RIO TINTO WINU PTY LTD

Water Balance

Winu Copper Gold Project

Document no. 311012-01475-REP-WB-039 Rev 0

25 March 2025

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PROJECT 311012-01475 - 311012-01475-REP-WB-039: Water Balance - Winu Copper Gold Project							
Rev	**Description**	**Originator**	**Reviewer**	**Worley Approver**	**Revision Date**	**Customer Approver**	**Approval Date**
Rev 0	Final	M. Butcher	K. Zic	G. Jacobs	25 March 2025		

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Executive summary

Executive summary

Water balance modelling has been undertaken for the Winu copper-gold project to evaluate the timing, magnitude and probability of water sources availability, storage, transfer, losses and use. This water balance modelling builds on previous work from Golder in 2022, Red Earth Engineering in 2022, Advisian in 2023 and Worley in 2024, with updates to the model assumptions reflecting the details of the current project.

Monte Carlo analysis based on historical rainfall shows significant variation in flows in the water balance derived from the large range of possible rainfall scenarios. Modelling has shown that the project is likely to be in surplus during the initial phases of the project, up to approximately Year 17 (Figure ES-1). From Year 18 to 32, the project is in deficit, where water is required from the regional borefield. The median required supply from the regional borefield during this period is 570 ML/year, with a range of 0 to 2,335 ML/year depending on rainfall.

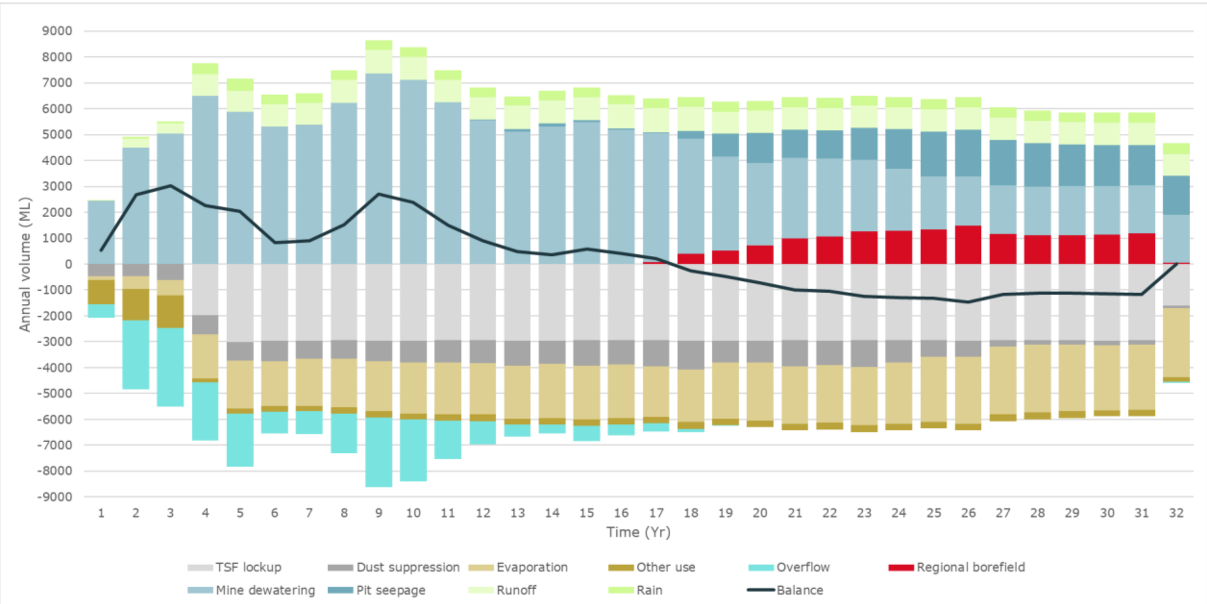


Figure ES–1: Median annual site water balance (ML/year)

Surplus water from the Mine Dewatering system will be directed to infiltration ponds. The peak surplus occurs during Year 3 of the project, during which mine dewatering requirements are greatest, and prior to processing commencing. Water balance indicates that the predicted water surplus is dominated by the rainfall/runoff at the site.

The uncertainty in mine dewatering predictions and the effectiveness of evaporation inhibitors has a significant effect on the water balance, in both the impacts on the amount of water required from the regional borefield and excess water requiring management. The design of the water management system needs to consider a range of possible conditions and identify contingencies that can be implemented for both supply and excess management.

The following actions are recommended to support further optimisation of the water balance in support of design activities:

- Modify the dewatering schedule and rates to coincide with seasonal patterns aiming to reduce the average annual magnitude of deficits and excess discharge volumes.
- Investigate options for optimising the mine dewatering strategy during the initial project phases to align the peak demand with mine dewatering.
- Manage a portion of the excess water by using levers such as increased evaporation.
- To date the water balance analyses have not considered water quality concentrations within the various water streams. It is recommended that water quality be considered, particularly if this could impact the suitability of the various water streams for use in meeting site water demands (process and/or non-process).
- The need for a regional borefield is still a priority and groundwater studies (both field and desktop) should continue with the aim of refining the target source of groundwater to meet supplementary water demands.

Acronyms and abbreviations

Acronyms and abbreviations	Definition
CWD	Clean Water Dam
DWP	Mine Dewatering Pond
LoP	Life of Project
LPG	Leading Practice Guideline
RCP	Representative Concentration Pathways
RP	Reclaim Pond
TSF	Tailings Storage Facility
WSP	Water Storage Pond

1. Introduction

The Winu copper-gold project, herein referred to as The Project, is located approximately 320 km east of Port Hedland in the Pilbara region of Western Australia (Figure 1-1).

The Project involves the development of a below-water table open-cut mining operation with a mineral processing plant located adjacent to the proposed mine. For the purpose of the water balance, a nominal 10.0 Mtpa processing rate has been assumed.

The proposed infrastructure and site layout are presented in Figure 1-2 and Figure 1-3, with the following key infrastructure:

- Run-of-Mine (RoM) pad,
- Stockpiles,
- Processing plant,
- Mine Pit,
- Solar farm and wind turbines,
- Camp and communications tower,
- Ammonium Nitrate Fuel Oil (ANFO) facility,
- Tailings Storage Facility (TSF),
- Clean Water Dam (CWD),
- Waste Rock Landform (WRL), and
- Water Settling Ponds (WSP)

The site water balance is a representation of the proposed water management system for the site, developed to evaluate the future performance in terms of water supply reliability and discharge risk. A Goldsim model was initially developed by Golder (2022) for the project, with the aim to quantify:

- Timing and magnitude of water requirements from the regional borefield, and
- Timing and magnitude of excess water discharges from the site.

Worley has updated the GoldSim water balance model as part of the initial phase of work at Winu, completed in 2022.

1.1 Scope of Work

The Scope of Work (SoW) is detailed in the 2022/2023 Hydrology and Hydrogeology Study Phase (Rio Tinto, 2022) and aims to highlight temporal variations and volumes of excess water and periods of deficit. Updating the existing GoldSim water balance model includes:

- Prediction of water surplus/deficit during the life of project,
- Incorporation of the predicted groundwater supply capacity,

- Confirmation of the required capacity as well as timing for the development of the regional borefield,
- Evaluation of the pit dewatering volumes/pit sump pumping,
- Forecast of the processing requirements, and
- Forecast of the non-processing water requirements.

Sensitivity analysis was undertaken to evaluate the uncertainty and impact of:

- Dewatering rates, based on updated groundwater modelling,
- Demands for processing activities,
- Demands for non-processing activities,
- Effectiveness of evaporation inhibitors, and
- Climate change.

In all model simulations the focus was on quantifying the frequency and magnitude of either site water deficits or excess discharges to the environment.

Sensitivity analysis compares the results associated with the impacts of the alternative operating strategies, dewatering rates, and environmental factors to those of the base case.

1.1.1 Objectives

The objectives of the water balance are:

- Optimize the use of mine dewatering to delay the requirement for the regional borefield,
- Operate the tailings reclaim pond at the target storage in all climatic conditions,
- Ensure that water is not stored in the TSF system following significant rainfall,
- Minimise the discharge of surplus mine dewatering while maintaining the pit dewatering targets,
- Reuse water captured in the WSPs, and
- Minimise water supplied from the regional borefield.

The process water demand was calculated on a daily time step, as a function of the processing rate (by ore type) and water requirements (by ore type).

1.2 Work excluded

Water balance modelling has not considered water quality aspects, associated with the processing of ore and their disposal to or recovery from tailings.

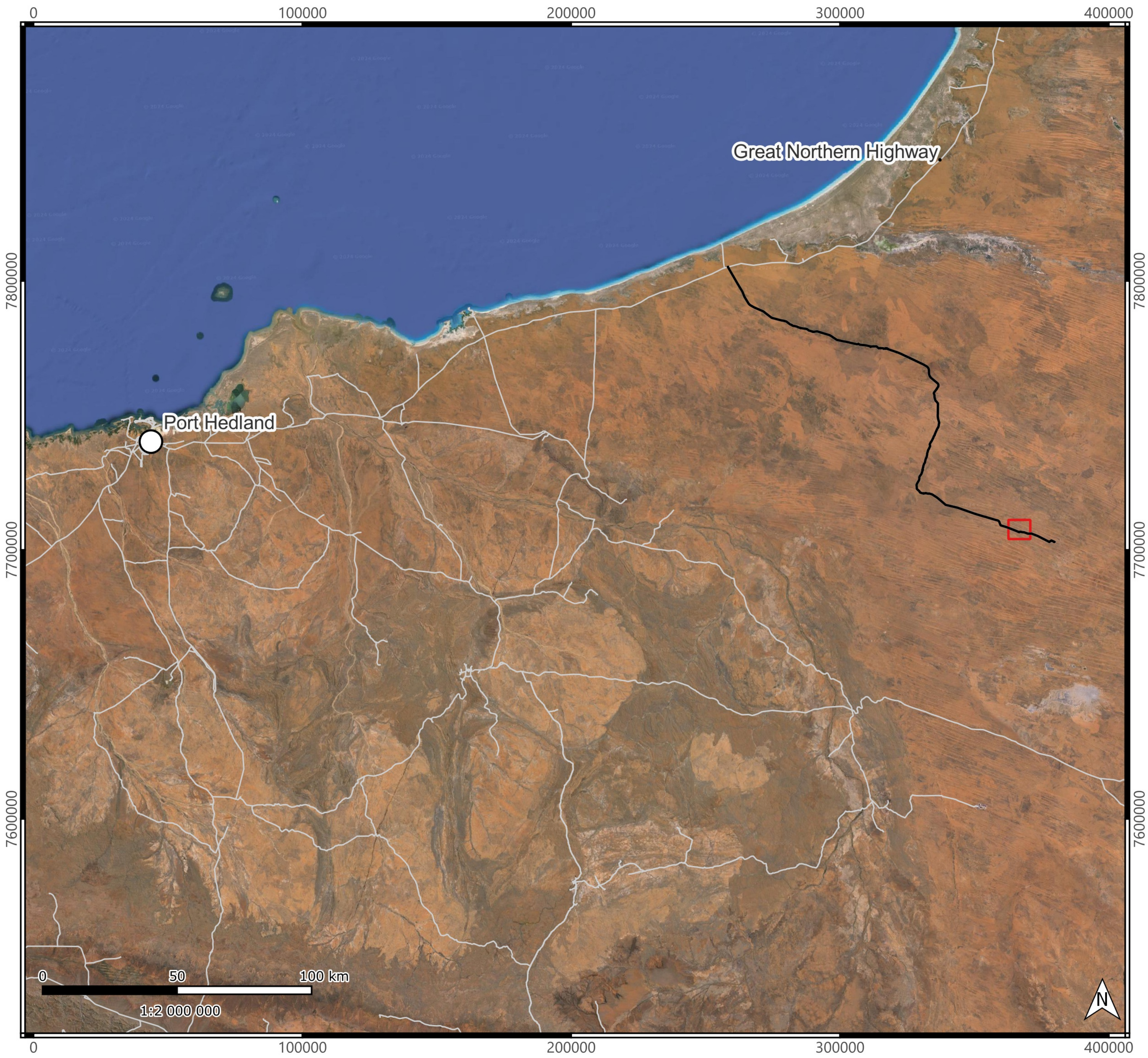
It is noted that the water quality aspects could have an impact on the suitability of the available water for the desired use, and/or change the temporal aspects of the deficit/surplus suggested herein.

1.3 Data provided

Key data/information provided is presented in Table 1-1.

Table 1-1: Key data/information provided

Data / information	Description	File / Format
Water demand calculations	Temporal estimate of water requirements for: • Construction • Mine haul road dust suppression • Mine potable requirements • Processing schedule by ore type	Winu - Site Wide Water Demand_10Mtpa Case_09122024_WIP_RevA_internal draft.xlsx
Mine progression schedule	Schedule of the mine cutback sequences and mining depth, used to inform the groundwater model target water level	sch55 prgression.xlsx
RT example of time required to meet design tailings density	Daily data of tailings density through the start-up and commissioning phase of a similar RT operation	OT TT Density_Full Data_data2013-2024.xlsx
Conceptual Tailings Storage and Management Report	Conceptual details of the proposed Tailings Storage Facility, including key assumptions	Winu TSF Conceptual Design - TSF Water Balance – 5H (Revision B).pdf
Conceptual Tailings Storage and Goldsim Model	Adjustment of Worley's Goldsim model to include the concept TSF	Winu 10 Mtpa Wbal_V2.gsm
Winu Goldsim Water Balance Model	Goldsim model developed by Golder for the Winu project in 2022	Winu_WBM_2022_Feb_v11 (Base case)_64%_68%.gsm
Winu Project - Site-Wide Water Balance Update 2022	Appendix I of the Hydrogeological Report. Provides details of the Goldsim model and results from the Golder Study in 2022.	20136763-062-R-Rev3-Hydrogeological Assessment.pdf
Winu Goldsim Water Balance Model	Update to the Goldsim model to include the tailings management by Red Earth Engineering (2022)	Winu_WBM_2022_June2022 (Run5)_Combined_With_TSF(20220818).gsm
Winu Operational Surface Water Management Plan – Rev 3	Conceptual Surface Water Management Plan for the project, May 2024 (Figure 1-3)	311012-01475-REP-HY-018-Rev3 Winu Operational Surface Water Management Plan Update 2023.pdf
CLIMsystems climate change projections for the Winu site	Projected change in key climate variables, including: • Mean monthly rainfall • Extreme precipitation • Evapotranspiration	Winu.xlsx Received 23/05/2024



Winu Copper Gold Project
Water Balance
Figure 1-1: Project Location

Project	Client
311012-01475	Rio Tinto

Notes:
Project CRS: GDA94 / MGA zone 51
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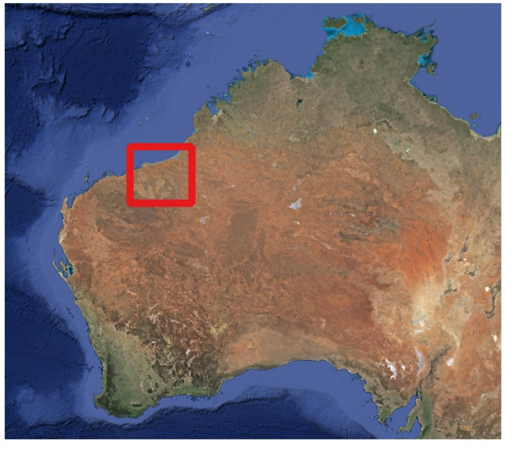
Date:02/07/2024

Legend

- Towns
- Site location
- Road Network
- Mine Access Road



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Winu Copper Gold Project
Water Balance
Figure 1-2: Site layout

Project
311012-01475

Client
Rio Tinto

Notes
Project CRS: GDA94 / MGA zone 51
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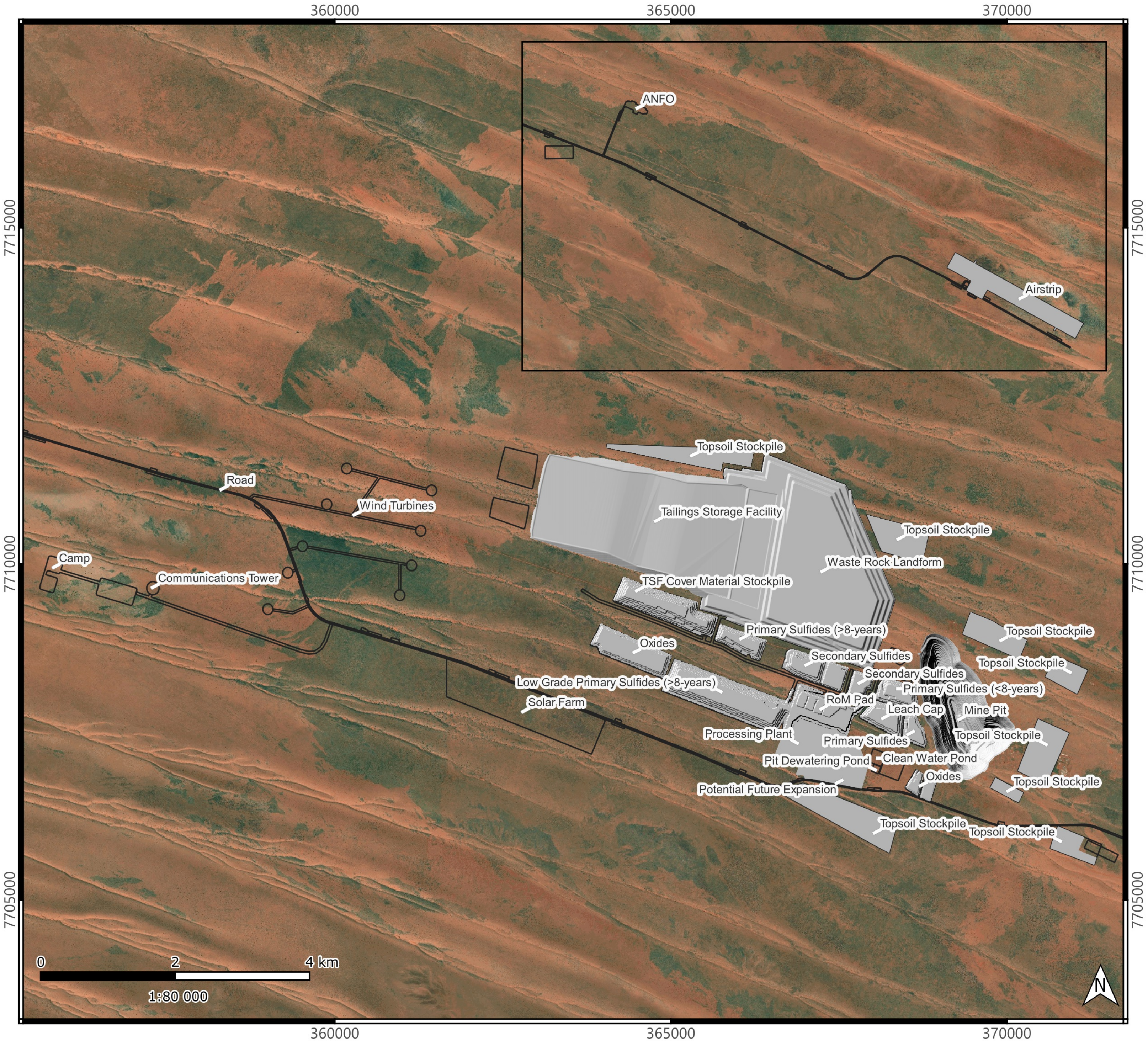
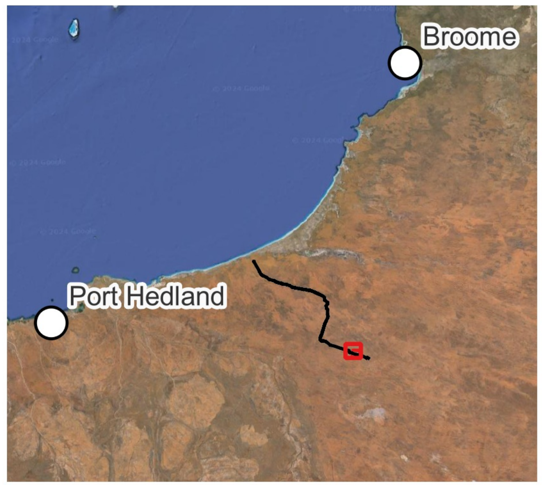
Date:02/07/2024

Legend

Proposed Mine Layout





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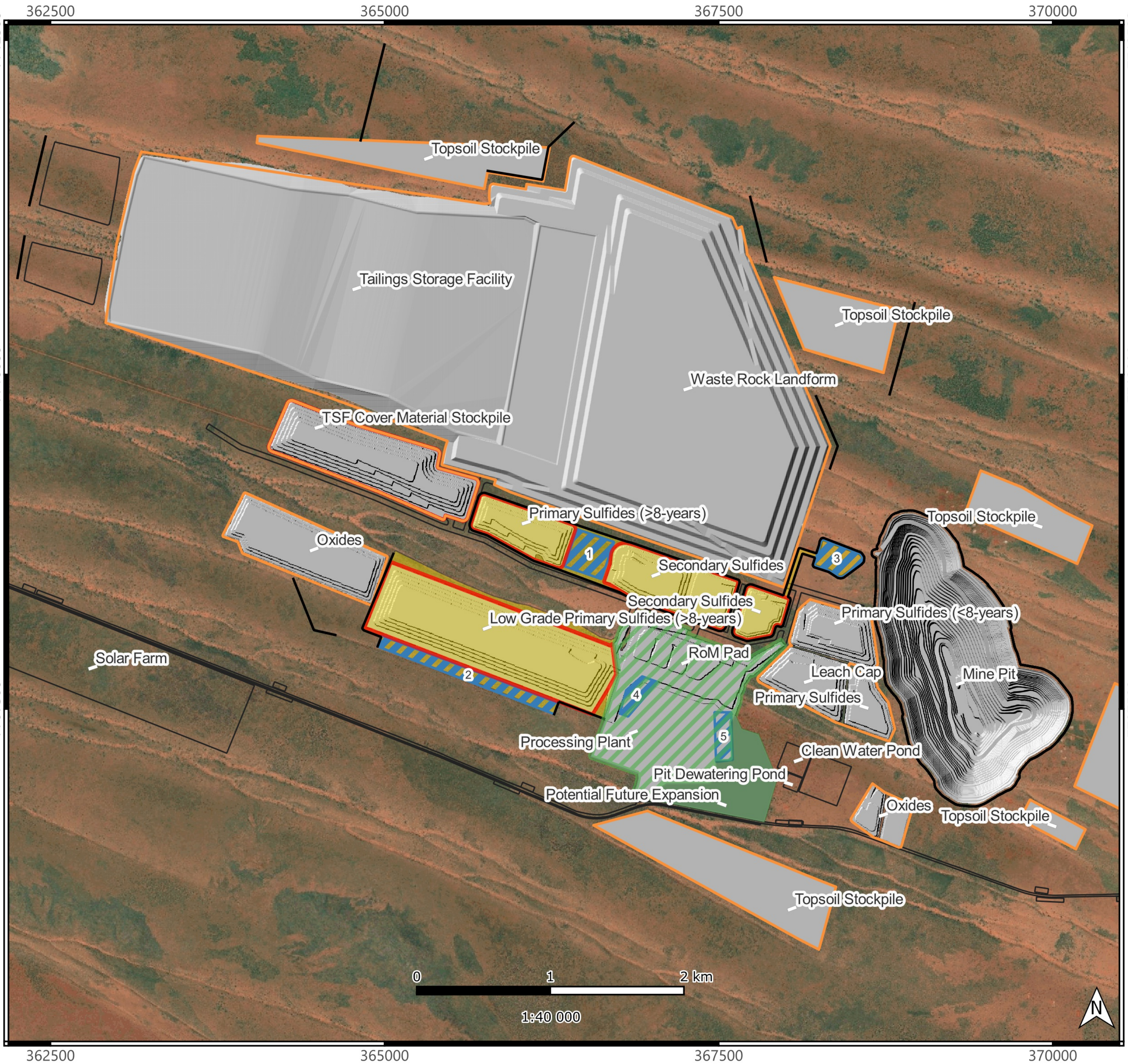

Winu Copper Gold Project
Water Balance
Figure 1-3: Surface Water Management Plan

Project | Client
311012-01475 | Rio Tinto

Notes
Project CRS: GDA94 / MGA zone 51
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RioTinto worley consulting

Legend

- Bunds
- Lined Toe Drains
- Unlined Toe Drains/Bunds
- Landforms
- Water Settling Ponds
- Contaminated Catchments

Lycopodium Managed Drainage

- Lycopodium Managed Drainage
- Potential Future Processing Plant Expansion

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2. Modelling details

The water balance model, based on the conceptual model of the mine water management, evaluates the flows of water across the site under different climate conditions.

Monte-Carlo analysis of possible climatic sequences were used to evaluate the timing, magnitude and probability of water source availability, storage, transfer, losses and use.

Sensitivity analysis is used to evaluate how key assumptions impact on the water balance results (Section 2.4).

The simulations cover the planned operation period of 32 years.

The site-wide water balance modelling, operating at a daily timestep, was implemented using the GoldSim software (version 14.0), developed by the GoldSim Technology Group LLC (www.goldsim.com).

2.1 Conceptualisation

Key water balance features shown in Figure 2-1, are presented on the schematic (flow chart) as follows:

- A portion of the water discharged to the TSF in the slurry will be reclaimed as make-up water for processing (the effects of water quality has not been considered).
- Water from dewatering and the regional bores will be transferred to the clean water dam (CWD), and distributed to:
  - Processing use,
  - Non-process use,
  - Non-process use encompasses water for construction activities (dust suppression and compaction), mine haul road dust suppression and potable water, and
  - Any surplus water will be discharged to infiltration ponds. The proposed management of excess water is via infiltration ponds to facilitate the release to the environment (Worley, 2024).
- Surface water management is detailed in Operational Surface Water Management Plan [311012-01475-REP-HY-018-Rev3] (Worley, 2024b). While the Operational Surface Water Management Plan details the strategies for potentially contaminated, sediment laden and clean runoff, this water balance only considers the potentially contaminated water. Key management strategies for potentially contaminated water includes (Figure 1-3):
  - Lined drains,
  - Flood bunds and
  - Water Settling Ponds
- Operational flood protection bunds limit surface water runoff into the mine pit.
- It is noted that under the Rio Tinto D5 standard, the TSF is not permitted to be used as a water reservoir for the management of excess water.

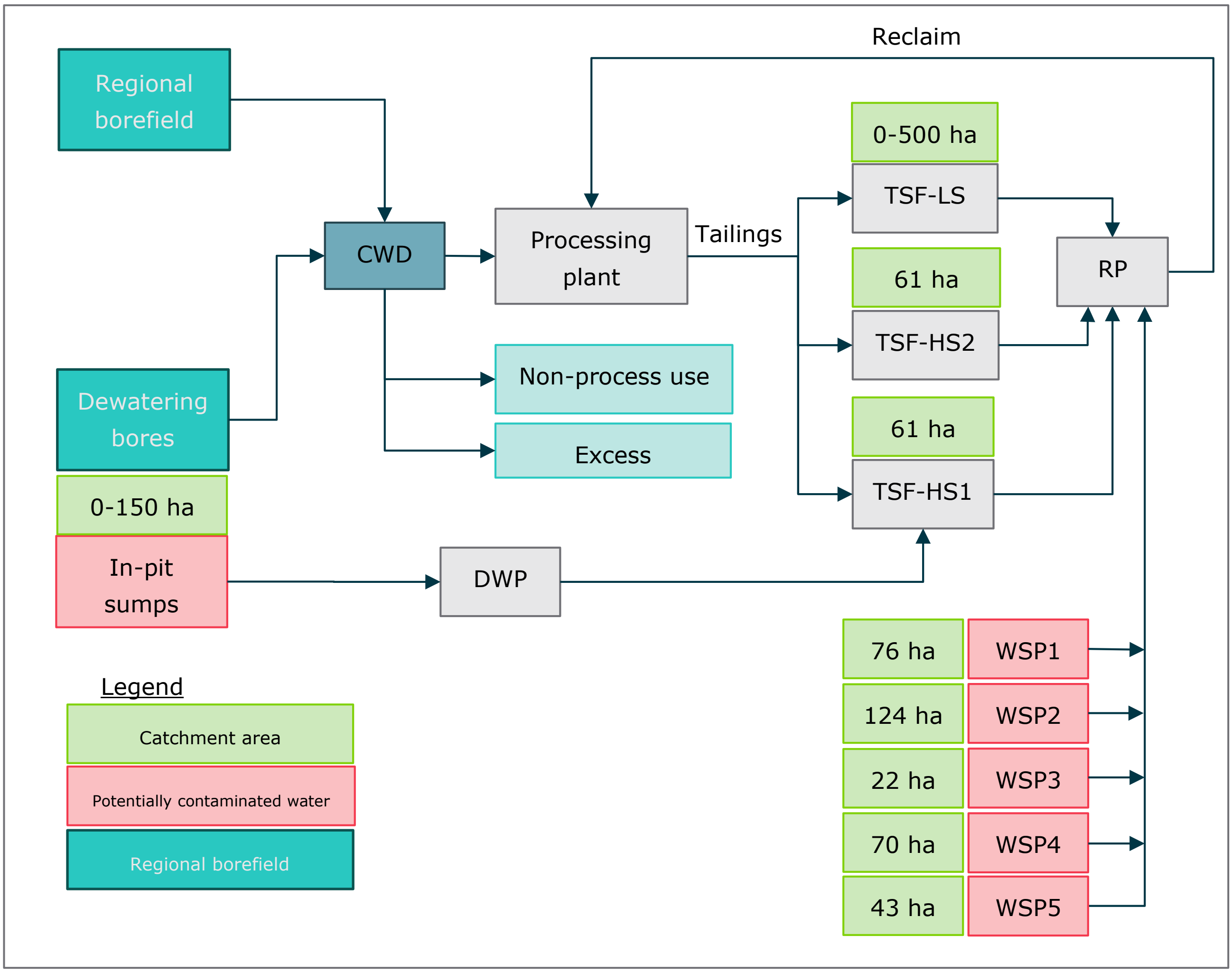

Figure 2-1: Conceptual model of site water balance

2.2 Model history and key components

The GoldSim model used herein was originally developed by Golder (2022). The model update developed during this study includes:

- Incorporation of the tailings management aspects (Section 2.3.5 and WWL, 2023),
- Updated mine dewatering estimates (Section 2.3.6),
- Updated mine bench progression (Section 2.3.6),
- Updated processing schedule (Section 2.3.7),
- Updated non-process water requirements (Section 2.3.8), and
- Updated catchment areas (Worley, 2024b).

The model incorporates TSF water balance formulation as developed for Winu by Red Earth Engineering (2022) and subsequently updated by Water Waste and Land (2023, 2024) to reflect the current TSF design.

2.3 Assumptions

Detailed assumptions for the base case water balance model are provided in "311012-01475-TM-WB-026-Rev1 Water Balance Assumptions Register (Worley, 2025a)". A description of the key assumptions is detailed below. Water requirements for the processing and non-processing activities are sourced from "Winu - Site Wide Water Demand_10Mtpa Case_09122024_WIP_RevA_internal draft.xlsx ".

2.3.1 Climate

The historical climate record has been adopted to consider seasonal rainfall patterns and extreme events. Daily climate data was obtained for -20.75, 121.75 (Lat, Long) for the period of 1/1/1900 to 31/12/2023 from the Queensland Government (2024) SILO Long Paddock website (https://www.longpaddock.qld.gov.au/silo).

The water balance model adopted (Worley, 2025a):

- Daily rainfall data from the SILO website, and
- SILO synthetic evaporation data.

A summary of the adopted average monthly rainfall and evaporation data (SILO), validated against the recorded data from the Telfer Mine Airport (BoM Station: 013030, approximately 100 km SE of the project), is shown in Figure 2-2 and Figure 2-3.

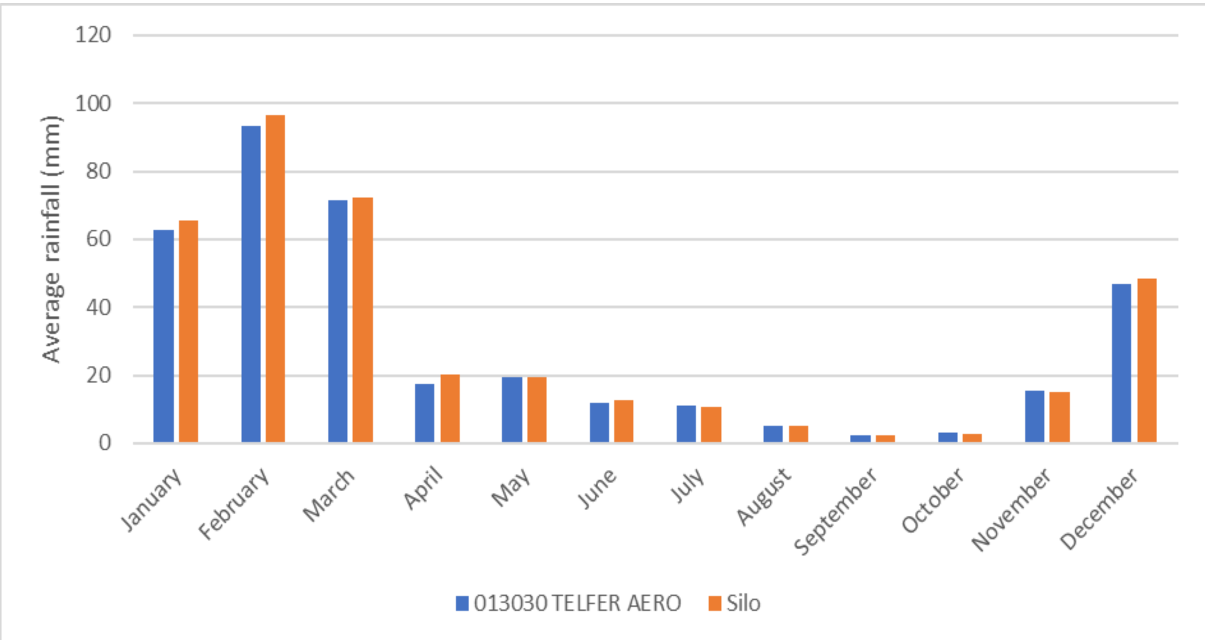

Figure 2-2: Monthly average rainfall comparison (Source: QLD Government, 2024 & BoM, 2024)

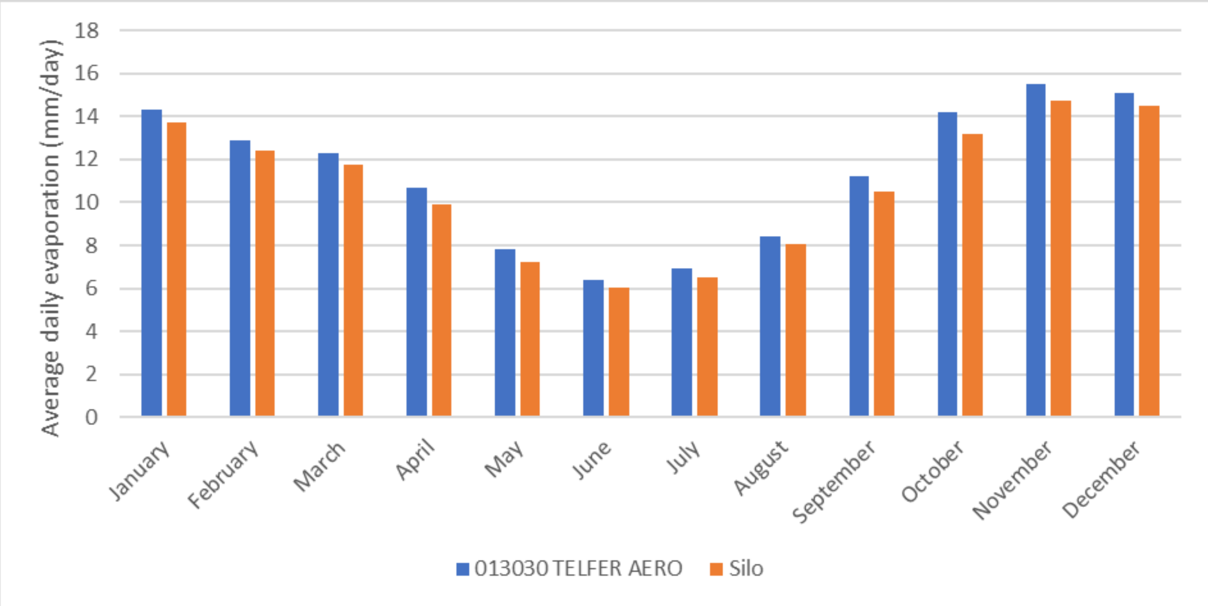

Figure 2-3: Monthly average evaporation comparison (Source: QLD Government, 2024 & BoM, 2024)

2.3.2 Evaporation

A comparison of synthetic evaporation for the pre-1991 and 1991-2020 periods from the SILO climate database is shown in Table 2-2. Synthetic evaporation was adopted in the water balance model due to inconsistency in the pan evaporation data, as discussed in the Water Balance Assumptions Register [311012-01475-TM-WB-026].

Table 2-1: BoM evaporation stations

ID	Name	Lat	Long	Elevation	Record	Relative location
004020	Marble Bar Comparison	21.18	119.75	182	1968 – 1988	213 km southwest
013030	Telfer Aero	21.71	122.23	292	1974 – 1995	120 km southeast
005026	Wittenoom	22.24	118.34	463	1967 – 2019	389 km southwest
013017	Giles	25.03	128.30	598	1967 – 1990	824 km southeast

Table 2-2: Mean annual evaporation analysis

Station	Mean annual rainfall (All records)	Historic period	Historic mean annual evaporation	Current climate mean (1990-2020)	Change (Current compared to historic)
Winu (SILO)	3346	1970 - 1990	3332	3355	0.7%
Giles	3504	1967 – 1990	3430	3590	4.7%
Telfer Aero	4125	Insufficient/incompatible data to undertaken analysis			
Marble Bar Comparison	3322				
Wittenoom	3139				

The daily evaporation data used in the water balance climate change sensitivity analysis was increased by 0.4% for the 1900–1990 period, to ensure that the full time series has a mean annual evaporation equivalent to the current climate (1991-2020). The change calculated in the SILO data is considered similar to the available data from the Giles BoM station, noting the different baseline period and the distance from the site.

2.3.3 Runoff

Pit runoff coefficients from the previous water balance modelling have been adopted (Golder, 2022). Runoff coefficients for the operational areas (including stockpiles) were sourced from the Operational Surface Water Management Plan (Worley, 2024b) for significant events, greater than 40 mm. Variable runoff coefficients have been applied between the runoff threshold from 5 mm to 40 mm to represent increasing proportion of runoff.

Runoff coefficients for the tailings facility are adopted from WWL (2023) for events greater than 40 mm. The range of values used are presented in the Water balance Assumption Register update 2024 (Worley, 2025a).

It is important to note that while variable runoff coefficients are applied in the water balance modelling to understand the likely runoff from different areas within the mine, the single value of the runoff coefficients are used in assessments of design events, for example for the design of the storages for the Water Settling Ponds and the Tailings Reclaim Pond.

2.3.4 Water supply priority

Water is sourced according to the priority shown in Table 2-3, noting that non-process water is supplied from the CWD only. The priority considers:

- Target storage in the TSF Reclaim Ponds is defined as part of the TSF Design (WWL, 2023),
- When water is well above the target levels in the Reclaim Pond, it should be used as a priority, even if the CWD is near or at capacity,
- A storm allowance in the CWD provides capacity for short term management of runoff from frequent storms can be managed without generating excess, and
- CWD operates within a target range, providing a storage buffer to ensure consistent supply for processing and non-processing requirements.

Considering these aspects, the adopted priority of water sources is detailed in Table 2-3.

Table 2-3: Process water supply priority

Priority	Source	Description
1	Reclaim Pond	Reclaim Pond > 200% target level
2	CWD Excess	CWD Storage > Storm level
3	Reclaim Pond	Reclaim Pond > Target level
4	CWD	Low level > CWD Storage > High level
5	Regional Borefield	Up to a maximum of 2800 ML/yr

2.3.5 Tailings

The tailings water balance was developed by WWL (2023). Tailings from the processing facility is split into high and low sulphur streams for separate deposition at the Tailings Storage Facility (TSF):

- The high sulphur tailings stream comprises approximately 6% of the total tailings and is deposited in a cell with a permanent water cover (marked as HS in Figure 2-1). Water is lost to evaporation and a component is retained in the pore space of the deposited tailings (31%), also referred to as interstitial water. Water is recovered from the high sulphur cell by pumping to a Reclaim Pond, whilst maintaining a water cover over the surface of the high sulphur tailings.
- The low sulphur tailings are deposited to a separate cell (marked as LS in Figure 2-1). 32% of the interstitial water in the pore space is retained. Any runoff that drains to the sump is mixed with the tailings supernatant and pumped to the Reclaim Pond.

Water is recovered to the process plant, while maintaining a target storage level. The commissioning phase of the processing plant has been represented by adjusting the design tailings density during the first 2 years of processing, based on Rio Tinto's experience at a similar project. The adjustment factor is detailed in Water balance Assumption Register update 2024 (Worley, 2025a).

2.3.6 Mine dewatering

The overall mine dewatering strategy (Worley, 2024) has been updated based on the latest bench progression (sch55 prgression.xlsx). The proposed dewatering strategy is:

- To maintain groundwater levels to 10 m beneath the pit floor for LoP operations.
- Dewatering using in-pit and ex-pit bores to sufficiently reduce groundwater levels in the local aquifer below pit floor levels to meet mining requirements over the various stages of the operation.
- Pit dewatering by sumps will commence when dewatering bores can no longer keep up with dewatering requirements. The seepage from pit walls will be captured by sumps and pumped from the pit to the mine dewatering pond, allow mining operations to continue.

The base case dewatering rates are shown in Figure 2-4 and the predicted water level compared to the cutback sequence in Figure 2-5. The Partial Flow Barrier case from the groundwater model (HFB1E-5) has been adopted in the water balance model.

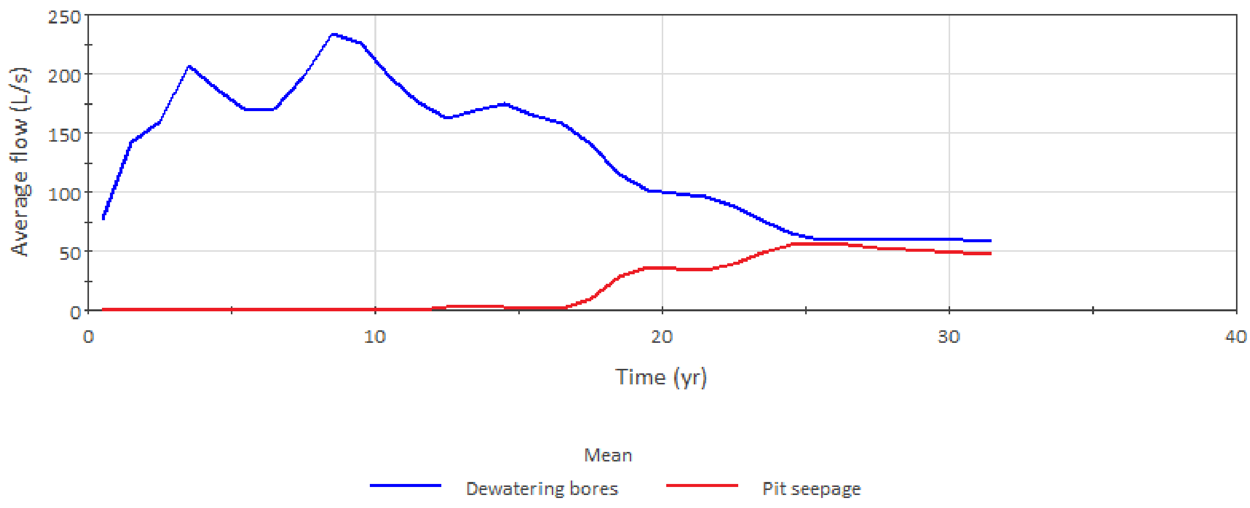

Figure 2-4 Dewatering rate from bores and seepage sumps (HFB1E-5)

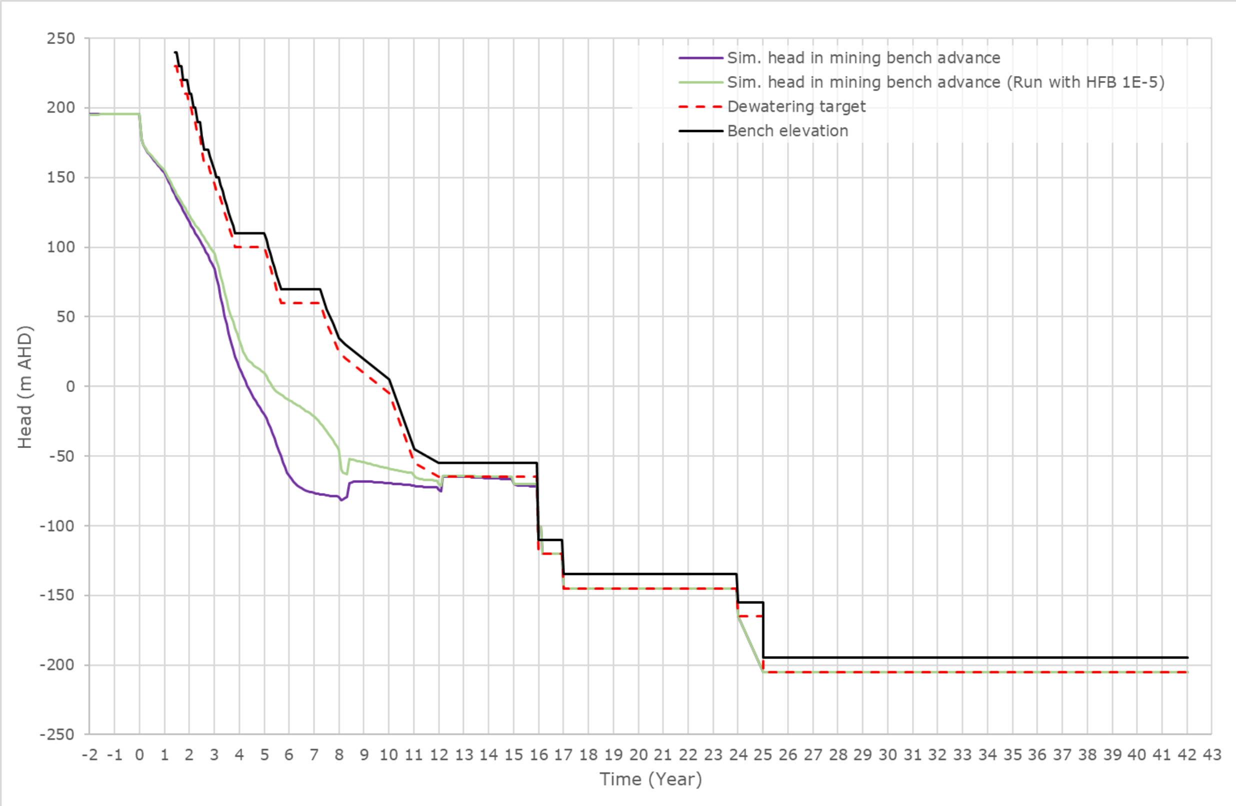

Figure 2-5 Dewatering target and modelled groundwater drawdown (Source: Worley, 2024)

2.3.7 Process requirements

Water requirements for processing are determined based on the processing schedule and water requirement for each ore type. Water requirement for each ore type is as follows:

- Oxide – 980 L/tonne
- Secondary – 870 L/tonne
- Primary – 800 L/tonne

Figure 2-6 shows the annual combined process water requirements.

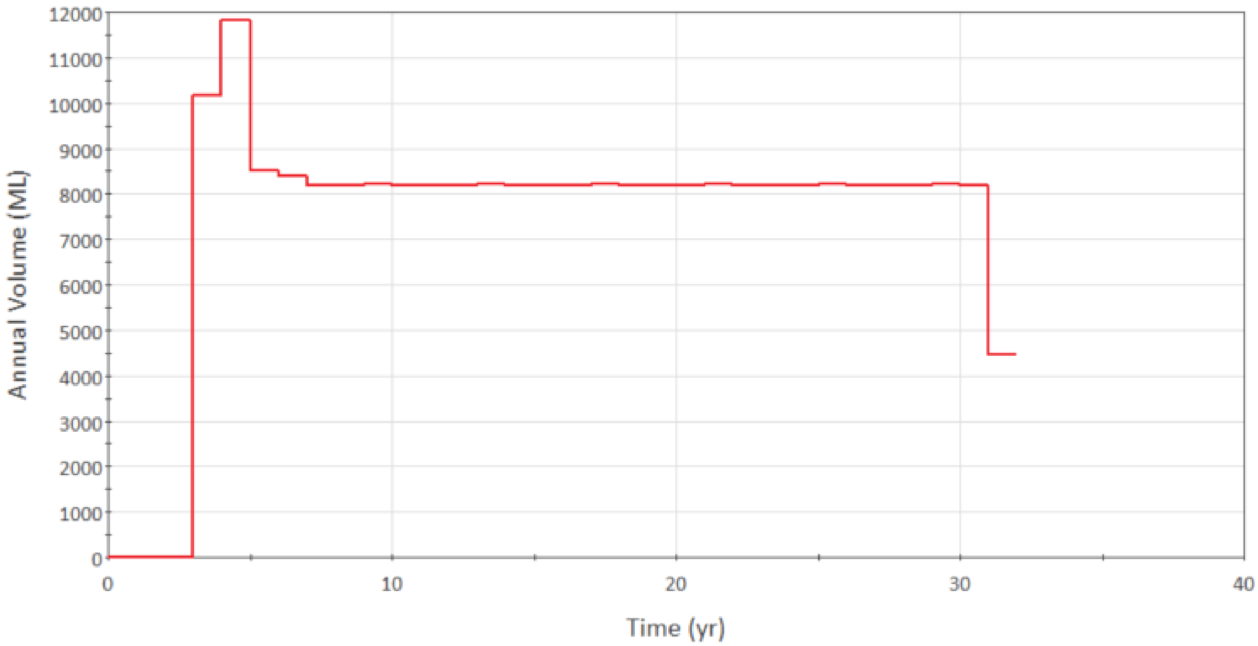

Figure 2-6 Annual process water requirements (ML/yr)

2.3.8 Non-process requirements

Non-process requirements for the mine include:

- On-site haul road dust suppression,
- Water requirements for construction earthworks and dust suppression,
- Non-process mine infrastructure,
- Potable requirements for the mine and accommodation, and
- Cooling tower

Dust suppression for the access road construction and maintenance is excluded from the water balance. Worley understands that water for the access road will be sourced from local supplies along the access road route. Figure 2-7 shows the annual combined non-process water requirements.

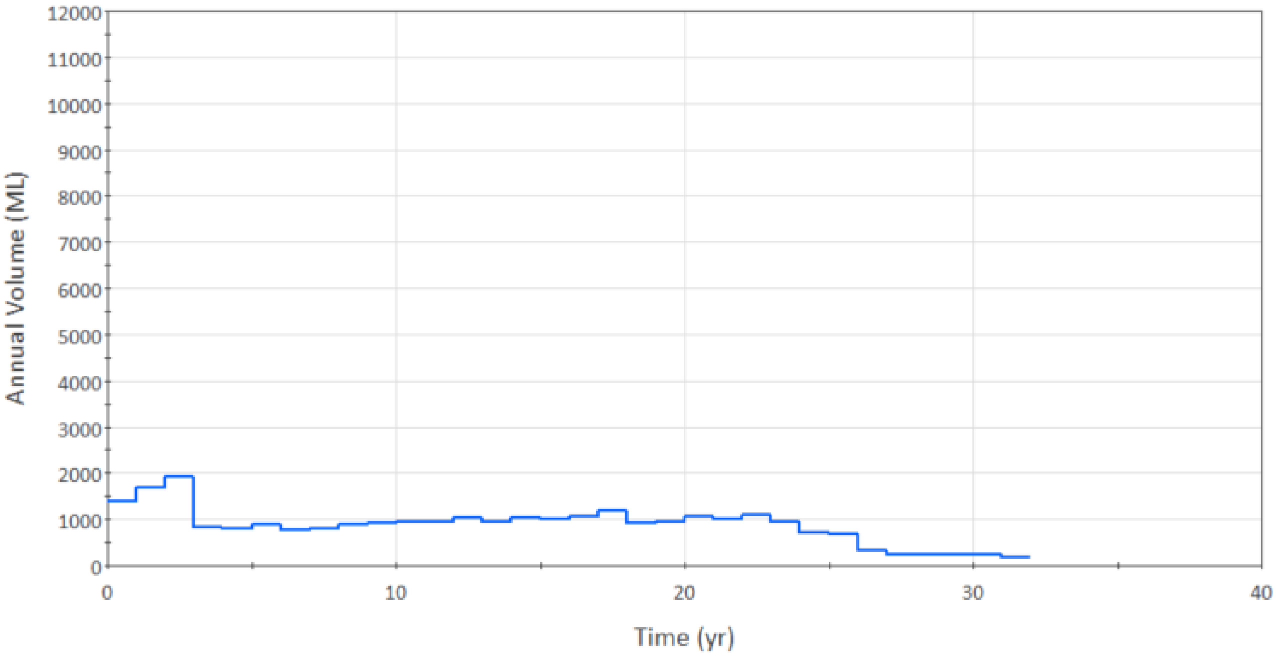

Figure 2-7 Annual non-process water requirements (ML/yr)

2.3.9 Evaporation inhibitors

Evaporation inhibitors are being proposed for use in the primary water storage facilities, although a specific technology has not yet been selected for implementation on-site. Table 2-4 provides a summary of the assumed evaporation reduction rates based on Worley's experience on the likely (median) effectiveness, noting that actual effectiveness could range from 20% to 80%.

Table 2-4: Adopted evaporation reduction rates

Storage	Adopted evaporation reduction
Clean Water Dam	35%
Reclaim Pond	40%
High Sulphur Tailings Cells	35%

Evaporation inhibitors could serve as a tool/lever in the water balance to minimize surplus water, with selected values aimed at reducing surplus water.

Uncertainty in the effectiveness of the evaporation inhibitors is further assessed in the sensitivity analysis.

2.4 Climate change

Climate change modelling and assessment utilises several specific terms. The following is an introductory explanation from the Rio Tinto Leading Practice Guideline (LPG) - Incorporating Climate Change into Mine Water Management Planning [RTEC-D-001, 2024]:

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations' body for assessing the science related to climate change. They provide projections for various climate change scenarios based on Global Climate Models (GCMs). More than one scenario exists for the future, because different levels of action could be taken by society in the future, which will change the future climate scenario outcomes. In other words, several potential pathways exist that differ depending on factors such as greenhouse gas emissions, economic development, and social inequality that influence the climate scenario outcome.

The IPCC's Fifth Assessment Report (IPCC, 2014) uses "Representative Concentration Pathways (RCPs)" as the name for these scenarios. However, in the latest Sixth Assessment Report (IPCC, 2023), "Shared Socioeconomic Pathways (SSPs)" were introduced. These scenarios, and their corresponding projections, provide researchers, policymakers, and businesses with valuable information for climate adaptation and mitigation planning.

The LPG recommends that two climate change scenarios be assessed. These account for the range of possible futures but allow for efficient assessment. The scenarios are:

1. Low Emissions Scenario (SSP1-2.6/RCP2.6): This low emission pathway is representative of scenarios that lead to very low greenhouse gas concentration levels. Global CO^2 emissions are cut severely, reaching net-zero after 2050. Temperatures stabilise around 1.8°C above pre-industrial levels by 2100.

2. High Emissions Scenario (SSP5-8.5/RCP8.5): This high emission pathway represents increasing greenhouse gas emissions over time, representing scenarios leading to high greenhouse gas concentration levels. The global economy grows quickly, but this growth is fuelled by exploiting fossil fuels and energy-intensive lifestyles. By 2100, average global temperatures are approximately 4.4°C above pre-industrial levels and continue rising beyond this date.

2.4.1 Current climate

The water balance model requires a daily time series of rainfall and evaporation for the project duration. As recommended in the LPG, the historical dataset utilised in the Water Balance Report has been adjusted to the current climate.

2.4.1.1 Rainfall

Rainfall data is available from several Bureau of Meteorology (BoM) stations in the region as well as SILO climate database. The nearest sites to Winu, which had complete (or near complete) datasets, were included in the analysis. Missing and/or incomplete records obtained from the BoM have been infilled with data from the SILO database. The stations considered are shown in Table 2-5 .

Table 2-5: BoM rainfall stations

ID	Name	Latitude	Longitude	Elevation	Record	Relative location
004041	Warrawagine	20.85	120.70	159	1897 - Current	110 km west
013030	Telfer Aero	21.71	122.23	292	1974 - Current	120 km southeast
004046	Yarrie	20.67	120.20	100	1898 - Current	160 km west
004019	Mandora	19.74	120.84	8	1913 – Current	114 km northwest

In accordance with the LPG, current climate conditions are assumed to be represented by the 1991–2020 period. Mean annual rainfall for the BoM stations and SILO data for Winu are shown in Table 2-6.

Table 2-6: Mean rainfall analysis

Station	Mean annual rainfall (All records)	Historic period	Historic mean annual rainfall	Current climate mean (1990-2020)	Change (Current compared to historic)
Telfer Aero	362	1970 – 1990	279	411	47%
Warrawagine	449	1900 – 1990	296	430	45%
Yarrie	356	1900 – 1990	327	433	32%
Mandora	371	1913 – 1990	336	478	42%
Winu (SILO)	327	1900 – 1990	283	438	34%

The pre-1991 daily rainfall data used in the water balance climate change sensitivity analysis was increased by 34% to ensure that the full time series has a mean annual rainfall equivalent to the current climate (1991-2020). The change calculated in the SILO data is consistent with observed data at nearby BoM stations, noting the different baseline periods.

2.4.2 Evaporation

A comparison of synthetic evaporation for the pre-1991 and 1991-2020 periods from the SILO climate database is shown in Table 2-2. Synthetic evaporation was adopted in the water balance model due to inconsistency in the pan evaporation data, as discussed in the Water Balance Assumptions Register [311012-01475-TM-WB-026].

Table 2-7: BoM evaporation stations

ID	Name	Lat	Long	Elevation	Record	Relative location
004020	Marble Bar Comparison	21.18	119.75	182	1968 – 1988	213 km southwest
013030	Telfer Aero	21.71	122.23	292	1974 – 1995	120 km southeast
005026	Wittenoom	22.24	118.34	463	1967 – 2019	389 km southwest
013017	Giles	25.03	128.30	598	1967 – 1990	824 km southeast

Table 2-8: Mean annual evaporation analysis

Station	Mean annual rainfall (All records)	Historic period	Historic mean annual evaporation	Current climate mean (1990-2020)	Change (Current compared to historic)
Winu (SILO)	3346	1970 - 1990	3332	3355	0.7%
Giles	3504	1967 – 1990	3430	3590	4.7%
Telfer Aero	4125	Insufficient/incompatible data to undertaken analysis			
Marble Bar Comparison	3322				
Wittenoom	3139				

The daily evaporation data used in the water balance climate change sensitivity analysis was increased by 0.4%, for the 1900–1990 period, to ensure that the full time series has a mean annual evaporation equivalent to the current climate (1991-2020). The change calculated in the SILO data is considered similar to the available data from the Giles BoM station, noting the different baseline period and the distance from the site.

2.4.3 Future climate

The future climate has been assessed for the SSP1-2.6 and SSP5-5.85 scenarios by scaling rainfall according to the projected changes from the CLIMsystems report. The CLIMsystems data is reproduced in Appendix A. The scaling aligned a project start date of 01 January 2027. The projected changes in climate are summarized in Figure 2-8 to Figure 2-11. Change in evapotranspiration from the CLIMsystem data is assumed to be the same as change in evaporation.

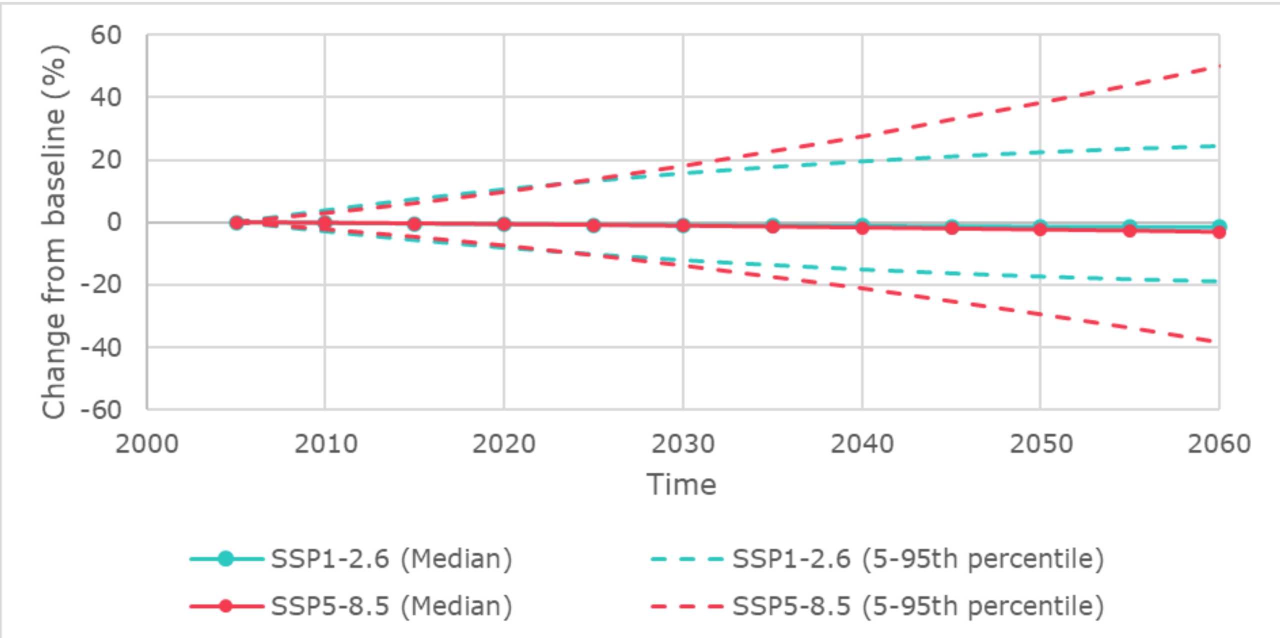

Figure 2-8: Projected change to mean rainfall

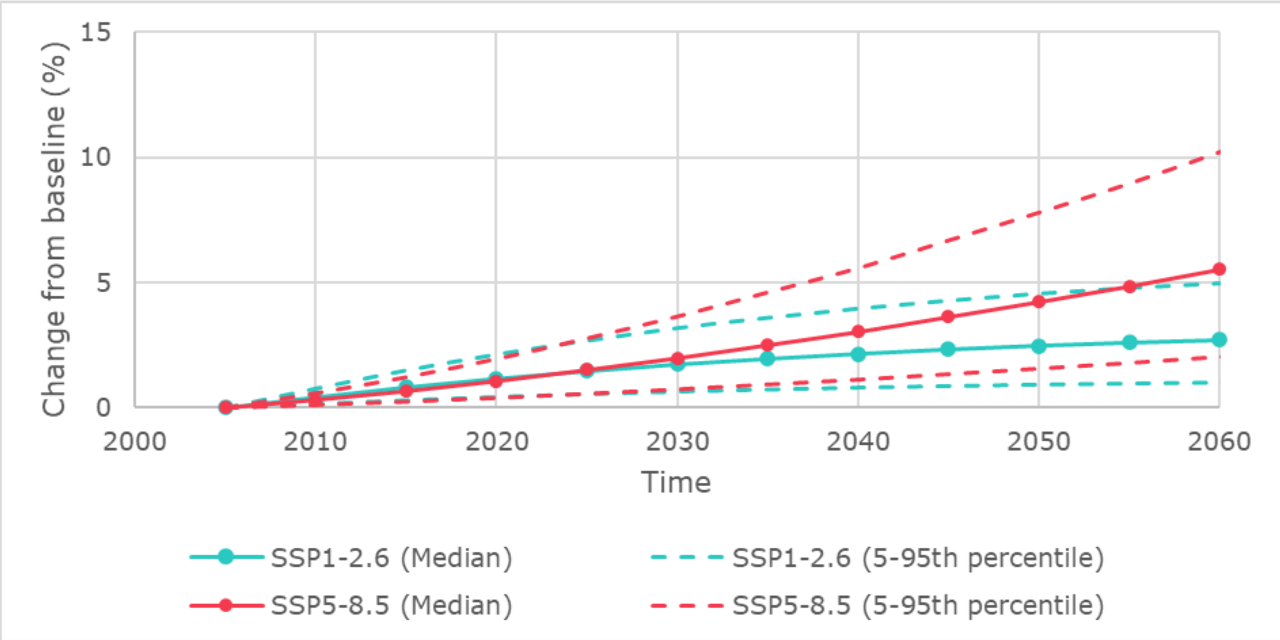

Figure 2-9: Projected change to mean evaporation

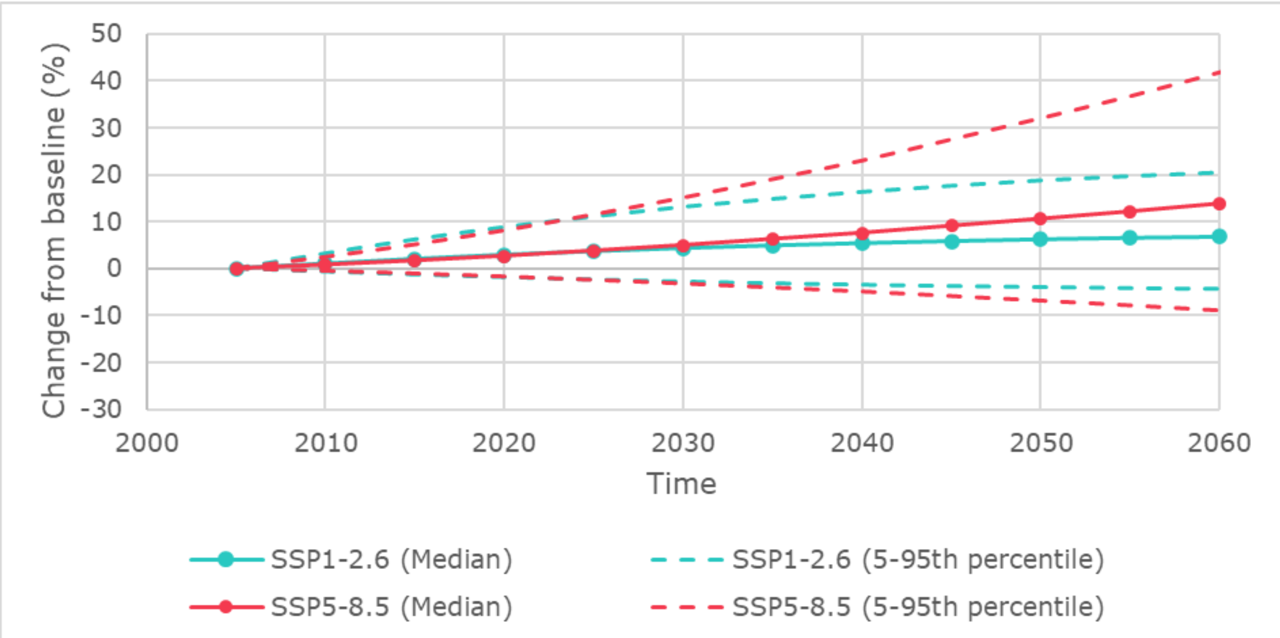

Figure 2-10: Projected change to 10% AEP rainfall

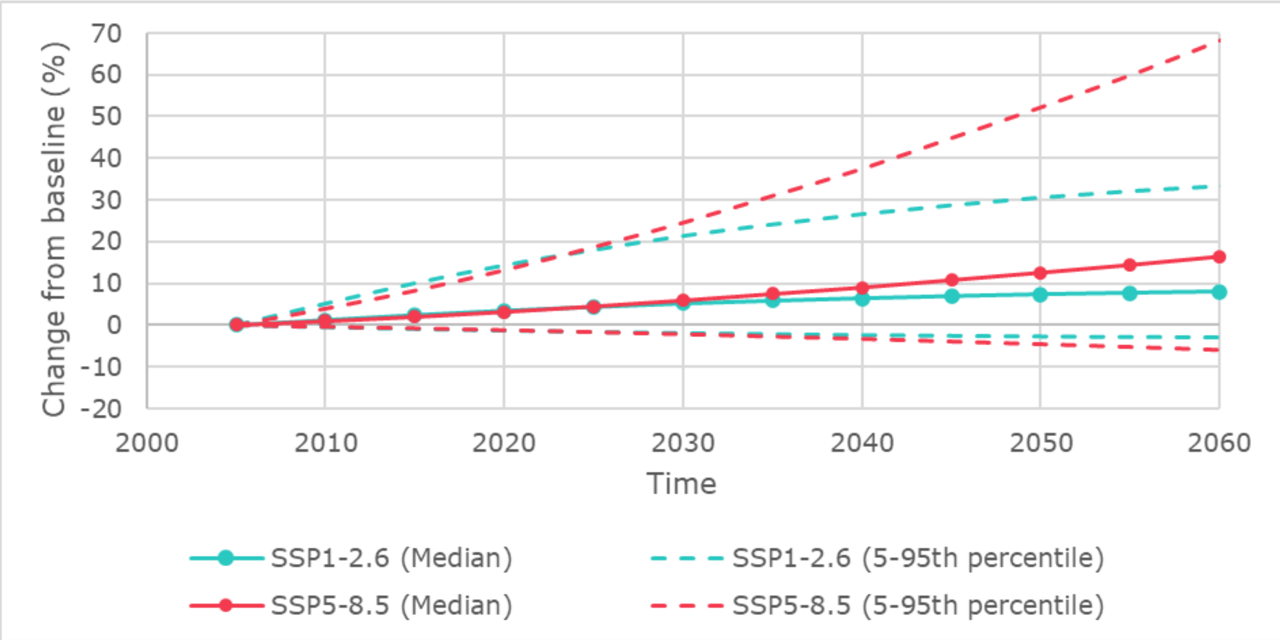

Figure 2-11: Projected change to 1% AEP rainfall

The sensitivity analysis in rainfall and evaporation evaluates the scenarios shown in Table 2-9:

Table 2-9: Adopted rainfall and evaporation percentiles for evaluated scenarios

Scenario	SSP	Rainfall	Evaporation
Low emission	1-2.6	Median	Median
High emission	5-5.8	Median	Median
Low emission - Wet	1-2.6	95th percentile	5th percentile
Low emission - Dry	1-2.6	5th percentile	95th percentile
High emission – Wet	5-5.8	95th percentile	5th percentile
High emission – Dry	5-5.8	5th percentile	95th percentile

2.5 Water balance components subject to sensitivity testing

2.5.1 Approach

Sensitivity analysis was focused on the following water balance elements:

- Mine dewatering,
- Process water demand,
- Non-process demand,
- Evaporation inhibitors,
- CWD Capacity,
- Tailings density, and
- Climate Change (Section 2.4).

Sensitivity analysis considers that there is a plausible range of values for the key assumptions relating to these aspects. Sensitivity analysis of the CWD was included to determine the influence of this dam's capacity to both the requirements from the regional borefield and surplus water.

Table 2-10 provides a summary of sensitivity considerations.

Table 2-10: Sensitivity summary

Case	Base	Upper	Lower
Mine dewatering	Mine dewatering strategy for bench progression Sc55	90th percentile (P90) from uncertainty analysis (HFB1E-5)	10th percentile (P10) from uncertainty analysis (HFB1E-5)
Process demand	Winu - Site Wide Water Demand_10Mtpa Case_09122024_WIP_RevA _internal draft.xlsx	Base +10%	Base -10%
Non-process demand	Winu - Site Wide Water Demand_10Mtpa Case_09122024_WIP_RevA _internal draft.xlsx	Base +20%	Base -20%
Evaporation inhibitor effectiveness (% reduction in evaporation)	TSF Reclaim Ponds = 45% TSF HS Cell = 50% CWD = 45%	TSF Reclaim Ponds = 70% TSF HS Cell = 80% CWD = 80%	TSF Reclaim Ponds = 20% TSF HS Cell = 20% CWD = 20%
Clean Water Dam (CWD)	Capacity = 400 ML	600 ML (+200 ML)	200 ML (-200 ML)
Tailings density	Oxide tailings density 64% Sulphide tailings density 68%	Oxide tailings density 62% Sulphide tailings density 65%	Oxide tailings density 59% Sulphide tailings density 63%

2.5.2 Mine dewatering

Groundwater model uncertainty analyses were performed by adjusting aquifer parameters to test dewatering rates while maintaining dewatering targets (Advisian, 2023). The groundwater model results are shown in Figure 2-12.

The water balance sensitivity for predicted dewatering requirements for the Partial Flow Barrier case (HFB1E-5) has been assessed by applying the 10/90th percentile uncertainty estimates (Section 2.3.6) over the project duration.

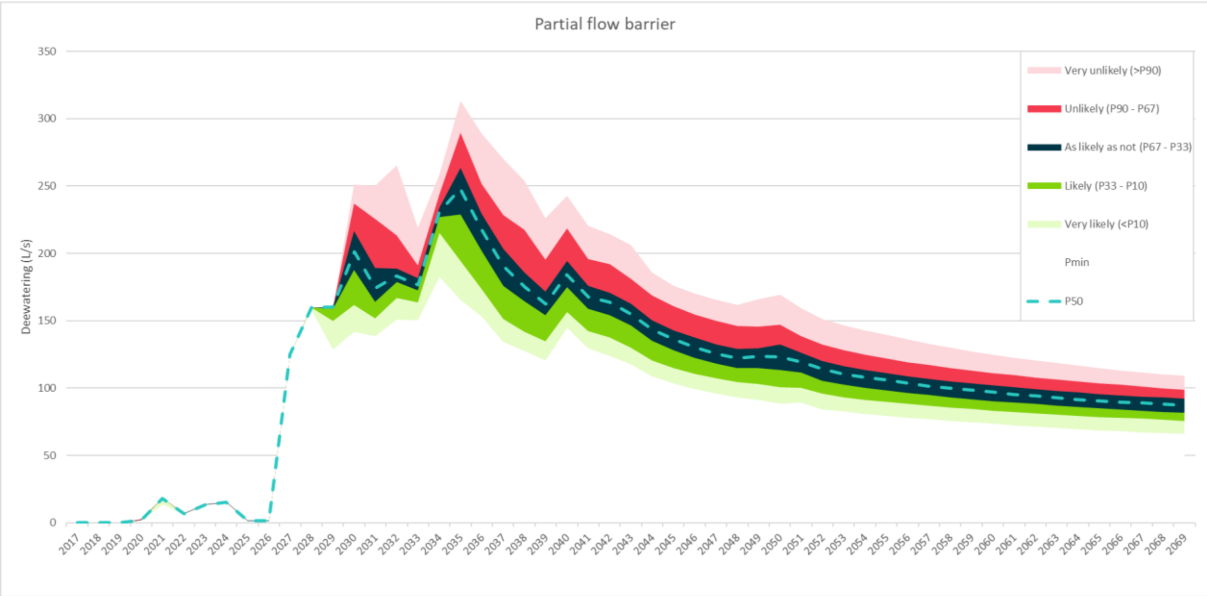

Figure 2-12: Dewatering rate sensitivity analysis – Partial Flow Barrier (Source: Worley, 2024)

2.5.3 Process demands

The main loss of water from the processing is interstitial water retained in the TSF. Sensitivity of the site water balance to the predicted interstitial loss in the TSF has been assessed by adjusting the processing losses (Section 2.3.7) by +/-10% over the project duration. Non-processing loss are adjusted by +/-20%.

2.5.4 Evaporation inhibitors

In Worley's experience the effectiveness of evaporation inhibitors is uncertain. Sensitivity of the site water balance to the predicted reduction has been assessed by adjusting the effectiveness (Section 2.3.9) to 20% for the lower sensitivity case and to 80/70% for the upper case for the Reclaim Pond and High Sulphur TSF Cells respectively.

2.5.5 Clean Water Dam capacity

The CWD provides supply buffering to the process and non-process requirements. It also provides some storage for wet periods where tailings return and mine dewatering is greater than the total site demands. Sensitivity of the site water balance to the dam's capacity has been assessed by adjusting the dam's capacity to 200 ML for the lower case and to 600 ML for the upper case.

2.5.6 Tailings density

Sensitivity of the site water balance to tailings density has been assessed by simulating lower tailings density, in a similar manner to the previous Water Balance by Golder (2022):

- The lower case assumes oxide tailings density of 62% and sulphide tailings density of 66% (by weight).

- The much lower density case assumes oxide tailings density of 59% and sulphide tailings density of 63%.
- Change in the interstitial water (i.e. increase in water content in the tailings) is assumed to be proportional to the change in density, with the low sulphur tailings cell increasing from 32% to 33% in the lower case and 34% in the much lower case. The high sulphur tailings cell increased from 31% to 32% in the lower case and 33% in the much lower case.

3. Results

3.1 Overview

Simulations were undertaken for a range of climatic scenarios (124 simulations), combined with sensitivity of the key assumptions. The modelling results are presented below:

- Mean annual water balance as shown in Figure 3-1, base case,
- Project water balance deficit over the life of project (LoP) to be supplemented with the regional borefield,
- Water supply for LoP from: rainfall runoff, pit dewatering, pit seepage and regional borefield supply,
- Time series of tailings return (Figure 3-11),
- Volumes of water stored at selected storage locations (CWD in Figure 3-12 and TSF in Figure 3-13),
- Water loss of LoP: interstitial water in tailings (Figure 3-14), evaporation from TSF (Figure 3-15) and pond (Figure 3-16),
- Excess water to be released to the environment by infiltration (Figure 3-17), and
- Sensitivity analysis on selected assumptions.

Note that the presentation of the mean annual water balance for supply, storage and excess through the project life includes the probability of results, arising from the possible climate scenarios. The resulting probability plots show the statistical distribution over the LoP, with the median showing the most likely result, the 20-80% band showing the general variability and the min/max showing the extremes as result of rare floods/droughts.

3.2 Mean annual water balance and water deficit

The site water balance changes over the LoP, with dewatering requirements greater during the early stages and a reduction of on-site haul road dust suppression requirements during the later phases of the project. The changing nature of the water balance over the project duration is shown in Figure 3-1.

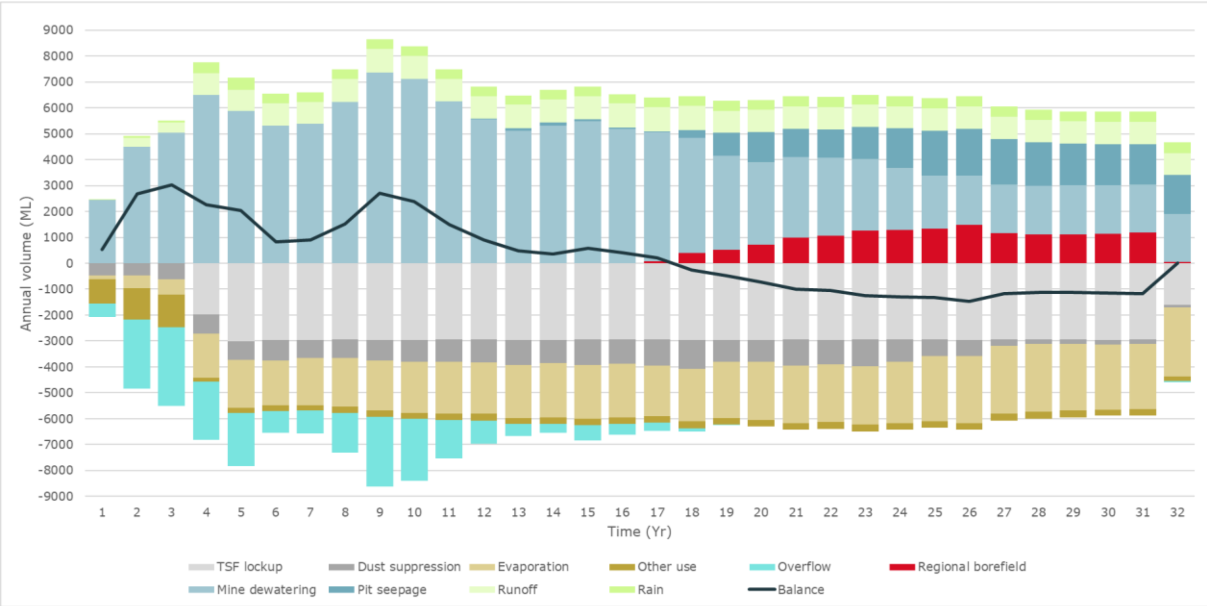

Figure 3-1: Median annual site water balance (ML/year) – base case

To illustrate the temporal change in the site water balance, Year 6 (early operations and high dewatering), Year 16 (dewatering rate decreasing) and Year 26 (late operations) are shown in Figure 3-2 to Figure 3-4.

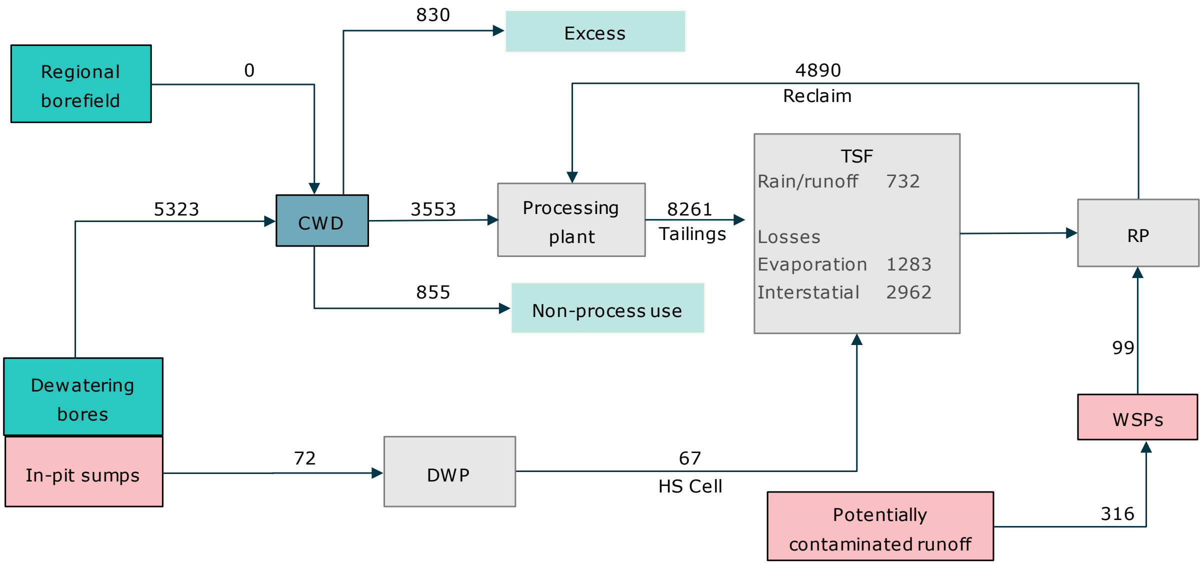

Figure 3-2: Median annual water balance, Year 6 (ML/year)

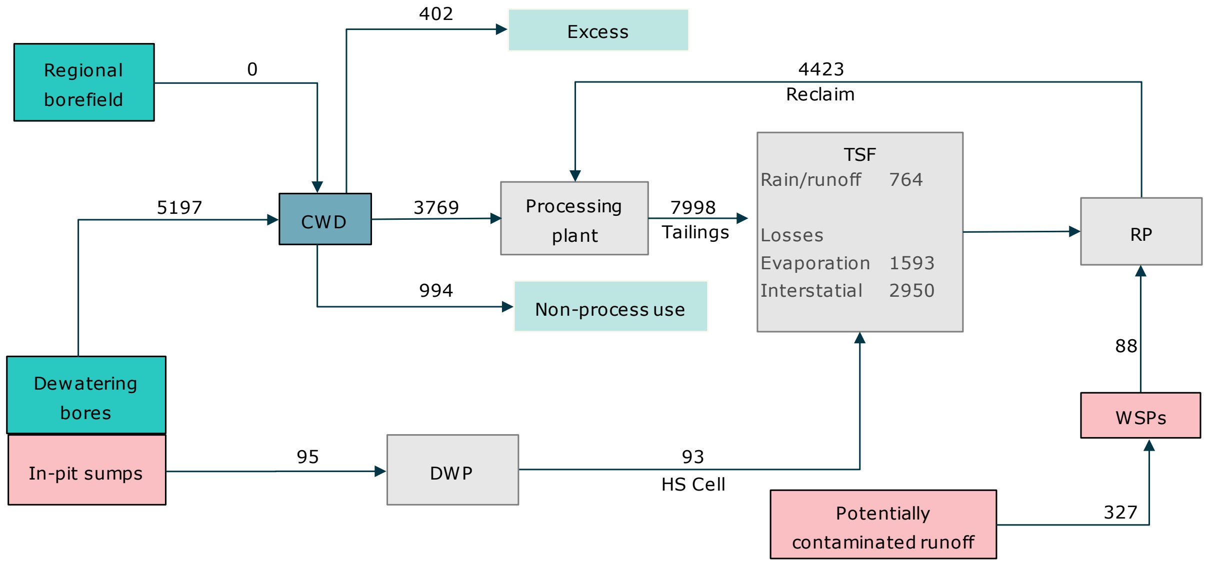

Figure 3-3: Median annual water balance, Year 16 (ML/year)

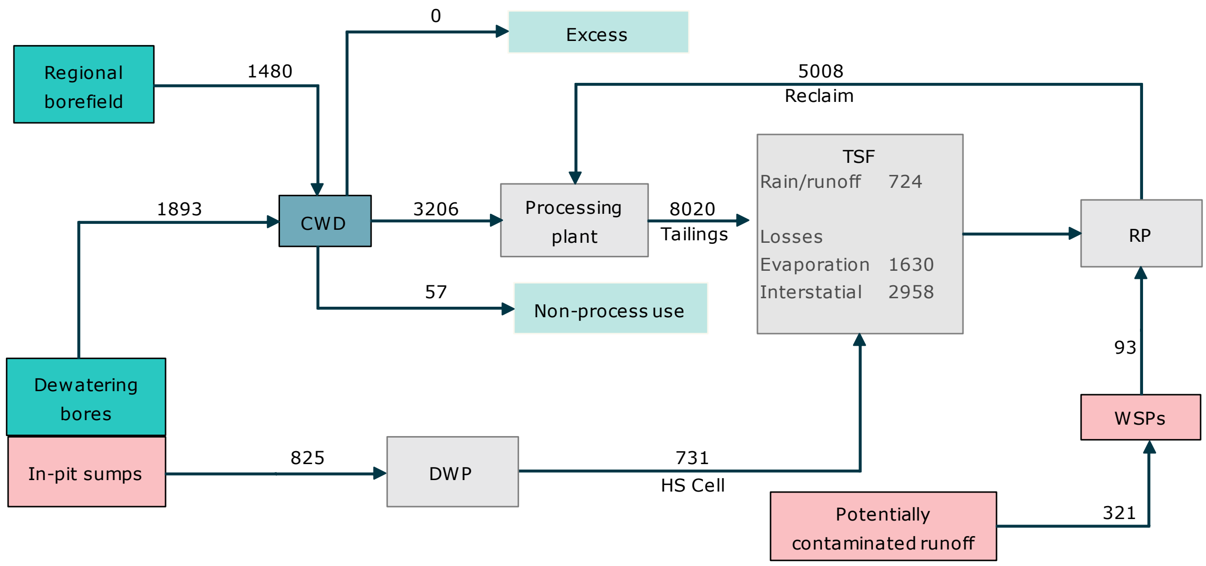

Figure 3-4: Median annual water balance, Year 26 (ML/year)

From the modelling results, as summarised in the above figures it can be concluded that:

1. The water balance is in clear excess during the initial phases of the project.
2. The water balance is near neutral from Year 6 to Year 7 and Year 12 to Year 16, with a small excess in most climatic conditions. In wetter years there is greater excess and drier years, the regional borefield is required.
3. The regional borefield is required in most climate conditions from Year 17 to 32, with the magnitude dependent on the climate.

3.3 Water supply

Pit dewatering is the primary source of water supply over the LoP, with contributions from runoff, direct rainfall and pit seepage. Annual median results are shown in Figure 3-5, with the annual supply probability shown in Figure 3-6 to Figure 3-10.

Some aspects are climate influenced and therefore show variability through the simulations and others (e.g. mine dewatering) are constant for each simulation and are not impacted by climate variability.

It can be noted that:

1. Large variations in the probabilistic range for rainfall and runoff reflect variable nature of rainfall.
2. Variations in the need for the regional borefield water supply affect the variable nature of the overall balance due to the rainfall and runoff contributions to the site water balance (Table 3-1).
3. Median water demand (P50) from the regional borefield considering climatic conditions from Year 13 is 570 ML/yr.
4. Water demand from the regional borefield is highest in Year 26 with median demand 1,480 ML/yr and maximum demand 2,335 ML/yr.
5. The highest water demand of the sensitivity cases (Section 3.9) results from the lower mine dewatering case (P10 mine dewatering), with median water demand 1,929 ML/yr and maximum 2,800 ML/yr.
6. Water demand is similar for the evaporation inhibitors, tailings density and process demand sensitivity cases, with maximum annual demand 2,782 ML/yr, 2,664 ML/yr and 2,648 ML respectively.
7. Maximum water demand is lower for the non-process demand and CWD capacity sensitivity cases, with maximum annual demand 2,468 ML/yr and 2,333 ML/yr respectively.

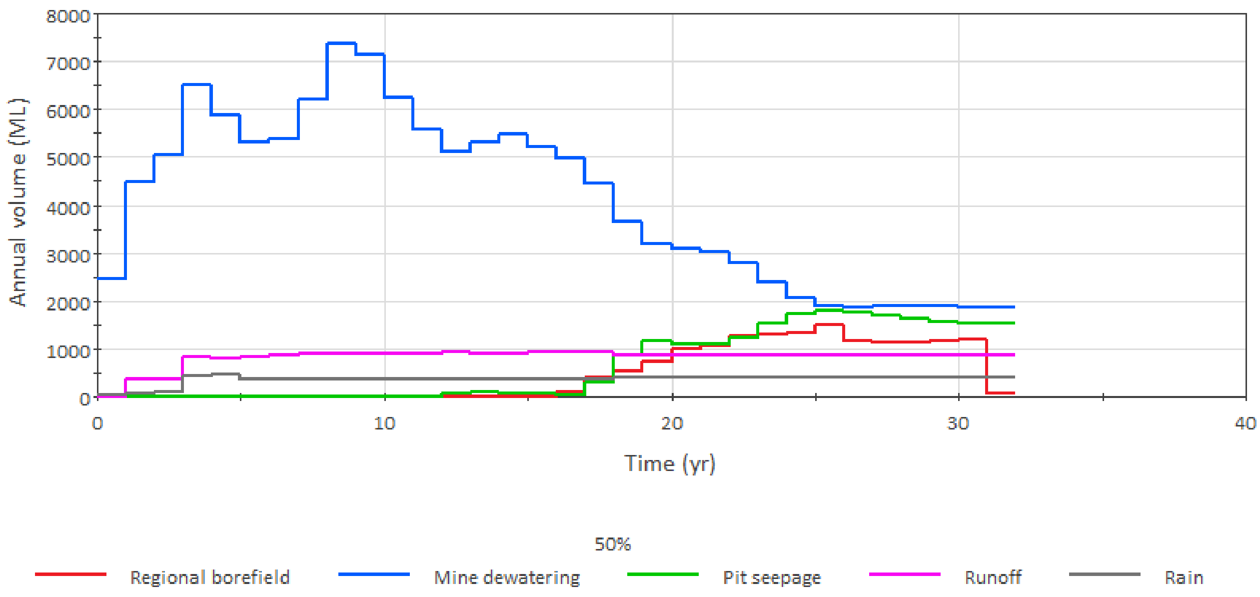

Figure 3-5: Median annual water source by type

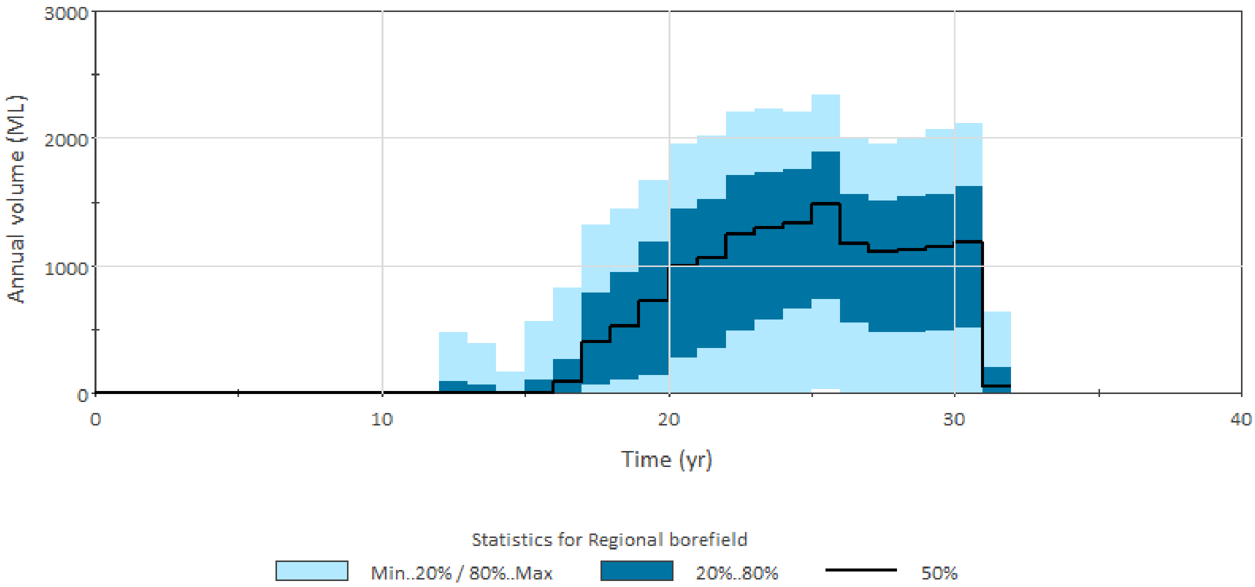

Figure 3-6: Annual regional borefield volume probabilistic range

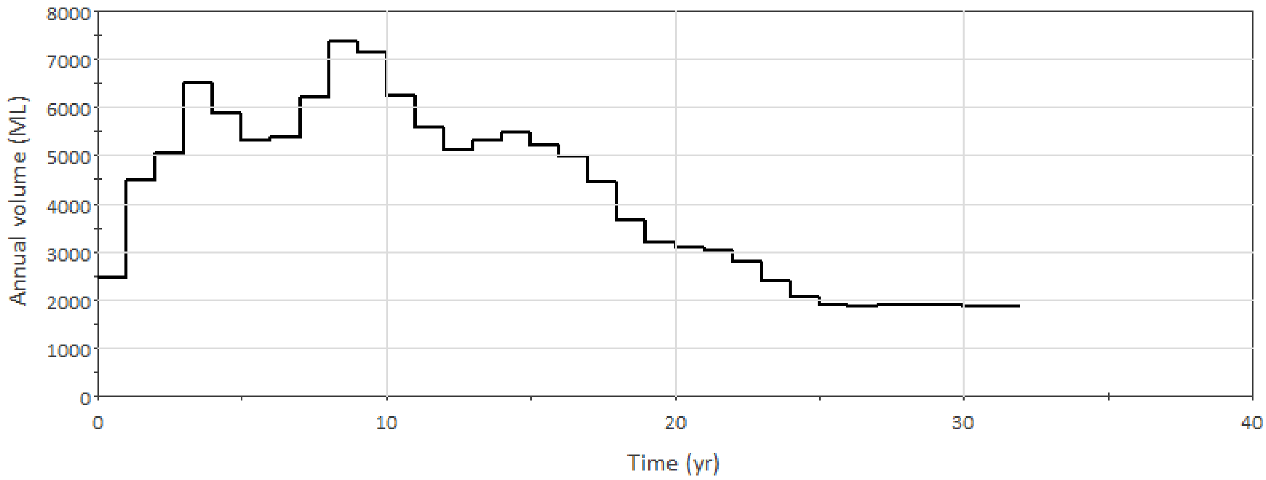

Figure 3-7: Annual dewatering rates

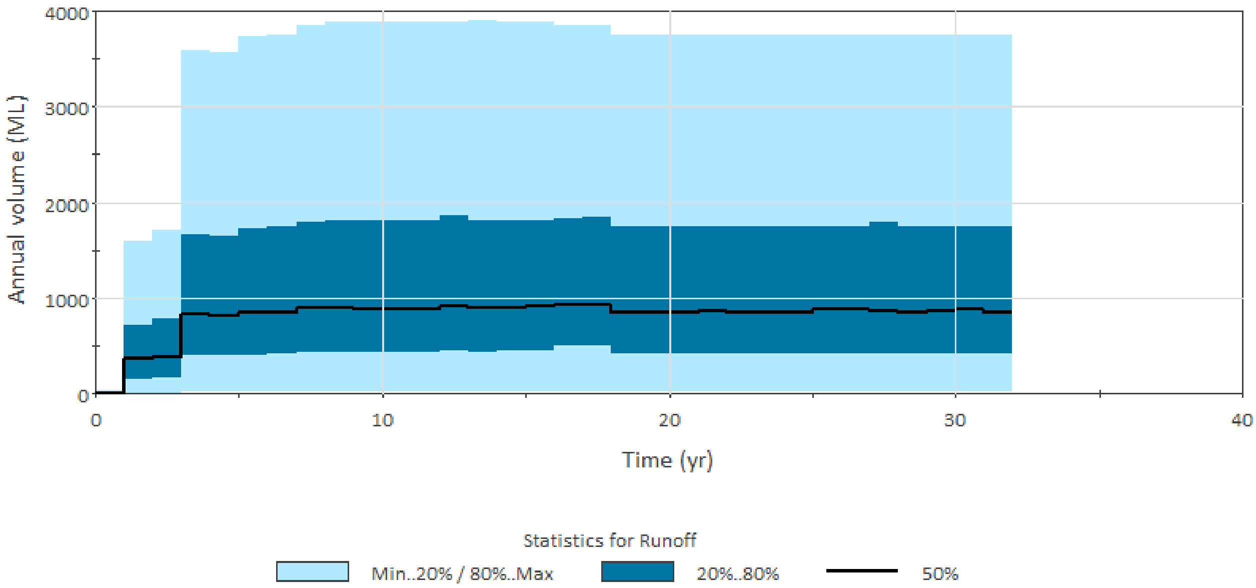

Figure 3-8: Annual site runoff volume probabilistic range

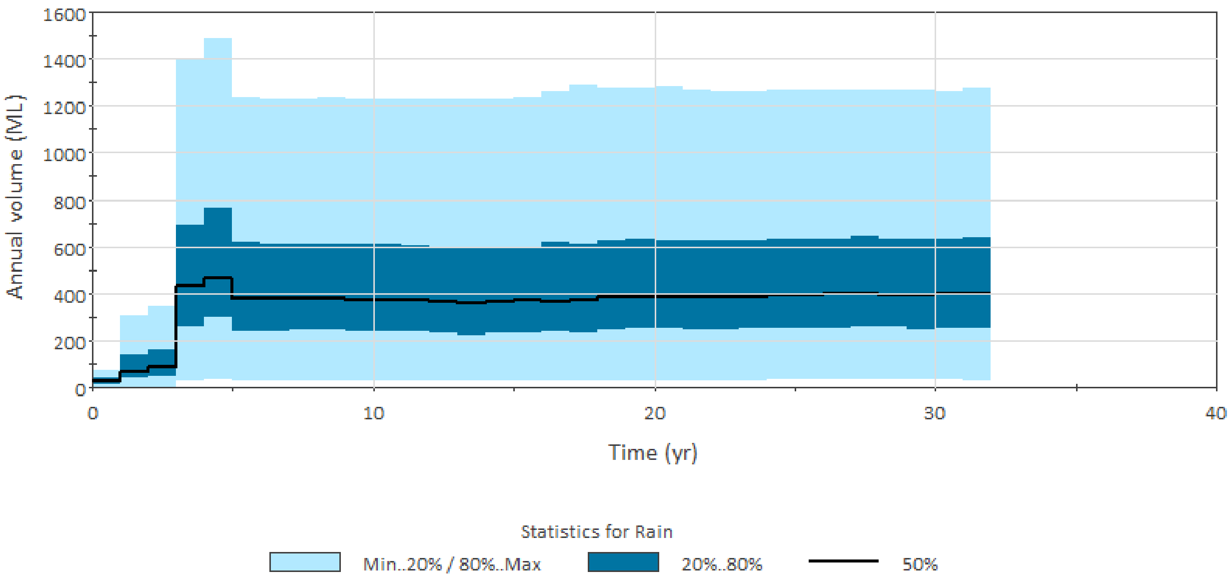

Figure 3-9: Annual site direct rainfall volume probabilistic range

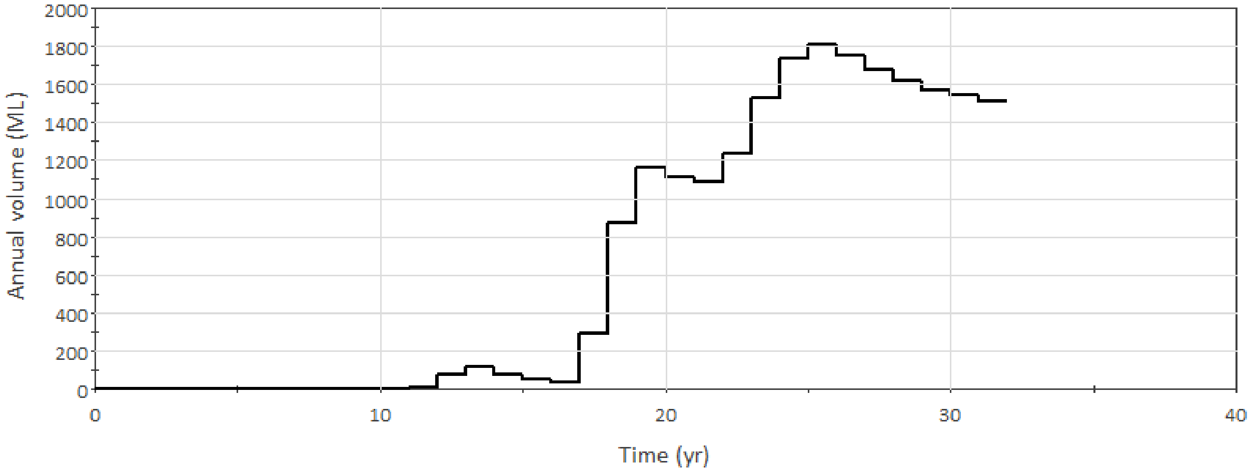

Figure 3-10: Annual pit seepage volume

Table 3-1: Regional borefield extraction (ML/yr)

Year	Min	P10	P20	P50	P80	P90	Max
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	91	158	475
14	0	0	0	0	63	89	386
15	0	0	0	0	0	0	167
16	0	0	0	0	98	177	557
17	0	0	0	85	267	407	819
18	0	0	61	404	779	922	1321
19	0	0	106	521	944	1040	1439
20	0	22	143	725	1180	1282	1673
21	0	114	280	987	1446	1578	1952
22	0	130	345	1058	1518	1644	2012
23	0	248	482	1248	1710	1837	2203
24	0	366	569	1291	1733	1895	2231
25	0	396	637	1330	1749	1883	2200
26	24	469	740	1480	1886	2031	2333
27	0	317	555	1172	1562	1702	2008
28	0	283	468	1114	1508	1629	1953
29	0	295	475	1123	1546	1670	2006
30	0	314	481	1145	1560	1680	2060
31	0	320	510	1184	1622	1738	2118
32	0	0	0	54	195	295	632

3.4 Tailings return

Water recovered from the TSF will be solely used for processing. Inspection of modelling results (Figure 3-11) indicates an initial peak following the commissioning phase, as tailings density ramps up and the reclaim pond reaches target levels. Following this, there is variability in the amount of water potentially returned, as a result of the climate influences, with less water returned during drier periods when evaporation is higher and increased returns following periods of higher rainfall and runoff.

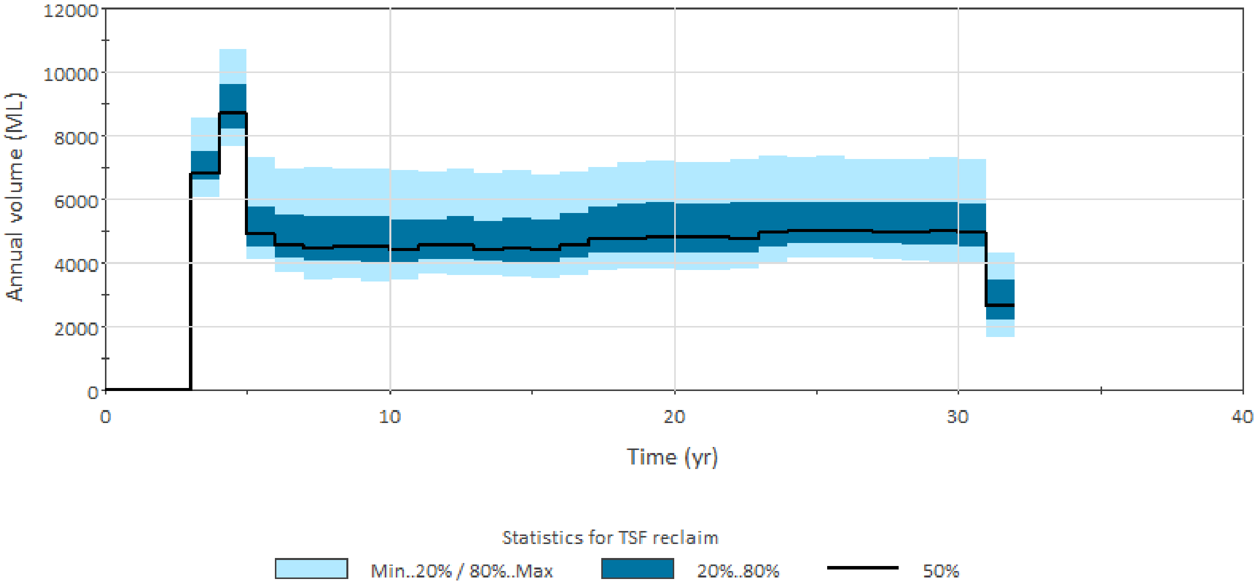

Figure 3-11: Annual Tailings Return volume probabilistic range

3.5 Storage

The storage probability for the CWD and TSF (mainly Reclaim Pond) is shown in Figure 3-12 and Figure 3-13, respectively.

This suggests:

1. The CWD maintains water storage through all the climate scenarios, and
2. The TSF storage is generally maintained at the target levels, however a significant storage volume is required to manage rare wet season events, where a significant amount of runoff is generated on the facility.

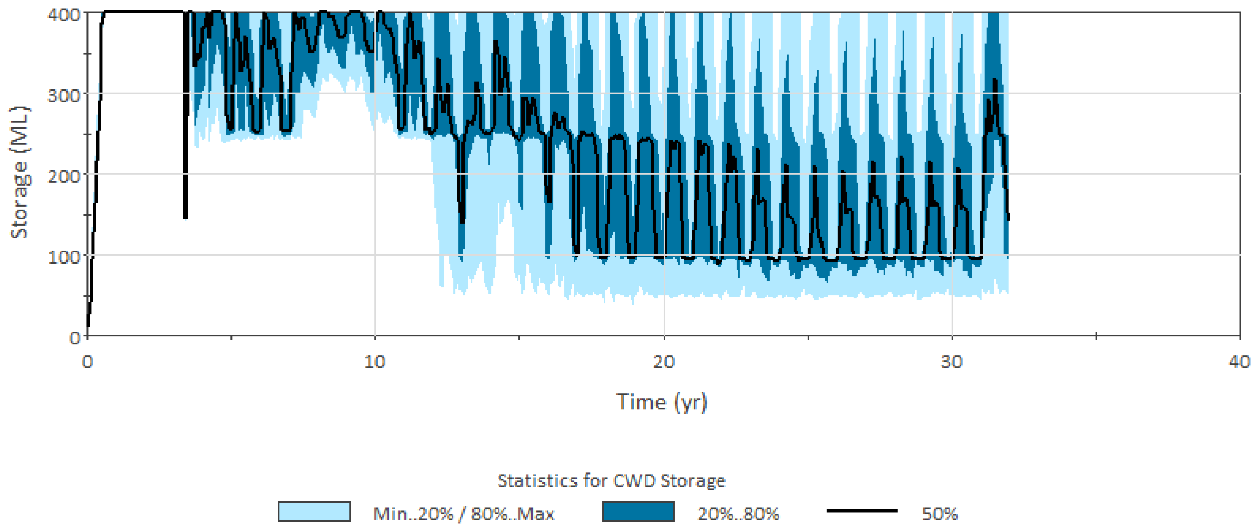

Figure 3-12: CWD Storage volume probabilistic range

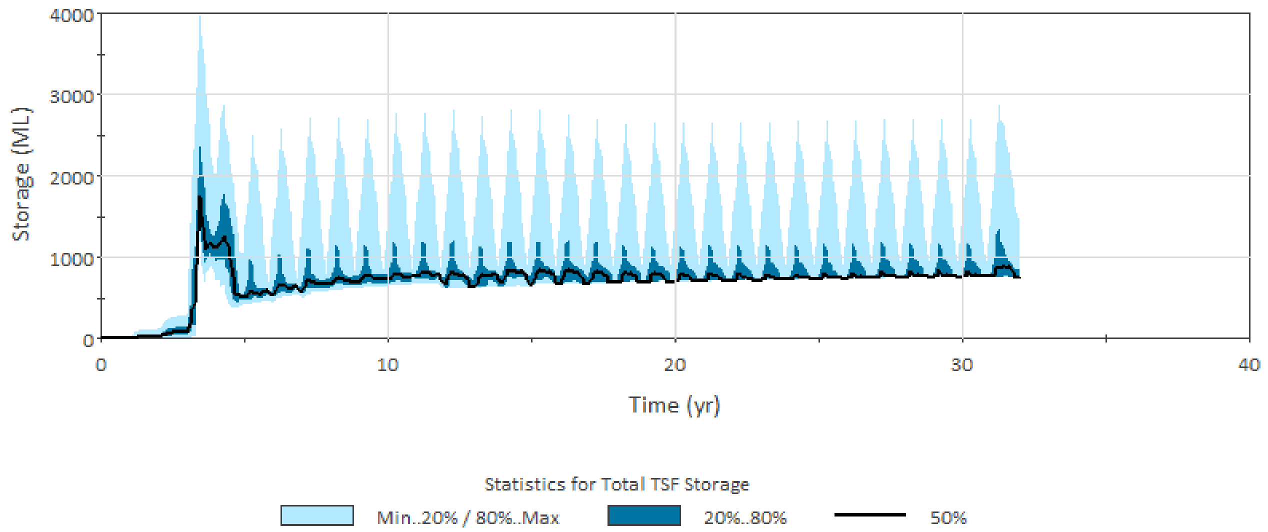

Figure 3-13: Total TSF storage volume probabilistic range

3.6 Losses

The main losses from the site water balance are from the TSF, with interstitial losses shown in Figure 3-14 and evaporation losses shown in Figure 3-15. Evaporation losses from all other water storages is shown in Figure 3-16. Sources with a probabilistic range are influenced by climatic conditions while others remain the same for all scenarios.

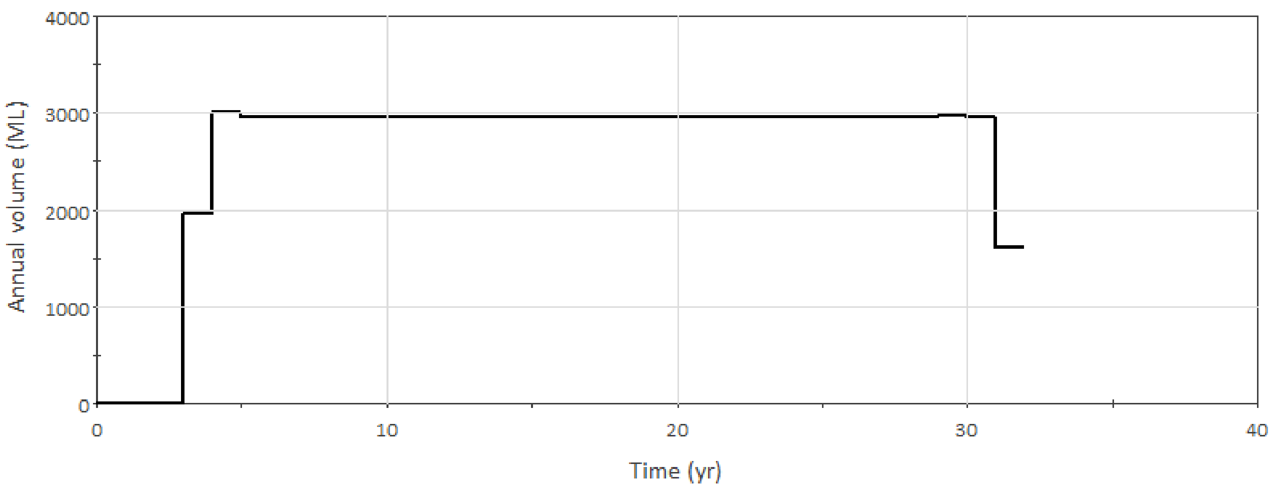

Figure 3-14: Annual TSF –interstitial volume loss

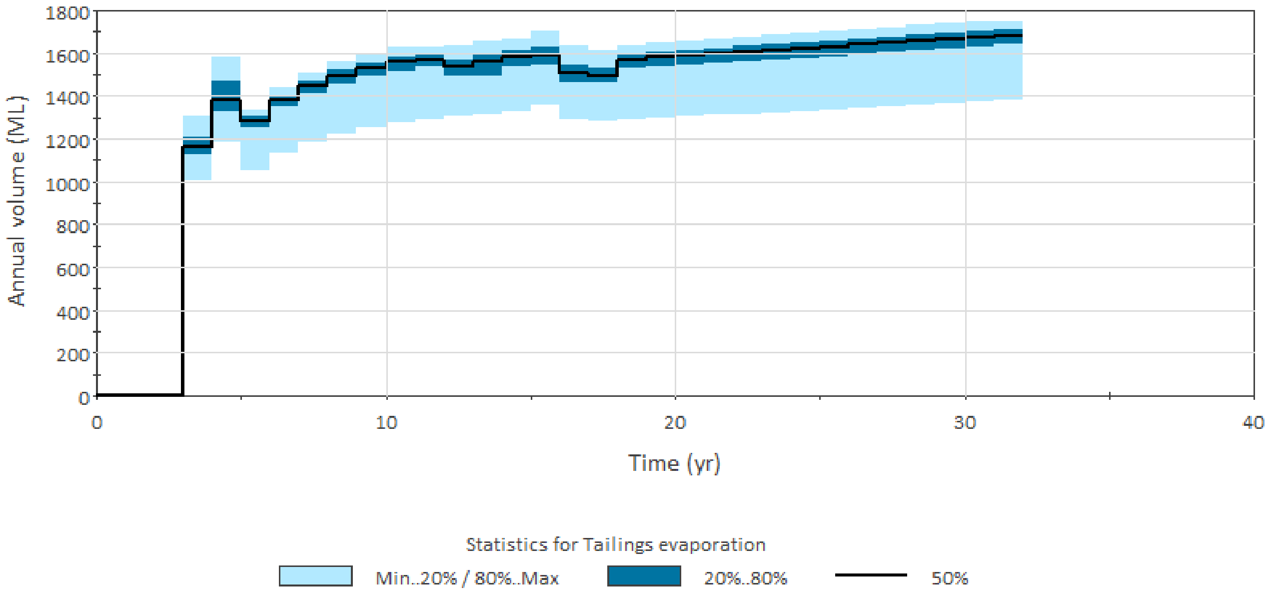

Figure 3-15: Annual TSF - Evaporation loss probabilistic range

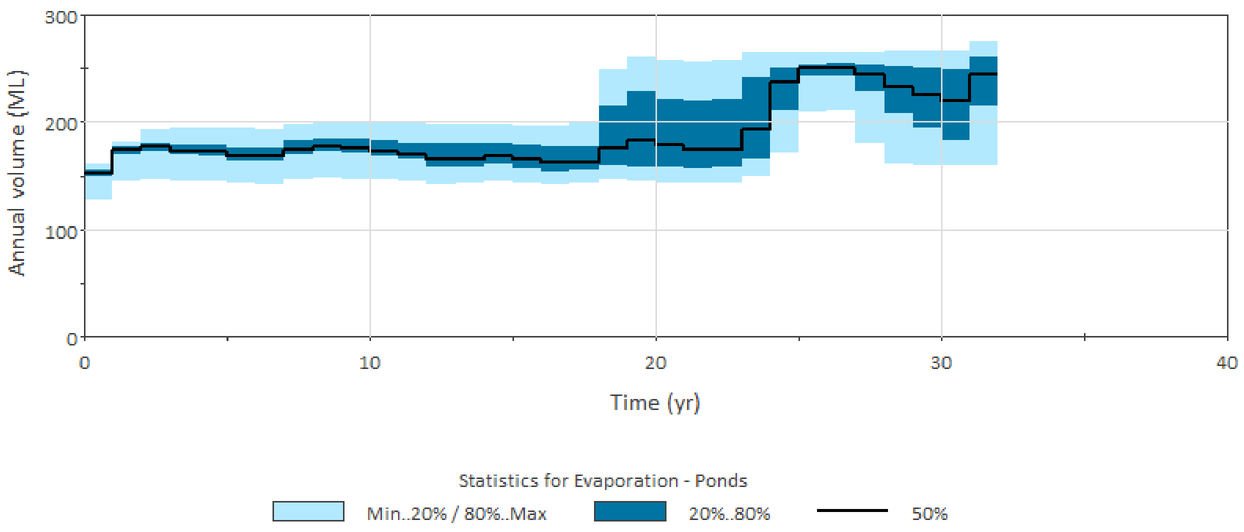

Figure 3-16: Annual Pond Evaporation loss probabilistic range

3.7 Surplus

Overflow from the CWD once volume exceeds 400ML represents surplus mine dewatering that cannot be utilized for either process or non-processing requirements. This water requires disposal through the infiltration ponds. The magnitude and timing of site water surplus is shown in Figure 3-17 and Table 3-2.

Medain annual excess water is approximately 892 ML/year across all simulations. Median (P50) surplus peaks in Year 3 at 3015 ML/year and Year 9/10 with the higher dewatering rates, then decreases to minor amounts by Year 18. From Year 20 surplus water is not generally expected (P50 is 0 ML/year), however excess of up to 1,203 ML/year could be expected in the most wet climatic conditions. The volume of surplus water is highly variable due to the influence of site climatic conditions.

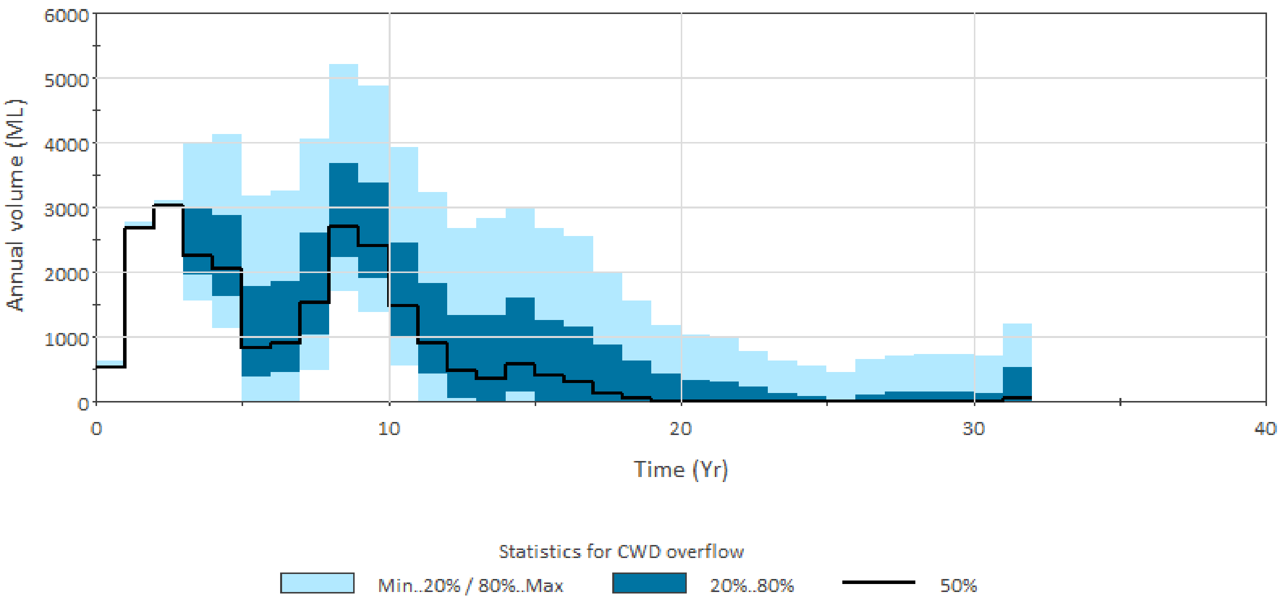

Figure 3-17: Excess water probabilistic range

Table 3-2: Excess water (ML/yr)

Year	Min	P10	P20	P50	P80	P90	Max
1	507	519	524	536	558	569	615
2	2649	2665	2668	2683	2707	2720	2772
3	2981	2997	3001	3015	3040	3052	3104
4	1555	1834	1962	2262	2989	3325	4008
5	1124	1458	1627	2041	2866	3201	4116
6	0	250	363	830	1775	2075	3186
7	0	300	441	890	1850	2131	3251
8	485	888	1036	1526	2589	2860	4057
9	1696	2041	2236	2694	3680	4025	5196
10	1370	1759	1910	2389	3375	3752	4877
11	547	868	1005	1486	2446	2805	3931
12	0	272	431	893	1836	2145	3231
13	0	0	50	479	1322	1616	2668
14	0	0	0	354	1325	1583	2832
15	0	10	151	574	1594	1849	2993
16	0	0	0	402	1262	1553	2668
17	0	0	0	299	1160	1420	2547
18	0	0	0	135	868	1096	1998
19	0	0	0	43	615	833	1546
20	0	0	0	0	415	572	1185
21	0	0	0	0	334	480	1014
22	0	0	0	0	311	459	993
23	0	0	0	0	216	376	782
24	0	0	0	0	136	274	620
25	0	0	0	0	89	214	542
26	0	0	0	0	31	135	439
27	0	0	0	0	108	253	663
28	0	0	0	0	148	290	711
29	0	0	0	0	143	290	723
30	0	0	0	0	143	292	719
31	0	0	0	0	126	274	703
32	0	0	0	58	523	740	1203

3.9 Sensitivity analysis

3.9.1 Water balance

A number of sensitivity simulations have been undertaken to capture the likely variations in the key site water management parameters, as a function of the likely variation in supply, demands, losses, use as well as the values of various modeling parameters. The sensitivity analysis results are shown in Appendix A. Figure 3-18 and Figure 3-19 represent the median annual water balance for the site-wide water balance considering the uncertainty in dewatering (P10/P90).

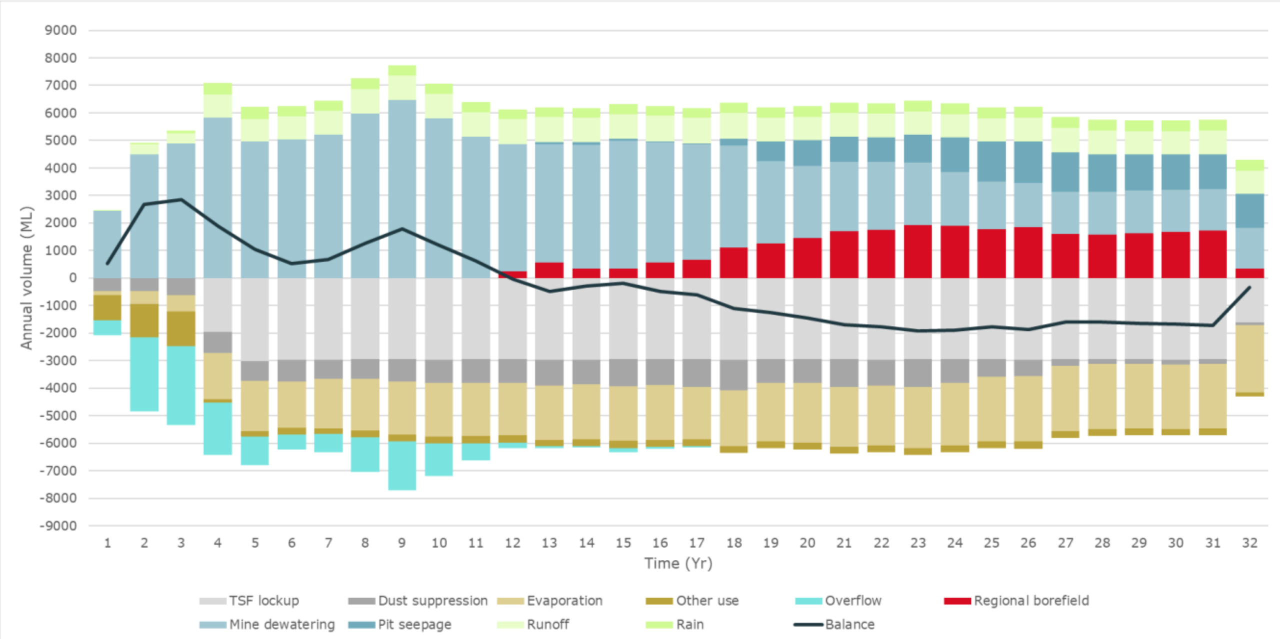

Figure 3-18 Site-wide water balance considering the P10 dewatering estimate

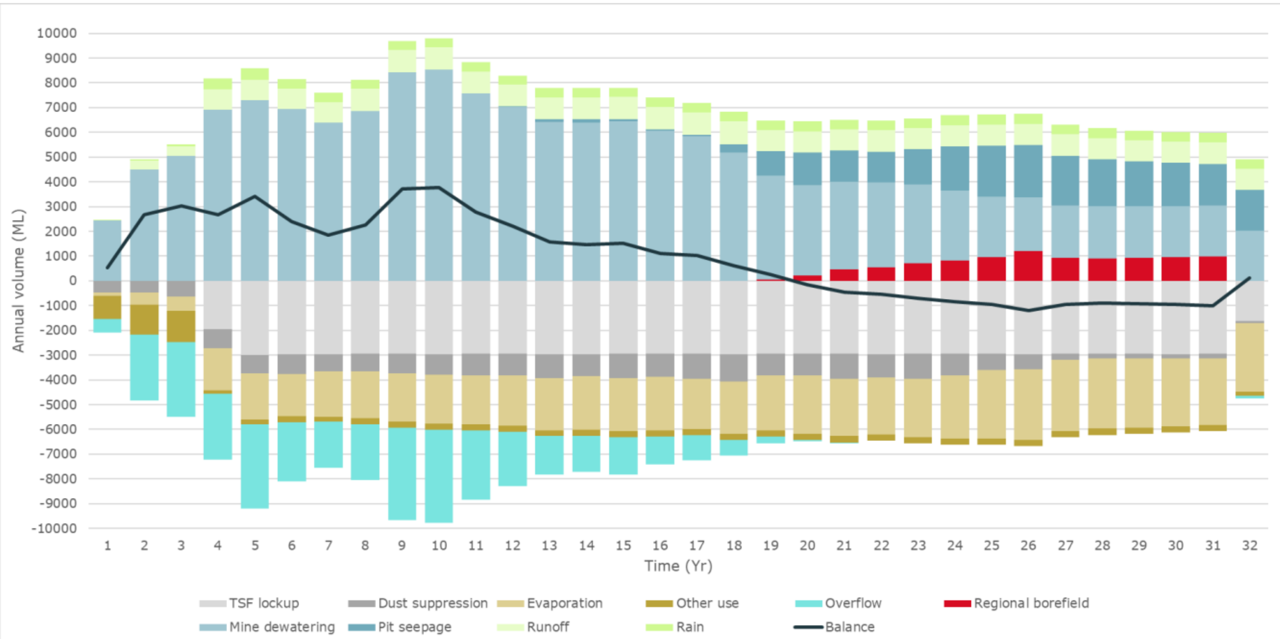

Figure 3-19 Site-wide water balance considering the P90 dewatering estimate

3.9.2 Regional borefield

Figure 3-20 to Figure 3-23 shows the effect of climatic scenarios on uncertainty of the key assumptions. A Monte Carlo analysis of the historical climatic records were assessed to evaluate potential rainfall and evaporation patterns. The graphical representations below illustrate the outcomes of the water balance based on various forecasts for the LoP: dry forecasts are represented by the Max outlier bar, normal climatic forecasts by the median point, and wet periods by the Min outlier.

The regional borefield supply represents the overall water balance potential deficit/surplus over the period in ML/yr. The colour bars indicates the sensitivity scenario as per the legend of each figure.

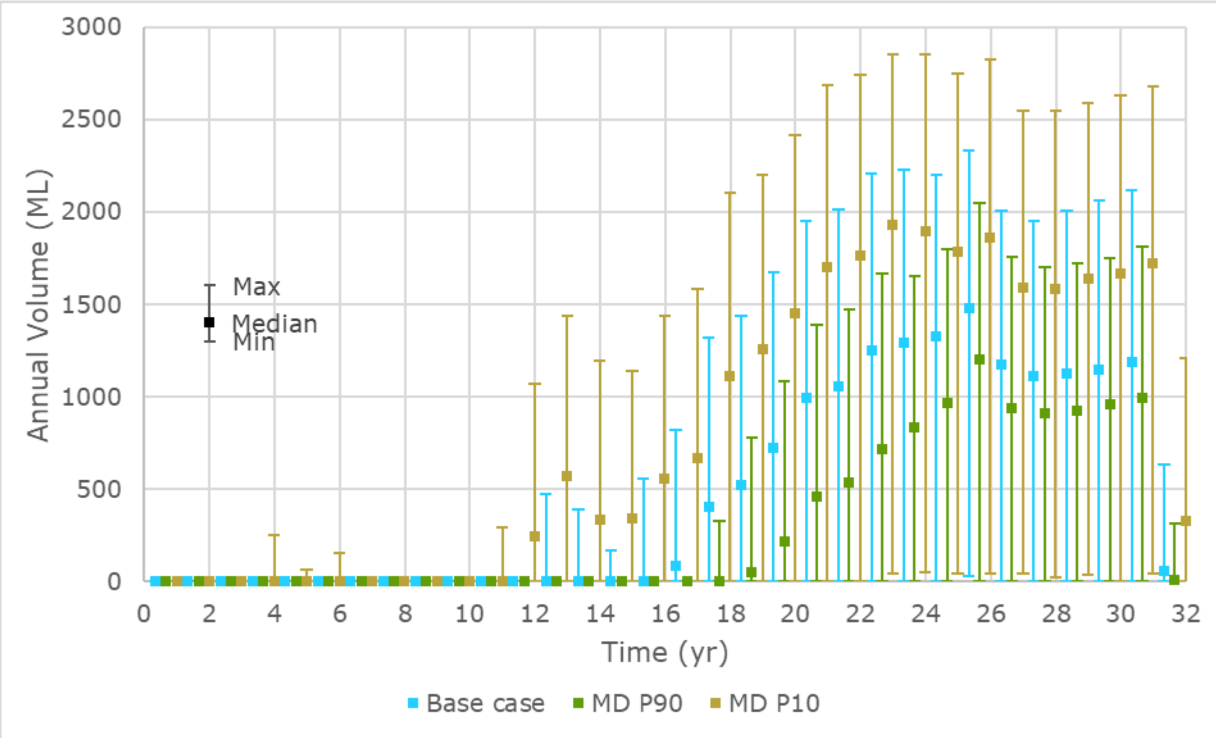

Figure 3-20: Regional Borefield Supply – Dewatering sensitivity

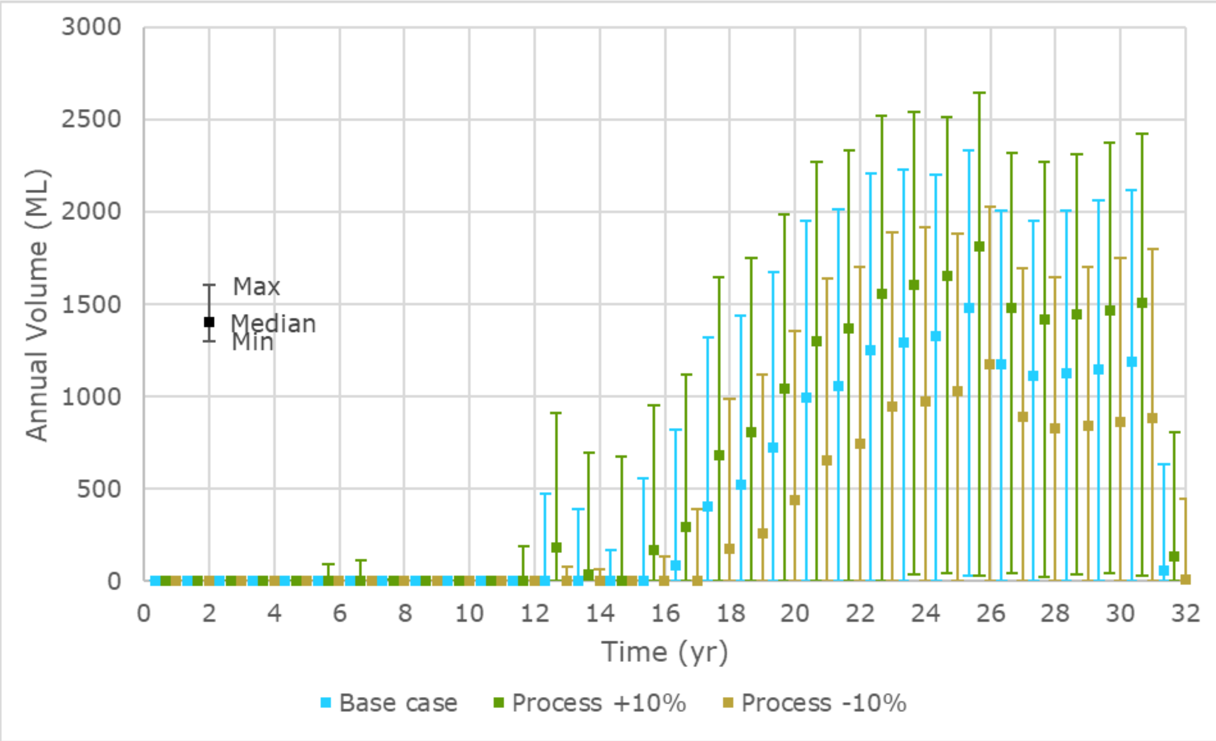

Figure 3-21: Regional Borefield Supply – Process demand sensitivity

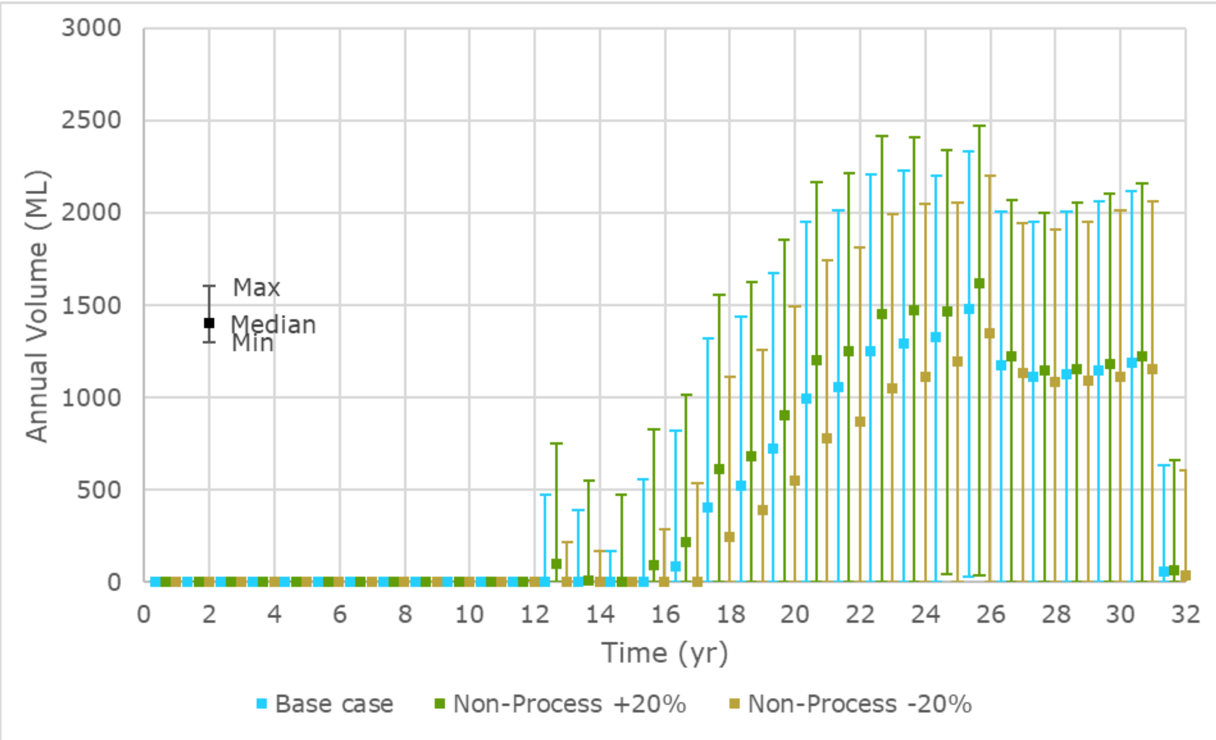

Figure 3-22: Regional Borefield Supply – Non process demand sensitivity

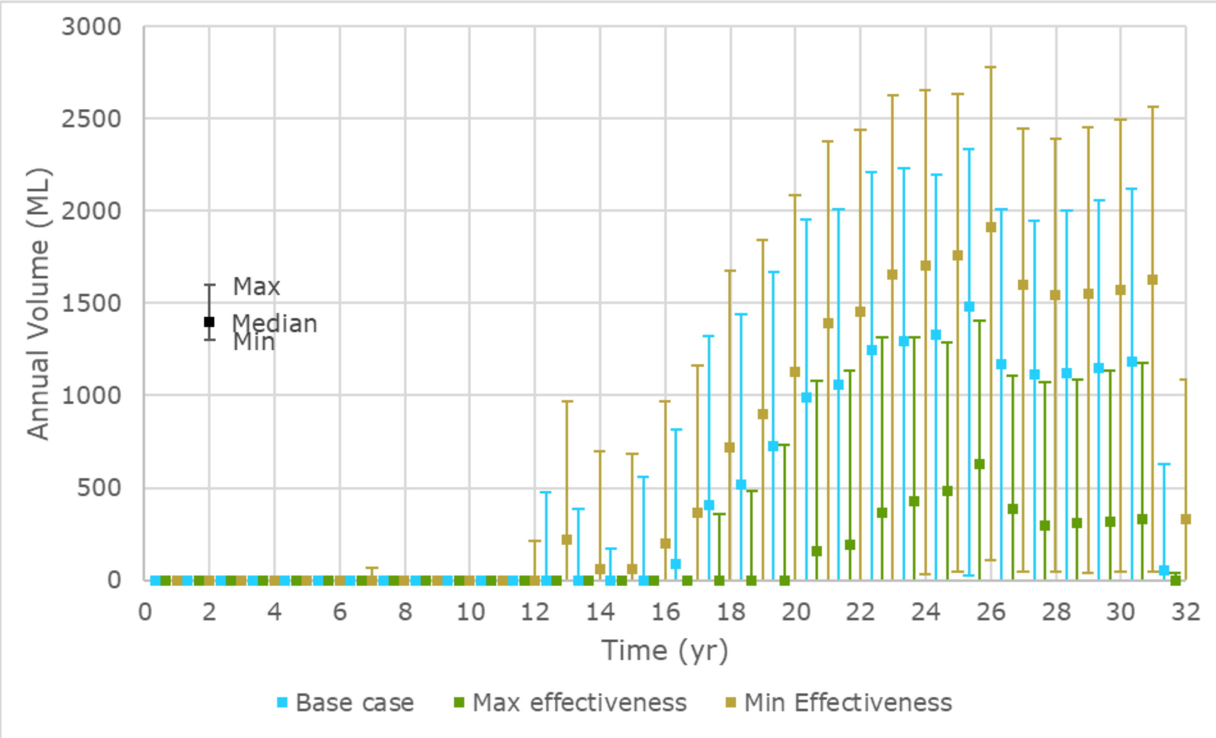

Figure 3-23: Regional Borefield Supply – Evaporation inhibitors sensitivity

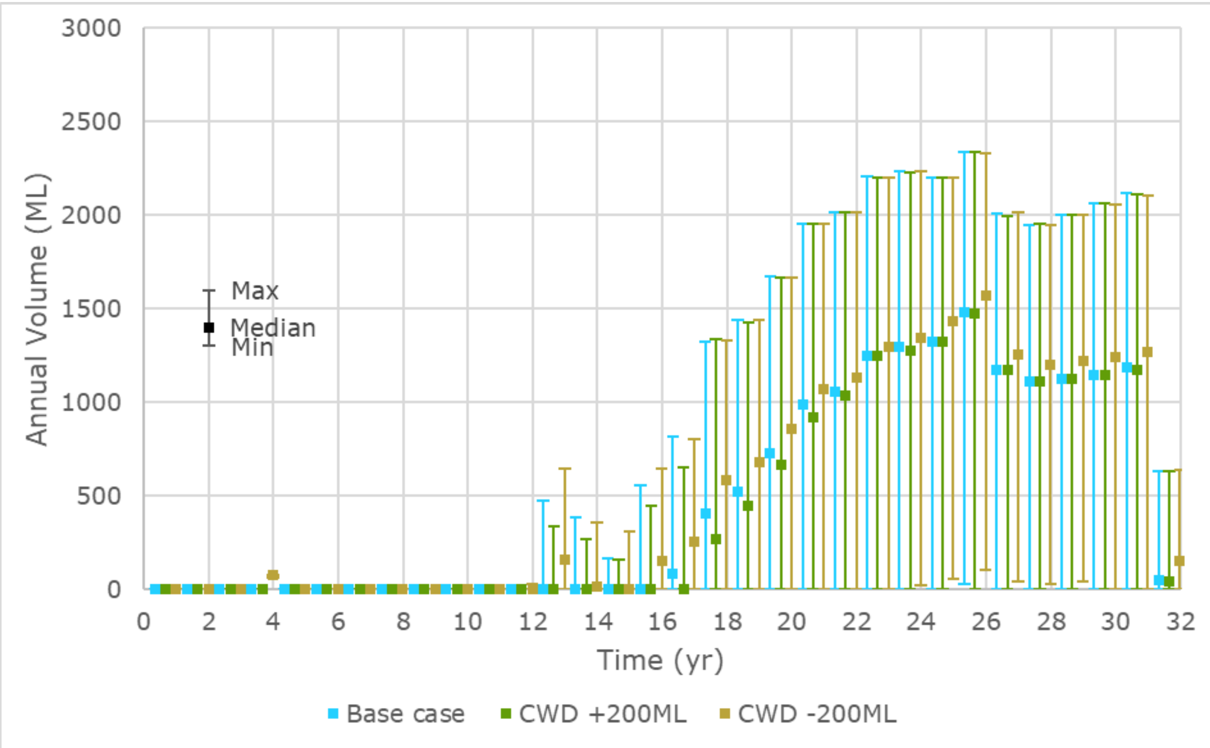

Figure 3-24: Regional Borefield Supply – CWD sensitivity

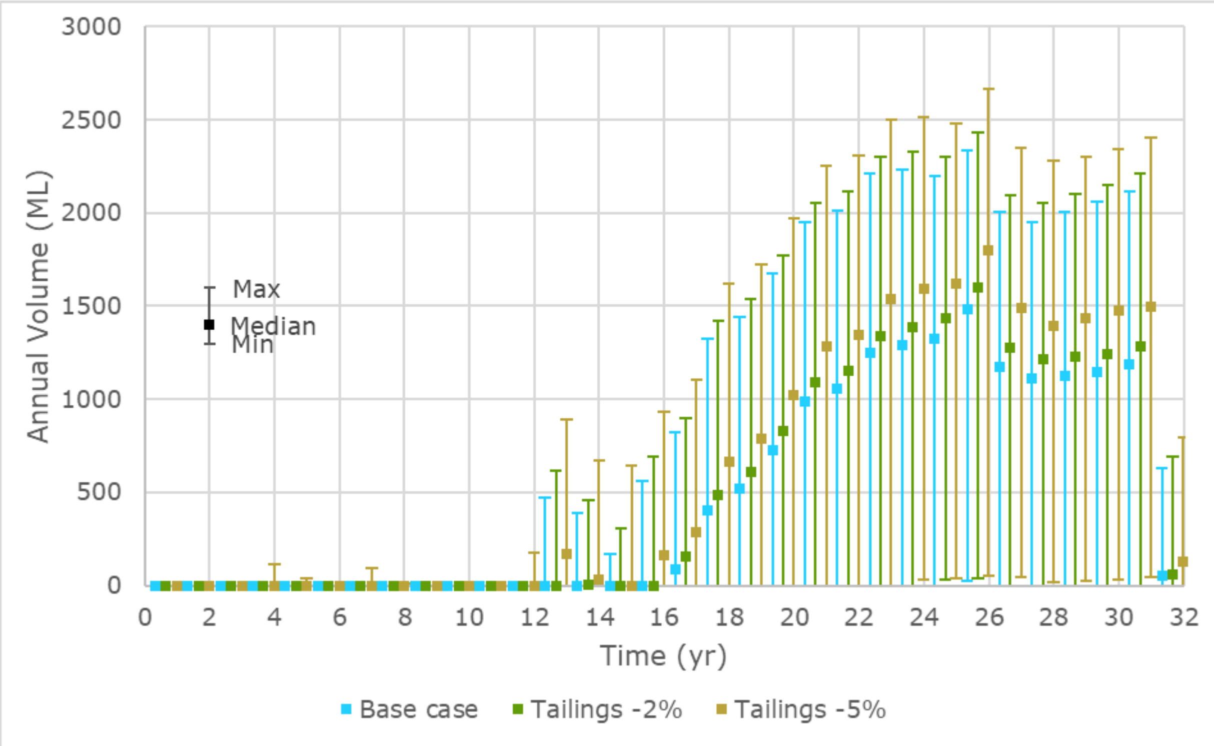

Figure 3-25: Regional Borefield Supply – Tailings density sensitivity

3.9.3 Surplus

Surplus water for the assessed sensitivity cases is presented in Appendix A. The mine dewatering sensitivity cases results in the greatest change in surplus water, with results presented in Figure 3-26. Peak surplus occurs in Year 9 with median and maximum CWD overflow 2,694 ML/yr and 5,196 ML/yr respectively. The upper dewatering case (P90) in median and maximum CWD overflow increasing to 3,726ML/yr and 6,237 ML/yr respectively. The lower dewatering case (P10) equivalent reduction, with median and maximum CWD 1,798ML/yr and 4,269 ML/yr respectively.

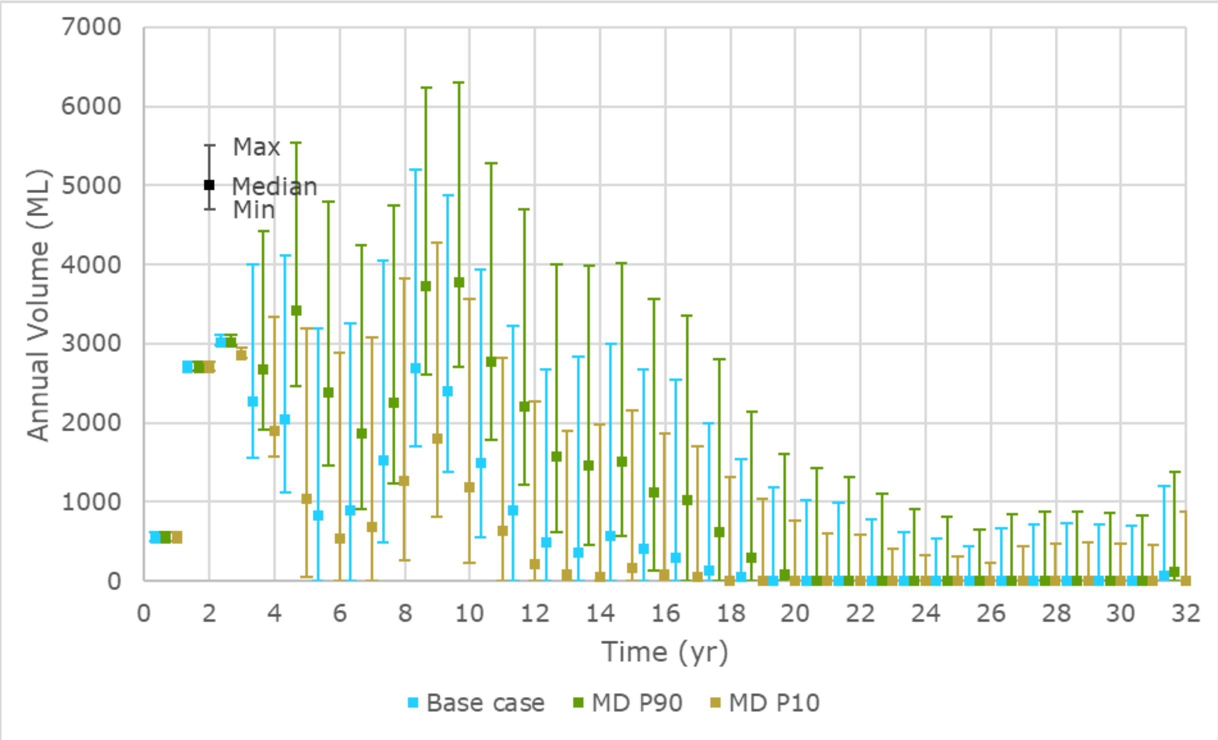

Figure 3-26: CWD overflow –mine dewatering sensitivity

3.10 Climate Change

A Monte Carlo analysis of the scaled climatic records was assessed to evaluate projected rainfall and evaporation patterns.

The considered climate change analysis (for the water balance) has not assessed any potential change in design rainfall, it rather estimated the continuous time series of rainfall with climate change.

The results will be presented for two aspects identified as key features of the sites water balance:

a. Water supply required by the regional borefield
b. TSF storage requirements, and
c. Surplus water

3.10.2 Regional borefield

Figure 3-27 presents the base case for the regional borefield water supply, considering the adjustment of the historic climate record to current climate conditions (Section 2.4).

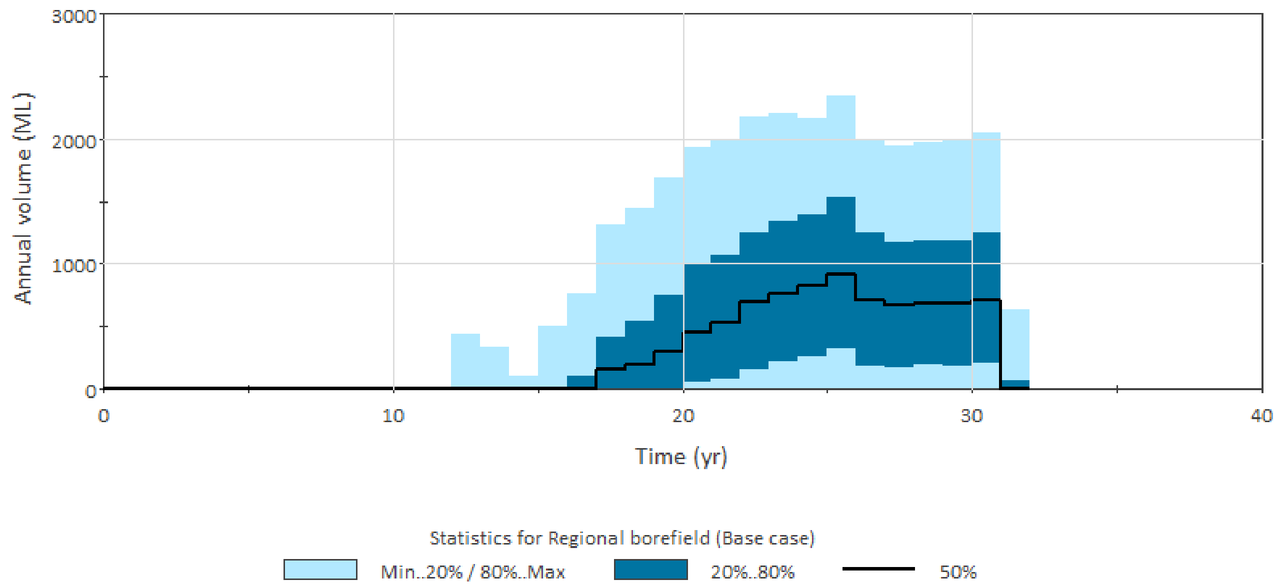

Figure 3-27: Regional borefield supply – Base case

The effect of the increased rainfall on the required supply from the regional borefield under the low emission (SSP1-2.6) and high emission (SSP5-8.5) is shown in Figure 3-28 and Figure 3-29, respectively with only minor difference in the assessed cases. Figure 3-31 shows required supply from the regional borefield under the most wet projection and Figure 3-32 shows the results under the most dry projection.

Compared to the base case (Figure 3-27) the median requirement from the borefield is reduced as a result of the higher rainfall, with similar probability distributions.

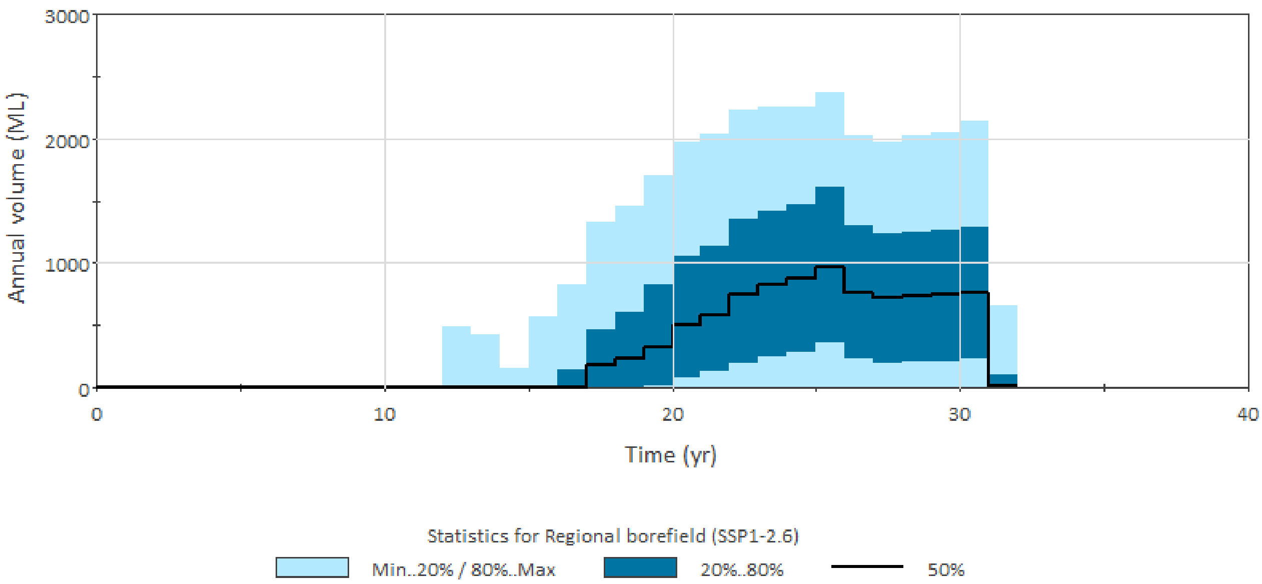

Figure 3-28: Regional borefield supply – Median climate change projection for low emission scenario

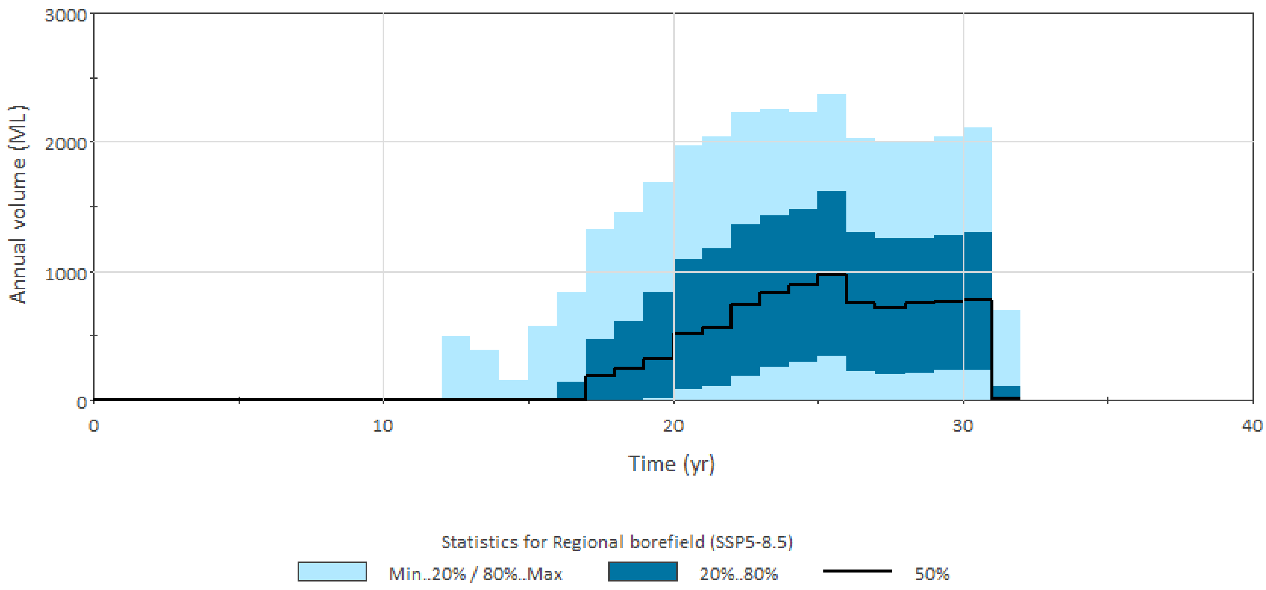

Figure 3-29: Regional borefield supply – Median climate change projection for high emission scenario

Figure 3-30, Figure 3-31 and Figure 3-32 illustrate the outcomes of the water balance based on various forecasts for the LoP:

- dry forecasts are represented by the Max outlier bar,
- normal climatic forecasts by the median point, and
- wet periods by the Min outlier.

The regional borefield supply represents the overall water balance potential deficit/surplus over the period in ML/yr. The colour bars indicate the sensitivity scenarios as per the legend of each figure.

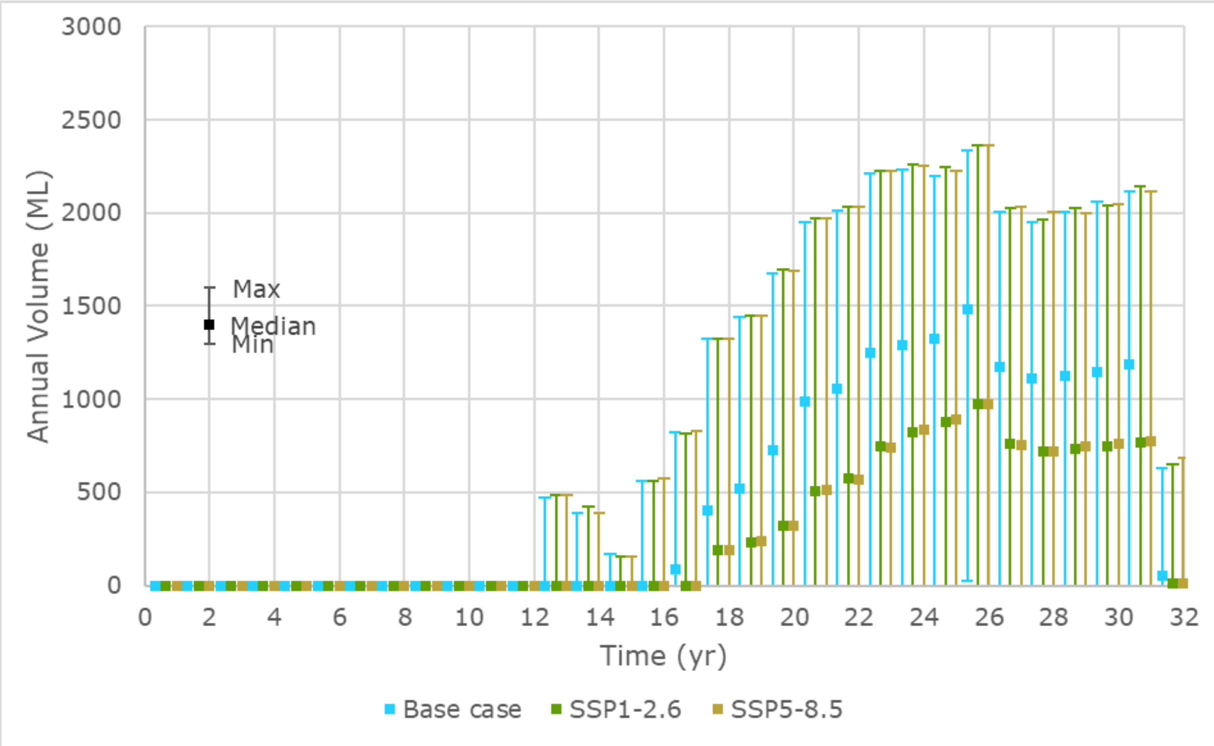

Figure 3-30: Regional borefield supply – Median climate change projection for low and high emissions

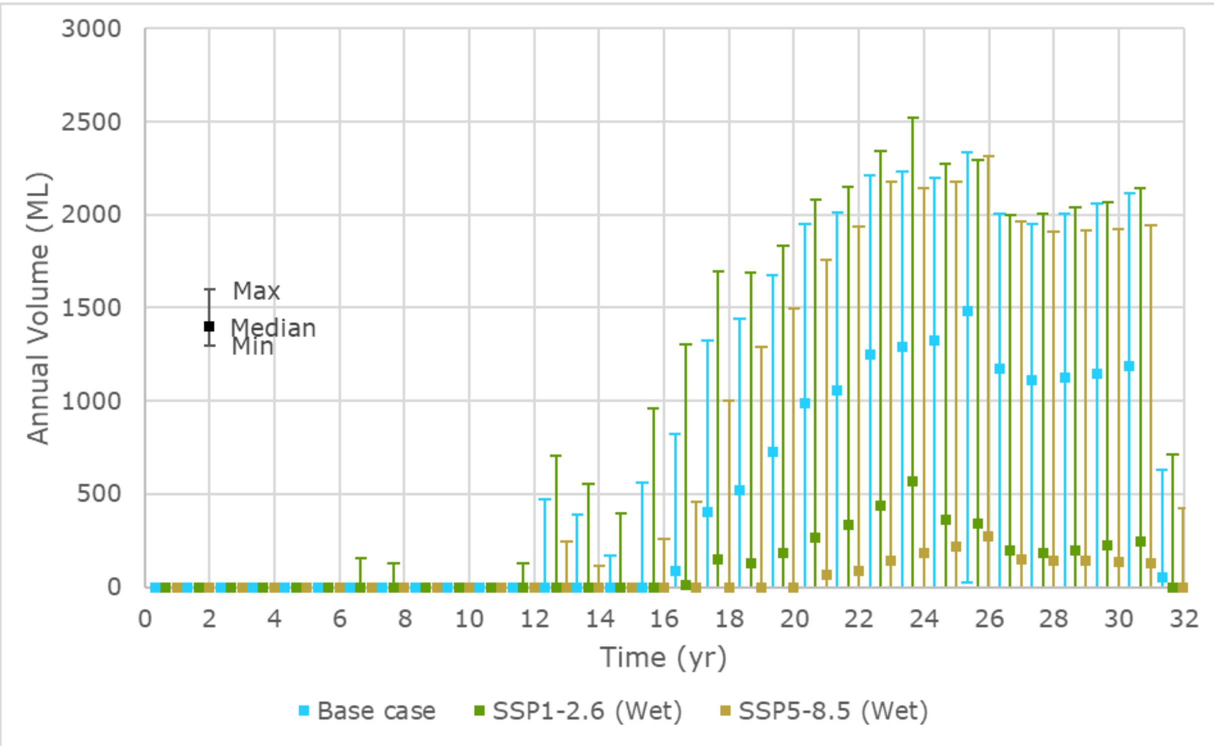

Figure 3-31: Regional borefield supply – Wet climate change projection

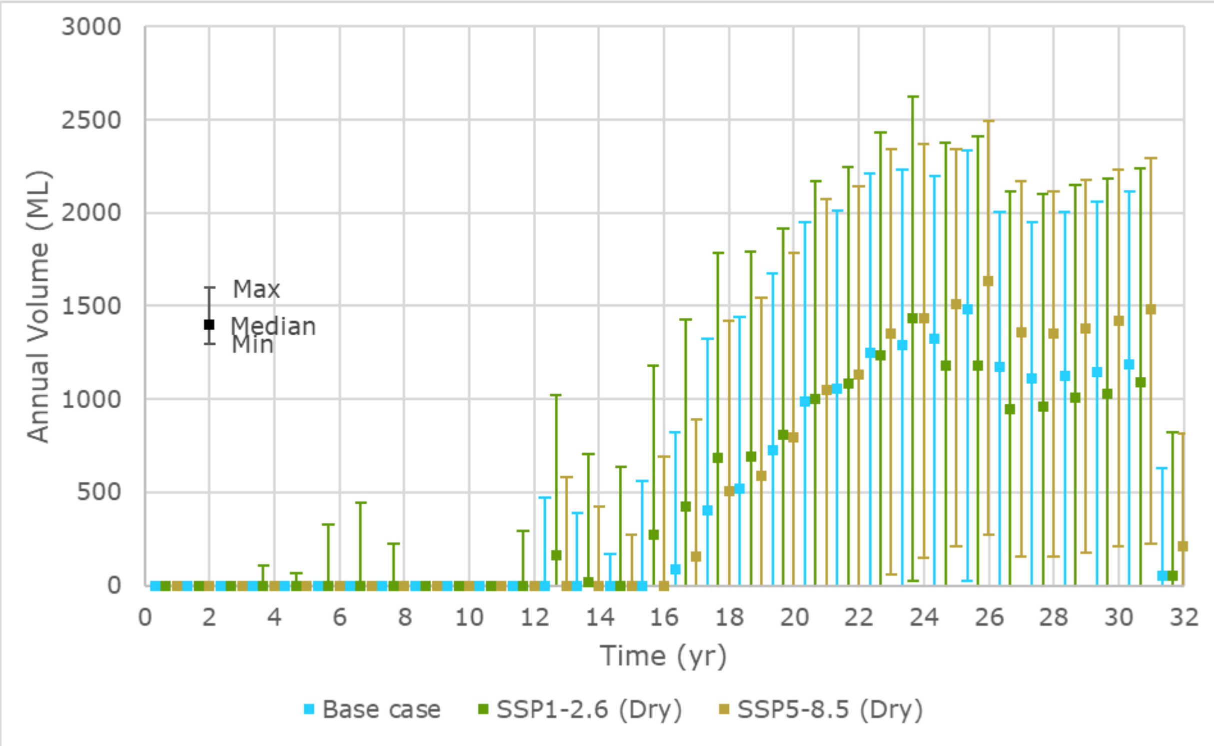

Figure 3-32: Regional borefield supply – Dry climate change projection

3.10.3 TSF storage requirements

Storage probability plots for the TSF are shown in Appendix B. Extreme Heavy rainfall is projected to increase over the LoP, as shown in Figure 2-10 and Figure 2-11, resulting in greater maximum storage volumes of water in the TSF system.

The maximum TSF storage is shown in Figure 3-33 and Figure 3-34, for the low and high emission scenarios, respectively. As shown in these figures, the maximum storage requirements for the TSF occurs during the early stages of the LoP, where the change in extreme rainfall is relatively small. There exist only minor differences between the low and high emission scenarios.

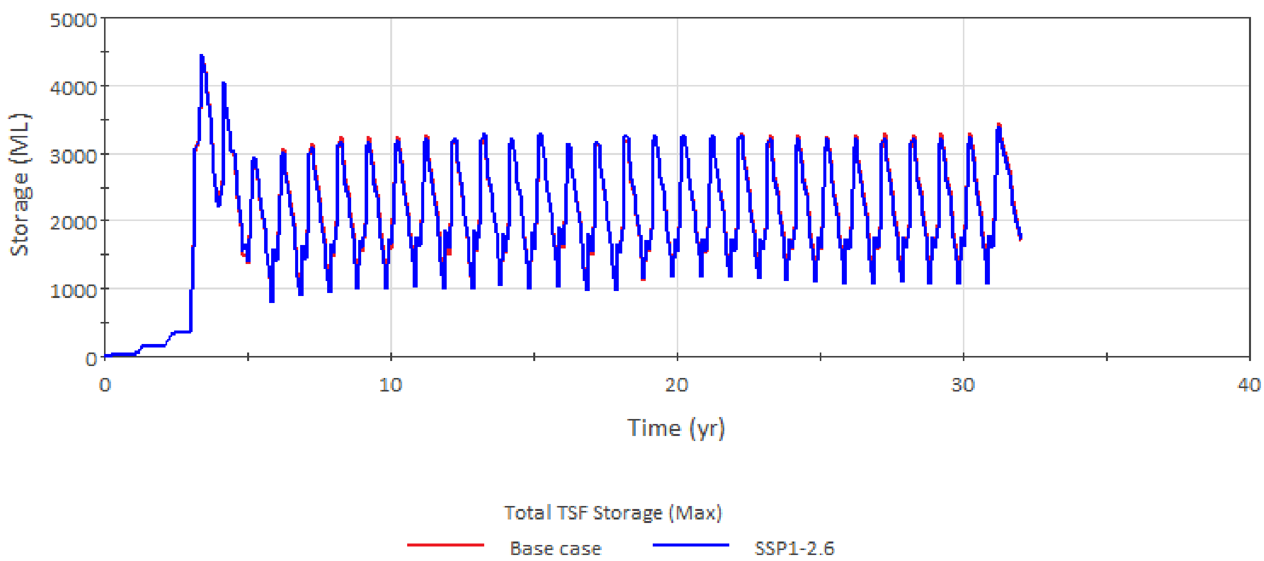

Figure 3-33: TSF maximum storage – low emission scenario

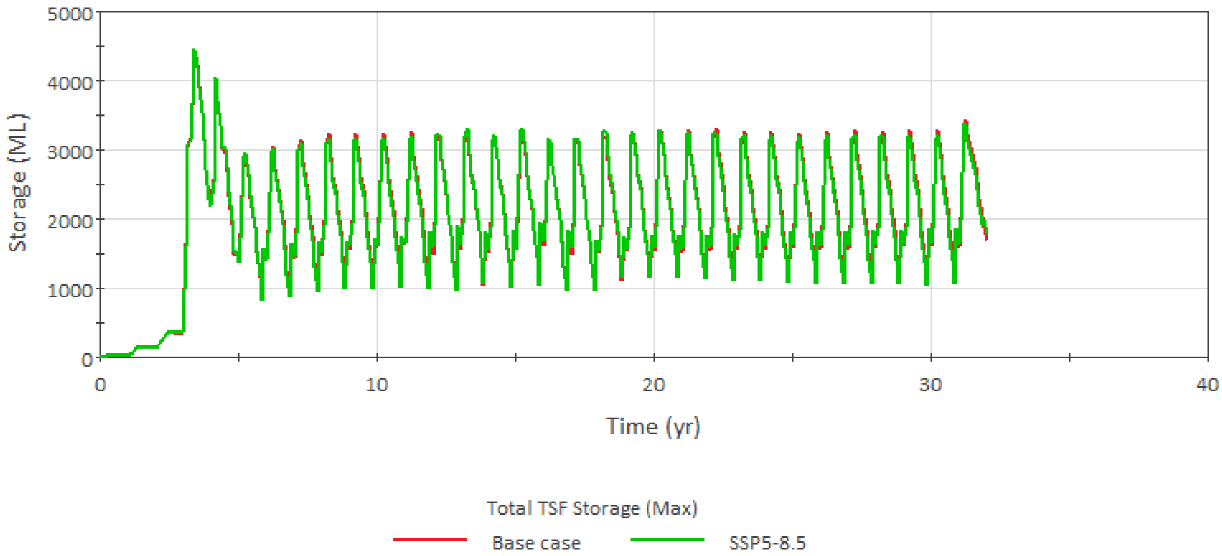

Figure 3-34: TSF maximum storage – high emission scenario

3.10.4 Surplus water

Figure 3-35 presents the base case for surplus water, showing projections under historic climate conditions.

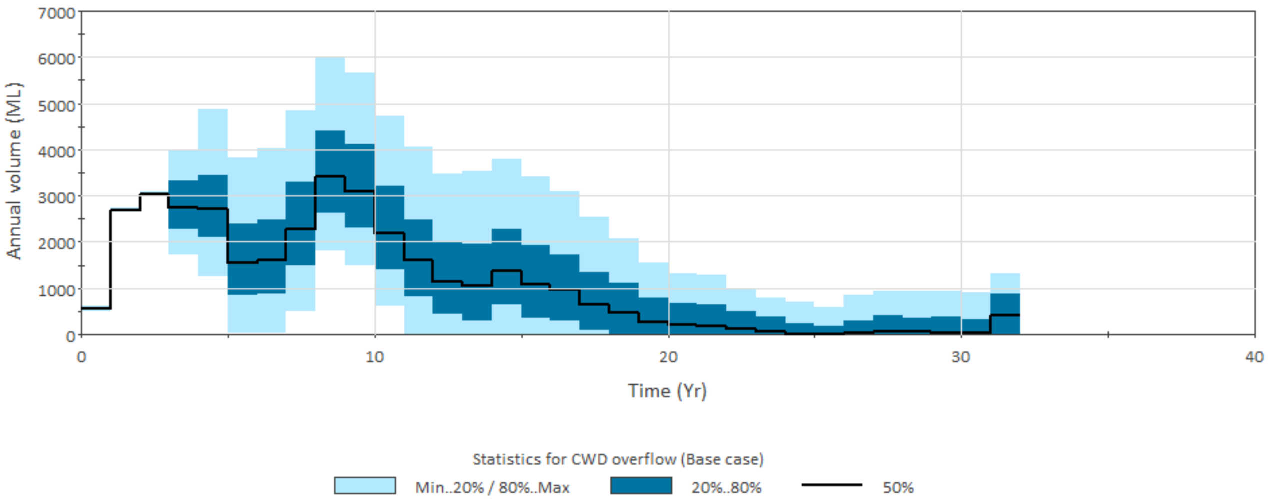

Figure 3-35: CWD overflow – base case

Projected surplus water for the low emission (SSP1-2.6) and high emission (SSP5-8.5) scenarios are shown in Figure 3-36 and Figure 3-37, respectively. Surplus water under both emission scenarios increases, with only minor differences between the emission scenarios (low and high). The projected increase in annual median surplus water under the climate scenarios is approximately 40% higher compared to historical records. However, this is primarily a result of the increase in the historic rainfall adopted in the analysis rather than projected changes in climate.

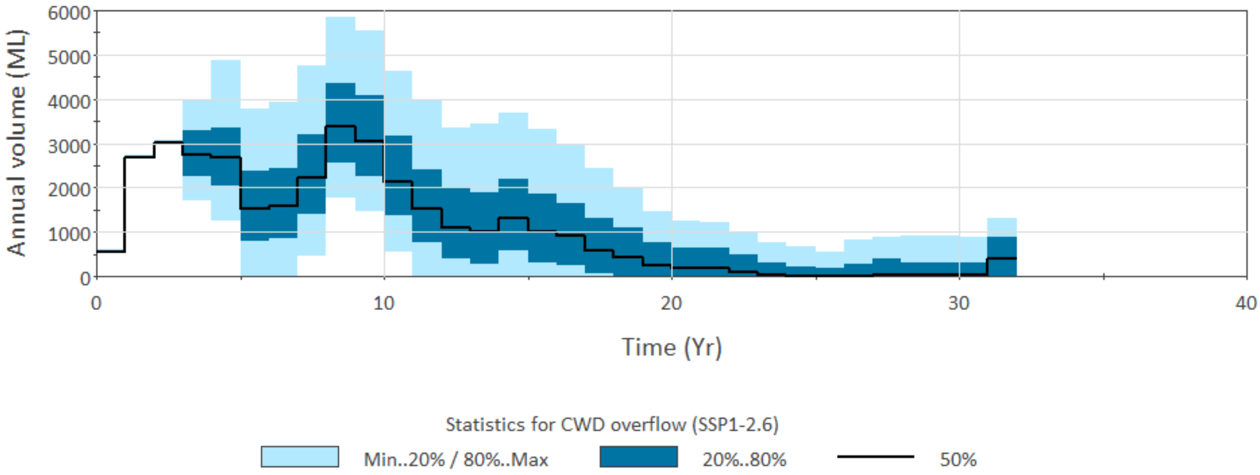

Figure 3-36: CWD overflow – low emission scenario

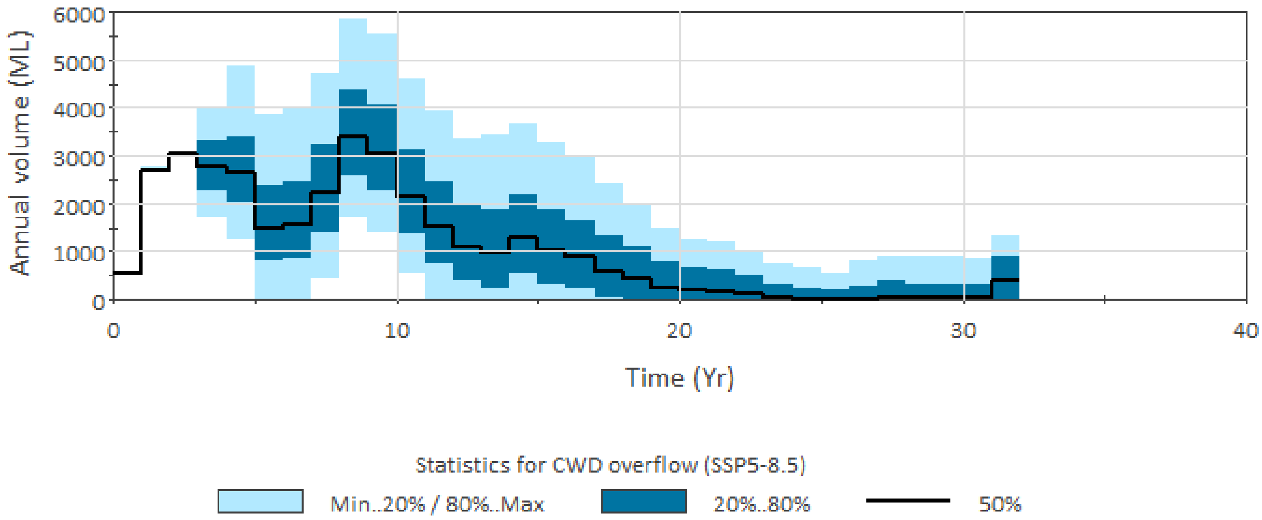

Figure 3-37: CWD overflow – high emission scenario

3.11 Summary

The key findings can be summarized as follows:

1. For the base case under normal climatic conditions the regional borefield is required from Year 17. Median requirements peaks in Year 26 at 1,480 ML/yr.
2. For the base case under the driest climatic conditions, the borefield is required from Year 13. Maximum requirements peak in Year 26 at 2,333 ML/yr.
3. For the base case, under all climatic conditions median water requirements from the regional borefield is 570 ML/yr.
4. Surplus water peaks in Year 9 with median and maximum CWD overflow 2,694 ML/yr and 5,196 ML/yr respectively. Surplus reduces to approximately 893 ML/year by Year 12 and to 0 ML/year by Year 20.
5. Mine dewatering sensitivity analysis provides the greatest range of both regional borefield requirements and surplus water.
   a. The lower mine dewatering rate (P10) case indicates the regional borefield is required earlier (Year 12) and the demand/magnitude is greater (Figure 3-20). Median regional borefield requirement is 1,929 ML/yr, with a maximum of 2,800 ML/yr.
   b. The upper dewatering case (P90) indicates median and maximum CWD overflow increasing to 3,726ML/yr and 6,237 ML/yr respectively.
6. Under the base case mine dewatering scenario, the climatic variation can influence the water balance significantly, ranging from a water balance deficit (dry scenario and base case to water neutral and/or surplus in the wet scenarios).
7. The effectiveness of the evaporation inhibitors has a significant impact on the water balance deficit and the regional borefield requirements (Figure 3-23). If the evaporation inhibitors are not as effective as predicted, the regional borefield is required from Year 12 onwards.
8. Performance of the tailings management system including tailings density and actual interstitial losses have a significant influence on the water balance and the requirement for the regional borefield from Year 12 onwards.
9. Assumptions regarding the CWD size and non-process water requirements have a minor impact on the regional borefield requirement (Figure 3-21 and Figure 3-22).
10. Climate change analysis using the LPG requires an adjustment of the historic climate time series pre-1991, to ensure that the full record has similar characteristics to the current climate (1991 – 2020). This means that 1900-1990 rainfall has to be significantly increased (34%), while evaporation requires a small adjustment (0.4%).
11. Under both low and high emission climate change scenarios, the median water supply requirement from the regional borefield is reduced compared to the base case. However, this is primarily a result of the increase in the historic rainfall adopted in the analysis rather than projected changes in climate. The range of requirements from the regional borefield is equivalent to the base case.

4. Conclusions

Based on the results of the updated water balance modelling the following conclusions are made:

- Under normal climate conditions, mine dewatering provides adequate supply to the site up to Year 16, without supply from the regional borefield. From Year 17 the regional borefield is required to supplement water supply to meet combined site water requirements. The regional borefield supply peak is in Year 26, with a median (P50) of 1,480 ML/yr.
- To ensure reliable water supply under all climatic conditions, the regional borefield is required from Year 13, with median supply requirement 570 ML/yr with a potential range of 0 to 2,333 ML/yr.
- Annual volume required from the regional borefield is predominantly sensitive to mine dewatering assumptions, with peak median supply under the P10 dewatering case increasing 1,929 ML/yr, with a maximum of 2,800 ML/yr.
- Supply from the regional borefield is also sensitive to evaporation inhibitors, tailings density and process demand assumptions, with sensitivity analysis showing peaks of between 2,648 and 2,782 ML/yr.
- Given the uncertainty of the actual mine dewatering rates, effectiveness of evaporation inhibitors, tailings density and process demand, supply of up to 2800ML/yr from the regional borefield provides contingency if the rates are lower than expected.
- The timing of the requirements for the regional borefield, even under the sensitivity cases mean there is some time (can be as early as Year 4 to 12) during the initial project operation to understand the site water balance and validate assumptions prior to the need to install the regional borefield and to optimize the design.
- Excess water generated from the mine dewatering during the initial phases will require management through infiltration. Median annual excess water discharge peaks in Year 3 at 3,015 ML/year, reducing to approximately 893 ML/year by Year 12 and to 0 ML/year by Year 20.
- There may be options to further optimize the dewatering strategy and bench progression to minimise the need for infiltration at this rate. However, the need to manage surplus water in the system exists. Modelling periods where there are both excess and supply from the regional borefield shows that the site storage is not effective at balancing times of excess mine dewatering and those of higher losses.
- Water management will therefore be critical to mine operations, both in terms of minimising water deficits and excess water discharge. Control over operations within the TSF and dewatering will require approaches such as a introducing a trigger action response plan (TARPS) including regular monitoring of water levels within the dams/ponds and TSF; this will be essential to quantify volumes of retained water and trigger actions for release or changes in operations such as dewatering.
- Climate change analysis suggest more rainfall compared to the full historic climate record, with lower regional borefield and greater surplus water requirements.

5. Recommendations

Considering the water balance results and conclusions of this study, the following recommendations are made to support further planning and design:

- Modifying the dewatering schedule and rates to coincide with seasonal patterns will likely reduce the average annual magnitude of deficits and excess discharge volumes.
- Investigate options for optimizing the mine dewatering strategy during the initial project phases to align the peak demand with mine dewatering.
- Manage a portion of the excess water by using levers such as increased evaporation.
- The water balance analyses have not considered water quality concentrations within the various water streams. It is recommended that water quality be considered, particularly if this could impact the suitability of the various water streams for use in meeting site water demands (process and/or non-process).
- The need for a regional borefield is still a priority and groundwater studies (both field and desktop) should continue with the aim of quantifying additional potential sources of groundwater to meet supplementary water demands.

6. References

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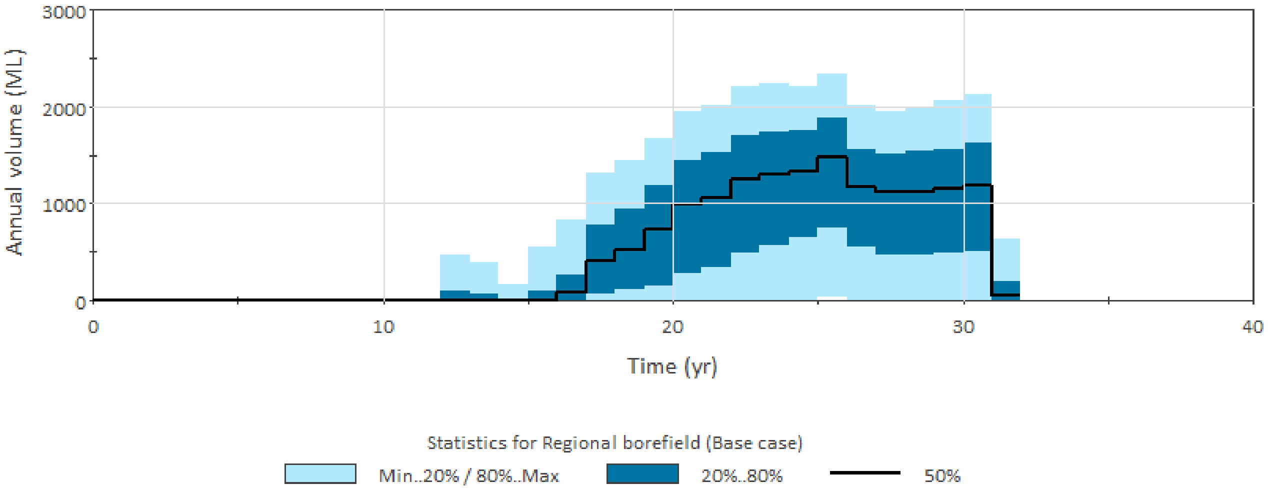
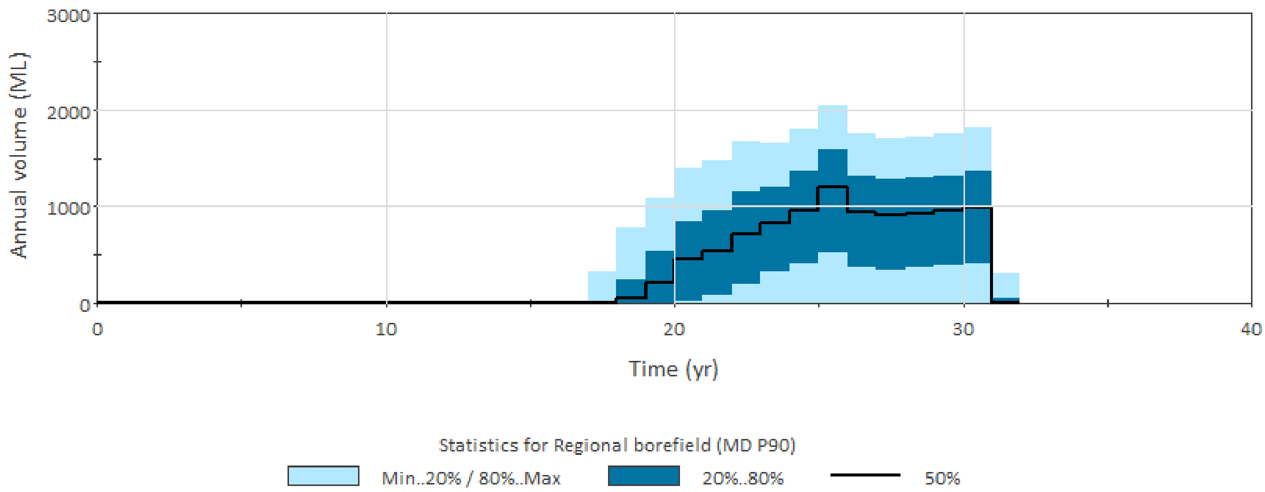
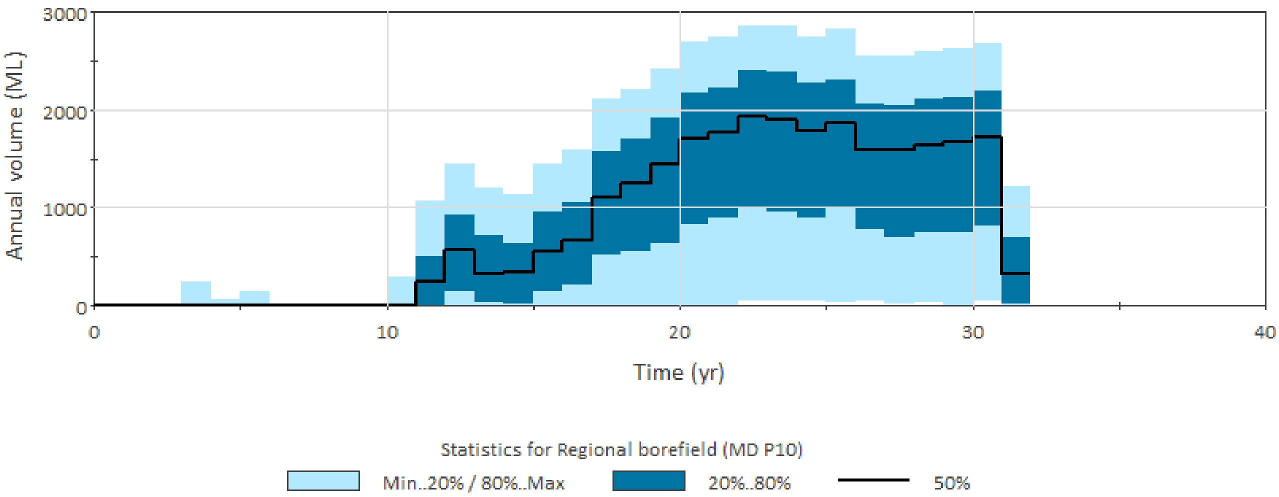
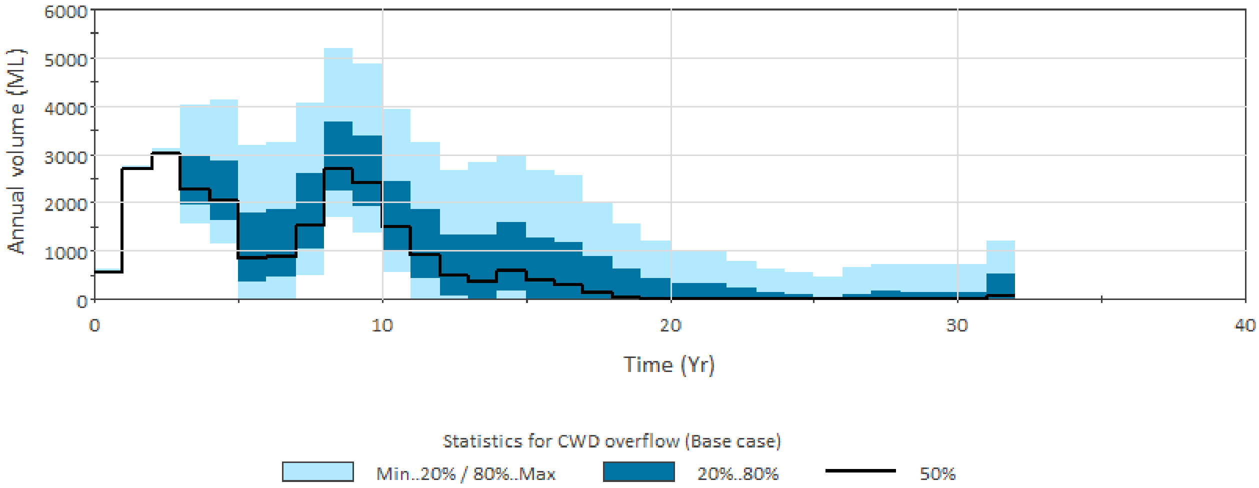
Appendix A. Sensitivity Analysis
Probability plots

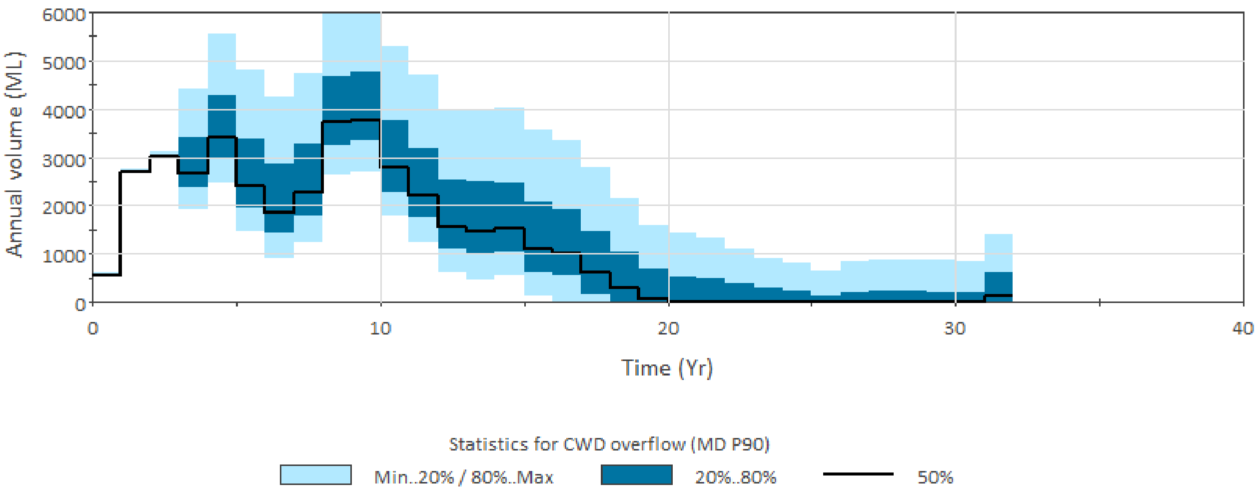
A.1 Mine dewatering








Annual volume (ML)
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
Time (Yr)
Statistics for CWD overflow (Base case)
Min..20% / 80%..Max
20%..80%
50%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3000
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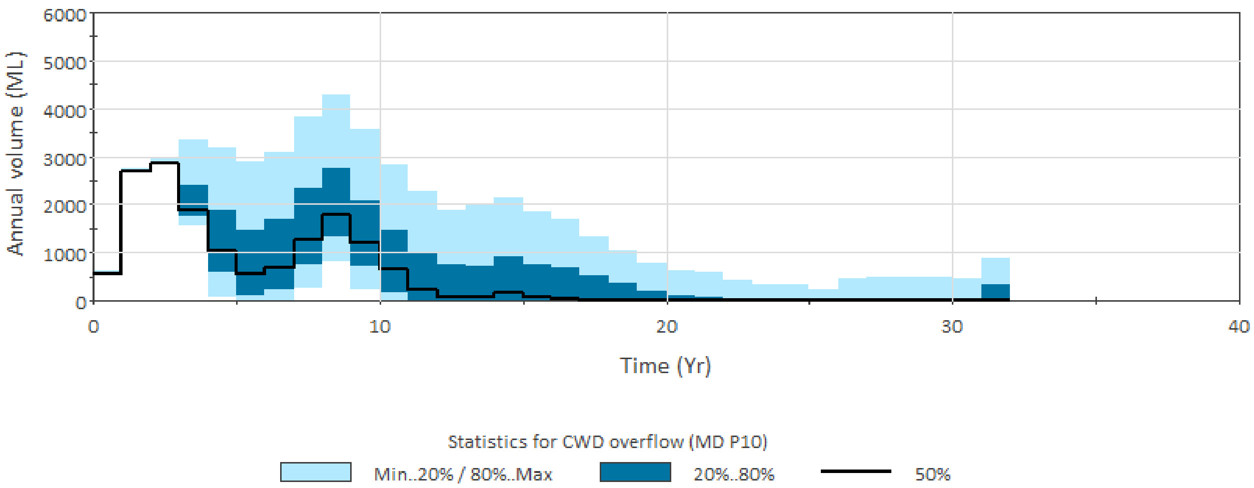
20
30
40
Time (Yr)
Statistics for CWD overflow (MD P90)
Min..20% / 80%..Max
20%..80%
50%


Annual volume (ML)
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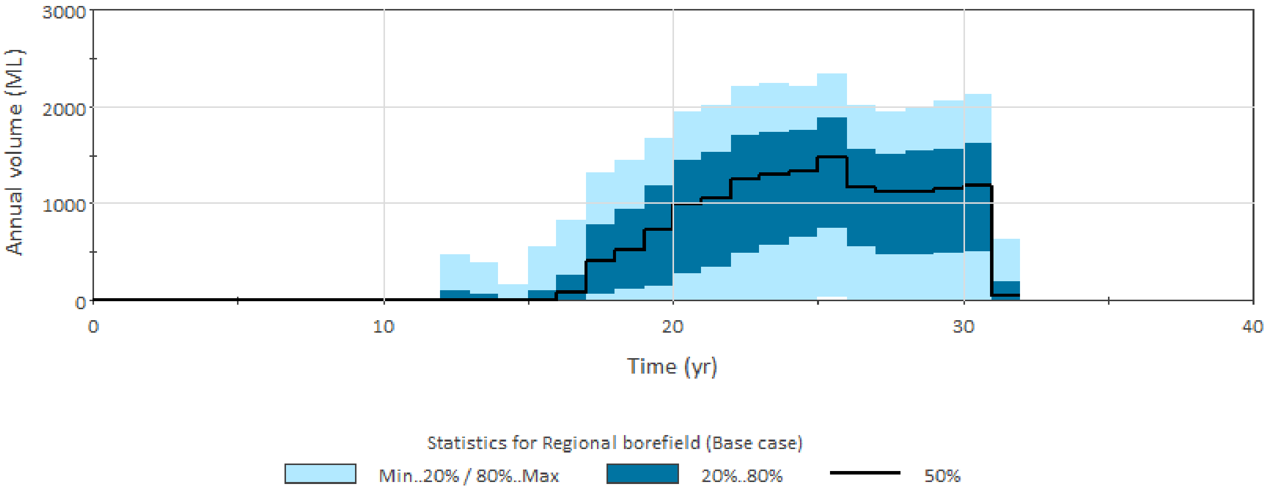
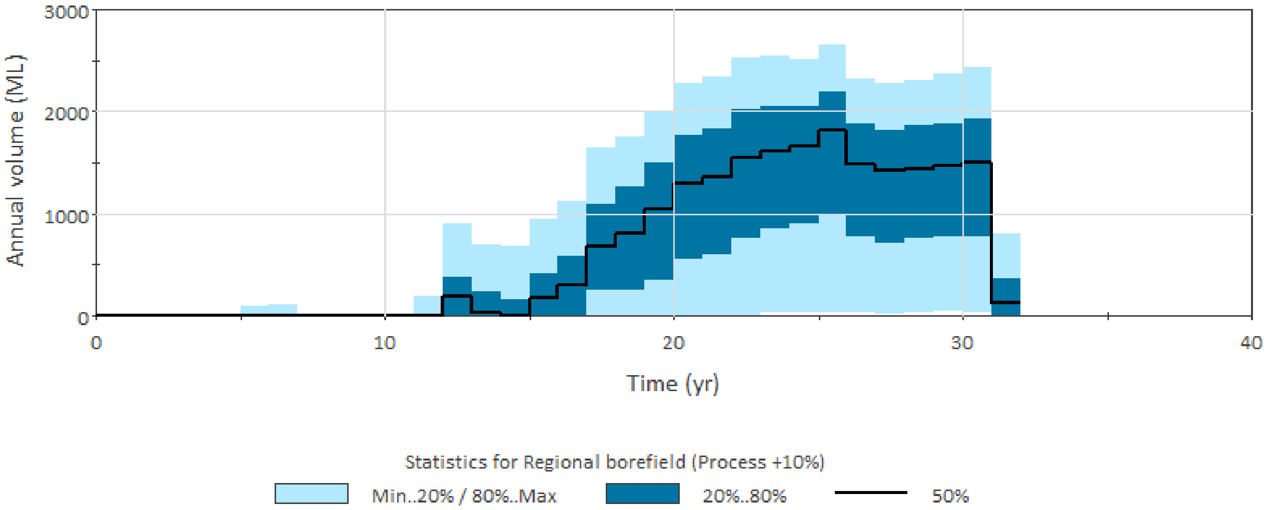
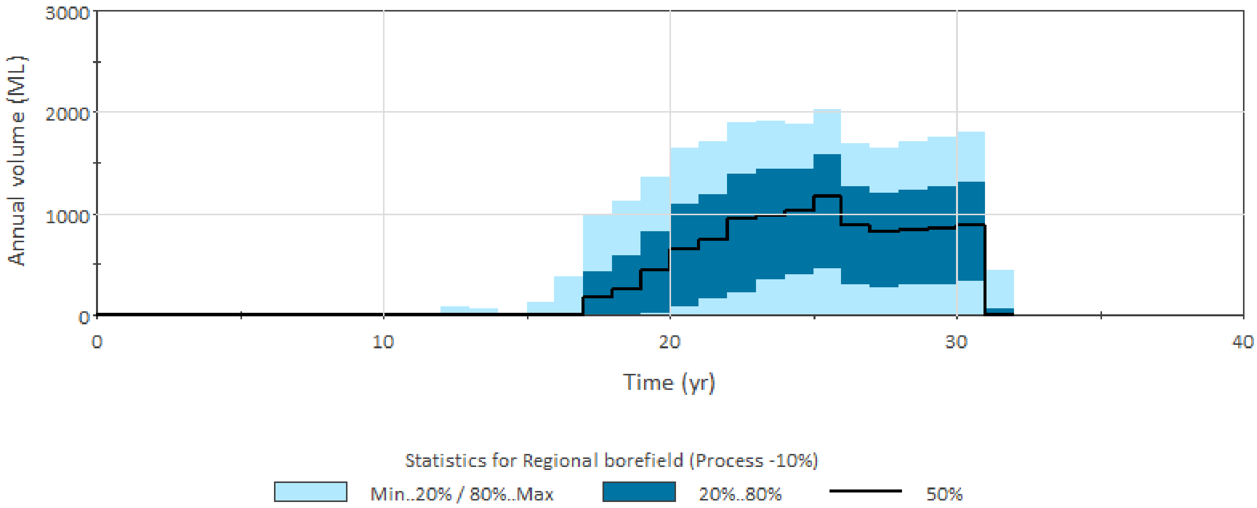
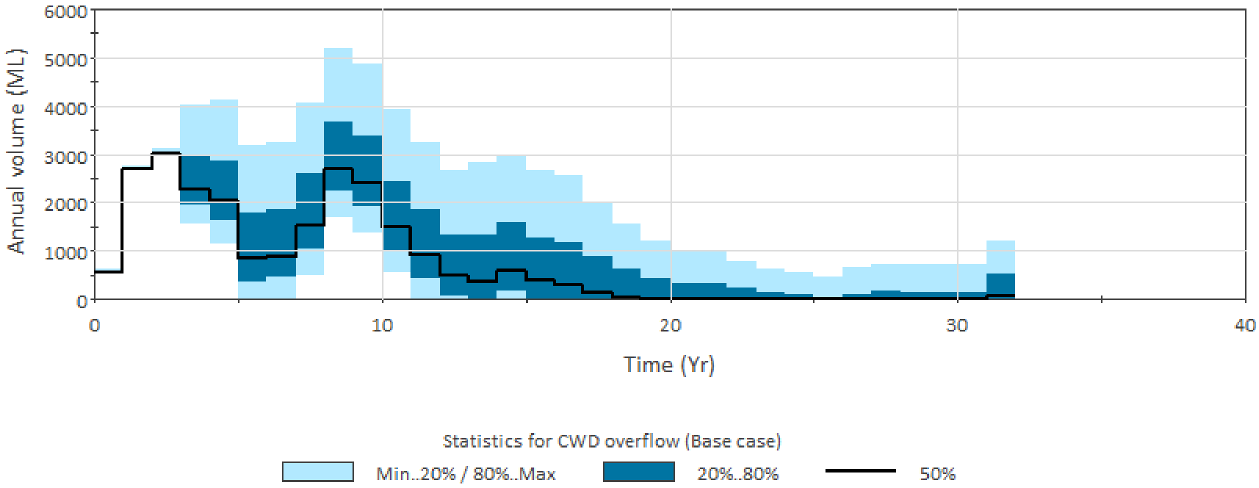
1000
0
0
10
20
30
40
Time (Yr)
Statistics for CWD overflow (MD P10)
Min..20% / 80%..Max
20%..80%
50%

A.2 Process demand








Annual volume (ML)
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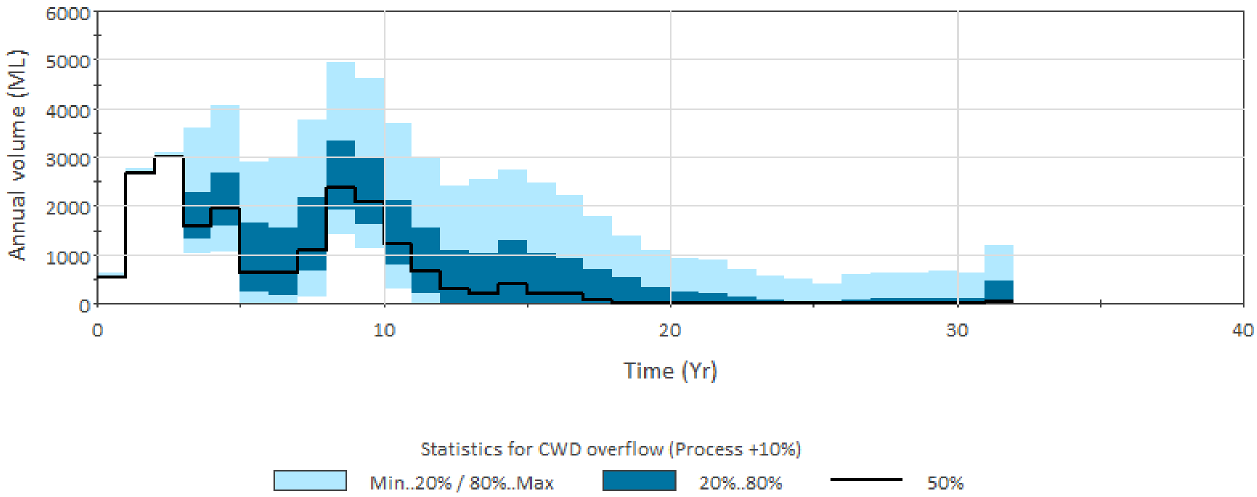
Time (Yr)
Statistics for CWD overflow (Base case)
Min..20% / 80%..Max
20%..80%
50%


Annual volume (ML)
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0
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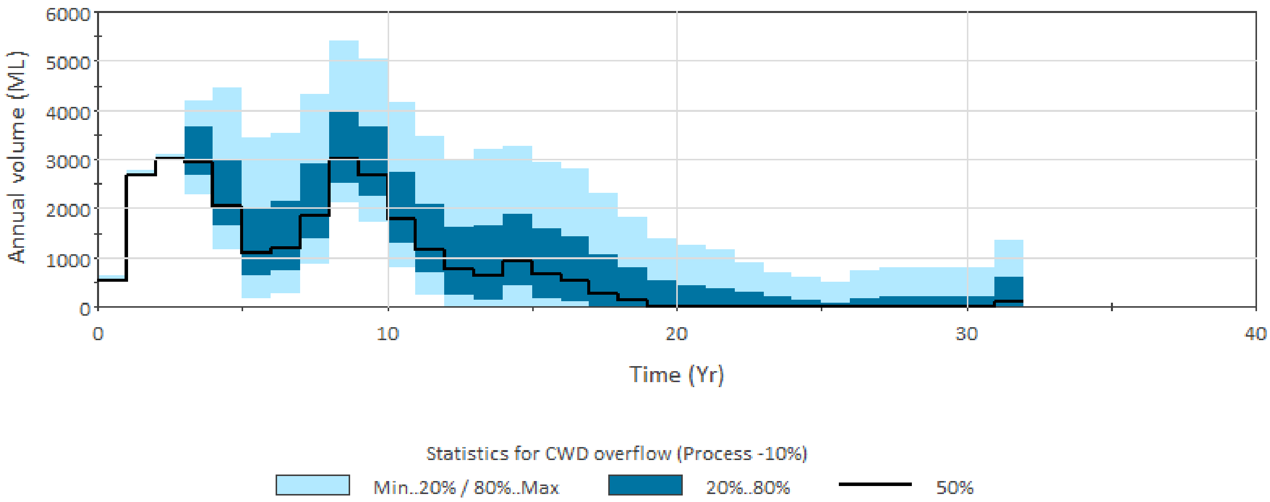
30
40
Time (Yr)
Statistics for CWD overflow (Process +10%)
Min..20% / 80%..Max
20%..80%
50%


Annual volume (ML)
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30
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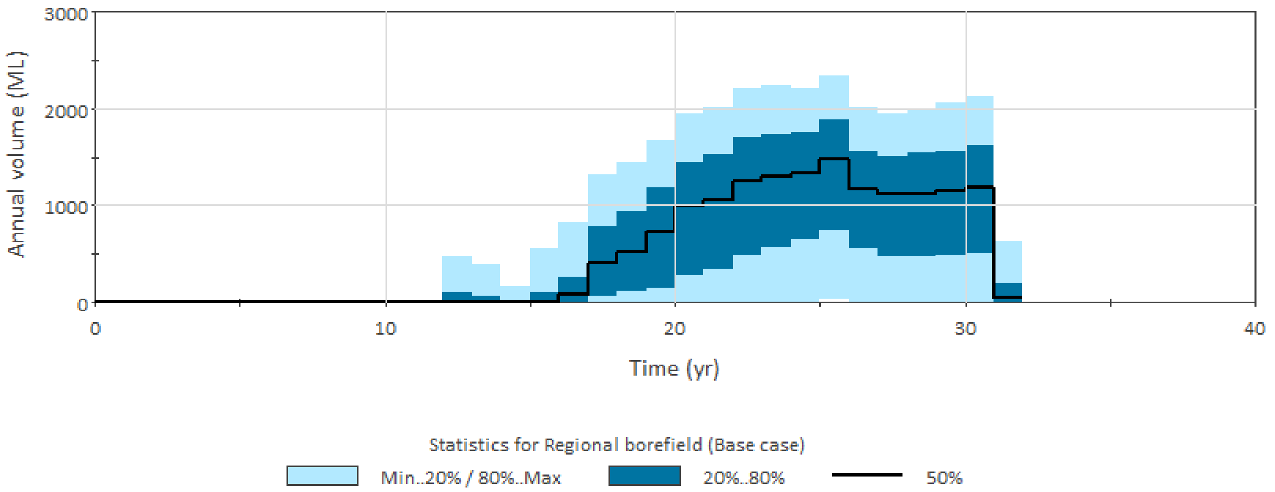
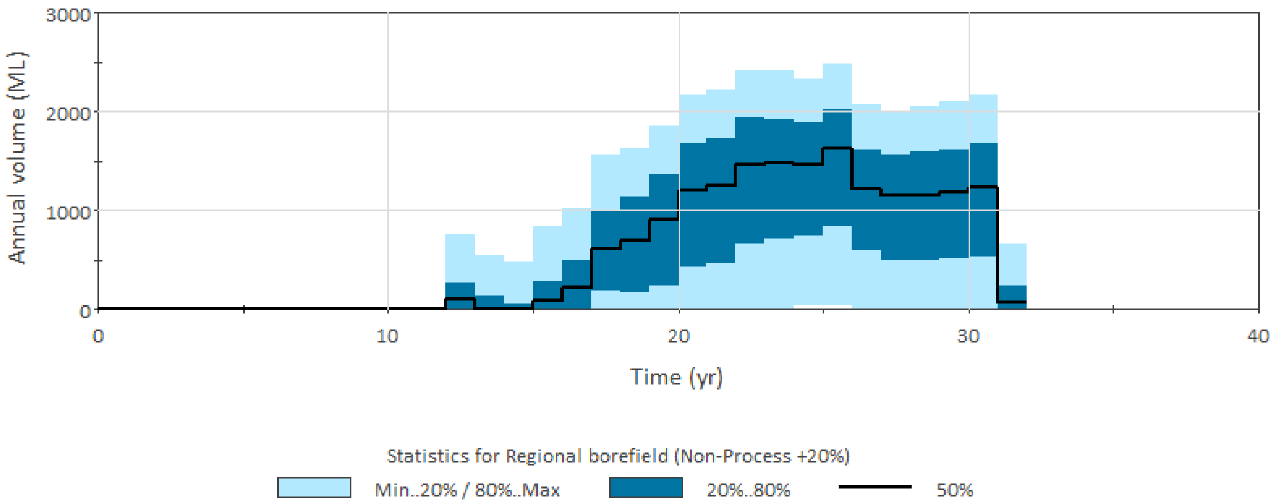
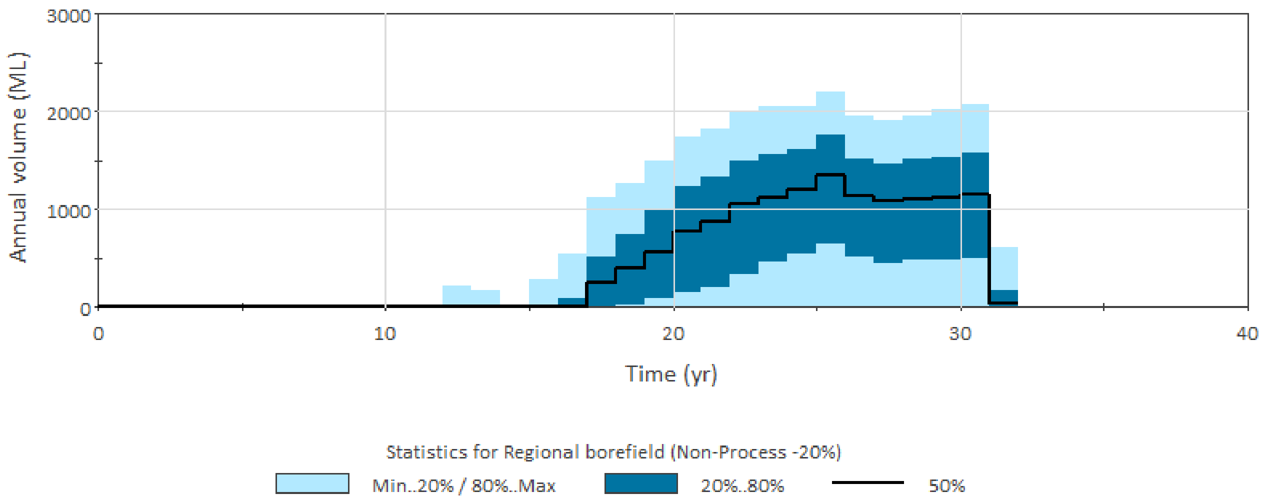
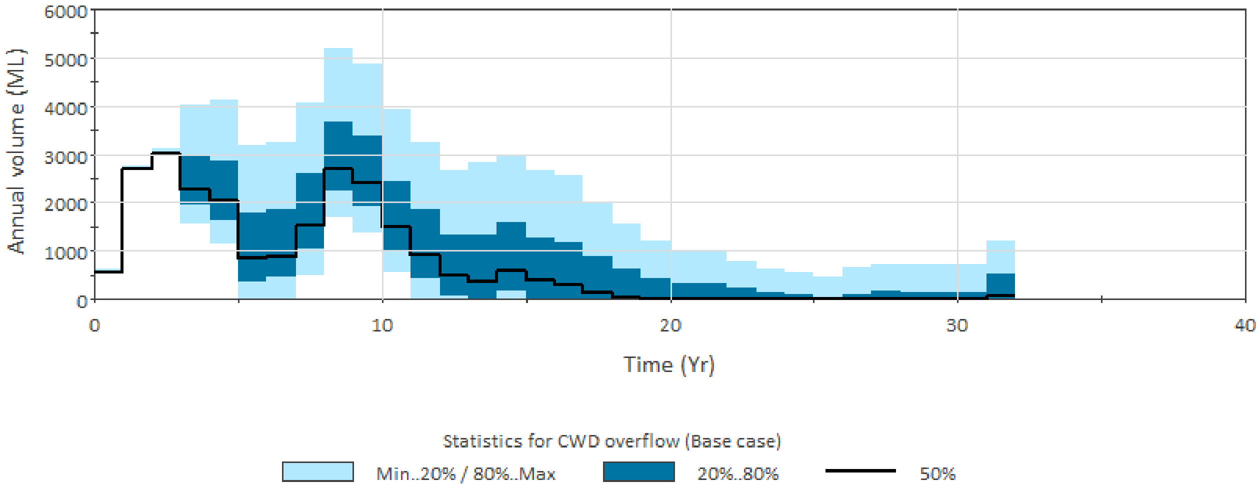
Time (Yr)
Statistics for CWD overflow (Process -10%)
Min..20% / 80%..Max
20%..80%
50%

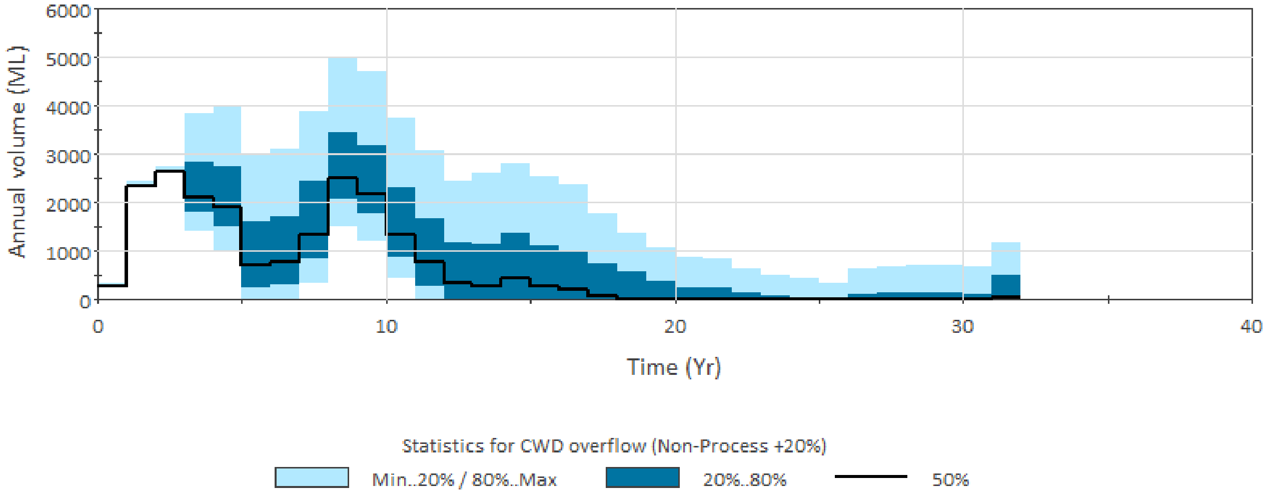
A.3 Non-process demand

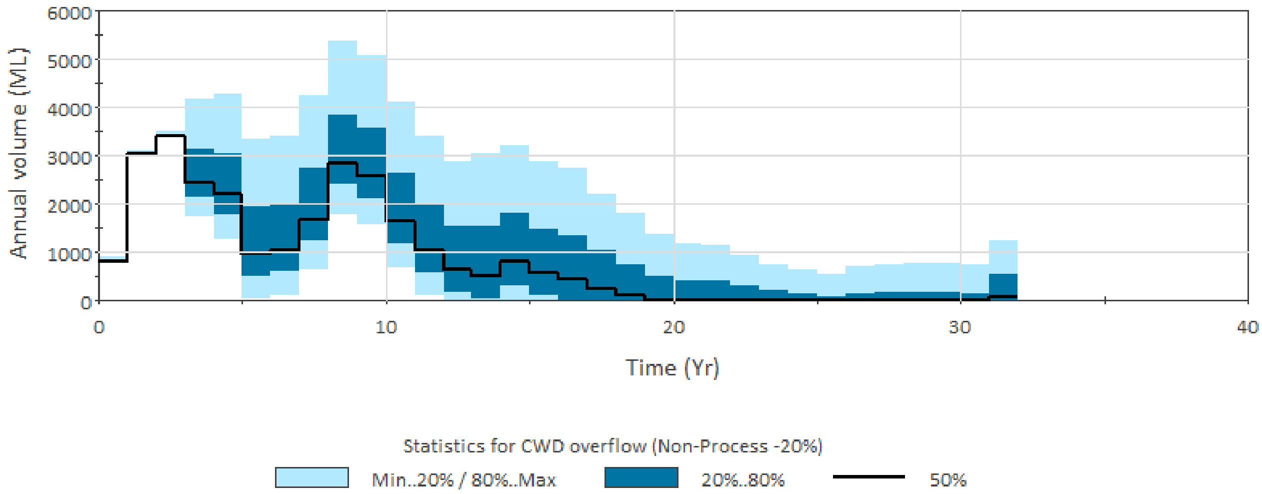




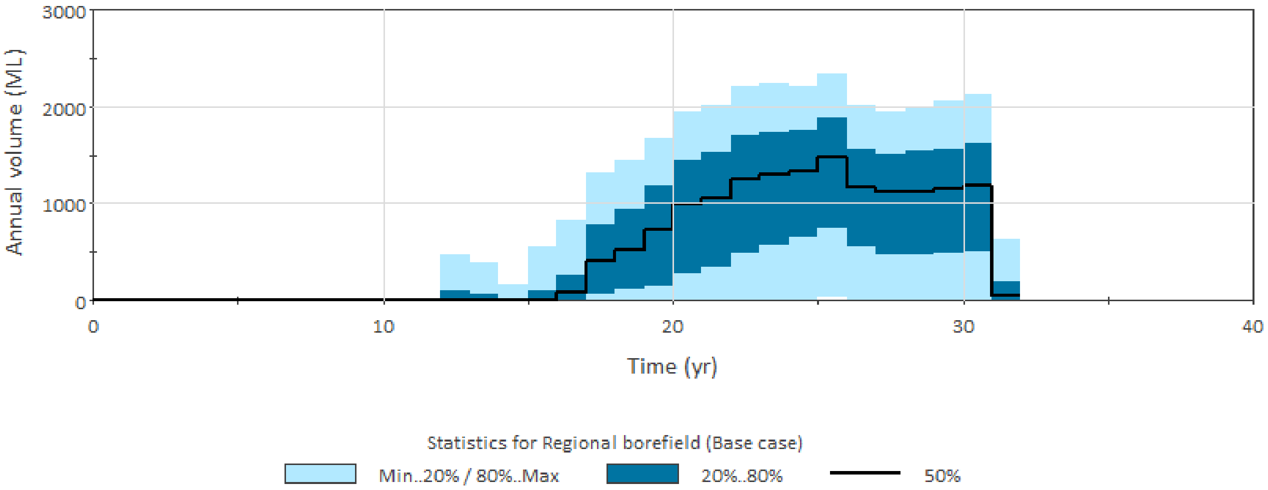


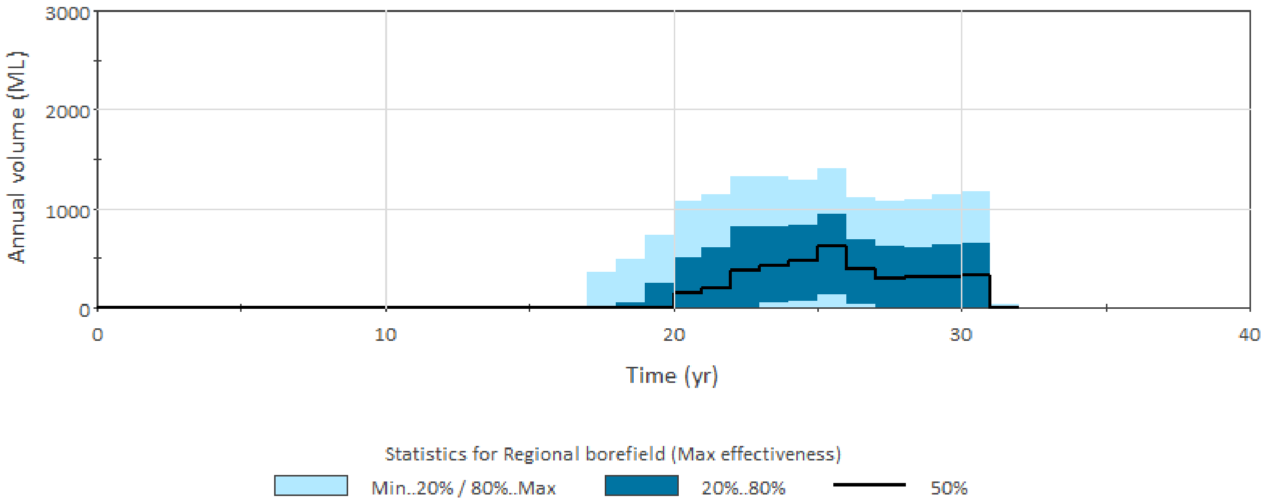

Annual volume (ML)
Time (Yr)
Statistics for CWD overflow (Base case)
Min..20% / 80%..Max
20%..80%
50%

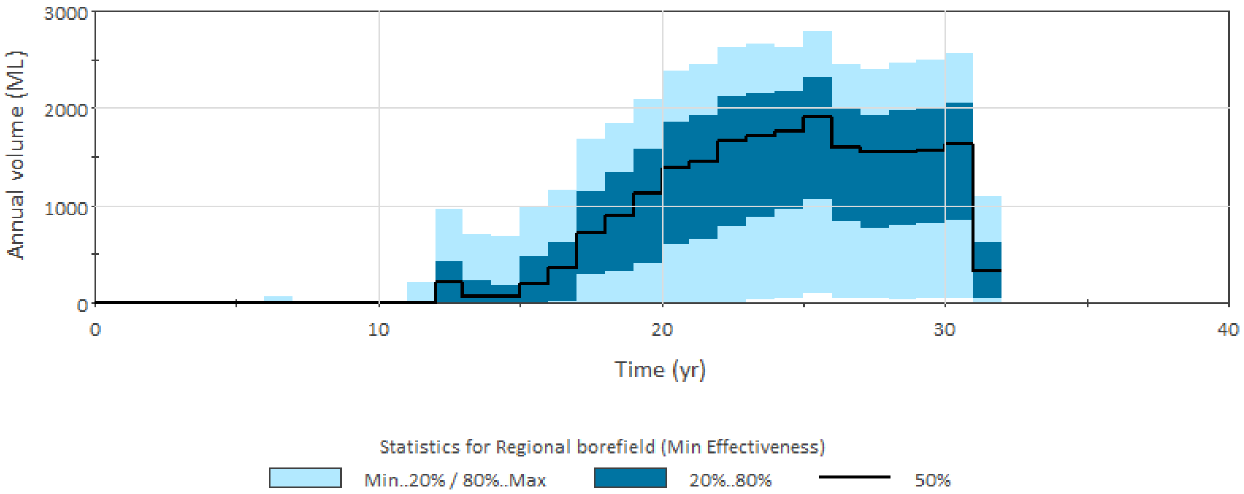

Annual volume (ML)
Time (Yr)
Statistics for CWD overflow (Non-Process +20%)
Min..20% / 80%..Max
20%..80%
50%

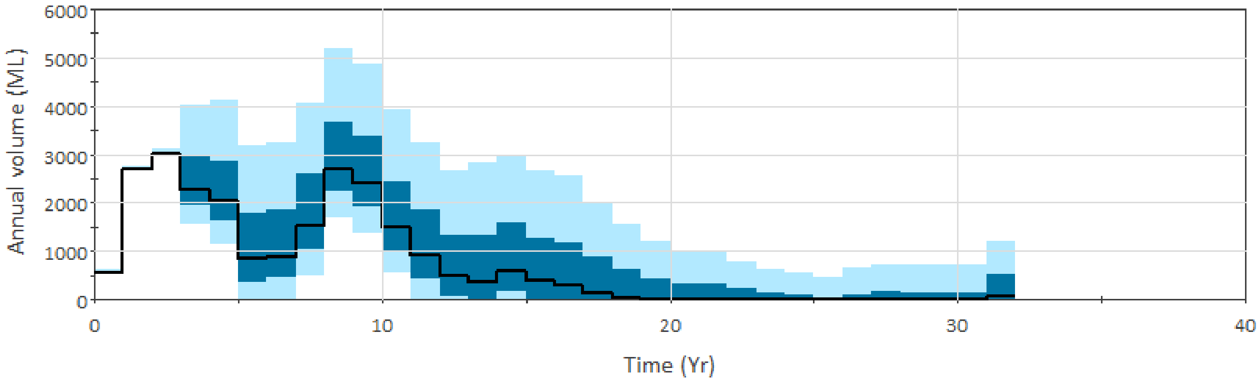

Annual volume (ML)
Time (Yr)
Statistics for CWD overflow (Non-Process -20%)
Min..20% / 80%..Max
20%..80%
50%

A.4 Evaporation inhibitors



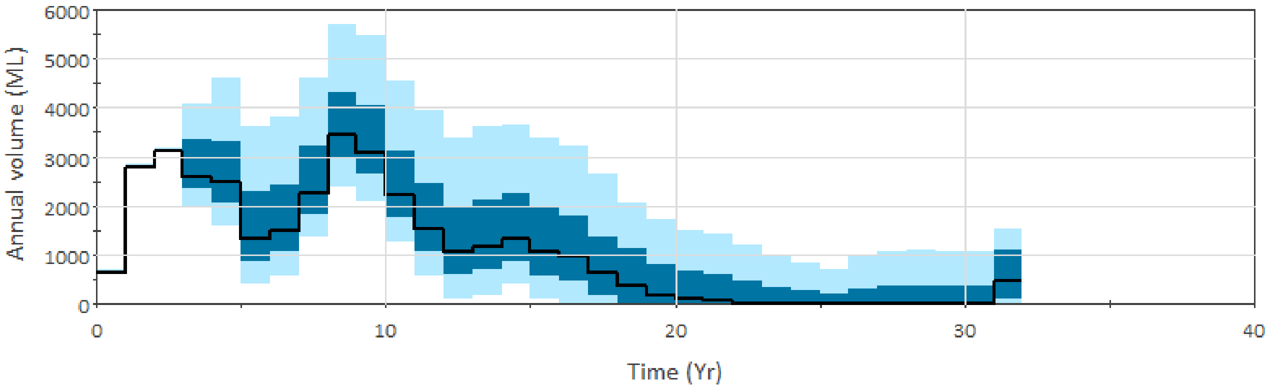






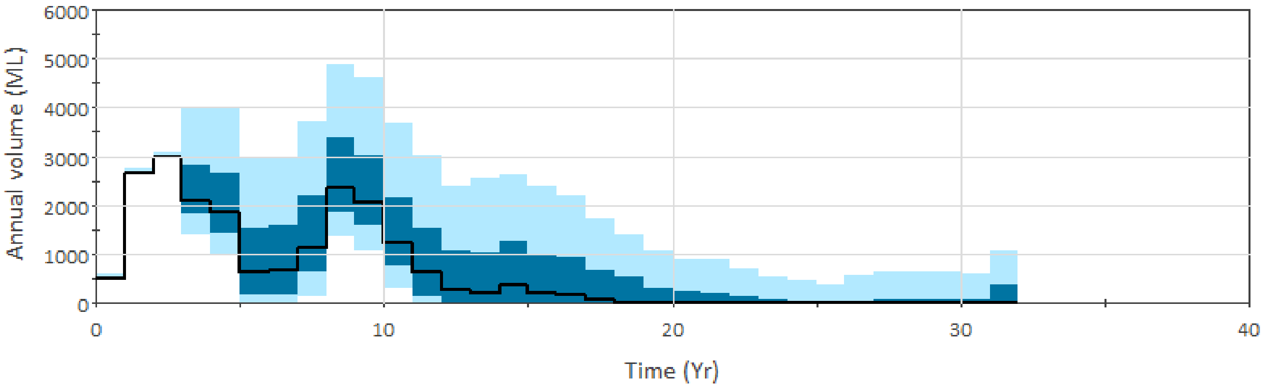
Statistics for CWD overflow (Base case)

Min..20% / 80%..Max 20%..80% 50%



Statistics for CWD overflow (Max effectiveness)

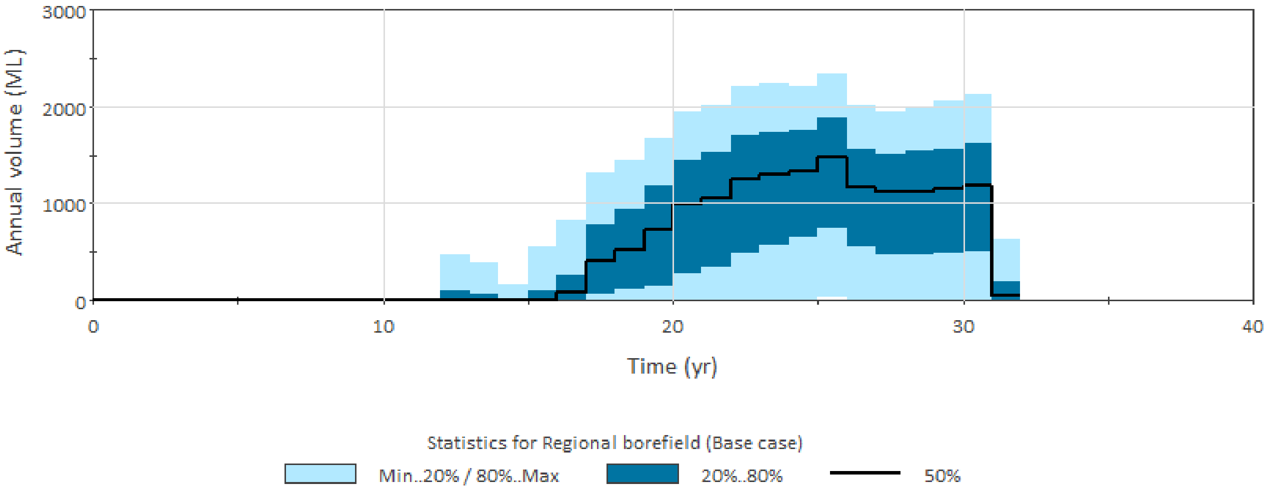
Min..20% / 80%..Max 20%..80% 50%

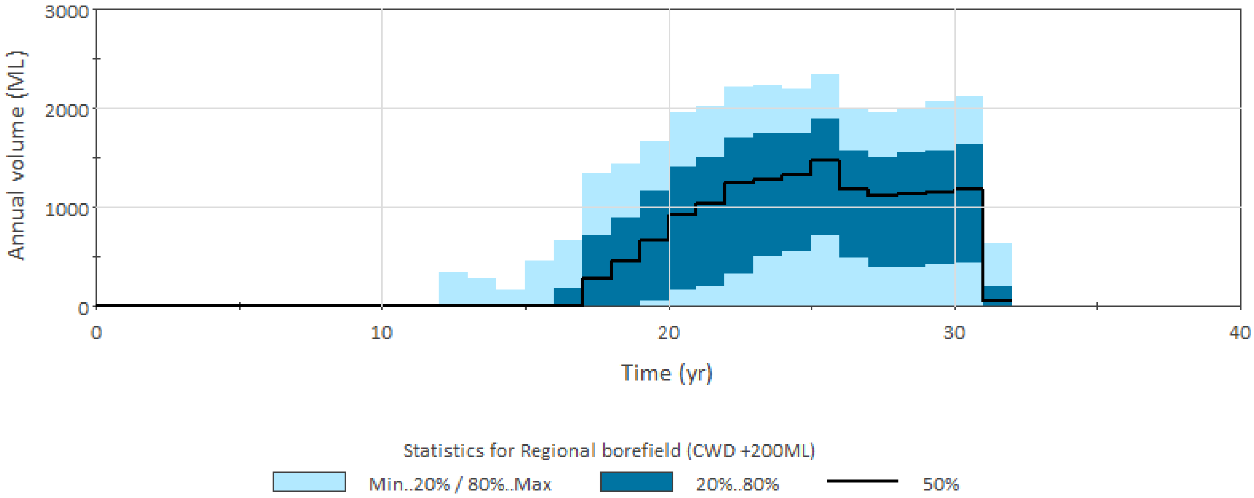


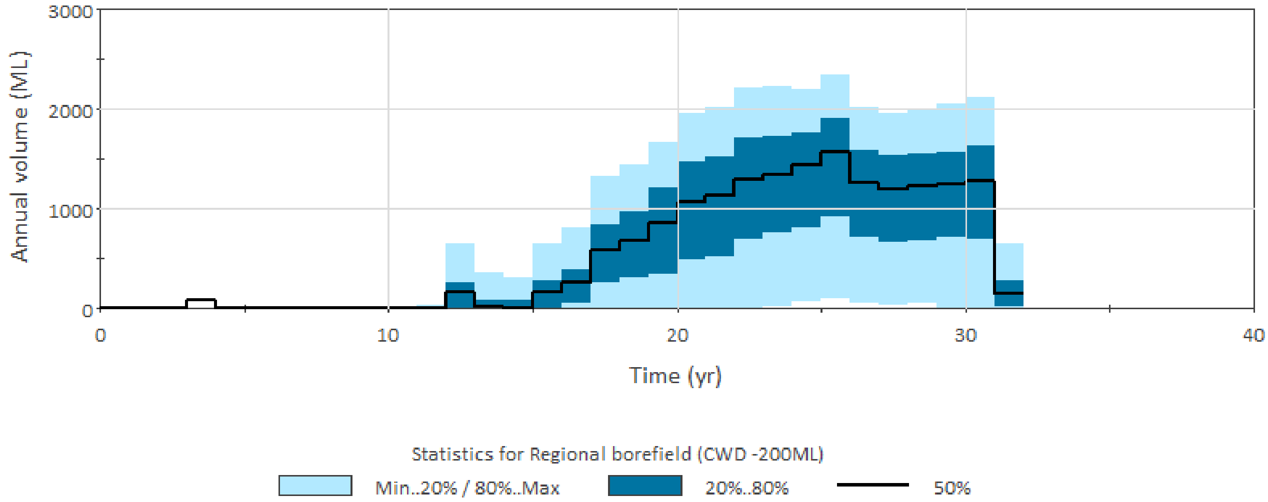
Statistics for CWD overflow (Min Effectiveness)

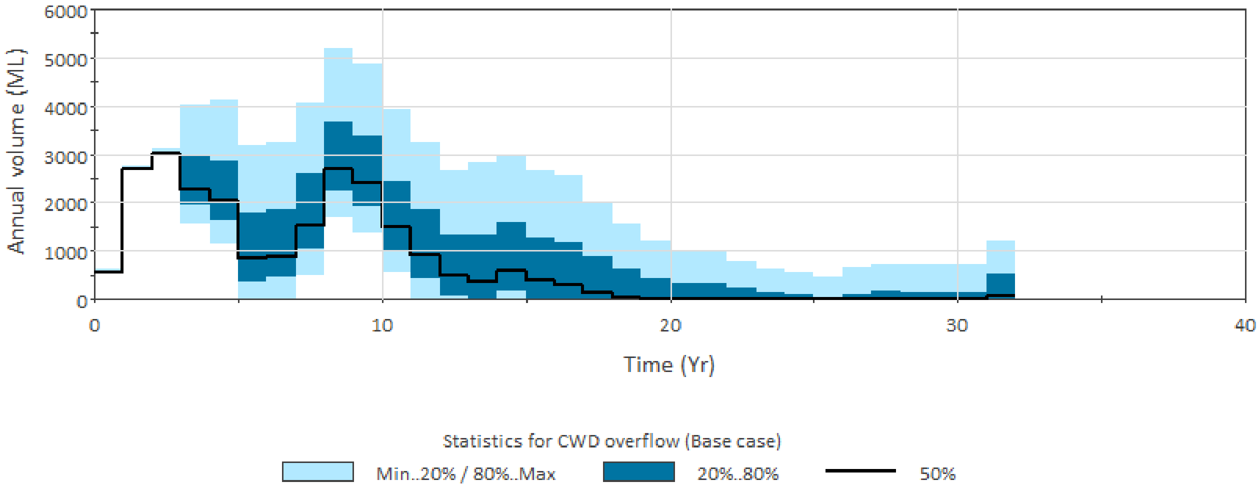
Min..20% / 80%..Max 20%..80% 50%

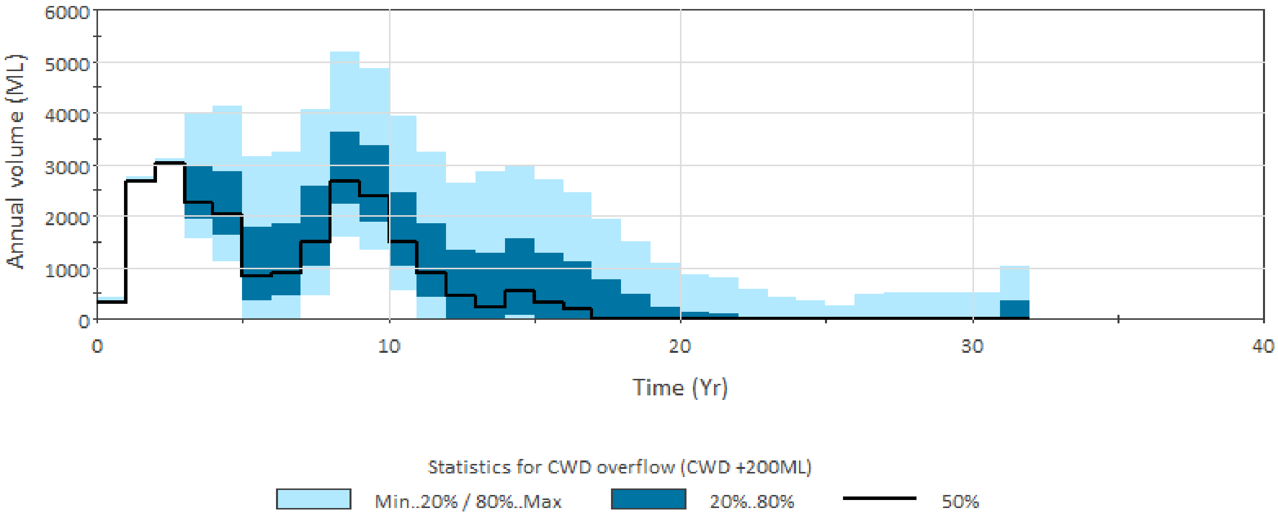
A.5 CWD capacity

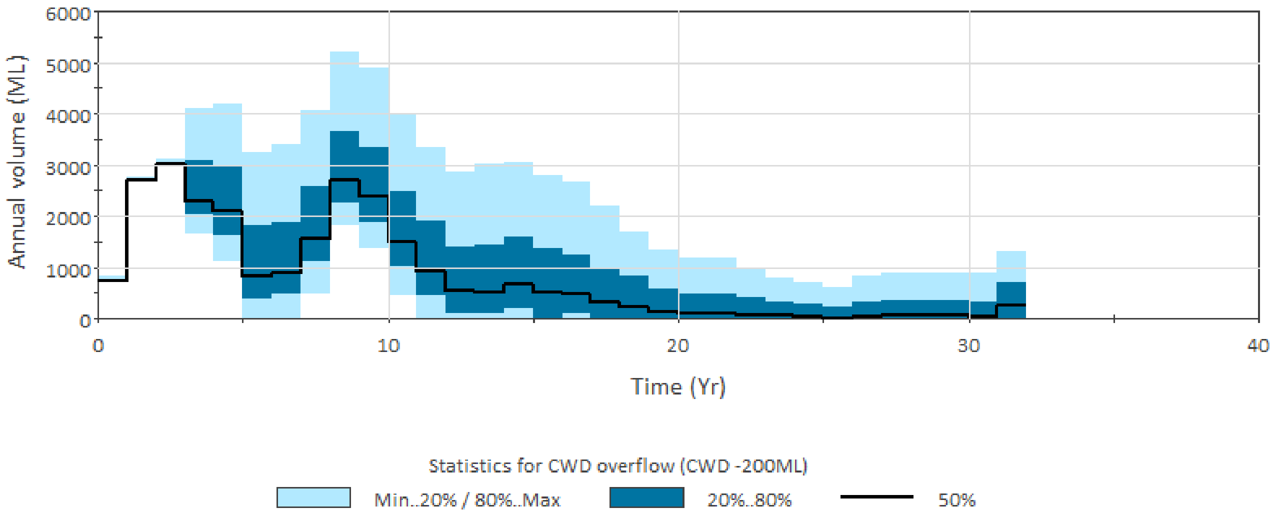




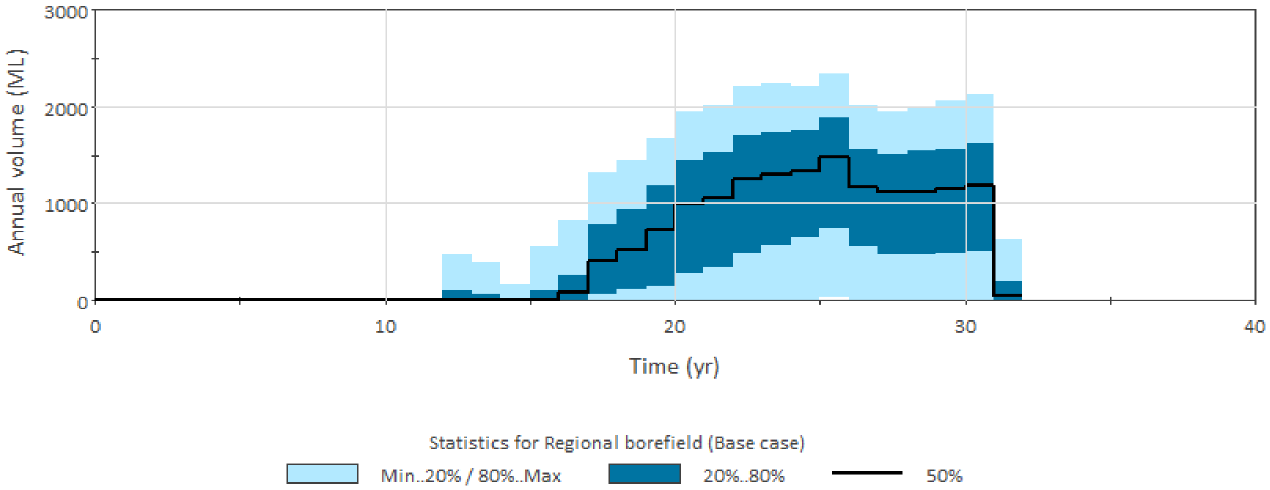


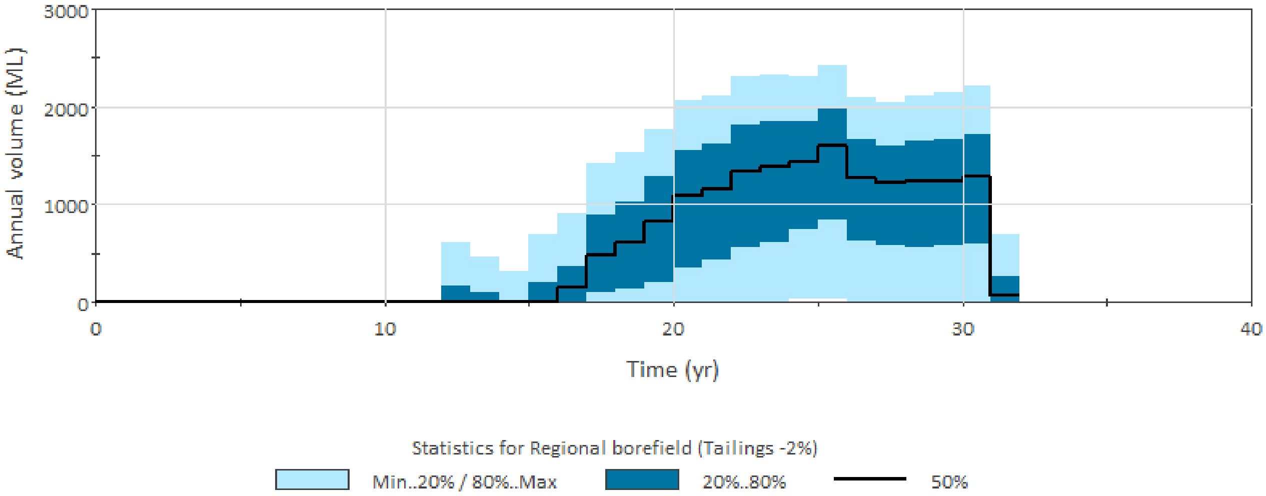

Annual volume (ML)
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
Time (Yr)
Statistics for CWD overflow (Base case)
Min..20% / 80%..Max
20%..80%
50%

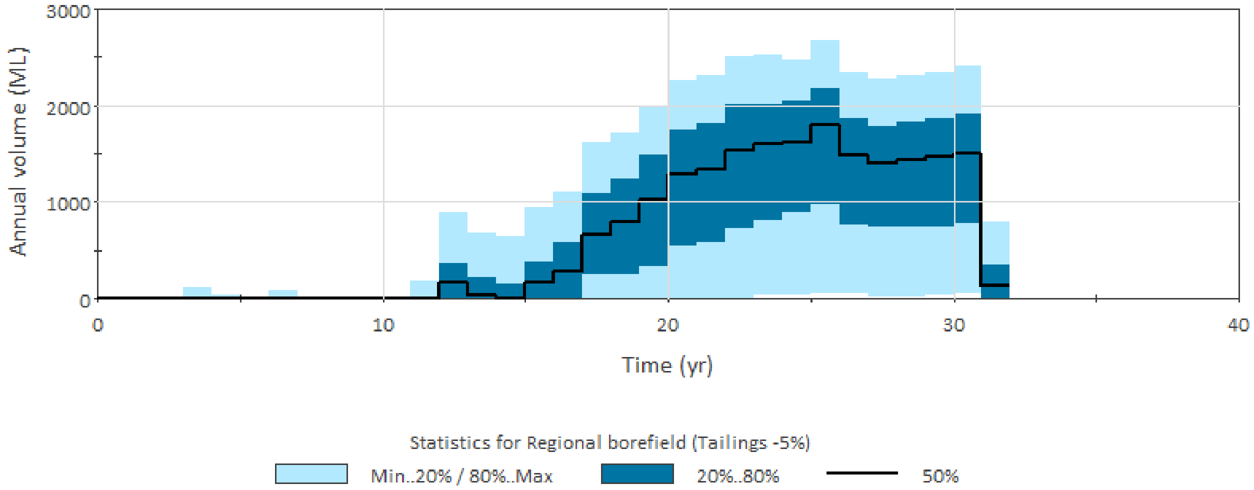

Annual volume (ML)
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
Time (Yr)
Statistics for CWD overflow (CWD +200ML)
Min..20% / 80%..Max
20%..80%
50%

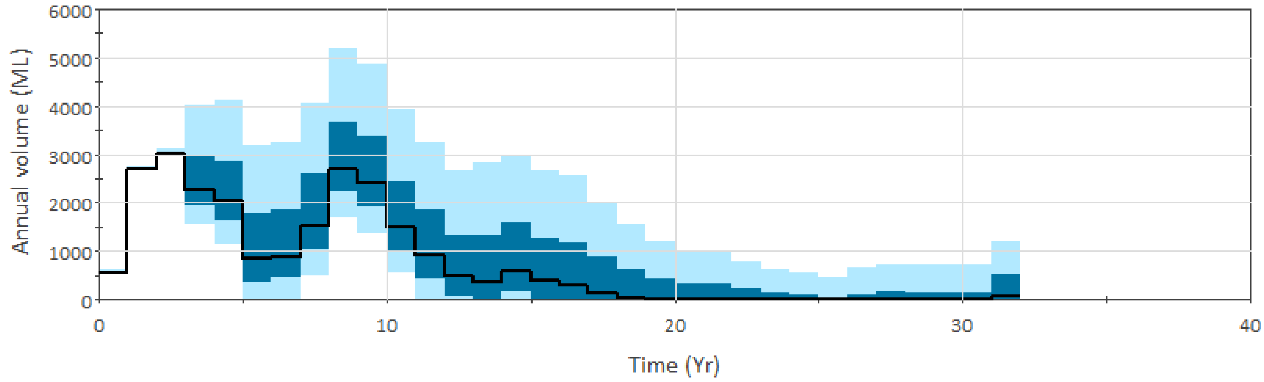

Annual volume (ML)
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
Time (Yr)
Statistics for CWD overflow (CWD -200ML)
Min..20% / 80%..Max
20%..80%
50%

A.6 Tailings Density



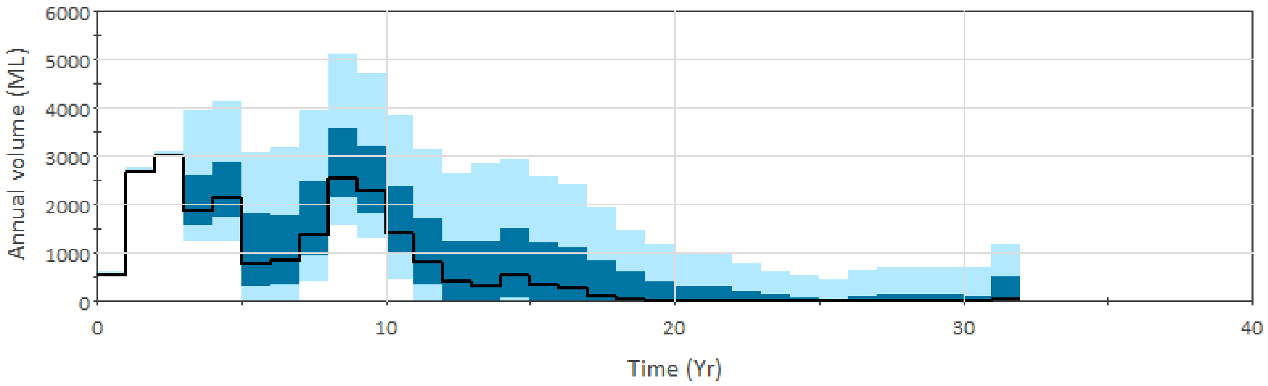






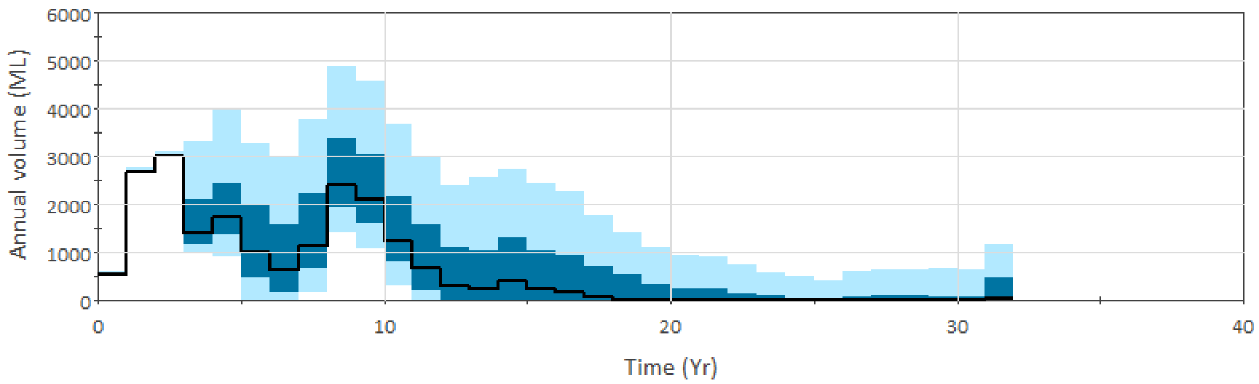
Statistics for CWD overflow (Base case)

Min..20% / 80%..Max 20%..80% 50%



Statistics for CWD overflow (Tailings -2%)

Min..20% / 80%..Max 20%..80% 50%



Statistics for CWD overflow (Tailings -5%)

Min..20% / 80%..Max 20%..80% 50%

Appendix B. Climate change projection data

CLIMsystems data

B.1 Mine dewatering

Table B-1: Details

Detail	
Name of site	Winu
Latitude:	-20.71899986
Longitude:	121.7100983
Summary generated:	15/04/2024

B.2 Introduction

Rio Tinto's assets, infrastructure, communities, people, and broader value chains are already exposed to the impacts of extreme weather events and climate change. The global nature of our operation means that we face a diverse range of meteorological, hydrological, and coastal extremes. With climate change, the frequency, intensity and spatiotemporal characteristics of these extremes are projected to change, so ensuring we understand how these risks may manifest in the future will ensure we are appropriately placed to respond.

Rio Tinto has engaged CLIMSystems as a climate data service provider to support our efforts in quantifying site-specific climate change risks. The data contained within these climate projection summaries are generated using their product, Climate Insights AR6, and utilises Coupled Model Intercomparison Project (CMIP6) models from the Intergovernmental Panel on Climate Change (IPCC) Working Group 6 (AR6) report.

Data is calculated from daily or monthly climate time series data following the specifications:

- **Baseline:** The baseline is the reference period for the historical data. In Climate Insights AR6, the period of 1991-2020 (centred in 2005) is applied as the baseline.
- **Scenarios:** Five CMIP6 scenarios are available: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5.
- **Ensemble Percentile:** The CMIP6 archive provides future projections from many GCMs, which formed a large ensemble. Ensemble analysis was carried out, and the 50th ensemble percentile (i.e. median) was used as the best estimation. The range between the 5th and 95th percentiles describes the uncertainty of GCM projections.
- **Time slices:** Starting from the baseline (centred in 2005), extending to 2100 with 5-year time steps. Time slices represent 20-year averages centred on each 5-year time step. For example, projections for the 2050 time horizons represent average conditions between 2041-2060.
- **Spatial resolution:** Projections contained in this summary are specific to the latitude and longitude as outlined on the cover page. Depending on the location of the site extraction and the variable of interest, the spatial resolution can vary. For example, the spatial resolution of rainfall projections in Australia is 0.05°.

A detailed guide outlining the methodology used to derive the data contained within this summary can be accessed here.

A note on using and interpreting climate projection data

Future climate change projections provide information that can be used to quantify current and future climate risks across Rio Tinto's entire value chain. Climate projection data can support detailed modelling and impact analyses and provide us with the tools for future planning and adapting to climate change. When using and interpreting climate projection data, there are a number of important points to consider to ensure that the climate data represents an adequate and appropriate number of global climate models and future emissions scenarios, is fit for purpose, contains the required information, and is robust to best inform decision-making.

The following points should be considered when using the data contained within these climate projection summaries:

- **The illusion of precision and quantifying uncertainty:** Climate models are capable of reproducing many key aspects of the large-scale climate system and of observed climate change and can provide useful information on appropriate spatial and temporal scales. However, in some parts of the world and for some variables, models are unable to capture the seasonal cycle, and have a poor representation of daily rainfall characteristics, particularly on local scales and for extremes. There is not a single projected future climate for a site, but a range of plausible futures depending on a number of future emissions scenarios. Because of the uncertainties inherent in future climate projections, scenarios should be regarded as representations of a plausible future (what *may* happen in the future) and not as forecasts or predictions (what *will* happen in the future).
- **Baseline vs. observed values:** In some cases, baseline values from Climate Insights may be materially different to observed historical values (e.g. extreme precipitation). This is because baseline values are calculated using gridded data and are interpolated from nearby meteorological stations, as opposed to observed values, which are in-situ and gauge-based. If your site/location has high-quality in-situ observations and if a material difference is observed between the Climate Insights baseline and the observed historical data, then users can apply the change from baseline from CLIMsystems to the observed historical data.
- **For engineering analysis and design:** The implications of using climate model projections to underpin engineering design parameters are significant. Applying climate model projections for engineering analysis and design requires multiple stages of decision-making, including adequate quantification of climate model uncertainty and relevant detailed analyses to inform risk-based engineering design.

The data and projections contained within this report are generated using Climate Insights and are true and correct to the best of CLIMsystems' knowledge as this summary was generated. CLIMsystems or Rio Tinto have not independently verified the information contained within this report. While both parties have no reason to doubt the accuracy of the information provided, the report is complete and accurate only to the extent that the information provided was itself accurate.

B.3 Projection data

Table B-2: Change from baseline – Monthly mean precipitation 5th percentile SSP1-2.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	-2.6	-3.0	-4.3	-5.4	-4.3	-6.4	-7.6	-9.9	-7.4	-8.4	-5.3	-2.5	-3.6
2015	-4.7	-5.4	-7.8	-9.8	-7.8	-11.6	-13.7	-18.0	-13.3	-15.2	-9.6	-4.6	-6.6
2020	-6.4	-7.5	-10.6	-13.4	-10.7	-15.8	-18.7	-24.6	-18.2	-20.8	-13.1	-6.2	-9.0
2025	-7.6	-8.9	-12.7	-16.0	-12.8	-18.9	-22.3	-29.3	-21.7	-24.8	-15.6	-7.4	-10.7
2030	-8.6	-10.0	-14.3	-18.0	-14.4	-21.3	-25.2	-33.1	-24.5	-28.0	-17.7	-8.4	-12.1
2035	-9.2	-10.8	-15.3	-19.3	-15.5	-22.8	-27.0	-35.5	-26.3	-29.9	-18.9	-9.0	-13.0
2040	-9.7	-11.3	-16.1	-20.3	-16.3	-24.1	-28.4	-37.3	-27.7	-31.5	-19.9	-9.5	-13.7
2045	-9.8	-11.5	-16.3	-20.6	-16.5	-24.4	-28.8	-37.8	-28.0	-31.9	-20.2	-9.6	-13.9
2050	-9.8	-11.5	-16.3	-20.6	-16.5	-24.4	-28.8	-37.8	-28.0	-31.9	-20.2	-9.6	-13.9
2055	-9.7	-11.3	-16.1	-20.3	-16.3	-24.1	-28.4	-37.3	-27.7	-31.5	-19.9	-9.5	-13.7
2060	-9.5	-11.0	-15.7	-19.8	-15.9	-23.5	-27.7	-36.4	-27.0	-30.7	-19.4	-9.2	-13.3
2065	-9.2	-10.8	-15.3	-19.3	-15.5	-22.8	-27.0	-35.5	-26.3	-29.9	-18.9	-9.0	-13.0

Table B-3: Change from baseline – Monthly mean precipitation 50th percentile SSP1-2.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	-0.5	0.4	-0.4	0.1	-0.2	-0.7	-1.1	-0.8	0.1	-0.2	-0.5	-0.5	-0.2
2015	-0.9	0.8	-0.8	0.1	-0.4	-1.3	-2.2	-1.5	0.2	-0.3	-1.0	-1.0	-0.5
2020	-1.3	1.1	-1.2	0.2	-0.6	-1.9	-3.2	-2.2	0.2	-0.5	-1.5	-1.4	-0.6
2025	-1.6	1.4	-1.5	0.2	-0.7	-2.3	-4.0	-2.7	0.3	-0.6	-1.8	-1.7	-0.8
2030	-1.9	1.6	-1.7	0.2	-0.9	-2.8	-4.7	-3.2	0.3	-0.7	-2.2	-2.0	-1.0
2035	-2.2	1.8	-2.0	0.3	-1.0	-3.1	-5.3	-3.7	0.4	-0.8	-2.5	-2.3	-1.1
2040	-2.4	2.0	-2.2	0.3	-1.1	-3.4	-5.9	-4.0	0.4	-0.9	-2.7	-2.5	-1.2
2045	-2.6	2.2	-2.3	0.3	-1.2	-3.7	-6.3	-4.4	0.5	-1.0	-2.9	-2.7	-1.3
2050	-2.8	2.3	-2.5	0.3	-1.2	-4.0	-6.7	-4.6	0.5	-1.1	-3.1	-2.9	-1.4
2055	-2.9	2.4	-2.6	0.3	-1.3	-4.2	-7.1	-4.9	0.5	-1.1	-3.3	-3.1	-1.5
2060	-3.0	2.5	-2.7	0.4	-1.4	-4.3	-7.3	-5.0	0.5	-1.2	-3.4	-3.2	-1.5
2065	-3.1	2.6	-2.8	0.4	-1.4	-4.4	-7.5	-5.2	0.6	-1.2	-3.5	-3.3	-1.5

Table B-4: Change from baseline – Monthly mean precipitation 95th percentile SSP1-2.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	2.3	3.6	2.0	5.9	8.2	5.7	9.5	10.6	15.9	8.7	7.2	4.6	3.8
2015	4.5	7.1	4.0	11.5	16.0	11.2	18.4	20.7	30.8	16.9	13.9	8.9	7.4
2020	6.5	10.1	5.6	16.4	22.8	15.9	26.2	29.4	43.9	24.1	19.8	12.7	10.6
2025	8.1	12.7	7.1	20.6	28.6	19.9	32.8	37.0	55.2	30.2	24.9	16.0	13.3
2030	9.6	15.0	8.4	24.5	33.9	23.7	39.0	43.8	65.4	35.9	29.6	18.9	15.7
2035	10.9	16.9	9.5	27.6	38.3	26.7	44.0	49.5	73.8	40.5	33.4	21.4	17.8
2040	12.0	18.7	10.5	30.4	42.2	29.4	48.4	54.5	81.3	44.6	36.7	23.5	19.6
2045	12.9	20.2	11.3	32.9	45.6	31.8	52.3	58.9	87.9	48.2	39.7	25.4	21.1
2050	13.8	21.4	12.0	35.0	48.5	33.8	55.7	62.6	93.5	51.3	42.2	27.0	22.5
2055	14.4	22.5	12.6	36.7	50.9	35.5	58.4	65.8	98.2	53.8	44.3	28.4	23.6
2060	15.0	23.4	13.1	38.1	52.9	36.9	60.7	68.3	101.9	55.9	46.0	29.5	24.5
2065	15.4	24.0	13.5	39.2	54.3	37.9	62.3	70.2	104.7	57.4	47.3	30.3	25.2

Table B-5: Change from baseline – Monthly mean precipitation 5th percentile SSP5-8.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	-1.6	-1.9	-2.7	-3.3	-2.7	-4.0	-4.7	-6.1	-4.6	-5.2	-3.3	-1.6	-2.3
2015	-3.3	-3.9	-5.5	-6.9	-5.6	-8.2	-9.7	-12.8	-9.5	-10.8	-6.8	-3.2	-4.7
2020	-5.3	-6.2	-8.8	-11.1	-8.9	-13.1	-15.5	-20.3	-15.1	-17.2	-10.9	-5.2	-7.4
2025	-7.5	-8.7	-12.5	-15.7	-12.6	-18.6	-21.9	-28.8	-21.4	-24.4	-15.4	-7.3	-10.6
2030	-9.8	-11.5	-16.3	-20.6	-16.5	-24.4	-28.8	-37.8	-28.0	-31.9	-20.2	-9.6	-13.9
2035	-12.4	-14.5	-20.6	-26.0	-20.8	-30.8	-36.3	-47.7	-35.4	-40.3	-25.5	-12.1	-17.5
2040	-15.0	-17.5	-24.9	-31.4	-25.2	-37.2	-43.9	-57.7	-42.7	-48.7	-30.8	-14.6	-21.1
2045	-17.9	-20.9	-29.8	-37.6	-30.1	-44.5	-52.5	-69.0	-51.1	-58.3	-36.8	-17.5	-25.3
2050	-20.9	-24.4	-34.7	-43.7	-35.1	-51.8	-61.1	-80.4	-59.5	-67.9	-42.9	-20.4	-29.5
2055	-24.0	-28.0	-39.8	-50.2	-40.2	-59.4	-70.1	-92.2	-68.3	-77.9	-49.2	-23.4	-33.8
2060	-27.3	-31.8	-45.4	-57.1	-45.8	-67.6	-79.8	-100	-77.8	-88.6	-56.0	-26.6	-38.4
2065	-30.7	-35.8	-51.1	-64.3	-51.6	-76.2	-89.9	-100	-87.6	-99.8	-63.1	-30.0	-43.2

Table B-6: Change from baseline – Monthly mean precipitation 50th percentile SSP5-8.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	-0.4	0.3	-0.3	0.0	-0.2	-0.5	-0.9	-0.6	0.1	-0.1	-0.4	-0.4	-0.2
2015	-0.8	0.6	-0.7	0.1	-0.3	-1.1	-1.8	-1.3	0.1	-0.3	-0.8	-0.8	-0.4
2020	-1.2	1.0	-1.1	0.1	-0.5	-1.7	-2.9	-2.0	0.2	-0.5	-1.3	-1.2	-0.6
2025	-1.7	1.4	-1.5	0.2	-0.8	-2.4	-4.1	-2.8	0.3	-0.6	-1.9	-1.8	-0.8
2030	-2.2	1.9	-2.0	0.3	-1.0	-3.2	-5.4	-3.7	0.4	-0.8	-2.5	-2.3	-1.1
2035	-2.8	2.3	-2.5	0.3	-1.3	-4.0	-6.8	-4.7	0.5	-1.1	-3.1	-2.9	-1.4
2040	-3.4	2.8	-3.0	0.4	-1.5	-4.8	-8.2	-5.7	0.6	-1.3	-3.8	-3.5	-1.7
2045	-4.1	3.4	-3.6	0.5	-1.8	-5.8	-9.8	-6.8	0.7	-1.5	-4.5	-4.2	-2.0
2050	-4.7	4.0	-4.2	0.5	-2.1	-6.7	-11.4	-7.9	0.8	-1.8	-5.3	-4.9	-2.3
2055	-5.4	4.5	-4.8	0.6	-2.4	-7.7	-13.1	-9.0	1.0	-2.1	-6.1	-5.7	-2.7
2060	-6.2	5.2	-5.5	0.7	-2.8	-8.8	-14.9	-10.3	1.1	-2.3	-6.9	-6.5	-3.1
2065	-7.0	5.8	-6.2	0.8	-3.1	-9.9	-16.8	-11.6	1.2	-2.6	-7.8	-7.3	-3.5

Table B-7: Change from baseline – Monthly mean precipitation 95th percentile SSP5-8.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	1.8	2.8	1.6	4.5	6.3	4.4	7.2	8.1	12.2	6.7	5.5	3.5	2.9
2015	3.7	5.8	3.2	9.4	13.1	9.1	15.0	16.9	25.2	13.8	11.4	7.3	6.1
2020	5.9	9.2	5.2	15.0	20.9	14.5	23.9	26.9	40.2	22.0	18.2	11.6	9.7
2025	8.4	13.1	7.3	21.3	29.6	20.6	34.0	38.2	57.0	31.3	25.8	16.5	13.7
2030	11.0	17.2	9.6	28.0	38.8	27.0	44.5	50.1	74.8	41.0	33.8	21.6	18.0
2035	13.9	21.7	12.1	35.3	49.0	34.1	56.2	63.3	94.4	51.8	42.7	27.3	22.7
2040	16.8	26.2	14.7	42.7	59.2	41.2	67.9	76.4	114.0	62.5	51.5	33.0	27.4
2045	20.1	31.3	17.6	51.1	70.8	49.4	81.3	91.5	136.5	74.8	61.7	39.5	32.8
2050	23.4	36.5	20.4	59.5	82.4	57.5	94.6	106.5	158.9	87.1	71.8	46.0	38.2
2055	26.8	41.8	23.4	68.2	94.6	65.9	108.5	122.1	182.3	99.9	82.3	52.7	43.9
2060	30.5	47.6	26.7	77.6	107.7	75.1	123.6	139.1	207.5	113.8	93.7	60.0	49.9
2065	34.4	53.6	30.1	87.4	121.2	84.5	139.2	156.6	233.7	128.1	105.6	67.6	56.2

Table B-8: Change from baseline – Monthly mean evapotranspiration 5th percentile SSP1-2.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	-0.03	-0.19	0.10	0.27	0.33	0.04	0.33	0.37	0.28	0.40	0.28	-0.09	0.16
2015	-0.06	-0.38	0.20	0.53	0.64	0.07	0.63	0.73	0.55	0.77	0.54	-0.18	0.31
2020	-0.09	-0.54	0.28	0.75	0.91	0.10	0.90	1.03	0.79	1.10	0.77	-0.25	0.44
2025	-0.11	-0.68	0.35	0.95	1.14	0.13	1.13	1.30	0.99	1.39	0.96	-0.32	0.55
2030	-0.13	-0.80	0.41	1.12	1.35	0.15	1.34	1.54	1.17	1.65	1.14	-0.38	0.65
2035	-0.15	-0.91	0.46	1.27	1.53	0.17	1.51	1.74	1.32	1.86	1.29	-0.44	0.74
2040	-0.17	-1.00	0.51	1.40	1.68	0.18	1.66	1.92	1.46	2.05	1.42	-0.48	0.81
2045	-0.19	-1.09	0.55	1.51	1.82	0.19	1.80	2.07	1.58	2.21	1.53	-0.52	0.87
2050	-0.20	-1.16	0.59	1.60	1.93	0.20	1.91	2.20	1.68	2.35	1.63	-0.56	0.93
2055	-0.21	-1.21	0.61	1.68	2.03	0.21	2.01	2.31	1.76	2.47	1.71	-0.59	0.98
2060	-0.22	-1.26	0.64	1.75	2.11	0.22	2.08	2.40	1.83	2.56	1.78	-0.61	1.01
2065	-0.22	-1.30	0.65	1.80	2.16	0.23	2.14	2.47	1.88	2.63	1.82	-0.63	1.04

Table B-9: Change from baseline – Monthly mean evapotranspiration 50th percentile SSP1-2.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.42	0.25	0.45	0.50	0.38	0.51	0.48	0.50	0.45	0.46	0.40	0.36	0.42
2015	0.82	0.49	0.87	0.97	0.73	1.00	0.93	0.96	0.88	0.90	0.78	0.69	0.82
2020	1.16	0.69	1.25	1.38	1.04	1.42	1.32	1.37	1.25	1.29	1.12	0.98	1.17
2025	1.46	0.87	1.57	1.74	1.31	1.79	1.66	1.72	1.57	1.61	1.40	1.23	1.47
2030	1.73	1.03	1.86	2.06	1.55	2.12	1.96	2.05	1.86	1.92	1.66	1.46	1.74
2035	1.96	1.16	2.10	2.33	1.75	2.40	2.22	2.31	2.10	2.16	1.87	1.65	1.96
2040	2.15	1.28	2.31	2.57	1.92	2.64	2.44	2.54	2.31	2.38	2.06	1.82	2.16
2045	2.33	1.38	2.50	2.77	2.08	2.85	2.64	2.75	2.50	2.57	2.23	1.97	2.34
2050	2.48	1.47	2.66	2.95	2.21	3.03	2.81	2.92	2.66	2.74	2.37	2.09	2.49
2055	2.60	1.54	2.79	3.10	2.32	3.19	2.95	3.07	2.79	2.87	2.49	2.20	2.61
2060	2.70	1.60	2.90	3.22	2.41	3.31	3.06	3.19	2.90	2.98	2.59	2.28	2.71
2065	2.77	1.64	2.98	3.31	2.47	3.40	3.15	3.27	2.98	3.07	2.66	2.34	2.79

Table B-10: Change from baseline – Monthly mean evapotranspiration 95th percentile SSP1-2.6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.73	1.10	0.83	0.58	0.55	0.92	0.95	0.73	0.65	1.09	0.70	0.50	0.77
2015	1.42	2.13	1.62	1.12	1.07	1.79	1.85	1.41	1.27	2.13	1.35	0.97	1.50
2020	2.02	3.04	2.31	1.60	1.52	2.55	2.63	2.01	1.81	3.04	1.93	1.38	2.14
2025	2.53	3.82	2.90	2.00	1.91	3.20	3.31	2.53	2.27	3.82	2.42	1.73	2.69
2030	3.01	4.54	3.44	2.38	2.27	3.80	3.93	3.00	2.70	4.53	2.87	2.05	3.19
2035	3.40	5.12	3.89	2.68	2.56	4.30	4.44	3.39	3.04	5.12	3.24	2.32	3.60
2040	3.74	5.65	4.28	2.95	2.82	4.73	4.89	3.73	3.35	5.64	3.57	2.55	3.97
2045	4.05	6.11	4.63	3.19	3.04	5.12	5.29	4.04	3.62	6.10	3.86	2.76	4.29
2050	4.31	6.50	4.93	3.40	3.24	5.45	5.63	4.29	3.85	6.50	4.11	2.94	4.57
2055	4.52	6.83	5.18	3.57	3.40	5.72	5.91	4.51	4.05	6.82	4.32	3.08	4.80
2060	4.70	7.09	5.38	3.70	3.53	5.94	6.14	4.68	4.20	7.09	4.48	3.20	4.98
2065	4.83	7.28	5.53	3.80	3.62	6.11	6.31	4.81	4.32	7.28	4.61	3.29	5.12

Table B-11: Change from baseline – Monthly mean evapotranspiration 5th percentile SSP5-8.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	-0.02	-0.15	0.08	0.21	0.25	0.03	0.25	0.29	0.22	0.31	0.21	-0.07	0.12
2015	-0.05	-0.31	0.16	0.43	0.52	0.06	0.52	0.59	0.45	0.63	0.44	-0.15	0.25
2020	-0.08	-0.49	0.25	0.69	0.83	0.09	0.82	0.95	0.72	1.01	0.70	-0.23	0.40
2025	-0.12	-0.70	0.36	0.98	1.18	0.13	1.17	1.34	1.02	1.43	0.99	-0.33	0.57
2030	-0.16	-0.92	0.47	1.28	1.54	0.17	1.53	1.76	1.34	1.88	1.30	-0.44	0.75
2035	-0.20	-1.17	0.59	1.62	1.95	0.21	1.93	2.23	1.69	2.38	1.64	-0.56	0.94
2040	-0.25	-1.42	0.71	1.96	2.36	0.24	2.33	2.69	2.05	2.87	1.99	-0.69	1.13
2045	-0.30	-1.70	0.85	2.34	2.82	0.28	2.79	3.22	2.45	3.44	2.38	-0.83	1.35
2050	-0.36	-1.99	0.98	2.73	3.29	0.32	3.25	3.75	2.85	4.00	2.77	-0.98	1.57
2055	-0.42	-2.30	1.12	3.13	3.78	0.36	3.73	4.30	3.27	4.59	3.18	-1.13	1.80
2060	-0.49	-2.63	1.27	3.56	4.30	0.39	4.24	4.90	3.72	5.23	3.62	-1.31	2.04
2065	-0.57	-2.98	1.42	4.01	4.85	0.42	4.77	5.52	4.19	5.90	4.07	-1.49	2.29

Table B-12: Change from baseline – Monthly mean evapotranspiration 50th percentile SSP5-8.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.32	0.19	0.34	0.38	0.29	0.39	0.36	0.38	0.35	0.36	0.31	0.27	0.32
2015	0.67	0.40	0.72	0.79	0.60	0.82	0.76	0.79	0.72	0.74	0.64	0.56	0.67
2020	1.06	0.63	1.14	1.27	0.95	1.30	1.21	1.26	1.14	1.18	1.02	0.90	1.07
2025	1.51	0.90	1.62	1.80	1.35	1.85	1.71	1.78	1.62	1.67	1.45	1.28	1.52
2030	1.98	1.18	2.12	2.36	1.77	2.43	2.25	2.34	2.13	2.19	1.90	1.67	1.99
2035	2.50	1.48	2.68	2.98	2.23	3.06	2.84	2.95	2.69	2.77	2.40	2.11	2.51
2040	3.02	1.79	3.24	3.60	2.70	3.70	3.43	3.57	3.25	3.34	2.90	2.55	3.03
2045	3.62	2.14	3.89	4.32	3.22	4.43	4.10	4.27	3.89	4.00	3.47	3.06	3.63
2050	4.22	2.49	4.53	5.03	3.75	5.17	4.78	4.97	4.52	4.66	4.04	3.56	4.23
2055	4.84	2.85	5.20	5.78	4.30	5.93	5.48	5.71	5.19	5.35	4.63	4.09	4.86
2060	5.52	3.25	5.93	6.58	4.89	6.75	6.24	6.50	5.91	6.09	5.28	4.65	5.53
2065	6.22	3.65	6.68	7.42	5.51	7.61	7.03	7.32	6.66	6.87	5.94	5.24	6.23

Table B-13: Change from baseline – Monthly mean evapotranspiration 95th percentile SSP5-8.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.56	0.84	0.64	0.44	0.42	0.70	0.73	0.56	0.50	0.84	0.53	0.38	0.59
2015	1.16	1.74	1.32	0.92	0.88	1.46	1.51	1.16	1.04	1.74	1.10	0.79	1.23
2020	1.85	2.78	2.11	1.46	1.40	2.33	2.41	1.84	1.65	2.78	1.76	1.26	1.96
2025	2.62	3.95	3.00	2.07	1.98	3.31	3.42	2.62	2.35	3.95	2.50	1.79	2.78
2030	3.44	5.19	3.94	2.72	2.59	4.35	4.49	3.43	3.08	5.19	3.28	2.35	3.65
2035	4.35	6.56	4.98	3.43	3.27	5.50	5.68	4.34	3.89	6.56	4.15	2.97	4.61
2040	5.26	7.94	6.02	4.14	3.94	6.66	6.88	5.24	4.71	7.94	5.02	3.59	5.58
2045	6.31	9.52	7.22	4.96	4.71	7.98	8.25	6.28	5.64	9.53	6.02	4.29	6.69
2050	7.36	11.11	8.43	5.78	5.48	9.31	9.62	7.32	6.57	11.12	7.02	5.00	7.80
2055	8.45	12.77	9.68	6.63	6.28	10.70	11.06	8.40	7.54	12.79	8.06	5.75	8.96
2060	9.64	14.57	11.05	7.55	7.14	12.21	12.62	9.58	8.59	14.60	9.19	6.55	10.21
2065	10.88	16.44	12.47	8.50	8.03	13.78	14.24	10.80	9.68	16.48	10.37	7.38	11.52

Table B-14: Change from baseline – Extreme precipitation 5th percentile SSP1-2.6

Year	2	3	5	10	20	100	200	500	1000	2000
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	-0.9	-0.8	-0.8	-0.7	-0.7	-0.5	-0.5	-0.5	-0.7	-0.7
2015	-1.8	-1.6	-1.5	-1.3	-1.3	-1.0	-0.9	-0.9	-1.3	-1.3
2020	-2.5	-2.3	-2.2	-1.9	-1.8	-1.4	-1.3	-1.3	-1.8	-1.8
2025	-3.2	-2.8	-2.7	-2.4	-2.3	-1.7	-1.6	-1.6	-2.3	-2.3
2030	-3.8	-3.4	-3.2	-2.8	-2.7	-2.1	-1.9	-1.9	-2.7	-2.7
2035	-4.3	-3.8	-3.6	-3.2	-3.1	-2.3	-2.1	-2.2	-3.1	-3.1
2040	-4.7	-4.2	-4.0	-3.5	-3.4	-2.6	-2.3	-2.4	-3.4	-3.4
2045	-5.1	-4.5	-4.3	-3.8	-3.7	-2.8	-2.5	-2.6	-3.6	-3.6
2050	-5.4	-4.8	-4.6	-4.1	-3.9	-2.9	-2.7	-2.7	-3.9	-3.9
2055	-5.7	-5.0	-4.8	-4.3	-4.1	-3.1	-2.8	-2.9	-4.1	-4.1
2060	-5.9	-5.2	-5.0	-4.4	-4.3	-3.2	-2.9	-3.0	-4.2	-4.2
2065	-6.0	-5.4	-5.1	-4.5	-4.4	-3.3	-3.0	-3.1	-4.3	-4.3

Table B-15: Change from baseline – Extreme precipitation 50th percentile SSP1-2.6

Year	2	3	5	10	20	100	200	500	1000	2000
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.8	0.9	1.1	1.1	1.1	1.2	1.3	1.7	2.5	2.5
2015	1.5	1.8	2.1	2.1	2.2	2.3	2.4	3.4	4.9	4.9
2020	2.2	2.6	3.0	2.9	3.1	3.3	3.5	4.8	7.0	7.0
2025	2.7	3.3	3.7	3.7	3.9	4.1	4.4	6.0	8.7	8.7
2030	3.2	3.9	4.4	4.3	4.6	4.9	5.2	7.2	10.4	10.4
2035	3.6	4.4	5.0	4.9	5.2	5.5	5.8	8.1	11.7	11.7
2040	4.0	4.8	5.5	5.4	5.7	6.0	6.4	8.9	12.9	12.9
2045	4.3	5.2	6.0	5.8	6.2	6.5	6.9	9.6	13.9	13.9
2050	4.6	5.5	6.4	6.2	6.6	6.9	7.4	10.2	14.8	14.8
2055	4.8	5.8	6.7	6.5	6.9	7.3	7.8	10.7	15.6	15.6
2060	5.0	6.0	6.9	6.8	7.2	7.6	8.1	11.1	16.2	16.2
2065	5.2	6.2	7.1	7.0	7.4	7.8	8.3	11.4	16.6	16.6

Table B-16: Change from baseline – Extreme precipitation 50th percentile SSP1-2.6

Year	2	3	5	10	20	100	200	500	1000	2000
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	2.3	2.6	2.9	3.2	3.4	4.4	5.2	6.6	8.9	8.9
2015	4.4	5.0	5.6	6.2	6.7	8.6	10.1	12.8	17.3	17.3
2020	6.3	7.2	8.0	8.8	9.5	12.3	14.4	18.2	24.6	24.6
2025	7.9	9.0	10.0	11.1	11.9	15.4	18.1	22.9	30.9	30.9
2030	9.4	10.7	11.9	13.2	14.1	18.3	21.5	27.1	36.7	36.7
2035	10.6	12.1	13.4	14.9	16.0	20.7	24.3	30.6	41.4	41.4
2040	11.7	13.3	14.8	16.4	17.6	22.8	26.7	33.7	45.6	45.6
2045	12.6	14.4	16.0	17.7	19.0	24.6	28.9	36.4	49.2	49.2
2050	13.4	15.3	17.0	18.8	20.2	26.2	30.7	38.7	52.4	52.4
2055	14.1	16.0	17.9	19.8	21.2	27.5	32.2	40.7	55.0	55.0
2060	14.6	16.6	18.5	20.5	22.0	28.5	33.5	42.2	57.1	57.1
2065	15.0	17.1	19.0	21.1	22.6	29.3	34.4	43.4	58.7	58.7

Table B-17: Change from baseline – Extreme precipitation 5th percentile SSP5-8.5

Year	2	3	5	10	20	100	200	500	1000	2000
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	-0.7	-0.6	-0.6	-0.5	-0.5	-0.4	-0.3	-0.4	-0.5	-0.5
2015	-1.5	-1.3	-1.2	-1.1	-1.1	-0.8	-0.7	-0.7	-1.0	-1.0
2020	-2.3	-2.1	-2.0	-1.7	-1.7	-1.3	-1.2	-1.2	-1.7	-1.7
2025	-3.3	-2.9	-2.8	-2.5	-2.4	-1.8	-1.6	-1.7	-2.4	-2.4
2030	-4.3	-3.8	-3.7	-3.2	-3.1	-2.4	-2.1	-2.2	-3.1	-3.1
2035	-5.4	-4.8	-4.6	-4.1	-4.0	-3.0	-2.7	-2.8	-3.9	-3.9
2040	-6.6	-5.8	-5.6	-4.9	-4.8	-3.6	-3.3	-3.3	-4.7	-4.7
2045	-7.9	-7.0	-6.7	-5.9	-5.7	-4.3	-3.9	-4.0	-5.7	-5.7
2050	-9.1	-8.1	-7.8	-6.9	-6.7	-5.0	-4.6	-4.7	-6.6	-6.6
2055	-10.5	-9.3	-9.0	-7.9	-7.6	-5.7	-5.2	-5.3	-7.6	-7.6
2060	-11.9	-10.6	-10.2	-9.0	-8.7	-6.5	-6.0	-6.1	-8.6	-8.6
2065	-13.5	-12.0	-11.5	-10.1	-9.8	-7.4	-6.7	-6.8	-9.7	-9.7

Table B-18: Change from baseline – Extreme precipitation 50th percentile SSP5-8.5

Year	2	3	5	10	20	100	200	500	1000	2000
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.3	1.9	1.9
2015	1.2	1.5	1.7	1.7	1.8	1.9	2.0	2.8	4.0	4.0
2020	2.0	2.4	2.7	2.7	2.8	3.0	3.2	4.4	6.4	6.4
2025	2.8	3.4	3.9	3.8	4.0	4.2	4.5	6.2	9.0	9.0
2030	3.7	4.4	5.1	5.0	5.3	5.5	5.9	8.2	11.9	11.9
2035	4.6	5.6	6.4	6.3	6.7	7.0	7.5	10.3	15.0	15.0
2040	5.6	6.7	7.7	7.6	8.0	8.5	9.0	12.5	18.1	18.1
2045	6.7	8.1	9.3	9.1	9.6	10.1	10.8	14.9	21.6	21.6
2050	7.8	9.4	10.8	10.6	11.2	11.8	12.6	17.4	25.2	25.2
2055	9.0	10.8	12.4	12.1	12.9	13.5	14.4	19.9	28.9	28.9
2060	10.2	12.3	14.1	13.8	14.6	15.4	16.4	22.7	32.9	32.9
2065	11.5	13.8	15.9	15.5	16.5	17.3	18.5	25.6	37.1	37.1

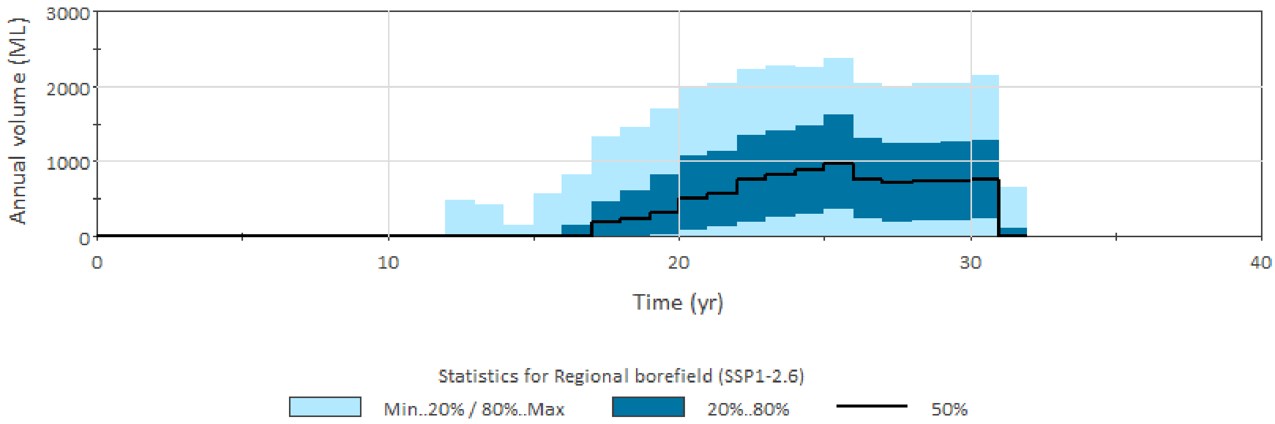
Table B-19: Change from baseline – Extreme precipitation 95th percentile SSP5-8.5

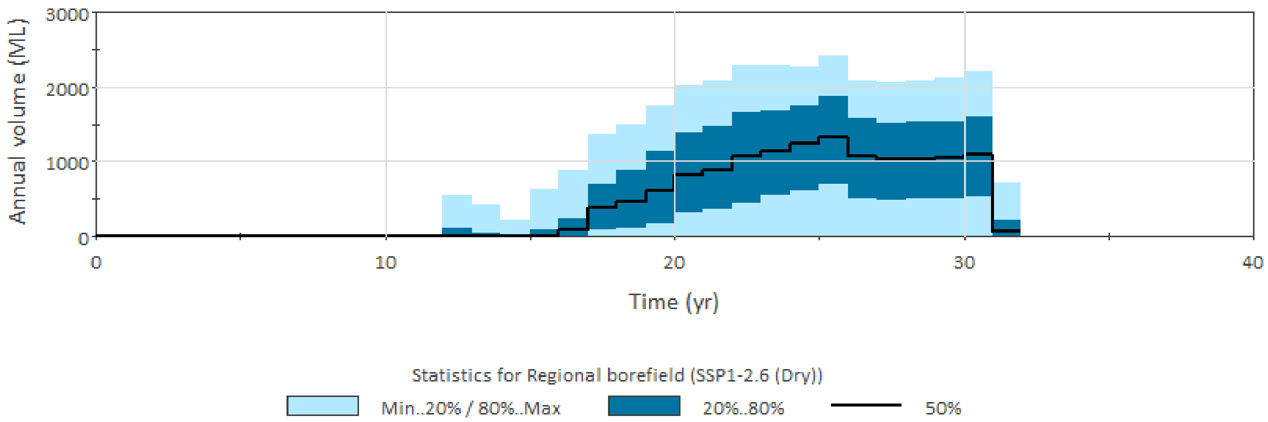
Year	2	3	5	10	20	100	200	500	1000	2000
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	1.7	2.0	2.2	2.4	2.6	3.4	4.0	5.0	6.8	6.8
2015	3.6	4.1	4.6	5.1	5.5	7.1	8.3	10.5	14.1	14.1
2020	5.8	6.6	7.3	8.1	8.7	11.2	13.2	16.7	22.5	22.5
2025	8.2	9.3	10.4	11.5	12.3	16.0	18.7	23.6	31.9	31.9
2030	10.7	12.2	13.6	15.1	16.2	20.9	24.6	31.0	41.9	41.9
2035	13.6	15.4	17.2	19.0	20.4	26.4	31.0	39.1	52.9	52.9
2040	16.4	18.6	20.7	23.0	24.6	31.9	37.5	47.3	63.9	63.9
2045	19.6	22.3	24.8	27.5	29.5	38.2	44.8	56.6	76.5	76.5
2050	22.8	26.0	28.9	32.0	34.3	44.5	52.2	65.9	89.0	89.0
2055	26.2	29.8	33.2	36.7	39.4	51.0	59.9	75.6	102.1	102.1
2060	29.8	33.9	37.7	41.8	44.8	58.1	68.1	86.0	116.3	116.3
2065	33.6	38.2	42.5	47.0	50.5	65.4	76.7	96.9	130.9	130.9

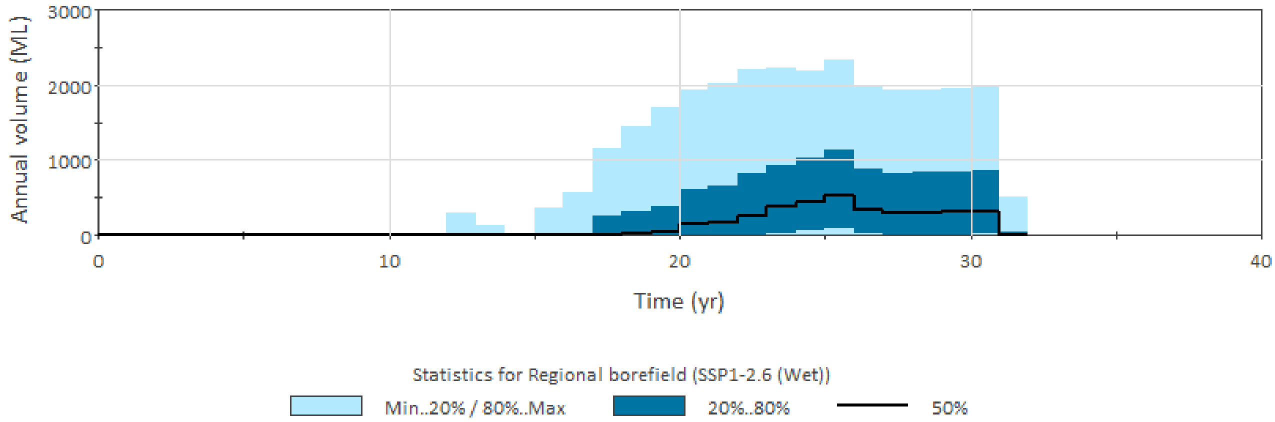
Appendix C. Climate Change Results

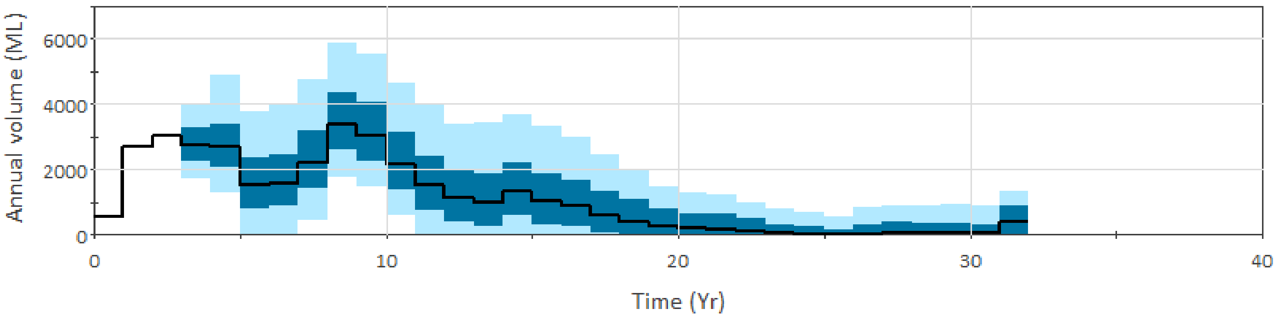
Probability plots

C.1 Low emission scenario



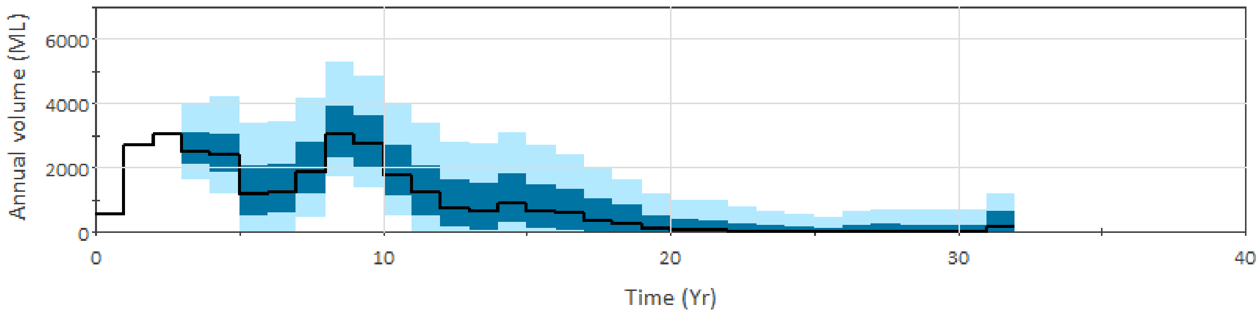






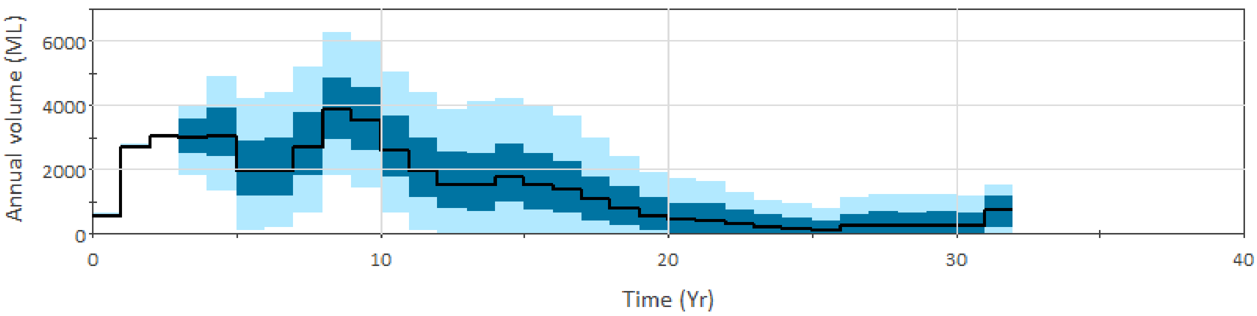
Statistics for CWD overflow (SSP1-2.6)

Min..20% / 80%..Max   20%..80%   50%



Statistics for CWD overflow (SSP1-2.6 (Dry))

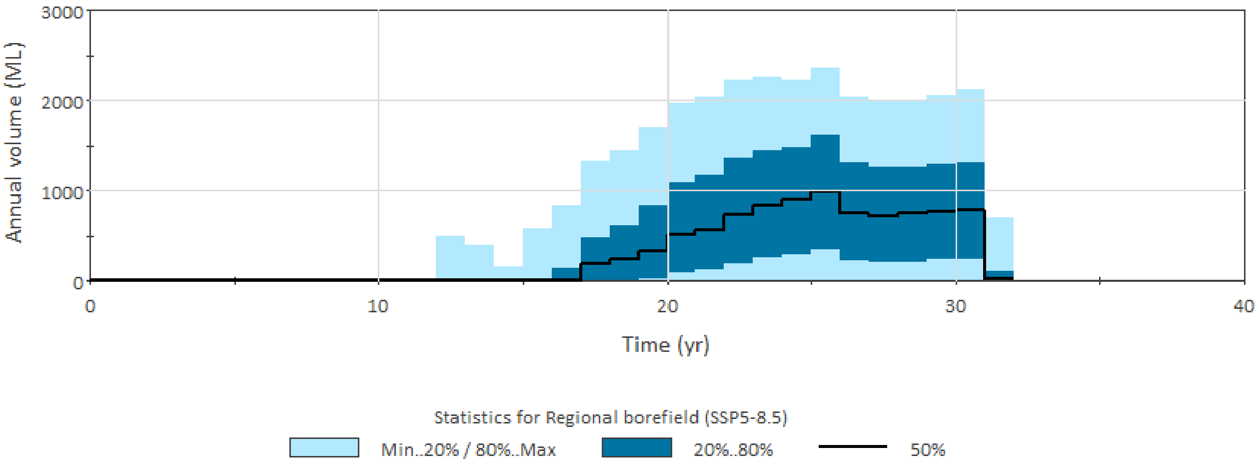
Min..20% / 80%..Max   20%..80%   50%

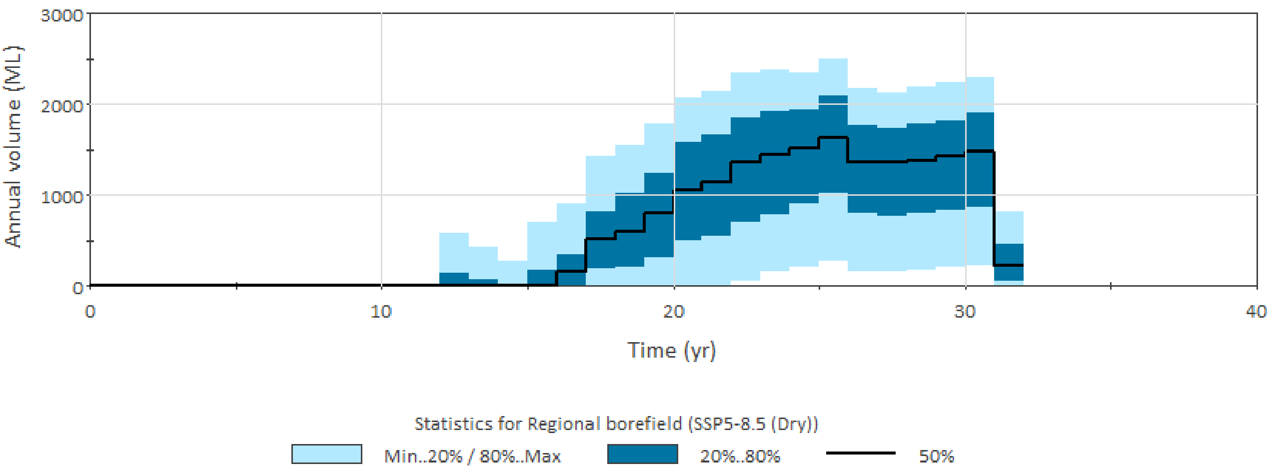


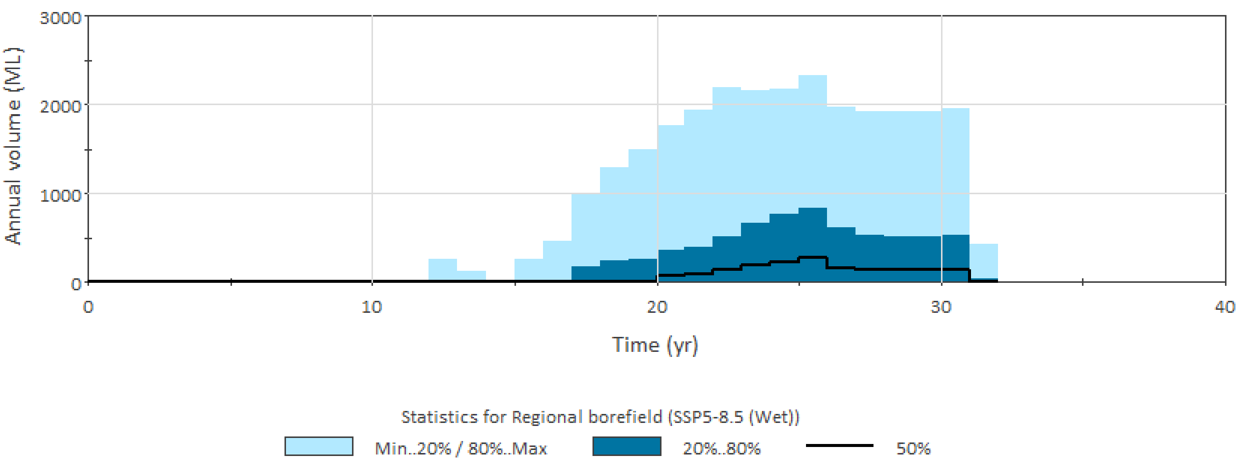
Statistics for CWD overflow (SSP1-2.6 (Wet))

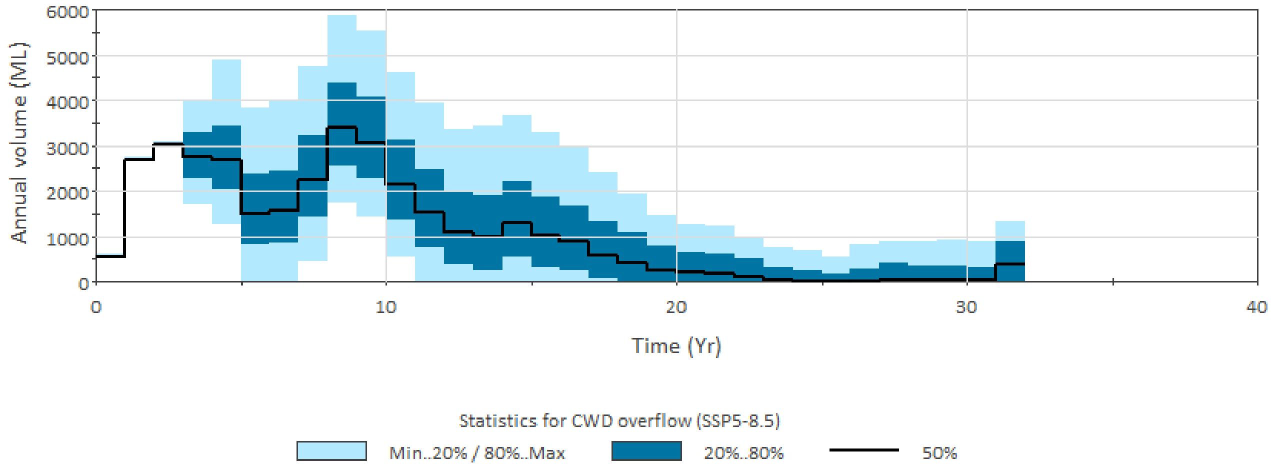
Min..20% / 80%..Max   20%..80%   50%

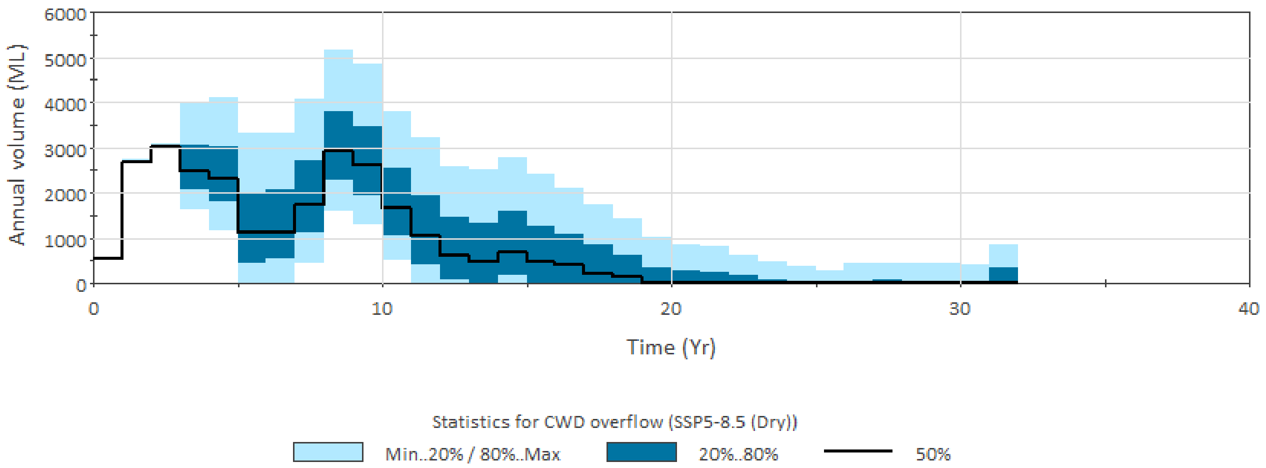
C.2 High emission scenario

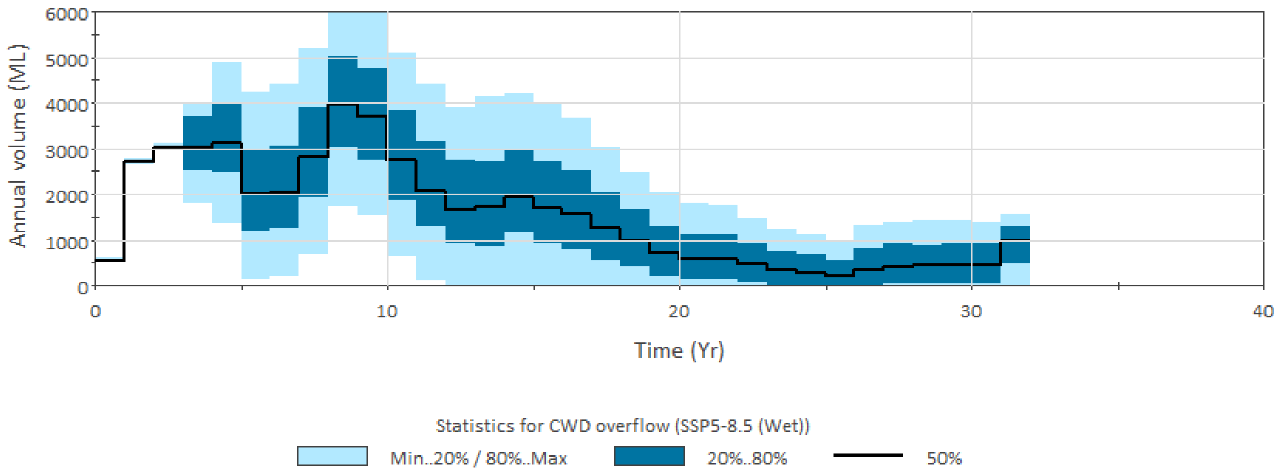




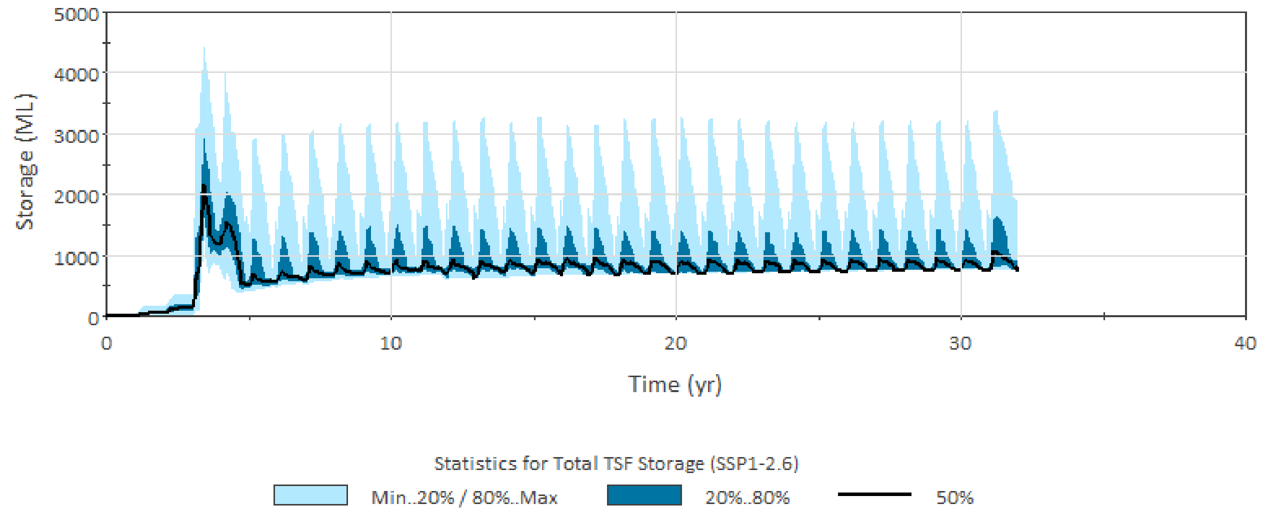


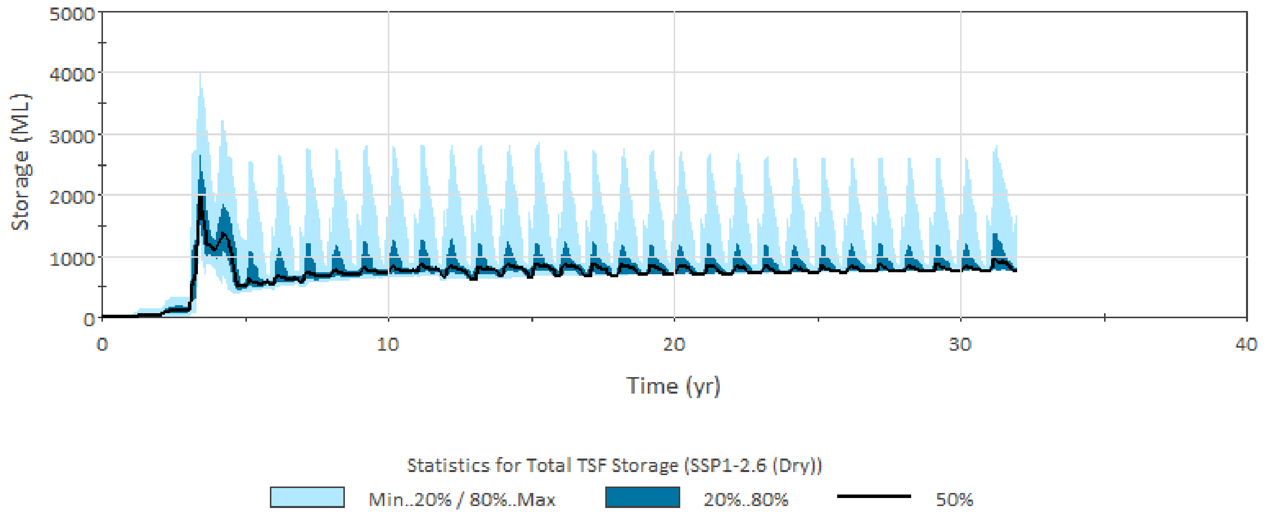

Annual volume (ML)
Time (Yr)
Statistics for CWD overflow (SSP5-8.5)
Min..20% / 80%..Max
20%..80%
50%

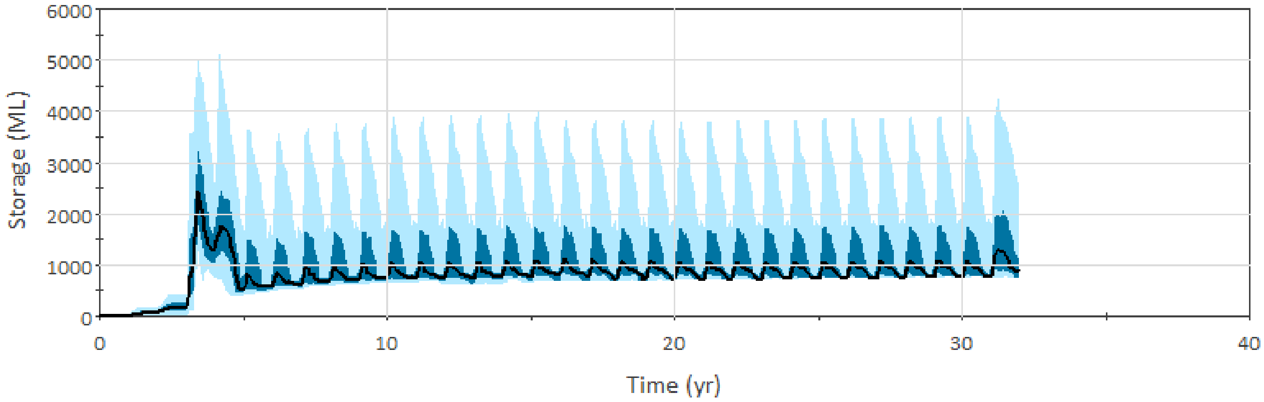

Annual volume (ML)
Time (Yr)
Statistics for CWD overflow (SSP5-8.5 (Dry))
Min..20% / 80%..Max
20%..80%
50%


Annual volume (ML)
Time (Yr)
Statistics for CWD overflow (SSP5-8.5 (Wet))
Min..20% / 80%..Max
20%..80%
50%

C.3 Storage plots

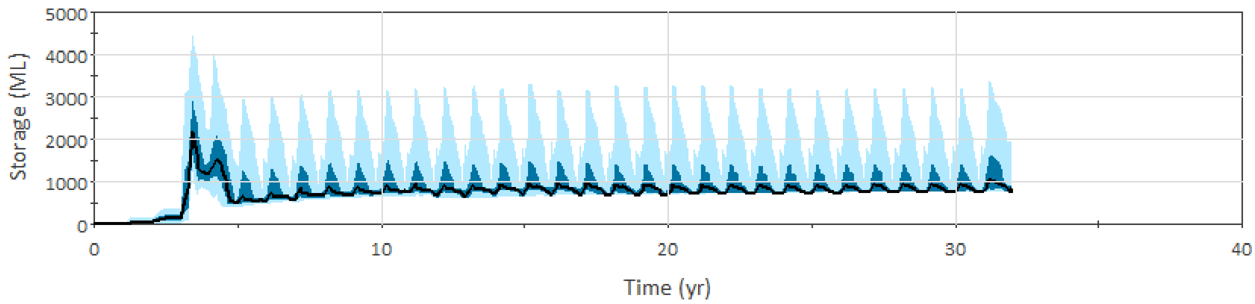






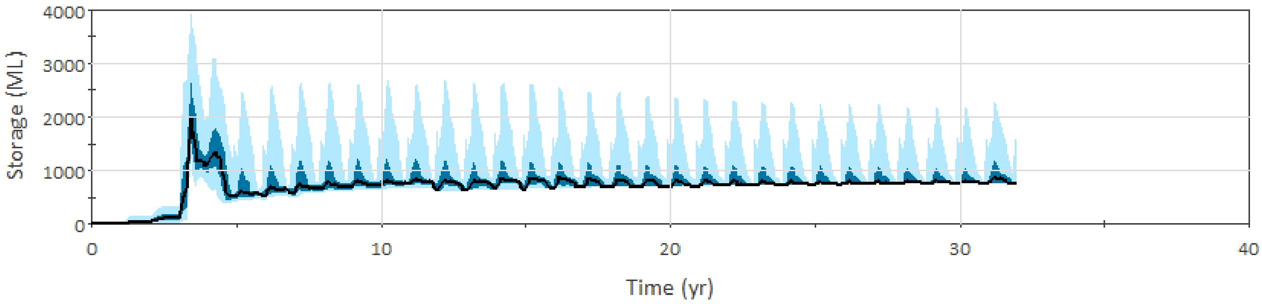
Statistics for Total TSF Storage (SSP1-2.6 (Wet))

Min..20% / 80%..Max 20%..80% 50%



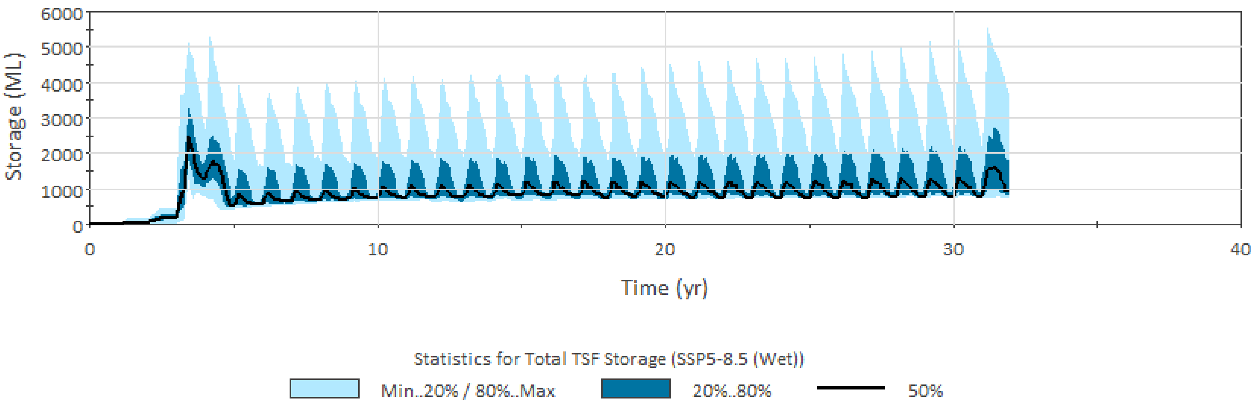
Statistics for Total TSF Storage (SSP5-8.5)

Min..20% / 80%..Max 20%..80% 50%



Statistics for Total TSF Storage (SSP5-8.5 (Dry))

Min..20% / 80%..Max 20%..80% 50%


6000
5000
4000
3000
2000
1000
0
Storage (ML)
0
10
20
30
40
Time (yr)
Statistics for Total TSF Storage (SSP5-8.5 (Wet))
Min..20% / 80%..Max
20%..80%
50%