Uley South groundwater model

Model calibration and post-audit

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Acknowledgement of Country

We acknowledge and respect the Traditional Custodians whose ancestral lands we live and work upon and we pay our respects to their Elders past and present.

We acknowledge and respect their deep spiritual connection and the relationship that Aboriginal and Torres Strait Islanders people have to Country.

We also pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia, as well as those across Australia.

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Summary

The Uley South groundwater model (DEW 2020) was originally constructed and calibrated with data up to December 2017. As new metered pumping data and recharge information has become available the model has been updated with additional scenarios also simulated. However, the model has never been explicitly re-calibrated during any of these updates.

This document describes a formal post-audit of the model performance against observed conditions since December 2017. These results show that the model performance against groundwater level measurements for the period of update is very good. Given this, and the fact that the conceptual model for the basin has not changed since the original model report, recalibration of the groundwater model is not required.

1 Introduction

The Uley South Basin is the primary source for municipal water supply on the Eyre Peninsula. Concern over declining groundwater levels and increasing salinity in recent years has raised the risk profile in this basin. This has occurred in the context of groundwater extraction for public supply reducing (e.g., Lincoln Basin, Wanilla Basin) or ceasing (e.g., Robinson Basin) from other small groundwater basins across Eyre Peninsula over time, due to increasing salinity. Consequently, SA Water commissioned the Department for Environment and Water (DEW) to develop a groundwater flow model for the Uley South Basin to understand current resource trends and estimate future risks.

A groundwater model was developed and calibrated to measured groundwater levels collected from 1961-2017 (DEW, 2020a). The model was used to run scenarios at the time it was developed and was externally peer-reviewed (Middlemis, 2019). The independent reviewer found the calibration of the model to be 'very good', noting that the model *"calibration period 1961-2017 included highly variable climatic conditions, and a wide range in groundwater extraction (2-7 GL/y) over five decades. Good matches were achieved to time series groundwater level data."* The review further noted that the modelling work represented *"an unusually high level of best practice modelling that provides a rigorous uncertainty assessment in terms of conceptual, geological, parameterisation and climate variability issues."*

Since this groundwater model was originally constructed it has been updated several times to run additional scenarios using any new metered pumping data and recharge information (DEW 2020b; DEW 2021a,b; DEW 2023a,b). For example, model scenarios were last requested in May 2023, so the model has been updated with metered pumping data up to April 2023.

Model scenario reports have been externally reviewed by the National Centre for Groundwater Research and Training (Cook and Post, 2021a,b) while others have been used by the NCGRT to conduct further analysis (Cook, 2023). In the independent review by Cook and Post (2021a), the authors state that they *"agree with the assessment by Middlemis (2019) that the model is fit for purpose to inform groundwater resources management strategies including seawater intrusion risks."*

When scenarios are run, the model outputs are visually compared to groundwater level measurements up to that point in time. However, the model has not explicitly recalibrated to new groundwater level measurements collected since 2017. The scenario reports always cite this under 'Assumptions and Limitations' and suggest further calibration could be pursued. Consequently, this assessment presents a quantitative assessment of model performance against post-calibration data.

2 Methodology

The results from initial model calibration are compared to model performance post-calibration. This process can be referred to as a type of model post-audit, which Anderson, Woessner and Hunt (2015) describe as a comparison between model predictions and conditions that actually occurred. The authors state that post-audits may occur in the context of adaptive management in which models are continually updated as long-term tools.

In this assessment model simulations from the past are not compared with current conditions, rather the performance of the model is assessed as to how well it simulates current conditions, based on the calibration documented in DEW (2020), and subsequent updates with new input data (pumping and recharge).

Comparison is made based on frequently used metrics of groundwater model fit, being the root mean squared error and scaled root mean square error (Barnett et al, 2012). A visual comparison between measured and modelled groundwater levels is also presented. The calculation of each metric is based on inputs summarised in Table 2.1.

Model	Duration of available data	Number of groundwater level measurements	Number of wells
Original calibration	1961-2017	23,114	103
Post-calibration model	2018-2023	3200	53

Table 2.1. Measurements on which model calibration statistics are based

3 Results

Results for the original model calibration and the post-audit performance against data collected since December 2017 are presented in Table 3.1. The post-audit statistics are slightly better than the original calibration. More importantly, the data measured since December 2017 generally compares well with the model results (Figure 3.2).

Model	Root mean squared error (m)	Scaled root mean square error (%)
Original calibration	0.62	1.7
Post-audit	0.27	0.88

Table 3.1. Model calibration statistics

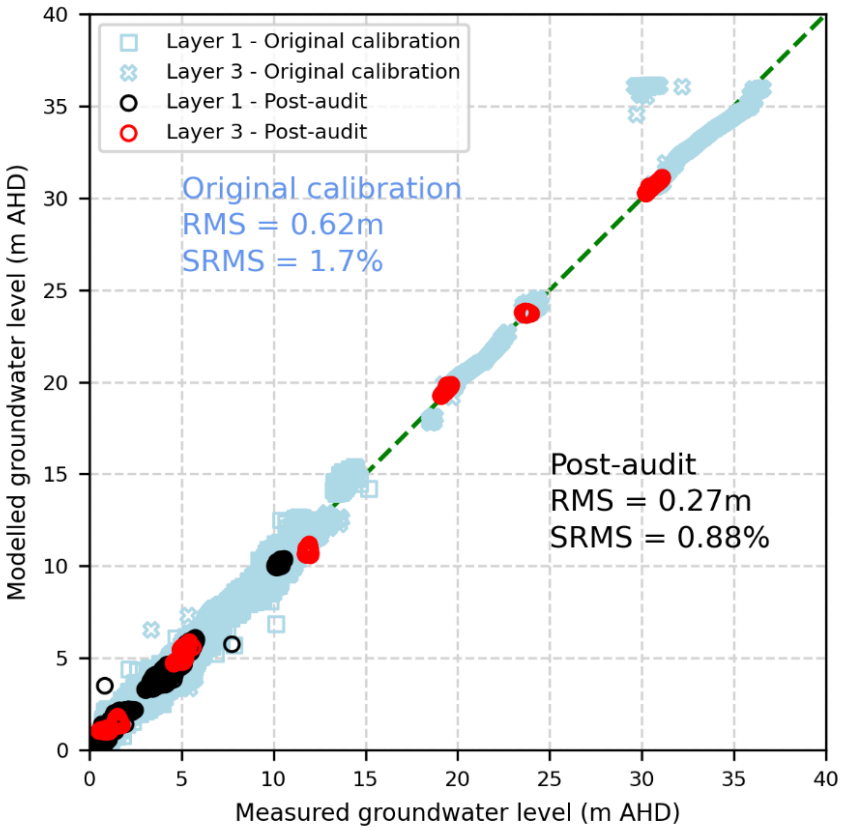

Figure 3.1. Measured vs modelled groundwater levels in Uley South for original and post-calibration period

4 Conclusions and recommendations

The performance of the Uley South groundwater model compared to data collected since it was originally calibrated is very good, both from a quantitative perspective and also in terms of the visual fit for of modelled groundwater levels to actual measurements across the basin. Further, though more data has been collected since the original model was developed, the conceptual model for the basin has not changed in any material way. Therefore, recalibration of the model is not considered a priority at this point in time.

Based on this assessment, it is recommended that ongoing updates of Uley South model with metered pumping data and recharge information are carried out when scenarios are required. Post-audits such as that documented here should continue and recalibration only pursued if the post-audit results indicate it is required.

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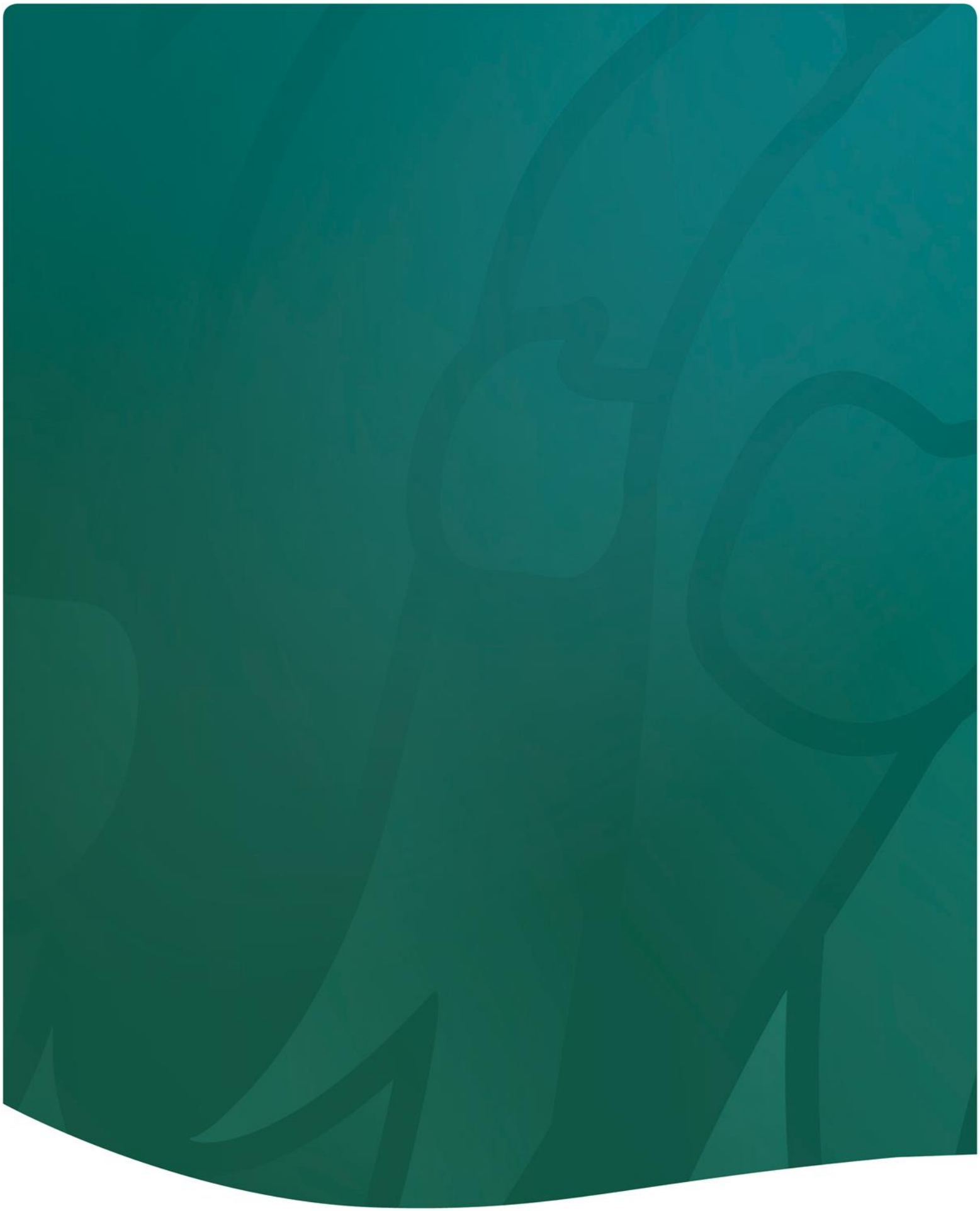

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