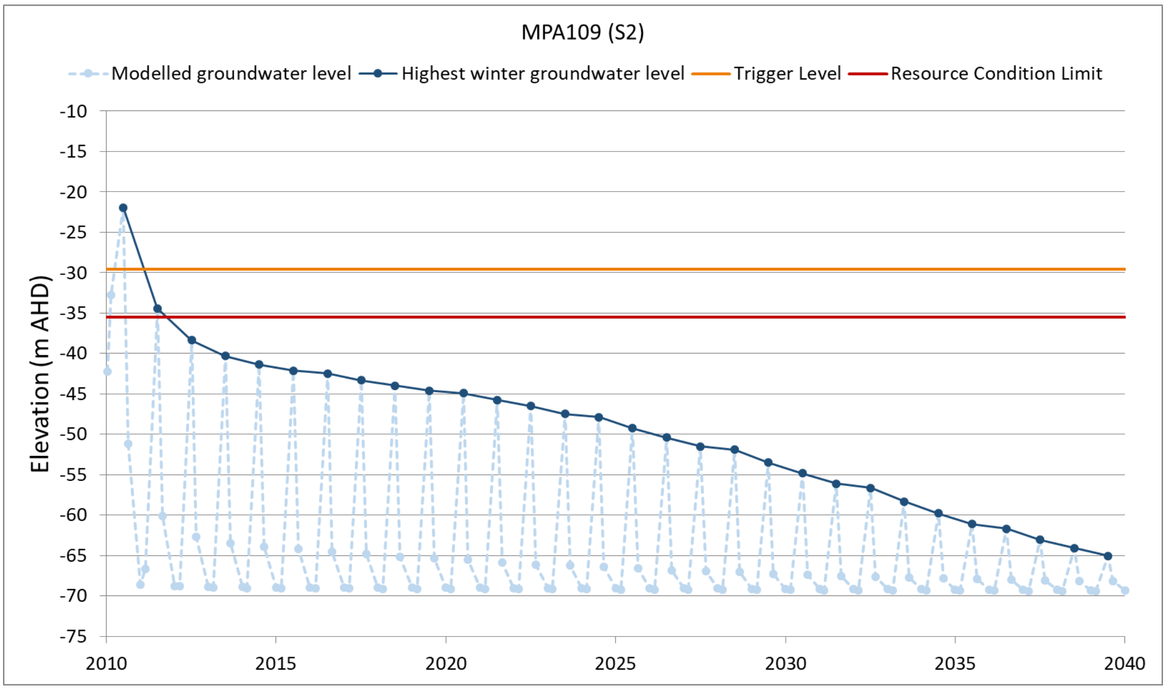

Figure 4.19 Modelled groundwater levels and key levels of interest for MPA109 – Scenario 2

4.2.2.2.2 Group 4

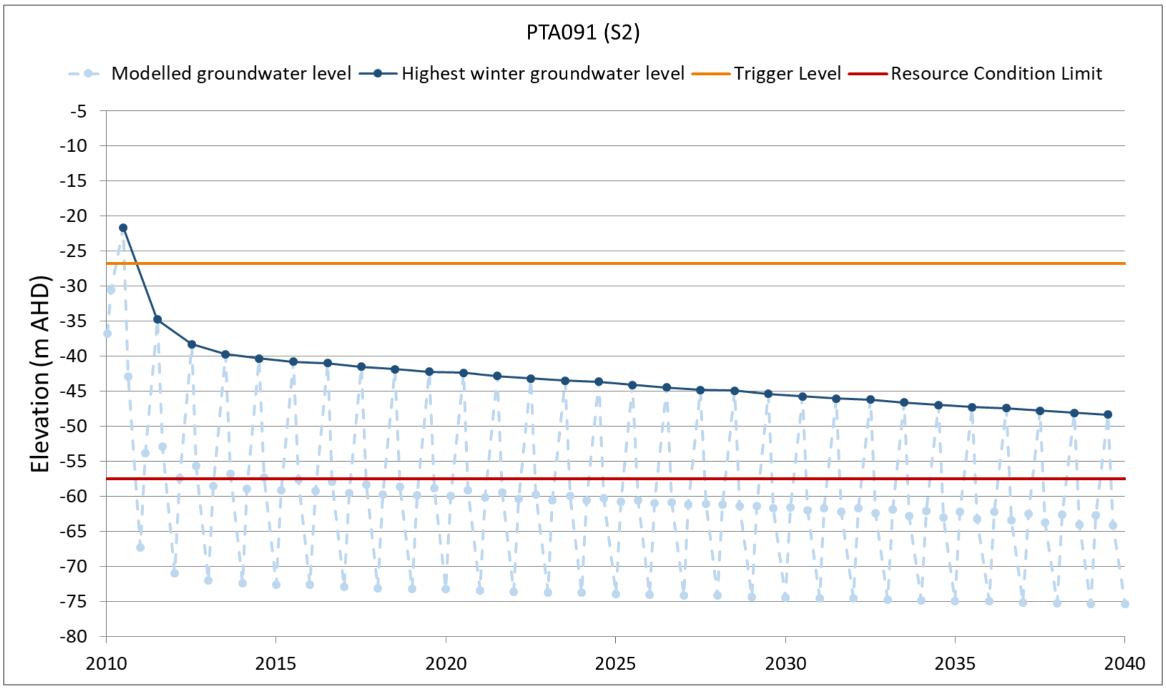

Figure 4.20 Modelled groundwater levels and key levels of interest for PTA091 – Scenario 2

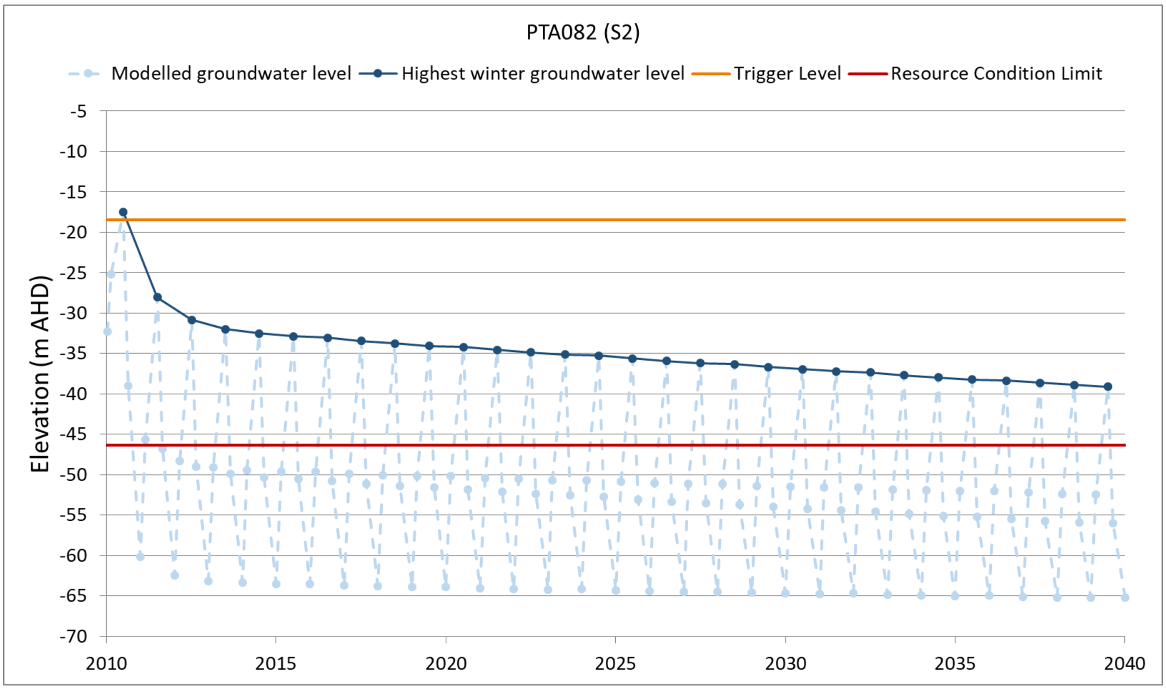

Figure 4.21 Modelled groundwater levels and key levels of interest for PTA082 – Scenario 2

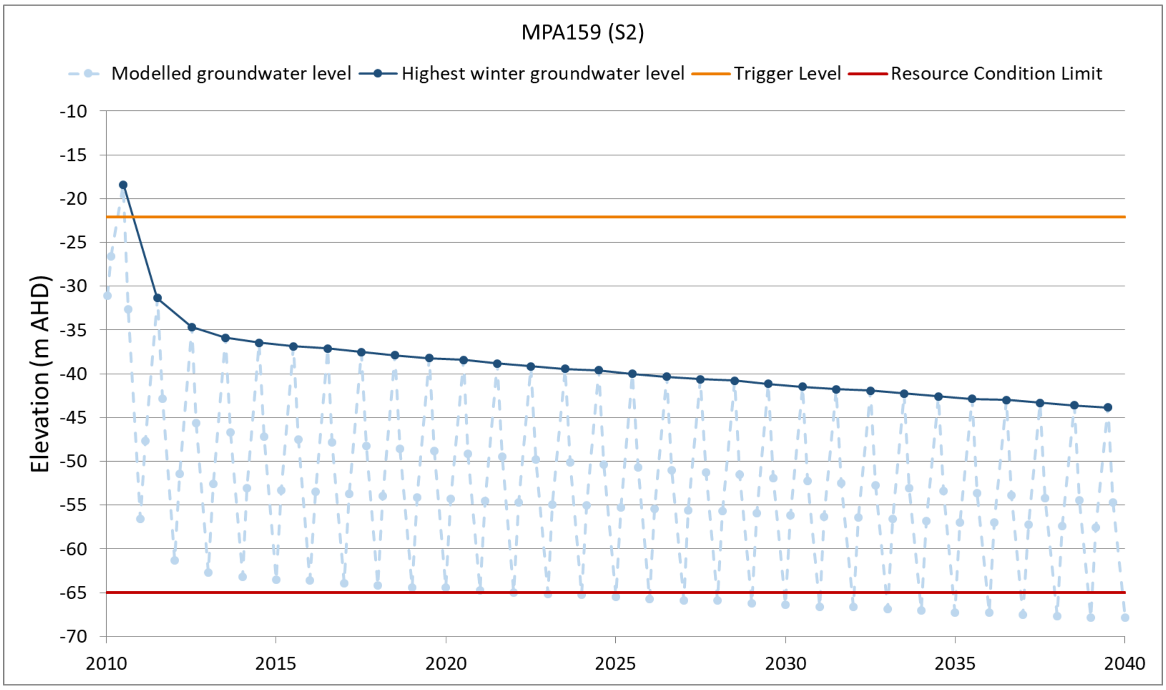

Figure 4.22 Modelled groundwater levels and key levels of interest for MPA159 – Scenario 2

4.2.3 Scenario 10

This scenario was originally designed to examine the impacts of varying extraction pumping levels in different GMZ. It is relevant to this investigation as the volumes pumped in T1 NAP and T2 Virginia are similar to the recommended extraction limit, which is the proposed management volume. In this scenario, pumping from the T2 Kangaroo Flat GMZ was kept at base case levels (Scenario 1); base case plus an extra 20% (Scenario 2) was pumped from T2 Virginia GMZ; double existing user demand plus an additional 1000 ML/y (Scenario 8) was pumped from the T1 and T2 GGE GMZ; full allocations plus an additional 2000 ML/y (Scenario 9) was pumped from the T2 Regional GMZ; and an additional 30% on top of base case volumes was pumped from all other GMZs. These increases correspond to almost 4800 ML/y additional extraction in NAP and 6700 ML/y in CA.

The results from this scenario have been re-analysed against the triggers outlined in Section 2. The results for individual wells have been included in Section 4.2.3.1 for T1 NAP and Section 4.2.3.2 for T2 Virginia. Because the key output of this reanalysis is to examine whether management would be triggered, individual wells are not discussed in these sections. Rather an overview is presented here as well as relevant comments on individual wells. A summary of the modelled results is given in Table 4.7.

The modelled response in the T1 NAP indicates that under this extraction pumping regime, the trigger level is breached in PTA111 after 24 years and, PTA093 after 25 years and PTA095 after 28 years of pumping. No wells breach the resource condition limit. Based on the triggered condition on management, the resource would become managed after 30 years of this pumping rate, as two wells in Group 1 have breached. In addition, all modelled water levels show a declining trend over the 30 years of the modelled simulation.

The modelled response in the T2 Virginia indicates that under this extraction pumping regime, the trigger level is breached in MPA159 after 9 years and PTA082 after 19 years of pumping. No wells breach the resource condition limit. Based on the triggered condition on management, the resource would become managed after 21 years of this pumping rate, as two wells in Group 4 have breached the trigger levels. In addition, all modelled water levels show a declining trend over the 30 years of the modelled simulation.

Table 4.7 Summary of modelled bore response – Scenario 10

GMZ	Monitoring group	Monitoring well	Winter trigger level (m AHD)	Resource Condition Limit (m AHD)	Triggered condition	Trigger breached	Resource condition breached
T1 NAP	Group 1	PTA161	-2.5	-5	2 out of 4	No	No
		PTA095	-3.6	-5		2038	No
		PTA111	-4	-5		2034	No
		MPA152	-0.62	-5		No	No
	Group 2	PTA051	-4.3	-5	Both	No	No
		PTA093	-4.2	-5		2035	No
T2 Virginia	Group 3	MPA144	-33.2	-46.1	Both	No	No
		MPA158*	-27.95	-42.93		N/A	N/A
		MPA109	-26.72	-57.5		No	No
	Group 4	PTA091	-18.4	-46.3	2 out of 3	No	No
		PTA082	-22.09	-65		2029	No
		MPA159	-2.5	-5		2019	No

*This modelling was undertaken prior to the issues with MPA109 being identified and results were provided for MPA109 rather than MPA158.

4.2.3.1 T1 NAP aquifer GMZ

4.2.3.1.1 Group 1

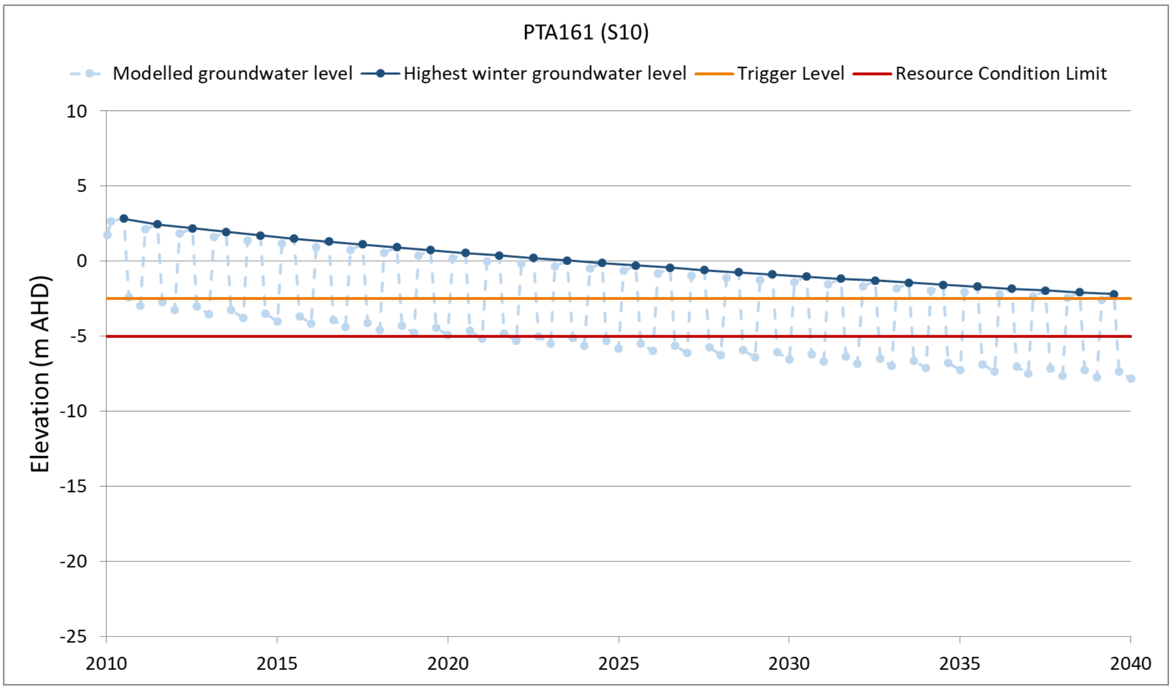

Figure 4.23 Modelled groundwater levels and key levels of interest for PTA161 – Scenario 10

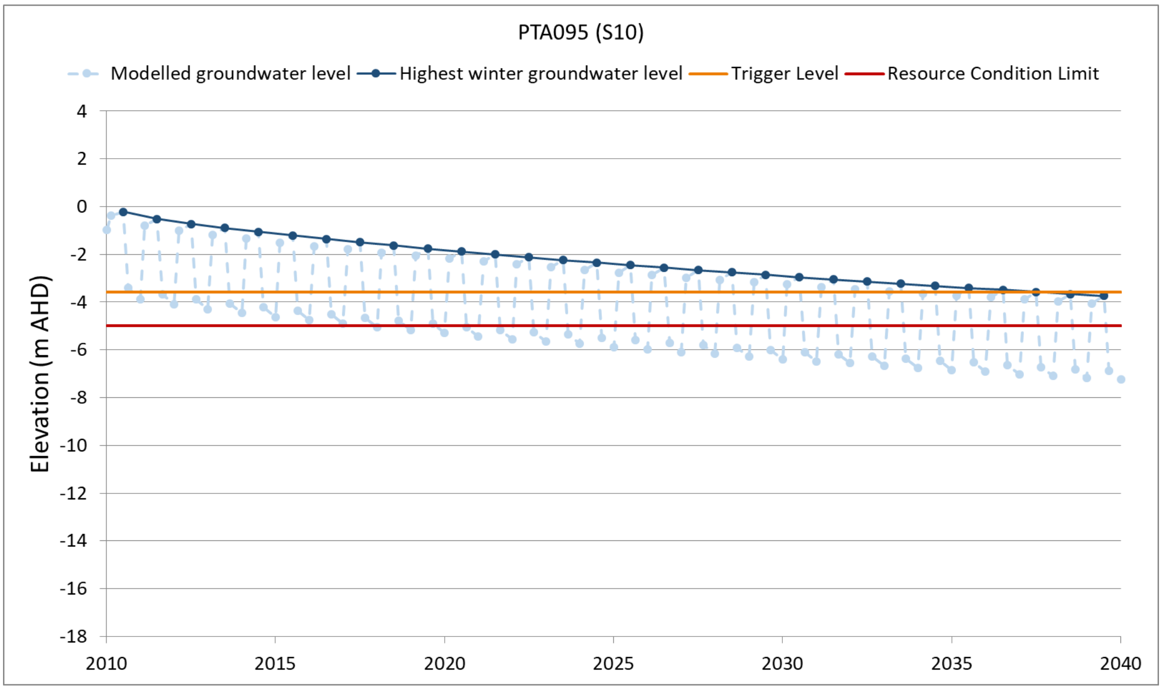

Figure 4.24 Modelled groundwater levels and key levels of interest for PTA095 – Scenario 10

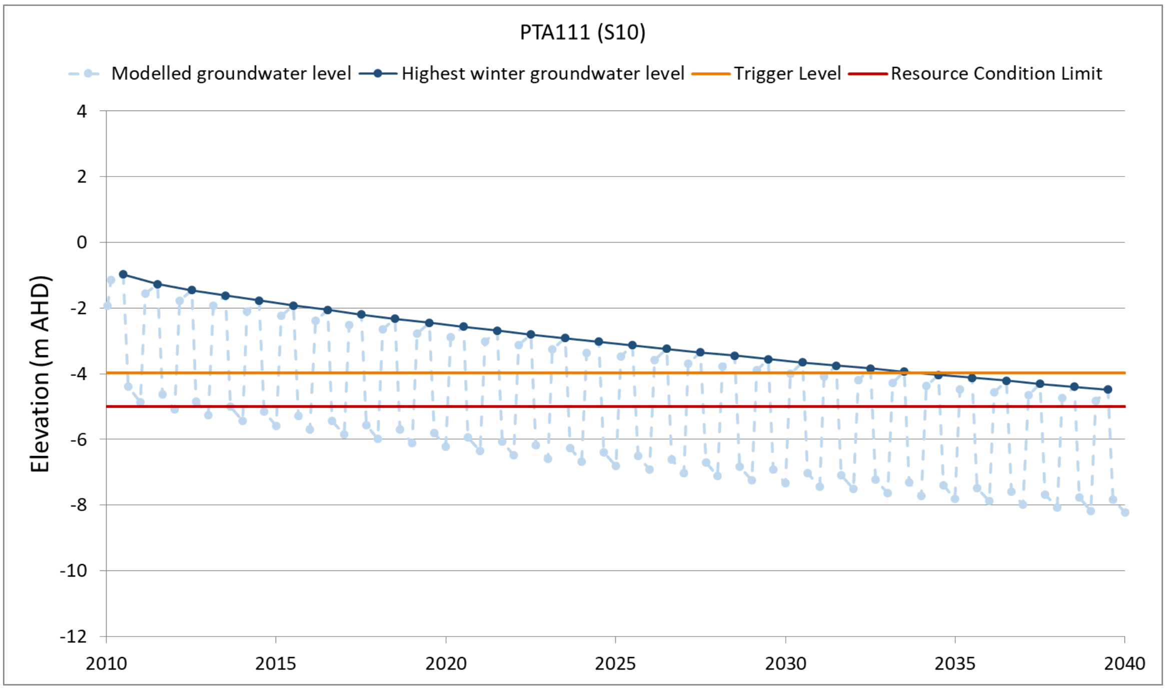

Figure 4.25 Modelled groundwater levels and key levels of interest for PTA011 – Scenario 10

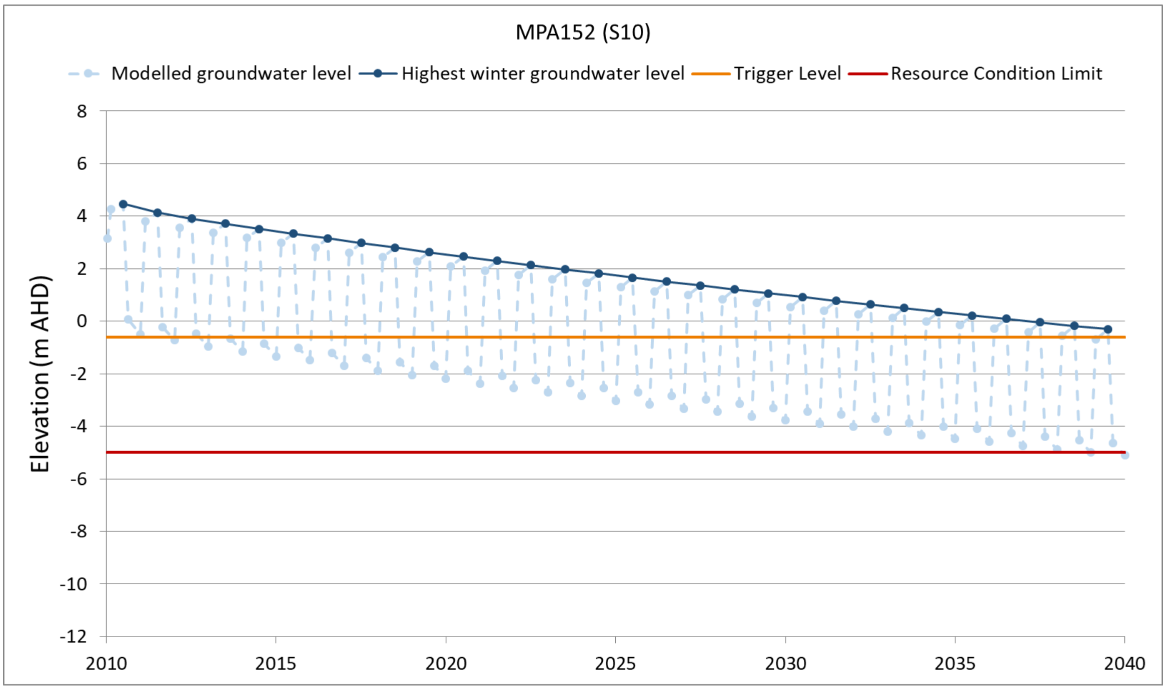

Figure 4.26 Modelled groundwater levels and key levels of interest for MPA152 – Scenario 10

4.2.3.1.2 Group 2

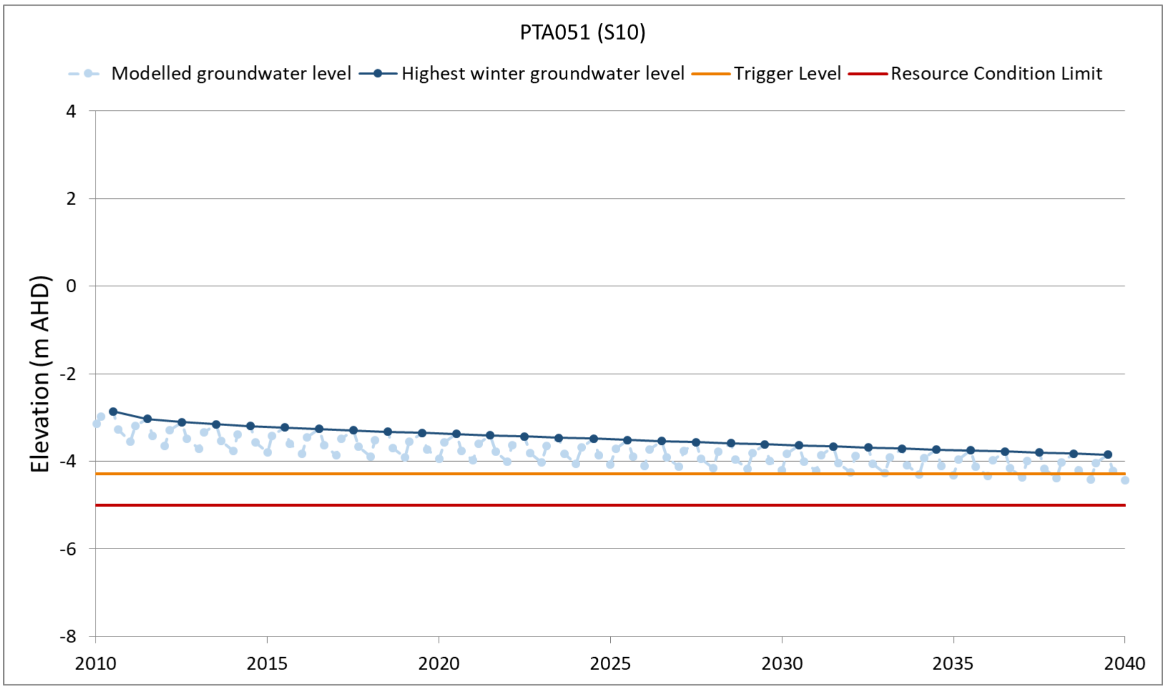

Figure 4.27 Modelled groundwater levels and key levels of interest for PTA051 – Scenario 10

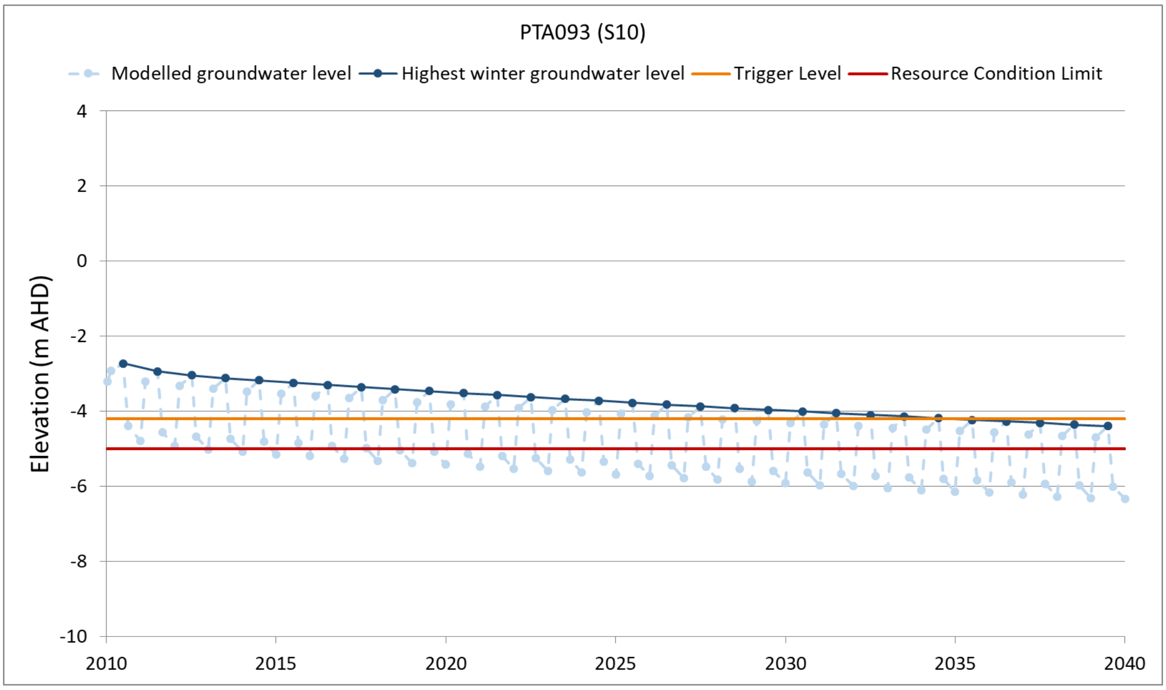

Figure 4.28 Modelled groundwater levels and key levels of interest for PTA093 – Scenario 10

4.2.3.2 T2 Virginia GMZ

4.2.3.2.1 Group 3

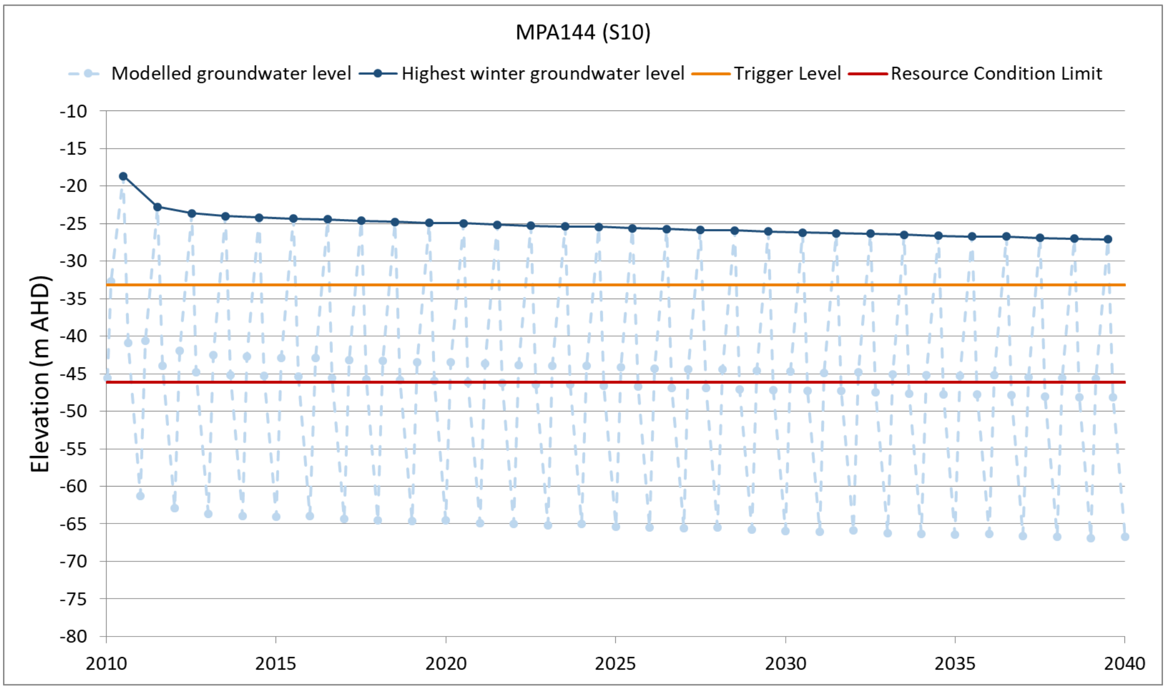

Figure 4.29 Modelled groundwater levels and key levels of interest for MPA144 – Scenario 10

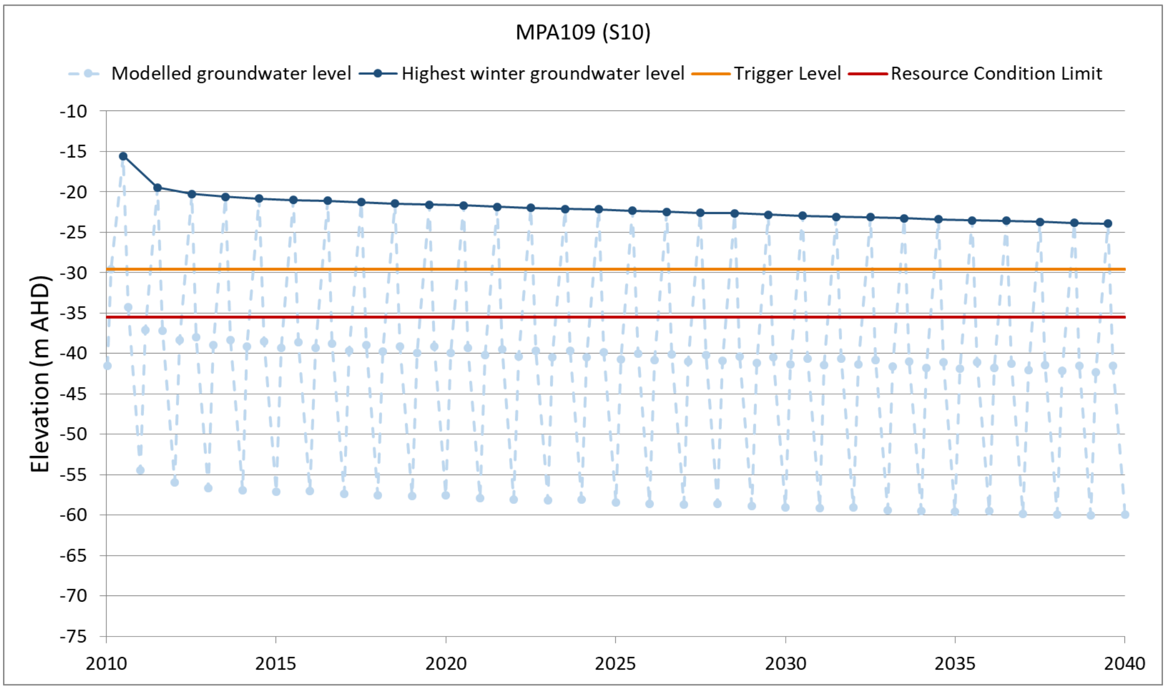

Figure 4.30 Modelled groundwater levels and key levels of interest for MPA109 – Scenario 10

4.2.3.2.2 Group 4

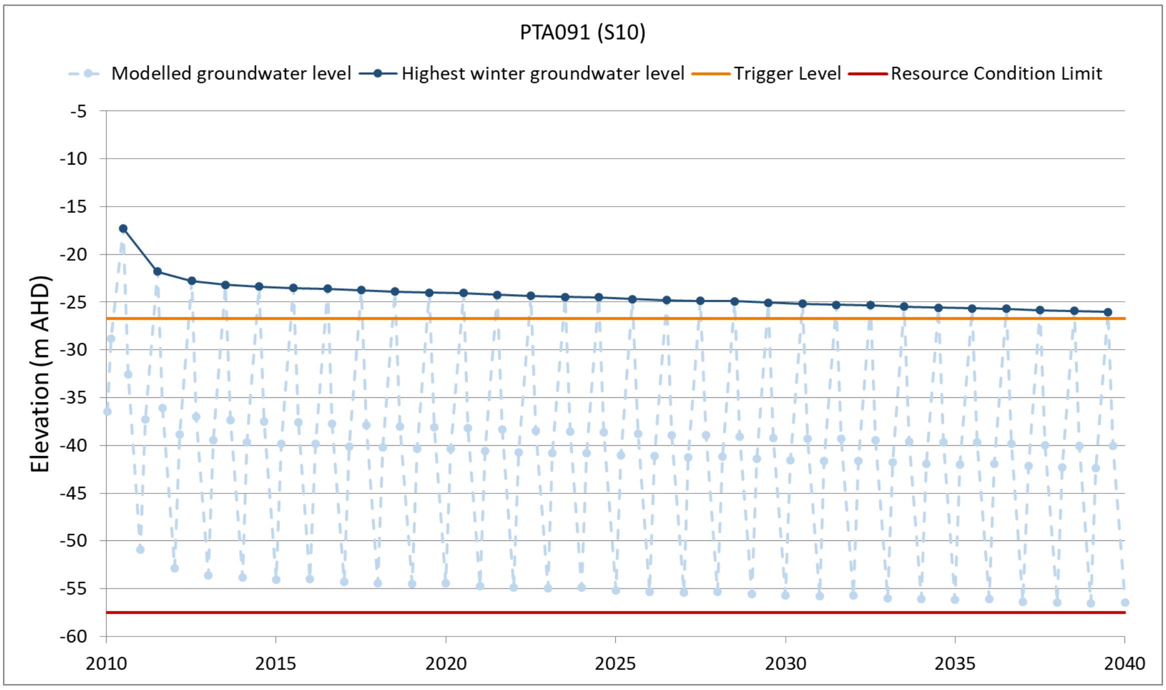

Figure 4.31 Modelled groundwater levels and key levels of interest for PTA091 – Scenario 10

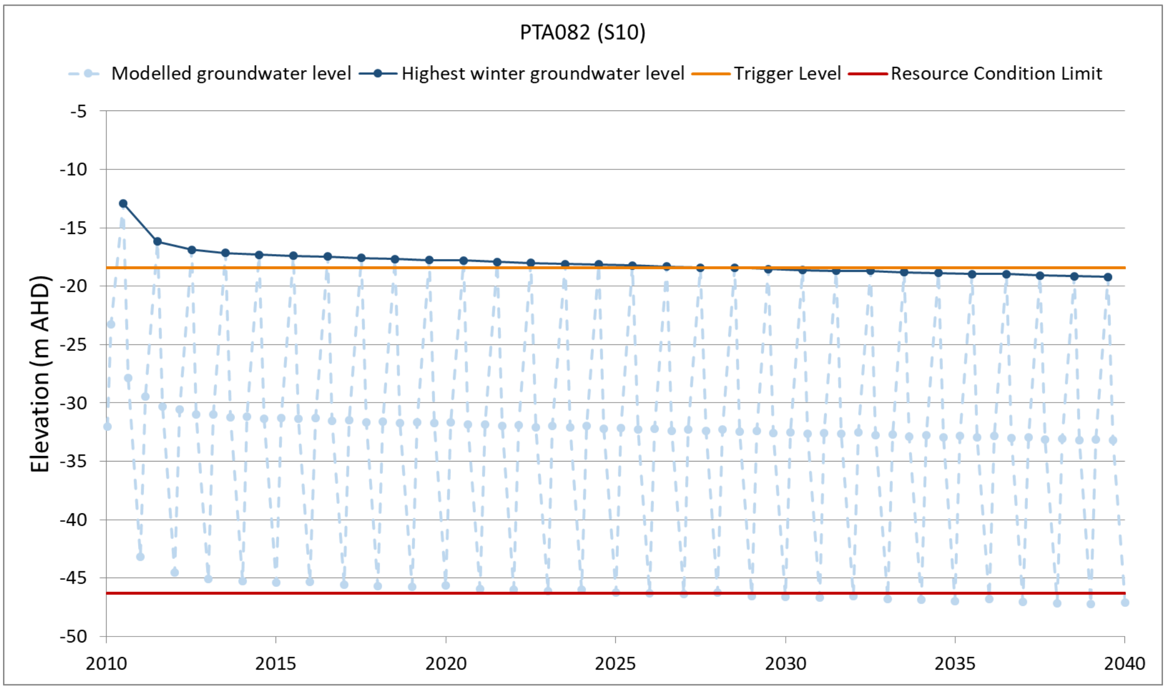

Figure 4.32 Modelled groundwater levels and key levels of interest for PTA082 – Scenario 10

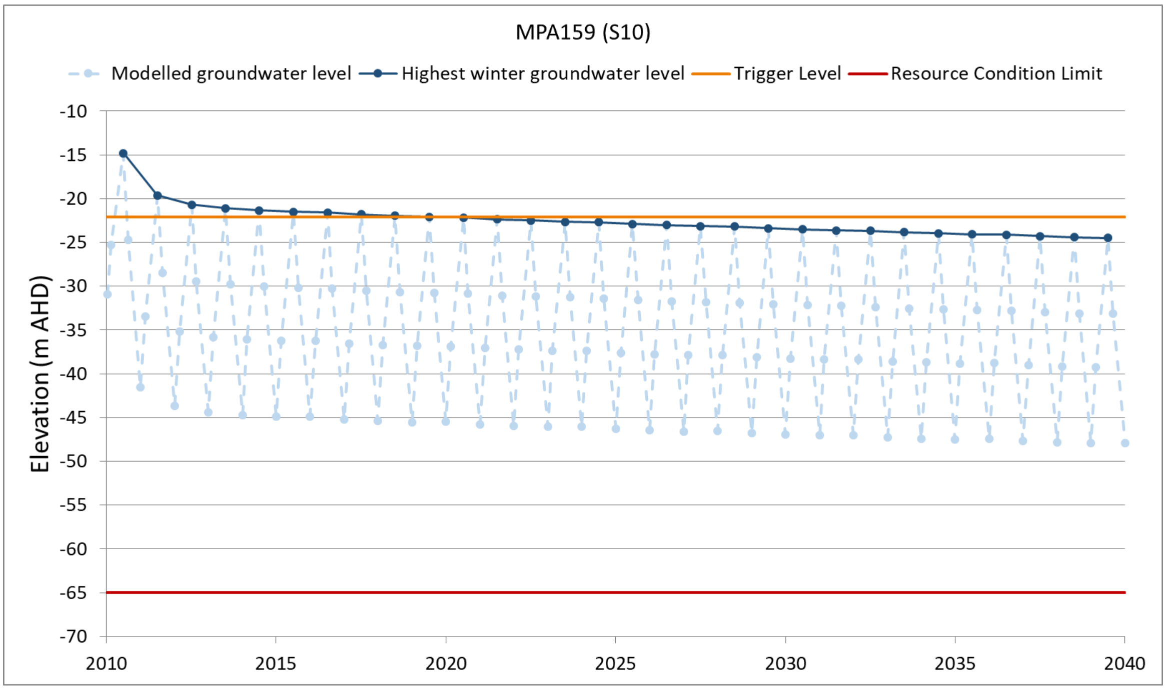

Figure 4.33 Modelled groundwater levels and key levels of interest for MPA159 – Scenario 10

4.3 Scenario results from the proposed management investigation

The scenarios used to investigate the proposed management approach were undertaken by consultants Groundwater Science. These were undertaken prior to this report being revised and there is some discrepancies between the trigger levels provided to the consultant for this work and the final trigger levels documented in this report. This does not impact the way scenarios were run for the T1 NAP GMZ, however it would have changed how the scenario was run for T2 Virginia GMZ and this is discussed further in section 4.3.2.

These scenarios were run iteratively. That is, a model run was undertaken, results analysed to determine when management should be applied and then the next iteration was run to include the management. This process was repeated until all appropriate applications of the management approach were applied to a 40 year period. A number of iterations were required to address the management required in both the T2 Virginia GMZ and the T1 NAP GMZ. This was applied to one model run, which meant that the management for both the T2 Virginia GMZ and the T1 NAP GMZ were applied as appropriate, within one run. For simplicity, the iterations for each GMZ have been described separately in their respective sections.

Scenario results are expressed in terms of years, where the scenario started in 2010. This is done for simplicity in the discussion and should not be taken to imply that in any given year the water levels will be as the model specified. Rather, the model represents a generic 40 year period and the results provided below should be interpreted as being indicative of the time frames over which actions and responses may occur.

4.3.1 T1 NAP aquifer GMZ

In the T1 NAP GMZ, management actions were applied when the conditions were met for either Group 1 or Group 2 wells. This is when a specified number of wells within a group is triggered in consecutive winters. A summary of the final model results and the extraction pumping schedule applied is given in Table 4.8. For simplicity, this has been presented annually rather than by season.

For the T1 NAP GMZ, the following sequence of model iterations was applied:

- Initial iteration: Full allocation pumping for the full duration.
    - Management conditions were met (two group 1 wells breaching trigger levels in consecutive winters) after 17 years
- Second iteration: Managed pumping volumes were applied to the T1 NAP GMZ after 18 years in the summer stress period.
    - No further iterations were required as water levels never recovered about trigger levels for the remainder of the model simulation (40 years).

Table 4.8 Summary of modelled bore response and pumping schedule – T1 NAP

<table>
<tr><th>GMZ</th><th colspan="6">T1 NAP</th><th rowspan="6">Pumping Volume</th></tr>
<tr><th>Monitoring group</th><th colspan="4">Group 1</th><th colspan="2">Group 2</th></tr>
<tr><th>Monitoring well</th><th>PTA161</th><th>PTA095</th><th>PTA111</th><th>MPA152</th><th>PTA051</th><th>PTA093</th></tr>
<tr><th>Winter trigger level (m AHD)</th><td>-2.5</td><td>-3.6</td><td>-4</td><td>-0.62</td><td>-4.3</td><td>-4</td></tr>
<tr><th>Resource Condition Limit (m AHD)</th><td>-5</td><td>-5</td><td>-5</td><td>-5</td><td>-5</td><td>-5</td></tr>
<tr><th>Triggered condition</th><td colspan="4">2 out of 4</td><td colspan="2">Both</td></tr>
<tr><td>2010</td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="18">Full</td></tr>
<tr><td>2011</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2012</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2013</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2014</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2015</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2016</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2017</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2018</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2019</td><td></td><td></td><td></td><td></td><td></td><td>Trigger Breach</td></tr>
<tr><td>2020</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2021</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2022</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2023</td><td></td><td></td><td></td><td></td><td></td><td rowspan="16">Trigger Breach</td></tr>
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<tr><td>2025</td><td></td><td></td><td rowspan="16">Trigger Breach</td><td></td><td></td></tr>
<tr><td>2026</td><td rowspan="17">Trigger Breach</td><td></td><td></td><td></td></tr>
<tr><td>2027</td><td></td><td></td><td></td></tr>
<tr><td>2028</td><td>Trigger Breach</td><td></td><td></td><td rowspan="15">Managed</td></tr>
<tr><td>2029</td><td></td><td></td><td></td></tr>
<tr><td>2030</td><td rowspan="13">Trigger Breach</td><td></td><td></td></tr>
<tr><td>2031</td><td></td><td></td></tr>
<tr><td>2032</td><td></td><td></td></tr>
<tr><td>2033</td><td></td><td></td></tr>
<tr><td>2034</td><td></td><td></td></tr>
<tr><td>2035</td><td></td><td></td></tr>
<tr><td>2036</td><td></td><td rowspan="7">Trigger Breach</td></tr>
<tr><td>2037</td><td></td></tr>
<tr><td>2038</td><td></td></tr>
<tr><td>2039</td><td></td><td rowspan="4">RCL Breached</td></tr>
<tr><td>2040</td><td></td></tr>
<tr><td>2041</td><td rowspan="2">RCL Breached</td><td rowspan="2">Trigger Breach</td></tr>
<tr><td>2042</td></tr>
</table>

2043						
2044						
2045						
2046						
2047						
2048						
2049						
2050						

The results from this scenario have been analysed against the triggers outlined in Section 2. The results for individual wells have been included below. For simplicity, the results are discussed holistically, rather than a detailed discussion of each individual well.

In the T1 NAP, the Group 1 wells initially breach trigger levels after 15 years (PTA111), with PTA161 breaching after 16 years. This results in managed volumes being applied after 18 years of pumping at full allocation. PTA095 also breaches trigger levels after 18 years, however recovers the following year, likely due to the reduced pumping rate under management. It re-triggers the following year and after 31 years, all Group 1 wells are breaching their trigger levels. In addition, after 31 years PTA111 has breached the resource condition limit.

For Group 2, trigger levels were breached in PTA093 after 9 years, however they recovered the following year. This bore experienced a further breach after 13 years, with levels continuously below the trigger level leading to a breach of the resource condition limit after 29 years. This occurred even though the managed pumping volumes had been in place since 18 years into the scenario. PTA051 breached trigger levels after 26 years, however the resource condition limit for this well was not breached for the duration of the scenario run.

In summary, key results from this scenario are:

- Management is required after 18 years of pumping at full allocation
- The management applied does not allow the system to recover above trigger levels
- Groundwater levels in all monitoring wells continue to decline for the duration of the scenario
- All monitoring wells breach their trigger levels after 31 years
- The resource condition limit is breached in two wells:
    - PTA093 after 29 years; and
    - PTA111 after 31 years.

4.3.1.1 Group 1

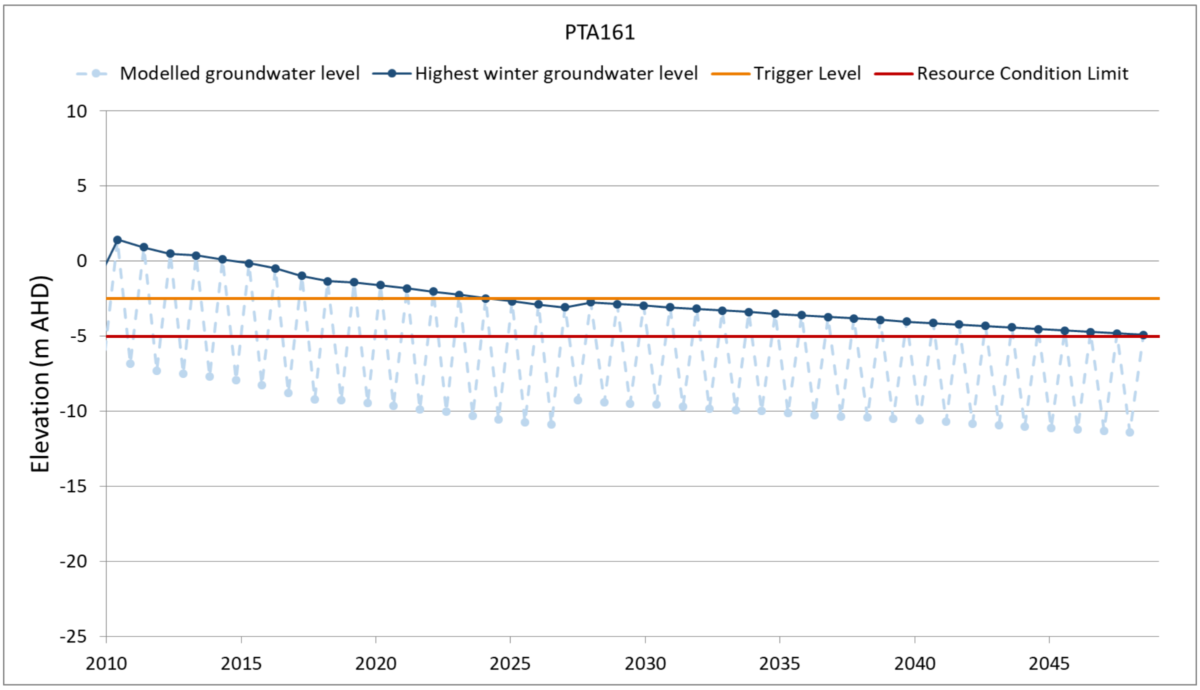

Figure 4.34 Modelled groundwater levels and key levels of interest for PTA161 – Management Scenario

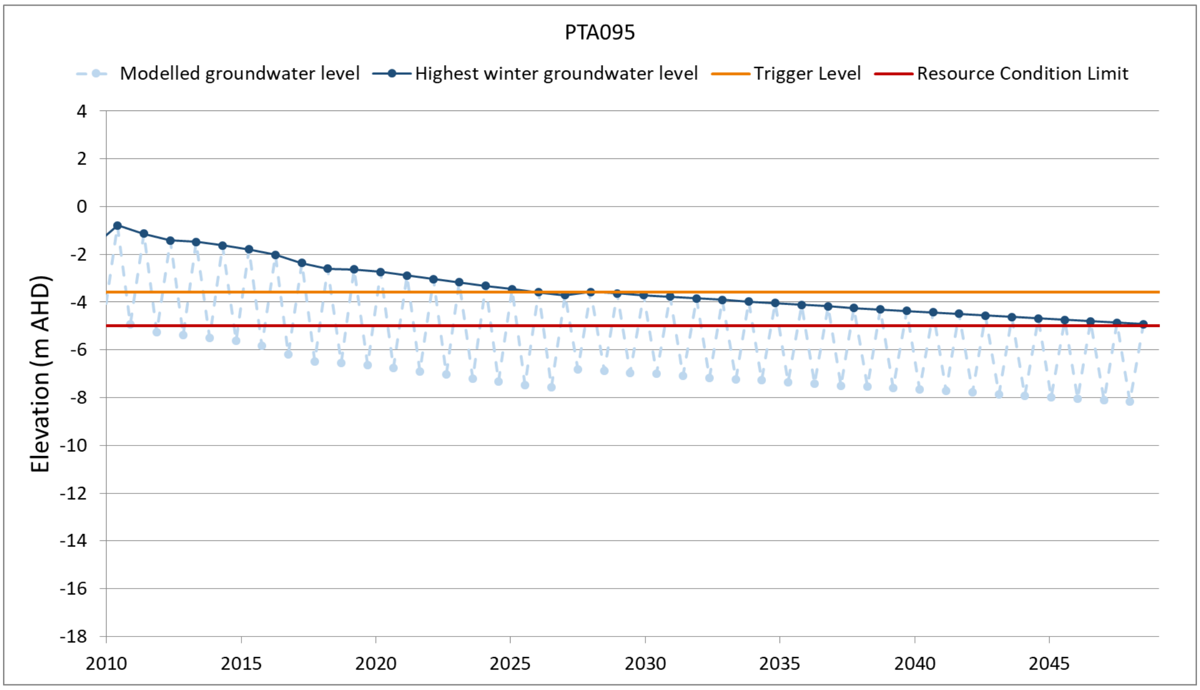

Figure 4.35 Modelled groundwater levels and key levels of interest for PTA095 – Management Scenario

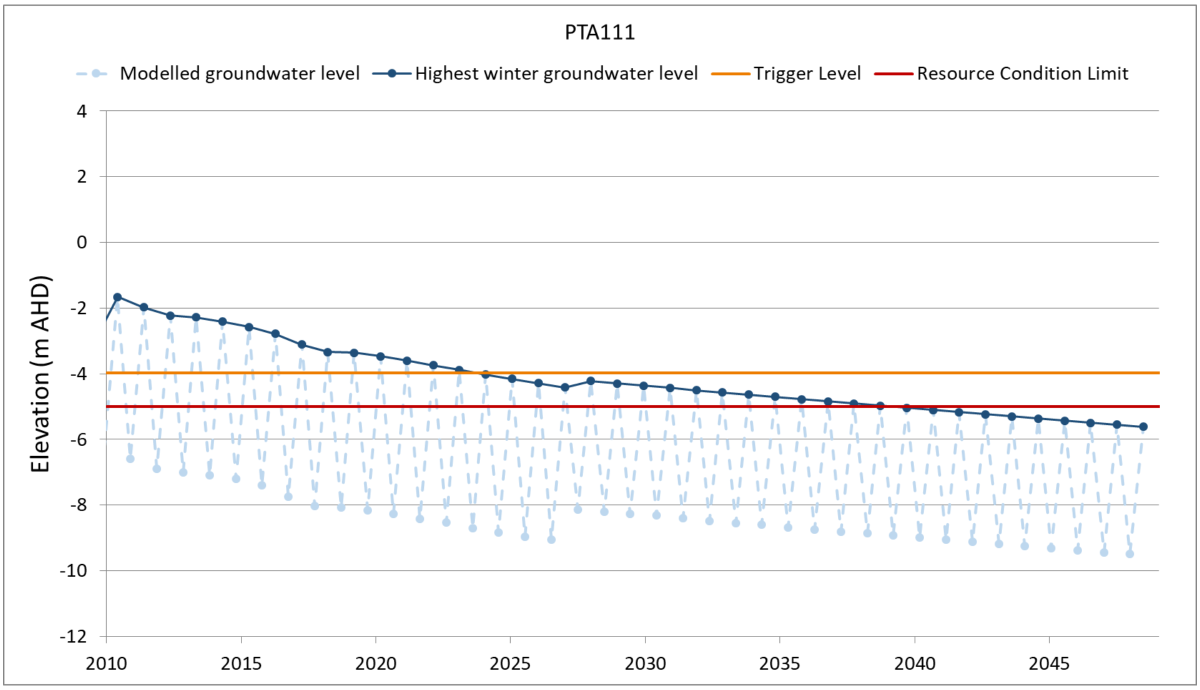

Figure 4.36 Modelled groundwater levels and key levels of interest for PTA011 – Management Scenario

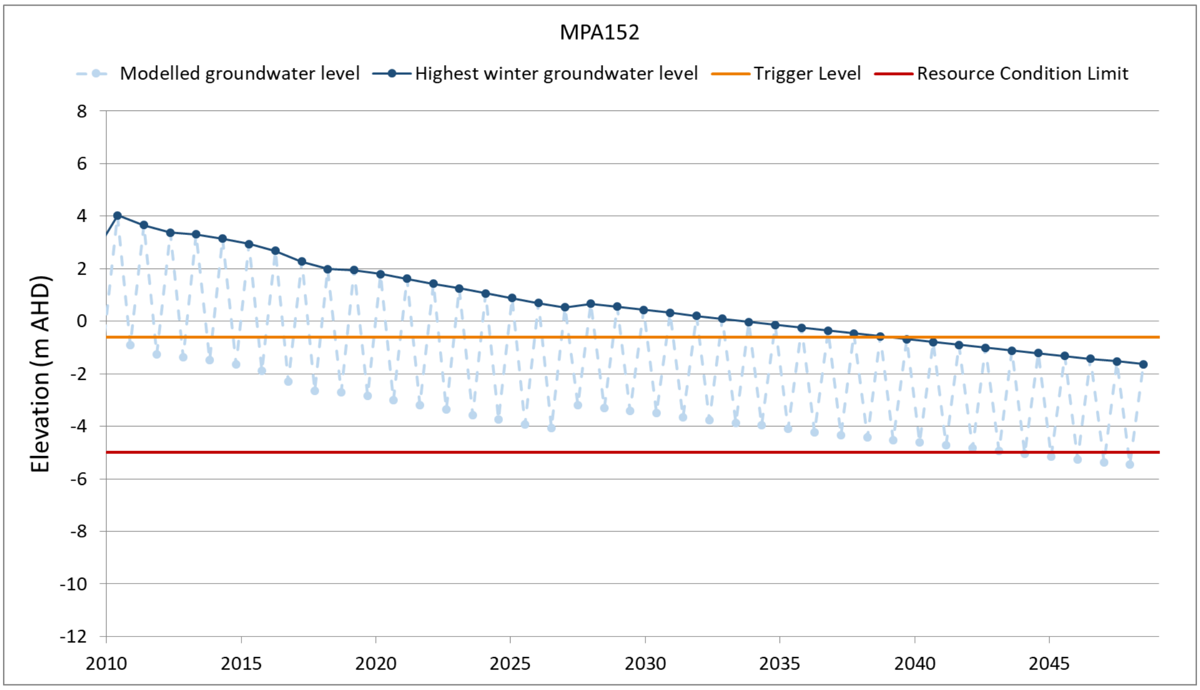

Figure 4.37 Modelled groundwater levels and key levels of interest for MPA152 – Management Scenario

4.3.1.2 Group 2

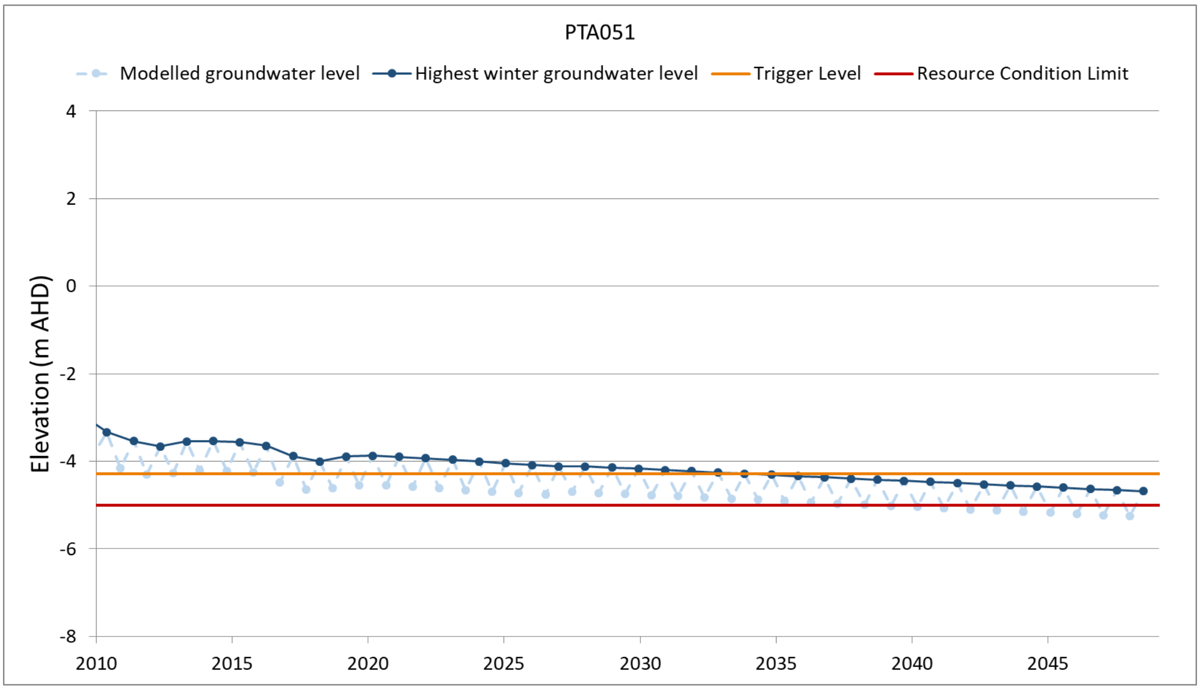

Figure 4.38 Modelled groundwater levels and key levels of interest for PTA051 – Management Scenario

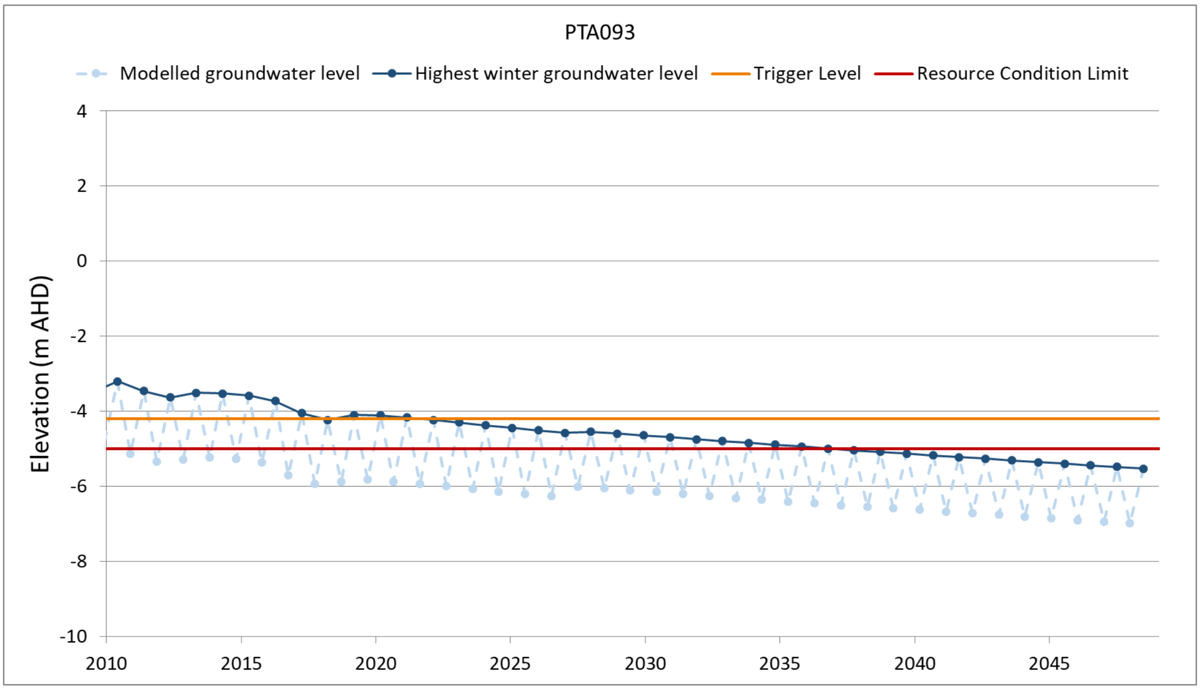

Figure 4.39 Modelled groundwater levels and key levels of interest for PTA093 – Management Scenario

4.3.2 T2 Virginia GMZ

In the T2 Virginia GMZ, management was applied when the conditions for management were met for either Group 3 or Group 4 wells. This is when a specified number of wells with the group is triggered in consecutive winters. As stated previously, this work was undertaken based on an older version of trigger levels where the trigger level for PTA082 was -20.44 m AHD, rather than -18.4 m AHD as is currently being considered for the WAP. This resulted in a "recovery", i.e. groundwater levels above -20.44 m AHD in 2015, which resulted in full allocation pumping rates being re-instated the following year. If the currently-proposed trigger levels where used instead, this would not have been a recovery, and managed pumping would have continued. It is possible that wells would have recovered sufficiently at a later date to reinstate full allocation pumping, or alternatively recovery would not have occurred and managed pumping volumes would have continued. Either way, it is unlikely that the discrepancy between the trigger levels would have changed the overall outcomes of the scenarios, just the time at which they occurred.

A summary of the final model results and the extraction pumping schedule applied is given in Table 4.9. For simplicity, this has been presented annually rather than by season.

For the T2 Virginia GMZ, the following sequence of model iterations were applied:

- Initial iteration: Full allocation pumping for the full duration.
    - Management conditions were met (two group 4 wells breaching trigger levels in consecutive winters) after 3 years
- Second iteration: Managed pumping volumes were applied to the T2 Virginia GMZ after 4 years in the summer stress period.
    - Recovery conditions were met (two group 4 wells recovered above trigger levels, assuming a trigger level of -20.44 m AHD for PTA082) after 6 years in the winter stress period
- Third iteration: Reinstated full allocation pumping in the T2 Virginia GMZ after 7 years in the summer stress period.
    - Management conditions were met (two group 4 wells breaching trigger levels in consecutive winters) after 9 years
- Fourth iteration: Managed pumping volumes were re-applied after 10 years, in the summer stress period.
    - The T2 Virginia GMZ never exhibited recovery above the trigger levels for the remainder of the model simulation (40 years).

Table 4.9 Summary of modelled bore response and pumping schedule – T2 Virginia

GMZ	**T2 Virginia**					**Pumping Volume**
Monitoring group	**Group 3**		**Group 4**			
Monitoring well	**MPA144**	**MPA158**	**PTA091**	**PTA082**	**MPA159**	
Winter trigger level (m AHD)	-33.2	-27.95	-26.72	-18.4	-22.09	
Resource Condition Limit (m AHD)	-46.1	-42.93	-57.5	-46.3	-65	
Triggered condition	Both		2 out of 3			

2010					
2011					Full
2012	Trigger Breach	Trigger Breach			
2013					
2014					Managed
2015					
2016					
2017					Full
2018					
2019	Trigger Breach	Trigger Breach			
2020					
2021					
2022					
2023					
2024					
2025					
2026					
2027					
2028					
2029					
2030			Trigger Breach	Trigger Breach	
2031					
2032					
2033					
2034					Managed
2035					
2036					
2037		Trigger Breach			
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The results from this scenario have been analysed against the triggers outlined in Section 2. The results for individual wells have been included below. For simplicity, the results are discussed holistically, rather than a detailed discussion of each individual well.

In the T2 Virginia, the Group 3 wells only breach their trigger levels after full allocation pumping is applied. Both wells in this group recover above trigger levels once managed pumping volumes are applied, and remain above the trigger levels for the remainder of the scenario. Both wells show a downward trend in water levels over time under managed pumping volumes.

For Group 4, trigger levels were breached in all three wells after a year of pumping at full allocation, resulting in managed pumping volumes being applied after three years. Both PTA091 and PTA082 showed recovery after two years of managed pumping (based on the trigger level for PTA082 as -20.44 m AHD). Full allocation pumping was reinstated the following year, which results in both wells breaching their trigger levels the year after. Managed pumping volumes are then applied, resulting in a recovery in PTA091 after 12 years, however PTA082 never recovers and managed pumping volumes are maintained. PTA091 drops below trigger levels after 14 years and remains below these levels for the remainder of the scenario.

As discussed in section 4.1.3.3, ongoing full allocation pumping is unlikely to occur in reality. However, this scenario illustrates that triggers can be breached after one year of full allocation pumping. One or two years of full or close to full allocation pumping in response to adverse climatic conditions may be a more realistic scenario, and this scenario explores the effectiveness of the management response to this.

In summary, key results from this scenario are:

- Management is required after three years of pumping at full allocation
- The system recovers above trigger levels after three years of managed pumping
    - this is based on the trigger level for PTA082 as -20.44 m AHD, rather than -18.4 m AHD
- Management is again required after an additional three years of pumping at full allocation
- The management applied does not allow the system to recover above trigger levels from this point.
- All monitoring wells show an initial steep rise in response to managed pumping, followed by a continual decline for the duration of the scenario.
- Group 3 wells only breach their trigger levels in response to full allocation pumping
- All Group 4 wells breach their trigger levels after 14 years and remain below trigger levels for the remainder of the scenario.
- The resource condition limit is not breached in any wells.

4.3.2.1 *Group 3*

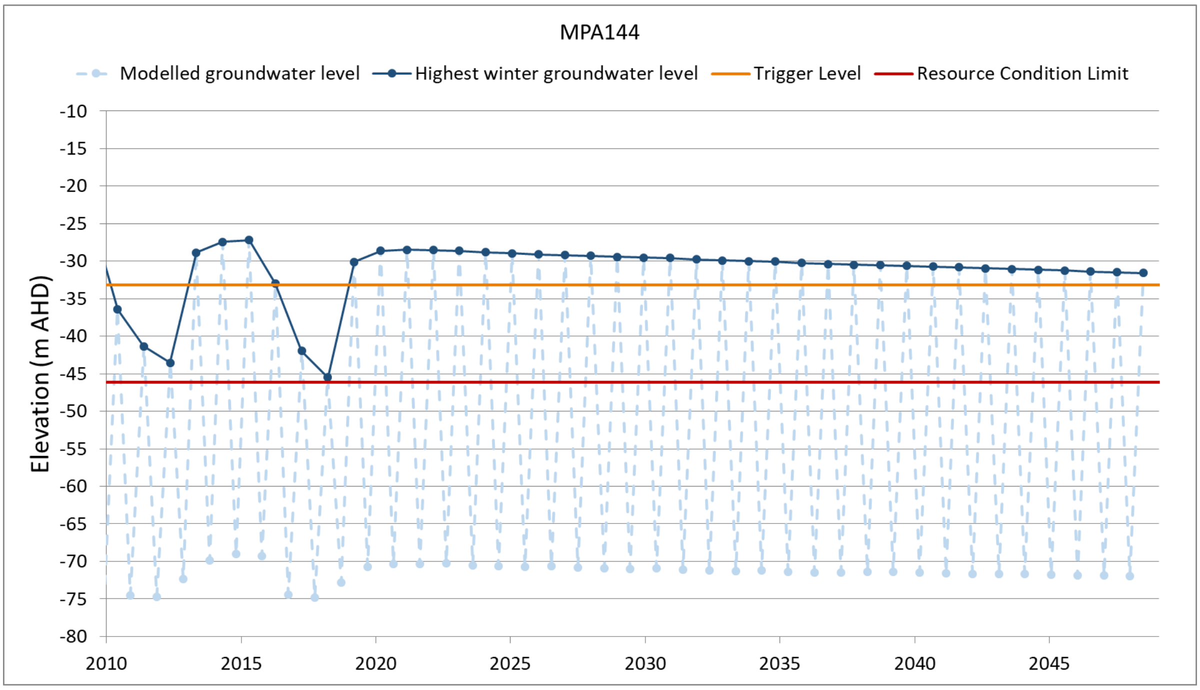

Figure 4.40 Modelled groundwater levels and key levels of interest for MPA144 – Management Scenario

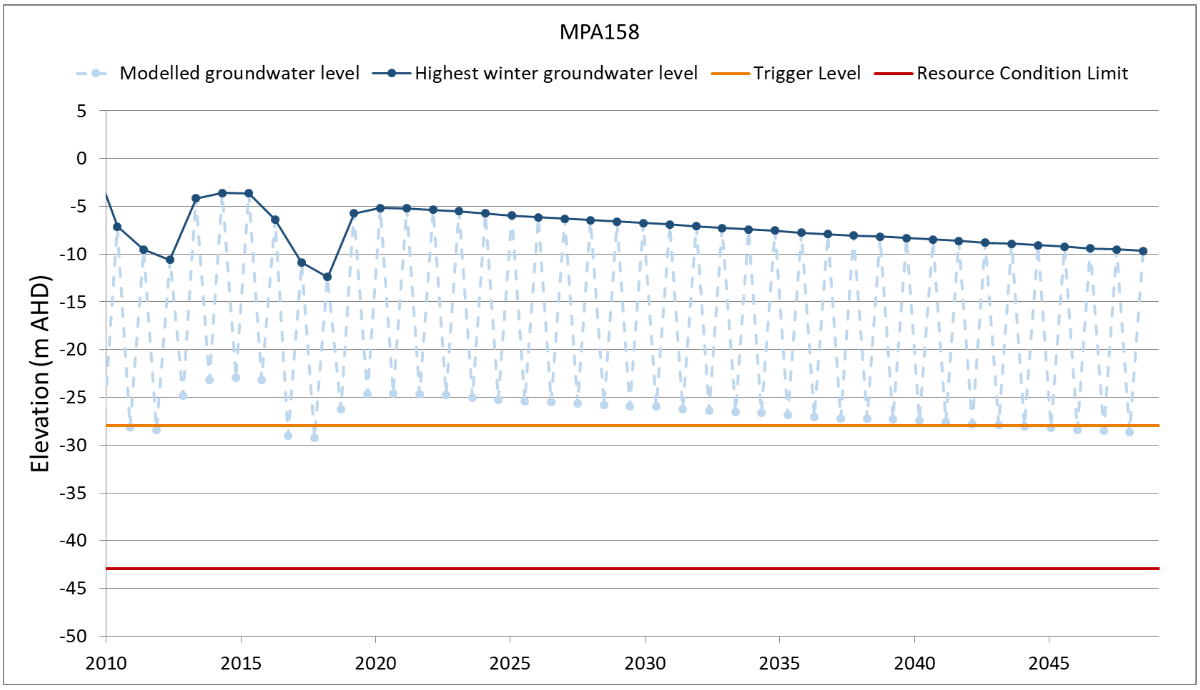

Figure 4.41 Modelled groundwater levels and key levels of interest for MPA158 – Management Scenario

4.3.2.2 Group 4

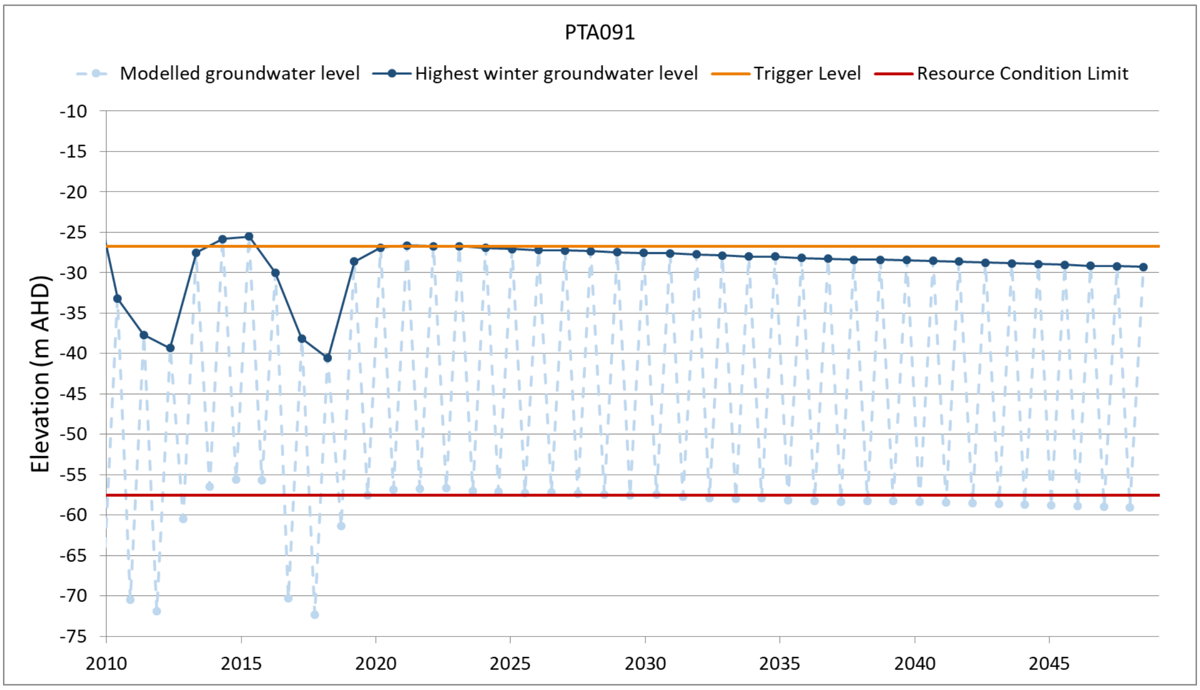

Figure 4.42 Modelled groundwater levels and key levels of interest for PTA091 – Management Scenario

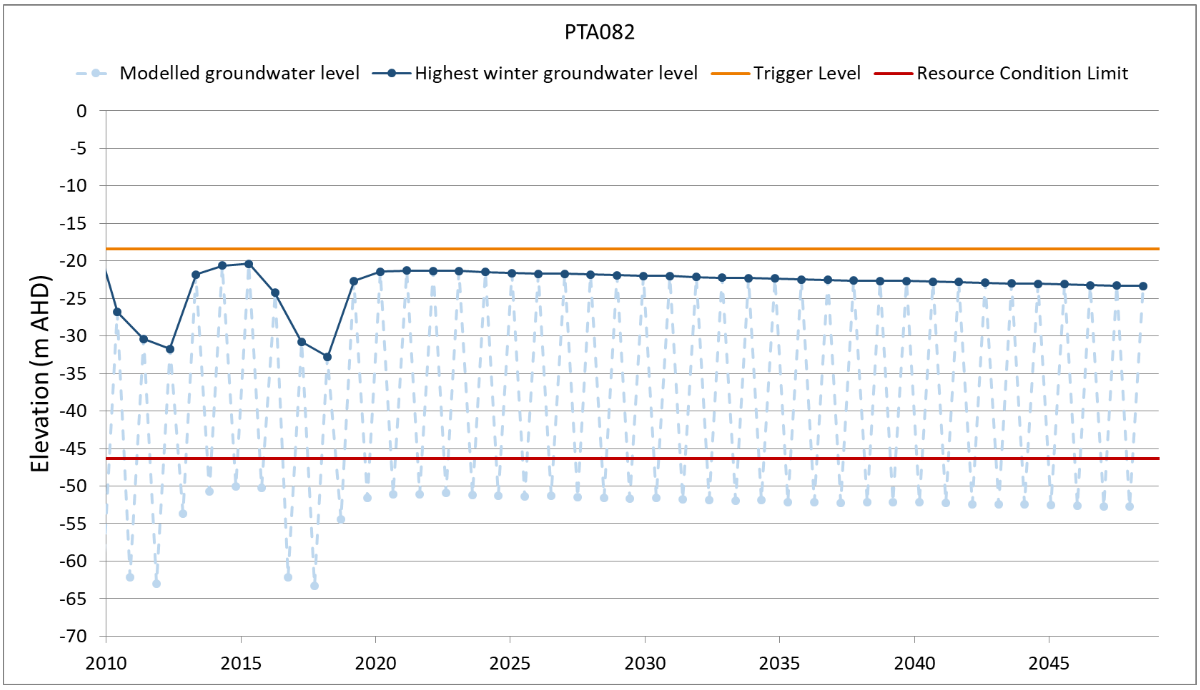

Figure 4.43 Modelled groundwater levels and key levels of interest for PTA082 – Management Scenario

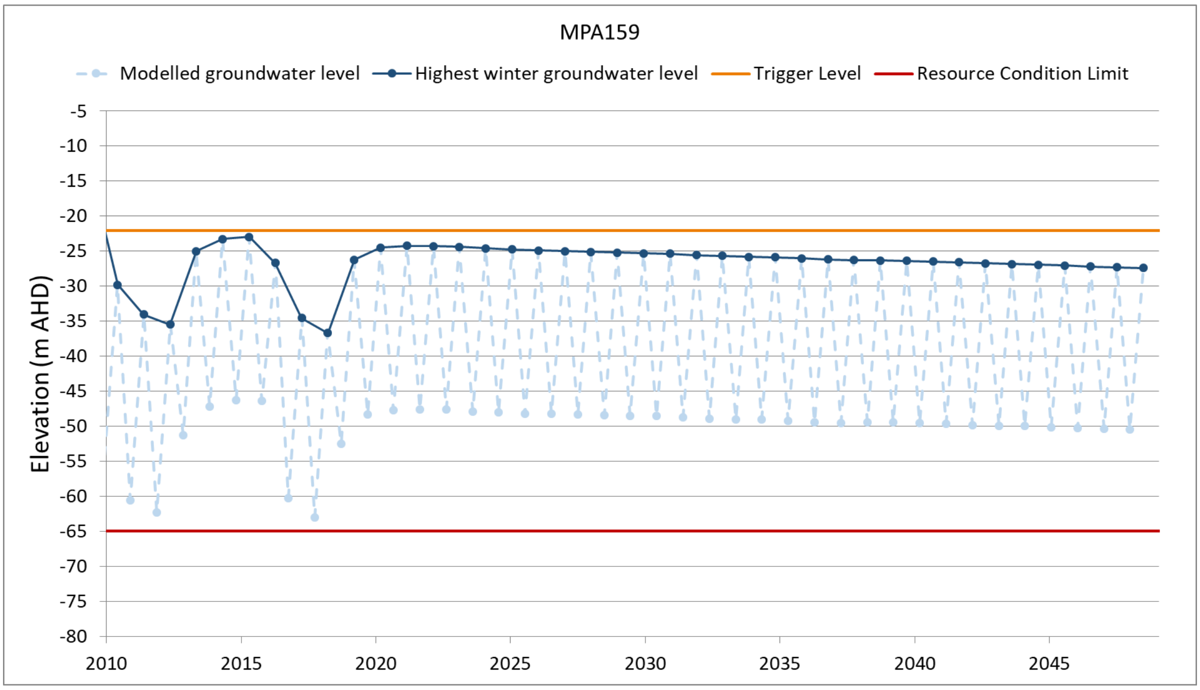

Figure 4.44 Modelled groundwater levels and key levels of interest for MPA159 – Management Scenario

4.4 Scenario results from investigating the managed pumping volume

Given the results of the previous scenario, an investigation into the difference between alternate managed pumping volumes was undertaken. Due to time constraints, these were not undertaken as per the previous scenario, where managed pumping volumes are applied in response to the system being triggered. These were undertaken as flat pumping rates for a 40 year period. The pumping rates examined were:

- 90% of the recommended extraction limit – 3743 ML/y for T1 NAP and 9965 ML/y for T2 Virginia
- 80% of the recommended extraction limit - 3327 ML/y for T1 NAP and 8858 ML/y for T2 Virginia
- 70% of the recommended extraction limit - 2911 ML/y for T1 NAP and 7750 ML/y for T2 Virginia
- 50% of the recommended extraction limit - 2080 ML/y for T1 NAP and 5536 ML/y for T2 Virginia.

A summary of these results is presented in Table 4.10. The key outputs presented in the table are the year each well breached its trigger level or resource condition limit. In addition, a winter decline rate has been included, which is calculated by taking the difference between the winter groundwater levels at the beginning and end of the scenario and dividing by the number of years. This was included to allow for better comparisons between the different runs, as the results for when wells breached trigger levels were similar across a number of model runs. In addition, figures have been included for the 90% and 50% of the recommended extraction limit runs (sections 4.4.1 and 4.4.2).

Given the design of the scenario, these results should be considered as guidance for further discussions, rather than offering more detailed solutions. These scenarios can inform how much impact the extraction pumping rate might have on the long term groundwater levels, but cannot inform how these variations in pumping rates would change the response when applied as per the management approach.

Table 4.10 Summary of modelled bore response – variations in managed pumping volume

GMZ		T1 NAP						T2 Virginia				
Monitoring group		**Group 1**				**Group 2**		**Group 3**		**Group 4**		
Monitoring well		**PTA161**	**PTA095**	**PTA111**	**MPA152**	**PTA051**	**PTA093**	**MPA144**	**MPA158**	**PTA091**	**PTA082**	**MPA159**
Winter trigger level (m AHD)		-2.5	-3.6	-4	-0.62	-4.3	-4.2	-33.2	-27.95	-26.72	-18.44	-22.09
Resource Condition Limit (m AHD)		-5	-5	-5	-5	-5	-5	-46.1	-42.93	-57.5	-46.3	-65
Triggered condition		2 out of 4				Both		Both		2 out of 3		
90% Recommended Extraction Limit	**Year trigger breached**	2041	2045	2041	N/A	2046	2031	N/A	N/A	2028	2011	2013
	Year resource condition breached	N/A	N/A	N/A	N/A	N/A	2048	N/A	N/A	N/A	N/A	N/A
	Winter decline rate (m/yr)	-0.14	-0.09	-0.09	-0.13	-0.03	-0.06	-0.17	-0.19	-0.16	-0.12	-0.17
80% Recommended Extraction Limit	**Year trigger breached**	N/A	N/A	N/A	N/A	N/A	2034	N/A	N/A	2029	2011	2013
	Year resource condition breached	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Winter decline rate (m/yr)	-0.13	-0.08	-0.08	-0.11	-0.03	-0.05	-0.16	-0.18	-0.15	-0.12	-0.17
70% Recommended Extraction Limit	**Year trigger breached**	N/A	N/A	N/A	N/A	N/A	2038	N/A	N/A	2030	2011	2013
	Year resource condition breached	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Winter decline rate (m/yr)	-0.11	-0.07	-0.06	-0.10	-0.03	-0.05	-0.16	-0.18	-0.15	-0.11	-0.16
50% Recommended Extraction Limit	**Year trigger breached**	N/A	N/A	N/A	N/A	N/A	2049	N/A	N/A	2034	2011	2014
	Year resource condition breached	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Winter decline rate (m/yr)	-0.08	-0.04	-0.04	-0.07	-0.02	-0.04	-0.15	-0.17	-0.13	-0.11	-0.15

4.4.1 T1 NAP aquifer GMZ

For T1 NAP, reducing the managed pumping volume has a significant impact over a 40 year period. At 90% of the recommended extraction limit, all bar one of the monitoring wells breach trigger levels after 40 years. At 50%, only one well breaches the trigger level after 40 years. The rate of decline in winter water levels is between 30 and 50% less between the 90% and 50% recommended extraction limit scenarios. This suggests that adjusting the managed pumping volumes has the potential to significantly change the effectiveness of management, although this should be explored further through scenarios similar to the one in section 4.3.

4.4.1.1 Group 1

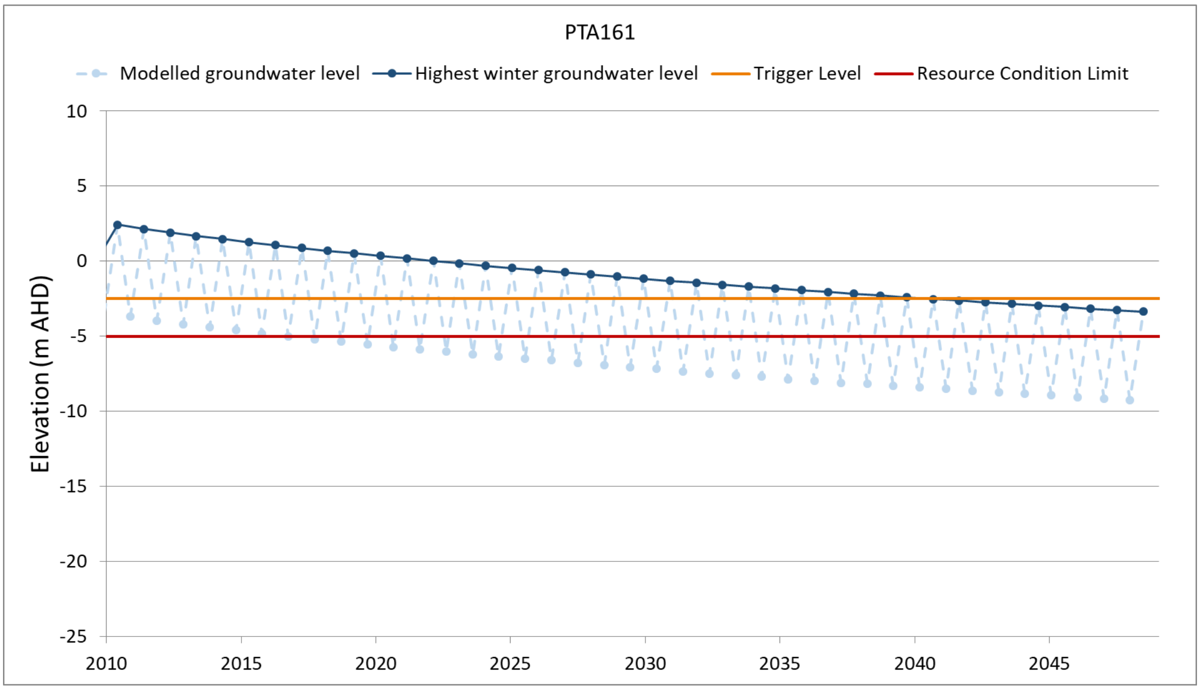

Figure 4.45 Modelled groundwater levels and key levels of interest for PTA161 – 90% REL

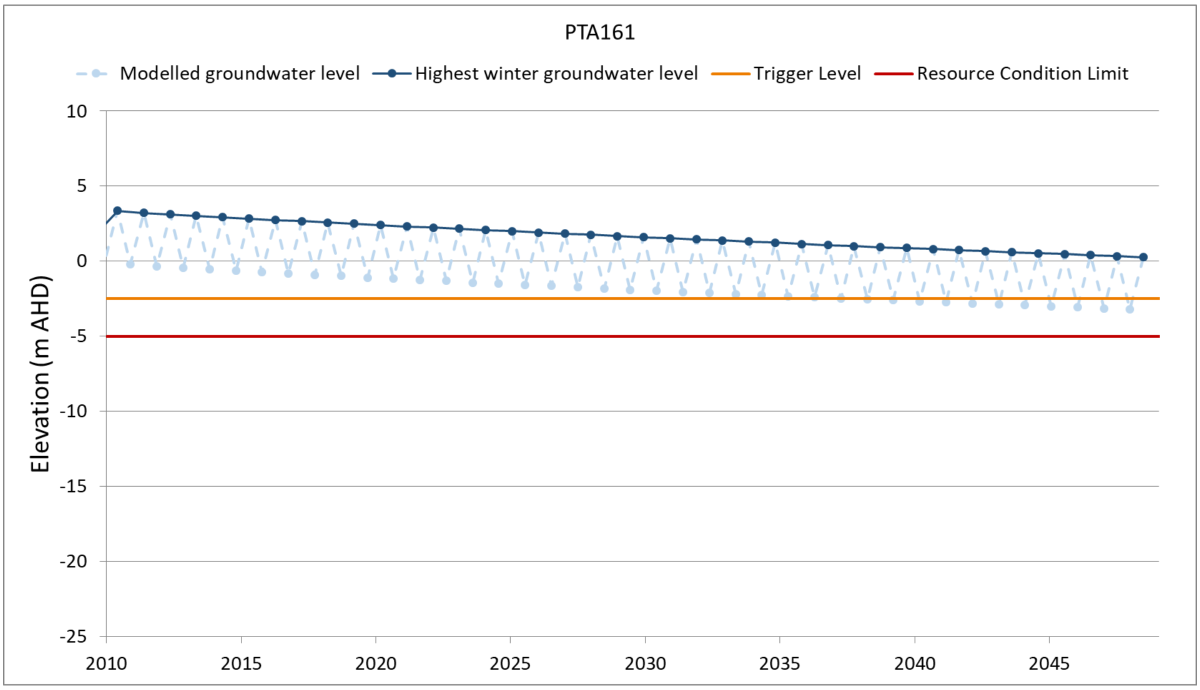

Figure 4.46 Modelled groundwater levels and key levels of interest for PTA161 – 50% REL

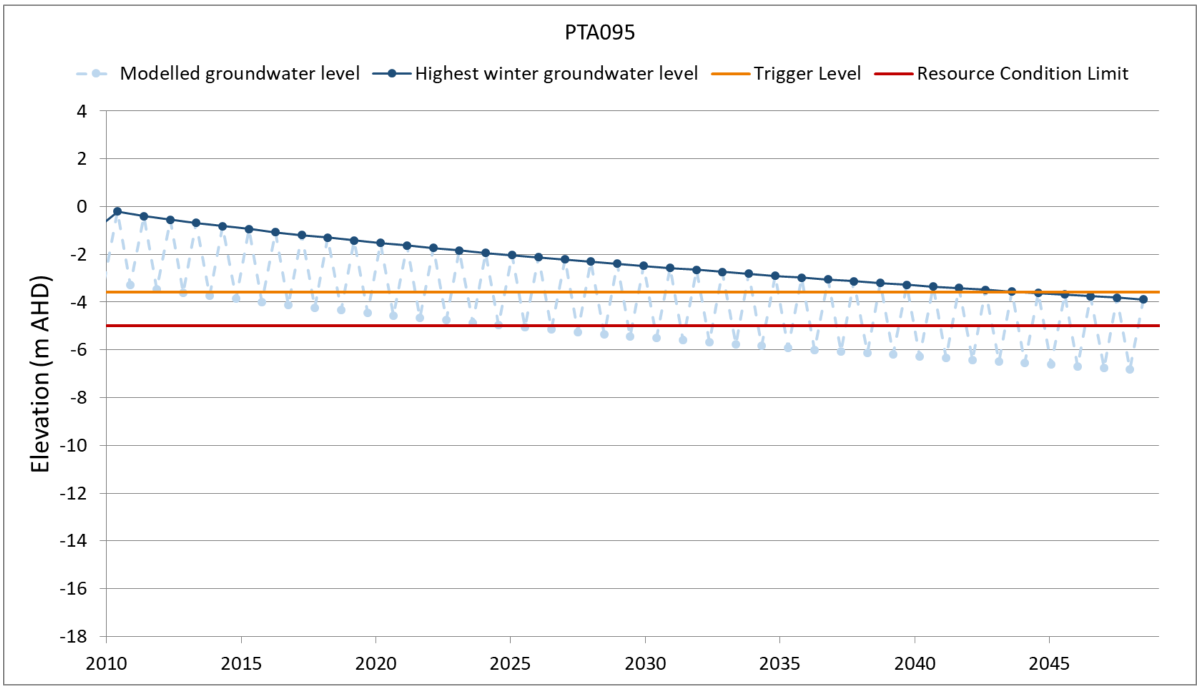

Figure 4.47 Modelled groundwater levels and key levels of interest for PTA095 – 90% REL

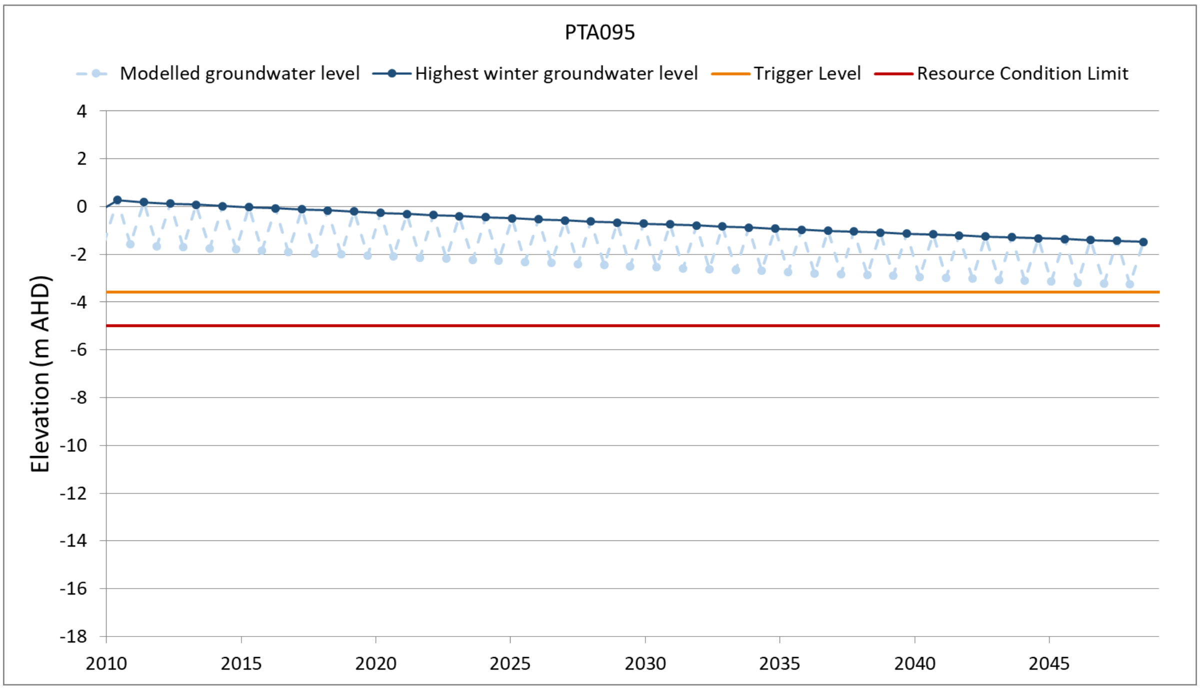

Figure 4.48 Modelled groundwater levels and key levels of interest for PTA095 – 50% REL

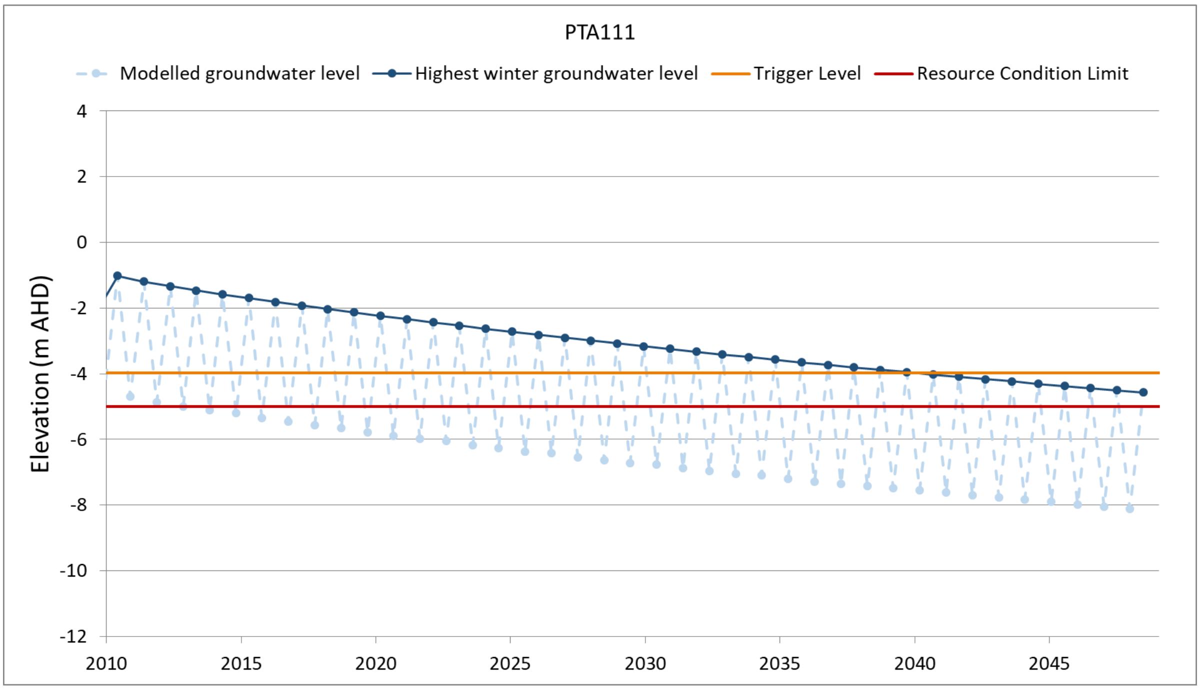

Figure 4.49 Modelled groundwater levels and key levels of interest for PTA011 – 90% REL

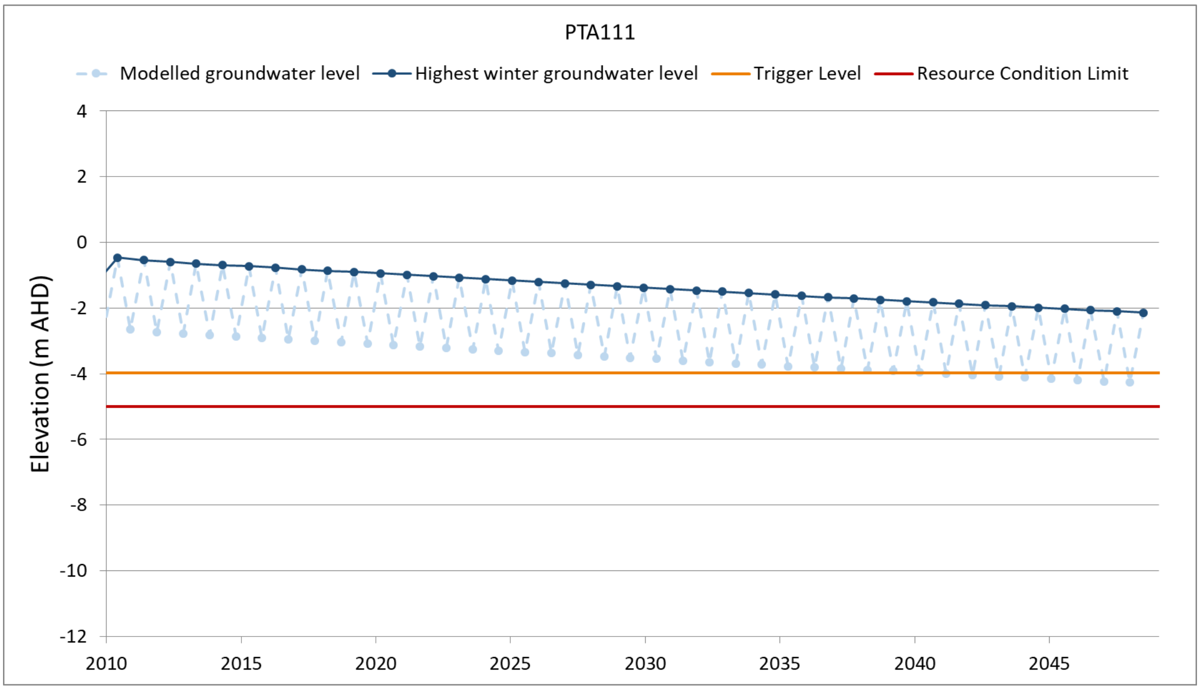

Figure 4.50 Modelled groundwater levels and key levels of interest for PTA011 – 50% REL

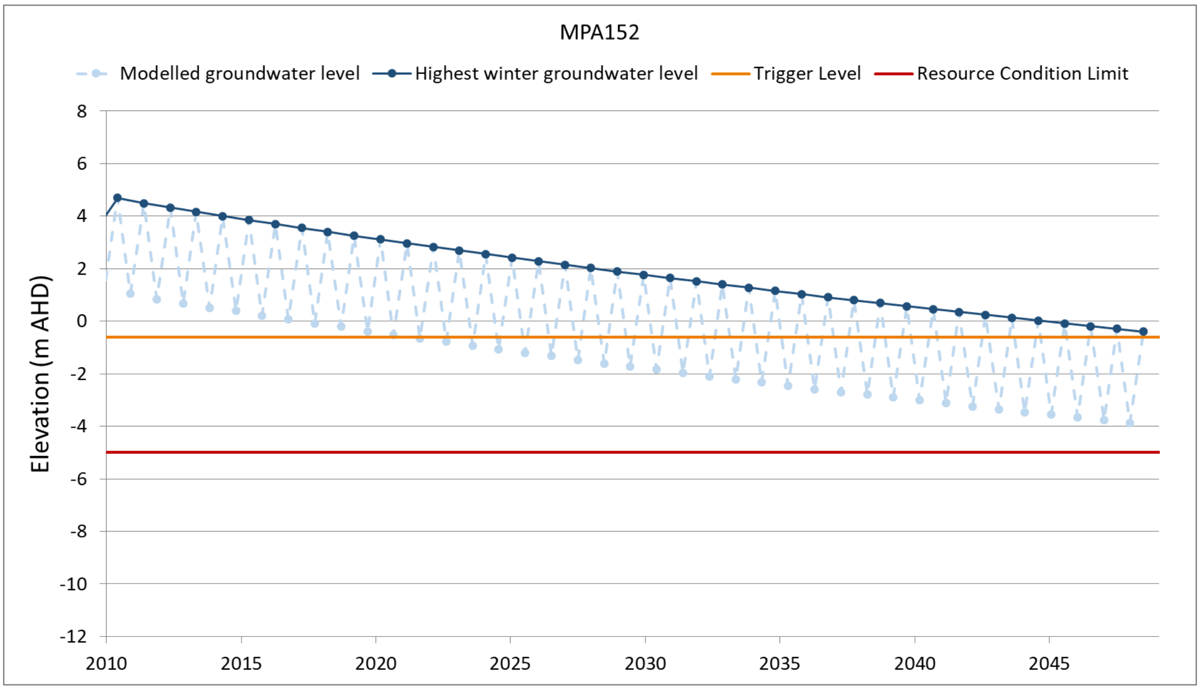

Figure 4.51 Modelled groundwater levels and key levels of interest for MPA152 – 90% REL

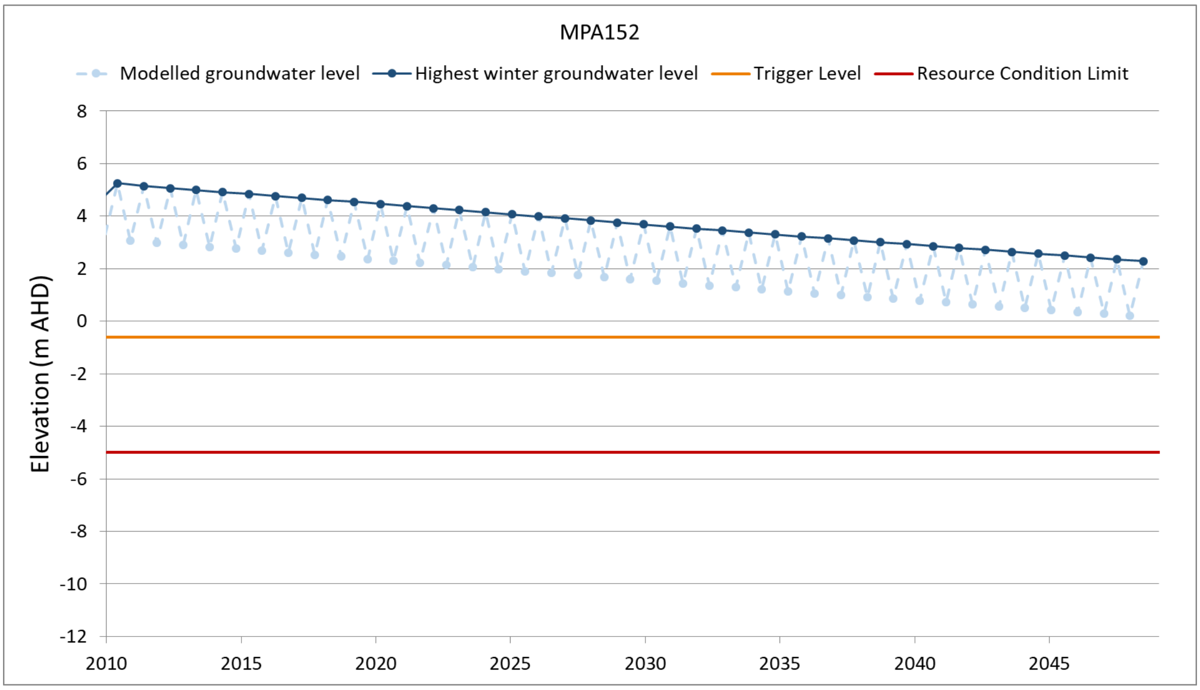

Figure 4.52 Modelled groundwater levels and key levels of interest for MPA152 – 50% REL

4.4.1.2 Group 2

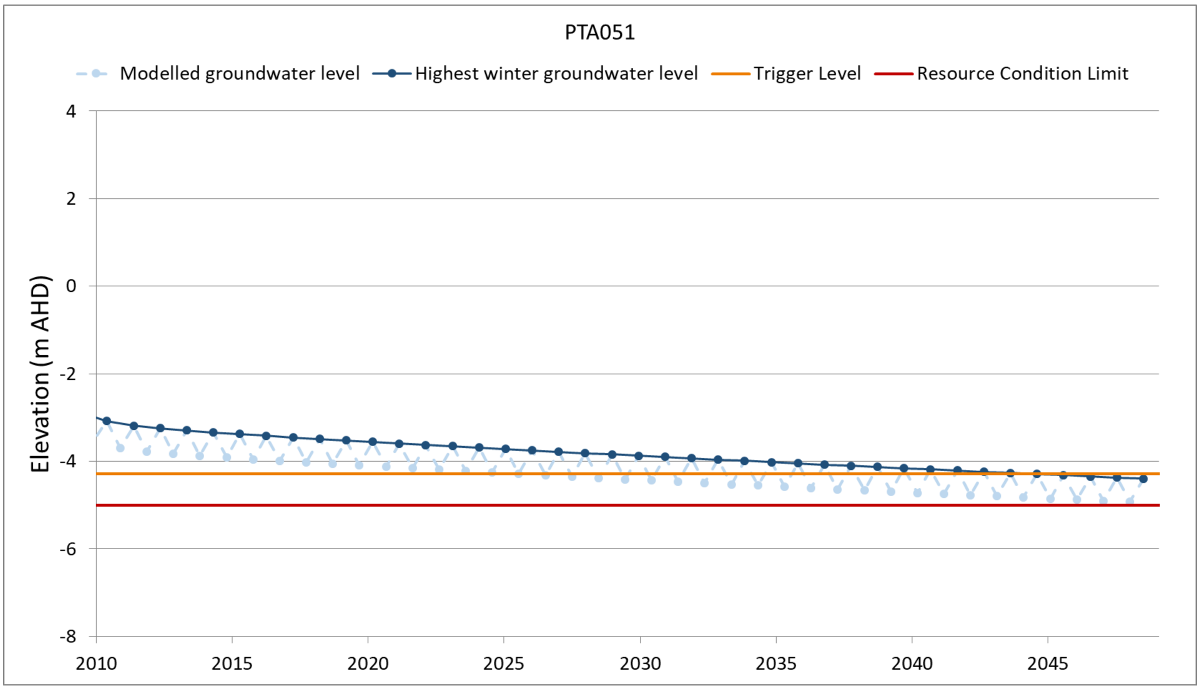

Figure 4.53 Modelled groundwater levels and key levels of interest for PTA051 – 90% REL

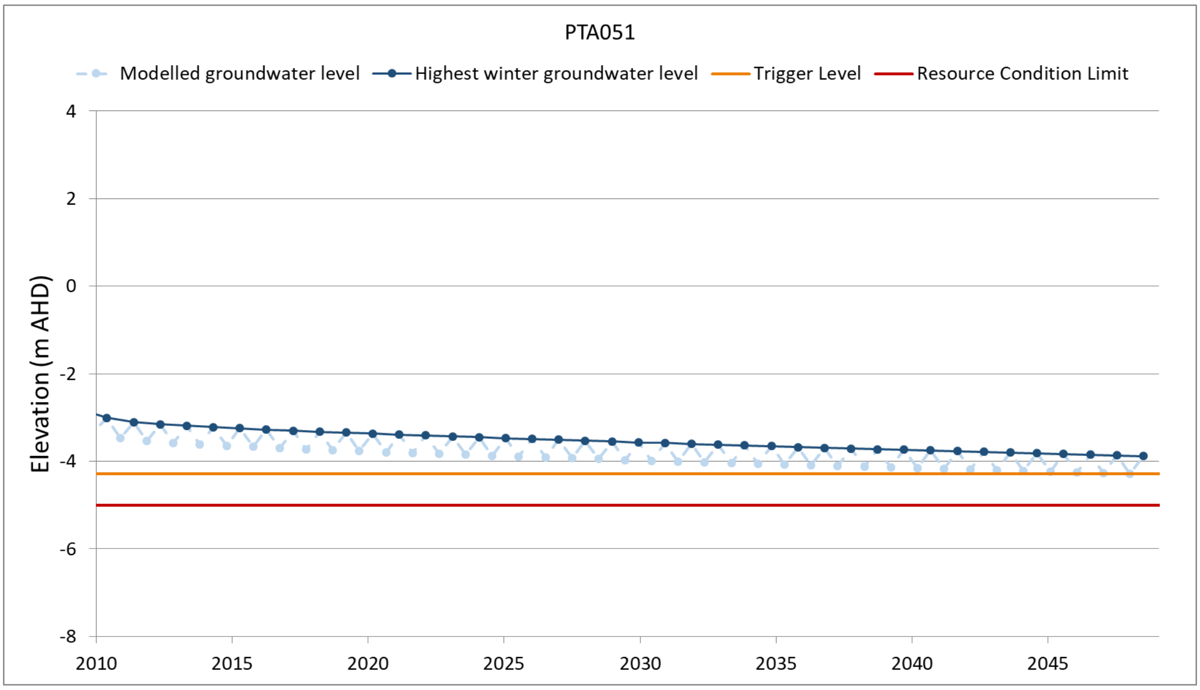

Figure 4.54 Modelled groundwater levels and key levels of interest for PTA051 – 50% REL

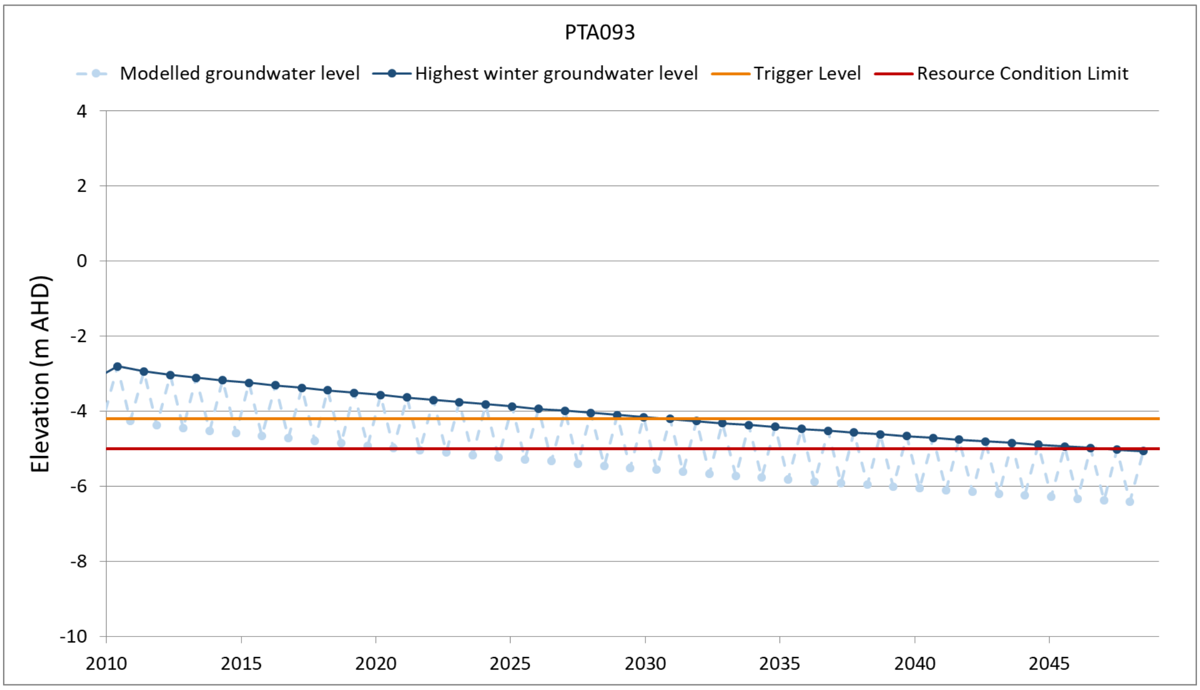

Figure 4.55 Modelled groundwater levels and key levels of interest for PTA093 – 90% REL

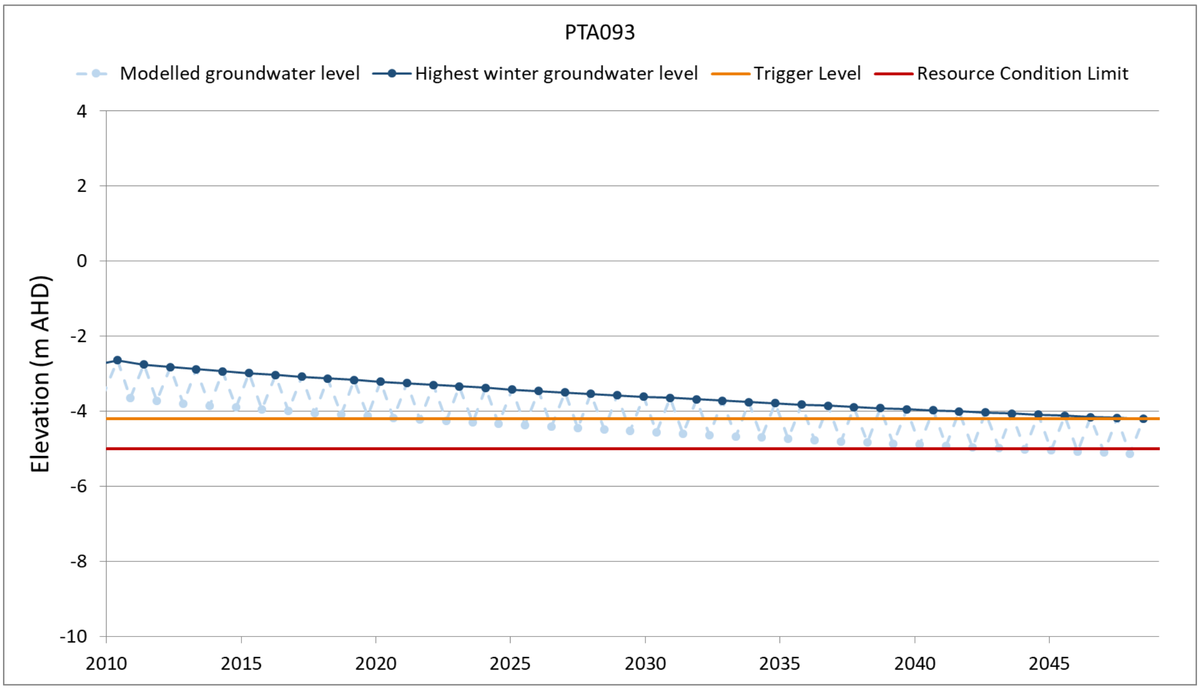

Figure 4.56 Modelled groundwater levels and key levels of interest for PTA093 – 50% REL

4.4.2 T2 Virginia GMZ

For T2 Virginia, reducing the managed pumping volume has an impact over a 40 year period, however it is not as significant as it was for T1 NAP. There is no difference in the number of wells breaching trigger levels over the 40 year period, however two of the wells breach earlier under 90% of the recommended extraction limit vs 50%. Specifically, PTA091 breaches 6 years earlier under 90% than 50%, and MPA159 breaches one year earlier for the same comparison. This is also supported by the differences in the rate of decline in winter water levels. There is a 10 to 15% reduction in the rate of decline in winter water levels between the 90% and 50% recommended extraction limit scenarios. This suggests that adjusting the managed pumping volumes may be less successful in changing effectiveness of management, although this should be explored further through scenarios similar to the one in section 4.3.

4.4.2.1 Group 3

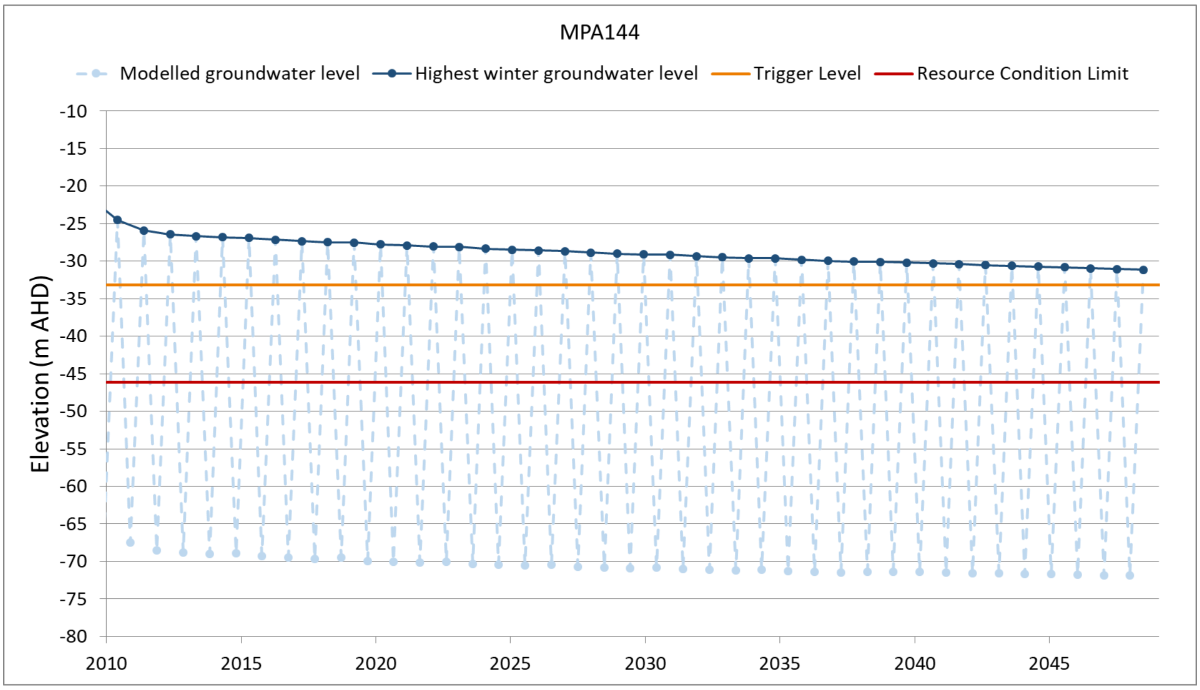

Figure 4.57 Modelled groundwater levels and key levels of interest for MPA144 – 90% REL

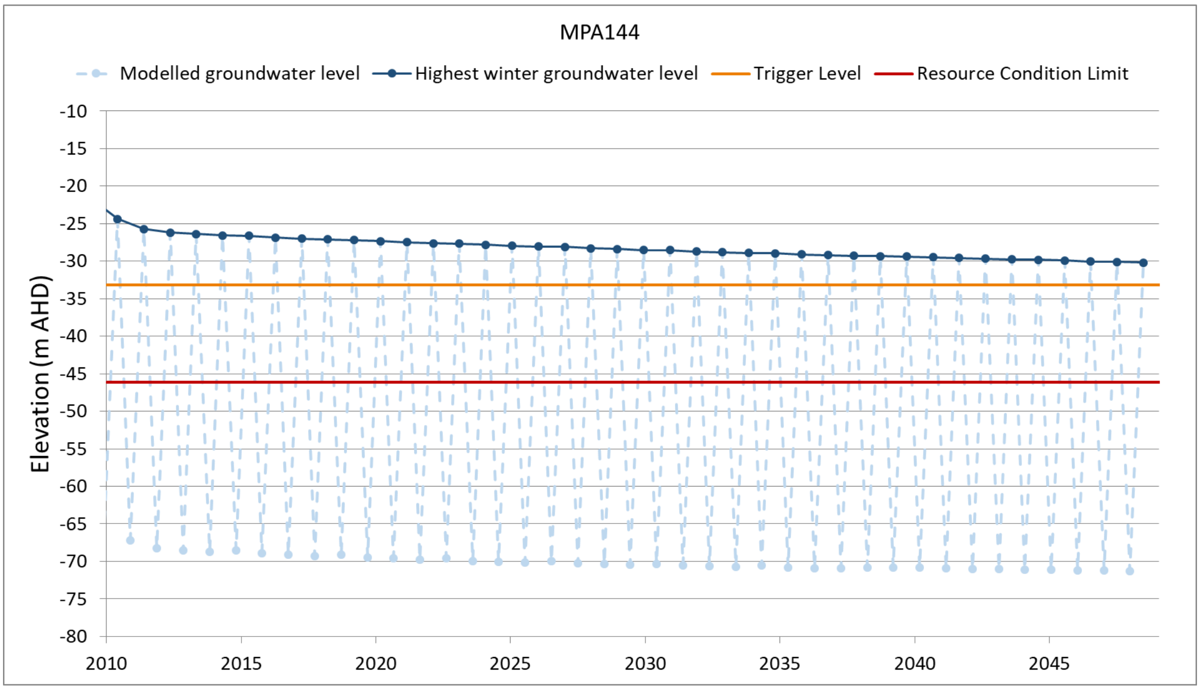

Figure 4.58 Modelled groundwater levels and key levels of interest for MPA144 – 50% REL

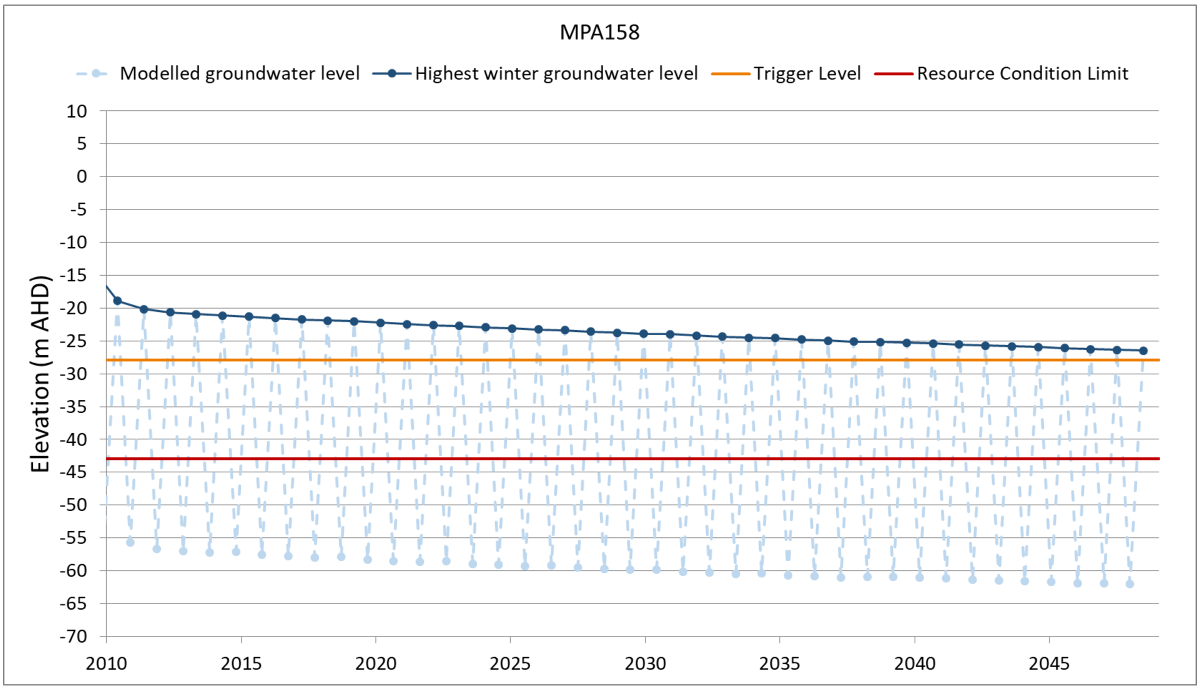

Figure 4.59 Modelled groundwater levels and key levels of interest for MPA158 – 90% REL

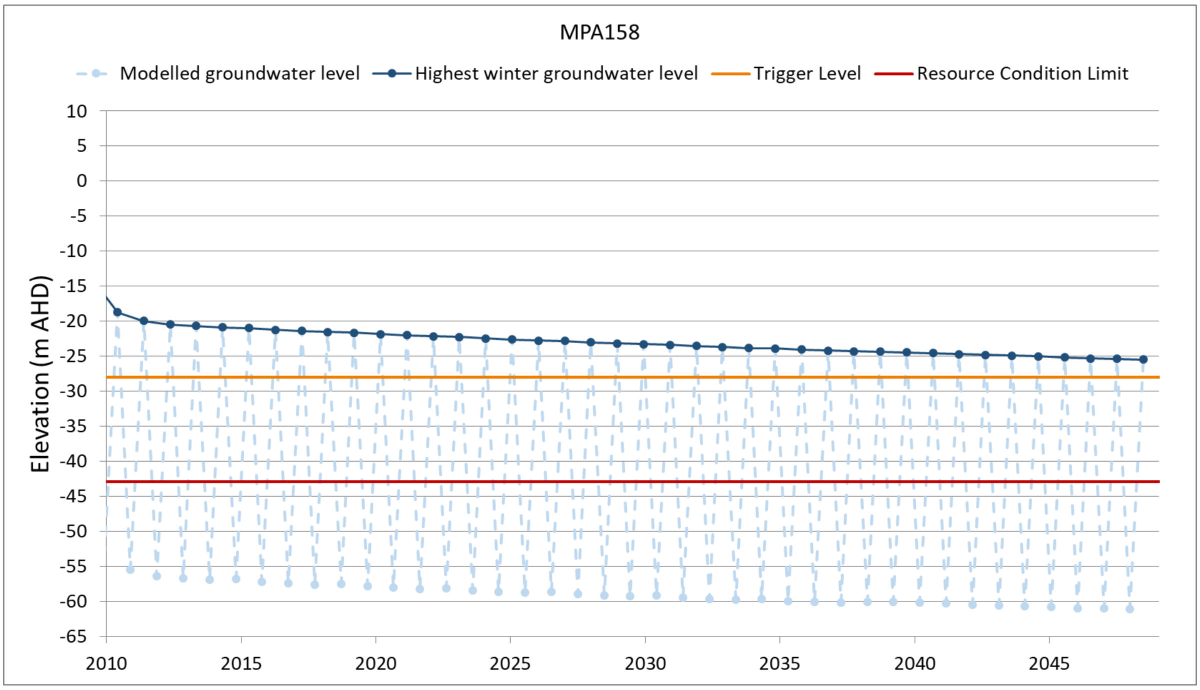

Figure 4.60 Modelled groundwater levels and key levels of interest for MPA158 – 50% REL

4.4.2.2 Group 4

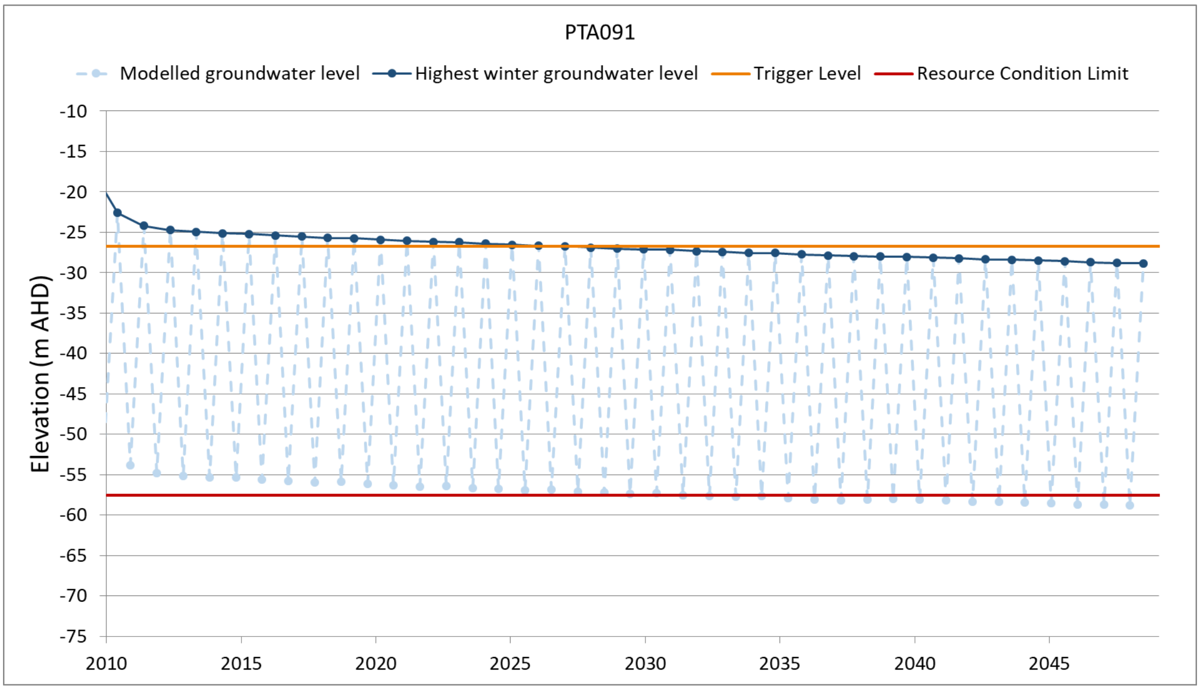

Figure 4.61 Modelled groundwater levels and key levels of interest for PTA091 – 90% REL

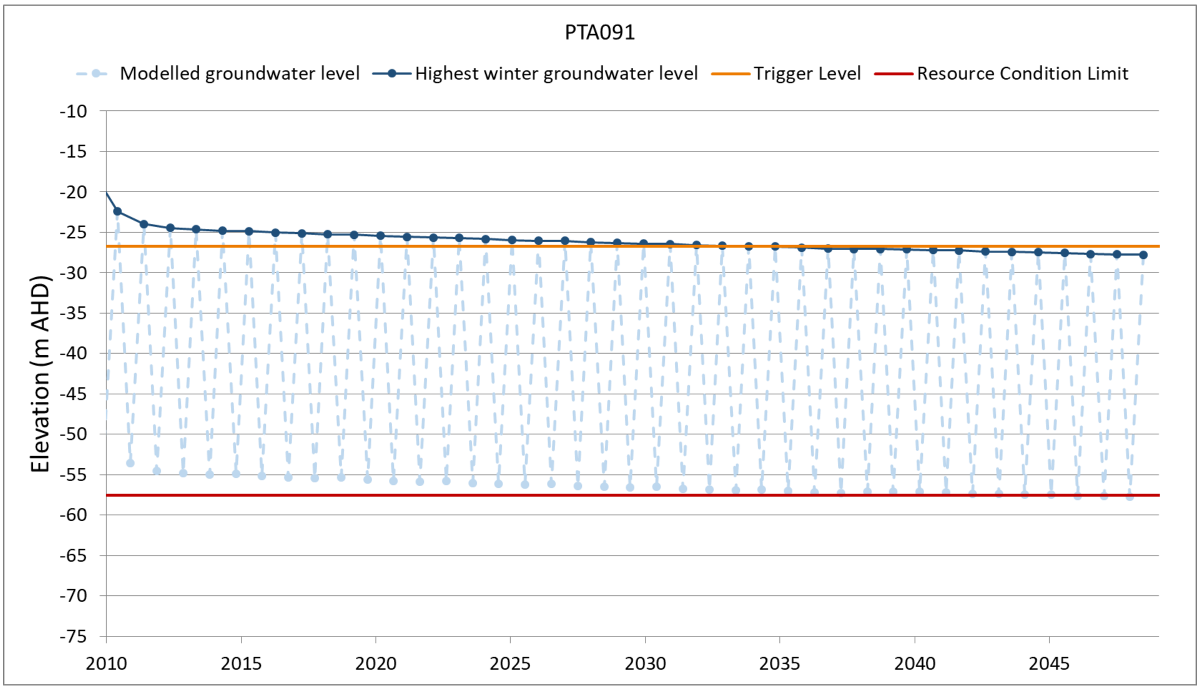

Figure 4.62 Modelled groundwater levels and key levels of interest for PTA091 – 50% REL

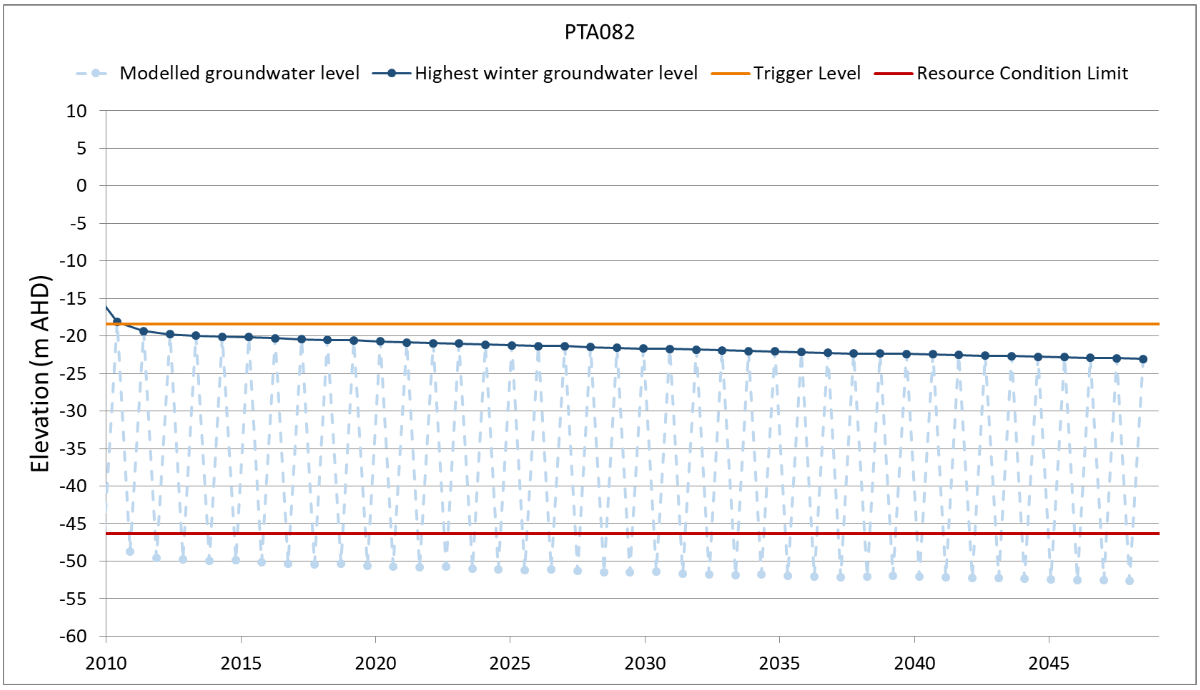

Figure 4.63 Modelled groundwater levels and key levels of interest for PTA082 – 90% REL

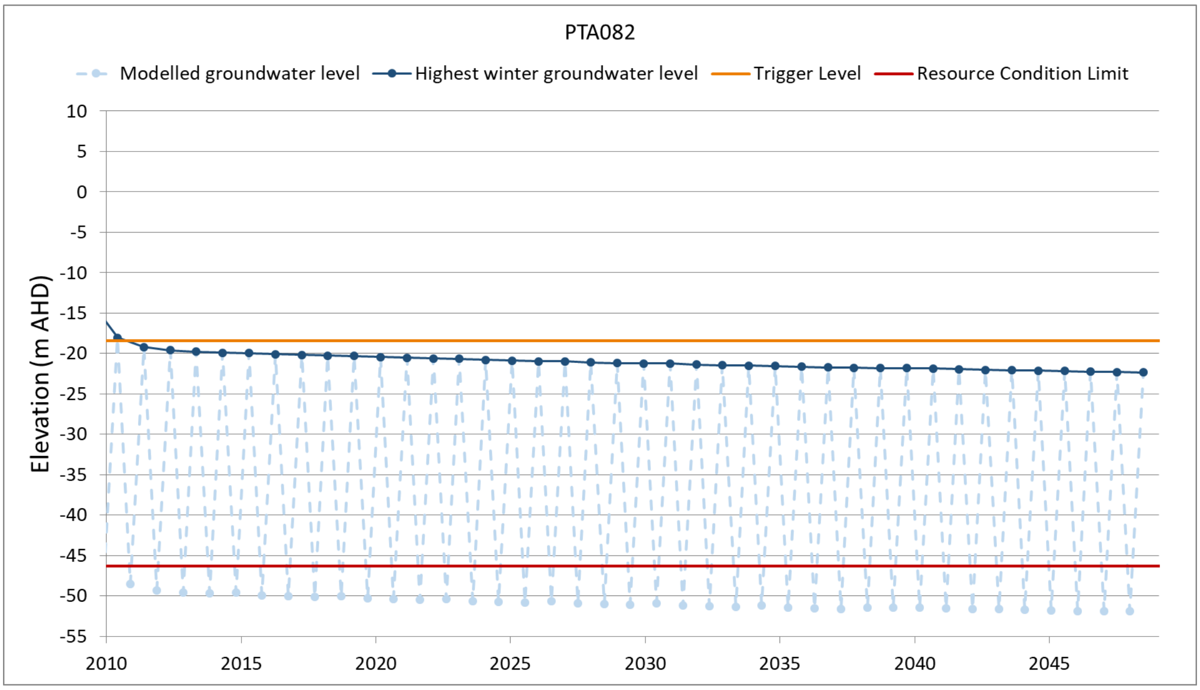

Figure 4.64 Modelled groundwater levels and key levels of interest for PTA082 – 50% REL

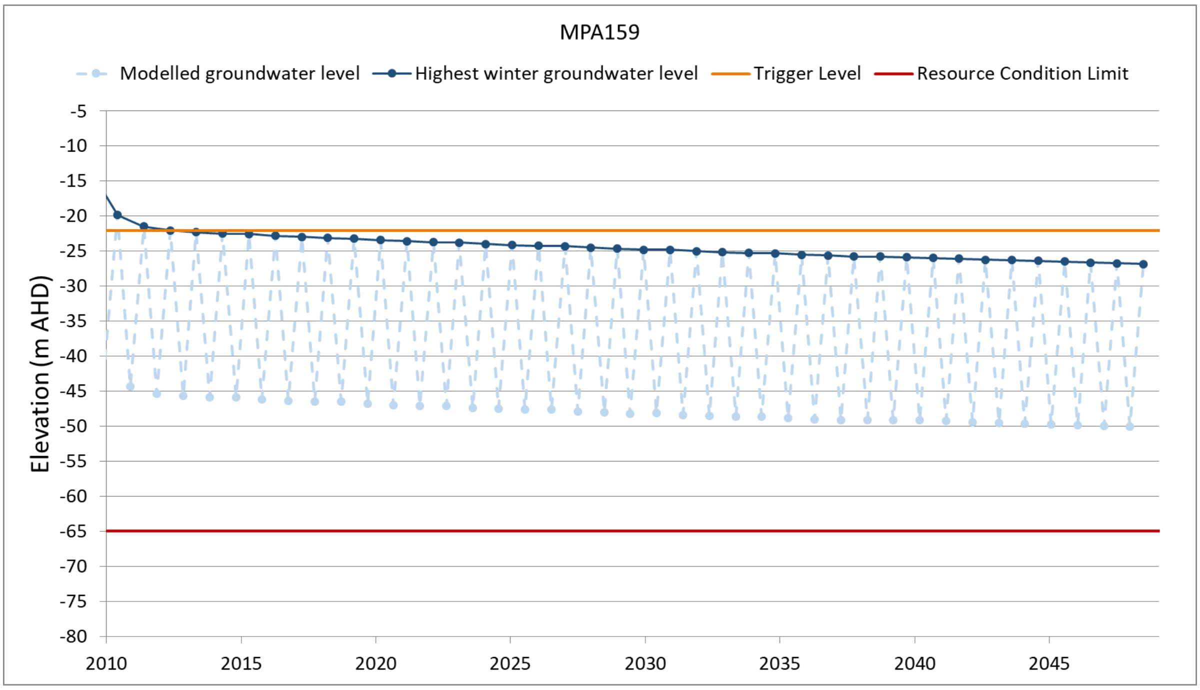

Figure 4.65 Modelled groundwater levels and key levels of interest for MPA159 – 90% REL

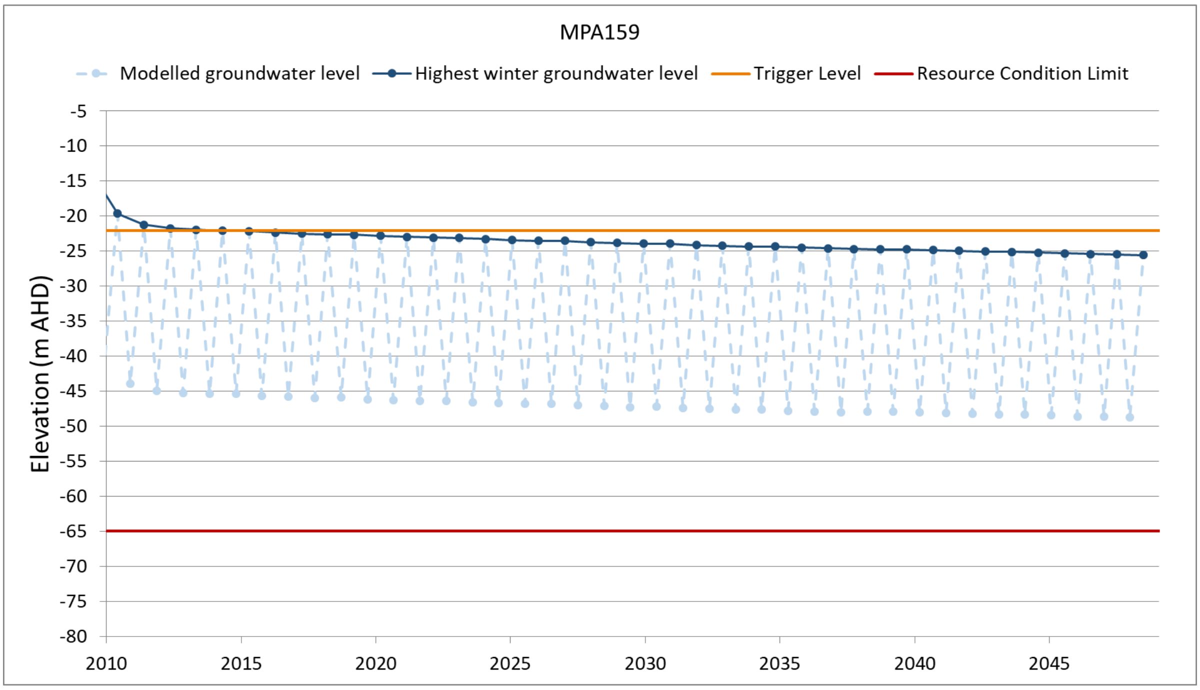

Figure 4.66 Modelled groundwater levels and key levels of interest for MPA159 – 50% REL

5 Summary and recommendations

5.1 Summary

This report summarises the investigations that were undertaken to determine the groundwater management approaches (use of recommended extraction limits and resource condition trigger levels) within the Plan that support the achievement of the Plan's objectives.

It also identifies the key areas targeted for management, specifically T1 NAP and T2 Virginia GMZs. In addition, it identifies T2 NAP and T2 Kangaroo Flat as GMZs that require ongoing monitoring. For T2 NAP, this is primarily due to the current allocation being 102% of the recommended extraction limit. For T2 Kangaroo Flat, monitoring is recommended to understand whether a reduction in allocation to be completed in June 2022 has been effective in managing the salinity issue previously identified in that area.

The proposed adaptive trigger management approach provides flexibility to water users through enabling water extraction to increase above the average annual extraction in years when drier conditions are observed, as there is evidence that suggests the resource can sustain short-term increased extraction on occasion. However sustained extraction of the water resource at a higher rate is likely to result in adverse impacts to the resource.

The groundwater trigger levels were designed to consider the risks to the aquifers from excessive water take via pumping. The Resource Capacity Report identified resource condition limits that are considered the point beyond which unacceptable risk to the resource could occur. For the T1 aquifer, these risks include:

- vertical leakage of higher-salinity groundwater from the overlying Quaternary aquifer; and
- the horizontal encroachment of higher-salinity groundwater from surrounding areas of the aquifer.

For the T2 aquifer the risk is depressurisation of the aquifer and changing the aquifer from a confined aquifer to an unconfined aquifer.

The trigger levels were developed by assessing historical water level data at times when the aquifers were under stress as well as considering the previously developed resource condition limits. From this, a set of trigger levels were derived as an early warning system for a management response to mitigate the risk of reaching the resource condition limits. To ensure that the trigger for management was not unduly sensitive, a number of wells in each GMZ have to breach trigger levels before the management process is initiated. Details of trigger levels are given in Table 2.4.

The pumping volume applied during the management response is based on the recommended extraction limits that represent the maximum volume that can be extracted before there is a potential for risk to the resource. These volumes are not volumes designed to assist in the recovery of an already stressed resource.

Groundwater modelling was used throughout the development of the recommended extraction limits and the proposed management to inform and test recommendations. The groundwater model used for this analysis (and in the Resource Capacity Report) is the Adelaide Plains groundwater flow and solute transport model, version AP2013 (Peat V and Yan W, 2014). The key scenarios relevant to the process of developing trigger levels and proposed management response are:

- Scenario 1 – 2006 to 2013 average use for T1 NAP and T2 Virginia over 30 years
- Scenario 2 – Full allocation for T1 NAP and T2 Virginia over 30 years

    - Note that the full allocation reflects the understanding of the current entitlement volume at the time the modelling was undertaken. Recent revisions of this data mean that there are differences between the volumes used in the modelling and the volumes in the Plan.
- Scenario 10 – Recommended extraction limit (REL) for T1 NAP and T2 Virginia over 30 years
- Management scenario – Full allocation plus applied management over 40 years
- Testing of managed pumping volumes over 40 years:
    - 90% of the recommended extraction limit – 3743 ML/y for T1 NAP and 9965 ML/y for T2 Virginia
    - 50% of the recommended extraction limit - 2080 ML/y for T1 NAP and 5536 ML/y for T2 Virginia.

These scenarios enable examination of a range of constant pumping volumes set out in the Plan (that is, the same pumping rate is applied over the full duration of the scenario). The exception to this is the management scenario, where the pumping rate is changed when the conditions have been met for managed pumping rates to be applied.

As stated in 4.1.3, this methodology is limited in its ability to represent the variations in pumping that have historically been observed. However, the scenarios undertaken allow for exploration of what is allowed for under the Plan, whether the management proposed is effective in a worst case scenario and some understanding of the implications for changing managed pumping volumes. Table 5.1 is a summary of key outcomes from the modelling.

Evidence suggests the resource in T2 Virginia GMZ can sustain short-term increased extraction, of one to two years, whereas the resource in T1 NAP can sustain increased extraction for a longer period, possibly in the order 10 to 20 years. However in both GMZ's sustained extraction of the water resource at a higher rate is likely to result in adverse impacts to the resource.

The model analysis demonstrates that under the full allocations permitted under the Plan, the proposed management is not effective at protecting the resource. This is particularly true for T1 NAP, where ongoing pumping of management volumes results in the breaching of the resource condition limit. Resource condition limits in T2 Virginia are only breached if full allocation pumping continues without management intervention. When management intervention does occur, trigger levels are likely to be breached in the long term, however resource condition limits are not exceeded.

Some limitations are noted in the modelling that is the basis for this assessment. In addition to recommending a number of improvements to the model, ongoing monitoring is also recommended to support assessment of whether further reductions in allocations should be pursued in a future update to the Plan to protect the resource, particularly in the face of projections for a drier and hotter climate.

Table 5.1 Summary of key outcomes from scenario modelling

Scenario	T1 NAP		T2 Virginia		Other key results
	Management activated	**RCLs breached**	**Management activated**	**RCLs breached**	
1 - Average use	No	No	No	No	T1 NAP modelled water levels show a declining trend over the 30 years. T2 Virginia modelled water levels show a predominately flat trend over the 30 years of the modelled simulation.
2 - Full allocation	After 13 years	All bar one (PTA111)	After 3 years	All group 3 wells* No group 4 wells*	This scenario is considered a worst case, as the likelihood of continual pumping at full allocations in the GMZ's is small. All monitoring wells show continuous decline in water level over the 30 year period.
10 – Recommended extraction limit (REL)	After 30 years	No	After 21 years	No	All monitoring wells show continuous decline in water level over the 30 year period, although less so than under full allocation.
Management	After 18 years	PTA093 after 29 years PTA111 after 31 years	After 3 years Recovery after 3 years of managed pumping After 9 years	No	For T1 NAP the applied management applied fails to allow the system to recover or prevent the breaching of resource condition limits in two wells. However, management is not required until after 18 years of full allocation pumping, which may represent an unrealistically long time for full allocation pumping to occur. For T2 Virginia, trigger levels are breached after one year of full allocation pumping. While long term pumping at full allocation rates is likely to be unrealistic, one or two years of full or close to full allocation pumping in response to adverse climatic conditions is possible and this scenario is intended to highlight the associated risks. The management response allows the resource to recover from the first trigger level breach, however it does not allow the system to

Scenario	T1 NAP		T2 Virginia		Other key results
	Management activated	RCLs breached	Management activated	RCLs breached	
					recover after the second breach, which occurred after 9 years. The management proposed also does not prevent the long term declining trend in water levels.
Managed pumping 90% of recommended extraction limit	After 31 years	PTA093 after 38 years	After 3 years	No	For T1 NAP the rate of decline in winter water levels is between 30 to 50% less for the 50% scenario compared to the 90% REL scenario. This suggests that adjusting the managed pumping volumes has the potential to significantly change the effectiveness of management. For T2 Virginia the rate of decline in winter water levels is between 10 to 15% less for the 50% scenario compared to the 90% REL scenario. This suggests that adjusting the managed pumping volumes may be less successful in changing effectiveness of management.
Managed pumping 50% of recommended extraction limit	No	No	After 4 years	No	

* For well groupings see Table 2.4

5.2 Recommendations

Water allocation plans are reviewed according to statutory timeframes and this provides an opportunity to progressively adopt the latest science. Given the limitations outlined in section 4.1.3, there are a number of recommendations for improvements to the model construction and the design of further scenarios for improved confidence in future scenario results.

5.2.1 Update of the Adelaide Plains groundwater model

The Adelaide Plains groundwater model should be updated to include the latest information about aquifer surfaces to improve confidence in the modelled results.

In addition, the model should be calibrated to the latest groundwater level data collected subsequent to the model development. This is reflected in the need to use model adjustment factors to align the model output with current measured data. Recalibration would address this issue.

The extraction regime in the Central Adelaide PWA has changed since the construction of the model, with several large industrial users no longer operating (e.g. Coca Cola, Penrice). The pumping volumes should be updated to reflect the current, licenced allocations.

5.2.2 Additional scenarios

The modelling analysis demonstrates that the management response will not be fully effective in protecting the resource. Further scenarios should be considered that examine:

- Applying different managed pumping rates in a management scenario
- Testing more realistic pumping scenarios to develop a more nuanced understanding of when triggers would be breached
- Potentially testing variations in triggers if changing managed pumping volumes is not effective at managing the resource.

6 References

Department for Environment and Water, 2020, *Estimation of groundwater resource capacity and recommended extraction limits for the Adelaide Plains Water Allocation Plan: Addendum 2020*, DEW Technical report 2020/17, Government of South Australia, Adelaide

Nation, E, Werner, AD and Habermehl, R, 2008, *Australia's coastal aquifers and sea level rise, Science for decision makers*, Brief prepared for the Department of Agriculture Fisheries and Forestry, Bureau of Rural Sciences, Canberra

Peat V and Yan W, 2014, *Groundwater modelling exercise to determine resource capacity,* unpublished report, Government of South Australia, through Department of Environment, Water and Natural Resources, prepared for Adelaide and Mount Lofty Ranges Natural Resources Management Board, Eastwood

RPS Aquaterra, 2011, *Adelaide Plains groundwater flow and solute transport model (AP2011)*, Adelaide

Watt E, Peat V and Barnett S, 2017, *Estimation of groundwater resource capacity and recommended extraction limits for the Adelaide Plains Water Allocation Plan*, DEWNR Technical Report 2017/03, Government of South Australia through Department of Environment, Water and Natural Resources, Adelaide.

7 Glossary

Allocation — See Water Allocation

Aquiclude — In hydrologic terms, a formation that contains water but cannot transmit it rapidly enough to furnish a significant supply to a well or spring

Aquifer — An underground layer of rock or sediment that holds water and allows water to percolate through

Aquifer, confined — Aquifer in which the upper surface is impervious (see 'confining layer') and the water is held at greater than atmospheric pressure; water in a penetrating well will rise above the surface of the aquifer

Aquifer, unconfined — Aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure

Aquitard — A layer in the geological profile that separates two aquifers and restricts the flow between them

Bore — See 'well'

Cone of depression — An inverted cone-shaped space within an aquifer caused by a rate of groundwater extraction that exceeds the rate of recharge; continuing extraction of water can extend the area and may affect the viability of adjacent wells, due to declining water levels or water quality

Confining layer — A rock unit impervious to water, which forms the upper bound of a confined aquifer; a body of impermeable material adjacent to an aquifer; see also 'aquifer, confined'

Consumptive pool — The water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8 of the Landscape Act, as determined by the Plan

Consumptive use — Licensed and non-licensed water use for the purposes of Part 8 of the Landscape Act

Decommissioning — The permanent closure of a well no longer in use

DENR — former Department of Environment and Natural Resources (Government of South Australia)

DEW — Department for Environment and Water

DEWNR — former Department of Environment, Water and Natural Resources (Government of South Australia)

DFW — former Department for Water (Government of South Australia)

DWLBC — former Department of Water, Land and Biodiversity Conservation (Government of South Australia)

EC — Electrical conductivity; 1 EC unit = 1 micro-Siemen per centimetre (µS/cm) measured at 25°C; commonly used as a measure of water salinity as it is quicker and easier than measurement by TDS

Entitlement shares — The individual shares which comprise a water access entitlement within a particular consumptive pool. The entitlement shares are valued at 1 kilolitre per share with the exception of entitlement shares issued in relation to the T1 Northern Adelaide Plains Consumptive Pool or the T2 Northern Adelaide Plains Consumptive pool which are subject to variation in accordance with principles 21 to 29 of the Plan

Existing user — A person who held a water licence under the previous Northern Adelaide Plains Prescribed Wells Area Water Allocation Plan, or was considered an existing user of the resource under section 155 of the Landscape Act or holds a water licence in relation to the Dry Creek or Central Adelaide PWAs

Extraction — The actual annual volume removed from the aquifer for consumptive/non-consumptive use

Full allocation — The maximum annual volume a licensee is entitled to extract under their water licence

Groundwater — Water occurring naturally below ground level or water pumped, diverted and released into a well for storage underground

Groundwater extraction — The process of taking water from an underground source, either temporarily or permanently

Groundwater Prohibition Area — A Groundwater Prohibition Area declared by the EPA, or an area declared as an Assessment Area by the EPA for investigation of identified groundwater contamination

Hydraulic gradient — In unconfined groundwater, the mean watertable gradient in the direction of groundwater flow. In confined aquifers, the pressure gradient in the direction of flow

Hydraulic conductivity (K) — A measure of the ease of flow through aquifer material: high K indicates low resistance, or high flow conditions; measured in metres per day

Hydrogeology — The study of groundwater, which includes its occurrence, recharge and discharge processes, and the properties of aquifers; see also 'hydrology'

Hydrology — The study of the characteristics, occurrence, movement and utilisation of water on and below the Earth's surface and within its atmosphere; see also 'hydrogeology'

Impact — A change in the chemical, physical, or biological quality or condition of a water body caused by external sources

Landscape Act (the) — The *Landscape South Australia Act 2019*

Licence — see 'water licence'

Licensed purposes — The purposes for taking water, for which a water allocation is required to take water under the Landscape Act, including the taking of water for stock and/or domestic purposes in the Northern Adelaide Plains PWA

Licensee — A person or entity who holds a water licence pursuant to section 121 of the Landscape Act

m AHD — Defines elevation in metres (m) according to the Australian Height Datum (AHD)

MAR — Managed aquifer recharge (MAR) is a process where water is intentionally placed and stored in an aquifer for later human use, or to benefit the environment

Maximum annual recovery volume — A volumetric limit stipulated as a condition on a recharge water licence which limits the volume of water which may be taken in a single water use year

Megalitre (ML) — one million litres

Minister — The Minister responsible for the administration of the Landscape Act

Monitoring — The systematic measurement of variables and processes over time to address a clearly defined set of objectives

Model — A conceptual or mathematical means of understanding elements of the real world that allows for evaluations of outcomes given certain conditions. Examples include estimating storm runoff, assessing the impacts of dams or evaluating ecological response to environmental change

MODFLOW — A three-dimensional, finite difference code developed by the USGS to simulate groundwater flow

Monitoring — (1) The repeated measurement of parameters to assess the current status and changes over time of the parameters measured (2) Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things

NAP — Northern Adelaide Plains

Non-consumptive use — Water for maintaining natural processes, including but not limited to aquifer throughflow and discharge, and water for groundwater-dependent ecosystems

Non-licensed purposes — The taking of groundwater for a purpose for which a water allocation is not required under the Landscape Act

NRM Act (the) — The *Natural Resources Management Act 2004*

Piezometer — A narrow tube, pipe or well; used for measuring moisture in soil, water levels in an aquifer, or pressure head in a tank, pipeline, etc

Potentiometric head — The potentiometric head or surface is the level to which water rises in a well due to water pressure in the aquifer, measured in metres (m); also known as piezometric surface

Prescribed well — A well declared to be a prescribed well under section 101 of the Landscape Act

Prescribed Wells Area (PWA) — An area of land within which wells are prescribed

Salinity — The concentration of dissolved salts in water or soil, expressed in terms of concentration (mg/L) or electrical conductivity (EC)

TDS — Total dissolved solids, measured in milligrams per litre (mg/L); a measure of water salinity

Tertiary aquifer — A term used to describe a water-bearing rock formation deposited in the Tertiary geological period (1–70 million years ago)

Unacceptable impact — An impact, or likely impact, upon the groundwater resource due to the taking of water, which exceeds the thresholds specified in the principles within this Plan or which is likely to negatively impact upon groundwater-dependent ecosystems or existing users of the resource

Unallocated water — any entitlement shares available within a consumptive pool that have not yet been granted on a water access entitlement

Water access entitlement — An entitlement to the holder of a water licence to gain access to a share of water available in the consumptive pool or pools to which the licence relates as per section 121(2) of the Landscape Act, as specified by the licence and after taking into account any factors specified by the relevant water allocation plan or prescribed by the regulations

Water allocation — The water obtained on account of a water access entitlement under a water licence as per section 127(1)(a) of the Landscape Act. A water allocation may also be obtained by a person, whether or not the person is a holder of a water licence, on the basis of a transfer of a water allocation that has been provided by the Minister under the terms of a water licence as per section 127(2)(b) of the Landscape Act. A water allocation will relate to a specified period of no more than 12 months as per section 127(8) of the Landscape Act

Water allocation plan — A plan prepared under Part 4 Division 2 of the Landscape Act

Water licence — A licence granted by the Minister under section 121 of the Landscape Act that provides the holder with a water access entitlement, which entitles the holder to gain access to a share of the water available for allocation in the consumptive pool as per section 121(2) of the Landscape Act

Water management authorisation — a water licence; or a water access entitlement; or a water allocation; or a water resource works approval; or a site use approval

Water-use year — A water use year runs from 1 July to 30 June in the following calendar year

Well — As defined by the Landscape Act, means (a) an opening in the ground excavated for the purpose of obtaining access to underground water; (b) an opening in the ground excavated for some other purpose but that gives access to underground water; and/or (c) a natural opening in the ground that gives access to underground water

Winter groundwater pressure level — The pressure level to which the groundwater in a confined aquifer will rise post the winter recovery period but prior to the commencement of the irrigation season. Usually measured in early spring (September – October)

8 Appendices

A. Adelaide Plains Groundwater Model – Groundwater Management Scenario Simulation

ADELAIDE PLAINS GROUNDWATER MODEL

Groundwater Management Scenario Simulation

Document number: DEW-20-1-R001a

Prepared for: Department of Environment and Water 28/7/2020

Document Title

Adelaide Plains Groundwater Model – Groundwater Management Scenario Simulation

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GROUNDWATER SCIENCE

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1 Introduction

1.1 Aim and Context

Groundwater Science were engaged by the South Australian Government Department for Environment and Water (DEW) to assist with a priority project required to support the development of the Adelaide Plains Water Allocation Plan. The aim of this project was to run model scenarios in the AP2011 groundwater model that investigate the response of the system to management strategies.

The Adelaide and Mount Lofty Ranges Natural Resources Management Board (the Board) has produced a draft water allocation plan for Northern Adelaide Plains (NAP) and Central Adelaide Plains (CAP) Prescribed Wells Areas (PWAs) – the (draft) Adelaide Plains Water Allocation Plan (APWAP). There is a need to investigate the likelihood that the proposed groundwater management approach will achieve the objectives outlined in the draft APWAP. This project aims to evaluate the efficacy of the proposed management approach through groundwater modelling.

The proposed management approach was outline in the document "*Science and Information, Project Plan, WAP Support for Adelaide Plains: Phase I Version: 0.7, Date: 05/02/2020".* The management approach comprised pumping the T1 and T2 aquifers at full allocation until Groundwater Level Triggers were reached. After time to implement a management response, pumping was then reduced to a lower rate until water level triggers were no longer exceeded. Full allocation pumping wa then resumed until triggers were again exceeded. The modelling cycle of full rate pumping and managed recovery was repeated for a duration of 40 years.

1.2 Scope of work

The Groundwater Model "AP2011 groundwater model" was provided by DEW. The model was used as-is with no modification to boundary conditions or model set up. The only modification to the model was the pumping schedules implemented as wells, and the location and elevation of one additional water level observation wells (MPA-158). The model was supplied and operated in the Visual Modflow Software package (Waterloo Hydrogeologic).

Two versions of the model were supplied AP2014_S1 and AP2014_S2. The AP2014_S2 model was used as the base case for simulation.

Water use simulations were run and the water level and water budget results exported to Excel for interpretation.

2 Management Strategy.

A system of 12 groundwater management zones (GMZs) were proposed where extraction limits for each zone could be used to inform the process of setting water access entitlements. GMZ's and recommended extraction limits are presented as Table 2.1.

Table 2.1: Groundwater management area extraction limits

Groundwater management area	Recommended extraction limits ML/y
T2 Virginia	11,072
T1 Northern Adelaide Plains	4,159
T1 Regional	10,494
T2 Northern Adelaide Plains	4,251
T2 Kangaroo Flat	1,500
T2 Regional	6,023
Golden Grove Embayment	4,552
Quaternary	6,762
Noarlunga Embayment	1,717
Lower Tertiary (T3/T4)	4,000
Northern Fractured Rock	5,116
Southern Fractured Rock	619

The management strategy comprised pumping at Full Allocation Volume (FAV, equivalent to the recommended extraction limits) until water level triggers were breached. Water level triggers are evaluated in winter during seasonal water level recovery. Details of monitoring wells and trigger levels are summarised in Table 2.2.

The aim of aquifer management is that, during the winter cycle, water levels are never below the Resource Condition Limits levels presented in Table 2.2.

Table 2.2: Groundwater monitoring wells in managed GMZs

Groundwater management zone	Monitoring group	Monitoring well	Winter trigger level (m AHD)	Resource Condition Limit (m AHD)	Model Water Level Correction (m added to model output)	Triggered condition
T2 Virginia	Group 1	MPA144	-33.2	-46.1	5	Both
		MPA158[1]	-27.95	-42.93	5	
	Group 2	PTA091	-26.72	-57.5	7	2 out of 3
		PTA082	-20.44	-46.3	4.5	
		MPA159	-22.09	-65	7	
T1 NAP	Group 6	PTA161	-2.5	-5	-1.5	2 out of 4
		PTA095	-4	-5	-5	
		PTA111	-4	-5	-4.1	
		MPA152	-3	-5	-4.3	
	Group 7	PTA051	-4.3	-5	-4.8	Both
		PTA093	-4	-5	-5.3	

Note 1) MPA158 replaces MPA109 since the replaced well no longer exists

2.1 Triggering of restrictions

If trigger levels are exceeded, then a warning is issued to license holders. If the triggers are exceeded for a second year, then restriction are applied in the following water use year. Table 2.3 presents the timing for application of water use restrictions

2.2 Removal of restrictions

If water level recovery is identified in winter, water use restrictions remain in place for the following summer. Restrictions are removed the following winter, and full allocation pumping continues in the following stress period. Table 2.4 presents the timing for removal of water use restrictions

Table 2.3: Timing of actions for management being applied

Year	Month	Management Trigger Identified	Water take restricted	Irrigation	Model Stress Period
1	January				S
	February				
	March				W
	April				
	May				
	June				
	July				
	August	First time winter trigger breached			
	September				S
	October			Warning issued to licensees and resource managers: potential for restrictions	
	November				
	December				
2	January				
	February				
	March				W
	April				
	May				
	June				
	July				
	August	Second time winter trigger breached			
	September				S
	October			Warning issued to licensees and resource managers: restrictions are imminent	
	November				
	December				
3	January				
	February				
	March				W
	April				
	May		Restrictions applied via condition on allocations		
	June				
	July				
	August				
	September				S
	October			Restrictions apply	
	November				
	December				
4	January				
	February				
	March				W
	April				
	May				
	June				

Table 2.4: Timing of actions for management being removed

Year	Month	Management Trigger Identified	Water take restricted	Irrigation	Model Stress Period
1	June				W
	July				
	August	Recovery identified			
	September				S
	October			Restrictions apply	
	November				
	December				
2	January				
	February				
	March				
	April				W
	May		Restriction removed		
	June				
	July				
	August				
	September				
	October			No restrictions until winter trigger is breached	S
	November				
	December				
3	January				
	February				
	March				
	April				W
	May				
	June				

2.3 Pumping Rates

The planned pumping rates are presented in Table 2.5. The Full Allocation Volume (FAV) pumping rate is the total allocated annual volume for each GMZ. The Managed Aquifer Volume is the reduced annual volume to be allocated during a management cycle. The annual volumes are applied as a seasonal pumping rate in the model.

Table 2.5: Modelled Full Allocation pumping rates for all groundwater management zones

Groundwater Management Zones		Planned Pumping Rates (ML/year)		Modelled Pumping Rates (ML/Year)		
		FAV	MAV	FAV	MAV	MAV percentage of FAV
GGE Fractured Rock	FRAGG			54	54	
NAP Fractured Rock	FRAN			373	373	
Quaternary	Q			1,693	1,693	
T1 Dry Creek	T1DC	2,972	2,972	2,972	2,972	
T1 Grange	T1G	1,940	1,940	1,940	1,940	
T1 and T2 GGE	T1GG/T2GG	1,526	1,526	1,526	1,526	
T1 NAP	T1N	5,091	4,159	5,091	4,159	81.7%
T1 Central Adelaide	T1R	1,777	1,777	1,777	1,777	
T1 Thebarton	T1Th	1,383	1,383	1,383	1,383	
T2 Kangaroo Flat	T2KF	1,500	1,500	1,500	1,500	
T2 NAP	T2N	4,304	4,251	4,304	4,304	
T2 Osborne	T2Os	1,199	1,199	1,199	1,199	
T2 Regional	T2R	212	212	212	212	
T2 Regency Park	T2RP	1,732	1,732	1,732	1,732	
T2 Virginia	T2V	14,917	11,072	14,917	11,072	74.2%
Total		**38,553**	**33,723**	**40,673**	**35,843**	

3 Model Scenario Execution

3.1 Initial Heads

The initial heads provided by DEW as DEWNR_JAN_2017_SC01.HDS were implemented in the model. This initial heads represent the condition at the end of Winter and the first time step of the current modelling is a summer (pumping) time step.

3.2 Pumping

Individual well pumping rates were obtained from the DEW AP2014_S2 model. This model included un-allocated pumping shown in Table 2.5 for GGE Fractured Rock, NAP Fractured Rock and Quaternary aquifers. This pumping is relevant to the aquifer system response and was kept in the model. For management cycles where MAV pumping rates were applied, all wells in a GMZ were reduced by the same percentage.

A number of wells were identified as pumping at a constant rate year round (industrial use) these were maintained with constant annual use but the rates were reduced during MAV pumping cycles.

3.3 Model Iterations

Model scenarios were run iteratively. Each model run identified the subsequent management trigger for change. The pumping rates were then varied to reflect the management change. Model iterations are summarised in Table 3.1.

Table 3.1: Model Iterations

Year	Stress Period	Season	End Day (Model Run)	G2 T1-NAP	G2 T2-VIR	G2_R2 T1-NAP	G2_R2 T2-VIR	G5 T1-NAP	G5 T2-VIR	G6 T1-NAP	G6 T2-VIR	G6 T1 N G6 Monitoring	G6 T1N G7 Monitoring	G6 T2 V G1 Monitoring	G6 T2 V G2 Monitoring
1	1	S	181	F	F	F	F	F	F	F	F				
	2	W	365	F	F	F	F	F	F	F	F			T	T
2	3	S	547	F	F	F	F	F	F	F	F				
	4	W	731	F	F	F	F	F	F	F	F			T	T
3	5	S	912	F	F	F	F	F	F	F	F				
	6	W	1,096	F	F	F	F	F	F	F	F			T	T
4	7	S	1,277	F	F	F	M	F	M	F	M				
	8	W	1,461	F	F	F	M	F	M	F	M			R	T
5	9	S	1,642	F	F	F	M	F	M	F	M				
	10	W	1,826	F	F	F	M	F	M	F	M			R	T
6	11	S	2,008	F	F	F	M	F	M	F	M				
	12	W	2,192	F	F	F	M	F	M	F	M			R	R
7	13	S	2,373	F	F	F	M	F	M	F	M				
	14	W	2,557	F	F	F	M	F	F	F	F			R	T
8	15	S	2,738	F	F	F	M	F	F	F	F				
	16	W	2,922	F	F	F	M	F	F	F	F			T	T
9	17	S	3,103	F	F	F	M	F	F	F	F				
	18	W	3,287	F	F	F	M	F	F	F	F			T	T
10	19	S	3,469	F	F	F	M	F	M	F	M				
	20	W	3,653	F	F	F	M	F	M	F	M			R	T
11	21	S	3,834	F	F	F	M	F	M	F	M				
	22	W	4,018	F	F	F	M	F	M	F	M			R	T
12	23	S	4,199	F	F	F	M	F	M	F	M				
	24	W	4,383	F	F	F	M	F	M	F	M			R	T
13	25	S	4,564	F	F	F	M	F	M	F	M				
	26	W	4,748	F	F	F	M	F	M	F	M			R	T
14	27	S	4,930	F	F	F	M	F	M	F	M				
	28	W	5,114	F	F	F	M	F	M	F	M			R	T
15	29	S	5,295	F	F	F	M	F	M	F	M				
	30	W	5,479	F	F	F	M	F	M	F	M			R	T
16	31	S	5,660	F	F	F	M	F	M	F	M				
	32	W	5,844	F	F	F	M	F	M	F	M	T		R	T
17	33	S	6,025	F	F	F	M	F	M	F	M				
	34	W	6,209	F	F	F	M	F	M	F	M	T		R	T
18	35	S	6,391	F	F	F	M	F	M	F	M				
	36	W	6,575	F	F	F	M	F	M	F	M	T		R	T
19	37	S	6,756	F	F	F	M	F	M	M	M				
	38	W	6,940	F	F	F	M	F	M	M	M	T		R	T
20	39	S	7,121	F	F	F	M	F	M	M	M				
	40	W	7,305	F	F	F	M	F	M	M	M	T		R	T
21	41	S	7,486	F	F	F	M	F	M	M	M				
	42	W	7,670	F	F	F	M	F	M	M	M	T		R	T
22	43	S	7,852	F	F	F	M	F	M	M	M				
	44	W	8,036	F	F	F	M	F	M	M	M	T		R	T
23	45	S	8,217	F	F	F	M	F	M	M	M				
	46	W	8,401	F	F	F	M	F	M	M	M	T		R	T
24	47	S	8,582	F	F	F	M	F	M	M	M				
	48	W	8,766	F	F	F	M	F	M	M	M	T		R	T
25	49	S	8,947	F	F	F	M	F	M	M	M				
	50	W	9,131	F	F	F	M	F	M	M	M	T		R	T
26	51	S	9,313	F	F	F	M	F	M	M	M				
	52	W	9,497	F	F	F	M	F	M	M	M	T	T	R	T
27	53	S	9,678	F	F	F	M	F	M	M	M				
	54	W	9,862	F	F	F	M	F	M	M	M	T	T	R	T
28	55	S	10,043	F	F	F	M	F	M	M	M				
	56	W	10,227	F	F	F	M	F	M	M	M	T	T	R	T
29	57	S	10,408	F	F	F	M	F	M	M	M				
	58	W	10,592	F	F	F	M	F	M	M	M	T	B	R	T
30	59	S	10,774	F	F	F	M	F	M	M	M				
	60	W	10,958	F	F	F	M	F	M	M	M	T	B	R	T
31	61	S	11,139	F	F	F	M	F	M	M	M				
	62	W	11,323	F	F	F	M	F	M	M	M	B	B	R	T
32	63	S	11,504	F	F	F	M	F	M	M	M				
	64	W	11,688	F	F	F	M	F	M	M	M	B	B	R	T
33	65	S	11,869	F	F	F	M	F	M	M	M				
	66	W	12,053	F	F	F	M	F	M	M	M	B	B	R	T
34	67	S	12,235	F	F	F	M	F	M	M	M				
	68	W	12,419	F	F	F	M	F	M	M	M	B	B	R	T
35	69	S	12,600	F	F	F	M	F	M	M	M				
	70	W	12,784	F	F	F	M	F	M	M	M	B	B	R	T
36	71	S	12,965	F	F	F	M	F	M	M	M				
	72	W	13,149	F	F	F	M	F	M	M	M	B	B	R	T
37	73	S	13,330	F	F	F	M	F	M	M	M				
	74	W	13,514	F	F	F	M	F	M	M	M	B	B	R	T
38	75	S	13,696	F	F	F	M	F	M	M	M				
	76	W	13,880	F	F	F	M	F	M	M	M	B	B	R	T
39	77	S	14,061	F	F	F	M	F	M	M	M				
	78	W	14,245	F	F	F	M	F	M	M	M	B	B	R	T
40	79	S	14,426	F	F	F	M	F	M	M	M				
	80	W	14,610	F	F	F	M	F	M	M	M	B	B	R	T

Notes: F: Full Allocation Pumping.
M: Managed Allocation Pumping.
T: Triggered WTL.
R: Recovered,
B: Breached RCL

Four iterations were required.

- The first iteration, G1, implemented FAV pumping for the full duration. The T2 Virginia GMZ well exceeded winter trigger levels (WTL) in the first winter stress period.

- The second iteration applied MAV pumping to the T2 Virginia GMZ in the 4th summer stress period. The T2 Virginia GMZ recovered above WTL in the 6th winter stress period. The recovery comprised water levels above WTL by 0.1m at a single Obswell; PTA-082.

- The third iteration reinstated FAV pumping to the T2 Virginia GMZ in the 7th winter stress period. The T2 Virginia GMZ water levels immediately breached WTL in the 7th winter stress period. MAV pumping was re-applied in the 10th summer stress period, however even with MAV pumping The T2 Virginia GMZ never exhibited recovery above the WTL for the remainder of the model simulation to 40 years total duration.

  The T1 NAP GMZ water levels fell below WCL in the 16th winter stress period.

- The fourth iteration applied MAV pumping to the T1 NAP GMZ in the 19th Summer stress period. However even with MAV pumping The T1 NAP GMZ never exhibited recovery above the WTL for the remainder of the model simulation to 40 years total duration.

  Water levels in the T1 NAP aquifer continue to decline under MAV pumping, and in the 29th winter stress period water level fall below Resource Condition Limits (RCLS) and continue to decline for the remainder of the model simulation to 40 years total duration.

3.4 Outputs

Water level elevations predicted at observation wells were exported for the end of each model stress period. Absolute elevations were adjusted per the values in Table 2.2 . This adjustment was based on the difference between calibrated model heads and the measured head determined by DEW during model construction and calibration.

The modelled heads for the final model iteration (Iteration 4, Model file G6) are presented as Figure 3.1 and Figure 3.2

. The Model water budget was exported for each time step as a check on model performance.

3.4.1 T2 Virginia GMZ

The simulations predict that water levels (head) in the T2 aquifer in the Virginia GMZ will fall below the WTL for all the Group 2 Obs wells from Year 14 onwards despite continuous MAV pumping being applied from the 10th summer stress pereiod to the end of themodel simulation at 40 years.

Water levels in the aquifer exhibit a consistent declining trend even under MAV pumping. The Resource Condition Limit in the T2 aquifer is never exceeded.

3.4.2 T1 NAP

The simulations predict that water levels in the T1 Aquifer exhibit a consistent declining trend. The Group 7 wells are sensitive to modifications to the T2 Virginia pumping regime as indicated by water level fluctuations in Years 1 to 10 when pumping rates are varied in the T2 Virginia GMZ.

Winter Trigger Levels are exceeded in Year 8 at PTA093 and a triggered condition (2 wells breaching WTLs) occurs in Year 16. The aquifer never recovers from the triggered condition even under continuous MAV pumping.

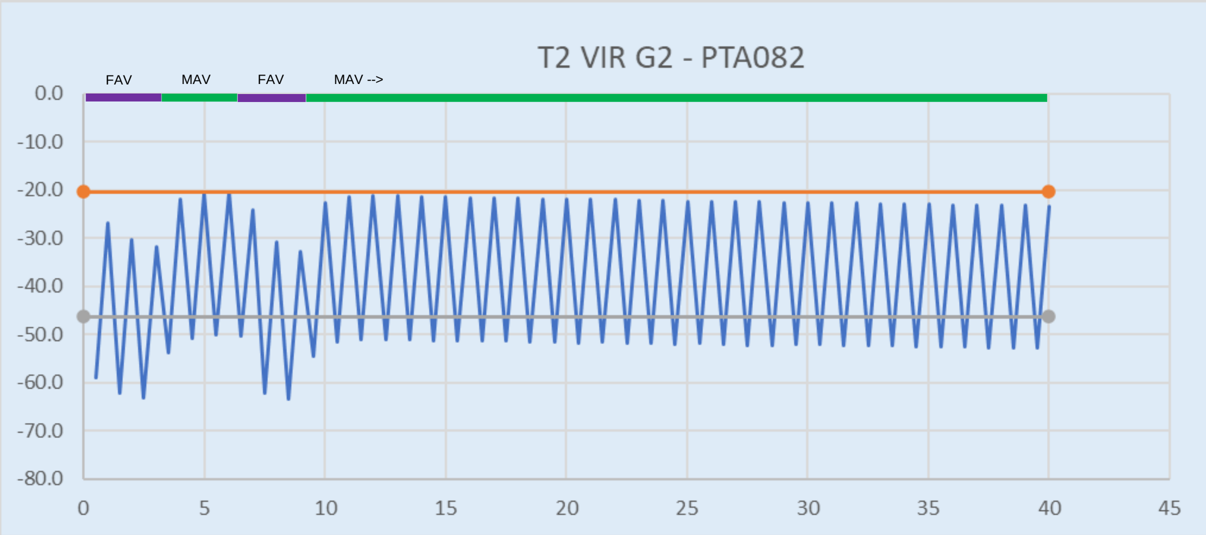
Resource Condition limits are breached at two obswells; PTA093 in year 29 and PTA111 in Year 31.

The reduction in pumping from FAV to MAV results in reduced seasonal water level fluctuation, and in a reduced overall rate of decline.

The consistent water level decline does continue even under continuous MAV pumping.

Figure 3.1: Iteration 4 (Model File G6) Hydrographs – Managed GMZ's

Figure 3.2: Iteration 4 (Model File G6) Hydrographs – Annotated with pumping



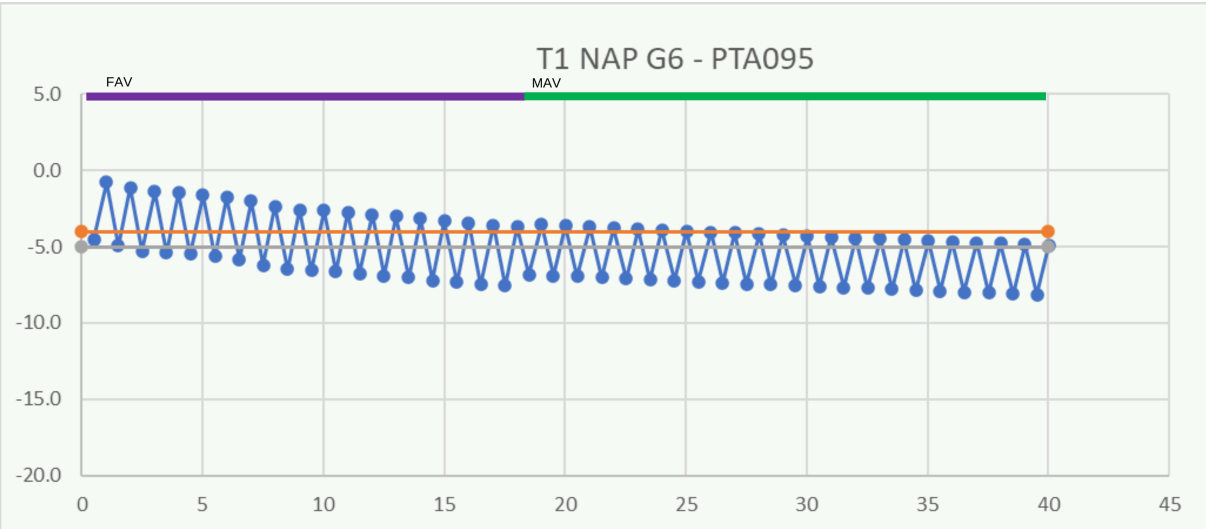


Figure 3.3: Iteration 4 (Model File G6) Hydrographs – Monitored GMZ's

3.5 Additional Continuous MAV pumping Scenario

One additional model scenario was run. This comprised continuous seasonal pumping at the MAV rate for 40 years. The aim was to understand the effectiveness of reducing pumping to the MAV rate to prevent exceeding Winter Trigger Levels and Resource Condition Limits. The model files and scenario are identified as G11.

The results are presented as Figure 3.4 . The simulation outputs show that:

- All monitoring bores exhibit a declining trend
- T1 NAP:
    - All T1 NAP bores drop below trigger levels within the 40 year period
    - PTA093 and PTA111 both drop below resource condition limits ~35 years into the scenario
    - PTA161 and PTA095 approach the resource condition limit by the end of the 40 year period
- T2 Virginia:
    - No monitoring bores drop below resource condition limits within the 40 year period
    - MPA144 and MPA109 approach but do not drop below trigger levels within the 40 year period
    - PTA082, PTA091 and PTA109 drop below trigger levels within the first 5 years

Figure 3.4: Continuous MAV Pumping scenario (Model File G11) Hydrographs – Managed GMZ's

Figure 3.5: Continuous MAV Pumping scenario (Model File G11) Hydrographs – Monitored GMZ’s

Vertical Axis – Elevation (mAHD)
Horizontal Axis – Time (years)

Modelled Head (mAHD)
Winter Trigger Level (mAHD)
Resource Condition Limit (mAHD)

4 Results and discussion

4.1 Management Scenarios

The management scenario model results are summarised in Table 4.1.

Table 4.1: Model G6 results compared to management criteria

Groundwater management zone	Monitoring group	Triggered condition	Monitoring well	Winter trigger level (m AHD)	TWL exceeded	Triggered	Resource Condition Limit (m AHD)	RCL Exceeded
T2 Virginia	Group 1	Both	MPA144	-33.2	y	y	-46.1	n
			MPA158[1]	-27.95	y		-42.93	n
	Group 2	2 out of 3	PTA091	-26.72	y	y	-57.5	n
			PTA082	-20.44	y		-46.3	n
			MPA159	-22.09	y		-65	n
T1 NAP	Group 6	2 out of 4	PTA161	-2.5	y	y	-5	n
			PTA095	-4	y		-5	n
			PTA111	-4	y		-5	y
			MPA152	-3	n		-5	n
	Group 7	Both	PTA051	-4.3	y	y	-5	n
			PTA093	-4	y		-5	y

The modelling indicates that:

- The trigger levels are reached in both the T1 NAP and T2 Virginia aquifers at all wells except MPA152 in the T1 NAP Group 6.
- In the T2 aquifer at Virginia, management is applied after trigger levels are reached. The aquifer exhibits water level recovery above trigger levels and return to full allocations is implemented. There is a subsequent re-triggering from which the aquifer never returns to above trigger levels.
- Both the T1 NAP and T2 Virginia Aquifer remain under managed conditions into the future.
- Even under managed conditions, there is a continuing long-term trend of decreasing water levels.
- Under managed conditions, T1 NAP bores (PTA111 and PTA093) fall below the resource condition limit. Other bores are trending towards breaching the resource condition limit though breach does not occur during the 40 year simulation.

The implication is that the proposed management approach may not be adequate to prevent the aquifer condition declining to unacceptable levels.

4.2 Continuous MAV pumping Scenario

The outcome of pumping for 40 years at the MAV rate is summarised in Table 4.2.

Table 4.2: Model G11 results compared to management criteria

Groundwater management zone	Monitoring group	Triggered condition	Monitoring well	Winter trigger level (m AHD)	TWL exceeded	Triggered	Resource Condition Limit (m AHD)	RCL Exceeded
T2 Virginia	Group 1	Both	MPA144	-33.2	n	n	-46.1	n
			MPA158[1]	-27.95	n		-42.93	n
	Group 2	2 out of 3	PTA091	-26.72	y	y	-57.5	n
			PTA082	-20.44	y		-46.3	n
			MPA159	-22.09	y		-65	n
T1 NAP	Group 6	2 out of 4	PTA161	-2.5	y	y	-5	n
			PTA095	-4	y		-5	n
			PTA111	-4	y		-5	y
			MPA152	-3	n		-5	n
	Group 7	Both	PTA051	-4.3	y	y	-5	n
			PTA093	-4	y		-5	y

The modelling indicates that

- All monitoring bores exhibit a declining trend
- T1 NAP:
  - All T1 NAP bores drop below trigger levels within the 40 year period
  - PTA093 and PTA111 both drop below resource condition limits ~35 years into the scenario
  - PTA161 and PTA095 approach the resource condition limit by the end of the 40 year period
- T2 Virginia:
  - No monitoring bores drop below resource condition limits within the 40 year period
  - MPA144 and MPA109 approach but do not drop below trigger levels within the 40 year period
  - PTA082, PTA091 and PTA109 drop below trigger levels within the first 5 years

The implication is that the MAV pumping rate may not be adequate to prevent the aquifer condition declining to unacceptable levels.

Appendix A Model Input Data

A1. Observation Wells

Well_ID	x	y	Screen Elevation (mAHD)
MPA048	287547	6166911	-63.9
MPA081	284542	6159052	-138.7
MPA109	278155	6163636	-91.6
MPA144	277466	6163159	-99.2
MPA152	280909	6154325	-98.5
MPA159	278472	6159988	-126
MUW029	284497	6171974	-28
MUW030	286809	6171947	-30
MUW031	286695	6176137	-12
MUW034	283753	6169003	-43.7
MUW038	284664	6171979	-28.8
PTA051	271013	6160502	-92.7
PTA082	274644	6164128	-105.9
PTA091	276330	6161309	-114
PTA093	272480	6160849	-83
PTA094	276978	6154411	-125
PTA095	276549	6154024	-65
PTA111	277844	6152994	-102
PTA127	276984	6154390	-91
PTA161	278098	6155718	-86
PTG031	272399	6165654	-113
PTG060	267989	6166116	-145
PTG085	277092	6166516	-67
MPA158	279851	6163288	-101

A2. Pumping Wells

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
FRAGG	662819941	283140	6140245	-260.6	-369.7	C	-28.00
FRAGG	6628-16339	277207	6130973	-281.4	-419.0	S	-40.28
FRAN	662805340	291807	6146256	-253.1	-359.7	C	-36.80
FRAN	662805341	292271	6146492	-253.2	-359.9	C	-36.80
FRAN	662805342	292250	6146776	-251.7	-357.8	C	-36.80
FRAN	662805343	292454	6146371	-255.6	-363.0	C	-36.80
FRAN	662811416	292269	6146243	-254.7	-361.9	C	-36.80
FRAN	662812212	291806	6146274	-253.1	-359.7	C	-36.80
FRAN	662818500	292432	6146288	-255.6	-363.0	C	-36.80
FRAN	662820853	292206	6146552	-253.2	-359.9	C	-36.80
FRAN	662822805	288354	6143630	-167.3	-221.6	C	-42.00
FRAN	662823011	292208	6146402	-253.2	-359.9	C	-36.80
Q	662820446	278226	6138267	-25.3	-67.2	C	-346.39
Q	105350-NAP-Q4	280313	6151870	-13.8	-48.0	S	-4.12
Q	5046-NAP-Q3	290352	6167781	27.2	7.5	S	-5.23
Q	5151-NAP-Q3	282279	6150430	-11.7	-54.3	S	-8.14
Q	5327-NAP-Q3	284923	6151043	-0.7	-50.4	S	-10.87
Q	5414-NAP-Q4_A	291217	6168195	30.7	9.8	S	-21.82
Q	5414-NAP-Q4_B	291431	6168092	30.7	9.9	S	-21.82
Q	5564-NAP-Q3	275601	6155414	-12.0	-36.2	S	-1.77
Q	5775NAP	280417	6157620	-4.3	-29.3	S	-12.95
Q	5818NAP	276383	6160435	-4.2	-25.5	S	-7.73
Q	5927-NAP-Q4	272896	6159925	-12.4	-35.7	S	-3.64
Q	6043NAP	289274	6166235	24.9	4.1	S	-0.68
Q	6088NAP	282778	6158735	0.8	-26.4	S	-0.68
Q	6091NAP	289904	6168330	29.7	9.7	S	-0.68
Q	6098NAP	281005	6159077	-1.3	-26.7	S	-0.68
Q	6099NAP	280916	6159120	-1.3	-26.7	S	-0.68
Q	6102NAP	272930	6169099	0.5	-14.0	S	-0.68
Q	6103-NAP-Q3	279109	6151939	-16.4	-49.0	S	-0.68
Q	6219NAP	290960	6168332	31.4	10.5	S	-11.25
Q	6420NAP	287251	6165946	21.5	2.1	S	-0.68
Q	6422NAP	274492	6157930	-11.9	-35.0	S	-0.68
Q	6459NAP	273768	6160026	-9.8	-32.4	S	-0.68
Q	6462NAP	273286	6159874	-11.4	-34.5	S	-0.68
Q	6528-00143	270103	6164462	-11.5	-37.4	S	-0.68
Q	6628-00790	278639	6169423	15.5	5.5	S	-0.68
Q	6628-00853	272312	6168654	-2.3	-18.2	S	-3.36
Q	6628-00949	274056	6166887	1.4	-14.8	S	-4.26
Q	6628-01112	274939	6163552	-1.5	-21.6	S	-0.68
Q	6628-01132	275320	6164219	1.3	-17.5	S	-3.27
Q	6628-01162	277462	6163477	-17.3	-31.5	S	-10.68
Q	6628-01164	278453	6163106	-16.7	-31.0	S	-46.41
Q	6628-01167	278545	6163107	-16.3	-30.6	S	-46.41
Q	6628-01178	275596	6163611	0.4	-19.2	S	-0.57
Q	6628-01211	279160	6164226	8.5	-8.6	S	-0.68
Q	6628-01216	279257	6164237	8.5	-8.6	S	-0.68
Q	6628-01220	279959	6164780	-22.2	-31.0	S	-18.41
Q	6628-01263	280341	6166286	-2.0	-12.3	S	-6.46
Q	6628-01272	282049	6166329	-0.2	-10.4	S	-57.64
Q	6628-01288	282548	6165535	14.6	-0.5	S	-0.68
Q	6628-01302	284005	6165270	-2.0	-14.7	S	-8.39
Q	6628-01366	288634	6166192	21.3	5.1	S	-16.45
Q	6628-01368	288032	6166292	22.6	3.2	S	-0.68
Q	6628-01371	287690	6166134	22.0	2.6	S	-0.68
Q	6628-01374	287394	6166322	21.7	2.9	S	-0.68
Q	6628-01395	287102	6166090	21.4	2.4	S	-0.68
Q	6628-01397	287196	6166238	21.1	3.0	S	-10.23
Q	6628-01399	288570	6166151	23.1	3.3	S	-3.86
Q	6628-01416	288080	6164024	-5.5	-22.5	S	-12.06
Q	6628-01428	287117	6164054	-5.8	-22.7	S	-24.55
Q	6628-01438	289213	6164571	22.1	-1.1	S	-0.68
Q	6628-01442	288886	6163443	-8.1	-26.6	S	-7.50
Q	6628-01444	288873	6164015	-5.0	-22.3	S	-17.00
Q	6628-01458	280148	6164079	9.7	-7.7	S	-0.57
Q	6628-01461	280982	6164741	11.9	-4.6	S	-0.68
Q	6628-01474	282670	6165140	14.4	-1.5	S	-0.68
Q	6628-01475	290442	6167280	25.2	6.3	S	-13.40
Q	6628-01476	282978	6165023	14.8	-1.4	S	-0.68
Q	6628-01507	283000	6164189	14.2	-4.1	S	-0.68
Q	6628-01529	282431	6163855	12.9	-4.9	S	-1.36
Q	6628-01550	281650	6163547	10.9	-8.3	S	-0.57
Q	6628-01720	291618	6168826	32.2	12.0	S	-18.46
Q	6628-01754	289132	6167087	25.7	5.8	S	-0.68
Q	6628-01765	290136	6167788	27.0	7.4	S	-0.68
Q	6628-01771	291347	6167929	30.0	9.2	S	-0.68
Q	6628-01915	290651	6165671	27.1	4.3	S	-7.68
Q	6628-01917	290730	6165940	27.3	4.8	S	-6.82
Q	6628-01922	290140	6165553	25.9	3.6	S	-16.04
Q	6628-01928	289443	6164725	20.5	2.1	S	-15.23
Q	6628-01929	289657	6164590	21.1	2.1	S	-20.49
Q	6628-01932	289579	6164629	23.5	0.5	S	-8.18
Q	6628-01935	289545	6165492	22.5	4.8	S	-10.91
Q	6628-01953	290647	6167617	27.3	7.9	S	-1.68
Q	6628-01961	289953	6166825	25.7	5.5	S	-3.14

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
Q	6628-01968	289785	6167095	25.6	6.1	S	-25.00
Q	6628-01971	289309	6166936	25.7	5.8	S	-2.91
Q	6628-01975	289723	6166138	25.3	4.4	S	-9.86
Q	6628-01977	290055	6166285	25.4	4.8	S	-3.18
Q	6628-01990	291305	6167661	29.3	8.6	S	-0.34
Q	6628-02013	292014	6167407	31.5	9.3	S	-0.68
Q	6628-02020	291910	6167341	31.8	9.2	S	-0.57
Q	6628-02026	290662	6165429	27.6	4.2	S	-0.86
Q	6628-02243	271804	6160734	-13.5	-37.4	S	-0.68
Q	6628-02259	274202	6159785	-9.2	-32.0	S	-0.68
Q	6628-02268	274937	6162846	-25.4	-40.5	S	-24.11
Q	6628-02295	275049	6160693	-6.5	-28.0	S	-0.68
Q	6628-02301	276346	6160900	-3.5	-24.6	S	-0.68
Q	6628-02303	276353	6160825	-3.5	-24.6	S	-0.68
Q	6628-02327	276287	6161060	-3.5	-24.5	S	-0.68
Q	6628-02342	276958	6158616	-6.7	-29.2	S	-0.34
Q	6628-02344	276449	6158724	-7.5	-29.9	S	-0.34
Q	6628-02378	276561	6160020	-4.6	-26.2	S	-0.68
Q	6628-02382	275338	6159545	-7.5	-29.7	S	-0.34
Q	6628-02458	276425	6161129	-3.2	-24.1	S	-0.68
Q	6628-02461	276756	6160795	-3.1	-24.5	S	-0.34
Q	6628-02464	276812	6161778	-1.7	-21.9	S	-6.81
Q	6628-02478	278204	6159996	-3.0	-25.7	S	-0.34
Q	6628-02487	278493	6162513	2.9	-17.2	S	-0.68
Q	6628-02528	279743	6161926	2.7	-17.8	S	-7.50
Q	6628-02540	279754	6160732	-0.3	-23.0	S	-0.68
Q	6628-02554	279699	6159562	-3.0	-26.9	S	-0.68
Q	6628-02642	279139	6158180	-5.3	-29.4	S	-3.57
Q	6628-02653	279620	6157920	-4.9	-29.4	S	-0.68
Q	6628-02674	289035	6163165	19.0	-7.0	S	-6.82
Q	6628-02686	280835	6157673	-3.8	-29.1	S	-0.68
Q	6628-02687	284423	6160075	5.5	-22.5	S	-0.68
Q	6628-02689	280296	6158059	-4.0	-28.8	S	-24.90
Q	6628-02713	281256	6162916	-13.6	-28.8	S	-1.60
Q	6628-02724	282300	6162510	9.0	-12.6	S	-0.68
Q	6628-02726	282510	6162683	10.0	-11.3	S	-0.68
Q	6628-02746	284710	6163200	-30.5	-41.4	S	-36.00
Q	6628-02752	283689	6162610	11.0	-11.2	S	-0.68
Q	6628-02763	282810	6161962	7.7	-15.6	S	-0.68
Q	6628-02767_A	280911	6161718	4.6	-17.9	S	-0.68
Q	6628-02768	280606	6161832	4.3	-17.4	S	-0.68
Q	6628-02786	281548	6160893	3.0	-21.3	S	-0.68
Q	6628-02788	282046	6160844	3.3	-20.9	S	-8.57
Q	6628-02811	280822	6159443	-1.0	-26.0	S	-0.68
Q	6628-02818	281498	6158924	-0.9	-26.7	S	-0.68
Q	6628-02898	283443	6158614	1.5	-26.3	S	-0.68
Q	6628-02902	284583	6158238	1.8	-26.9	S	-0.68
Q	6628-03280	280304	6151368	-55.1	-82.3	S	-17.16
Q	6628-03295	280001	6149931	-19.9	-58.8	S	-19.66
Q	6628-03317	278941	6151548	-18.0	-51.7	S	-0.68
Q	6628-03341	278932	6150574	-92.9	-107.8	S	-27.28
Q	6628-03770	280018	6153337	-11.1	-39.8	S	-0.68
Q	6628-03775	279452	6154211	-8.9	-35.0	S	-0.23
Q	6628-03780	278391	6154661	-8.6	-33.8	S	-0.23
Q	6628-03781	278779	6154360	-9.4	-35.4	S	-0.23
Q	6628-03782	278429	6154634	-59.3	-76.7	S	-17.82
Q	6628-03787	278617	6155294	-7.8	-32.8	S	-3.50
Q	6628-03831	279387	6157253	-5.5	-30.1	S	-0.34
Q	6628-03833	279346	6156860	-5.7	-30.4	S	-0.68
Q	6628-03834	279115	6157556	-5.7	-30.1	S	-0.68
Q	6628-03848	278119	6152634	-15.3	-44.7	S	-0.68
Q	6628-03888	277854	6154158	-11.0	-37.1	S	-7.76
Q	6628-04847	280709	6150599	-19.9	-51.3	S	-16.82
Q	6628-04871	280572	6151638	-14.0	-48.9	S	-17.16
Q	6628-04873	280663	6151733	-14.0	-48.9	S	-11.77
Q	6628-04876	280412	6151619	-52.6	-78.7	S	-7.73
Q	6628-04881	282086	6150762	-12.1	-53.3	S	-5.40
Q	6628-04913	282262	6151085	-14.7	-47.8	S	-9.09
Q	6628-04923	281706	6151314	-54.6	-84.3	S	-11.35
Q	6628-04927	281890	6151510	-11.0	-49.7	S	-6.82
Q	6628-04928	282571	6151200	-55.5	-87.0	S	-8.73
Q	6628-04946	283609	6151233	-11.1	-47.9	S	-7.79
Q	6628-04983	285130	6150954	-54.8	-92.2	S	-11.45
Q	6628-04985	285223	6151178	0.2	-49.1	S	-11.45
Q	6628-04993	285763	6151491	4.5	-44.6	S	-20.78
Q	6628-05026	282114	6150402	-58.3	-90.1	S	-9.18
Q	6628-05034	282405	6150679	17.8	-7.6	S	-14.91
Q	6628-05035	282486	6150183	-16.2	-51.4	S	-4.18
Q	6628-05036	282491	6150125	-16.2	-51.4	S	-6.81
Q	6628-05058	284146	6151104	-5.0	-52.7	S	-4.33
Q	6628-05065	283432	6149868	-9.3	-56.4	S	-0.68
Q	6628-05068	283753	6149433	-9.8	-57.2	S	-0.68
Q	6628-05069_A	283677	6149707	-9.7	-56.6	S	-1.91
Q	6628-05074	283772	6149491	-9.8	-57.2	S	-0.57
Q	6628-05085	283824	6149898	-13.2	-51.6	S	-2.05
Q	6628-05086	284350	6150319	-5.6	-54.7	S	-0.68
Q	6628-05087	284360	6150276	-5.9	-54.5	S	-4.33
Q	6628-05118	285295	6150274	-1.6	-52.5	S	-0.57
Q	6628-05119	285418	6150162	-5.8	-47.1	S	-10.77

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
Q	6628-05169	280529	6147563	-65.0	-94.1	S	-12.55
Q	6628-05182	281125	6148727	-18.9	-59.9	S	-0.68
Q	6628-05184	281296	6148880	-18.4	-59.6	S	-0.68
Q	6628-05186	281240	6148805	-18.4	-59.6	S	-0.68
Q	6628-06086	277293	6164073	-15.6	-29.3	S	-17.66
Q	6628-06880	280729	6156959	-4.3	-30.0	S	-0.91
Q	6628-09483	285420	6150800	-53.7	-91.2	S	-39.10
Q	6628-11195	282944	6150654	-9.5	-53.7	S	-6.82
Q	6628-11764	279110	6163250	-31.2	-40.6	S	-14.83
Q	6628-11994	279110	6163250	-79.7	-124.2	S	-15.68
Q	6628-12016	291493	6166499	29.3	7.1	S	-2.04
Q	6628-12162	271550	6169075	-4.0	-21.7	S	-0.60
Q	6628-12164	289700	6164900	-0.9	-18.3	S	-10.55
Q	6628-12517	282660	6165230	14.5	-1.0	S	-0.57
Q	6628-12911	278500	6157780	-6.7	-30.5	S	-0.57
Q	6628-13344	283620	6159880	4.1	-23.3	S	-0.68
Q	6628-13961	291250	6167630	28.6	8.2	S	-0.34
Q	6628-14215	281169	6158991	-1.3	-26.8	S	-0.68
Q	6628-14222	278910	6164100	-11.3	-24.3	S	-39.28
Q	6628-14313	280802	6159213	-1.6	-26.2	S	-1.36
Q	6628-15156	283566	6151009	-6.9	-53.0	S	-0.57
Q	6628-15586	280547	6157921	-3.9	-28.9	S	-0.68
Q	6628-15617	292226	6167623	31.5	10.0	S	-0.57
Q	6628-15892	289470	6166474	2.8	-12.7	S	-22.70
Q	6628-16277	283047	6161413	-20.1	-38.4	S	-7.50
Q	6628-16399	280867	6151483	-53.7	-81.0	S	-9.07
Q	6628-16416	280825	6157316	-4.1	-29.6	S	-0.68
Q	6628-16495	278507	6160003	-47.7	-58.7	S	-56.28
Q	6628-16533	278847	6165263	-7.2	-18.7	S	-24.55
Q	6628-16691_Q2	274344	6158488	-10.8	-33.8	S	-0.68
Q	6628-16691_Q3	273709	6158015	-12.4	-35.9	S	-2.23
Q	6628-17373	282172	6158637	0.1	-26.6	S	-0.57
Q	6628-18142	281746	6165461	13.3	-1.4	S	-0.10
Q	6628-18378	278236	6154721	-9.0	-33.7	S	-9.84
Q	6628-18619	283790	6160484	5.3	-21.7	S	-4.50
Q	6628-18878	281282	6168503	17.9	6.4	S	-0.57
Q	6628-18879	282784	6158988	1.3	-26.0	S	-0.68
Q	6628-18880	275933	6160991	-4.2	-25.3	S	-0.68
Q	6628-19038	286455	6152885	6.2	-40.9	S	-0.57
Q	6628-19716	270790	6168063	-8.6	-28.6	S	-1.88
Q	6628-19890	279373	6164051	8.5	-8.9	S	-0.68
Q	6628-20039	288842	6165400	22.7	1.9	S	-11.04
Q	6628-20486	285930	6166591	1.3	-11.3	S	-6.81
Q	6628-20728	277940	6157716	-33.0	-50.6	S	-3.52
Q	6628-20728_B	289280	6166075	24.4	3.9	S	-4.55
Q	6628-20887	281621	6162370	-16.2	-32.5	S	-61.14
Q	6628-21031	273742	6162392	-49.9	-61.0	S	-2.05
Q	6628-21687	276562	6167296	8.4	-4.2	S	-10.00
Q	6628-21972	276676	6160814	-3.1	-24.3	S	-0.68
Q	6628-22077	288005	6166288	20.7	5.1	S	-5.68
Q	6628-22124	278300	6162950	-35.1	-44.5	S	-16.32
Q	6628-22188_A	286789	6150147	-101.1	-121.6	S	-14.83
Q	6628-22764	290987	6167583	-12.8	-23.3	S	-21.53
Q	6628-23697	292025	6168216	30.5	10.2	S	-0.68
Q	6724-NAP-Q4	285982	6158205	5.1	-25.5	S	-2.18
Q	6785NAP	275067	6158558	-10.0	-32.7	S	-0.57
Q	6795NAP	281087	6159031	-1.3	-26.7	S	-0.68
Q	NAP-Q2	289800	6167750	27.2	7.5	S	-11.14
Q	Q1_Q2	285868	6159699	6.1	-23.2	S	-0.57
T1DC	652800376	269863	6148483	-113.7	-150.7	C	-304.00
T1DC	662815245	272136	6146021	-120.9	-159.5	C	-399.73
T1DC	662815331	272020	6146460	-119.4	-157.1	C	-399.73
T1DC	662820472	273375	6145639	-123.5	-162.0	C	-500.00
T1DC	6628-04356	278656	6144972	-131.5	-164.5	C	-46.81
T1DC	6628-04370	277776	6144586	-132.4	-167.0	C	-170.79
T1DC	6628-13020	278862	6146789	-126.4	-152.2	C	-301.01
T1DC	6628-13170	278399	6142855	-135.3	-183.6	C	-425.13
T1DC	6628-18042	278321	6142918	-135.3	-183.6	C	-425.13
T1G	652800432	271095	6136819	-154.8	-210.4	C	-34.00
T1G	652800433	271113	6136767	-156.1	-211.7	C	-34.00
T1G	652800434	271435	6136682	-156.5	-212.1	C	-34.00
T1G	652800435	271435	6136682	-156.5	-212.1	C	-34.00
T1G	652800436	271188	6136399	-157.8	-213.3	C	-34.00
T1G	652800437	271360	6136387	-158.2	-213.8	C	-34.00
T1G	652800438	271228	6136171	-158.6	-214.2	C	-34.00
T1G	652800439	271228	6136171	-158.6	-214.2	C	-34.00
T1G	652800440	271010	6136152	-158.2	-213.7	C	-34.00
T1G	652800441	271010	6136151	-158.2	-213.7	C	-34.00
T1G	652800442	271010	6136151	-158.2	-213.7	C	-34.00
T1G	652800507	271222	6138477	-150.1	-205.1	C	-170.00
T1G	652800508	271466	6138299	-150.7	-205.8	C	-170.00
T1G	652800525	271334	6137087	-154.9	-210.5	C	-34.00
T1G	652800893	271360	6136585	-157.4	-212.9	C	-34.00
T1G	652801125	271074	6136158	-158.2	-213.7	C	-34.00
T1G	652801126	271318	6136062	-159.0	-214.6	C	-34.00
T1G	652801127	271311	6136088	-159.0	-214.6	C	-34.00
T1G	652801731	271213	6136872	-155.3	-210.8	C	-34.00
T1G	652802050	271273	6136039	-158.6	-214.2	C	-34.00
T1G	652802456	270937	6137152	-154.0	-209.5	C	-34.00

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T1G	652802570	271326	6136634	-156.5	-212.1	C	-34.00
T1G	652802722	271195	6136418	-156.9	-212.5	C	-34.00
T1G	662807369	272691	6135341	-163.8	-220.2	C	-44.60
T1G	662807371	272299	6135288	-163.2	-219.5	C	-44.60
T1G	662808632	271669	6137150	-155.3	-210.9	C	-34.00
T1G	662808633	271669	6137150	-155.3	-210.9	C	-34.00
T1G	662808653	271750	6136635	-157.4	-213.0	C	-34.00
T1G	662808654	271776	6136964	-156.5	-212.2	C	-34.00
T1G	662808669	272804	6135728	-162.6	-218.7	C	-44.60
T1G	662808670	272807	6135749	-162.6	-218.7	C	-44.60
T1G	662808671	272479	6135623	-162.3	-218.1	C	-44.60
T1G	662808672	272449	6135619	-162.3	-218.1	C	-44.60
T1G	662808673	272671	6135504	-163.4	-219.4	C	-44.60
T1G	662811542	272792	6135764	-162.6	-218.7	C	-44.60
T1G	662815682	271815	6137105	-155.7	-211.4	C	-34.00
T1G	662816746	272457	6135608	-162.3	-218.1	C	-44.60
T1G	662818789	271775	6136590	-158.2	-213.8	C	-34.00
T1G	662819815	271561	6136549	-157.8	-213.4	C	-34.00
T1G	662822029	272284	6135321	-163.2	-219.5	C	-44.60
T1G	662822030	272398	6135377	-163.5	-219.8	C	-44.60
T1G	662822031	272456	6135415	-163.1	-219.0	C	-44.60
T1G	662822032	272412	6135453	-163.1	-219.0	C	-44.60
T1G	662822596	271691	6137225	-154.5	-210.1	C	-34.00
T1G	662822699	271730	6137184	-155.7	-211.4	C	-34.00
T1GG	662701875	273852	6121323	-76.3	-107.1	C	-121.70
T1GG	662706214	273918	6121013	-69.7	-103.2	C	-121.70
T1GG	662708325	276694	6124103	-73.9	-108.2	C	-192.00
T1GG	662711393	274247	6122354	-85.2	-116.4	C	-11.00
T1GG	662800001	280905	6133657	10.3	-7.9	C	-7.50
T1GG	662800002	280880	6133835	8.8	-12.3	C	-7.50
T1GG	662800003	281008	6133677	10.3	-7.9	C	-7.50
T1GG	662800004	281074	6133921	9.7	-10.2	C	-7.50
T1GG	662800108	281461	6134030	11.0	-9.2	C	-39.60
T1GG	662800137	281301	6133811	11.5	-6.0	C	-39.60
T1GG	662800162	281322	6134217	10.4	-12.4	C	-7.50
T1GG	662800163	281556	6134339	11.0	-10.4	C	-7.50
T1GG	662800402	279531	6134124	-1.4	-31.9	C	-7.50
T1GG	662800403	280107	6133271	5.6	-14.5	C	-7.50
T1GG	662800404	280147	6133302	5.6	-14.5	C	-7.50
T1GG	662800405	280273	6133520	5.2	-16.4	C	-7.50
T1GG	662800681	280791	6134442	7.2	-22.1	C	-7.50
T1GG	662806971	289626	6144503	70.8	-23.4	C	-28.00
T1GG	662808093	277223	6129259	-49.9	-78.3	C	-36.00
T1GG	662811116	281844	6134799	10.4	-14.9	C	-7.50
T1GG	662811117	281761	6134685	10.4	-14.9	C	-7.50
T1GG	662811489	281529	6133957	12.0	-4.1	C	-39.60
T1GG	662811490	281440	6133934	11.5	-6.0	C	-39.60
T1GG	662812928	278864	6127223	-38.2	-63.5	C	-37.00
T1GG	662814545	279722	6135432	-2.5	-51.4	C	-7.50
T1GG	662814546	280202	6135508	0.7	-46.0	C	-7.50
T1GG	662814547	281524	6135186	8.8	-23.4	C	-7.50
T1GG	662814548	280822	6135353	5.2	-35.2	C	-7.50
T1GG	662815257	281450	6133923	11.5	-6.0	C	-39.60
T1GG	662815330	281412	6133968	11.5	-6.0	C	-39.60
T1GG	662816087	280257	6133698	4.8	-18.3	C	-7.50
T1GG	662816186	284912	6140618	21.6	-50.8	C	-14.00
T1GG	662816422	281759	6134395	11.4	-8.5	C	-7.50
T1GG	662816423	281752	6134393	11.4	-8.5	C	-7.50
T1GG	662816460	280407	6125643	-13.6	-55.5	C	-46.00
T1GG	662817117	279132	6124473	-33.5	-71.8	C	-17.00
T1GG	662817952	286672	6132903	91.8	20.7	C	-116.00
T1GG	662817964	281042	6127228	-26.0	-55.3	C	-19.00
T1GG	662818266	281247	6133882	10.6	-8.1	C	-39.60
T1GG	662820845	292312	6145746	132.3	8.4	C	-34.00
T1GG	662822336	280962	6131324	4.5	-7.4	C	-87.00
T1GG	662823395	289739	6141406	53.7	-35.4	C	-13.00
T1GG	662825014	280099	6135251	-0.4	-45.5	C	-7.50
T1GG	662825016	279921	6134067	2.3	-26.1	C	-7.50
T1GG	662825017	279425	6133693	-3.1	-31.4	C	-7.50
T1GG	662825018	280179	6133374	5.6	-14.5	C	-7.50
T1GG	662825019	280222	6133806	4.4	-20.1	C	-7.50
T1GG	662825020	281117	6133684	11.1	-6.0	C	-7.50
T1GG	662825021	281059	6134101	9.1	-13.4	C	-7.50
T1GG	662825022	281678	6134099	11.5	-7.2	C	-7.50
T1GG	662825025	281237	6135087	7.4	-27.7	C	-7.50
T1GG	662825334	281868	6134435	10.9	-11.7	C	-7.50
T1GG	662825335	281882	6134397	11.4	-8.5	C	-7.50
T1N	108094NAP-T1	281140	6154036	-86.9	-115.1	S	-18.00
T1N	5054NAP-T1	281144	6150633	-112.1	-135.2	S	-1.14
T1N	5214NAP-T1	276566	6160066	-59.7	-74.4	S	-6.81
T1N	5217NAP-T1	275435	6156238	-75.2	-98.0	S	-4.55
T1N	5368NAP-1	275496	6156036	-75.8	-98.9	S	-1.36
T1N	5372NAP-T1	275205	6156456	-75.1	-97.4	S	-8.14
T1N	5415NAP-T1	282993	6150775	-118.1	-141.9	S	-14.73
T1N	5421NAP-T1	276661	6154425	-78.9	-103.9	S	-9.73
T1N	5438NAP-1	280100	6157771	-70.8	-92.1	S	-26.78
T1N	5559NAP-T1	283148	6158811	-68.7	-87.2	S	-1.77
T1N	5626NAPTERTIARYT1	282303	6150275	-117.9	-141.9	S	-11.32
T1N	5699NAP-T1	276263	6154570	-79.4	-104.0	S	-9.14

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T1N	5788NAP-1	278174	6156922	-72.7	-95.9	S	-6.14
T1N	5813NAP-T1	283048	6150142	-121.2	-145.3	S	-9.05
T1N	6082NAP-T1	275748	6157812	-70.3	-89.9	S	-1.50
T1N	6097NAP	277769	6168794	-18.6	-28.6	S	-7.57
T1N	6269NAP-T1	277755	6155305	-76.7	-102.6	S	-9.09
T1N	6293NAP-T1	288508	6164182	-40.2	-57.8	S	-5.44
T1N	6528-00097	268552	6165319	-81.0	-100.2	S	-0.68
T1N	6528-00109	269660	6165786	-77.4	-94.6	S	-18.36
T1N	6528-00113	269788	6167045	-71.3	-87.9	S	-1.88
T1N	6528-00117	270305	6165036	-75.1	-92.4	S	-0.68
T1N	6528-00119	269622	6164909	-80.8	-95.5	S	-25.00
T1N	6528-00132	267905	6165028	-82.9	-103.0	S	-0.68
T1N	6528-00597	267600	6165300	-83.1	-103.5	S	-0.68
T1N	6528-01134	268860	6165150	-82.9	-98.2	S	-20.00
T1N	6528-01143	269120	6163980	-84.8	-100.8	S	-4.55
T1N	6528-01312	271012	6164334	-75.7	-89.5	S	-93.49
T1N	6528-01376_A	269200	6164266	-83.7	-99.2	S	-19.66
T1N	6528-01454	269152	6167905	-72.0	-88.2	S	-1.88
T1N	6528-01455	270638	6168090	-64.3	-77.0	S	-62.75
T1N	6528-01558	268506	6164023	-84.5	-104.2	S	-62.05
T1N	6528-01601	269312	6165493	-80.0	-94.5	S	-12.73
T1N	6528-01860	269842	6162503	-86.0	-103.0	S	-15.91
T1N	6528-02035	268565	6163506	-85.8	-106.1	S	-0.68
T1N	6528-02036	268657	6163659	-87.1	-103.6	S	-22.73
T1N	6528-02037	268771	6163486	-85.3	-105.5	S	-0.68
T1N	6528-02038	268788	6163590	-85.3	-105.5	S	-0.68
T1N	6528-02067	268677	6164058	-86.2	-102.4	S	-94.45
T1N	6528-02143	268810	6163521	-87.1	-103.7	S	-11.50
T1N	6528-02155	268777	6163293	-87.6	-104.4	S	-114.49
T1N	6528-02477	270419	6165789	-73.6	-90.4	S	-0.68
T1N	6528-02769	269478	6163886	-82.1	-101.7	S	-11.53
T1N	6530NAP-T1	275246	6164715	-45.5	-57.3	S	-0.68
T1N	6593NAP	278946	6147697	-121.3	-148.7	S	-0.68
T1N	6616-NAPT1	276294	6157187	-72.0	-93.2	S	-0.68
T1N	6628-02262	272668	6160134	-74.9	-95.4	S	-0.68
T1N	6628-02383	276647	6157987	-69.4	-88.9	S	-0.68
T1N	6628-02384	276251	6157887	-69.6	-89.1	S	-0.68
T1N	6628-02399	275578	6157756	-73.3	-89.4	S	-23.81
T1N	6628-02473	278263	6160223	-60.4	-72.0	S	-15.00
T1N	6628-02475	278002	6160095	-61.1	-73.0	S	-4.50
T1N	6628-02484	278427	6160020	-61.4	-73.3	S	-6.98
T1N	6628-02557	278438	6159877	-62.4	-74.5	S	-3.14
T1N	6628-02559	278760	6159768	-63.7	-76.1	S	-7.82
T1N	6628-02631	277794	6158746	-67.5	-81.5	S	-45.46
T1N	6628-02643	279372	6157929	-71.9	-88.2	S	-8.27
T1N	6628-02766	280113	6160800	-58.3	-69.4	S	-48.73
T1N	6628-03007	281270	6153680	-91.8	-113.3	S	-18.31
T1N	6628-03009	280624	6153712	-88.9	-110.2	S	-11.46
T1N	6628-03010	281041	6154405	-84.3	-113.2	S	-31.00
T1N	6628-03019	281280	6154028	-89.8	-112.3	S	-12.36
T1N	6628-03030	280409	6154607	-84.4	-108.2	S	-33.64
T1N	6628-03031	280708	6154430	-86.3	-109.9	S	-15.26
T1N	6628-03266	279367	6152168	-97.2	-119.2	S	-7.14
T1N	6628-03281	280074	6150583	-113.1	-129.9	S	-9.55
T1N	6628-03290	280340	6150304	-115.4	-132.7	S	-7.50
T1N	6628-03300	280360	6149687	-119.2	-136.5	S	-20.56
T1N	6628-03344	279595	6149616	-115.9	-136.2	S	-0.68
T1N	6628-03429	279633	6147223	-125.3	-149.0	S	-16.03
T1N	6628-03430	279790	6148306	-122.9	-142.7	S	-4.27
T1N	6628-03433	279809	6148346	-122.9	-142.7	S	-11.68
T1N	6628-03766	279125	6152485	-95.8	-114.6	S	-22.99
T1N	6628-03786	278500	6155031	-78.2	-105.0	S	-0.32
T1N	6628-03788	278311	6154977	-78.3	-105.5	S	-0.68
T1N	6628-03789	278394	6155762	-78.8	-99.8	S	-9.27
T1N	6628-03790	278580	6155172	-78.0	-105.3	S	-0.68
T1N	6628-03791	278627	6155278	-80.1	-101.7	S	-4.99
T1N	6628-03793_A	278878	6155522	-79.7	-101.3	S	-10.76
T1N	6628-03794	277926	6156077	-77.4	-97.8	S	-9.00
T1N	6628-03796	278124	6156216	-74.7	-99.4	S	-8.41
T1N	6628-03797	278223	6155781	-78.6	-99.5	S	-5.00
T1N	6628-03798	278268	6155952	-78.1	-98.8	S	-24.09
T1N	6628-03803	280022	6155115	-82.2	-105.4	S	-22.26
T1N	6628-03806	279003	6156254	-74.8	-100.7	S	-0.68
T1N	6628-03807	278460	6156008	-77.7	-98.3	S	-40.06
T1N	6628-03826	279961	6156423	-75.3	-100.8	S	-83.68
T1N	6628-03847	278154	6153165	-89.3	-113.8	S	-3.41
T1N	6628-03851	278006	6153011	-89.4	-113.7	S	-11.37
T1N	6628-03852_A	278609	6153117	-91.4	-111.6	S	-6.82
T1N	6628-03853	278661	6153183	-89.2	-113.9	S	-17.37
T1N	6628-03854	278797	6152605	-94.3	-113.7	S	-11.66
T1N	6628-03856	278701	6152821	-92.8	-112.6	S	-35.73
T1N	6628-03857	278742	6152629	-94.3	-113.7	S	-12.50
T1N	6628-03861	278619	6152642	-94.4	-113.6	S	-9.09
T1N	6628-03892_A	277737	6154138	-84.6	-105.3	S	-9.91
T1N	6628-03900	277335	6154291	-82.7	-103.3	S	-8.68
T1N	6628-03902	277638	6153754	-87.2	-107.4	S	-42.44
T1N	6628-03903	277440	6154273	-82.7	-103.3	S	-11.45
T1N	6628-03912	278189	6154475	-82.3	-103.9	S	-8.36
T1N	6628-03922	278297	6154480	-79.6	-106.7	S	-0.57

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T1N	6628-03923	278015	6153845	-86.1	-106.9	S	-10.23
T1N	6628-03929	278135	6155362	-77.3	-103.3	S	-2.04
T1N	6628-03931	277801	6154662	-80.8	-102.0	S	-4.67
T1N	6628-03933	277733	6155031	-79.8	-100.7	S	-9.32
T1N	6628-03936	277733	6154530	-81.8	-103.0	S	-12.55
T1N	6628-03940	277945	6155024	-80.0	-101.2	S	-27.15
T1N	6628-03941	277931	6154706	-81.1	-102.5	S	-14.09
T1N	6628-03942	278156	6154967	-80.8	-102.3	S	-8.82
T1N	6628-03944	277112	6154885	-79.6	-99.9	S	-6.77
T1N	6628-03946	277176	6154964	-79.6	-99.9	S	-4.73
T1N	6628-03949_A	277197	6154772	-80.0	-100.5	S	-17.00
T1N	6628-03950_A	277564	6154978	-80.1	-100.9	S	-9.35
T1N	6628-03951	277507	6155089	-79.6	-100.2	S	-7.50
T1N	6628-03952	277387	6154482	-81.3	-102.0	S	-12.14
T1N	6628-03953	277435	6155038	-79.4	-99.8	S	-7.50
T1N	6628-03954	277082	6154787	-79.9	-100.2	S	-8.65
T1N	6628-03956	277604	6155206	-76.8	-101.9	S	-2.28
T1N	6628-03957	277431	6154518	-81.3	-102.0	S	-13.26
T1N	6628-03958	277265	6154428	-81.0	-101.5	S	-18.41
T1N	6628-03962	277009	6154789	-79.9	-100.2	S	-12.50
T1N	6628-03968	276490	6154976	-79.5	-100.1	S	-1.70
T1N	6628-03970	276206	6154431	-79.6	-103.8	S	-7.50
T1N	6628-03973	276323	6155649	-75.8	-99.1	S	-29.95
T1N	6628-03975	276208	6155466	-78.6	-97.6	S	-9.86
T1N	6628-03984	277131	6155308	-76.2	-101.2	S	-0.68
T1N	6628-03986	277718	6155933	-77.8	-98.1	S	-15.14
T1N	6628-03987	277900	6155700	-78.5	-99.1	S	-15.00
T1N	6628-03990	277125	6155941	-77.4	-96.9	S	-7.50
T1N	6628-03991	276802	6155981	-77.3	-96.5	S	-19.58
T1N	6628-03992	276684	6156149	-76.9	-95.8	S	-26.59
T1N	6628-03994	276282	6156112	-76.9	-95.5	S	-13.41
T1N	6628-03995	276247	6155642	-78.0	-96.9	S	-11.14
T1N	6628-03996	276449	6155707	-77.9	-97.0	S	-10.18
T1N	6628-03997	276337	6155668	-77.9	-97.0	S	-7.31
T1N	6628-03999	276406	6156374	-74.1	-97.2	S	-0.68
T1N	6628-04000	276450	6156535	-73.5	-96.2	S	-0.68
T1N	6628-04004	277141	6156056	-76.9	-96.3	S	-19.58
T1N	6628-04006	276582	6156439	-75.8	-94.0	S	-2.95
T1N	6628-04019	274789	6156296	-78.8	-96.9	S	-6.43
T1N	6628-04024	275117	6156130	-76.2	-99.3	S	-0.68
T1N	6628-04026	275461	6156128	-76.1	-98.7	S	-6.72
T1N	6628-04027	274853	6156042	-79.5	-97.8	S	-6.77
T1N	6628-04040	275654	6155842	-78.6	-97.3	S	-17.27
T1N	6628-04042	275693	6155603	-79.3	-98.2	S	-7.96
T1N	6628-04044	275633	6156672	-76.1	-93.7	S	-14.55
T1N	6628-04046	275297	6156589	-77.3	-95.2	S	-7.39
T1N	6628-04047	275504	6156943	-75.5	-92.8	S	-9.09
T1N	6628-04052	276170	6156856	-74.6	-92.0	S	-5.68
T1N	6628-04054	275114	6156589	-77.3	-95.2	S	-5.05
T1N	6628-04878	280590	6150377	-113.8	-135.3	S	-1.14
T1N	6628-04880	280602	6150011	-115.3	-136.6	S	-8.05
T1N	6628-04889	281103	6150204	-117.2	-135.5	S	-13.22
T1N	6628-04922	281684	6151261	-111.4	-130.6	S	-11.35
T1N	6628-04995	287350	6151600	-113.0	-132.2	S	-18.43
T1N	6628-05016	281689	6149465	-122.2	-141.4	S	-12.05
T1N	6628-05017	281939	6149794	-122.5	-141.6	S	-6.81
T1N	6628-05069_B	283677	6149707	-9.7	-56.6	S	-1.91
T1N	6628-05092_A	285066	6150804	-123.8	-143.4	S	-25.60
T1N	6628-05167	280762	6147905	-125.0	-147.2	S	-39.55
T1N	6628-05171	280625	6147987	-122.1	-149.1	S	-16.14
T1N	6628-05172	280599	6147909	-124.6	-146.6	S	-23.19
T1N	6628-08000	280200	6147590	-122.3	-151.3	S	-4.55
T1N	6628-10981	277130	6155600	-75.8	-100.6	S	-0.68
T1N	6628-10991	279264	6164095	-37.9	-47.6	S	-217.82
T1N	6628-11985	276430	6162750	-52.0	-62.1	S	-8.50
T1N	6628-12125	273200	6159080	-74.7	-95.0	S	-5.00
T1N	6628-12576	279450	6160700	-59.0	-70.3	S	-28.96
T1N	6628-12873	278200	6152950	-93.0	-112.6	S	-23.19
T1N	6628-12945	274850	6159980	-65.7	-82.7	S	-0.68
T1N	6628-12945_B	274994	6160161	-64.4	-80.3	S	-8.53
T1N	6628-12947	279370	6157010	-72.5	-95.8	S	-0.34
T1N	6628-13553	280150	6157800	-72.2	-88.8	S	-2.07
T1N	6628-13840	276760	6154050	-84.2	-104.1	S	-13.03
T1N	6628-13872	282750	6158350	-73.1	-89.8	S	-16.52
T1N	6628-13927	280800	6158635	-69.3	-83.9	S	-34.17
T1N	6628-14027	279812	6145153	-131.6	-163.9	C	-366.35
T1N	6628-14050_B	276804	6162255	-85.1	-142.6	S	-7.91
T1N	6628-14253	281760	6153560	-95.6	-117.2	S	-14.08
T1N	6628-14343	277228	6154622	-80.0	-100.5	S	-5.32
T1N	6628-14417	278076	6155788	-76.2	-101.5	S	-48.39
T1N	6628-15214	281180	6154060	-89.8	-112.3	S	-21.64
T1N	6628-15352	278062	6154767	-81.1	-102.5	S	-14.37
T1N	6628-15353	277964	6155187	-80.0	-101.2	S	-10.00
T1N	6628-15356	280871	6157410	-72.1	-94.7	S	-0.68
T1N	6628-15373	277700	6154150	-84.6	-105.3	S	-7.91
T1N	6628-15448	276957	6156268	-74.2	-97.4	S	-19.58
T1N	6628-15450	277107	6155806	-77.4	-96.9	S	-26.60
T1N	6628-15531	279743	6155279	-81.2	-104.0	S	-78.92
T1N	6628-15588	278005	6153196	-89.4	-113.7	S	-35.34

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T1N	6628-15674	281910	6161498	-54.9	-65.8	S	-14.73
T1N	6628-15844_A	277813	6154829	-80.3	-101.3	S	-14.45
T1N	6628-15893	282147	6161658	-53.4	-64.3	S	-21.19
T1N	6628-15905	277531	6155151	-79.6	-100.2	S	-7.27
T1N	6628-16040	274926	6157784	-72.8	-92.7	S	-0.68
T1N	6628-16074	275778	6159165	-66.9	-80.5	S	-0.68
T1N	6628-16075	274289	6158702	-73.7	-89.3	S	-0.68
T1N	6628-16106	275081	6159127	-69.5	-83.8	S	-6.41
T1N	6628-16107	275547	6159116	-67.5	-81.3	S	-1.19
T1N	6628-16108	277950	6159325	-64.7	-77.4	S	-95.14
T1N	6628-16110	275506	6159031	-67.5	-81.3	S	-7.96
T1N	6628-16111	275714	6159184	-66.9	-80.5	S	-0.82
T1N	6628-16112	275192	6159027	-68.8	-82.9	S	-4.97
T1N	6628-16114	275416	6158658	-68.2	-85.9	S	-0.68
T1N	6628-16115	275215	6159015	-67.3	-84.4	S	-0.68
T1N	6628-16116	278441	6156398	-77.0	-97.4	S	-81.14
T1N	6628-16215	274452	6158758	-73.0	-88.4	S	-5.18
T1N	6628-16221	274761	6159008	-68.7	-86.3	S	-0.68
T1N	6628-16254	277637	6158578	-68.3	-82.8	S	-11.51
T1N	6628-16278	274737	6159088	-70.2	-84.7	S	-8.86
T1N	6628-16279	274731	6158668	-70.0	-88.3	S	-0.68
T1N	6628-16280	274667	6158588	-73.0	-88.5	S	-1.19
T1N	6628-16397	274816	6158538	-70.7	-89.4	S	-0.68
T1N	6628-16398	274736	6158608	-70.0	-88.3	S	-0.68
T1N	6628-16442	274701	6159373	-68.0	-85.3	S	-0.68
T1N	6628-16444	277867	6156278	-76.7	-96.5	S	-21.82
T1N	6628-16493	273171	6160393	-71.9	-91.0	S	-0.68
T1N	6628-16497	277062	6154873	-79.5	-99.6	S	-11.72
T1N	6628-16544	282742	6150748	-119.7	-138.7	S	-40.34
T1N	6628-16561	278829	6154085	-85.4	-107.2	S	-32.38
T1N	6628-16607	277413	6155487	-75.9	-101.1	S	-0.68
T1N	6628-16622	274741	6158693	-70.0	-88.3	S	-0.68
T1N	6628-16692	279132	6152113	-99.1	-117.1	S	-8.73
T1N	6628-16793	277317	6153908	-85.6	-105.8	S	-13.65
T1N	6628-17136	279781	6149278	-117.6	-138.9	S	-11.05
T1N	6628-17165	275411	6158768	-68.2	-85.9	S	-0.68
T1N	6628-17267	280697	6147618	-125.1	-147.8	S	-5.60
T1N	6628-17291	278932	6152813	-92.6	-112.4	S	-16.37
T1N	6628-17292	280760	6154420	-86.3	-109.9	S	-45.86
T1N	6628-17438	281022	6152218	-100.7	-119.9	S	-17.16
T1N	6628-17762	278092	6155168	-80.0	-101.2	S	-28.74
T1N	6628-17787	284537	6151203	-122.1	-141.0	S	-22.27
T1N	6628-18069_106855	275381	6159923	-63.3	-79.4	S	-0.68
T1N	6628-18069_6765	275417	6159643	-64.1	-80.4	S	-0.34
T1N	6628-18457	278327	6160298	-60.5	-72.2	S	-5.73
T1N	6628-18620	279952	6160048	-62.4	-74.3	S	-9.97
T1N	6628-18778	278000	6154204	-83.4	-104.6	S	-51.46
T1N	6628-18802	278858	6154044	-85.4	-107.2	S	-26.63
T1N	6628-19037	278286	6154868	-78.4	-104.8	S	-9.84
T1N	6628-19250	278237	6153308	-90.2	-110.4	S	-29.43
T1N	6628-19389	272762	6161088	-73.4	-89.1	S	-116.73
T1N	6628-19416	281382	6153508	-93.8	-115.0	S	-25.71
T1N	6628-19517	277787	6155348	-79.3	-100.0	S	-27.15
T1N	6628-19518	276432	6155948	-77.4	-96.3	S	-5.29
T1N	6628-19895	278136	6155371	-79.7	-100.9	S	-7.10
T1N	6628-20088_A	277034	6155139	-79.0	-99.0	S	-4.96
T1N	6628-20350	274025	6167230	-40.6	-50.2	S	-9.00
T1N	6628-20487	279929	6157622	-72.9	-90.0	S	-55.46
T1N	6628-20556_A	278285	6155462	-79.2	-100.2	S	-18.39
T1N	6628-20564	279859	6159320	-64.9	-80.9	S	-50.51
T1N	6628-20568	280036	6158620	-67.1	-85.1	S	-50.51
T1N	6628-20717	278223	6154966	-80.8	-102.3	S	-14.19
T1N	6628-20738	289280	6166075	-31.5	-44.1	S	-45.46
T1N	6628-20885	278064	6168656	-18.1	-28.1	S	-0.68
T1N	6628-20905	277200	6160650	-58.3	-69.6	S	-14.83
T1N	6628-20951	281853	6161753	-53.3	-64.0	S	-25.72
T1N	6628-21279	275699	6156113	-75.8	-98.4	S	-5.00
T1N	6628-21314	278675	6153428	-89.0	-109.7	S	-14.38
T1N	6628-21569	278042	6154087	-84.8	-105.7	S	-22.73
T1N	6628-21788	282590	6153716	-97.8	-120.2	S	-13.22
T1N	6628-21789	283253	6151946	-113.4	-133.0	S	-14.69
T1N	6628-21790	283824	6151268	-121.1	-139.7	S	-21.36
T1N	6628-21874	282757	6164201	-32.4	-42.1	S	-14.32
T1N	6628-21983	280964	6149458	-121.0	-139.5	S	-33.29
T1N	6628-22012	277361	6154059	-84.2	-104.6	S	-26.53
T1N	6628-22208	283058	6165520	-26.7	-35.9	S	-18.01
T1N	6628-22234	283058	6165520	-26.7	-35.9	S	-31.00
T1N	6628-22335	281962	6161726	-53.3	-64.1	S	-21.19
T1N	6628-22432	287059	6151340	-111.5	-129.5	S	-13.22
T1N	6628-22519	275533	6156628	-76.1	-93.7	S	-23.18
T1N	6628-22534	284259	6150255	-126.6	-146.1	S	-21.12
T1N	6628-22565	281252	6154851	-86.1	-109.6	S	-12.62
T1N	6628-22568	275305	6157786	-73.6	-89.8	S	-19.83
T1N	6628-22571	278050	6160434	-59.3	-70.8	S	-12.00
T1N	6628-22611	282216	6151504	-112.3	-131.6	S	-16.25
T1N	6628-22612	281903	6149157	-124.3	-144.7	S	-13.22
T1N	6628-22932	280984	6154612	-86.2	-109.9	S	-15.64
T1N	6628-23046	282930	6152365	-109.0	-129.4	S	-16.52
T1N	6628-23051	277805	6156053	-77.3	-97.4	S	-15.14

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T1N	6628-23161	281333	6154100	-90.6	-113.1	S	-35.80
T1N	6628-23460	279752	6149434	-118.8	-135.8	S	-11.65
T1N	6628-23486	280817	6149401	-120.5	-138.8	S	-41.73
T1N	6628-23487	280842	6149543	-120.5	-138.8	S	-14.85
T1N	6628-23488	280892	6149291	-121.1	-139.8	S	-19.97
T1N	6628-23638	279541	6155463	-80.4	-102.7	S	-83.68
T1N	6628-24981	278261	6156160	-75.2	-100.4	S	-16.01
T1N	6628-25433	280831	6159006	-67.9	-80.8	S	-11.88
T1N	6659NAPUNDERGROUND	268023	6165238	-82.4	-102.3	S	-3.72
T1N	6698NAP-T1	278309	6154530	-79.8	-107.2	S	-0.68
T1N	6907NAP-T1	276497	6154652	-78.0	-102.8	S	-2.28
T1N	PERMIT134789	277697	6154630	-78.2	-103.9	S	-16.59
T1R	662807607	274014	6131623	-172.3	-238.7	C	-31.80
T1R	662807656	274790	6131656	-173.3	-240.7	C	-14.00
T1R	662807657	274388	6131930	-172.6	-239.1	C	-31.80
T1R	662807658	274428	6132221	-171.6	-237.3	C	-31.80
T1R	662807659	274319	6132080	-172.1	-238.2	C	-31.80
T1R	662807846	274106	6128103	-71.1	-102.9	C	-45.60
T1R	662807847	274149	6128499	-184.6	-259.8	C	-45.60
T1R	662807849	274384	6128476	-185.0	-260.4	C	-45.60
T1R	662807852	273982	6128542	-184.2	-259.1	C	-45.60
T1R	662808044	274797	6128803	-62.2	-94.9	C	-45.60
T1R	662810693	273966	6132193	-171.3	-236.9	C	-31.80
T1R	662812054	274089	6132272	-170.8	-236.0	C	-31.80
T1R	662812385	279013	6134771	-161.8	-225.8	C	-15.00
T1R	662813237	274183	6131567	-173.2	-240.3	C	-31.80
T1R	662813452	274026	6132284	-170.8	-236.0	C	-31.80
T1R	662815323	272199	6129349	-177.2	-247.0	C	-210.00
T1R	662815556	273980	6128499	-184.2	-259.1	C	-45.60
T1R	662816239	274102	6132288	-171.2	-236.6	C	-31.80
T1R	662817025	274722	6128678	-64.8	-96.8	C	-45.60
T1R	662817026	274522	6131928	-172.7	-239.4	C	-31.80
T1R	662819739	271712	6132953	-166.8	-227.3	C	-88.00
T1R	662820552	274253	6131369	-173.8	-241.2	C	-14.00
T1R	662822322	274251	6128586	-184.6	-259.8	C	-45.60
T1R	662822429	274734	6142261	-136.6	-183.7	C	-26.00
T1R	662822597	276538	6133389	-166.8	-231.8	C	-360.00
T1R	662823154	278920	6136315	-157.4	-218.7	C	-60.00
T1R	662823335	274439	6128457	-185.0	-260.4	C	-45.60
T1R	662823526	274439	6128457	-185.0	-260.4	C	-45.60
T1R	662824910	274670	6131664	-173.2	-240.4	C	-31.80
T1R	662825015	278996	6134689	-161.8	-225.8	C	-15.00
T1R	662825154	274571	6131676	-173.2	-240.4	C	-31.80
T1R	662807608_A	274112	6131879	-172.2	-238.5	C	-14.00
T1R	662807608_B	274112	6131879	-172.2	-238.5	C	-31.80
T1R	662818780_A	274352	6132198	-172.1	-238.2	C	-14.00
T1R	662818780_B	274352	6132198	-172.1	-238.2	C	-31.80
T1R	662820854_A	274702	6131817	-172.6	-239.6	C	-14.00
T1R	662820854_B	274702	6131817	-172.6	-239.6	C	-31.80
T1Th	662800516	278604	6133525	-167.8	-234.6	C	-108.35
T1Th	662801435	278645	6133628	-166.6	-232.8	C	-108.35
T1Th	662804576	278606	6133363	-169.0	-236.4	C	-108.35
T1Th	662807724	278579	6133453	-167.8	-234.6	C	-108.35
T1Th	662807725	278538	6133623	-166.6	-232.8	C	-108.35
T1Th	662812446	278525	6133684	-166.6	-232.8	C	-108.35
T1Th	662812516	278546	6133586	-167.8	-234.6	C	-108.35
T1Th	662813732	278463	6134320	-162.8	-227.1	C	-624.57
T2GG	662708681	273902	6121213	-107.8	-170.5	C	-121.70
T2GG	662813386	279290	6125339	-71.4	-110.6	C	-1.00
T2KF	6628-09480	283617	6172286	-19.5	-42.4	S	-1.77
T2KF	6628-12943	285893	6173158	-17.4	-37.0	S	-85.53
T2KF	6628-18708	286446	6172094	-21.4	-42.0	S	-1.59
T2KF	6628-18829	286525	6172092	-21.7	-41.9	S	-104.62
T2KF	6628-19387	284457	6172005	-19.4	-42.7	S	-156.17
T2KF	6628-19388	284328	6172024	-19.4	-42.7	S	-154.76
T2KF	6628-19553	286850	6172113	-22.0	-41.9	S	-110.50
T2KF	6628-19554	286898	6172167	-22.0	-41.9	S	-116.43
T2KF	6628-19920	284407	6172071	-19.4	-42.7	S	-158.63
T2KF	6628-20084	284627	6172004	-19.4	-42.6	S	-95.78
T2KF	6628-20269	284715	6172006	-19.5	-42.6	S	-134.96
T2KF	6628-21967	286853	6172004	-22.0	-41.9	S	-178.75
T2KF	6628-22765	284101	6172102	-19.3	-42.8	S	-46.21
T2KF	6628-22766	284212	6172167	-19.3	-42.8	S	-66.40
T2KF	KANUGW	287488	6173605	-18.0	-34.3	S	-87.89
T2N	5104NAP-T2	278397	6166906	-50.2	-90.1	S	-9.66
T2N	5116NAP-T2	286682	6166842	-47.7	-80.5	S	-37.81
T2N	5146NAP-T2	271444	6166545	-101.4	-163.6	S	-15.68
T2N	5604NAP-T2	279913	6166314	-52.3	-95.6	S	-9.31
T2N	5634NAP-T2	281255	6166037	-52.4	-97.6	S	-24.00
T2N	6264NAP-T2	289260	6165743	-64.6	-106.1	S	-2.88
T2N	6473NAP	274756	6156072	-124.6	-196.4	S	-1.50
T2N	6528-00090	268514	6167172	-118.0	-190.4	S	-1.88
T2N	6528-00102	269417	6168019	-109.2	-176.4	S	-1.88
T2N	6528-00106	269847	6165345	-126.7	-184.6	S	-16.14
T2N	6528-00108	270078	6165322	-125.6	-183.0	S	-14.18
T2N	6528-00111	269682	6165782	-126.5	-185.0	S	-18.18
T2N	6528-00116	270679	6164946	-122.0	-177.3	S	-2.04
T2N	6528-00128	267974	6163564	-138.8	-196.4	S	-45.50
T2N	6528-00129	267812	6163480	-138.3	-194.7	S	-40.92

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2N	6528-00142	270596	6164137	-124.9	-180.4	S	-99.90
T2N	6528-02069	270103	6160495	-131.3	-197.1	S	-0.68
T2N	6628-00781	278902	6169539	-40.0	-66.9	S	-22.14
T2N	6628-00783	275739	6169083	-50.4	-90.3	S	-4.36
T2N	6628-00792	277819	6169273	-41.0	-76.2	S	-0.68
T2N	6628-00795	277401	6168972	-44.0	-80.4	S	-1.59
T2N	6628-00797	276930	6169074	-44.6	-81.6	S	-0.68
T2N	6628-00800	276050	6169224	-49.1	-88.2	S	-3.87
T2N	6628-00849	272402	6167350	-93.3	-137.8	S	-55.00
T2N	6628-00864	274454	6168551	-59.5	-103.8	S	-3.41
T2N	6628-00870	278952	6168191	-47.0	-76.7	S	-4.77
T2N	6628-00873	278714	6168224	-42.5	-78.6	S	-6.81
T2N	6628-00882	278279	6167833	-45.4	-82.7	S	-4.86
T2N	6628-00883	278462	6168189	-44.4	-81.3	S	-9.09
T2N	6628-00888	277859	6167145	-49.8	-89.0	S	-2.50
T2N	6628-00890	275983	6167257	-58.0	-90.1	S	-60.69
T2N	6628-00901	274993	6166558	-69.1	-104.9	S	-7.81
T2N	6628-00903	275875	6166370	-61.1	-102.8	S	-0.72
T2N	6628-00904	274597	6166989	-65.7	-110.9	S	-3.37
T2N	6628-00909	275559	6168109	-53.8	-94.2	S	-5.81
T2N	6628-00910	275182	6167324	-62.0	-95.7	S	-9.10
T2N	6628-00915	274654	6167378	-67.3	-103.1	S	-8.87
T2N	6628-00917	275047	6167678	-62.4	-96.7	S	-0.68
T2N	6628-00920	279671	6166907	-53.2	-86.2	S	-42.64
T2N	6628-00921	279700	6167111	-51.9	-84.4	S	-18.27
T2N	6628-00922	279722	6166693	-50.4	-92.0	S	-42.64
T2N	6628-00924	279853	6166934	-53.1	-86.2	S	-6.81
T2N	6628-00925	278938	6167112	-48.6	-88.1	S	-30.55
T2N	6628-00926	278907	6167088	-52.4	-84.4	S	-15.00
T2N	6628-00927	279071	6166959	-53.6	-86.1	S	-21.14
T2N	6628-00950	273968	6167043	-70.7	-118.5	S	-12.36
T2N	6628-00951	274295	6167210	-71.5	-108.9	S	-8.64
T2N	6628-00952	274103	6166874	-74.2	-112.4	S	-7.78
T2N	6628-00953	273833	6167160	-72.7	-121.6	S	-0.68
T2N	6628-00954	273800	6167500	-75.2	-114.1	S	-1.91
T2N	6628-00955	273850	6167600	-70.4	-115.0	S	-0.68
T2N	6628-00960	271477	6166230	-102.3	-165.0	S	-0.68
T2N	6628-00965	271117	6165694	-107.2	-172.2	S	-4.09
T2N	6628-00966	271646	6166284	-106.7	-156.3	S	-7.27
T2N	6628-00967	271882	6166561	-103.8	-152.2	S	-18.18
T2N	6628-00977	272188	6167360	-89.9	-146.0	S	-5.46
T2N	6628-00980	272074	6167000	-98.8	-145.3	S	-9.55
T2N	6628-00981	271912	6167204	-97.8	-143.9	S	-4.78
T2N	6628-00982	273035	6167219	-86.1	-128.4	S	-8.73
T2N	6628-00983	273595	6166845	-81.3	-122.0	S	-7.10
T2N	6628-00987	272451	6166757	-96.4	-142.1	S	-20.46
T2N	6628-00990	272703	6166464	-87.5	-142.7	S	-5.18
T2N	6628-01004	271688	6164674	-113.8	-165.8	S	-99.90
T2N	6628-01268	282282	6167515	-43.6	-82.5	S	-17.63
T2N	6628-01269	282386	6167086	-49.6	-82.3	S	-37.51
T2N	6628-01271	282174	6166554	-53.4	-88.3	S	-74.86
T2N	6628-01293	282975	6165778	-57.7	-94.0	S	-16.14
T2N	6628-01296	283086	6166036	-55.2	-90.4	S	-3.65
T2N	6628-01297	283021	6166032	-55.2	-90.4	S	-5.68
T2N	6628-01309	286279	6168003	-42.0	-66.3	S	-32.55
T2N	6628-01310	286745	6167974	-44.1	-68.0	S	-84.20
T2N	6628-01313	285779	6168029	-41.6	-66.5	S	-51.14
T2N	6628-01315	286090	6167296	-47.0	-73.6	S	-62.27
T2N	6628-01318	286663	6167925	-43.8	-68.0	S	-14.41
T2N	6628-01339_B	288955	6168771	-41.4	-66.2	S	-14.41
T2N	6628-01352_A	283261	6166772	-51.3	-84.4	S	-3.64
T2N	6628-01354	284104	6167722	-44.2	-73.1	S	-95.47
T2N	6628-01387	286123	6166470	-53.8	-82.0	S	-60.93
T2N	6628-01388	286248	6166900	-50.5	-77.7	S	-60.93
T2N	6628-01514	285678	6166157	-56.1	-86.1	S	-96.88
T2N	6628-02834	284716	6160275	-108.8	-159.1	S	-33.09
T2N	6628-02876	282163	6158949	-109.3	-179.1	S	-45.46
T2N	6628-02881_A	281999	6158178	-123.7	-182.0	S	-5.14
T2N	6628-03808	278764	6155763	-137.4	-201.4	S	-24.00
T2N	6628-03901	277654	6154538	-131.2	-209.4	S	-1.01
T2N	6628-04016	275508	6156512	-129.4	-189.2	S	-14.09
T2N	6628-04030	274971	6155706	-133.8	-192.1	S	-11.91
T2N	6628-04031	275263	6155600	-127.2	-198.0	S	-0.68
T2N	6628-04032	275271	6155423	-127.2	-200.2	S	-1.01
T2N	6628-04035	275510	6155622	-133.0	-192.9	S	-9.09
T2N	6628-04087	274695	6156074	-132.1	-189.3	S	-17.77
T2N	6628-04089	274779	6155953	-125.8	-197.5	S	-0.68
T2N	6628-05006	289408	6165658	-65.4	-107.5	S	-1.22
T2N	6628-07161	275939	6156482	-129.1	-189.6	S	-20.87
T2N	6628-07162	277227	6155846	-125.5	-203.4	S	-19.58
T2N	6628-12794	280793	6157071	-123.6	-199.8	S	-19.09
T2N	6628-13169	278285	6167349	-48.2	-86.9	S	-40.91
T2N	6628-13177	279070	6167410	-50.1	-81.1	S	-29.55
T2N	6628-13433	278450	6167150	-52.9	-84.8	S	-29.27
T2N	6628-13547	271950	6164850	-109.1	-159.5	S	-39.37
T2N	6628-13662	285900	6168200	-40.4	-64.5	S	-71.37
T2N	6628-13719	274300	6157400	-127.8	-185.0	S	-57.85
T2N	6628-13944	273300	6166600	-84.8	-126.7	S	-6.23
T2N	6628-14018	272200	6164250	-109.8	-160.7	S	-11.93

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2N	6628-14161	272400	6164300	-107.9	-158.3	S	-13.64
T2N	6628-14162	272500	6164300	-106.0	-155.8	S	-13.64
T2N	6628-14252	273306	6160232	-113.9	-182.2	S	-0.68
T2N	6628-14262	272920	6167700	-83.7	-125.4	S	-47.73
T2N	6628-14295	272140	6166690	-98.6	-145.0	S	-7.61
T2N	6628-14488	286750	6168210	-41.6	-64.7	S	-151.87
T2N	6628-14954	283000	6165880	-56.4	-92.2	S	-0.60
T2N	6628-15140	272464	6164228	-101.9	-164.3	S	-13.64
T2N	6628-15149	277430	6156040	-132.8	-195.6	S	-32.73
T2N	6628-15344	271724	6166601	-102.9	-150.9	S	-2.91
T2N	6628-15446	272750	6167225	-88.6	-131.6	S	-11.36
T2N	6628-15652	273439	6159795	-123.1	-178.7	S	-1.31
T2N	6628-15730	280969	6166667	-49.5	-92.1	S	-6.75
T2N	6628-16392	278647	6167208	-51.5	-82.9	S	-27.73
T2N	6628-16485	284492	6168583	-39.2	-65.4	S	-107.28
T2N	6628-16534	278602	6168018	-47.6	-77.3	S	-15.68
T2N	6628-16606	273160	6160328	-121.7	-176.9	S	-0.68
T2N	6628-16792	277397	6155773	-134.3	-197.4	S	-40.14
T2N	6628-16872	281540	6166378	-55.3	-91.2	S	-54.70
T2N	6628-17289	284812	6159768	-113.7	-165.7	S	-33.09
T2N	6628-17820	273275	6167587	-77.6	-128.6	S	-8.32
T2N	6628-17958	287087	6171033	-28.0	-45.9	S	-23.74
T2N	6628-18096	273552	6166663	-82.5	-123.6	S	-20.73
T2N	6628-18376	272966	6160938	-114.2	-182.6	S	-0.68
T2N	6628-18572	275672	6156218	-130.2	-190.2	S	-14.09
T2N	6628-18782	278120	6154160	-140.6	-200.1	S	-118.49
T2N	6628-18946	280927	6167383	-49.9	-82.5	S	-12.37
T2N	6628-18949	277797	6154593	-139.2	-202.2	S	-33.82
T2N	6628-19481A	273103	6159296	-118.6	-187.5	S	-5.00
T2N	6628-19481B	272613	6159055	-121.6	-189.1	S	-5.00
T2N	6628-19481C	273243	6158768	-120.1	-188.5	S	-5.00
T2N	6628-19669	285322	6167088	-48.1	-76.4	S	-68.25
T2N	6628-19891	284090	6165754	-57.7	-92.0	S	-11.09
T2N	6628-19892	282906	6168993	-34.0	-66.8	S	-10.46
T2N	6628-19894	274994	6155526	-127.9	-200.2	S	-6.82
T2N	6628-19921	270967	6165270	-117.1	-170.6	S	-49.10
T2N	6628-20253	286982	6167740	-45.8	-70.0	S	-54.17
T2N	6628-20271	286695	6170911	-28.1	-46.9	S	-34.06
T2N	6628-20483	285930	6166591	-53.5	-81.9	S	-136.32
T2N	6628-20484	286728	6166612	-53.1	-80.0	S	-60.93
T2N	6628-20492	289488	6165097	-74.3	-111.1	S	-27.00
T2N	6628-20493	272831	6166755	-91.9	-136.1	S	-11.37
T2N	6628-20681	272680	6167340	-85.8	-140.0	S	-11.36
T2N	6628-20726	278223	6154966	-139.2	-203.1	S	-23.53
T2N	6628-20831	283502	6159078	-116.4	-170.9	S	-13.27
T2N	6628-20855	283502	6159078	-116.4	-170.9	S	-5.46
T2N	6628-20903	282843	6166200	-55.3	-90.8	S	-14.55
T2N	6628-20907	272954	6167424	-79.7	-131.6	S	-8.73
T2N	6628-20977	272939	6166983	-88.4	-131.5	S	-5.46
T2N	6628-21246	274317	6167140	-70.5	-107.4	S	-8.05
T2N	6628-21311	278441	6167306	-51.7	-83.1	S	-7.50
T2N	6628-21312	280420	6166203	-52.3	-96.1	S	-0.68
T2N	6628-21313	286362	6167877	-43.6	-68.1	S	-93.26
T2N	6628-21402	282420	6167556	-47.1	-78.5	S	-17.63
T2N	6628-21460	274786	6169455	-58.5	-92.9	S	-3.73
T2N	6628-21543	282444	6167557	-47.1	-78.5	S	-16.37
T2N	6628-21568_A	274786	6169455	-58.5	-92.9	S	-14.01
T2N	6628-21682	275818	6156423	-129.2	-189.4	S	-24.96
T2N	6628-22280_B	272425	6167399	-93.3	-137.8	S	-7.09
T2N	6628-22301	274057	6167048	-75.3	-113.9	S	-4.00
T2N	6628-22555	289902	6162830	-93.0	-139.1	S	-9.00
T2N	6628-23055	291455	6167775	-55.8	-82.2	S	-47.27
T2N	6628-23437	287002	6167328	-48.4	-73.5	S	-43.39
T2N	6628-23467	284532	6166262	-50.1	-89.0	S	-17.42
T2N	6628-23640	286063	6167951	-43.0	-68.1	S	-60.12
T2N	6628-24986	288917	6168848	-40.0	-63.9	S	-14.41
T2N	6628-24988	285672	6169010	-35.3	-58.1	S	-48.19
T2N	6628-25139	286169	6168095	-42.0	-66.3	S	-134.71
T2N	6662NAP-T2	278236	6155326	-129.7	-208.9	S	-0.68
T2N	6764NAP-T2	271991	6167347	-92.1	-149.2	S	-0.68
T2N	PERMIT130192	271800	6167765	-91.9	-149.1	S	-10.91
T2N	PERMIT135870	276989	6155738	-125.8	-203.7	S	-9.50
T2N	PERMIT158103	270079	6165106	-126.2	-183.6	S	-61.07
T2N	PERMIT162682	271730	6165448	-102.4	-164.6	S	-13.64
T2N	PERMIT182584	278850	6167007	-48.8	-88.2	S	-9.09
T2N	PERMIT200232	270349	6165152	-116.0	-185.4	S	-40.91
T2Os	662815205	272133	6146059	-181.4	-240.4	C	-239.84
T2Os	662822421	271869	6146239	-180.2	-239.0	C	-239.84
T2Os	662822422	271807	6146018	-181.5	-240.5	C	-239.84
T2Os	662822559	271887	6145851	-182.7	-241.9	C	-239.84
T2Os	662822560	272087	6146336	-180.1	-238.9	C	-239.84
T2R	662807848	274351	6128485	-292.1	-430.5	C	-45.60
T2R	662822321	274426	6128489	-292.1	-430.5	C	-45.60
T2R	6628-02671	287230	6160332	-105.6	-167.8	S	-10.55
T2R	6628-14325	291102	6163352	-86.3	-144.9	S	-15.05
T2R	6628-15145	281789	6153609	-150.6	-209.5	S	-22.73
T2R	6628-18545	281006	6153263	-137.3	-202.9	S	-6.67
T2R	6628-18570	279756	6149375	-163.5	-207.6	S	-62.05
T2R	6628-21321	282298	6154645	-144.1	-225.1	S	-3.75

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2RP	662820033	278356	6138326	-238.9	-333.8	C	-346.39
T2RP	662820250	278023	6138279	-237.7	-326.7	C	-346.39
T2RP	662820415	278234	6138272	-238.3	-330.2	C	-346.39
T2RP	662820763	278235	6138212	-238.3	-330.2	C	-346.39
T2RP	662822558	278340	6138487	-237.8	-325.0	C	-346.39
T2V	121653NAP-T2	277192	6161092	-91.7	-156.1	S	-9.09
T2V	185757NAP-T2	286079	6165626	-56.2	-93.5	S	-2.32
T2V	187823NAP-T2	288073	6164650	-69.8	-113.1	S	-7.57
T2V	5764NAP-T2	275444	6157562	-118.0	-191.1	S	-13.50
T2V	6068NAP	275011	6158740	-112.7	-183.6	S	-0.68
T2V	6188NAP-T2	280885	6161919	-85.2	-146.4	S	-4.55
T2V	6189NAP-T2	281144	6161681	-86.8	-148.4	S	-54.54
T2V	6221NAP	275576	6164003	-77.8	-128.0	S	-4.45
T2V	6237NAP	289099	6165314	-67.3	-110.3	S	-3.00
T2V	6242NAP-T2	288032	6163458	-79.9	-129.8	S	-9.00
T2V	6270NAP-T2	288896	6165275	-66.8	-109.1	S	-1.60
T2V	6291NAP-T2	281541	6161485	-88.5	-150.5	S	-54.55
T2V	6311NAP-T2	274198	6161945	-98.7	-160.8	S	-16.25
T2V	6470NAP	273732	6161056	-107.0	-173.2	S	-0.68
T2V	6472NAP	273428	6160270	-113.6	-182.0	S	-0.68
T2V	6489NAP	274252	6160178	-109.1	-177.1	S	-0.68
T2V	6502NAP	274155	6160496	-107.0	-174.0	S	-0.68
T2V	6628-00893	275294	6165702	-72.7	-109.0	S	-4.13
T2V	6628-00895	275483	6165866	-69.8	-105.1	S	-7.50
T2V	6628-00899	275103	6165993	-67.1	-111.5	S	-20.46
T2V	6628-00906	274066	6160963	-106.5	-172.9	S	-0.68
T2V	6628-00929	278856	6166235	-57.3	-91.4	S	-52.96
T2V	6628-00930	279028	6166196	-58.4	-93.2	S	-29.10
T2V	6628-00932	278653	6166495	-52.5	-93.8	S	-22.50
T2V	6628-00998	273837	6165527	-82.3	-135.3	S	-0.68
T2V	6628-01010	273224	6164500	-99.4	-147.0	S	-36.46
T2V	6628-01026	275029	6164980	-80.6	-120.4	S	-7.50
T2V	6628-01028	275302	6164482	-80.8	-120.5	S	-21.59
T2V	6628-01036	275651	6164287	-81.3	-121.2	S	-25.37
T2V	6628-01037	275905	6164766	-71.2	-117.6	S	-0.68
T2V	6628-01041	276827	6164971	-71.5	-107.8	S	-53.74
T2V	6628-01046	275535	6164786	-78.1	-116.6	S	-11.09
T2V	6628-01051	277513	6164750	-66.5	-113.0	S	-0.68
T2V	6628-01052	277275	6164531	-73.6	-111.2	S	-53.42
T2V	6628-01057_A	278222	6164965	-68.4	-106.1	S	-15.03
T2V	6628-01058	278459	6164611	-69.6	-108.2	S	-45.01
T2V	6628-01061	278680	6164966	-62.9	-110.1	S	-0.68
T2V	6628-01065	279167	6165002	-65.3	-103.5	S	-61.41
T2V	6628-01066	279656	6164845	-61.5	-110.2	S	-0.68
T2V	6628-01068	275892	6165646	-68.8	-103.5	S	-5.31
T2V	6628-01070	275412	6165756	-67.0	-111.1	S	-1.32
T2V	6628-01071	275390	6165550	-72.8	-109.1	S	-3.36
T2V	6628-01073	275639	6165612	-70.0	-105.2	S	-5.99
T2V	6628-01074	276407	6165555	-67.7	-102.1	S	-2.04
T2V	6628-01075	276529	6165603	-65.6	-99.4	S	-3.41
T2V	6628-01076	276282	6165284	-69.8	-104.9	S	-7.50
T2V	6628-01081	277134	6165838	-58.9	-100.6	S	-6.81
T2V	6628-01090	273412	6163756	-101.7	-150.4	S	-29.28
T2V	6628-01092	273865	6163271	-100.2	-148.2	S	-14.32
T2V	6628-01093	273732	6163413	-99.2	-146.9	S	-15.46
T2V	6628-01095	274232	6164452	-84.5	-139.2	S	-0.68
T2V	6628-01099	274740	6163320	-92.3	-137.3	S	-19.14
T2V	6628-01102	275534	6163133	-89.0	-133.0	S	-19.76
T2V	6628-01105	275421	6163530	-87.4	-130.4	S	-14.32
T2V	6628-01107	275260	6163439	-88.6	-132.0	S	-20.00
T2V	6628-01109	274871	6163231	-92.3	-137.3	S	-2.14
T2V	6628-01131	275131	6163915	-86.3	-128.5	S	-23.59
T2V	6628-01138	277255	6163110	-84.1	-127.1	S	-12.62
T2V	6628-01140	279852	6163551	-72.1	-127.0	S	-0.10
T2V	6628-01144	279818	6163371	-79.2	-124.2	S	-27.28
T2V	6628-01150	276974	6163530	-76.7	-127.7	S	-1.38
T2V	6628-01151	277182	6163502	-81.1	-122.5	S	-22.73
T2V	6628-01152	277307	6163513	-80.8	-122.4	S	-95.47
T2V	6628-01166	278577	6163160	-82.1	-126.6	S	-46.41
T2V	6628-01174	275501	6164006	-82.8	-123.4	S	-5.66
T2V	6628-01206	277265	6164451	-73.6	-111.2	S	-17.66
T2V	6628-01264_A	280173	6166062	-57.8	-93.6	S	-1.01
T2V	6628-01281_A	280811	6164672	-66.9	-107.5	S	-26.91
T2V	6628-01287	282023	6165895	-52.9	-98.7	S	-26.91
T2V	6628-01292	282778	6165418	-59.1	-96.3	S	-30.69
T2V	6628-01295	283175	6165238	-60.3	-97.3	S	-19.09
T2V	6628-01303_A	283858	6165201	-60.7	-96.3	S	-12.46
T2V	6628-01329	288431	6167572	-50.4	-74.5	S	-85.92
T2V	6628-01338	288863	6168027	-47.4	-69.9	S	-51.14
T2V	6628-01339	288832	6168596	-42.0	-67.8	S	-51.14
T2V	6628-01341	287450	6168163	-44.1	-66.9	S	-64.16
T2V	6628-01362	288702	6166053	-64.1	-94.8	S	-22.73
T2V	6628-01365_A	288632	6166376	-61.6	-90.9	S	-18.16
T2V	6628-01370	287495	6166595	-56.2	-83.5	S	-29.73
T2V	6628-01380	287324	6166613	-54.5	-81.1	S	-29.55
T2V	6628-01381	287093	6166153	-58.7	-87.3	S	-13.86
T2V	6628-01383	286964	6166187	-58.7	-87.3	S	-6.30
T2V	6628-01405	289080	6165315	-71.6	-106.4	S	-37.00
T2V	6628-01413	287115	6165643	-62.7	-92.5	S	-14.57

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2V	6628-01414_A	287000	6165550	-64.1	-94.5	S	-53.87
T2V	6628-01419	288200	6164200	-78.2	-115.5	S	-4.32
T2V	6628-01425	287468	6164766	-68.6	-110.5	S	-15.95
T2V	6628-01449	286575	6163293	-83.9	-122.3	S	-59.10
T2V	6628-01452	286705	6163314	-84.3	-122.9	S	-29.87
T2V	6628-01453	287302	6163683	-81.9	-120.0	S	-10.91
T2V	6628-01457	280225	6164108	-71.8	-114.3	S	-40.03
T2V	6628-01463	280704	6164552	-68.3	-109.6	S	-41.73
T2V	6628-01464	281078	6164586	-68.0	-109.3	S	-41.73
T2V	6628-01467	282138	6165226	-56.2	-104.0	S	-20.48
T2V	6628-01468	282221	6165203	-60.8	-99.4	S	-20.48
T2V	6628-01500	282207	6164413	-65.8	-106.5	S	-30.46
T2V	6628-01511	284576	6165083	-63.1	-97.1	S	-137.52
T2V	6628-01513	285166	6165615	-58.8	-90.3	S	-96.88
T2V	6628-01520	280334	6163479	-77.1	-121.6	S	-50.79
T2V	6628-01523	280774	6163601	-75.0	-118.8	S	-12.27
T2V	6628-01527	282890	6164266	-62.1	-112.0	S	-28.41
T2V	6628-01528	282568	6163731	-72.4	-114.8	S	-26.63
T2V	6628-01546	285816	6164975	-66.8	-98.7	S	-36.06
T2V	6628-01548	286084	6164617	-69.0	-101.3	S	-46.63
T2V	6628-01549	281513	6163521	-75.8	-119.7	S	-102.79
T2V	6628-01562	284548	6164115	-67.3	-111.8	S	-0.68
T2V	6628-01565	284322	6163918	-68.9	-115.2	S	-8.57
T2V	6628-01568	285027	6163947	-70.0	-114.1	S	-0.68
T2V	6628-01569	285262	6163442	-79.2	-116.5	S	-39.83
T2V	6628-01575	285539	6163866	-71.6	-114.6	S	-4.55
T2V	6628-01578	286450	6163498	-81.6	-118.7	S	-2.13
T2V	6628-01580	282002	6163250	-77.1	-121.2	S	-17.28
T2V	6628-01718	289056	6168339	-46.5	-68.4	S	-175.19
T2V	6628-01752	289118	6167755	-51.5	-76.0	S	-82.93
T2V	6628-01757	289199	6167651	-51.5	-76.0	S	-12.27
T2V	6628-01759	289748	6167447	-51.7	-83.9	S	-3.62
T2V	6628-02053	281362	6163270	-78.0	-122.7	S	-102.79
T2V	6628-02251	273339	6161053	-110.3	-177.5	S	-12.81
T2V	6628-02267	274162	6162736	-99.8	-147.5	S	-7.04
T2V	6628-02280	274865	6162356	-98.1	-145.7	S	-42.23
T2V	6628-02281	275225	6162454	-94.3	-140.7	S	-50.35
T2V	6628-02282	275054	6162633	-94.4	-140.4	S	-38.64
T2V	6628-02285	274804	6162395	-98.1	-145.7	S	-16.03
T2V	6628-02296	274964	6161116	-104.5	-156.4	S	-99.84
T2V	6628-02318	275746	6160841	-101.9	-154.4	S	-11.36
T2V	6628-02324_A	276358	6160751	-101.6	-154.8	S	-6.66
T2V	6628-02337	275913	6160745	-102.5	-155.7	S	-7.50
T2V	6628-02340	275823	6158227	-119.9	-178.3	S	-31.82
T2V	6628-02370	276501	6160054	-105.5	-160.7	S	-6.81
T2V	6628-02373	276530	6159849	-106.8	-162.7	S	-12.62
T2V	6628-02396	276109	6157671	-115.9	-189.9	S	-0.68
T2V	6628-02407_A	277448	6161964	-92.5	-140.8	S	-12.32
T2V	6628-02409_A	277448	6161964	-91.1	-138.5	S	-10.20
T2V	6628-02416	277372	6162274	-89.7	-136.2	S	-10.91
T2V	6628-02417	277400	6162050	-91.1	-138.5	S	-12.84
T2V	6628-02420	276806	6162718	-82.6	-137.9	S	-3.09
T2V	6628-02425	276524	6162199	-92.3	-139.7	S	-40.95
T2V	6628-02426	276092	6162332	-92.5	-139.2	S	-8.59
T2V	6628-02433	276595	6161919	-93.6	-141.9	S	-5.91
T2V	6628-02442	276391	6162107	-92.7	-140.1	S	-9.21
T2V	6628-02443	276756	6162900	-86.5	-130.3	S	-9.95
T2V	6628-02444	277132	6162701	-87.1	-131.7	S	-5.93
T2V	6628-02449	276661	6161738	-89.0	-149.9	S	-9.82
T2V	6628-02451	276295	6161555	-96.7	-146.8	S	-17.96
T2V	6628-02467	276784	6161704	-88.7	-149.6	S	-7.96
T2V	6628-02474	277613	6160300	-103.6	-158.3	S	-58.28
T2V	6628-02492	278136	6162965	-84.2	-128.9	S	-7.50
T2V	6628-02493	277666	6162968	-85.0	-129.2	S	-7.08
T2V	6628-02497	278134	6162966	-78.9	-134.3	S	-4.55
T2V	6628-02499	277786	6162974	-84.7	-129.0	S	-12.14
T2V	6628-02500	279400	6163150	-75.6	-131.8	S	-0.68
T2V	6628-02501	277716	6162936	-79.5	-134.3	S	-52.60
T2V	6628-02507	278112	6162212	-88.9	-135.9	S	-10.10
T2V	6628-02508	280002	6162999	-82.6	-129.0	S	-46.41
T2V	6628-02510	279976	6162364	-87.9	-136.3	S	-52.60
T2V	6628-02533	280072	6161326	-96.5	-148.0	S	-42.23
T2V	6628-02555_A	279414	6159529	-110.4	-167.1	S	-9.29
T2V	6628-02558_A	278619	6160011	-105.5	-160.7	S	-9.89
T2V	6628-02570	276653	6160278	-104.1	-158.7	S	-7.50
T2V	6628-02581	277217	6160140	-104.9	-160.3	S	-15.91
T2V	6628-02584	277388	6160321	-103.6	-158.3	S	-15.23
T2V	6628-02585	277777	6160126	-105.1	-160.4	S	-12.73
T2V	6628-02592	278233	6159893	-106.7	-162.6	S	-20.00
T2V	6628-02597	279412	6159256	-111.9	-169.2	S	-5.11
T2V	6628-02600	280075	6158842	-108.0	-179.8	S	-50.51
T2V	6628-02601	277659	6159323	-103.8	-175.5	S	-11.14
T2V	6628-02607	276940	6159863	-106.3	-162.3	S	-6.34
T2V	6628-02608	277002	6159773	-107.6	-164.3	S	-7.98
T2V	6628-02715	281423	6162471	-85.5	-132.7	S	-45.46
T2V	6628-02723	282110	6162791	-82.9	-128.5	S	-45.10
T2V	6628-02729	285297	6161924	-95.3	-139.8	S	-33.09
T2V	6628-02734	285754	6162723	-88.8	-129.4	S	-43.39
T2V	6628-02739	285625	6162826	-86.4	-126.2	S	-54.50

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2V	6628-02767_B	280911	6161718	4.6	-17.9	S	-0.68
T2V	6628-02819_A	281943	6159599	-103.9	-172.0	S	-2.27
T2V	6628-02819_B	281943	6159599	-103.9	-172.0	S	-2.27
T2V	6628-02821	280210	6159015	-106.5	-177.7	S	-0.68
T2V	6628-03189	280728	6162994	-82.4	-128.7	S	-52.60
T2V	6628-03191	275242	6162852	-92.0	-137.2	S	-40.05
T2V	6628-03815	277872	6156703	-122.7	-200.2	S	-0.57
T2V	6628-03816	288116	6167597	-49.8	-74.0	S	-78.71
T2V	6628-03817_A	277593	6157322	-126.1	-187.6	S	-21.75
T2V	6628-03819	278121	6156817	-129.5	-191.8	S	-13.91
T2V	6628-03820	278306	6156935	-122.1	-199.6	S	-14.55
T2V	6628-03822	278329	6156788	-123.3	-201.2	S	-0.68
T2V	6628-03824	279196	6156837	-122.7	-200.1	S	-10.47
T2V	6628-03989	277588	6156249	-124.8	-202.7	S	-32.73
T2V	6628-04003	276211	6156354	-130.0	-191.0	S	-28.47
T2V	6628-04012_A	277372	6157085	-127.1	-188.6	S	-8.53
T2V	6628-04051	275511	6157278	-125.9	-185.1	S	-20.91
T2V	6628-04128	285410	6164691	-67.8	-100.7	S	-62.27
T2V	6628-04634	276400	6163560	-83.3	-124.8	S	-26.20
T2V	6628-05939	280400	6164580	-68.7	-109.9	S	-80.73
T2V	6628-05983	277250	6162760	-87.1	-131.7	S	-20.85
T2V	6628-06078	276730	6165575	-66.7	-101.2	S	-7.27
T2V	6628-06080_A	275280	6163869	-86.3	-128.5	S	-17.88
T2V	6628-06104	279450	6158200	-119.7	-179.2	S	-181.84
T2V	6628-06106	277447	6158365	-118.7	-178.5	S	-27.28
T2V	6628-06108	277566	6158548	-117.3	-176.7	S	-16.37
T2V	6628-08933	275740	6164720	-77.0	-115.0	S	-58.05
T2V	6628-09463	277357	6163111	-83.8	-127.0	S	-45.61
T2V	6628-10986	278010	6158670	-116.0	-175.0	S	-53.30
T2V	6628-11080	277070	6161850	-92.9	-141.1	S	-7.96
T2V	6628-11159	283770	6166080	-55.0	-88.6	S	-28.27
T2V	6628-11164	275045	6164200	-85.2	-126.9	S	-30.04
T2V	6628-11166	281215	6165199	-58.9	-107.8	S	-22.73
T2V	6628-11192	279401	6165722	-56.4	-101.3	S	-45.01
T2V	6628-11193	278100	6158400	-117.7	-177.1	S	-53.30
T2V	6628-11358	287780	6163170	-88.2	-129.8	S	-24.19
T2V	6628-11407	275100	6163600	-87.4	-130.2	S	-9.23
T2V	6628-11438	275870	6163940	-83.1	-123.9	S	-24.58
T2V	6628-11475	275470	6163860	-85.1	-126.7	S	-45.55
T2V	6628-11494	277020	6160530	-102.3	-156.3	S	-10.55
T2V	6628-11507	274986	6161260	-103.2	-154.4	S	-93.98
T2V	6628-11508	275290	6164480	-82.1	-122.4	S	-21.59
T2V	6628-11541	283450	6162450	-85.5	-130.1	S	-21.59
T2V	6628-11544	276620	6159570	-109.6	-166.6	S	-8.64
T2V	6628-11555	275743	6164235	-75.3	-124.1	S	-0.68
T2V	6628-11562	280560	6161820	-91.4	-141.0	S	-30.36
T2V	6628-11563	273530	6163890	-98.9	-146.6	S	-20.43
T2V	6628-11580	280700	6164650	-66.9	-107.5	S	-15.46
T2V	6628-11589	275670	6164780	-78.1	-116.6	S	-32.73
T2V	6628-11612	279200	6163750	-76.3	-119.4	S	-52.60
T2V	6628-11640	279495	6160800	-99.6	-152.5	S	-28.96
T2V	6628-11750	273250	6164300	-100.4	-148.6	S	-18.38
T2V	6628-11757	280200	6161610	-93.1	-143.3	S	-30.36
T2V	6628-11776_A	276300	6160800	-100.2	-152.8	S	-9.64
T2V	6628-11791	278850	6156954	-122.6	-200.1	S	-32.50
T2V	6628-11795	281300	6163450	-76.1	-120.2	S	-36.39
T2V	6628-11855	275900	6161970	-95.0	-143.3	S	-17.50
T2V	6628-11860	275187	6163930	-83.0	-131.8	S	-4.16
T2V	6628-11990	275800	6161900	-95.7	-144.1	S	-22.28
T2V	6628-11991	286297	6162140	-94.7	-138.1	S	-10.62
T2V	6628-12031	275800	6165750	-68.8	-103.5	S	-25.00
T2V	6628-12076	276268	6157311	-117.8	-192.3	S	-51.14
T2V	6628-12077	277860	6163495	-80.1	-122.1	S	-118.47
T2V	6628-12079	278755	6157684	-124.2	-185.1	S	-98.20
T2V	6628-12080	279180	6161450	-94.7	-145.5	S	-56.28
T2V	6628-12082	282550	6165400	-59.2	-96.8	S	-95.47
T2V	6628-12107	280250	6159900	-107.5	-162.8	S	-20.46
T2V	6628-12163	274940	6165150	-79.1	-118.2	S	-14.27
T2V	6628-12167_A	279450	6161390	-96.4	-147.9	S	-56.28
T2V	6628-12326	277970	6163250	-81.3	-124.3	S	-12.05
T2V	6628-12327	280200	6162850	-82.6	-129.0	S	-52.60
T2V	6628-12356	276730	6156910	-127.5	-188.6	S	-13.52
T2V	6628-12380	276600	6162800	-87.0	-130.8	S	-14.77
T2V	6628-12414_A	276050	6162730	-90.0	-135.0	S	-7.59
T2V	6628-12456	276740	6164370	-76.2	-114.4	S	-37.11
T2V	6628-12462	278480	6165040	-66.5	-103.8	S	-45.01
T2V	6628-12463	287650	6167700	-47.0	-70.7	S	-136.16
T2V	6628-12464	278050	6162920	-84.5	-128.9	S	-9.21
T2V	6628-12465	278400	6159150	-113.0	-171.0	S	-68.08
T2V	6628-12504	275200	6161850	-98.1	-146.8	S	-65.46
T2V	6628-12599	276850	6164420	-74.6	-112.2	S	-37.11
T2V	6628-12600	278562	6164855	-62.9	-110.1	S	-0.68
T2V	6628-12601	281300	6163700	-74.2	-117.7	S	-87.89
T2V	6628-12614	274660	6163700	-91.5	-136.1	S	-10.05
T2V	6628-12640	281950	6164010	-69.0	-110.9	S	-1.17
T2V	6628-12841	274520	6159990	-114.6	-169.7	S	-40.91
T2V	6628-12870	275090	6163400	-89.9	-133.8	S	-49.68
T2V	6628-12872_A	278240	6162950	-84.2	-128.9	S	-19.50
T2V	6628-12935	277080	6165030	-69.4	-105.1	S	-7.50

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2V	6628-13004	280800	6162200	-87.8	-136.0	S	-52.60
T2V	6628-13005	281090	6162600	-84.0	-130.9	S	-45.46
T2V	6628-13010	277150	6164200	-75.1	-113.4	S	-30.91
T2V	6628-13023	276940	6163070	-84.5	-127.4	S	-20.05
T2V	6628-13025	282350	6164380	-66.7	-107.7	S	-54.72
T2V	6628-13031	276855	6164609	-68.7	-114.4	S	-37.11
T2V	6628-13050	289700	6167400	-54.7	-80.9	S	-85.92
T2V	6628-13052	278050	6162700	-86.0	-131.2	S	-6.00
T2V	6628-13184	277180	6158670	-115.3	-174.3	S	-34.55
T2V	6628-13215	275900	6162280	-92.5	-139.2	S	-8.41
T2V	6628-13217	276200	6160100	-99.1	-167.4	S	-16.59
T2V	6628-13284	275080	6164200	-85.2	-126.9	S	-7.50
T2V	6628-13332_A	277080	6163910	-78.6	-118.2	S	-18.24
T2V	6628-13333	276650	6160780	-101.4	-154.7	S	-16.09
T2V	6628-13380	273370	6161890	-105.2	-169.9	S	-0.68
T2V	6628-13381	278910	6161440	-94.7	-145.5	S	-50.96
T2V	6628-13388	275005	6164512	-83.6	-124.7	S	-20.91
T2V	6628-13414	281300	6164170	-70.4	-112.7	S	-7.50
T2V	6628-13415	287150	6164515	-74.0	-108.3	S	-35.49
T2V	6628-13416	280930	6164140	-65.7	-118.2	S	-0.90
T2V	6628-13417	275950	6160600	-102.5	-155.7	S	-4.09
T2V	6628-13467	278100	6161270	-96.4	-147.6	S	-12.27
T2V	6628-13538	273063	6164478	-95.5	-155.3	S	-9.32
T2V	6628-13548	285300	6165100	-64.3	-96.5	S	-165.02
T2V	6628-13549	287750	6164440	-75.5	-111.0	S	-111.91
T2V	6628-13550	288020	6163960	-81.3	-120.0	S	-9.62
T2V	6628-13577	287470	6162700	-91.1	-133.6	S	-95.63
T2V	6628-13632_A	278950	6163590	-78.2	-121.8	S	-16.03
T2V	6628-13633	286700	6163450	-82.4	-120.1	S	-22.31
T2V	6628-13642	276060	6163800	-82.0	-122.4	S	-17.24
T2V	6628-13644	277300	6160800	-99.5	-152.2	S	-14.80
T2V	6628-13704	288380	6163200	-87.4	-129.5	S	-46.59
T2V	6628-13705	288300	6163090	-89.2	-132.1	S	-65.10
T2V	6628-13706	277580	6160200	-103.6	-158.3	S	-9.95
T2V	6628-13707_A	278100	6162700	-85.8	-131.2	S	-7.59
T2V	6628-13808	285900	6163200	-82.8	-120.4	S	-1.25
T2V	6628-13816	274850	6165490	-77.8	-116.5	S	-12.50
T2V	6628-13837	277600	6163750	-78.9	-119.9	S	-45.61
T2V	6628-13873	283740	6162590	-86.6	-130.6	S	-33.09
T2V	6628-13945	277343	6165859	-58.5	-100.4	S	-3.00
T2V	6628-13946	282305	6161240	-97.0	-146.7	S	-20.14
T2V	6628-13978	279410	6164240	-71.1	-112.3	S	-27.91
T2V	6628-13979	276700	6163250	-83.6	-125.7	S	-63.06
T2V	6628-13980	275800	6163100	-88.2	-131.9	S	-51.78
T2V	6628-13981	276373	6163915	-80.5	-120.3	S	-37.11
T2V	6628-13982	276658	6160181	-105.5	-160.7	S	-27.34
T2V	6628-13984	277110	6162480	-88.6	-134.1	S	-30.51
T2V	6628-13997	281060	6165210	-62.4	-101.3	S	-7.50
T2V	6628-13998	276450	6162600	-88.9	-133.6	S	-7.50
T2V	6628-14003	281134	6161301	-90.5	-153.6	S	-32.88
T2V	6628-14011_A	275550	6163000	-89.0	-133.0	S	-25.75
T2V	6628-14012_A	277700	6157550	-125.1	-186.4	S	-9.84
T2V	6628-14050_A	276804	6162255	-85.1	-142.6	S	-10.18
T2V	6628-14163	284299	6165162	-62.6	-97.7	S	-72.16
T2V	6628-14165	277771	6162424	-82.3	-139.1	S	-2.64
T2V	6628-14166	276425	6163432	-83.3	-124.8	S	-52.39
T2V	6628-14181	281886	6164857	-64.0	-103.9	S	-40.61
T2V	6628-14202	276040	6158809	-115.1	-172.9	S	-13.90
T2V	6628-14210	273769	6161228	-106.0	-171.5	S	-0.68
T2V	6628-14223	273894	6161216	-112.3	-165.1	S	-0.68
T2V	6628-14224	273685	6161179	-115.3	-169.0	S	-0.68
T2V	6628-14265	274800	6161700	-102.0	-151.8	S	-90.92
T2V	6628-14270	280230	6164290	-70.3	-112.1	S	-40.03
T2V	6628-14272	277170	6160560	-102.2	-156.3	S	-17.54
T2V	6628-14306	280630	6159120	-113.8	-170.8	S	-114.11
T2V	6628-14307	276440	6160450	-103.0	-156.8	S	-31.82
T2V	6628-14308	276440	6160450	-103.0	-156.8	S	-17.96
T2V	6628-14319	279740	6160720	-101.3	-154.7	S	-48.73
T2V	6628-14320	275850	6162470	-92.0	-137.9	S	-15.36
T2V	6628-14321	276510	6156220	-130.5	-192.0	S	-17.91
T2V	6628-14342	281196	6165376	-62.2	-101.2	S	-10.91
T2V	6628-14383	282001	6164572	-66.2	-107.1	S	-24.00
T2V	6628-14419	281810	6164650	-65.3	-105.8	S	-13.64
T2V	6628-14421	276320	6161400	-96.4	-146.5	S	-7.50
T2V	6628-14422	277520	6160090	-105.0	-160.4	S	-28.00
T2V	6628-14423	276158	6162104	-93.1	-140.5	S	-9.27
T2V	6628-14427	285480	6164250	-71.3	-104.9	S	-40.61
T2V	6628-14487	278631	6166244	-57.7	-91.6	S	-22.50
T2V	6628-14490	287140	6163775	-81.4	-119.1	S	-10.91
T2V	6628-14491	274315	6162659	-92.2	-150.5	S	-0.68
T2V	6628-14512	273310	6163870	-100.7	-149.1	S	-18.38
T2V	6628-14955	277720	6164240	-73.9	-112.9	S	-45.61
T2V	6628-14960	277450	6160380	-103.6	-158.3	S	-58.96
T2V	6628-14961	277970	6162930	-84.5	-128.9	S	-9.21
T2V	6628-15128	286570	6164680	-70.6	-103.4	S	-84.55
T2V	6628-15129	276540	6156170	-131.4	-193.1	S	-17.91
T2V	6628-15136	276097	6162807	-88.7	-132.9	S	-4.32
T2V	6628-15137	273469	6161125	-116.8	-170.9	S	-0.68
T2V	6628-15139	274986	6161260	-103.2	-154.4	S	-6.82

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2V	6628-15155	283423	6166234	-53.7	-87.6	S	-0.60
T2V	6628-15182	283780	6164399	-68.2	-106.1	S	-9.66
T2V	6628-15184	276010	6162780	-90.0	-135.0	S	-4.77
T2V	6628-15260	288840	6168010	-47.4	-69.9	S	-58.14
T2V	6628-15266	276872	6160224	-97.3	-165.1	S	-12.73
T2V	6628-15295	279980	6160630	-101.4	-154.7	S	-48.73
T2V	6628-15297	276754	6162165	-91.9	-139.3	S	-19.18
T2V	6628-15301	287192	6163753	-81.4	-119.1	S	-18.34
T2V	6628-15345	279920	6164650	-67.6	-107.9	S	-22.28
T2V	6628-15346	279990	6164650	-67.6	-107.9	S	-22.28
T2V	6628-15351	275718	6158860	-108.6	-180.0	S	-0.68
T2V	6628-15366	278409	6163303	-80.7	-124.2	S	-15.00
T2V	6628-15369	275319	6158395	-113.9	-185.9	S	-4.55
T2V	6628-15374_A	279000	6162050	-89.8	-138.4	S	-56.28
T2V	6628-15419	276414	6156258	-130.2	-191.5	S	-7.50
T2V	6628-15447_A	274063	6160720	-114.3	-168.1	S	-0.68
T2V	6628-15491	282510	6165645	-57.9	-95.0	S	-18.98
T2V	6628-15523	276873	6161950	-93.3	-141.5	S	-12.69
T2V	6628-15529	280861	6164147	-71.3	-113.8	S	-77.51
T2V	6628-15532	273308	6160819	-117.9	-172.4	S	-0.68
T2V	6628-15584	277765	6161816	-92.2	-140.6	S	-6.84
T2V	6628-15585_A	273874	6160441	-116.8	-171.3	S	-0.68
T2V	6628-15590	286489	6163385	-83.6	-121.7	S	-46.59
T2V	6628-15592	273503	6160351	-112.6	-180.8	S	-0.68
T2V	6628-15602	287880	6165208	-68.1	-100.0	S	-11.98
T2V	6628-15646	280852	6160073	-106.1	-160.5	S	-11.15
T2V	6628-15648	273596	6160560	-111.7	-179.6	S	-0.68
T2V	6628-15785	278677	6165338	-64.6	-101.4	S	-36.37
T2V	6628-15868	278692	6165252	-64.6	-101.4	S	-36.37
T2V	6628-15891	282546	6163934	-70.4	-112.1	S	-49.03
T2V	6628-15894	278316	6160086	-105.4	-160.6	S	-10.86
T2V	6628-15903	280864	6163727	-75.0	-118.8	S	-11.05
T2V	6628-16039	287163	6164499	-74.0	-108.3	S	-4.41
T2V	6628-16041	273364	6160467	-119.6	-174.5	S	-0.68
T2V	6628-16073	275163	6159080	-116.6	-173.4	S	-12.24
T2V	6628-16104	277253	6164722	-72.0	-109.1	S	-53.42
T2V	6628-16105	280035	6162081	-89.6	-138.6	S	-102.79
T2V	6628-16113_A	277435	6159275	-110.6	-168.4	S	-10.31
T2V	6628-16222	276492	6160558	-103.0	-156.8	S	-12.64
T2V	6628-16223	273957	6163348	-98.5	-145.8	S	-14.32
T2V	6628-16267	275072	6164103	-86.5	-128.9	S	-30.89
T2V	6628-16275	287337	6162153	-96.4	-141.1	S	-96.88
T2V	6628-16276	287482	6162503	-92.9	-136.2	S	-97.10
T2V	6628-16393	277147	6162958	-85.6	-129.4	S	-5.93
T2V	6628-16440	281972	6164383	-67.5	-108.9	S	-10.22
T2V	6628-16490	282246	6165043	-57.4	-105.8	S	-0.24
T2V	6628-16491	277112	6162118	-91.3	-138.6	S	-6.14
T2V	6628-16492	274967	6163158	-92.1	-137.1	S	-28.61
T2V	6628-16494	276752	6159638	-107.9	-164.5	S	-11.82
T2V	6628-16560	277367	6165490	-65.4	-100.3	S	-7.50
T2V	6628-16584	279247	6165058	-65.3	-103.5	S	-45.01
T2V	6628-16585_A	277912	6163438	-79.7	-122.0	S	-16.91
T2V	6628-16588_A	277437	6157158	-127.1	-188.6	S	-10.13
T2V	6628-16605	277647	6161108	-98.0	-150.0	S	-9.09
T2V	6628-16658_A	275647	6161143	-101.3	-153.0	S	-21.45
T2V	6628-16667	279157	6163428	-78.0	-121.8	S	-5.06
T2V	6628-16668	277412	6160553	-102.2	-156.3	S	-11.36
T2V	6628-16682	275072	6163878	-87.7	-130.5	S	-29.27
T2V	6628-16785_A	277947	6163478	-79.7	-122.0	S	-18.75
T2V	6628-16786_A	277112	6164083	-76.7	-115.6	S	-15.95
T2V	6628-16788	286879	6166103	-58.2	-86.8	S	-6.82
T2V	6628-16790	275400	6157950	-123.5	-182.0	S	-19.32
T2V	6628-16899	287858	6163215	-86.4	-127.1	S	-60.99
T2V	6628-16947	277776	6162153	-85.0	-144.0	S	-7.50
T2V	6628-17063_A	278897	6162583	-86.7	-133.7	S	-23.46
T2V	6628-17064	273701	6159878	-113.1	-181.8	S	-0.68
T2V	6628-17065	276002	6161158	-99.8	-151.6	S	-7.68
T2V	6628-17066	276187	6161213	-97.9	-148.9	S	-11.18
T2V	6628-17067	275761	6160793	-103.2	-156.3	S	-30.86
T2V	6628-17128	274137	6160108	-116.0	-170.8	S	-3.44
T2V	6628-17221_A	275022	6163973	-87.7	-130.5	S	-4.86
T2V	6628-17222	276657	6162793	-88.4	-133.1	S	-8.41
T2V	6628-17255	277447	6156878	-128.3	-190.1	S	-17.97
T2V	6628-17286	281271	6163963	-67.4	-120.7	S	-13.64
T2V	6628-17287	287352	6168078	-44.1	-66.9	S	-101.60
T2V	6628-17290_A	276820	6162305	-90.6	-137.0	S	-15.47
T2V	6628-17523	275150	6157990	-124.0	-182.3	S	-14.77
T2V	6628-17917	273896	6159928	-113.1	-181.8	S	-0.68
T2V	6628-17918_A	274807	6161378	-104.6	-155.9	S	-21.02
T2V	6628-17919	275182	6158128	-122.8	-180.8	S	-6.91
T2V	6628-17920	285132	6163113	-83.6	-122.8	S	-39.83
T2V	6628-17921	285797	6161968	-96.0	-140.2	S	-53.45
T2V	6628-18165	277117	6159218	-110.4	-168.3	S	-25.15
T2V	6628-18189	278289	6156852	-129.5	-191.8	S	-11.36
T2V	6628-18377	273218	6160909	-112.5	-180.5	S	-0.68
T2V	6628-18422	276720	6159812	-106.6	-162.5	S	-24.55
T2V	6628-18453	276477	6164073	-79.1	-118.1	S	-16.76
T2V	6628-18455	278297	6162143	-90.4	-138.3	S	-8.96
T2V	6628-18497	277072	6160908	-99.6	-152.4	S	-27.28

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2V	6628-18498	273432	6161828	-111.7	-163.9	S	-30.04
T2V	6628-18520	276357	6162138	-92.7	-140.1	S	-26.82
T2V	6628-18578	276508	6165210	-68.8	-103.9	S	-10.68
T2V	6628-18579	283307	6162988	-81.4	-124.7	S	-11.20
T2V	6628-18580_A	278232	6160093	-105.3	-160.5	S	-9.33
T2V	6628-18581	277137	6157153	-126.7	-188.1	S	-12.83
T2V	6628-18589	287412	6165198	-68.9	-101.1	S	-47.15
T2V	6628-18590	277612	6162923	-85.0	-129.2	S	-68.51
T2V	6628-18591	273801	6160608	-109.3	-176.5	S	-0.68
T2V	6628-18615	283612	6164648	-64.9	-102.4	S	-9.19
T2V	6628-18616	286926	6166273	-53.8	-88.2	S	-3.30
T2V	6628-18622	276437	6163503	-83.3	-124.8	S	-26.20
T2V	6628-18776	285012	6162663	-87.6	-129.0	S	-24.99
T2V	6628-18833	277452	6160423	-102.2	-156.3	S	-16.88
T2V	6628-18945	275187	6165401	-74.3	-111.3	S	-19.09
T2V	6628-18948	278037	6162083	-90.5	-138.2	S	-34.29
T2V	6628-19041	286932	6164003	-77.2	-112.7	S	-29.87
T2V	6628-19042	286767	6163928	-78.6	-114.6	S	-55.82
T2V	6628-19044	275503	6157954	-123.1	-181.8	S	-25.68
T2V	6628-19162	281507	6164198	-70.0	-112.2	S	-13.50
T2V	6628-19163	275412	6157987	-123.5	-182.0	S	-4.09
T2V	6628-19391	275602	6161918	-96.4	-144.9	S	-22.28
T2V	6628-19392	276102	6162628	-89.3	-134.2	S	-17.96
T2V	6628-19482	277797	6161975	-92.2	-140.6	S	-4.25
T2V	6628-19483	277972	6162438	-87.6	-133.6	S	-25.91
T2V	6628-19500	276662	6159798	-108.2	-164.7	S	-7.49
T2V	6628-19512	279347	6166398	-57.0	-91.5	S	-24.33
T2V	6628-19515	288727	6163573	-86.4	-128.4	S	-10.41
T2V	6628-19516	277037	6160718	-100.9	-154.3	S	-11.36
T2V	6628-19555	276563	6165322	-68.8	-103.9	S	-42.38
T2V	6628-19893	277254	6162260	-89.9	-136.3	S	-12.32
T2V	6628-19956	274034	6163315	-98.5	-145.8	S	-7.77
T2V	6628-20035	284430	6164535	-63.5	-107.7	S	-4.09
T2V	6628-20140	287029	6162597	-92.2	-134.7	S	-5.55
T2V	6628-20171	278368	6157277	-126.9	-188.6	S	-18.09
T2V	6628-20173	286891	6162427	-91.9	-134.0	S	-2.28
T2V	6628-20254	277058	6158943	-106.6	-179.2	S	-9.41
T2V	6628-20292	280551	6160309	-104.6	-158.6	S	-13.64
T2V	6628-20294	276793	6156493	-129.7	-191.2	S	-70.10
T2V	6628-20433	282082	6163862	-71.0	-113.5	S	-13.64
T2V	6628-20434	284185	6165290	-61.0	-95.6	S	-28.19
T2V	6628-20482_A	277336	6159240	-110.6	-168.4	S	-15.38
T2V	6628-20558	275908	6159158	-113.7	-171.2	S	-15.95
T2V	6628-20559	276762	6162996	-86.5	-130.3	S	-9.82
T2V	6628-20570	279859	6159320	-112.0	-169.2	S	-21.93
T2V	6628-20648_A	285339	6164597	-69.5	-102.8	S	-9.22
T2V	6628-20725	277940	6157716	-124.0	-185.1	S	-29.78
T2V	6628-20737	276207	6163807	-81.1	-121.0	S	-24.15
T2V	6628-20769	276417	6163883	-80.5	-120.3	S	-15.31
T2V	6628-20770	277868	6158981	-114.2	-172.7	S	-6.75
T2V	6628-20776	288262	6164024	-80.0	-118.2	S	-8.18
T2V	6628-20777	279551	6159145	-113.5	-171.2	S	-11.36
T2V	6628-20836	279940	6163884	-73.8	-116.8	S	-40.91
T2V	6628-20886_A	276441	6160674	-101.6	-154.8	S	-12.75
T2V	6628-20900	278989	6164956	-62.2	-110.0	S	-0.68
T2V	6628-20901	277427	6160681	-100.8	-154.3	S	-14.81
T2V	6628-20950	279787	6163944	-73.9	-116.9	S	-1.24
T2V	6628-20952	279175	6162678	-84.8	-131.4	S	-62.95
T2V	6628-20974	285858	6164133	-74.0	-107.5	S	-26.93
T2V	6628-20984	274336	6163515	-93.9	-139.5	S	-26.47
T2V	6628-21006	287665	6165245	-67.5	-99.1	S	-66.02
T2V	6628-21251	275913	6162892	-88.7	-132.9	S	-45.88
T2V	6628-21252_A	280749	6161659	-93.1	-143.1	S	-11.90
T2V	6628-21255	274865	6164012	-88.0	-131.0	S	-14.78
T2V	6628-21256	275658	6163817	-84.1	-125.3	S	-45.46
T2V	6628-21261	274767	6160196	-112.2	-166.8	S	-13.64
T2V	6628-21315	280338	6157841	-123.4	-183.3	S	-12.00
T2V	6628-21316	274049	6160578	-108.8	-176.1	S	-0.68
T2V	6628-21344	277349	6159683	-100.9	-171.2	S	-0.68
T2V	6628-21571	274957	6165471	-71.3	-118.1	S	-0.68
T2V	6628-21677	276168	6161247	-97.9	-148.9	S	-10.46
T2V	6628-21681	277338	6162020	-91.1	-138.5	S	-9.04
T2V	6628-21707	281422	6164248	-68.8	-110.6	S	-40.61
T2V	6628-21791	278336	6157092	-128.3	-190.3	S	-15.93
T2V	6628-21831	273582	6160457	-111.7	-179.6	S	-0.68
T2V	6628-21832	282845	6164381	-66.9	-107.2	S	-28.41
T2V	6628-21833	286988	6162946	-88.5	-129.3	S	-95.63
T2V	6628-21962	277778	6162688	-86.3	-131.3	S	-55.73
T2V	6628-21970	285134	6162936	-85.8	-125.9	S	-107.54
T2V	6628-22076	280712	6160160	-106.1	-160.5	S	-26.91
T2V	6628-22078	280624	6160017	-106.1	-160.6	S	-20.00
T2V	6628-22079	287853	6166123	-60.9	-89.6	S	-9.59
T2V	6628-22080_A	286085	6162362	-92.7	-135.2	S	-49.69
T2V	6628-22307	276717	6159933	-106.6	-162.5	S	-3.00
T2V	6628-22381	274864	6163637	-90.1	-134.1	S	-12.42
T2V	6628-22431	280259	6163534	-77.2	-121.7	S	-16.50
T2V	6628-22433_A	279166	6163637	-76.3	-119.4	S	-10.79
T2V	6628-22518	281092	6164926	-65.2	-105.3	S	-54.55
T2V	6628-22521	277684	6162084	-90.9	-138.4	S	-6.68

GMZ	Well_ID	x	y	Screen top (mAHD)	Screen Base (mAHD)	Pumping Seasonal Constant	Rate (ML/year)
T2V	6628-22563	275387	6162626	-92.2	-137.7	S	-51.58
T2V	6628-22569	280092	6165107	-60.1	-108.3	S	-5.91
T2V	6628-22570	276038	6162968	-88.7	-132.9	S	-15.00
T2V	6628-22606	283473	6165415	-59.0	-95.1	S	-14.12
T2V	6628-22785	276714	6162133	-91.9	-139.3	S	-9.09
T2V	6628-23057	278806	6159711	-108.6	-164.9	S	-14.55
T2V	6628-23136	287576	6164179	-78.7	-115.5	S	-9.09
T2V	6628-23164	287395	6168027	-44.1	-66.9	S	-104.78
T2V	6628-23630	276602	6164710	-73.6	-110.6	S	-11.87
T2V	6628-23641	289192	6168554	-45.5	-66.7	S	-175.19
T2V	6628-23772	278452	6163307	-75.5	-129.4	S	-46.41
T2V	6628-23832	287912	6167346	-50.7	-75.5	S	-84.20
T2V	6628-23833	279615	6159767	-108.9	-165.1	S	-3.75
T2V	6628-23834	275269	6163467	-88.6	-132.0	S	-19.76
T2V	6628-24547	287253	6167421	-44.6	-74.7	S	-22.73
T2V	6628-24634	285243	6163208	-81.4	-119.7	S	-43.39
T2V	6628-24635	283652	6165406	-59.1	-94.7	S	-56.68
T2V	6628-24983	280374	6161079	-98.3	-150.3	S	-102.82
T2V	6628-24984	275137	6163733	-87.4	-130.2	S	-19.76
T2V	6628-24985_A	275019	6158024	-123.4	-181.2	S	-4.50
T2V	6628-25141	275529	6161625	-91.4	-152.6	S	-17.64
T2V	6628-25278	284479	6165527	-57.4	-95.5	S	-68.17
T2V	6628-25279	287888	6164896	-67.8	-109.5	S	-95.63
T2V	6628-25457	274775	6163722	-86.6	-137.6	S	-11.49
T2V	6628-25460	282754	6163871	-67.3	-115.0	S	-34.54
T2V	6628-25844	288912	6164598	-73.5	-121.0	S	-10.91
T2V	6628-26084	275016	6164065	-81.3	-133.7	S	-4.86
T2V	6628-90065	275690	6158950	-109.3	-180.5	S	-0.68
T2V	6904NAP-T2	276549	6157871	-114.4	-188.6	S	-0.68
T2V	NAP_6109	280915	6159120	-107.0	-177.4	S	-11.88
T2V	NAP-T2PERMIT124285	276720	6159811	-99.8	-169.2	S	-6.82
T2V	NAP-T2PERMIT129493	280350	6162418	-80.5	-139.7	S	-52.60
T2V	PERMIT134790	280882	6162078	-89.6	-138.4	S	-4.55
T2V	PERMIT154561	276050	6162730	-90.0	-135.0	S	-2.25
T2V	PERMIT184088	280943	6162056	-83.6	-143.9	S	-10.63
T2V	PERMIT184970	278767	6162865	-83.4	-128.9	S	-9.91
T2V	PERMIT185631	278037	6160117	-105.2	-160.4	S	-13.12
T2V	PERMIT186605	275465	6162967	-85.6	-141.2	S	-30.04
T2V	PERMIT187285	275582	6158343	-113.4	-185.6	S	-9.09
T2V	PERMIT190308	283744	6166221	-53.6	-86.8	S	-54.19
T2V	PERMIT194194	275675	6164156	-82.8	-123.4	S	-9.10
T2V	PERMIT55155	275712	6165599	-66.0	-109.7	S	-1.44

Appendix B Model Outputs

B1. Head Outputs (mAHD un-corrected)

B1.1. Model G6 (Cyclic Management Pumping)

Years	Time	PTG085	PTG060	PTG031	PTA161	PTA127	PTA111	PTA095	PTA094	PTA093	PTA091	PTA082	PTA051	MUW038	MUW034	MUW031	MUW030	MUW029	MPA159	MPA152	MPA144	MPA158	MPA081	MPA048
0.5	181	-36.2	-8.4	-29.5	-4.8	-3.9	-2.1	-2.0	-22.1	0.5	-72.4	-63.3	1.0	15.8	16.1	53.6	19.0	13.5	-61.2	3.8	-78.9	-72.4	-17.3	-38.9
1.0	365	-13.9	-3.1	-14.2	2.9	1.7	2.4	1.7	-15.5	2.1	-40.2	-31.3	1.5	27.6	20.3	54.5	31.4	27.0	-36.8	8.3	-41.4	-34.7	-8.6	5.7
1.5	547	-37.6	-9.9	-32.5	-5.3	-4.3	-2.5	-2.4	-26.2	0.2	-77.5	-66.7	0.6	15.6	15.6	52.7	18.9	13.4	-67.6	3.4	-79.6	-73.6	-21.7	-39.8
2.0	731	-16.6	-3.9	-16.1	2.4	1.3	2.1	1.4	-17.6	1.8	-44.7	-34.9	1.3	27.4	19.8	54.2	31.2	26.8	-41.0	8.0	-46.3	-38.9	-10.8	4.8
2.5	912	-38.1	-10.4	-33.4	-5.8	-4.7	-2.8	-2.8	-27.5	0.0	-78.9	-67.5	0.5	15.4	15.1	52.4	18.7	13.1	-69.3	3.0	-79.7	-73.8	-23.0	-40.6
3.0	1096	-17.8	-4.1	-16.7	2.0	1.0	1.9	1.1	-18.3	1.7	-46.3	-36.2	1.1	27.2	19.3	53.8	31.0	26.6	-42.5	7.7	-48.5	-40.7	-11.6	4.2
3.5	1277	-33.9	-9.7	-30.3	-6.0	-4.9	-2.9	-2.9	-24.8	0.0	-67.4	-58.2	0.5	15.3	15.3	52.1	18.8	13.0	-58.3	2.9	-77.3	-66.4	-18.1	-29.4
4.0	1461	-10.5	-3.0	-12.8	1.9	0.9	1.8	1.0	-15.1	1.8	-34.5	-26.3	1.3	27.1	19.3	53.5	30.9	26.4	-32.0	7.6	-33.9	-28.1	-7.0	7.8
4.5	1642	-32.1	-8.9	-28.4	-6.2	-5.0	-3.0	-3.0	-22.7	0.1	-63.5	-55.2	0.6	15.1	15.1	51.8	18.6	12.9	-54.1	2.8	-74.9	-63.1	-15.7	-29.2
5.0	1826	-9.9	-2.6	-12.0	1.6	0.7	1.7	0.9	-14.1	1.8	-32.8	-25.1	1.3	26.9	19.0	53.2	30.7	26.3	-30.2	7.4	-32.4	-26.8	-6.0	7.8
5.5	2008	-31.8	-8.7	-28.0	-6.4	-5.2	-3.1	-3.1	-22.3	0.0	-62.6	-54.5	0.6	15.0	14.8	51.5	18.5	12.8	-53.3	2.7	-74.0	-62.4	-15.3	-29.1
6.0	2192	-9.9	-2.5	-11.9	1.3	0.5	1.5	0.7	-14.0	1.7	-32.5	-24.9	1.2	26.8	18.8	52.9	30.5	26.1	-29.9	7.2	-32.2	-26.6	-5.9	7.5
6.5	2373	-32.0	-8.8	-28.1	-6.7	-5.4	-3.3	-3.3	-22.3	-0.1	-62.7	-54.7	0.5	14.8	14.5	51.2	18.2	12.5	-53.4	2.4	-74.3	-62.6	-15.4	-29.6
7.0	2557	-12.5	-2.8	-13.1	1.0	0.2	1.3	0.5	-14.9	1.6	-37.0	-28.8	1.2	26.5	18.3	52.6	30.2	25.9	-33.7	7.0	-37.9	-31.6	-7.5	4.2
7.5	2738	-38.2	-9.9	-32.5	-7.3	-5.8	-3.6	-3.7	-26.2	-0.4	-77.2	-66.6	0.3	14.5	13.6	50.9	17.6	12.2	-67.3	2.0	-79.5	-73.6	-21.9	-41.2
8.0	2922	-17.6	-4.0	-16.3	0.5	-0.2	1.0	0.1	-18.0	1.3	-45.1	-35.3	0.9	26.3	17.7	52.4	29.9	25.6	-41.5	6.6	-47.0	-39.9	-11.7	2.8
8.5	3103	-38.7	-10.5	-33.7	-7.7	-6.2	-3.9	-4.0	-28.1	-0.6	-79.3	-67.8	0.2	14.2	13.2	50.7	17.4	12.0	-70.0	1.7	-79.8	-73.9	-24.0	-41.7
9.0	3287	-19.3	-4.3	-17.2	0.2	-0.4	0.8	-0.1	-19.0	1.1	-47.6	-37.3	0.8	26.1	17.3	52.2	29.6	25.4	-43.7	6.3	-50.5	-42.5	-12.8	2.2
9.5	3469	-34.9	-9.9	-30.7	-7.8	-6.2	-4.0	-4.0	-25.6	-0.6	-68.3	-58.9	0.2	14.2	13.4	50.6	17.5	12.0	-59.5	1.6	-77.8	-67.6	-19.3	-31.1
10.0	3653	-11.7	-3.2	-13.3	0.1	-0.5	0.7	-0.1	-16.0	1.2	-35.6	-27.2	0.9	25.9	17.3	52.0	29.5	25.3	-33.2	6.2	-35.1	-29.5	-8.2	5.8
10.5	3834	-33.3	-9.1	-29.0	-7.9	-6.3	-4.0	-4.1	-23.6	-0.5	-64.5	-56.1	0.3	14.0	13.2	50.4	17.2	11.7	-55.4	1.5	-75.7	-64.4	-17.0	-31.0
11.0	4018	-11.0	-2.8	-12.5	-0.1	-0.6	0.6	-0.2	-15.0	1.2	-33.9	-25.9	0.9	25.7	17.0	51.8	29.3	25.1	-31.5	6.1	-33.6	-28.2	-7.3	5.7
11.5	4199	-33.1	-9.0	-28.7	-8.1	-6.5	-4.2	-4.3	-23.2	-0.6	-63.8	-55.6	0.2	13.8	12.9	50.2	17.0	11.5	-54.6	1.3	-75.4	-64.0	-16.6	-31.2
12.0	4383	-11.0	-2.8	-12.4	-0.3	-0.8	0.5	-0.4	-14.8	1.1	-33.6	-25.8	0.9	25.5	16.7	51.6	29.1	24.9	-31.2	5.9	-33.5	-28.1	-7.2	5.5
12.5	4564	-33.1	-9.0	-28.6	-8.4	-6.7	-4.3	-4.4	-23.2	-0.6	-63.8	-55.6	0.2	13.6	12.7	50.0	16.8	11.3	-54.6	1.1	-75.4	-64.0	-16.7	-31.4
13.0	4748	-11.1	-2.8	-12.5	-0.5	-0.9	0.4	-0.5	-14.9	1.1	-33.7	-25.8	0.9	25.3	16.4	51.5	28.8	24.7	-31.3	5.7	-33.5	-28.2	-7.4	5.2
13.5	4930	-33.1	-9.0	-28.6	-8.5	-6.8	-4.4	-4.5	-23.2	-0.7	-63.7	-55.4	0.2	13.5	12.5	49.9	16.7	11.2	-54.6	1.0	-75.3	-63.9	-16.8	-31.3
14.0	5114	-11.2	-2.8	-12.5	-0.8	-1.1	0.2	-0.7	-15.0	1.0	-33.7	-25.8	0.8	25.1	16.1	51.3	28.6	24.5	-31.4	5.5	-33.6	-28.3	-7.5	4.9
14.5	5295	-33.4	-9.0	-28.7	-8.8	-7.0	-4.6	-4.7	-23.3	-0.8	-64.0	-55.7	0.1	13.2	12.3	49.7	16.4	11.0	-54.9	0.7	-75.5	-64.3	-17.0	-31.8
15.0	5479	-11.4	-2.8	-12.6	-1.0	-1.3	0.1	-0.8	-15.1	0.9	-33.9	-26.0	0.8	24.9	15.8	51.1	28.4	24.3	-31.6	5.4	-33.8	-28.5	-7.7	4.6
15.5	5660	-33.5	-9.0	-28.8	-9.0	-7.2	-4.7	-4.8	-23.4	-0.8	-64.1	-55.8	0.1	13.0	12.0	49.6	16.2	10.8	-55.0	0.6	-75.6	-64.5	-17.2	-32.0
16.0	5844	-11.5	-2.8	-12.6	-1.2	-1.4	-0.1	-1.0	-15.2	0.9	-34.1	-26.1	0.8	24.7	15.5	51.0	28.2	24.1	-31.8	5.2	-34.0	-28.7	-7.9	4.3
16.5	6025	-33.7	-9.1	-28.9	-9.2	-7.3	-4.9	-5.0	-23.6	-0.9	-64.2	-55.9	0.1	12.8	11.8	49.4	16.0	10.6	-55.2	0.4	-75.7	-64.7	-17.3	-32.2
17.0	6209	-11.7	-2.9	-12.7	-1.4	-1.6	-0.2	-1.1	-15.3	0.8	-34.2	-26.2	0.7	24.5	15.2	50.8	28.0	23.9	-31.9	5.0	-34.1	-28.9	-8.1	4.0
17.5	6391	-33.6	-9.0	-28.8	-9.4	-7.4	-5.0	-5.1	-23.6	-1.0	-64.2	-55.8	0.0	12.7	11.6	49.3	15.8	10.5	-55.2	0.2	-75.6	-64.6	-17.5	-32.1
18.0	6575	-11.8	-2.9	-12.7	-1.6	-1.7	-0.3	-1.2	-15.4	0.7	-34.3	-26.2	0.7	24.3	15.0	50.7	27.7	23.7	-32.0	4.8	-34.2	-29.0	-8.2	3.7
18.5	6756	-33.8	-9.0	-28.9	-7.8	-6.3	-4.0	-4.3	-23.5	-0.7	-64.4	-56.0	0.1	12.5	11.4	49.2	15.6	10.2	-55.3	1.1	-75.8	-65.0	-17.6	-32.6
19.0	6940	-11.9	-2.9	-12.7	-1.2	-1.5	-0.1	-1.1	-15.4	0.8	-34.3	-26.3	0.7	24.1	14.7	50.5	27.5	23.5	-32.1	5.0	-34.3	-29.2	-8.3	3.4
19.5	7121	-34.0	-9.0	-28.9	-7.9	-6.3	-4.1	-4.4	-23.6	-0.8	-64.5	-56.1	0.1	12.3	11.2	49.1	15.4	10.0	-55.4	1.0	-75.9	-65.2	-17.7	-32.8
20.0	7305	-12.0	-2.9	-12.8	-1.4	-1.6	-0.2	-1.1	-15.4	0.7	-34.4	-26.4	0.7	23.9	14.4	50.4	27.3	23.3	-32.2	4.9	-34.4	-29.4	-8.5	3.2
20.5	7486	-34.1	-9.0	-29.0	-8.0	-6.4	-4.2	-4.5	-23.6	-0.8	-64.6	-56.2	0.1	12.1	10.9	49.0	15.2	9.9	-55.6	0.9	-76.0	-65.3	-17.9	-33.0
21.0	7670	-12.1	-2.9	-12.8	-1.5	-1.6	-0.3	-1.2	-15.5	0.7	-34.6	-26.5	0.6	23.8	14.2	50.2	27.1	23.1	-32.3	4.7	-34.5	-29.6	-8.6	2.9
21.5	7852	-34.0	-9.0	-28.9	-8.1	-6.5	-4.2	-4.5	-23.7	-0.8	-64.5	-56.0	0.0	12.0	10.8	48.9	15.1	9.8	-55.5	0.8	-75.9	-65.2	-18.0	-32.9

Years	Time	PTG085	PTG060	PTG031	PTA161	PTA127	PTA111	PTA095	PTA094	PTA093	PTA091	PTA082	PTA051	MUW038	MUW034	MUW031	MUW030	MUW029	MPA159	MPA152	MPA144	MPA158	MPA081	MPA048
22.0	8036	-12.2	-2.9	-12.8	-1.6	-1.7	-0.3	-1.3	-15.6	0.6	-34.6	-26.5	0.6	23.6	14.0	50.1	26.9	22.9	-32.4	4.6	-34.6	-29.7	-8.8	2.7
22.5	8217	-34.3	-9.1	-29.0	-8.2	-6.6	-4.3	-4.6	-23.8	-0.9	-64.7	-56.3	0.0	11.7	10.5	48.8	14.8	9.5	-55.8	0.7	-76.1	-65.6	-18.2	-33.4
23.0	8401	-12.4	-2.9	-12.9	-1.7	-1.8	-0.4	-1.3	-15.7	0.6	-34.8	-26.6	0.6	23.4	13.7	49.9	26.7	22.8	-32.6	4.5	-34.8	-29.9	-8.9	2.4
23.5	8582	-34.4	-9.1	-29.1	-8.3	-6.7	-4.4	-4.7	-23.9	-1.0	-64.9	-56.4	0.0	11.6	10.3	48.7	14.6	9.3	-55.9	0.5	-76.2	-65.8	-18.3	-33.6
24.0	8766	-12.5	-3.0	-13.0	-1.8	-1.9	-0.5	-1.4	-15.8	0.5	-34.9	-26.7	0.5	23.2	13.5	49.8	26.5	22.6	-32.7	4.4	-34.9	-30.1	-9.1	2.2
24.5	8947	-34.5	-9.1	-29.2	-8.4	-6.7	-4.4	-4.7	-23.9	-1.0	-65.0	-56.5	-0.1	11.4	10.1	48.6	14.4	9.2	-56.0	0.4	-76.3	-65.9	-18.5	-33.8
25.0	9131	-12.6	-3.0	-13.0	-1.9	-2.0	-0.5	-1.5	-15.8	0.5	-35.0	-26.8	0.5	23.0	13.2	49.7	26.3	22.4	-32.8	4.3	-35.0	-30.2	-9.3	1.9
25.5	9313	-34.5	-9.1	-29.1	-8.5	-6.8	-4.5	-4.8	-24.0	-1.0	-64.9	-56.3	-0.1	11.3	9.9	48.5	14.3	9.1	-56.0	0.3	-76.2	-65.9	-18.6	-33.8
26.0	9497	-12.7	-3.0	-13.0	-2.0	-2.0	-0.6	-1.5	-15.9	0.4	-35.0	-26.8	0.5	22.8	13.0	49.5	26.1	22.2	-32.9	4.2	-35.1	-30.3	-9.4	1.7
26.5	9678	-34.7	-9.1	-29.2	-8.6	-6.9	-4.6	-4.9	-24.1	-1.1	-65.1	-56.6	-0.1	11.0	9.7	48.4	14.1	8.8	-56.2	0.2	-76.4	-66.2	-18.8	-34.2
27.0	9862	-12.8	-3.0	-13.1	-2.1	-2.1	-0.7	-1.6	-16.0	0.4	-35.2	-27.0	0.5	22.6	12.7	49.4	25.9	22.0	-33.0	4.1	-35.2	-30.6	-9.6	1.5
27.5	10043	-34.8	-9.2	-29.3	-8.7	-7.0	-4.7	-4.9	-24.2	-1.2	-65.2	-56.7	-0.1	10.9	9.5	48.3	13.9	8.7	-56.4	0.1	-76.5	-66.4	-19.0	-34.4
28.0	10227	-12.9	-3.0	-13.2	-2.2	-2.2	-0.7	-1.7	-16.1	0.3	-35.3	-27.0	0.4	22.5	12.5	49.3	25.7	21.8	-33.2	3.9	-35.4	-30.7	-9.7	1.2
28.5	10408	-35.0	-9.2	-29.3	-8.8	-7.0	-4.7	-5.0	-24.2	-1.2	-65.3	-56.8	-0.2	10.7	9.3	48.2	13.7	8.5	-56.5	0.0	-76.5	-66.5	-19.1	-34.6
29.0	10592	-13.0	-3.0	-13.2	-2.3	-2.3	-0.8	-1.7	-16.1	0.3	-35.4	-27.1	0.4	22.3	12.3	49.1	25.5	21.7	-33.3	3.8	-35.5	-30.9	-9.9	1.0
29.5	10774	-34.9	-9.2	-29.3	-8.9	-7.1	-4.8	-5.0	-24.3	-1.2	-65.2	-56.6	-0.2	10.7	9.1	48.1	13.6	8.4	-56.5	-0.1	-76.4	-66.5	-19.2	-34.6
30.0	10958	-13.1	-3.0	-13.2	-2.4	-2.3	-0.9	-1.8	-16.2	0.2	-35.4	-27.1	0.4	22.1	12.1	49.0	25.3	21.5	-33.3	3.7	-35.5	-31.0	-10.0	0.8
30.5	11139	-35.0	-9.1	-29.3	-9.0	-7.1	-4.8	-5.1	-24.3	-1.3	-65.2	-56.6	-0.2	10.5	8.9	48.1	13.5	8.3	-56.5	-0.2	-76.4	-66.5	-19.3	-34.8
31.0	11323	-13.2	-3.1	-13.2	-2.5	-2.4	-0.9	-1.9	-16.2	0.2	-35.5	-27.2	0.4	21.9	11.8	48.9	25.1	21.3	-33.4	3.6	-35.6	-31.1	-10.1	0.6
31.5	11504	-35.1	-9.2	-29.3	-9.1	-7.2	-4.9	-5.2	-24.3	-1.3	-65.3	-56.7	-0.2	10.4	8.7	48.0	13.3	8.1	-56.6	-0.3	-76.5	-66.6	-19.4	-34.9
32.0	11688	-13.3	-3.1	-13.3	-2.6	-2.5	-1.0	-1.9	-16.3	0.1	-35.5	-27.3	0.3	21.7	11.6	48.8	24.9	21.1	-33.5	3.5	-35.7	-31.2	-10.2	0.3
32.5	11869	-35.2	-9.2	-29.3	-9.2	-7.3	-5.0	-5.2	-24.4	-1.4	-65.4	-56.8	-0.3	10.2	8.6	47.9	13.1	8.0	-56.7	-0.4	-76.5	-66.8	-19.6	-35.1
33.0	12053	-13.4	-3.1	-13.3	-2.7	-2.6	-1.1	-2.0	-16.4	0.1	-35.6	-27.3	0.3	21.5	11.4	48.7	24.7	20.9	-33.6	3.4	-35.8	-31.4	-10.4	0.1
33.5	12235	-35.3	-9.2	-29.4	-9.3	-7.4	-5.0	-5.3	-24.5	-1.4	-65.5	-56.9	-0.3	10.1	8.4	47.8	13.0	7.9	-56.9	-0.5	-76.6	-67.0	-19.7	-35.3
34.0	12419	-13.5	-3.1	-13.4	-2.8	-2.6	-1.1	-2.1	-16.4	0.0	-35.8	-27.4	0.3	21.4	11.2	48.6	24.6	20.8	-33.8	3.3	-36.0	-31.6	-10.6	-0.1
34.5	12600	-35.4	-9.2	-29.4	-9.4	-7.4	-5.1	-5.4	-24.6	-1.5	-65.6	-56.9	-0.3	9.9	8.2	47.8	12.8	7.7	-56.9	-0.6	-76.7	-67.1	-19.9	-35.5
35.0	12784	-13.6	-3.1	-13.4	-2.9	-2.7	-1.2	-2.1	-16.5	0.0	-35.8	-27.5	0.3	21.2	11.0	48.5	24.4	20.6	-33.8	3.2	-36.0	-31.7	-10.7	-0.3
35.5	12965	-35.4	-9.2	-29.5	-9.5	-7.5	-5.1	-5.4	-24.6	-1.5	-65.7	-57.0	-0.3	9.8	8.0	47.7	12.7	7.6	-57.0	-0.7	-76.7	-67.2	-20.0	-35.7
36.0	13149	-13.7	-3.1	-13.4	-3.0	-2.8	-1.3	-2.2	-16.6	-0.1	-35.9	-27.5	0.2	21.0	10.8	48.4	24.2	20.4	-33.9	3.1	-36.2	-31.8	-10.8	-0.5
36.5	13330	-35.5	-9.2	-29.5	-9.6	-7.6	-5.2	-5.5	-24.7	-1.6	-65.7	-57.0	-0.4	9.6	7.8	47.6	12.5	7.4	-57.1	-0.9	-76.8	-67.3	-20.1	-35.9
37.0	13514	-13.8	-3.1	-13.5	-3.1	-2.8	-1.3	-2.2	-16.6	-0.1	-36.0	-27.6	0.2	20.8	10.6	48.3	24.1	20.2	-34.1	3.0	-36.3	-32.0	-11.0	-0.7
37.5	13696	-35.7	-9.3	-29.6	-9.7	-7.7	-5.3	-5.5	-24.8	-1.6	-65.9	-57.2	-0.4	9.5	7.6	47.5	12.4	7.3	-57.3	-1.0	-76.9	-67.5	-20.3	-36.1
38.0	13880	-13.9	-3.2	-13.5	-3.2	-2.9	-1.4	-2.3	-16.7	-0.1	-36.1	-27.7	0.2	20.6	10.4	48.2	23.9	20.0	-34.2	2.9	-36.4	-32.2	-11.1	-0.9
38.5	14061	-35.7	-9.3	-29.6	-9.8	-7.7	-5.3	-5.6	-24.8	-1.6	-65.9	-57.2	-0.4	9.4	7.5	47.5	12.2	7.2	-57.3	-1.1	-76.9	-67.6	-20.4	-36.3
39.0	14245	-14.0	-3.2	-13.6	-3.3	-3.0	-1.5	-2.4	-16.8	-0.2	-36.2	-27.8	0.1	20.5	10.2	48.1	23.7	19.9	-34.3	2.8	-36.5	-32.3	-11.3	-1.1
39.5	14426	-35.8	-9.3	-29.6	-9.9	-7.8	-5.4	-5.7	-24.9	-1.7	-66.0	-57.2	-0.5	9.2	7.3	47.4	12.1	7.0	-57.4	-1.2	-77.0	-67.7	-20.6	-36.4
40.0	14610	-14.1	-3.2	-13.6	-3.4	-3.0	-1.5	-2.4	-16.8	-0.2	-36.3	-27.8	0.1	20.3	10.0	48.0	23.6	19.7	-34.4	2.7	-36.6	-32.4	-11.4	-1.3

B1.2. Model G11 (Continuous MAV Pumping)

Years	Time	PTG085	PTG060	PTG031	PTA161	PTA127	PTA111	PTA095	PTA094	PTA093	PTA091	PTA082	PTA051	MUW038	MUW034	MUW031	MUW030	MUW029	MPA159	MPA152	MPA144	MPA158	MPA081	MPA048
0.5	181	-28.9	-7.4	-25.3	-3.1	-2.6	-1.1	-1.2	-18.9	1.0	-57.5	-50.6	1.2	15.9	16.8	53.7	19.4	13.6	-48.0	4.9	-69.6	-18.95	-11.9	-27.1
1.0	365	-8.0	-1.8	-10.4	3.6	2.2	2.9	2.1	-11.9	2.4	-29.6	-22.7	1.7	27.7	20.7	54.5	31.6	27.0	-26.9	8.8	-29.6	-58.04	-3.7	9.7
1.5	547	-30.5	-8.2	-27.0	-3.4	-2.9	-1.3	-1.4	-20.8	0.8	-60.9	-53.3	1.0	15.8	16.5	52.8	19.4	13.6	-51.4	4.6	-72.6	-23.93	-13.8	-27.6
2.0	731	-8.8	-2.2	-11.2	3.2	1.9	2.7	1.9	-13.0	2.3	-31.3	-23.9	1.6	27.6	20.4	54.2	31.5	26.9	-28.6	8.6	-31.0	-60.76	-4.7	9.2
2.5	912	-31.1	-8.4	-27.5	-3.8	-3.2	-1.5	-1.6	-21.4	0.7	-61.9	-54.1	0.9	15.6	16.1	52.5	19.2	13.3	-52.4	4.4	-73.6	-25.23	-14.4	-28.2
3.0	1096	-9.1	-2.3	-11.5	3.0	1.7	2.5	1.7	-13.3	2.2	-31.8	-24.3	1.5	27.4	20.1	53.9	31.3	26.7	-29.2	8.4	-31.5	-61.72	-5.1	8.8
3.5	1277	-31.4	-8.5	-27.7	-4.0	-3.4	-1.7	-1.8	-21.7	0.6	-62.3	-54.4	0.9	15.4	15.8	52.2	19.0	13.2	-52.8	4.2	-73.9	-25.74	-14.7	-28.6
4.0	1461	-9.3	-2.4	-11.6	2.7	1.5	2.3	1.5	-13.5	2.1	-32.1	-24.5	1.5	27.2	19.8	53.6	31.1	26.6	-29.4	8.2	-31.7	-62.07	-5.3	8.5
4.5	1642	-31.6	-8.5	-27.8	-4.3	-3.6	-1.8	-2.0	-21.8	0.5	-62.5	-54.5	0.8	15.3	15.5	51.8	18.8	13.0	-53.0	4.0	-74.1	-26.02	-14.9	-28.9
5.0	1826	-9.5	-2.4	-11.7	2.4	1.3	2.2	1.4	-13.6	2.0	-32.2	-24.7	1.4	27.1	19.5	53.2	30.9	26.4	-29.6	8.0	-31.9	-62.31	-5.5	8.2
5.5	2008	-31.6	-8.5	-27.7	-4.5	-3.8	-2.0	-2.1	-21.9	0.5	-62.4	-54.5	0.8	15.2	15.2	51.6	18.7	12.9	-53.1	3.8	-74.0	-26.24	-15.1	-28.9
6.0	2192	-9.6	-2.4	-11.7	2.2	1.1	2.0	1.2	-13.7	2.0	-32.3	-24.7	1.4	26.9	19.2	53.0	30.7	26.2	-29.7	7.8	-32.0	-62.27	-5.7	7.9
6.5	2373	-31.9	-8.6	-27.9	-4.8	-4.0	-2.1	-2.3	-22.0	0.4	-62.8	-54.8	0.7	14.9	14.9	51.3	18.4	12.7	-53.4	3.6	-74.5	-26.38	-15.3	-29.5
7.0	2557	-9.8	-2.5	-11.8	2.0	1.0	1.9	1.1	-13.9	1.9	-32.5	-24.9	1.3	26.7	18.9	52.7	30.5	26.1	-30.0	7.6	-32.3	-62.70	-5.9	7.6
7.5	2738	-32.1	-8.6	-28.0	-5.0	-4.1	-2.3	-2.4	-22.2	0.3	-62.9	-54.9	0.7	14.8	14.6	51.1	18.2	12.5	-53.6	3.4	-74.7	-26.63	-15.5	-29.7
8.0	2922	-10.0	-2.5	-11.9	1.7	0.8	1.8	0.9	-14.0	1.8	-32.7	-25.0	1.3	26.5	18.6	52.5	30.3	25.9	-30.1	7.4	-32.4	-62.92	-6.1	7.3
8.5	3103	-32.2	-8.7	-28.1	-5.2	-4.3	-2.4	-2.6	-22.3	0.2	-63.1	-55.0	0.7	14.6	14.3	50.8	18.0	12.3	-53.7	3.3	-74.8	-26.84	-15.6	-30.0
9.0	3287	-10.2	-2.5	-12.0	1.5	0.6	1.6	0.8	-14.1	1.7	-32.8	-25.1	1.2	26.4	18.3	52.3	30.0	25.7	-30.3	7.3	-32.6	-63.11	-6.2	7.1
9.5	3469	-32.2	-8.6	-28.0	-5.4	-4.4	-2.5	-2.7	-22.3	0.2	-63.0	-54.9	0.6	14.5	14.1	50.7	17.8	12.2	-53.7	3.1	-74.7	-27.03	-15.8	-30.0
10.0	3653	-10.3	-2.6	-12.0	1.3	0.5	1.5	0.6	-14.2	1.7	-32.9	-25.2	1.2	26.2	18.0	52.1	29.8	25.5	-30.4	7.1	-32.7	-63.05	-6.4	6.8
10.5	3834	-32.5	-8.7	-28.2	-5.7	-4.6	-2.7	-2.9	-22.5	0.1	-63.3	-55.2	0.6	14.2	13.8	50.5	17.5	12.0	-54.0	2.9	-75.1	-27.15	-16.0	-30.5
11.0	4018	-10.5	-2.6	-12.1	1.1	0.3	1.4	0.5	-14.3	1.6	-33.1	-25.4	1.2	26.0	17.7	51.9	29.6	25.3	-30.6	6.9	-32.9	-63.45	-6.6	6.5
11.5	4199	-32.7	-8.7	-28.3	-5.9	-4.8	-2.8	-3.0	-22.6	0.0	-63.5	-55.3	0.5	14.0	13.6	50.3	17.3	11.8	-54.2	2.8	-75.2	-27.39	-16.2	-30.7
12.0	4383	-10.6	-2.6	-12.2	0.9	0.2	1.3	0.4	-14.4	1.5	-33.2	-25.5	1.1	25.8	17.5	51.7	29.4	25.2	-30.8	6.8	-33.1	-63.65	-6.8	6.3
12.5	4564	-32.8	-8.8	-28.3	-6.1	-4.9	-2.9	-3.1	-22.7	0.0	-63.6	-55.4	0.5	13.9	13.3	50.1	17.1	11.6	-54.4	2.6	-75.3	-27.58	-16.3	-30.9
13.0	4748	-10.7	-2.7	-12.2	0.7	0.0	1.1	0.2	-14.5	1.5	-33.4	-25.6	1.1	25.6	17.2	51.6	29.2	25.0	-30.9	6.6	-33.2	-63.83	-6.9	6.0
13.5	4930	-32.8	-8.7	-28.3	-6.2	-5.0	-3.0	-3.2	-22.7	-0.1	-63.6	-55.3	0.5	13.8	13.1	50.0	17.0	11.5	-54.3	2.5	-75.2	-27.77	-16.4	-30.9
14.0	5114	-10.8	-2.7	-12.3	0.5	-0.1	1.0	0.1	-14.6	1.4	-33.4	-25.6	1.1	25.4	17.0	51.4	29.0	24.8	-31.0	6.4	-33.3	-63.76	-7.1	5.8
14.5	5295	-33.1	-8.8	-28.4	-6.4	-5.2	-3.1	-3.4	-22.9	-0.2	-63.9	-55.6	0.4	13.5	12.9	49.8	16.7	11.3	-54.6	2.3	-75.5	-27.87	-16.6	-31.3
15.0	5479	-11.0	-2.7	-12.4	0.3	-0.3	0.9	0.0	-14.7	1.3	-33.6	-25.8	1.0	25.3	16.7	51.3	28.7	24.6	-31.2	6.3	-33.5	-64.14	-7.3	5.5
15.5	5660	-33.2	-8.8	-28.5	-6.6	-5.3	-3.3	-3.5	-23.0	-0.3	-64.0	-55.7	0.4	13.3	12.6	49.7	16.5	11.1	-54.8	2.1	-75.6	-28.11	-16.8	-31.5
16.0	5844	-11.2	-2.7	-12.4	0.2	-0.4	0.8	-0.1	-14.8	1.3	-33.8	-25.9	1.0	25.1	16.4	51.1	28.5	24.4	-31.4	6.1	-33.6	-64.32	-7.4	5.2
16.5	6025	-33.4	-8.9	-28.6	-6.8	-5.5	-3.4	-3.6	-23.1	-0.3	-64.1	-55.8	0.4	13.1	12.4	49.5	16.3	10.9	-54.9	2.0	-75.7	-28.29	-17.0	-31.7
17.0	6209	-11.3	-2.8	-12.5	0.0	-0.5	0.7	-0.2	-14.9	1.2	-33.9	-26.0	0.9	24.9	16.1	51.0	28.3	24.2	-31.5	6.0	-33.8	-64.49	-7.6	4.9
17.5	6391	-33.4	-8.8	-28.5	-6.9	-5.6	-3.4	-3.7	-23.1	-0.4	-64.1	-55.7	0.3	13.0	12.2	49.4	16.2	10.8	-54.9	1.8	-75.6	-28.46	-17.1	-31.6
18.0	6575	-11.4	-2.8	-12.5	-0.2	-0.7	0.6	-0.3	-15.0	1.1	-33.9	-26.0	0.9	24.7	15.8	50.8	28.1	24.0	-31.6	5.8	-33.9	-64.41	-7.7	4.7
18.5	6756	-33.6	-8.9	-28.7	-7.1	-5.7	-3.6	-3.8	-23.3	-0.4	-64.3	-56.0	0.3	12.8	12.0	49.3	15.9	10.5	-55.2	1.7	-75.9	-28.56	-17.3	-32.1
19.0	6940	-11.6	-2.8	-12.6	-0.4	-0.8	0.5	-0.4	-15.1	1.1	-34.1	-26.2	0.9	24.5	15.6	50.7	27.9	23.9	-31.8	5.7	-34.1	-64.78	-7.9	4.4
19.5	7121	-33.7	-8.9	-28.7	-7.3	-5.9	-3.7	-3.9	-23.4	-0.5	-64.5	-56.1	0.3	12.6	11.8	49.2	15.7	10.4	-55.4	1.5	-76.0	-28.79	-17.5	-32.3
20.0	7305	-11.7	-2.8	-12.6	-0.5	-0.9	0.4	-0.5	-15.2	1.0	-34.3	-26.3	0.8	24.3	15.3	50.5	27.7	23.7	-31.9	5.5	-34.2	-64.95	-8.1	4.1
20.5	7486	-33.9	-9.0	-28.8	-7.5	-6.0	-3.8	-4.0	-23.5	-0.6	-64.6	-56.2	0.2	12.4	11.6	49.1	15.5	10.2	-55.5	1.4	-76.1	-28.96	-17.6	-32.5
21.0	7670	-11.8	-2.8	-12.7	-0.7	-1.0	0.3	-0.6	-15.3	0.9	-34.4	-26.3	0.8	24.1	15.0	50.4	27.5	23.5	-32.1	5.4	-34.3	-65.11	-8.3	3.9
21.5	7852	-33.8	-8.9	-28.7	-7.6	-6.1	-3.9	-4.1	-23.5	-0.6	-64.5	-56.1	0.2	12.3	11.4	49.0	15.4	10.1	-55.5	1.2	-75.9	-29.13	-17.7	-32.4
22.0	8036	-11.9	-2.8	-12.7	-0.8	-1.1	0.2	-0.7	-15.3	0.9	-34.4	-26.4	0.8	23.9	14.8	50.2	27.3	23.3	-32.1	5.2	-34.4	-65.03	-8.4	3.6
22.5	8217	-34.1	-9.0	-28.9	-7.8	-6.2	-4.0	-4.2	-23.7	-0.7	-64.8	-56.3	0.2	12.1	11.2	48.9	15.1	9.8	-55.7	1.1	-76.2	-29.22	-17.9	-32.9
23.0	8401	-12.1	-2.9	-12.8	-1.0	-1.3	0.1	-0.8	-15.5	0.8	-34.6	-26.5	0.7	23.7	14.5	50.1	27.0	23.1	-32.3	5.1	-34.6	-65.39	-8.6	3.4
23.5	8582	-34.2	-9.0	-29.0	-7.9	-6.3	-4.1	-4.3	-23.8	-0.8	-64.9	-56.4	0.1	11.9	11.0	48.8	14.9	9.7	-55.9	0.9	-76.3	-29.44	-18.1	-33.1
24.0	8766	-12.2	-2.9	-12.9	-1.1	-1.4	0.0	-0.9	-15.6	0.8	-34.7	-26.6	0.7	23.6	14.3	50.0	26.8	22.9	-32.5	4.9	-34.7	-65.56	-8.8	3.1
24.5	8947	-34.3	-9.0	-29.0	-8.1	-6.4	-4.2	-4.4	-23.9	-0.8	-65.0	-56.5	0.1	11.7	10.8	48.7	14.7	9.5	-56.0	0.8	-76.4	-29.61	-18.3	-33.3
25.0	9131	-12.3	-2.9	-12.9	-1.3	-1.5	-0.1	-1.0	-15.6	0.7	-34.8	-26.7	0.7	23.4	14.0	49.8	26.6	22.8	-32.6	4.8	-34.9	-65.71	-8.9	2.9
25.5	9313	-34.3	-9.0	-28.9	-8.2	-6.5	-4.3	-4.5	-23.9	-0.9	-65.0	-56.4	0.1	11.6	10.6	48.6	14.6	9.4	-56.0	0.7	-76.3	-29.77	-18.4	-33.2
26.0	9497	-12.4	-2.9	-12.9	-1.4	-1.6	-0.2	-1.1	-15.7	0.6	-34.9	-26.7	0.6	23.2	13.8	49.7	26.4	22.6	-32.7	4.7	-34.9	-65.62	-9.0	2.6
26.5	9678	-34.5	-9.1	-29.1	-8.4	-6.7	-4.4	-4.6	-24.0	-0.9	-65.2	-56.7	0.0	11.4	10.4	48.5	14.4	9.2	-56.3	0.5	-76.5	-29.85	-18.6	-33.7

Years	Time	PTG085	PTG060	PTG031	PTA161	PTA127	PTA111	PTA095	PTA094	PTA093	PTA091	PTA082	PTA051	MUW038	MUW034	MUW031	MUW030	MUW029	MPA159	MPA152	MPA144	MPA158	MPA081	MPA048
27.0	9862	-12.5	-3.0	-13.0	-1.6	-1.7	-0.3	-1.2	-15.8	0.6	-35.1	-26.9	0.6	23.0	13.6	49.5	26.2	22.4	-32.9	4.5	-35.1	-65.97	-9.2	2.4
27.5	10043	-34.7	-9.1	-29.2	-8.5	-6.8	-4.5	-4.7	-24.1	-1.0	-65.4	-56.8	0.0	11.2	10.2	48.4	14.2	9.0	-56.4	0.4	-76.6	-30.07	-18.7	-33.9
28.0	10227	-12.7	-3.0	-13.1	-1.7	-1.8	-0.4	-1.3	-15.9	0.5	-35.2	-27.0	0.6	22.8	13.3	49.4	26.0	22.2	-33.0	4.4	-35.2	-66.13	-9.4	2.2
28.5	10408	-34.8	-9.1	-29.2	-8.6	-6.9	-4.6	-4.8	-24.2	-1.0	-65.5	-56.9	-0.1	11.1	10.0	48.3	14.0	8.8	-56.5	0.2	-76.6	-30.23	-18.9	-34.1
29.0	10592	-12.8	-3.0	-13.1	-1.9	-1.9	-0.5	-1.4	-16.0	0.5	-35.3	-27.0	0.5	22.7	13.1	49.3	25.8	22.0	-33.1	4.3	-35.4	-66.28	-9.6	1.9
29.5	10774	-34.8	-9.1	-29.1	-8.7	-6.9	-4.6	-4.9	-24.2	-1.1	-65.4	-56.7	-0.1	11.0	9.8	48.2	14.0	8.8	-56.5	0.1	-76.5	-30.38	-19.0	-34.0
30.0	10958	-12.9	-3.0	-13.1	-2.0	-2.0	-0.6	-1.5	-16.0	0.4	-35.3	-27.1	0.5	22.5	12.9	49.2	25.7	21.9	-33.2	4.1	-35.4	-66.19	-9.7	1.7
30.5	11139	-34.8	-9.1	-29.1	-8.9	-7.0	-4.7	-4.9	-24.3	-1.1	-65.4	-56.7	-0.1	10.8	9.6	48.2	13.8	8.6	-56.5	0.0	-76.5	-30.46	-19.1	-34.2
31.0	11323	-12.9	-3.0	-13.1	-2.1	-2.1	-0.7	-1.6	-16.1	0.4	-35.4	-27.1	0.5	22.3	12.7	49.1	25.5	21.7	-33.3	4.0	-35.5	-66.22	-9.8	1.5
31.5	11504	-34.9	-9.1	-29.2	-9.0	-7.1	-4.8	-5.0	-24.3	-1.2	-65.4	-56.8	-0.1	10.7	9.4	48.1	13.6	8.5	-56.6	-0.1	-76.6	-30.57	-19.2	-34.4
32.0	11688	-13.1	-3.0	-13.2	-2.2	-2.2	-0.8	-1.7	-16.2	0.3	-35.5	-27.2	0.4	22.2	12.5	49.0	25.3	21.5	-33.4	3.9	-35.6	-66.34	-9.9	1.3
32.5	11869	-35.0	-9.1	-29.2	-9.1	-7.2	-4.9	-5.1	-24.4	-1.2	-65.5	-56.9	-0.2	10.5	9.3	48.0	13.5	8.3	-56.7	-0.2	-76.7	-30.71	-19.4	-34.5
33.0	12053	-13.2	-3.0	-13.2	-2.4	-2.3	-0.8	-1.7	-16.2	0.3	-35.6	-27.3	0.4	22.0	12.2	48.9	25.1	21.4	-33.5	3.8	-35.7	-66.48	-10.1	1.0
33.5	12235	-35.2	-9.1	-29.3	-9.2	-7.3	-5.0	-5.2	-24.5	-1.3	-65.7	-57.0	-0.2	10.4	9.1	47.9	13.3	8.2	-56.9	-0.4	-76.8	-30.85	-19.6	-34.7
34.0	12419	-13.3	-3.1	-13.3	-2.5	-2.4	-0.9	-1.8	-16.3	0.2	-35.7	-27.4	0.4	21.8	12.0	48.8	25.0	21.2	-33.6	3.6	-35.9	-66.69	-10.3	0.8
34.5	12600	-35.2	-9.2	-29.3	-9.4	-7.4	-5.0	-5.3	-24.6	-1.3	-65.7	-57.0	-0.2	10.3	8.9	47.9	13.2	8.1	-57.0	-0.5	-76.8	-31.03	-19.7	-34.9
35.0	12784	-13.4	-3.1	-13.3	-2.6	-2.5	-1.0	-1.9	-16.4	0.2	-35.8	-27.4	0.4	21.6	11.8	48.7	24.8	21.0	-33.7	3.5	-35.9	-66.76	-10.4	0.6
35.5	12965	-35.3	-9.2	-29.3	-9.5	-7.5	-5.1	-5.3	-24.6	-1.4	-65.8	-57.1	-0.3	10.1	8.7	47.8	13.0	7.9	-57.1	-0.6	-76.8	-31.15	-19.8	-35.1
36.0	13149	-13.5	-3.1	-13.4	-2.7	-2.6	-1.1	-2.0	-16.5	0.1	-35.9	-27.5	0.3	21.4	11.6	48.6	24.6	20.8	-33.8	3.4	-36.1	-66.88	-10.5	0.4
36.5	13330	-35.4	-9.2	-29.4	-9.6	-7.6	-5.2	-5.4	-24.7	-1.4	-65.9	-57.2	-0.3	10.0	8.5	47.7	12.9	7.8	-57.2	-0.7	-76.9	-31.29	-20.0	-35.3
37.0	13514	-13.6	-3.1	-13.4	-2.9	-2.6	-1.2	-2.1	-16.6	0.1	-36.0	-27.6	0.3	21.3	11.4	48.5	24.4	20.7	-34.0	3.3	-36.2	-67.01	-10.7	0.2
37.5	13696	-35.6	-9.2	-29.5	-9.7	-7.7	-5.3	-5.5	-24.8	-1.5	-66.1	-57.3	-0.3	9.8	8.4	47.7	12.7	7.6	-57.4	-0.8	-77.0	-31.43	-20.1	-35.5
38.0	13880	-13.7	-3.1	-13.5	-3.0	-2.7	-1.2	-2.1	-16.7	0.0	-36.1	-27.7	0.3	21.1	11.2	48.4	24.3	20.5	-34.1	3.1	-36.3	-67.22	-10.9	0.0
38.5	14061	-35.6	-9.2	-29.5	-9.9	-7.8	-5.4	-5.6	-24.9	-1.5	-66.1	-57.3	-0.4	9.7	8.2	47.6	12.6	7.5	-57.4	-1.0	-77.0	-31.60	-20.3	-35.6
39.0	14245	-13.8	-3.1	-13.5	-3.1	-2.8	-1.3	-2.2	-16.7	0.0	-36.2	-27.7	0.2	20.9	11.0	48.3	24.1	20.3	-34.2	3.0	-36.4	-67.28	-11.0	-0.2
39.5	14426	-35.7	-9.2	-29.5	-10.0	-7.8	-5.4	-5.6	-24.9	-1.6	-66.2	-57.4	-0.4	9.6	8.0	47.5	12.4	7.4	-57.5	-1.1	-77.1	-31.71	-20.4	-35.8
40.0	14610	-13.9	-3.2	-13.5	-3.2	-2.9	-1.4	-2.3	-16.8	-0.1	-36.3	-27.8	0.2	20.7	10.8	48.2	24.0	20.1	-34.3	2.9	-36.5	-67.40	-11.1	-0.4

B2. Water Balance Outputs

B2.1. Model G6 (Cyclic Management Pumping)

Time [day]	TOTAL OUT Rates [m^3/day]	RECHARGE OUT Rates [m^3/day]	HEAD DEP BOUNDS OUT Rates [m^3/day]	ET OUT Rates [m^3/day]	RIVER LEAKAGE OUT Rates [m^3/day]	WELLS OUT Rates [m^3/day]	CONSTANT HEAD OUT Rates [m^3/day]	STORAGE OUT Rates [m^3/day]	TOTAL IN Rates [m^3/day]	RECHARGE IN Rates [m^3/day]	HEAD DEP BOUNDS IN Rates [m^3/day]	ET IN Rates [m^3/day]	RIVER LEAKAGE IN Rates [m^3/day]	WELLS IN Rates [m^3/day]	CONSTANT HEAD IN Rates [m^3/day]	STORAGE IN Rates [m^3/day]
181	445824	0	5604	142943	74069	157433	5976	59800	445825	87960	7692	0	13759	0	3817	332597
365	328587	0	5208	142488	53822	67004	6107	53957	328584	87960	7637	0	13391	0	3641	215955
547	373827	0	4912	140668	43876	156774	5894	21703	373830	87960	7932	0	14031	0	4086	259821
731	293597	0	4713	140825	37599	66960	6033	37467	293595	87960	7764	0	13693	0	3780	180397
912	350181	0	4500	139783	32446	157433	5845	10174	350182	87960	8027	0	14334	0	4194	235666
1096	276187	0	4186	139710	28823	67004	5983	30482	276185	87960	7839	0	14058	0	3851	162476
1277	319315	0	3882	138173	25368	140290	5825	5776	319316	87960	8017	0	14498	0	4171	204670
1461	260243	0	3800	137592	22923	62781	5997	27150	260241	87960	7768	0	14140	0	3756	146616
1642	309685	0	3683	135738	20327	140438	5835	3663	309686	87960	7968	0	14576	0	4087	195094
1826	250173	0	3626	134670	18570	62825	6001	24481	250170	87960	7771	0	14256	0	3726	136458
2008	300538	0	3535	132315	16517	139872	5835	2463	300541	87960	7994	0	14602	0	4082	185903
2192	241521	0	3501	130909	15214	62781	5994	23122	241519	87960	7808	0	14311	0	3733	127706
2373	293256	0	3421	128286	13559	140438	5826	1726	293257	87960	8043	0	14697	0	4104	178452
2557	234589	0	3392	126400	12583	67004	5972	19239	234586	87960	7881	0	14447	0	3778	120520
2738	302146	0	3313	123125	11228	157433	5789	1259	302147	87960	8195	0	14772	0	4255	186965
2922	229065	0	3281	120482	10553	66960	5906	21883	229062	87960	8049	0	14588	0	3946	114519
3103	293634	0	3208	116745	9481	157433	5741	1027	293635	87960	8321	0	14733	0	4392	178229
3287	221891	0	3178	114329	9027	67004	5859	22494	221888	87960	8134	0	14571	0	4030	107192
3469	269301	0	3109	111564	8160	139872	5722	873	269304	87960	8308	0	14835	0	4369	153832
3653	212238	0	3085	109893	7872	62781	5869	22739	212235	87960	8053	0	14627	0	3932	97663
3834	264525	0	3016	107457	7133	140438	5730	751	264525	87960	8242	0	14894	0	4283	149146
4018	206298	0	2992	105800	6953	62825	5873	21856	206295	87960	8032	0	14705	0	3897	91701
4199	259382	0	2923	103338	6311	140438	5728	645	259382	87960	8242	0	14967	0	4276	143937
4383	201002	0	2901	101580	6218	62781	5867	21655	200999	87960	8039	0	14796	0	3903	86300
4564	254310	0	2832	99105	5655	140438	5719	560	254309	87960	8255	0	15044	0	4292	138757
4748	196266	0	2811	97553	5625	62825	5855	21597	196263	87960	8061	0	14880	0	3925	81436
4930	249176	0	2742	95215	5125	139872	5709	513	249178	87960	8273	0	15110	0	4312	133523
5114	191686	0	2718	93510	5142	62781	5843	21692	191683	87960	8074	0	14931	0	3943	76774
5295	244891	0	2646	90915	4690	140438	5695	506	244891	87960	8292	0	15122	0	4337	129179
5479	186810	0	2620	88960	4751	62825	5827	21828	186807	87960	8098	0	14975	0	3969	71804
5660	239846	0	2547	86263	4348	140438	5681	569	239846	87960	8313	0	15170	0	4362	124041
5844	181567	0	2520	83994	4436	62781	5813	22023	181563	87960	8113	0	15029	0	3991	66469
6025	233948	0	2449	80726	4068	140438	5666	601	233948	87960	8328	0	15197	0	4386	118076
6209	175652	0	2422	78285	4171	62825	5797	22153	175649	87960	8134	0	15059	0	4016	60479
6391	227901	0	2349	75660	3844	139872	5652	523	227902	87960	8345	0	15241	0	4407	111949
6575	171097	0	2324	74117	3963	62781	5782	22130	171093	87960	8147	0	15108	0	4036	55842
6756	220585	0	2255	72139	3683	136431	5657	419	220584	87960	8346	0	15255	0	4363	104660
6940	167303	0	2232	70988	3805	61701	5783	22795	167300	87960	8158	0	15130	0	4029	52023
7121	217339	0	2165	69218	3556	136431	5652	316	217338	87960	8360	0	15274	0	4376	101366
7305	164196	0	2145	68152	3679	61657	5777	22786	164193	87960	8170	0	15107	0	4041	48914
7486	214353	0	2081	66480	3451	136431	5645	265	214353	87960	8375	0	15235	0	4391	98390
7670	161254	0	2064	65382	3575	61701	5768	22765	161251	87960	8189	0	15080	0	4058	45963
7852	210735	0	2001	63602	3373	135887	5637	235	210737	87960	8389	0	15232	0	4403	94752
8036	158125	0	1985	62422	3498	61657	5760	22802	158121	87960	8199	0	15097	0	4069	42796
8217	208071	0	1926	60555	3317	136431	5627	214	208070	87960	8405	0	15268	0	4420	92016
8401	154806	0	1913	59145	3452	61701	5749	22847	154803	87960	8218	0	15114	0	4087	39423
8582	203920	0	1855	56538	3281	136431	5617	197	203919	87960	8420	0	15280	0	4436	87822
8766	148995	0	1844	53412	3412	61657	5740	22931	148991	87960	8230	0	15145	0	4101	33555
8947	196605	0	1788	49351	3246	136431	5607	181	196604	87960	8435	0	15310	0	4452	80447

Time	TOTAL OUT	RECHARGE OUT	HEAD DEP BOUNDS OUT	ET OUT	RIVER LEAKAGE OUT	WELLS OUT	CONSTANT HEAD OUT	STORAGE OUT	TOTAL IN	RECHARGE IN	HEAD DEP BOUNDS IN	ET IN	RIVER LEAKAGE IN	WELLS IN	CONSTANT HEAD IN	STORAGE IN
9131	141805	0	1779	46260	3374	61701	5728	22963	141801	87960	8248	0	15172	0	4118	26303
9313	189665	0	1726	43071	3213	135887	5597	171	189666	87960	8447	0	15337	0	4464	73457
9497	136278	0	1719	40804	3338	61657	5719	23041	136274	87960	8257	0	15196	0	4129	20732
9678	185477	0	1667	38456	3179	136431	5586	157	185476	87960	8462	0	15365	0	4481	69207
9862	132414	0	1661	36947	3305	61701	5706	23094	132410	87960	8276	0	15223	0	4147	16804
10043	181803	0	1612	34894	3146	136431	5575	145	181802	87960	8477	0	15391	0	4497	65477
10227	128745	0	1608	33322	3272	61657	5696	23190	128741	87960	8286	0	15226	0	4160	13107
10408	178497	0	1560	31665	3120	136431	5564	156	178495	87960	8490	0	15395	0	4512	62138
10592	126854	0	1556	31360	3261	61701	5683	23292	126850	87960	8304	0	15253	0	4177	11156
10774	177018	0	1509	30774	3136	135887	5553	159	177019	87960	8502	0	15402	0	4524	60630
10958	126359	0	1506	30908	3264	61701	5672	23308	126355	87960	8316	0	15261	0	4190	10628
11139	176619	0	1458	30494	3115	135887	5543	123	176618	87960	8514	0	15426	0	4536	60182
11323	126095	0	1456	30693	3235	61701	5662	23348	126090	87960	8327	0	15286	0	4202	10314
11504	176330	0	1410	30306	3088	135887	5532	107	176328	87960	8526	0	15450	0	4549	59843
11688	125877	0	1410	30515	3205	61701	5650	23396	125873	87960	8340	0	15312	0	4216	10045
11869	176069	0	1365	30140	3059	135887	5521	97	176068	87960	8539	0	15473	0	4563	59532
12053	125701	0	1366	30359	3174	61701	5639	23463	125697	87960	8353	0	15338	0	4230	9816
12235	175827	0	1323	29992	3032	135887	5509	84	175828	87960	8552	0	15499	0	4579	59237
12419	125545	0	1325	30215	3143	61701	5627	23534	125540	87960	8366	0	15365	0	4245	9604
12600	175605	0	1283	29861	3007	135887	5498	70	175604	87960	8564	0	15524	0	4592	58963
12784	125382	0	1285	30086	3113	61701	5615	23582	125378	87960	8378	0	15385	0	4258	9396
12965	175391	0	1244	29733	2982	135887	5486	59	175390	87960	8576	0	15550	0	4606	58698
13149	125236	0	1247	29958	3083	61701	5604	23643	125232	87960	8390	0	15407	0	4272	9203
13330	175185	0	1207	29608	2957	135887	5475	51	175184	87960	8588	0	15575	0	4620	58440
13514	125102	0	1211	29835	3056	61701	5592	23707	125098	87960	8402	0	15427	0	4285	9023
13696	174984	0	1172	29485	2934	135887	5463	44	174985	87960	8601	0	15600	0	4635	58188
13880	124984	0	1178	29712	3030	61701	5580	23783	124979	87960	8415	0	15451	0	4300	8853
14061	174795	0	1140	29367	2911	135887	5451	39	174794	87960	8612	0	15626	0	4648	57947
14245	124862	0	1146	29596	3004	61701	5569	23847	124857	87960	8426	0	15473	0	4313	8685
14426	174613	0	1109	29254	2889	135887	5440	34	174612	87960	8624	0	15651	0	4661	57715
14610	124748	0	1116	29483	2978	61701	5557	23913	124744	87960	8437	0	15495	0	4326	8525

GROUNDWATER SCIENCE

B2.2. Model G11 (Continuous MAV Pumping)

Time	TOTAL OUT	RECHARGE OUT	HEAD DEP BOUNDS OUT	ET OUT	RIVER LEAKAGE OUT	WELLS OUT	CONSTANT HEAD OUT	STORAGE OUT	TOTAL IN	RECHARGE IN	HEAD DEP BOUNDS IN	ET IN	RIVER LEAKAGE IN	WELLS IN	CONSTANT HEAD IN	STORAGE IN
[day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]	Rates [m^3/day]
181	427,131	-	5,609	143,257	74,125	137,689	6,017	60,434	427,132	87,960	7,619	-	13,585	-	3,700	314,267
365	324,344	-	5,217	143,020	53,890	62,090	6,180	53,947	324,342	87,960	7,515	-	13,174	-	3,495	212,197
547	355,650	-	4,919	141,358	43,986	137,138	5,979	22,269	355,654	87,960	7,758	-	13,747	-	3,839	242,349
731	288,365	-	4,724	141,663	37,719	62,046	6,146	36,067	288,363	87,960	7,590	-	13,366	-	3,565	175,881
912	332,059	-	4,508	140,638	32,595	137,689	5,957	10,671	332,060	87,960	7,821	-	13,970	-	3,895	218,413
1096	270,698	-	4,198	140,649	28,978	62,090	6,121	28,662	270,695	87,960	7,649	-	13,645	-	3,604	157,838
1277	317,889	-	3,888	139,007	25,516	137,689	5,940	5,848	317,890	87,960	7,874	-	14,186	-	3,930	203,939
1461	258,802	-	3,805	138,352	23,060	62,046	6,103	25,436	258,799	87,960	7,696	-	13,811	-	3,629	145,702
1642	307,799	-	3,686	136,373	20,452	137,689	5,926	3,674	307,799	87,960	7,925	-	14,334	-	3,958	193,621
1826	249,477	-	3,628	135,255	18,689	62,090	6,084	23,731	249,474	87,960	7,751	-	13,980	-	3,655	136,127
2008	298,520	-	3,537	132,841	16,627	137,138	5,913	2,466	298,524	87,960	7,977	-	14,457	-	3,982	184,147
2192	241,047	-	3,502	131,416	15,323	62,046	6,069	22,692	241,044	87,960	7,801	-	14,126	-	3,675	127,482
2373	291,167	-	3,422	128,769	13,661	137,689	5,899	1,727	291,167	87,960	8,032	-	14,577	-	4,009	176,589
2557	233,185	-	3,394	126,902	12,690	62,090	6,052	22,058	233,182	87,960	7,857	-	14,260	-	3,700	119,406
2738	283,259	-	3,318	123,729	11,356	137,689	5,887	1,281	283,259	87,960	8,081	-	14,695	-	4,035	168,487
2922	224,988	-	3,290	121,207	10,689	62,046	6,038	21,719	224,986	87,960	7,899	-	14,426	-	3,720	110,981
3103	274,993	-	3,215	117,541	9,636	137,689	5,875	1,038	274,993	87,960	8,122	-	14,785	-	4,060	160,067
3287	217,128	-	3,189	115,214	9,189	62,090	6,021	21,426	217,125	87,960	7,941	-	14,536	-	3,743	102,944
3469	267,706	-	3,115	112,400	8,315	137,138	5,863	874	267,709	87,960	8,156	-	14,908	-	4,082	152,603
3653	211,135	-	3,090	110,675	8,020	62,046	6,008	21,296	211,132	87,960	7,969	-	14,666	-	3,760	96,775
3834	262,731	-	3,018	108,149	7,273	137,689	5,851	751	262,731	87,960	8,187	-	15,012	-	4,107	147,465
4018	205,867	-	2,995	106,457	7,087	62,090	5,992	21,247	205,864	87,960	8,001	-	14,792	-	3,784	91,327
4199	257,472	-	2,925	103,936	6,441	137,689	5,839	644	257,473	87,960	8,214	-	15,118	-	4,131	142,050
4383	200,721	-	2,902	102,158	6,344	62,046	5,978	21,292	200,718	87,960	8,020	-	14,921	-	3,803	86,013
4564	252,335	-	2,834	99,650	5,777	137,689	5,826	559	252,335	87,960	8,233	-	15,218	-	4,153	136,769
4748	196,012	-	2,813	98,092	5,746	62,090	5,962	21,310	196,009	87,960	8,045	-	15,027	-	3,825	81,152
4930	247,184	-	2,743	95,735	5,241	137,138	5,815	512	247,186	87,960	8,251	-	15,301	-	4,173	131,500
5114	191,420	-	2,719	94,024	5,259	62,046	5,949	21,423	191,417	87,960	8,057	-	15,093	-	3,841	76,465
5295	242,867	-	2,647	91,421	4,803	137,689	5,802	506	242,866	87,960	8,270	-	15,328	-	4,196	127,111
5479	186,539	-	2,621	89,459	4,864	62,090	5,933	21,573	186,536	87,960	8,081	-	15,149	-	3,864	71,481
5660	237,807	-	2,548	86,755	4,457	137,689	5,788	569	237,806	87,960	8,290	-	15,390	-	4,219	121,947
5844	181,288	-	2,522	84,480	4,547	62,046	5,919	21,775	181,285	87,960	8,096	-	15,220	-	3,882	66,126
6025	231,901	-	2,451	81,211	4,176	137,689	5,775	600	231,901	87,960	8,305	-	15,427	-	4,240	115,968
6209	175,389	-	2,423	78,764	4,281	62,090	5,903	21,929	175,385	87,960	8,115	-	15,265	-	3,904	60,141
6391	225,860	-	2,351	76,136	3,950	137,138	5,763	523	225,861	87,960	8,322	-	15,480	-	4,258	109,840
6575	170,844	-	2,326	74,588	4,072	62,046	5,890	21,922	170,840	87,960	8,128	-	15,327	-	3,919	55,504
6756	222,386	-	2,256	72,506	3,768	137,689	5,749	418	222,386	87,960	8,339	-	15,514	-	4,280	106,292
6940	167,384	-	2,233	71,335	3,898	62,090	5,874	21,953	167,380	87,960	8,150	-	15,361	-	3,942	51,967
7121	219,048	-	2,166	69,513	3,632	137,689	5,735	314	219,047	87,960	8,357	-	15,544	-	4,302	102,884
7305	164,304	-	2,146	68,448	3,762	62,046	5,861	22,041	164,300	87,960	8,163	-	15,352	-	3,960	48,865
7486	216,011	-	2,082	66,738	3,518	137,689	5,721	264	216,010	87,960	8,374	-	15,510	-	4,322	99,844
7670	161,402	-	2,065	65,648	3,652	62,090	5,845	22,103	161,398	87,960	8,183	-	15,345	-	3,981	45,929
7852	212,351	-	2,002	63,836	3,434	137,138	5,708	234	212,353	87,960	8,388	-	15,512	-	4,339	96,153
8036	158,296	-	1,986	62,665	3,567	62,046	5,832	22,199	158,292	87,960	8,194	-	15,371	-	3,996	42,770
8217	209,665	-	1,927	60,768	3,374	137,689	5,693	214	209,664	87,960	8,405	-	15,557	-	4,360	93,382
8401	154,987	-	1,914	59,369	3,516	62,090	5,816	22,282	154,983	87,960	8,214	-	15,389	-	4,018	39,400
8582	205,489	-	1,856	56,735	3,334	137,689	5,678	196	205,488	87,960	8,421	-	15,574	-	4,380	89,152
8766	149,185	-	1,844	53,620	3,472	62,046	5,802	22,401	149,181	87,960	8,227	-	15,426	-	4,036	33,533
8947	198,154	-	1,789	49,535	3,296	137,689	5,664	181	198,153	87,960	8,436	-	15,608	-	4,399	81,750
9131	142,014	-	1,780	46,454	3,431	62,090	5,787	22,473	142,010	87,960	8,246	-	15,466	-	4,056	26,281
9313	191,189	-	1,727	43,243	3,261	137,138	5,650	170	191,190	87,960	8,450	-	15,639	-	4,415	74,726
9497	136,494	-	1,720	40,986	3,393	62,046	5,773	22,577	136,490	87,960	8,256	-	15,498	-	4,071	20,704

Time	TOTAL OUT	RECHARGE OUT	HEAD DEP BOUNDS OUT	ET OUT	RIVER LEAKAGE OUT	WELLS OUT	CONSTANT HEAD OUT	STORAGE OUT	TOTAL IN	RECHARGE IN	HEAD DEP BOUNDS IN	ET IN	RIVER LEAKAGE IN	WELLS IN	CONSTANT HEAD IN	STORAGE IN
9678	186,991	-	1,668	38,617	3,225	137,689	5,636	157	186,990	87,960	8,465	-	15,669	-	4,435	70,459
9862	132,638	-	1,662	37,117	3,354	62,090	5,757	22,657	132,633	87,960	8,275	-	15,525	-	4,092	16,781
10043	183,301	-	1,612	35,045	3,190	137,689	5,621	145	183,300	87,960	8,481	-	15,694	-	4,455	66,710
10227	128,980	-	1,609	33,482	3,319	62,046	5,743	22,781	128,975	87,960	8,287	-	15,530	-	4,109	13,090
10408	179,978	-	1,560	31,806	3,161	137,689	5,606	156	179,977	87,960	8,495	-	15,699	-	4,473	63,350
10592	127,095	-	1,557	31,510	3,306	62,090	5,727	22,905	127,090	87,960	8,304	-	15,557	-	4,129	11,140
10774	178,478	-	1,509	30,907	3,174	137,138	5,592	158	178,479	87,960	8,508	-	15,707	-	4,489	61,815
10958	126,600	-	1,506	31,048	3,307	62,090	5,713	22,937	126,596	87,960	8,317	-	15,565	-	4,145	10,609
11139	178,067	-	1,459	30,619	3,152	137,138	5,578	123	178,066	87,960	8,520	-	15,737	-	4,504	61,346
11323	126,337	-	1,457	30,825	3,276	62,090	5,698	22,991	126,333	87,960	8,329	-	15,593	-	4,160	10,290
11504	177,765	-	1,411	30,423	3,122	137,138	5,564	107	177,764	87,960	8,533	-	15,765	-	4,520	60,986
11688	126,136	-	1,410	30,639	3,245	62,090	5,684	23,068	126,131	87,960	8,343	-	15,620	-	4,177	10,031
11869	177,492	-	1,366	30,249	3,093	137,138	5,550	97	177,491	87,960	8,546	-	15,789	-	4,537	60,658
12053	125,971	-	1,366	30,475	3,213	62,090	5,670	23,158	125,967	87,960	8,356	-	15,647	-	4,194	9,809
12235	177,236	-	1,323	30,093	3,063	137,138	5,535	84	177,237	87,960	8,560	-	15,814	-	4,556	60,347
12419	125,820	-	1,325	30,324	3,181	62,090	5,655	23,245	125,816	87,960	8,370	-	15,674	-	4,212	9,599
12600	177,003	-	1,283	29,956	3,035	137,138	5,521	70	177,002	87,960	8,573	-	15,837	-	4,572	60,060
12784	125,677	-	1,286	30,189	3,150	62,090	5,640	23,323	125,673	87,960	8,382	-	15,702	-	4,227	9,401
12965	176,780	-	1,244	29,823	3,009	137,138	5,507	59	176,779	87,960	8,585	-	15,863	-	4,588	59,782
13149	125,534	-	1,248	30,055	3,119	62,090	5,626	23,397	125,530	87,960	8,395	-	15,726	-	4,243	9,205
13330	176,565	-	1,207	29,694	2,983	137,138	5,493	51	176,564	87,960	8,598	-	15,889	-	4,604	59,513
13514	125,408	-	1,212	29,926	3,088	62,090	5,612	23,480	125,403	87,960	8,408	-	15,747	-	4,260	9,029
13696	176,355	-	1,172	29,566	2,957	137,138	5,479	44	176,356	87,960	8,612	-	15,915	-	4,623	59,247
13880	125,295	-	1,178	29,799	3,059	62,090	5,597	23,573	125,291	87,960	8,421	-	15,769	-	4,277	8,864
14061	176,158	-	1,140	29,444	2,933	137,138	5,465	39	176,157	87,960	8,623	-	15,939	-	4,638	58,997
14245	125,169	-	1,146	29,677	3,033	62,090	5,583	23,641	125,165	87,960	8,433	-	15,790	-	4,292	8,690
14426	175,968	-	1,109	29,325	2,910	137,138	5,451	34	175,966	87,960	8,635	-	15,965	-	4,654	58,753
14610	125,061	-	1,116	29,559	3,006	62,090	5,569	23,721	125,056	87,960	8,444	-	15,813	-	4,307	8,531

Government
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Environment and Water