Stormwater and water balance assessment

Mahalo North

June 2025

Anderson Consulting Pty Ltd

STORMWATER AND WATER BALANCE ASSESSMENT, Mahalo North

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1 Introduction

Terrasanna Consultants engaged Anderson Consulting (AC) to prepare a stormwater and water balance assessment for a proposed Gas Compression Facility (GCF) to be developed by Comet Ridge Mahalo North Pty Ltd ('Comet Ridge') at a location covered by Authority to Prospect (ATP) 2048.

2 Site description

The proposed GCF site ('the GCF' or 'the site') is located on Lot 10, WNA115 in the Central Highlands Regional Council area approximately 42 km north of Rolleston, 54 km east of Springsure and 60 km south of Blackwater. The site location is shown on Figure 1.

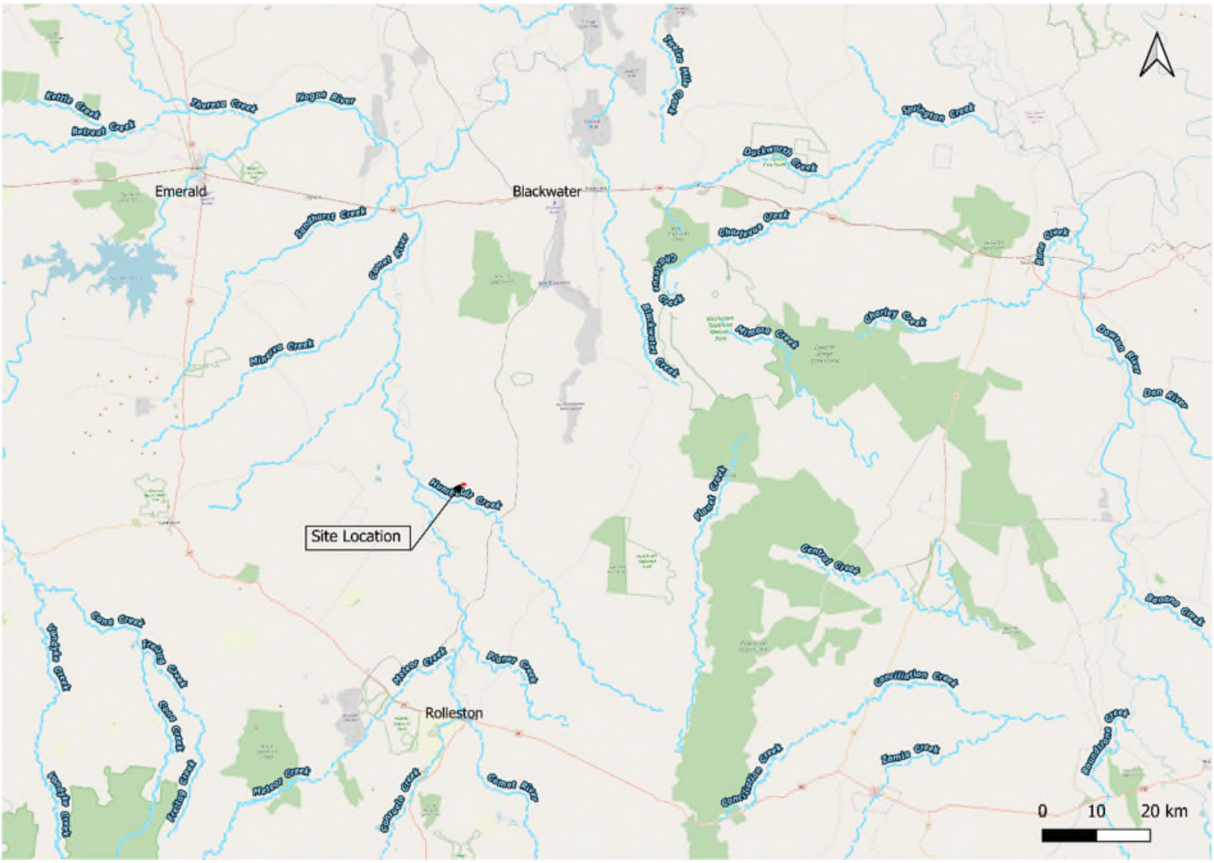


Figure 1 - Site location (image source: OpenMaps)

The GCF site has an approximate area of 16.5 hectares (ha) whilst the lot on which it sits has an area of 7550 ha. Currently the site is used for agriculture (beef production), with the proposed GCF footprint consisting of pastures with some scattered trees (see Figure 2).

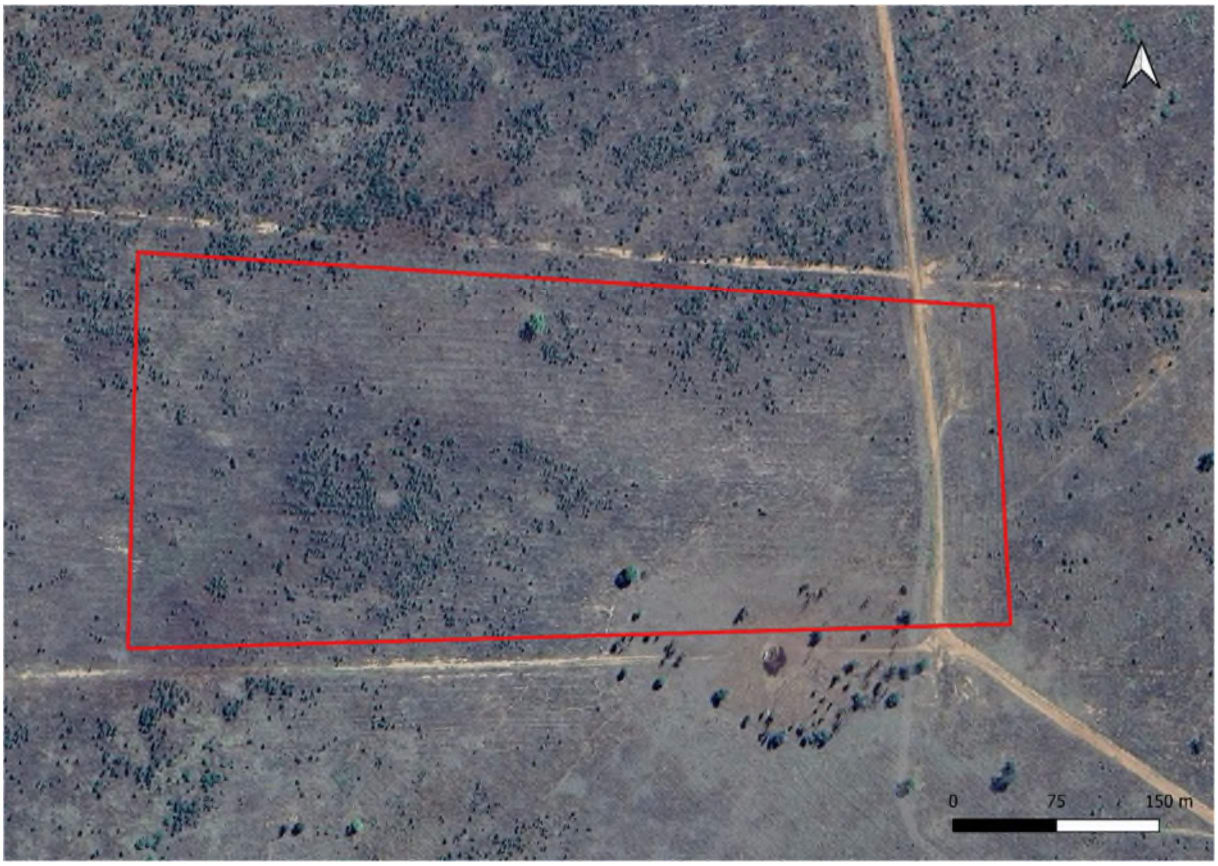


Figure 2 - Aerial photograph of proposed GCF site boundary shown as a red line (Image source: Google Satellite)

2.1 Proposed development

The proposed GCF will receive produced groundwater from a series of coal seam gas wells drilled in the surrounding area. Groundwater extracted from these wells will be conveyed via pipeline to the GCF site. The produced water will initially be collected in an above-ground storage tank before being transferred to a reverse osmosis (RO) treatment plant.

Following treatment, the permeate (treated water) will be stored in a designated treated water tank for potential beneficial reuse. The RO process also generates a concentrated brine stream, which will be captured and stored in a separate brine storage tank. All tanks associated with the facility are to be located above ground.

In addition to the water storage and treatment infrastructure, the GCF will include gas compression equipment, the RO plant and related systems, a gas flare, internal gravel roads, car parking, a site office, and accommodation facilities. The conceptual layout of the GCF is presented in Figure 3.

It is noted that the overall site footprint is larger than the area currently required for the tanks and associated infrastructure. This provides a reserved area that allows for contingency infrastructure if required.

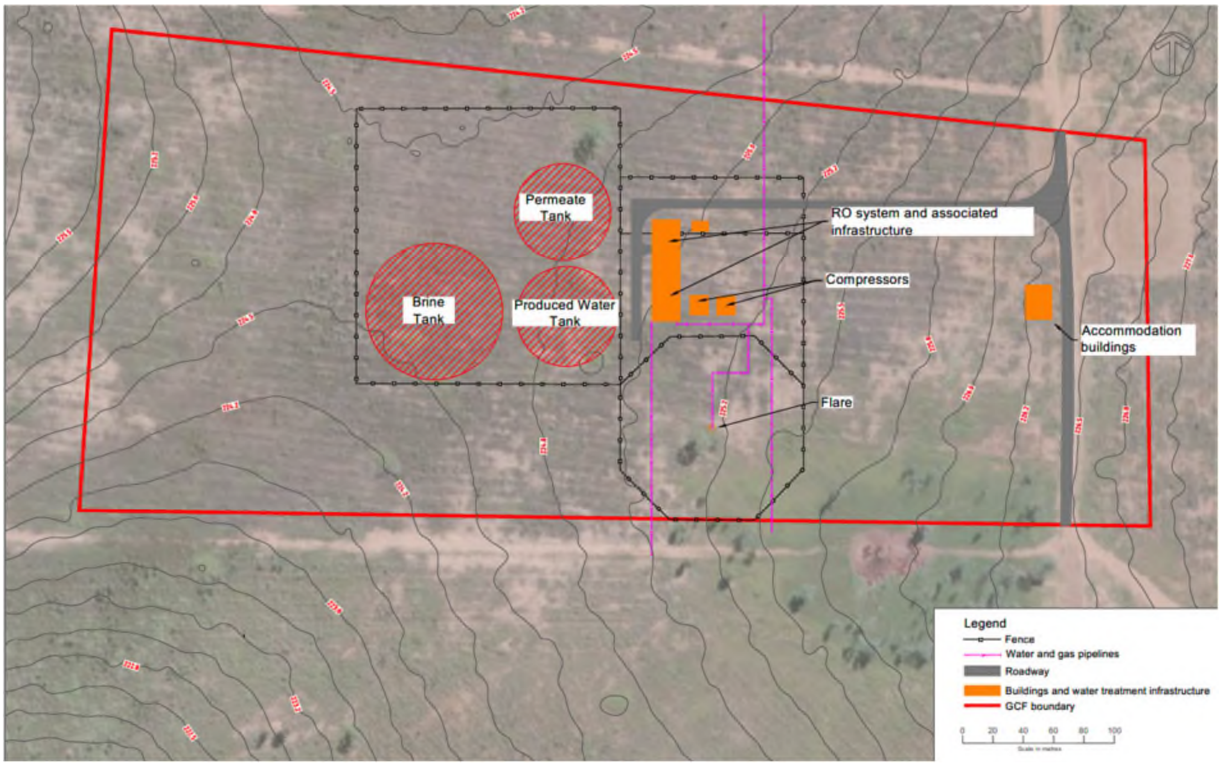


Figure 3 - GCF Layout.

2.2 Topography and landform

Based on provided [1] LIDAR[2] and survey information in the vicinity of the GCF site, land elevations range from ~224 metres Australian Height Datum (mAHD) to ~228 mAHD. Lands to the west and the east of the GCF boundaries increase in elevation and to the north and the south they decrease in elevation, meaning that the GCF would be located on a north south catchment divide.

The northern portion of the GCF drains to a series of unnamed water courses located 3 km from the GCF boundary. Those watercourses ultimately discharge into Three Mile Creek. The southern portion of the site drains via a series of unnamed water courses located approximately 450 m from the GCF boundary. Those watercourses ultimately discharge to Humboldt Creek (see Figure 4).

Site slopes are mostly slight, with an average 2° slope in the GCF. The GCF has limited external catchments consisting of the higher elevation landform to the east and west. The western external catchment has an area of 7.8 ha and the eastern external catchment has an area of 4.3 ha (See Figure 5).

[1] 2023 Fugro LIDAR

[2] LIDAR is light detection and ranging. It is a method for determine distance by targeting an object or a surface with laser and measuring the time for the reflected light to return to the receiver. Lidar is commonly captured from an aircraft for the survey of landform surfaces.

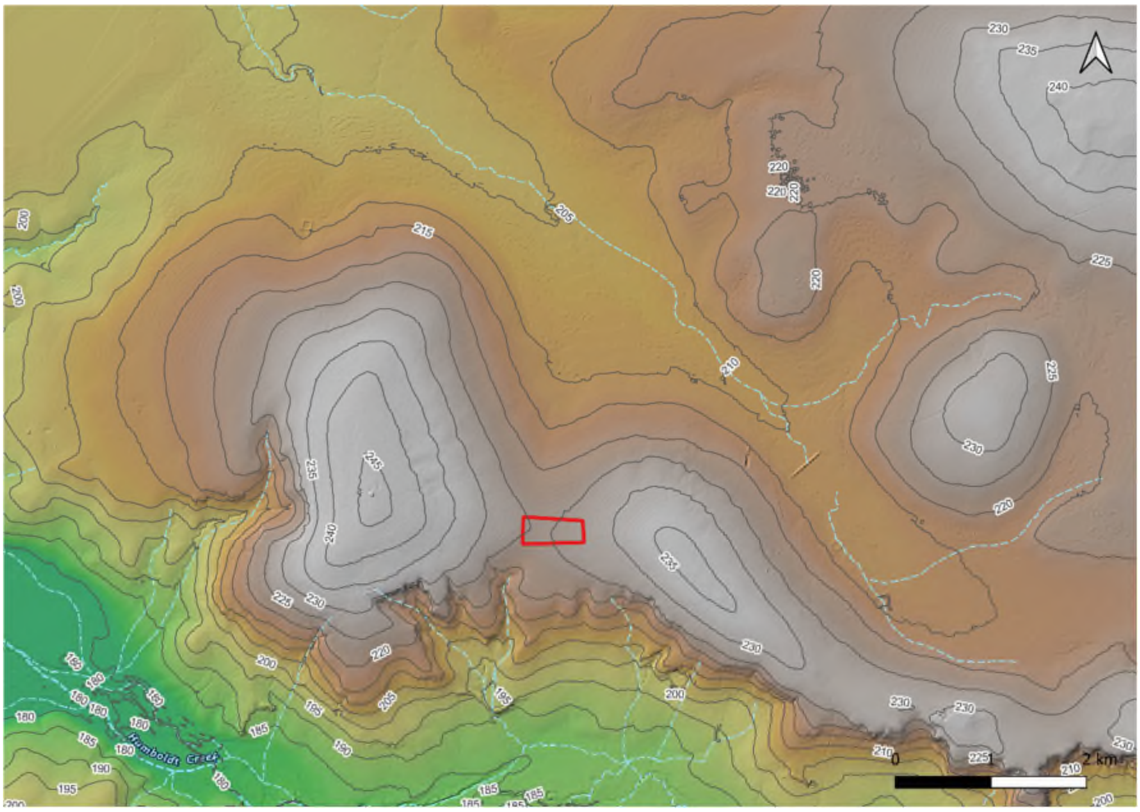


Figure 4 - LIDAR survey in mAHD. GCF shown in red line, mapped water courses marked with blue lines

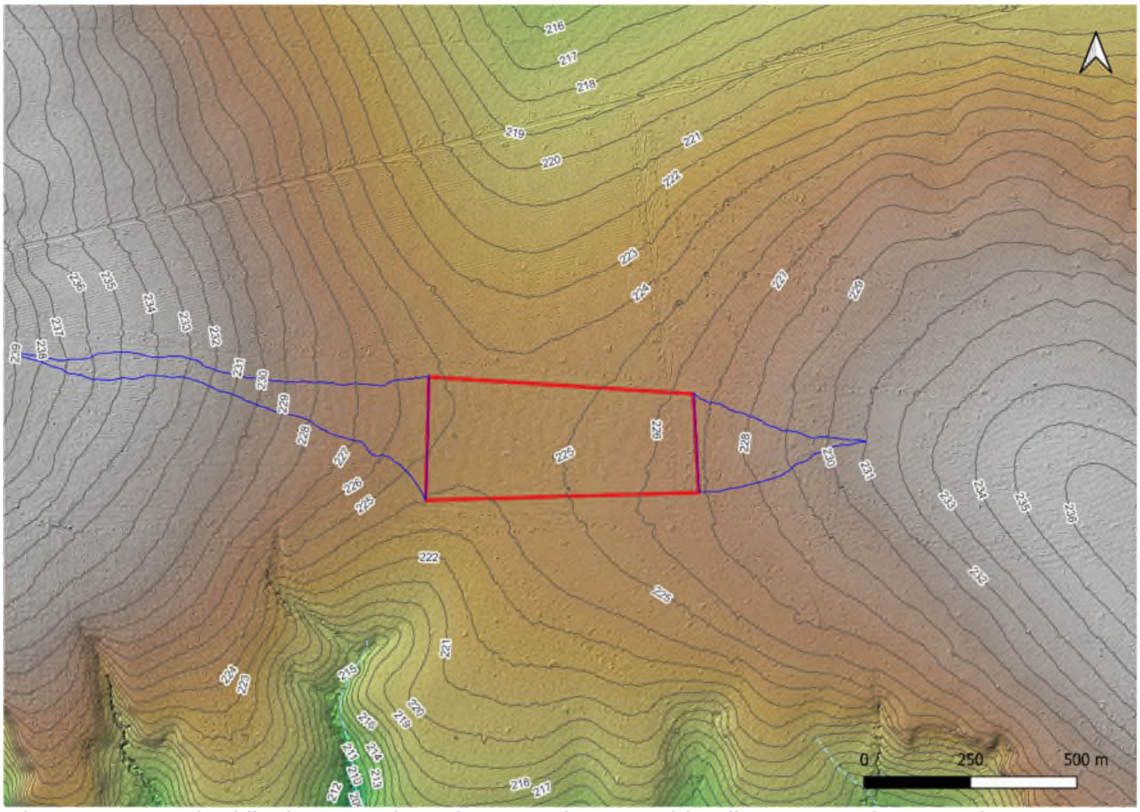


Figure 5 - GCF (red line) external catchments shown as blue line LIDAR date 2022)

3 Stormwater management objectives

The objectives of the stormwater management design are to:

- Ensure the proposed storage (tanks) and treatment systems are adequately sized to prevent overtopping during significant rainfall events and extended wet periods.
- Minimise the risk of contaminated stormwater or produced water being released to the environment.
- Provide contingency measures and alternative management options to prevent uncontrolled discharges.
- Establish a system that allows for representative monitoring.
- Ensure compliance with the requirements of the *Environmental Protection Act 1994 (Qld)*.

4 Stormwater and water balance assessment

4.1 Water balance model

A daily timestep water balance model was created to assess the performance of the proposed produced water, treated water and brine storage tanks. The water balance incorporated the predicted groundwater inflow rates, local climate data, proposed storage tank sizes, operational constraints and likely predicted beneficial reuse options.

4.1.1 Climate data

Climate data for the local area, including rainfall and evaporation, was sourced from the Queensland Government's Long Paddock website. The dataset spans from 1900 to 2024, providing 125 years of continuous historical records. A summary of the annual rainfall statistics is presented in Table 1. This includes key statistical measures (e.g. minimum, percentiles, median, average, and maximum), the associated annual rainfall totals, and the corresponding year in which each occurred. The daily evaporation statistics are included in Appendix 2.

Table 1 - Summary of annual rainfall statistics for 1900 to 2024.

Statistic	Annual rainfall (mm)	Corresponding year
Minimum	193.0	1902
10th Percentile	395.2	2015
20th Percentile	457.4	2020
25th Percentile	471.3	1929
Median	578.3	1904 and 1959
Average	605.8	1960
75th Percentile	697.0	1990
80th Percentile	743.3	2000
90th percentile	842.1	2022
Maximum	1496.5	2010

To better understand the nature of extreme rainfall events, both short-duration (1-day) and extended-duration (5-day and 10-day) rainfall totals were analysed using 125 years of historical data. The results are summarised in Table 2 below.

Table 2 - Summary of extreme weather events in rainfall data set

Statistic	Maximum daily rainfall total (mm)	Highest 5 day moving total (mm)	Highest 10 day moving total (mm)
Depth of rainfall	129.5	288.6	428
Date of event	5/01/2002	9/02/1954	9/02/1954

The wettest 1-day rainfall total was 129.5 mm in January 2002 whilst the wettest multiple day event was in February 1954.

To conservatively assess the performance of the proposed produced water system and storages daily timestep modelling was undertaken for three rainfall scenarios being:

- 1900 to 1925 (Scenario 1)
- 1949 to 1974 (Scenario 2)
- 1999 to 2024 (Scenario 3)

These time periods were selected to ensure the inclusion of the largest and most extreme historical weather events within the daily timestep modelling. The model was run over a 25-year simulation period, consistent with the project design life, using actual historical rainfall data from each scenario period. This approach ensures that the model reflects realistic and observed rainfall patterns, rather than relying on synthetic or generated data.

The annual rainfall totals for each year within each scenario are presented in Table 3 to Table 5 below. Each table includes:

- The model day at the end of each calendar year, used as a reference point for interpreting modelling outputs presented later in the report.
- The percentile rank of each year's rainfall total, relative to the full 125-year historical record (1900–2024).
- A summary of the minimum, average, and maximum annual rainfall values within the scenario period, together with their respective percentile rankings.

Table 3 - Scenario 1 rainfall analysis 1900 to 1925

Year	End of year model day count	Cumulative annual Rainfall (mm)	Percentile Rank (of the 125 years of rainfall data)
1900	365	513.0	33.0
1901	730	464.7	21.7
1902	1095	193.0	0.0
1903	1460	660.9	69.3
1904	1826	578.3	50.8
1905	2191	575.1	49.1
1906	2556	802.7	87.0
1907	2921	615.9	56.4
1908	3287	661.1	70.1
1909	3652	654.9	68.5
1910	4017	738.3	79.0
1911	4382	661.9	70.9
1912	4748	651.5	67.7
1913	5113	617.1	58.0
1914	5478	390.4	8.0
1915	5843	295.8	3.2
1916	6209	735.4	78.2
1917	6574	986.1	96.7
1918	6939	845.2	90.3
1919	7304	307.8	4.8
1920	7670	547.5	39.5
1921	8035	787.2	84.6
1922	8400	651.1	66.1
1923	8765	458.1	20.9
1924	9131	809.9	87.9
1925	9496	760.3	80.6
Minimum		193.0	0.0
Average		614.0	55.5
Maximum		986.1	96.7

Table 4 - Scenario 2 rainfall analysis 1949 to 1974

Year	End of year model day count	Cumulative annual Rainfall (mm)	Percentile rank (of the 125 years of rainfall data)
1949	365	633.3	61.2
1950	730	1057.4	97.5
1951	1095	455.6	19.3
1952	1460	595.2	52.4
1953	1826	526.4	35.4
1954	2191	1119.7	98.3
1955	2556	829.5	88.7
1956	2921	1235.1	99.1
1957	3287	301.2	4.0
1958	3652	519.4	33.8
1959	4017	578.3	50.0
1960	4382	602.8	54.0
1961	4748	761.3	81.4
1962	5113	686.5	73.3
1963	5478	651.1	66.1
1964	5843	569.5	45.9
1965	6209	413.2	15.3
1966	6574	512.8	32.2
1967	6939	616.9	57.2
1968	7304	683.1	72.5
1969	7670	242.5	0.8
1970	8035	613.8	55.6
1971	8400	646.1	64.5
1972	8765	469.5	24.1
1973	9131	886.1	92.7
1974	9496	924.1	94.3
Minimum		242.5	0.8
Average		658.9	56.5
Maximum		1235.1	99.1

Table 5 - Scenario 3 Rainfall Analysis 1999 to 2024

Year	End of year model day count	Cumulative annual Rainfall (mm)	Percentile rank (of the 125 years of rainfall data)
1999	365	399.1	11.2
2000	730	739.0	79.8
2001	1095	445.6	18.5
2002	1460	418.6	16.1
2003	1826	406.1	12.9
2004	2191	493.1	27.4
2005	2556	559.2	40.3
2006	2921	420.6	16.9
2007	3287	570.2	47.5
2008	3652	800.3	86.2
2009	4017	410.3	14.5
2010	4382	1496.5	100.0
2011	4748	633.5	62.0
2012	5113	645.9	63.7
2013	5478	468.0	22.5
2014	5843	475.7	25.8
2015	6209	394.0	9.6
2016	6574	597.0	53.2
2017	6939	634.9	62.9
2018	7304	501.8	29.0
2019	7670	278.2	2.4
2020	8035	457.8	20.1
2021	8400	531.9	36.2
2022	8765	837.4	89.5
2023	9131	492.7	26.6
2024	9496	571.5	48.3
Minimum		278.2	2.4
Average		564.6	39.4
Maximum		1496.5	100.0

The results show that the wettest modelling scenario was Scenario 2 (1949–1974), with an average percentile rank of 56.5.

To assess how these selected 25-year periods compare to the broader 125-year rainfall record, an analysis was undertaken using a 25-year block averages of percentile ranks.

The average percentile rank was calculated for 25-year blocks throughout the historical dataset (see Table 6). This provides context for how representative each modelling scenario is when considered against the full historical range.

Table 6 - Cumulative average percentile rank for 25-year blocks throughout the rainfall data period.

Year	Cumulative annual rainfall (mm)	Average percentile rank for prior 25 years
1925	760.3	55.5
1938	504.5	48.9
1950	1057.4	46.9
1963	651.1	54.0
1974	924.1	56.5
1988	693.8	55.5
2000	739.0	51.6
2013	468.0	44.9
2024	571.5	39.4

The results show that indeed 1949 to 1974 was the wettest 25-year period, followed by 1900 to 1925. The period from 1999 to 2024, whilst it included the wettest day on record overall for the modelling period, had the lowest percentile rank average of all 25-year periods assessed.

To further assess the distribution of rainfall across the modelling scenarios, a cumulative rainfall plot was generated for each of the three scenarios Figure 6. The results clearly show that Scenario 2 maintained consistently higher cumulative rainfall over the full 25-year period when compared with Scenarios 1 and 3.

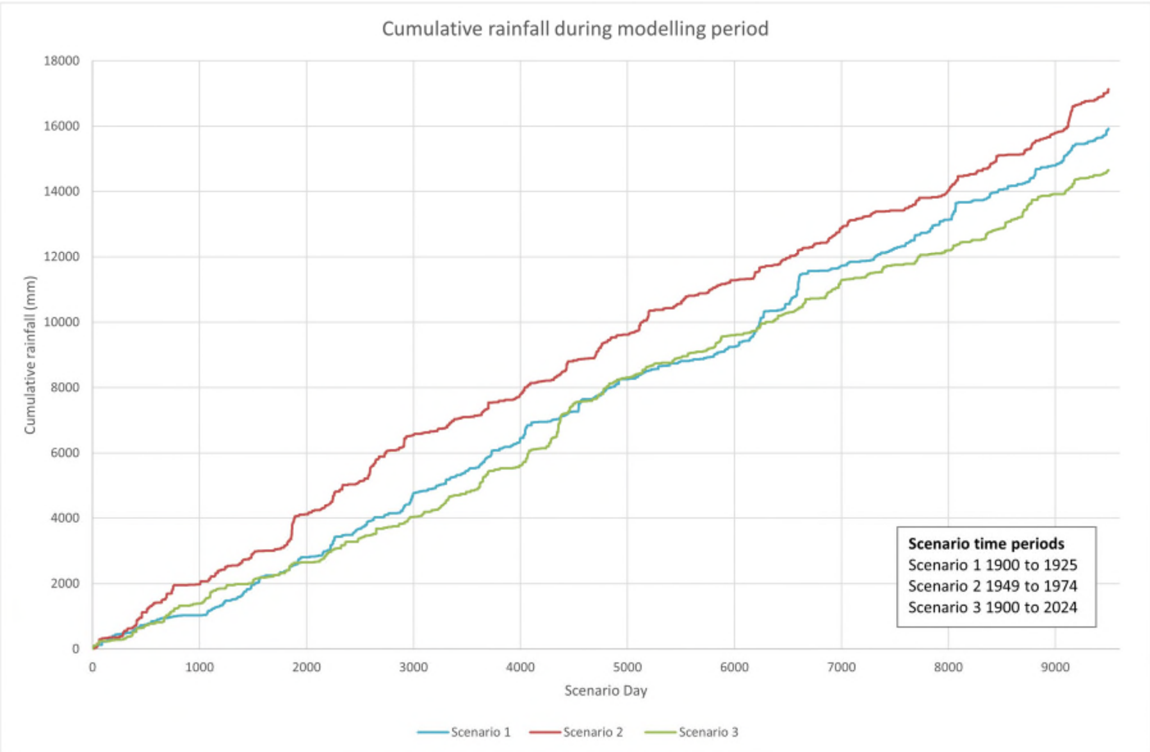


Figure 6 - Cumulative rainfall plot for each scenario.

4.1.2 Storage characteristics

Three above-ground storage tank types are proposed as part of the produced water management system:

1. Produced Water Tank – stores raw water extracted from the coal seam gas wells.
2. Treated Water Tank – stores permeate (treated water) generated from the reverse osmosis (RO) treatment process.
3. Brine Tank – stores the concentrated waste stream (brine) resulting from the RO process.

The operational volumes and overflow capacities for each tank are provided in Table 7, with a 0.3 m freeboard applied to all storages.

Table 7 - Summary of storage characteristics

Storage Type	Operational Volume	Overflow Volume
Produced Water Storage	7,916 m^3 (2.8m H x 60m diameter)	8,765 m^3 (3.1m H x 60m diameter)
Permeate Water Storage	7,398 m^3 (2.8m H x 58m diameter)	8,190 m^3 (3.1m H x 58m diameter)
Brine Storage	15517 m^{3*} (2.8m H x 84m diameter)	17,179 m^3 (3.1m H x 84m diameter)

Note: * a second brine tank may be used during the life of the project. This scenario and a single brine tank scenario are included in the modelling scenarios.

The maximum recorded daily rainfall for the area is 129.5 mm. For comparison, the design rainfall intensities from the Bureau of Meteorology's IFD data (see Appendix 1) for the site are as follows:

- 1% AEP (100-year ARI), 24-hour event: 231 mm
- 1% AEP, 48-hour event: 276 mm
- 1% AEP, 72-hour event: 302 mm

These values confirm that the adopted 0.3 m freeboard provides sufficient capacity and time (at least 48 hours) for operational response measures (e.g. pumping, transfer, or treatment) to be implemented in advance of potential overtopping. Further discussion on contingency actions is provided below.

4.1.3 Produced water volumes

The produced water volumes used in the modelling were provided by Comet Ridge. Figure 7 presents a plot of the predicted daily inflow from the wells over the life of the project.

The data indicate a maximum predicted inflow rate approximating 430 m^3/day, with an average inflow rate approximating 215 m^3/day sustained up to day 4,500 of the model run. After this point, the daily inflow volume gradually declines until no further flow is produced.

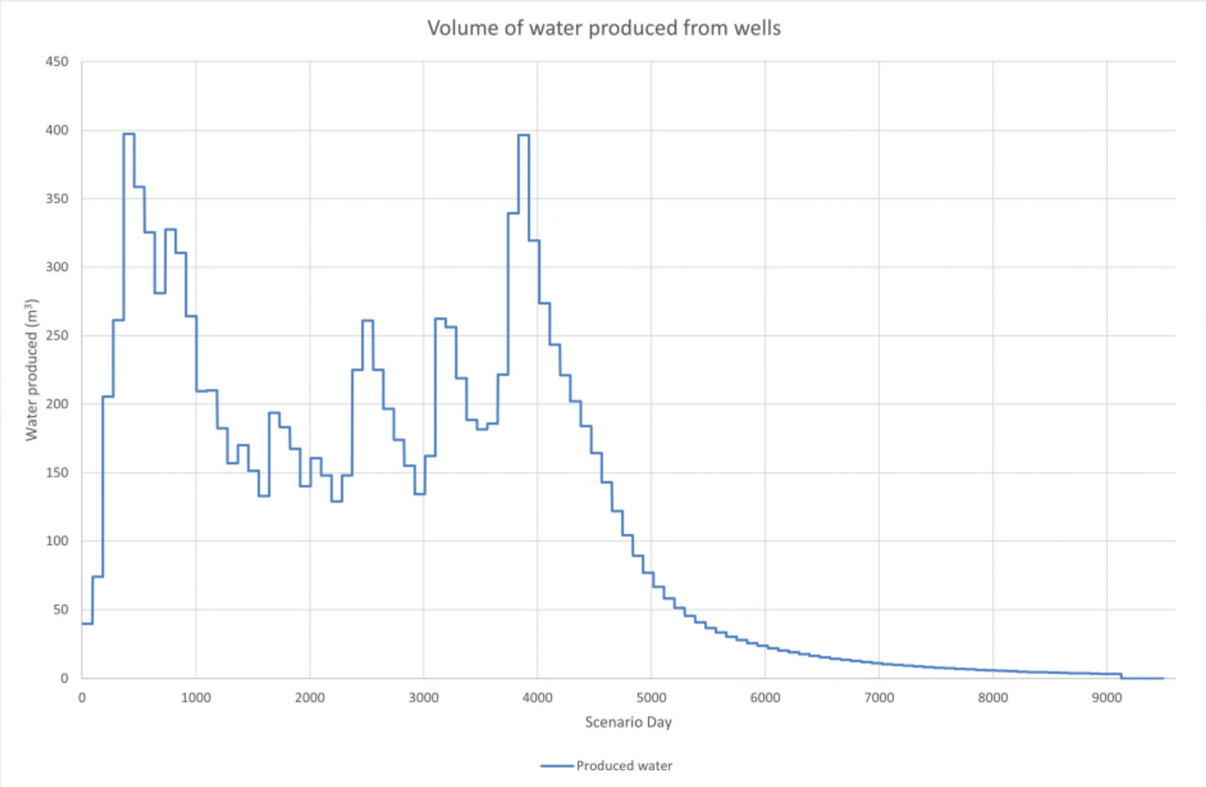


Figure 7 - Daily water production volumes from wells for the life of the project

4.2 Model setup and assumptions

The daily timestep modelling for the tank storage water balance was undertaken with the following assumptions:

- Rainfall Inputs: Three historical rainfall scenarios, as outlined in Section 4.1.1. A sensitivity run was also performed testing the impact of climate change being increased rainfall (using an RCP 8.5).
- Evaporation Losses: Actual recorded daily evaporation data for each scenario, adjusted using a pan factor of 0.7.
- Tank Storage Capacities: As detailed in Section 4.1.2.
- Produced Water Inflows: Based on predicted daily inflow rates from Figure 7. An additional scenario was modelled with inflow volumes increased by 10% to test system sensitivity.
- RO Treatment Efficiency: Assumed at 80%, meaning that for every 1.0 ML of water treated, 0.8 ML becomes permeate and 0.2 ML becomes brine.
- Brine Recirculation: When the brine tank approached operational capacity, excess brine was recirculated to the produced water tank for reprocessing.
- Beneficial Reuse: Treated water (permeate) was assumed to be used for beneficial purposes immediately upon treatment, up to a maximum daily reuse volume. The average and peak reuse volumes adopted for the various modelling scenarios are summarised in the Results section.

A conceptual flow diagram of the model setup is shown in *Figure 8*.

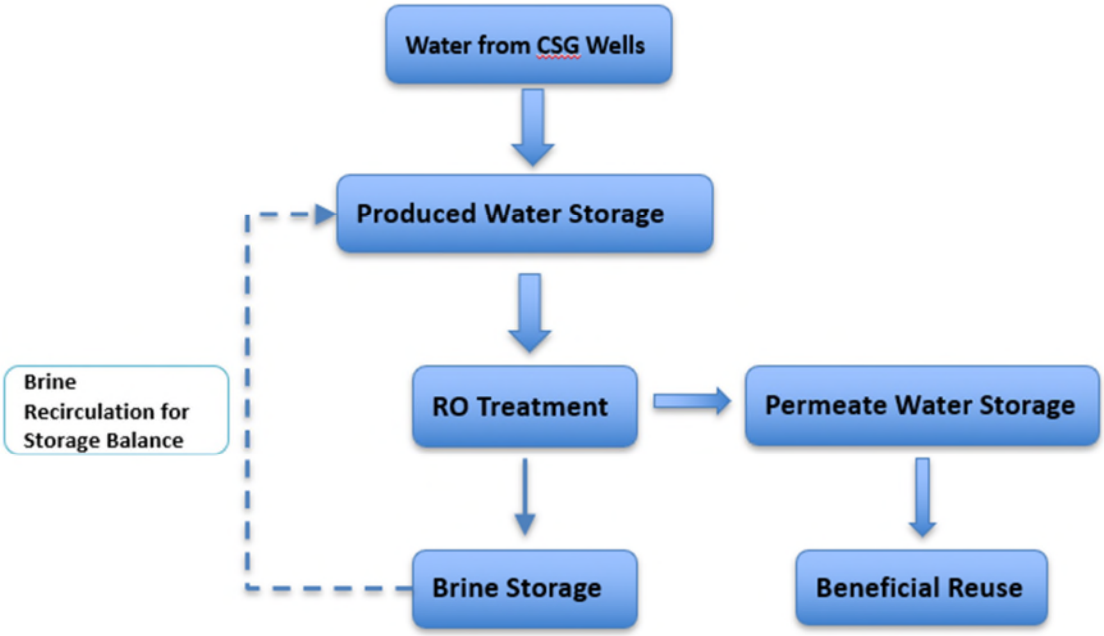


Figure 8 - Conceptual model layout

4.3 Water balance results

The results for the various scenarios are included below.

4.3.1 Model Scenario 1 - single brine tank

A single brine tank scenario was assessed under all three rainfall conditions. The modelling results confirm that no overtopping occurred for any of the storage tanks throughout the simulation period. A summary of the results is included in Table 8 with charts of the tank volumes, beneficial reuse and daily volume of treated water included in Appendix 2.

Table 8 - Modelled Scenario 1 - single brine tank

Scenario	Years	Rainfall maximum daily (mm)	Average daily water treatment (m^3/day)	Maximum daily water treatment (m^3/day)	Average Daily Beneficial Water use (m^3/day)	Maximum Daily beneficial water use (m^3/day)	Total volume of brine recirculated back to production tank (m^3)	Maximum daily volume of brine recirculated back to production tank (m^3/day)
1	1900 to 1925	105.8	130.75	383	135.2	378.0	152,027.0	619.4
2	1949 to 1974	121.4	132.40	383	137.1	378.0	163,561.0	696.7
3	1999 to 2024	129.5	131.37	383	135.5	378.0	154,722.0	747.6

When the brine tank approached operational capacity, excess brine was recirculated to the produced water tank for reprocessing via the RO system, consistent with the modelling assumptions.

To maintain storage volumes within operational limits and prevent overtopping, the following was required:

- Average daily treatment rate of approximately 130 m^3/day
- Maximum daily treatment rate of 383 m^3/day

- Beneficial reuse of permeate:
  - Average: ~136 m³/day
  - Maximum: 378 m³/day

In total, approximately 150,000 to 160,000 m³ of brine was recirculated to the produced water tank throughout the duration of each scenario, with peak daily recirculation rates of up to 745 m³/day.

4.3.2 Model Scenario 2 - two brine tanks

In the two brine tank scenario, modelling again confirmed that no overtopping occurred for any of the storage tanks across all rainfall scenarios. A summary of the results is included in Table 9 with charts of the tank volumes, beneficial reuse and daily volume of treated water included in Appendix 2.

As in Scenario 1, when the brine tanks approached operational capacity, any excess brine was recirculated to the produced water tank for re-treatment. However, the availability of additional brine storage significantly reduced the volume and frequency of required recirculation events.

To maintain operational water levels and avoid overtopping, the following was required:

- Average daily water treatment: ~120 m³/day
- Maximum daily water treatment: 350 m³/day
- Beneficial reuse of permeate:
  - Average: ~124 m³/day
  - Maximum: 335 m³/day
- Brine recirculation volume:
  - Total: ~11,000 to 19,000 m³ across the modelled scenarios
  - Maximum daily rate: up to 628 m³/day

The two-tank configuration provided greater operational flexibility and reduced the dependency on brine recirculation to manage storage levels.

Table 9 - Modelled Scenario 2 - two brine tanks

Scenario	Years	Rainfall maximum daily (mm)	Average daily water treatment (m³/day)	Maximum daily water treatment (m³/day)	Average Daily Beneficial Water use (m³/day)	Maximum Daily beneficial water use (m³/day)	Total volume of brine recirculated back to production tank (m³)	Maximum daily volume of brine recirculated back to production tank (m³/day)
1	1900 to 1925	105.8	118.97	350	123.4	335.0	11,083.2	583.7
2	1949 to 1974	121.4	120	350	124.8	335.0	19,081.7	267.7
3	1999 to 2024	129.5	119.18	350	123.3	335.0	11,229.1	628.6

4.3.3 Model Scenario 3 – 10% increase in produced water flows

A sensitivity scenario was modelled using a 10% increase in produced water inflows, combined with the two-brine tank configuration. The objective was to assess whether the system could maintain operational performance under elevated inflows. A summary of the results is included in Table 10 with charts of the tank volumes, beneficial reuse and daily volume of treated water included in Appendix 2.

The results indicate that no overtopping occurred in any of the storages, even under the increased inflow conditions. The additional brine storage provided sufficient capacity to buffer the system, with recirculation back to the produced water tank used as a contingency measure when required.

To maintain system performance and prevent overtopping, the following was required:

- Average daily treatment rate: ~133 m³/day
- Maximum daily treatment rate: 410 m³/day
- Beneficial reuse (on-site or third-party):
  - Average: ~137 m³/day
  - Maximum: 396 m³/day
- Brine recirculation:
  - Total volume: ~35,000 to 43,000 m³ across the scenarios
  - Peak daily recirculation: up to 640 m³/day

Table 10 - Modelled Scenario 3 - 10% increase in production

Scenario	Years	Rainfall maximum daily (mm)	Average daily water treatment (m³/day)	Maximum daily water treatment (m³/day)	Average Daily Beneficial Water use (m³/day)	Maximum Daily beneficial water use (m³/day)	Total volume of brine recirculated back to production tank (m³)	Maximum daily volume of brine recirculated back to production tank (m³/day)
1	1900 to 1925	105.8	132.83	410	137.3	396.0	35,011.5	595.7
2	1949 to 1974	121.4	133.87	410	138.6	396.0	43,362.3	361.3
3	1999 to 2024	129.5	133.09	410	137.2	396.0	35,235.6	640.6

4.3.4 Model Scenario 4 – Climate change and 10% increase in produced flows.

A sensitivity scenario was modelled using an increase in rainfall intensity in accordance with RCP 8.5 model, the modelling was conservative as it only included increased rainfall and did not account for increased evaporation. The model also assumed a 10% increase in produced water inflows, combined with the two-brine tank configuration. The objective was to assess whether the system could maintain operational performance under elevated rainfall and inflows. A summary of the results is included in Table 11 with charts of the tank volumes, beneficial reuse and daily volume of treated water included in Appendix 2.

The results indicate that no overtopping occurred in any of the storages, even under the increased rainfall and inflow conditions. The additional brine storage provided sufficient capacity to buffer the system, with recirculation back to the produced water tank used as a contingency measure when required.

To maintain system performance and prevent overtopping, the following was required:

- Average daily treatment rate: ~133 m³/day
- Maximum daily treatment rate: 415 m³/day
- Beneficial reuse (on-site or third-party):
  - Average: ~139 m³/day
  - Maximum: 405 m³/day
- Brine recirculation:
  - Total volume: ~39,300 to 48,900 m³ across the scenarios
  - Peak daily recirculation: up to 711 m³/day

Table 11 - Modelled Scenario 4 – Climate change increased rainfall and 10% increase in production

Scenario	Years	Rainfall maximum daily (mm)	Average daily water treatment (m^3/day)	Maximum daily water treatment (m^3/day)	Average Daily Beneficial Water use (m^3/day)	Maximum Daily beneficial water use (m^3/day)	Total volume of brine recirculated back to production tank (m^3)	Maximum daily volume of brine recirculated back to production tank (m^3/day)
1	1900 to 1925	116.38	133.48	415	138.18	405	39,391.6	653.9
2	1949 to 1974	131.49	134.70	415	139.80	405	48,876.9	581.9
3	1999 to 2024	142.45	133.85	415	138.20	405	40,366.4	710.5

4.4 Water balance conclusion

The water balance assessment evaluated the performance of the proposed storage tanks under a range of climatic conditions, including some of the wettest periods recorded in the 125-year historical dataset for the locale. The modelling has demonstrated that the proposed tank sizes, configurations, and adopted freeboard provide sufficient capacity to manage both short-duration intense rainfall events and prolonged multi-day rainfall periods. This confirms the system's robustness and suitability under extreme weather conditions.

5 GCF Site stormwater management

Although the tanks are located above ground, they will be positioned to ensure that, in the unlikely event of a discharge, any flow from the tanks is directed southward into a designated capture basin. This basin provides a controlled location for monitoring and early detection of any unintended releases from the storage system.

To support this objective and minimise the volume of external catchment contributing runoff to the basin, a combination of swales and bunds will be incorporated into the site design. The conceptual layout of the system and location of the capture dam is presented in Figure 9. This layout depicts the 4 ha contributing catchment to the capture dam. The layout is subject to detailed engineering design.

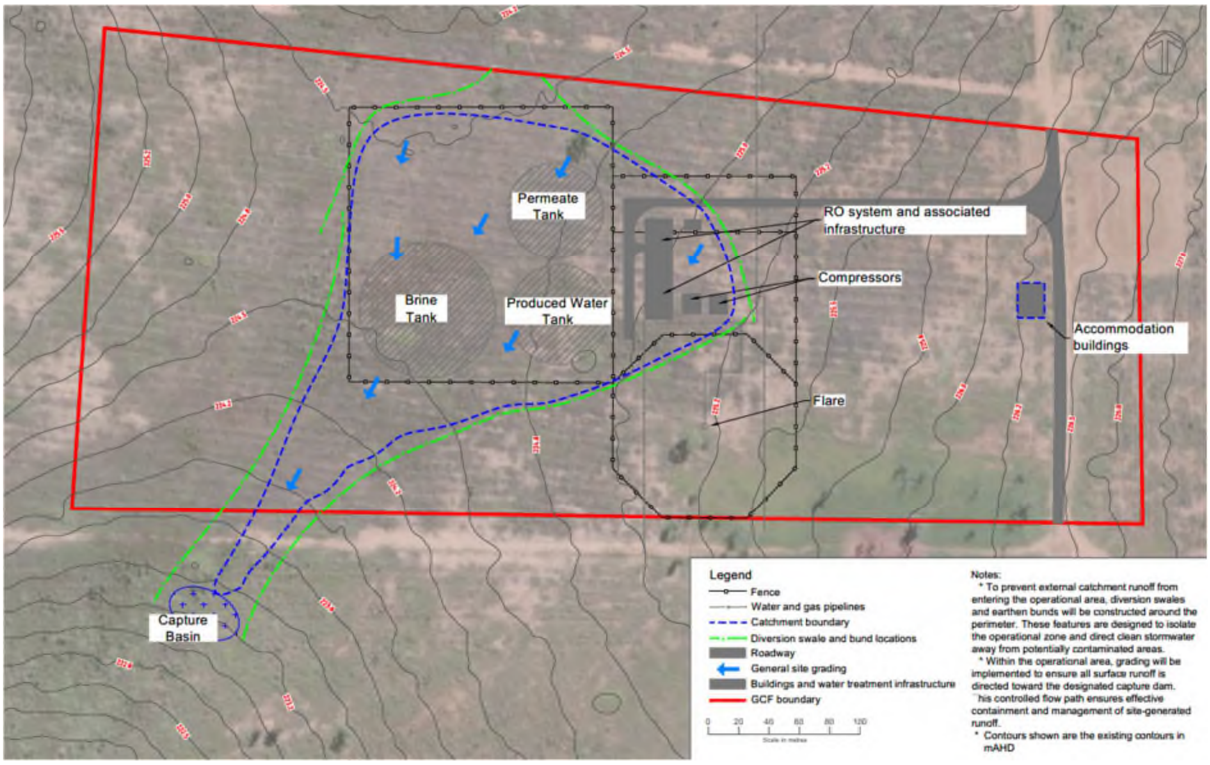


Figure 9 - Conceptual stormwater management layout.

5.1 Initial sizing of proposed capture basin

The capture dam has been sized based on the following design assumptions:

- Upgradient catchment area: ranging from 2.6 to 4.0 hectares.
- Runoff coefficient: 0.495 (to account for clay soils in accordance with Table 4.9.1 of 2017 QUDM).
- Design rainfall: 25 mm over 24 hours, consistent with the proposed water quality monitoring trigger. This threshold captures approximately 95% of daily rainfall events based on the historical 125-year dataset.

Runoff volume = rainfall depth (m) x catchment area (m^3) x runoff coefficient

- 2.6 ha scenario = 0.025 m x 26,000 m^2 x 0.495

  = Runoff volume ~325 m^3

- 4 ha scenario = 0.025 m x 40,000 m^2 x 0.495

  = Runoff volume ~495 m^3

Therefore, the capacity of the capture basin should be between 325 m^3 and 495 m^3. The final design of the dam should include freeboard and additional capacity to account for sediment accumulation.

5.2 MUSICX modelling

To confirm the suitability of the preliminary capture basin sizing, a MUSICX model was developed for the GCF site. The model incorporated the catchment characteristics and hydrological assumptions outlined above to assess whether the initial basin sizing would adequately manage runoff under long-term climatic conditions.

In addition, a separate MUSICX assessment was undertaken for the proposed accommodation buildings to evaluate the reliability of the roof water supply.

5.2.1 Capture Basin MUSICX model setup

The MUSICX model[3] was configured with the following parameters:

- **Catchment areas:**

  Two scenarios were run:

  - A 2.6 ha catchment developed scenario, comprising 2.0 ha of 50% impervious industrial land plus 0.6 ha of 100% pervious agricultural land (see Figure 10).
  - A 4 ha catchment developed scenario, comprising 1.7 ha of 100% pervious agricultural land and 2.3 ha of industrial land assumed to be 50% pervious, representing the RO plant, above-ground tanks, access roads, and surrounding infrastructure.

  These catchment splits are conservative with respect to post-development runoff, as the model setup assumes that runoff is generated from the tank footprints. However, as the site water balance notes, no overflow occurs from the tanks under the modelled conditions.

- **Temporal Resolution:**
  The model was run on a daily timestep.

- **Climatic Data:**
  Historical daily rainfall and evaporation data were sourced from the Long Paddock dataset for the period 1900 to 2024.

[3] Node setup as per MUSICX Version 1.50.0.13877 defaults for rainfall runoff and pollutant generation defaults.

- **Outlet Structure:**
  - The capture basin incorporates a piped outlet, designed to discharge the captured runoff over a 24-hour drain-down period following rainfall events. A 2.0 m wide overflow weir was included to manage discharge during larger rainfall events.
- **Basin Drainage and Losses:**
  The capture dam is configured to fully drain between events, with the following assumptions:
  - A seepage rate of 0.0 mm/hr
  - An evaporation coefficient of 0.7

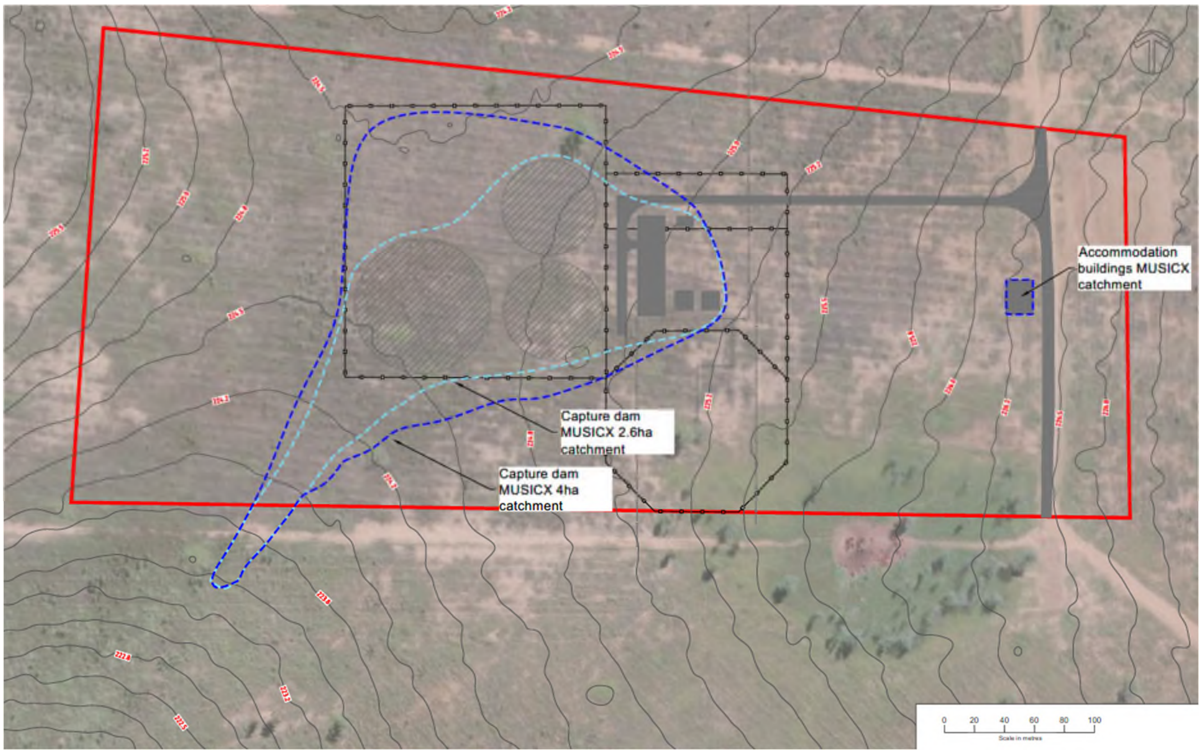


Figure 10 - MUSIC X catchment boundaries

5.2.2 Capture basin MUSIC X model results

The model was run over a 125-year historical climate sequence to assess long-term capture basin performance under a range of rainfall conditions, including dry and wet cycles. The model results are summarised in Table 11.

Table 12 - Capture basin MUSICX Water balance results 1900 to 2024

Parameter	Scenario 2.6 ha contributing catchment	Scenario 4 ha contributing catchment
Basin volume (m^3)	325	495
Flow into basin (ML/yr)	24.76	30.80
ET loss (ML/yr)	0.57	0.87
Seepage (ML/yr)	0.00	0.00
Pipe outlet (ML/yr)	24.19	29.94
Weir overflow (ML/yr)	0.00	0.00

Key outputs from the MUSIC modelling included the frequency and volume of discharge, the volume captured and retained, and the extent of any dam overtopping. The MUSIC simulation results confirmed that the initially sized dams (for both scenarios) are sufficient to capture and retain runoff from rainfall events over the modelled period (1900 to 2024), with no weir overflow and only controlled discharge via the piped outlet structure.

5.2.3 MUSIC X accommodation buildings modelling

In addition to the capture basin modelling, the reliability of roof water supply for the accommodation buildings was assessed using the MUSIC X model. The MUSICX model[4] was configured with the following parameters:

- **Catchment area:**
  - Post-development: 192 $m^2$of 80% pervious urban land (elevated deck, footpaths, parking etc and 108 m^2 of urban roof area assumed to be 0% pervious, representing the roof area of the accommodation (assuming three x 12m x 3m building).
- **Temporal Resolution:**
  The model was run on a daily timestep.
- **Climatic Data:**
  Historical daily rainfall and evaporation data were sourced from the Long Paddock dataset for the period 1900 to 2024.
  - **Rainwater tanks:**
    It was assumed that all roof water from the accommodation buildings would be directed to rainwater tanks to be used for use in the buildings. It was assumed that the 3 x 22,500 LL tanks are to be installed. With an average reuse of 900L/day (based on 200L/person and 4 people and landscape irrigation).

5.2.4 Accommodation buildings MUSIC X model results

The results of the 125-year modelling run for the accommodation buildings with rainwater tanks are shown in Table 13.

Table 13 - Accommodation area MUSICX Water supply 1900 to 2024

Parameter	Accommodation buildings
Tank volume (m^3)	68
Flow into tanks (ML/yr)	0.344
ET loss (ML/yr)	0.000
Reuse supplied (ML/yr)	0.323
Reuse requested (ML/yr)	0.329
Pipe outlet (ML/yr)	0.021

Results from the MUSIC simulation confirm the three x 22,500L tanks will be able to meet 98% of the required water use demand assuming 900L/day use.

[4] Node setup as per MUSICX Version 1.50.0.13877 defaults for rainfall runoff and pollutant generation defaults.

6 Site stormwater design measures and management contingencies

6.1 Management measures

To ensure effective protection of downstream water quality and compliance with relevant environmental standards throughout the lifecycle of the Mahalo North Gas Compression Facility (GCF), the following stormwater and water management measures are proposed for both the construction and operational phases. It is noted that the measures are subject to further detailed specification once approval is gained and detailed site layout and engineering completed. These measures have been informed by hydrological modelling, MUSICX simulations, the site-specific water balance, and the requirements of the Environmental Protection Act 1994 (Qld).

6.1.1 GCF Construction Phase management measures

During construction, the primary objectives are to manage erosion, minimise sediment export, and prevent discharge of contaminated runoff. Table 14 summarises the key management actions.

Table 14 - Construction Phase Stormwater and Erosion Controls

Measure	Description
Erosion and Sediment Control Plan (ESCP)	A site-specific ESCP will be implemented in accordance with the IECA (Best Practice Erosion and Sediment Control Guidelines, 2008).
Sediment fencing and check dams	Installed downslope of disturbed areas to trap sediment and reduce turbidity. Maintained regularly.
Diversion bunds/swales	Constructed to direct clean upstream runoff away from disturbed construction zones.
Sediment basin	The proposed operational phase capture basin is to be constructed at the commencement of earthworks so that it can be used as a sediment basin during the proposed earthworks within the GCF area.
Stabilised access points	Gravel pads and rumble grids at entry points to prevent soil tracking onto access roads.
Progressive stabilisation	Exposed surfaces to be stabilised as soon as practical using mulch, temporary grassing, or geotextiles.
Weather-based controls	Earthworks paused during high rainfall periods; erosion controls checked before and after storm events.
Surface water monitoring	Surface water monitoring is to be undertaken during the construction phase to ensure that discharge from the sediment basin and the GCF meets the established construction phase discharge criteria

Measure	Description
Dewatering management	Any water pumped from excavations to be filtered prior to discharge; no release of turbid or oily water permitted.
Spill containment	Spill kits located near plant and fuel storage; any spills cleaned and reported immediately.

6.1.2 GCF Operational Phase Management Measures and Contingency

The stormwater capture basin has been sized to accommodate runoff generated from 25mm in 24-hour rainfall event, based on a contributing catchment area ranging from 2.6ha to 4ha and a runoff coefficient of 0.495. This sizing was validated using long-term MUSICX simulations (1900–2024), which confirmed the basin's ability to retain and slowly discharge stormwater without overtopping under all historical rainfall scenarios.

The above-ground tanks (produced water, permeate, and brine) were designed to store peak projected volumes with a 0.3 m freeboard. Modelling confirmed that the tank system, in both single and dual brine tank configurations, remains within operational limits without overflow, even under prolonged rainfall and elevated inflow conditions.

The accommodation buildings were also assessed separately using MUSICX modelling. A conservative approach was taken, assuming a combination of pervious and impervious areas associated with building roofs, decks, and hardstand. All roof runoff is directed to three 22,500 L rainwater tanks. The model demonstrated that 98% of water demand could be met on-site.

These design considerations ensure the stormwater management system capable of withstanding both current and future operating conditions. The additional operational methods and controls proposed are summarised in Table 15.

Table 15 - Operational Phase Stormwater and Site Management Measures and contingency

Measure	Description
Stormwater runoff management and monitoring	
Site grading	The operational phase has site grading and bunds and swales to ensure that all runoff from the tanks and RO plant and associated infrastructure would be directed to a capture basin.
Clean/dirty water separation	Bunds and swales direct uncontaminated runoff away from operational zones and contaminated runoff toward the basin.
Capture basin and piped outlet	The basin is designed for runoff from the GCF for rainfall events up to a 25mm in 24 hours, consistent with the proposed water quality monitoring trigger. This threshold captures approximately 95% of daily rainfall events based on the historical 125-year dataset. Runoff is discharged via an outlet pipe over 24 hours.
Stormwater isolation valve	The piped outlet from the capture basin would have a valve to enable water to be held within the basin for treatment or redirection (e.g. to tanks for treatment using RO plant) in the case of a contaminated discharge event.

Surface water monitoring	Routine and event-based water quality monitoring of the capture basin and downstream receiving environment allow for identification of any impacts on the water quality as a result of operations. In the event of impacted water quality identified within the basin, the outlet can be shut-off to facilitate treatment or redirection.
Overflow weir	A 2 m wide weir allows safe discharge during extreme events. Modelling indicates no overtopping occurred over the 125-year simulation.
Tank management	
Containment Tanks	The tanks (produced water, permeate and brine) are above ground tanks which prevent surface runoff from entering the tanks. The tanks have been sized to allow for extreme weather events with the incorporation of 300mm freeboard.
Tank level monitoring and alarms	Tanks equipped with SCADA-linked level sensors and alarms to enable rapid response. The alarms would be set with multiple levels (i.e. 1m to overtopping 0.5m to overtopping and maximum operational level being 0.3m till overtopping) to ensure that personnel are aware as the levels within the tanks are reaching capacity.
Recirculation between tanks	The system includes capability for recirculating excess water between the produced water and brine tanks to prevent overtopping. Modelling confirmed this approach effectively maintains operational levels even during peak inflows and prolonged rainfall.
Secondary containment for tanks	All tanks are to have two liners (primary and secondary) with interstitial leak detection. Minimum 0.3 m freeboard is maintained.
Tank Contingency	
Stop production of product water	Production processes can be paused during high rainfall events or when tank storage capacity is nearing its limit. This safeguard prevents excess inflow to the water management system and reduces the risk of containment system exceedance. Production restart is only permitted once sufficient storage capacity is restored.
Offsite tankering	In the unlikely event that onsite containment is exceeded, tankering of excess water offsite is available as a contingency.
Additional tanks	In the event that produced flows are greater than the anticipated rate additional tanks can be constructed to assist in water management.
Infrastructure monitoring and maintenance	
Monitoring and inspection	Routine inspection of basin, tanks, bunds, and swales. Post-rainfall inspections mandatory.
Maintenance program	Regular removal of sediment from basin, upkeep of vegetated swales, and service of outlets and valves.

A detailed Stormwater and Water Management Plan will be prepared following approval and prior to the commencement of construction. This plan will clearly specify responsibilities for implementation, monitoring, maintenance, and reporting, including:

- Who is responsible for each management action.
- The frequency and method of monitoring.
- The actual triggers for alarms and similar controls.
- Corrective actions in response to exceedances or equipment failures.
- Recordkeeping and reporting procedures.

7 Potential impacts of the project on the natural stormwater flow paths outside of the GCF

Temporary roadways will be constructed to facilitate well drilling. Upon completion of drilling and establishment of the wells, it is understood that these temporary roads will be removed, with the natural ground level reinstated and the area rehabilitated (i.e. re-vegetated). Provided the original landform is satisfactorily re-established, the natural flow paths and surface hydrology will not be permanently altered. However, during the short period when the temporary roadway is in place, localised changes to surface flow patterns may occur due to disturbance of the existing topography.

Additionally, it is understood that gathering lines will be installed sub-surface and therefore are not expected to impact the site's natural flow regime, provided trenches are backfilled and rehabilitated to match pre-disturbance conditions.

It is noted that in the vicinity of the tanks (within the Gas Compression Area), shallow rock may limit trenching depth, potentially affecting burial of pipelines. However, this area is already addressed within the site's conceptual stormwater layout and proposed capture system, which has been designed to manage flows from disturbed and hardstand surfaces.

8 Conclusions

The stormwater and water balance assessment for the Mahalo North GCF demonstrates that the proposed system can accommodate a range of climatic conditions including extreme and prolonged rainfall events.

Key outcomes and considerations include:

- **Detailed daily timestep scenario modelling**:
  - Daily timestep modelling assessed performance across three distinct 25-year periods, including the wettest in the 125-year historical record.
  - The system successfully managed both short-duration (e.g. 129 mm in a day) and extended rainfall events (up to 428 mm over 10 days) without overtopping.
- **Storage design**:
  - The proposed tanks, with an additional 0.3 m freeboard, offer 2 to 3 days of buffer during a 1% AEP event.
  - All modelling scenarios - including increased inflow conditions and climate change - confirmed that no overtopping occurred under any condition.
  - The addition of a second brine storage reduced brine recirculation volume by over 90% in rainfall events when compared to the single tank configuration.
  - The system design includes the capacity for inter-tank recirculation, enabling redistribution of water between produced water and brine tanks as a contingency measure.
- **Climate change and 10% increased inflow scenario**:
  - A sensitivity scenario incorporating higher rainfall (climate change RCP 8.5) and 10% higher produced water inflows confirmed that the system still operated within design limits.
- **Proposed stormwater capture dam:**
  - The site layout and stormwater management design incorporate multiple layers of protection to prevent uncontrolled discharge. In the unlikely event of overtopping, all tanks (produced water, permeate, brine) are positioned to direct flows toward a capture basin.
  - The basin is designed for runoff from the GCF for rainfall events up to 25 mm in 24 hours, consistent with the proposed water quality monitoring trigger. This threshold captures approximately 95% of daily rainfall events based on the historical 125-year dataset. Runoff is discharged via an outlet pipe over 24 hours.
  - This basin provides a controlled point for monitoring and containment. To further minimise risk, swales and bunds are incorporated into the site design to reduce external catchment inflow and manage on-site runoff effectively.

- The piped outlet from the capture basin would have a valve to enable water to be held within the basin for treatment or redirection (e.g. to tanks for treatment using RO plant) in the case of a contaminated discharge event.

- **Accommodation water balance:**
  - Roof runoff from accommodation buildings is captured in three 22,500 L rainwater tanks, with modelling showing 98% of daily demand met via on-site supply.

- **Additional contingency measures:**
  - The water balance modelling confirms that the system has sufficient capacity during rainfall events to allow for inter-tank water transfer. While this was effective in preventing overtopping in all scenarios, additional contingency options (such as offsite tankering) remain available if required.
  - SCADA-linked level alarms are to be installed at multiple warning thresholds (1.0 m, 0.5 m, and 0.3 m below overflow) to provide sufficient time for response actions.
  - Production processes can be paused during high rainfall events or when tank storage capacity is nearing its limit. This safeguard prevents excess inflow to the water management system and reduces the risk of containment system exceedance. Production restart is only permitted once sufficient storage capacity is restored.
  - The modular system design allows for the construction of additional tanks if produced water volumes exceed design estimates.
  - A detailed Stormwater and Water Management Plan (SWMP) including standard operating procedures will be prepared prior to construction to guide implementation following the detailed design, monitoring, maintenance, and emergency response procedures.

Overall, the assessment confirms that the system has been conservatively designed and will remain effective under a wide range of climatic and operational conditions.

9 Appendices

10 Appendix 1 - IFD

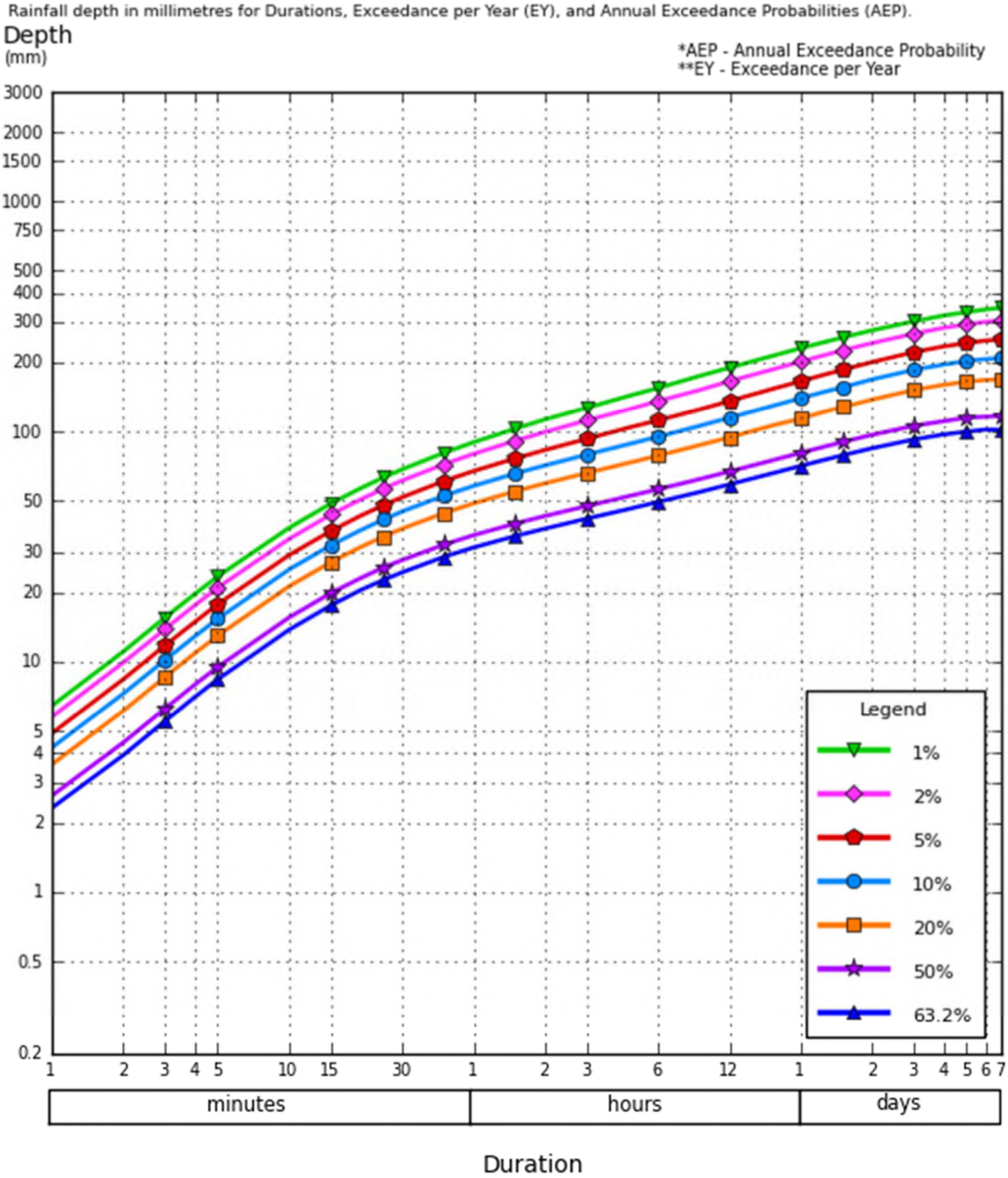
Label:Comet Ridge

Requested coordinate Latitude: -24.0500 Longitude: 148.6000
Nearest grid cell Latitude: 24.0375 (S) Longitude: 148.6125 (E)

IFD Design Rainfall Depth (mm)

Issued: 09 June 2025

Rainfall depth in millimetres for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).

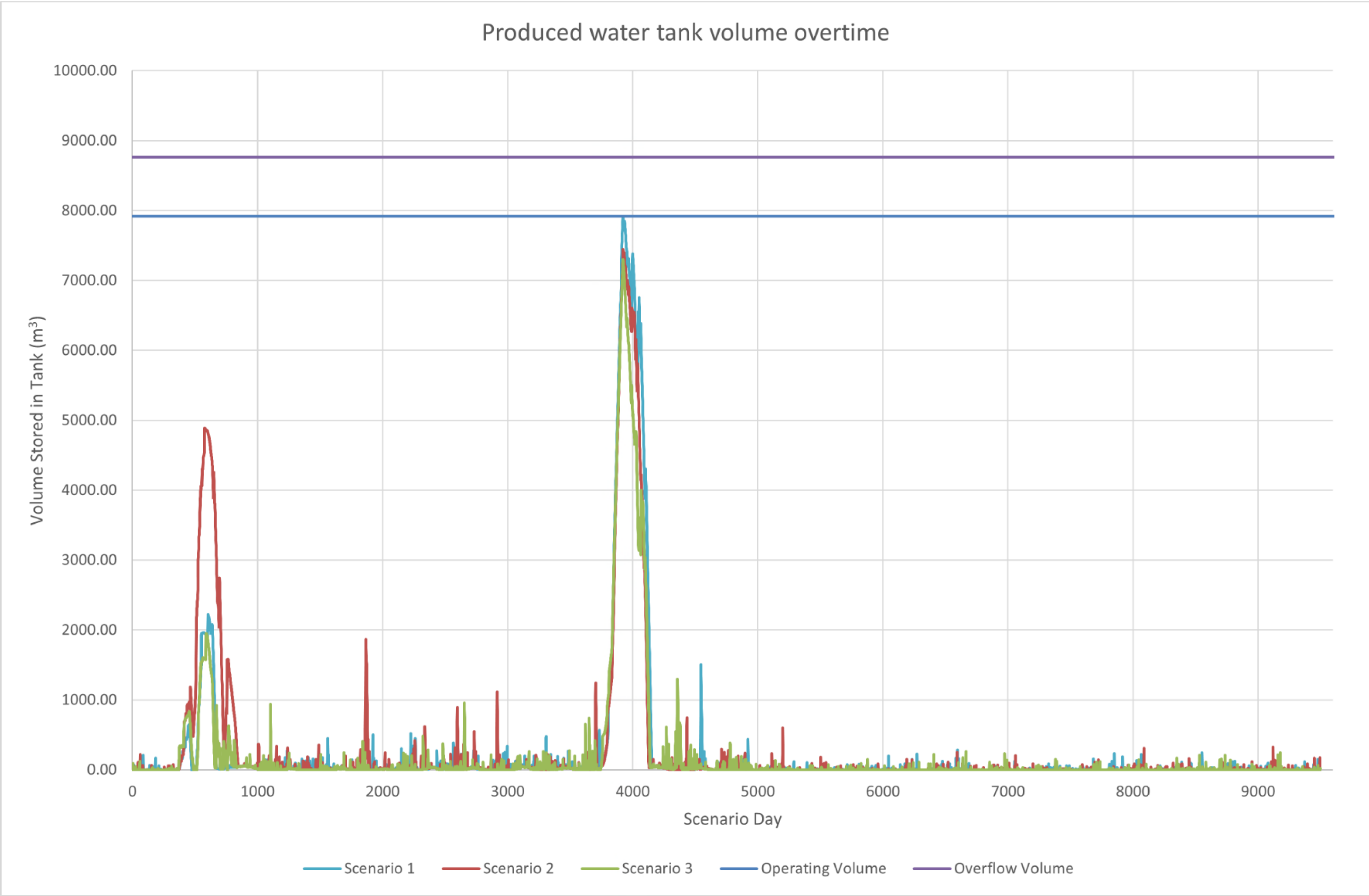


11 Appendix 2 – Water balance modelling results

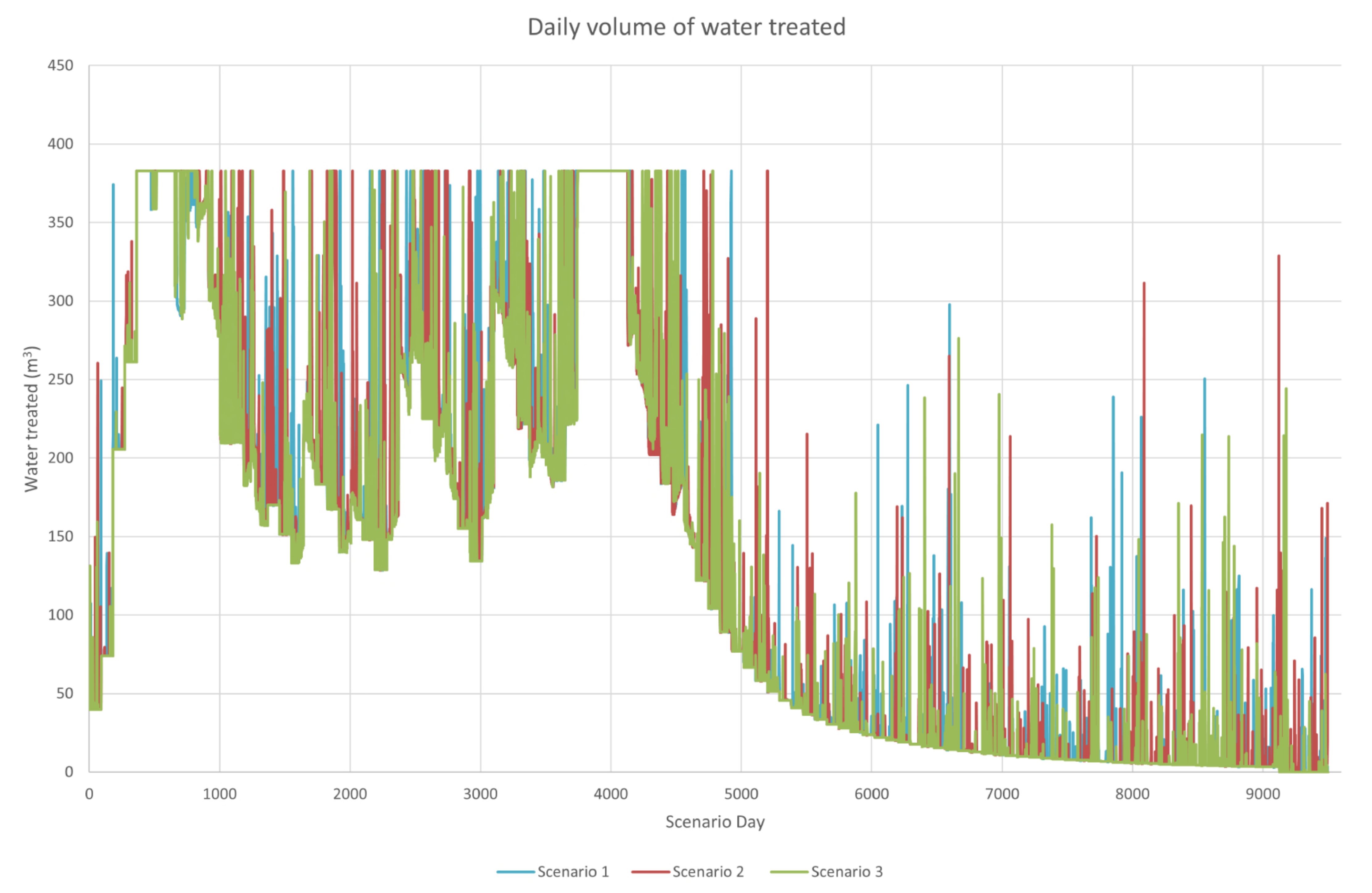
Daily Evaporation statistics

Statistic	Daily Evaporation 1900 to 2024 (mm)
Minimum	0.1
25th Percentile	3.8
Median	2.9
Average	5.7
75th percentile	7.4
85th percentile	7.8
95th percentile	8.6
Maximum	16.4

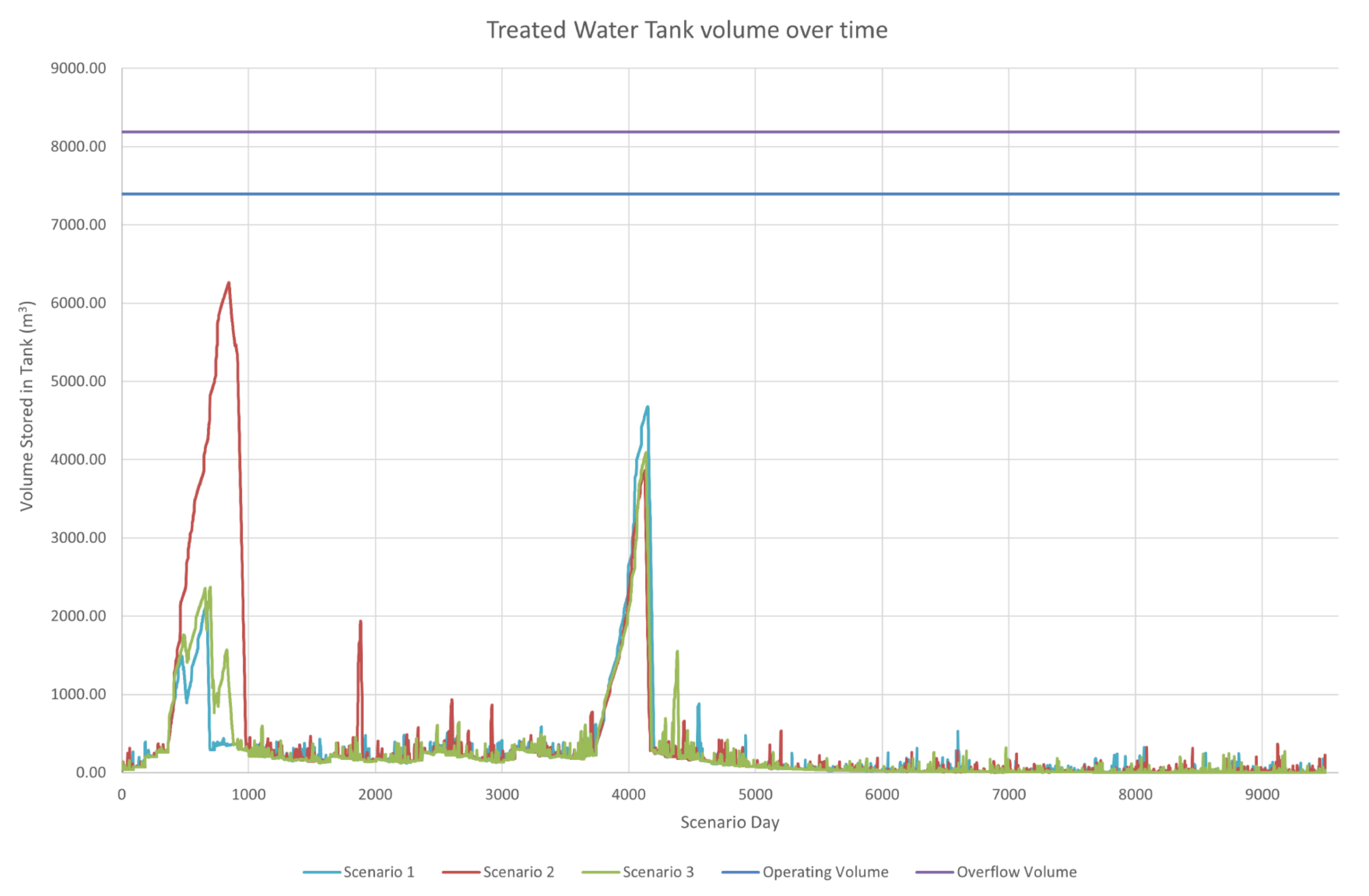
Model Scenario 1 – one brine tank



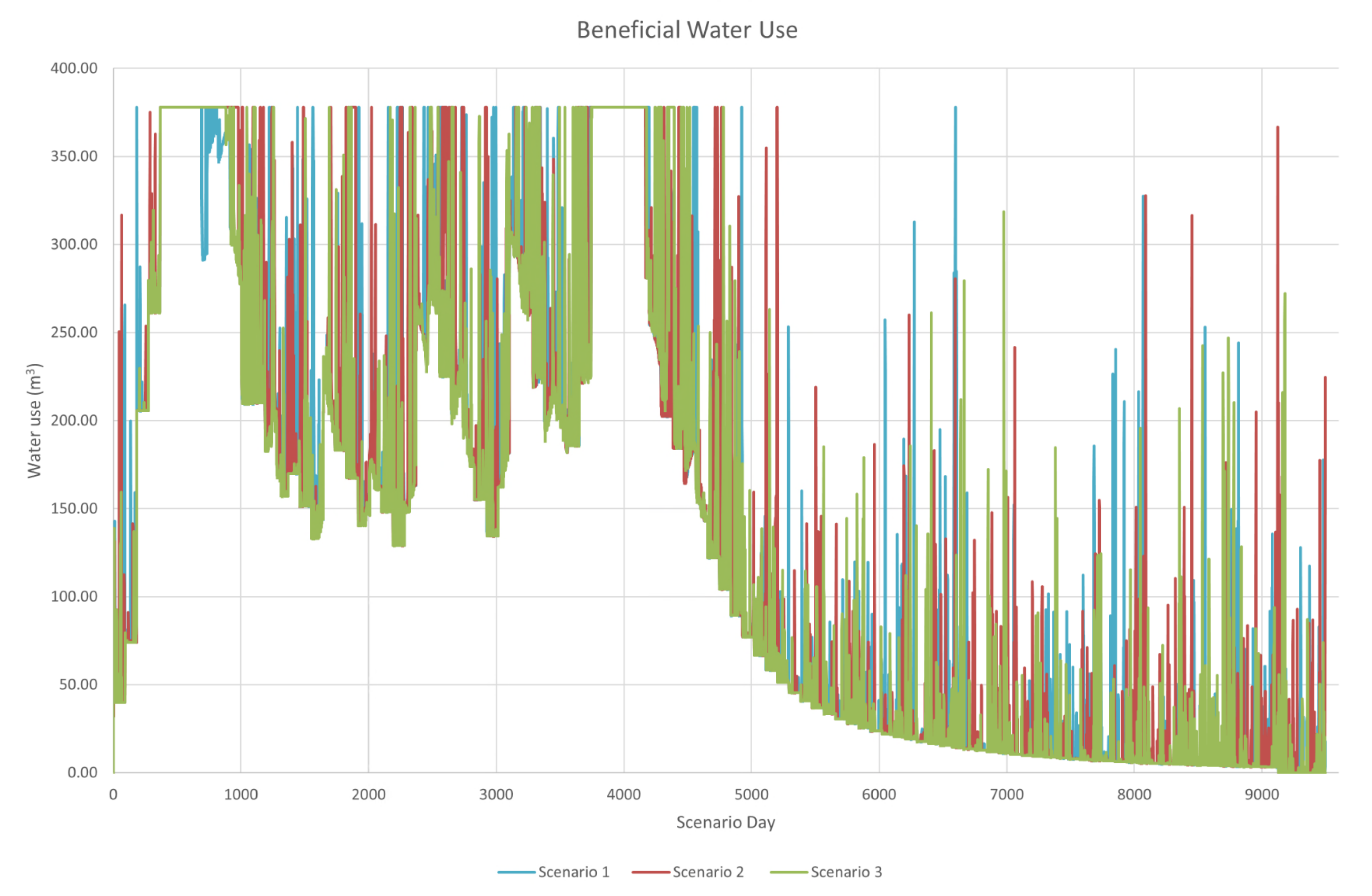
Produced water tank volume overtime
Volume Stored in Tank (m3)
10000.00
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume



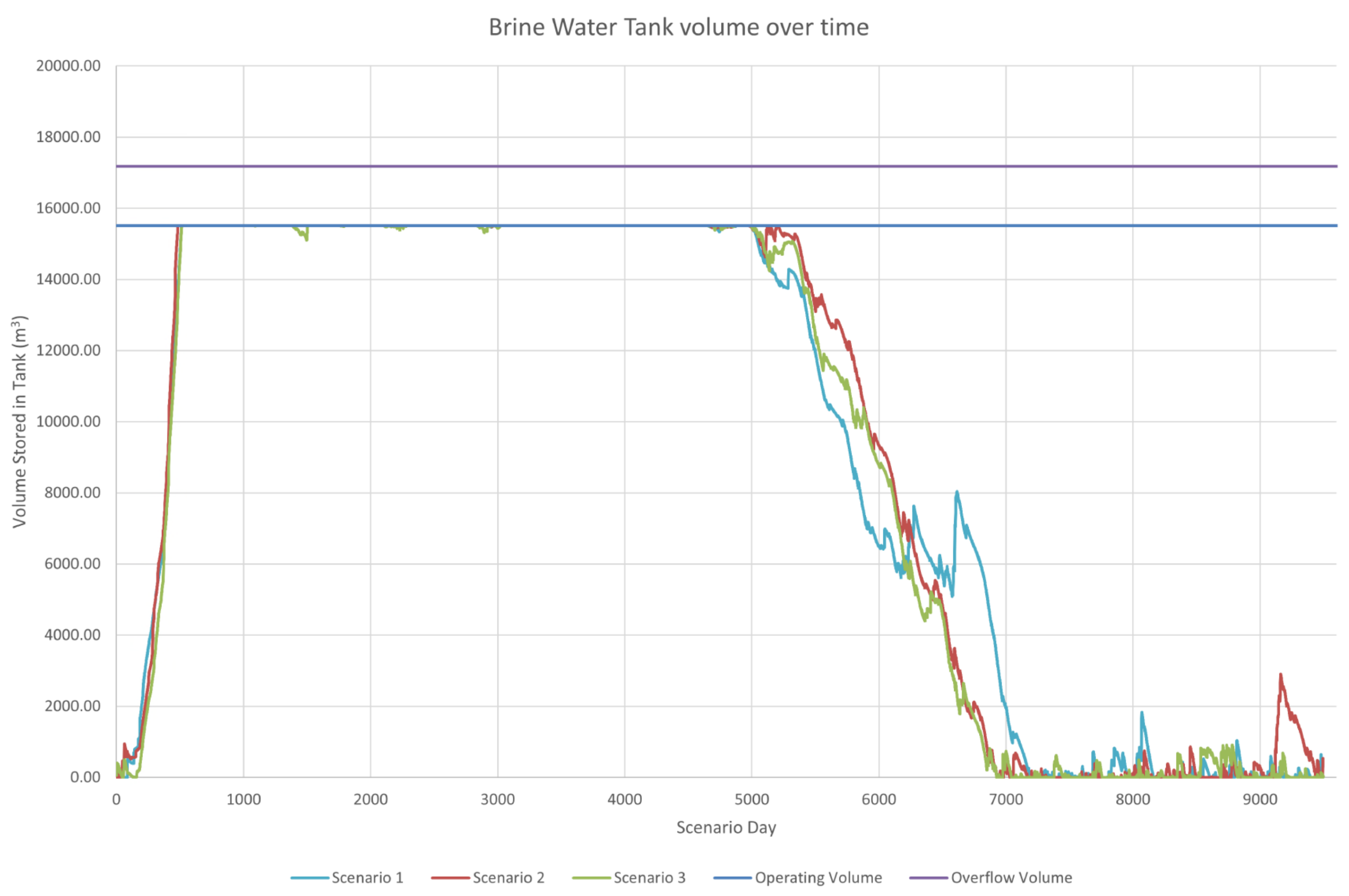
Daily volume of water treated
Water treated (m3)
450
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3



Treated Water Tank volume over time
Volume Stored in Tank (m3)
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume

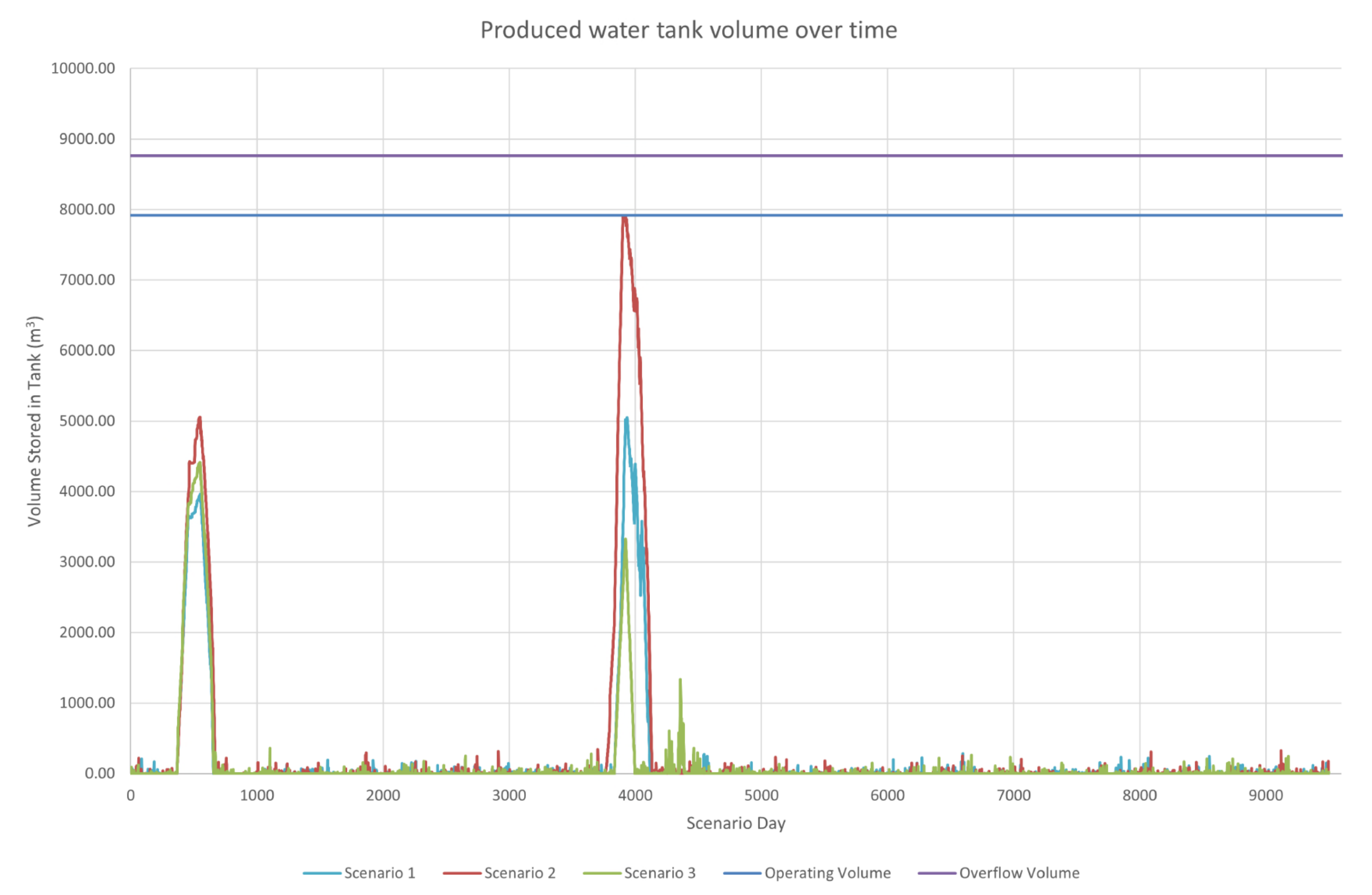


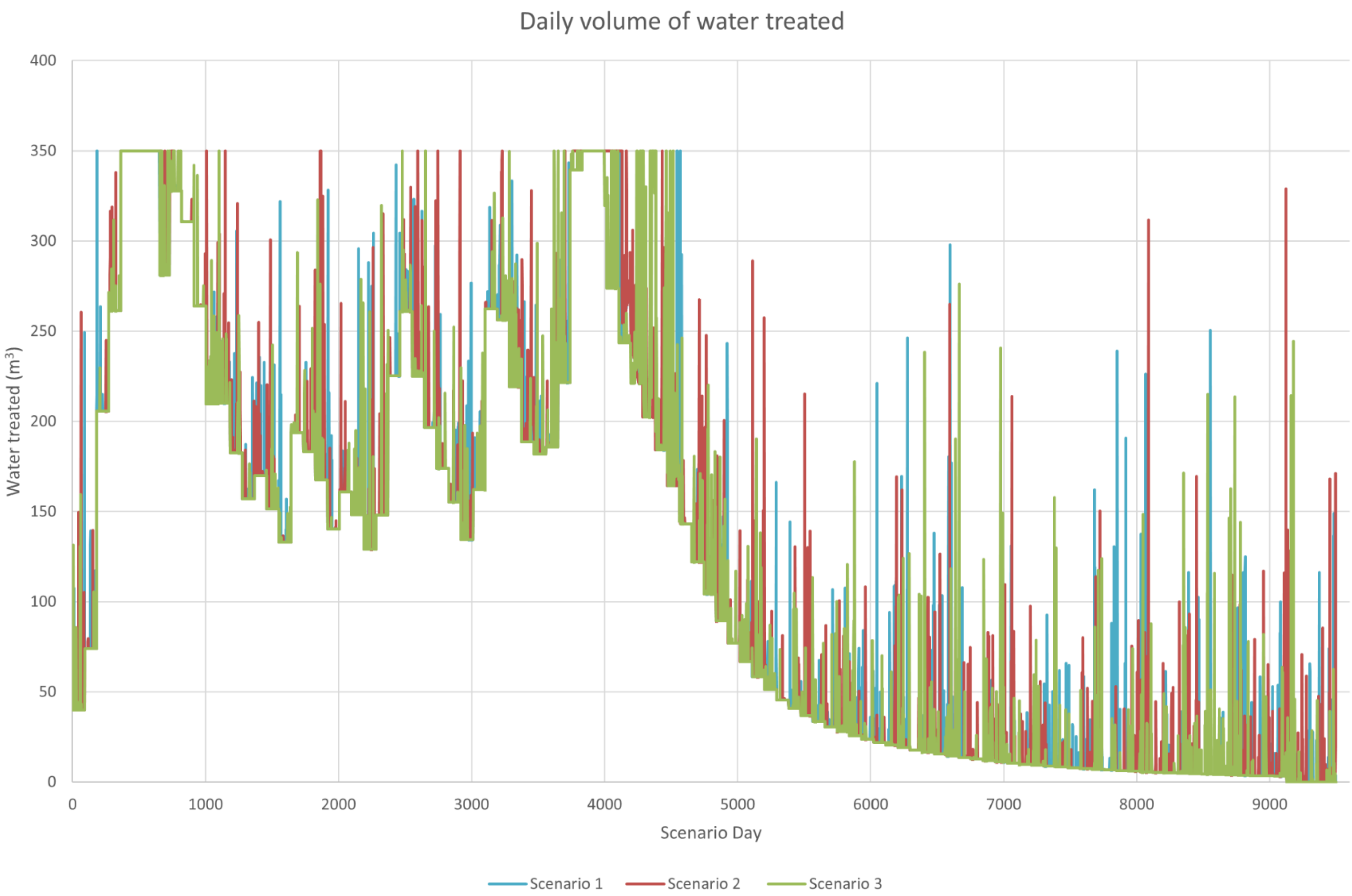
Beneficial Water Use
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Water use (m3)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3

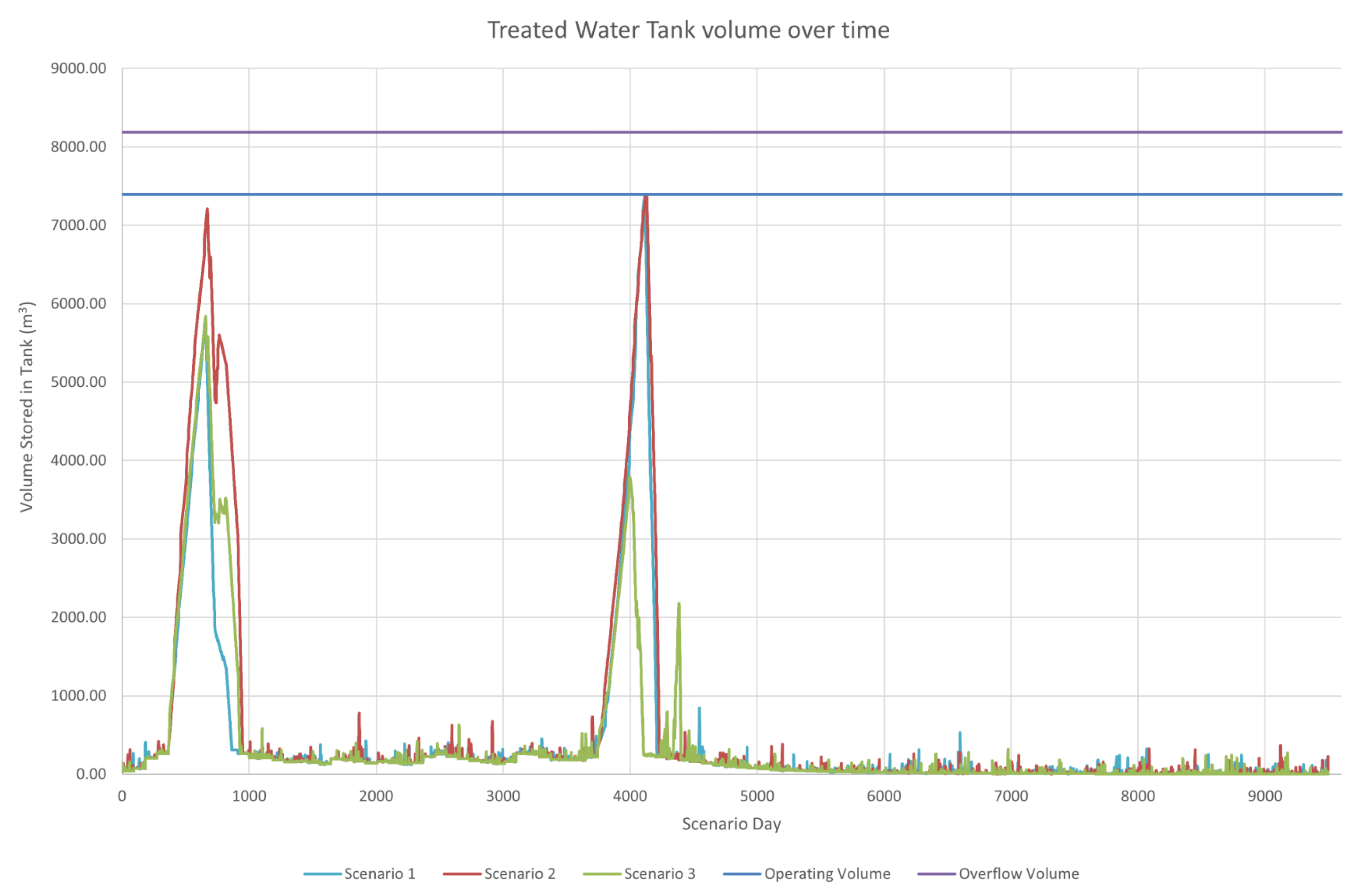


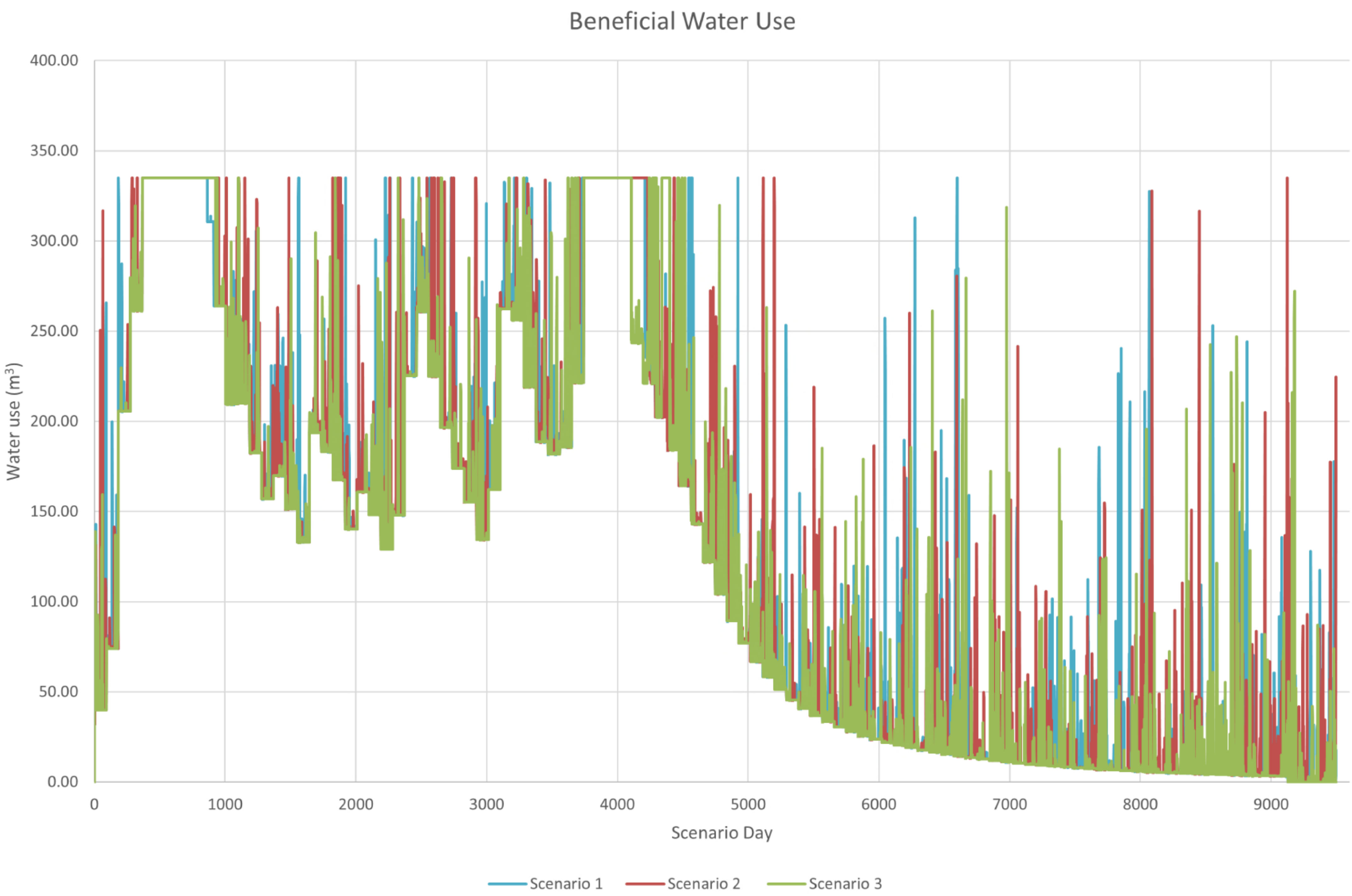
Brine Water Tank volume over time
Volume Stored in Tank (m3)
20000.00
18000.00
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume

Model Scenario 2 – two brine tanks

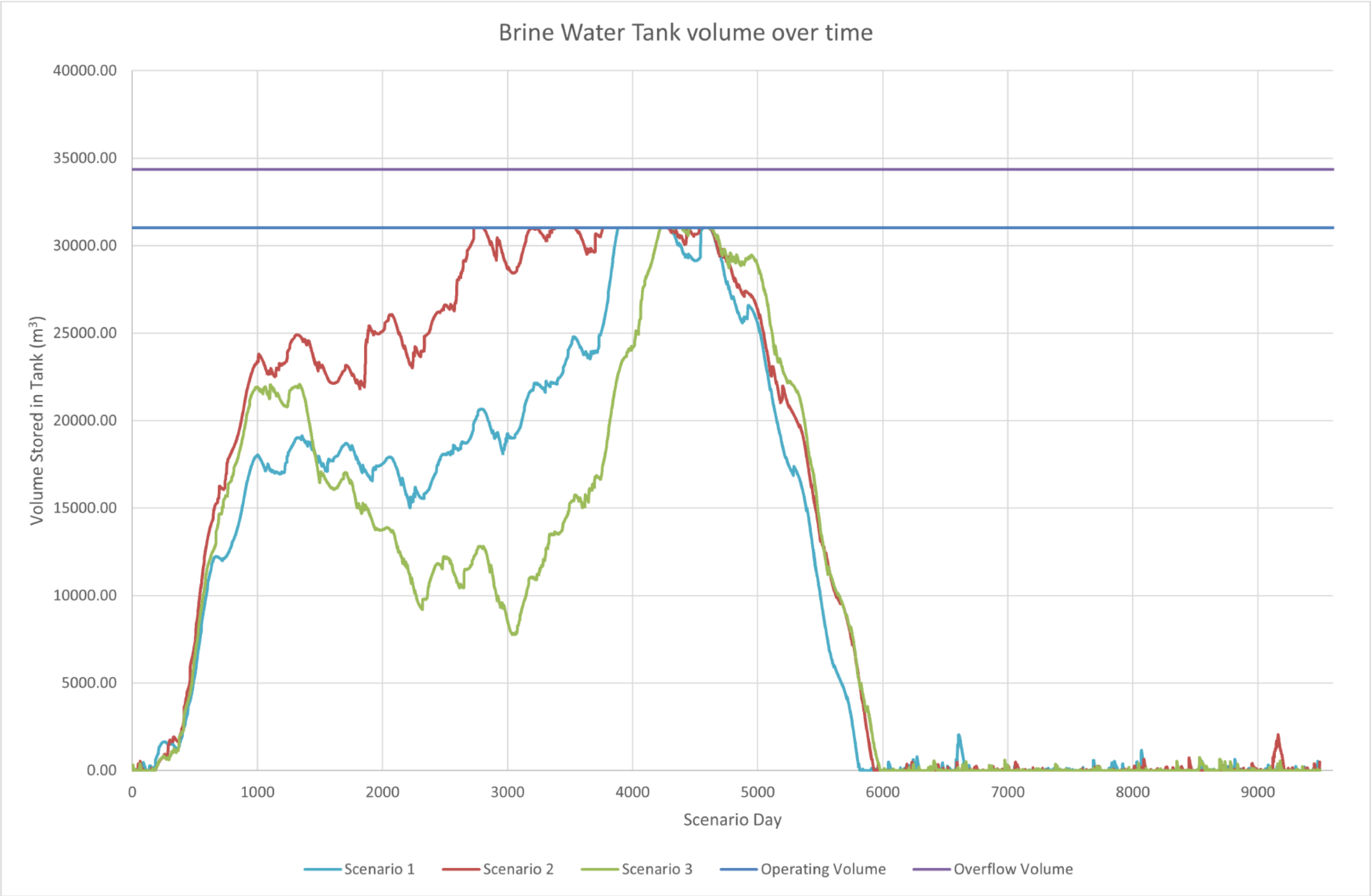

Produced water tank volume over time
Volume Stored in Tank (m³)
10000.00
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume


Daily volume of water treated
Water treated (m3)
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3


Treated Water Tank volume over time
Volume Stored in Tank (m3)
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume

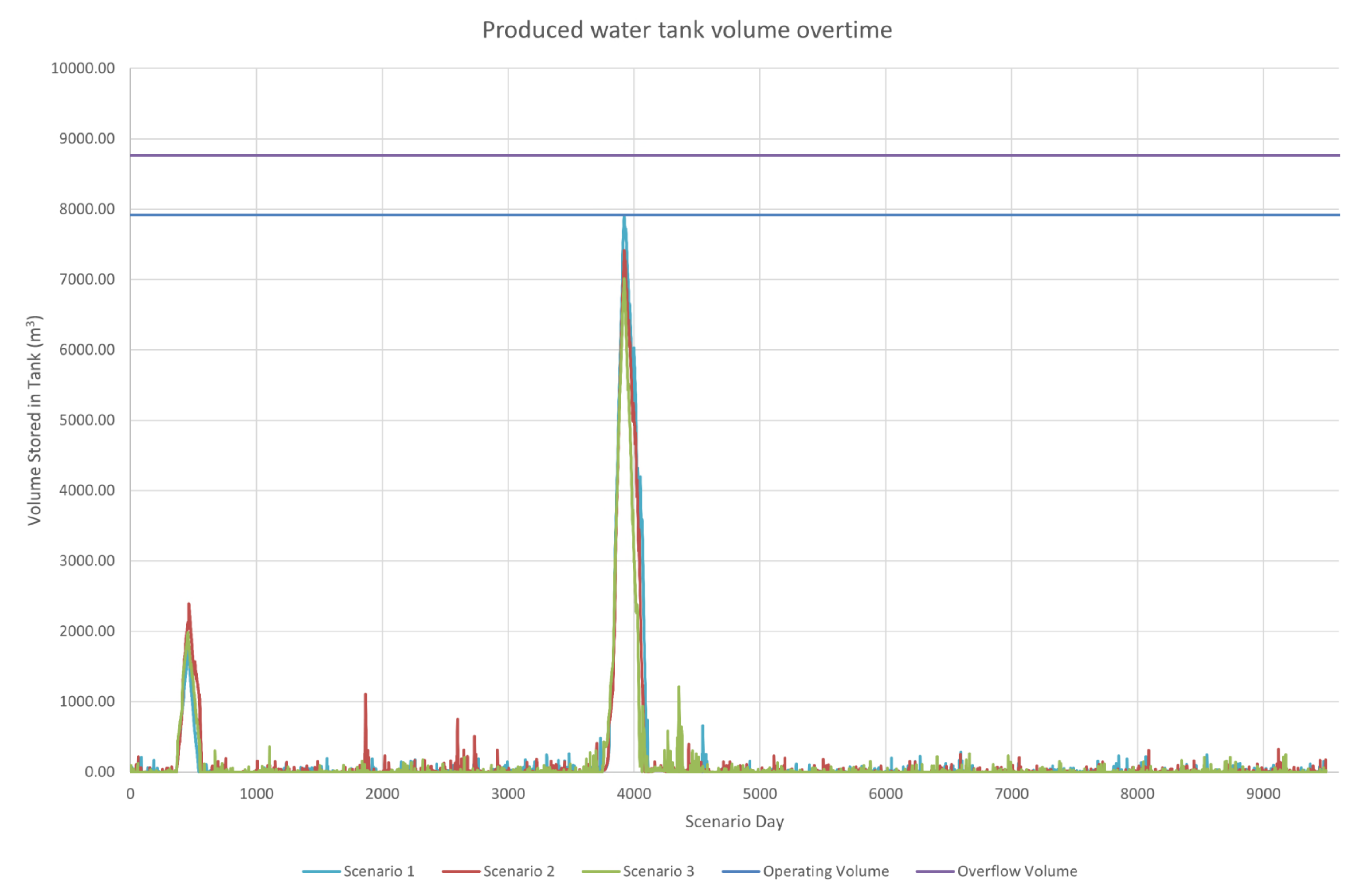


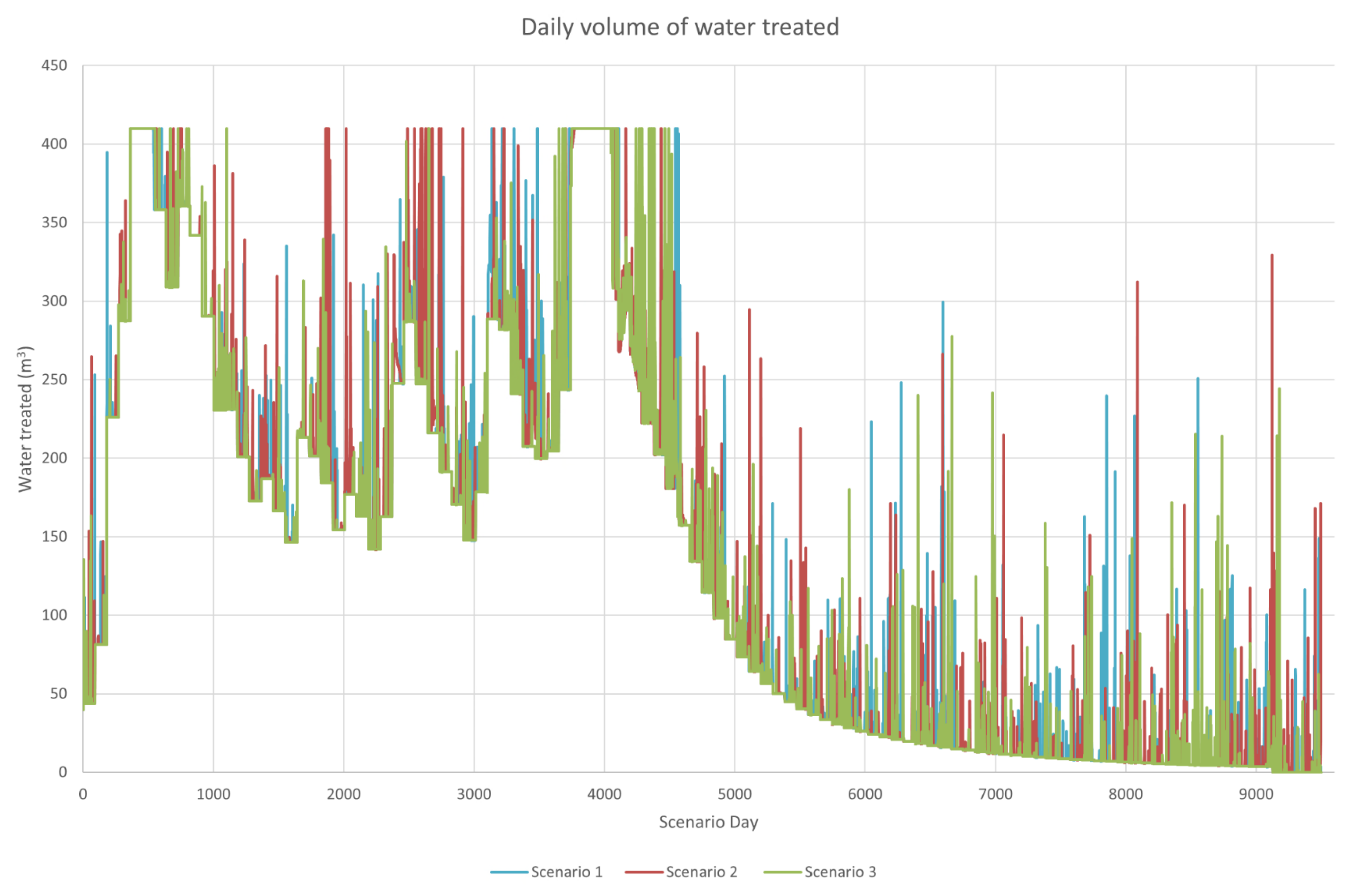
Beneficial Water Use
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Water use (m^3)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3

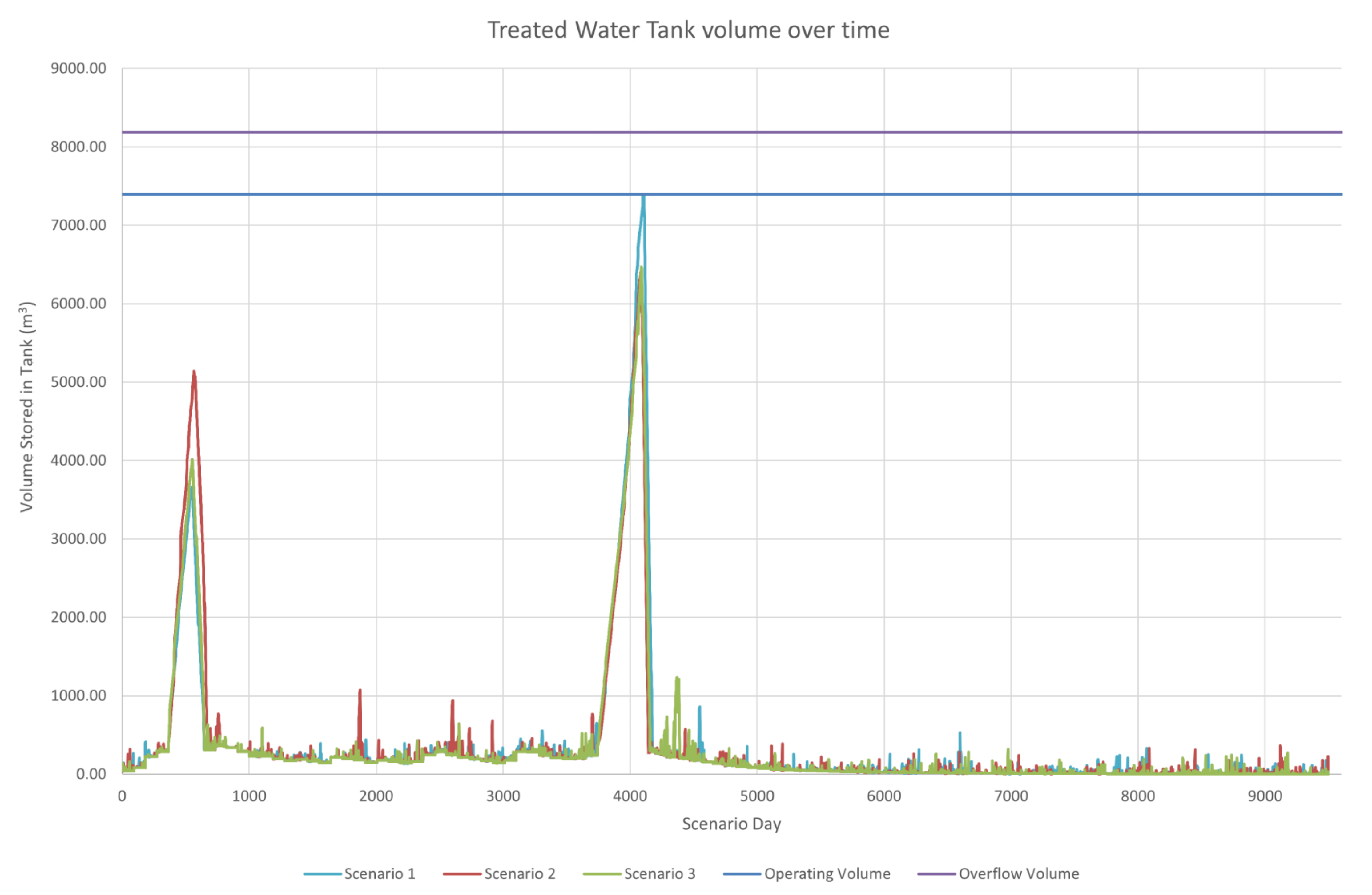


Brine Water Tank volume over time
Volume Stored in Tank (m3)
40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume

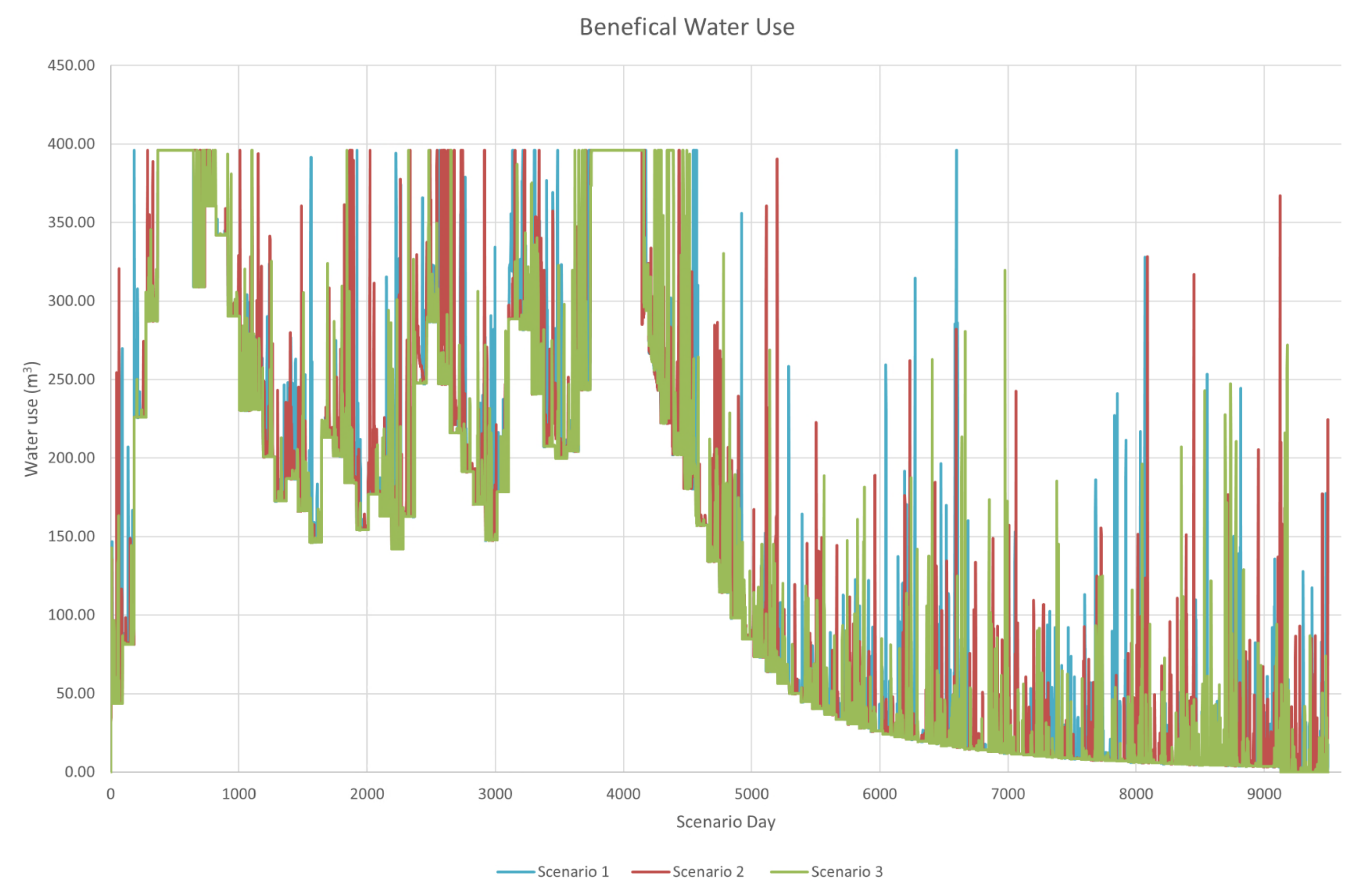
Model Scenario 3 – 10% increase in production flows

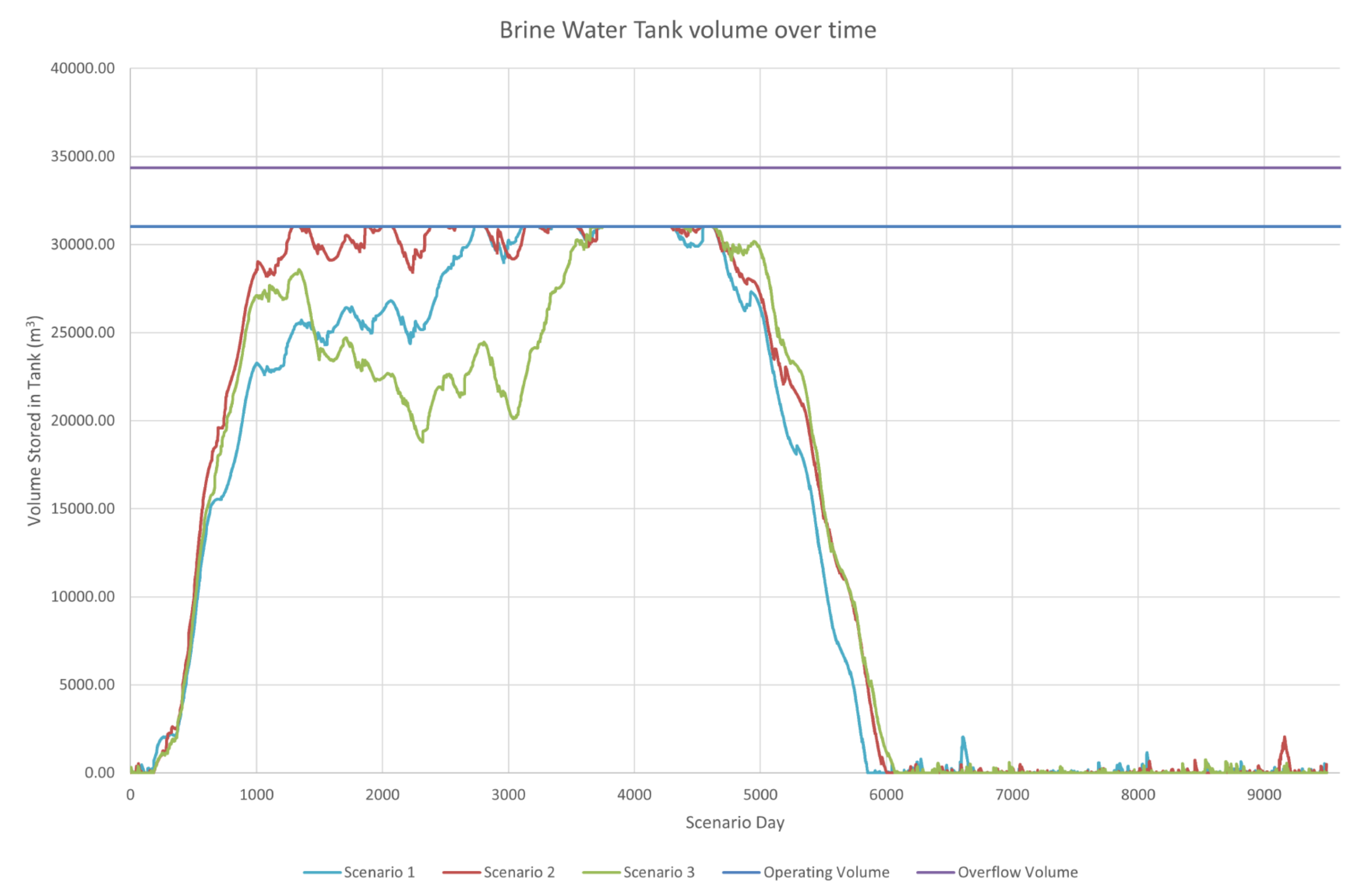

Produced water tank volume overtime
Volume Stored in Tank (m3)
10000.00
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume


Daily volume of water treated
Water treated (m3)
450
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3



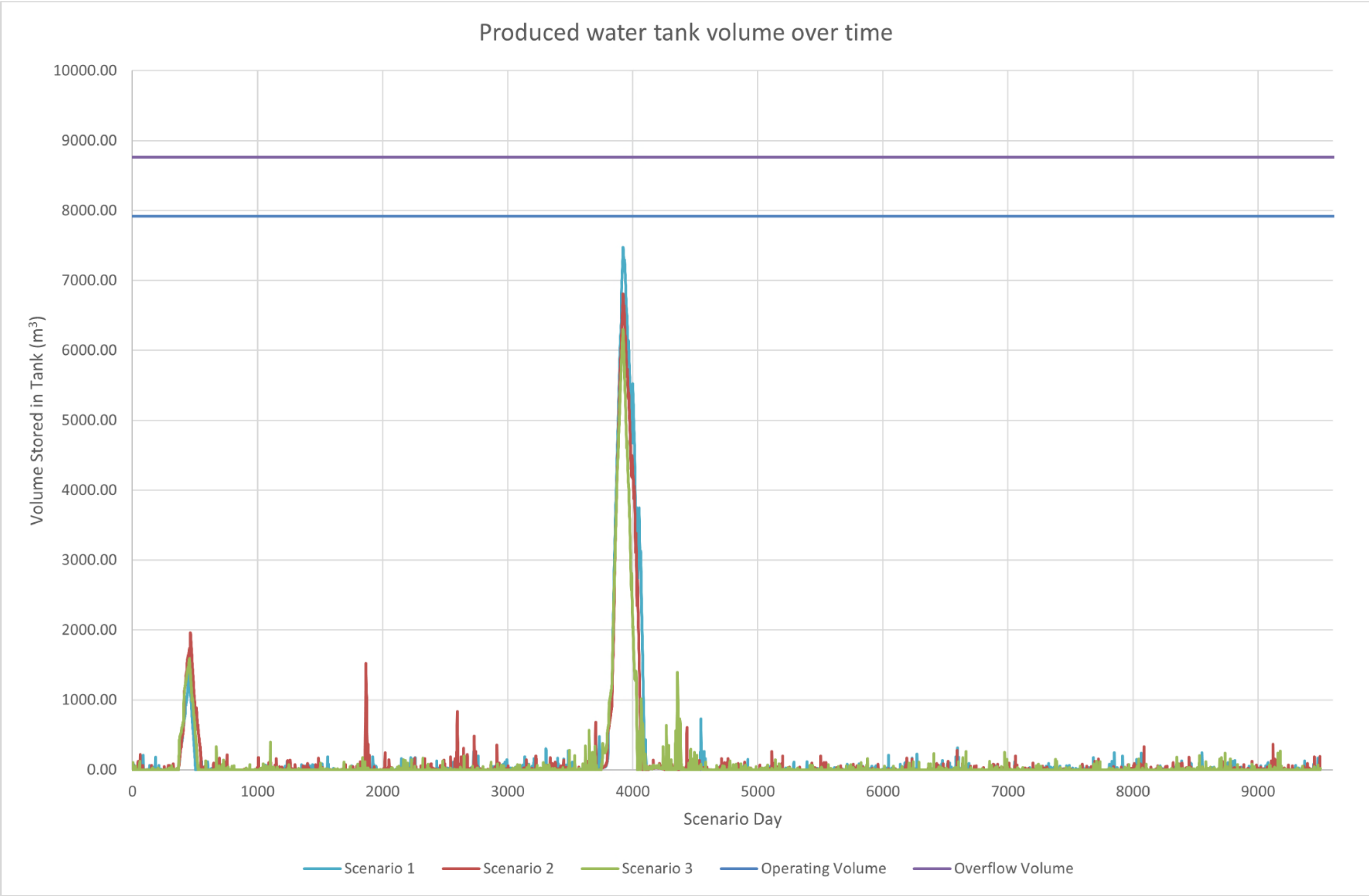
Treated Water Tank volume over time
Volume Stored in Tank (m3)
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume


Benefical Water Use
Water use (m3)
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3

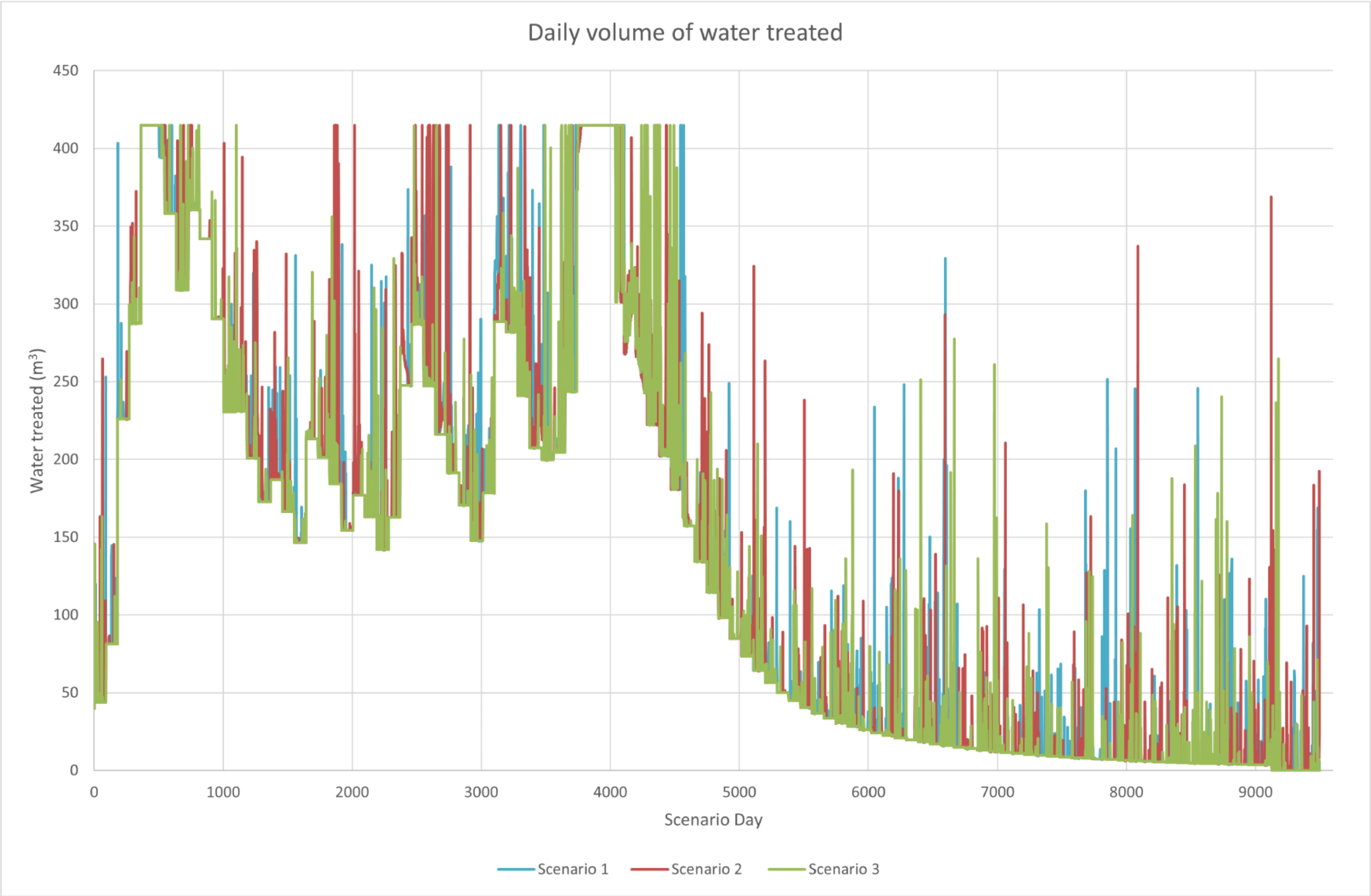


Brine Water Tank volume over time
Volume Stored in Tank (m3)
40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume

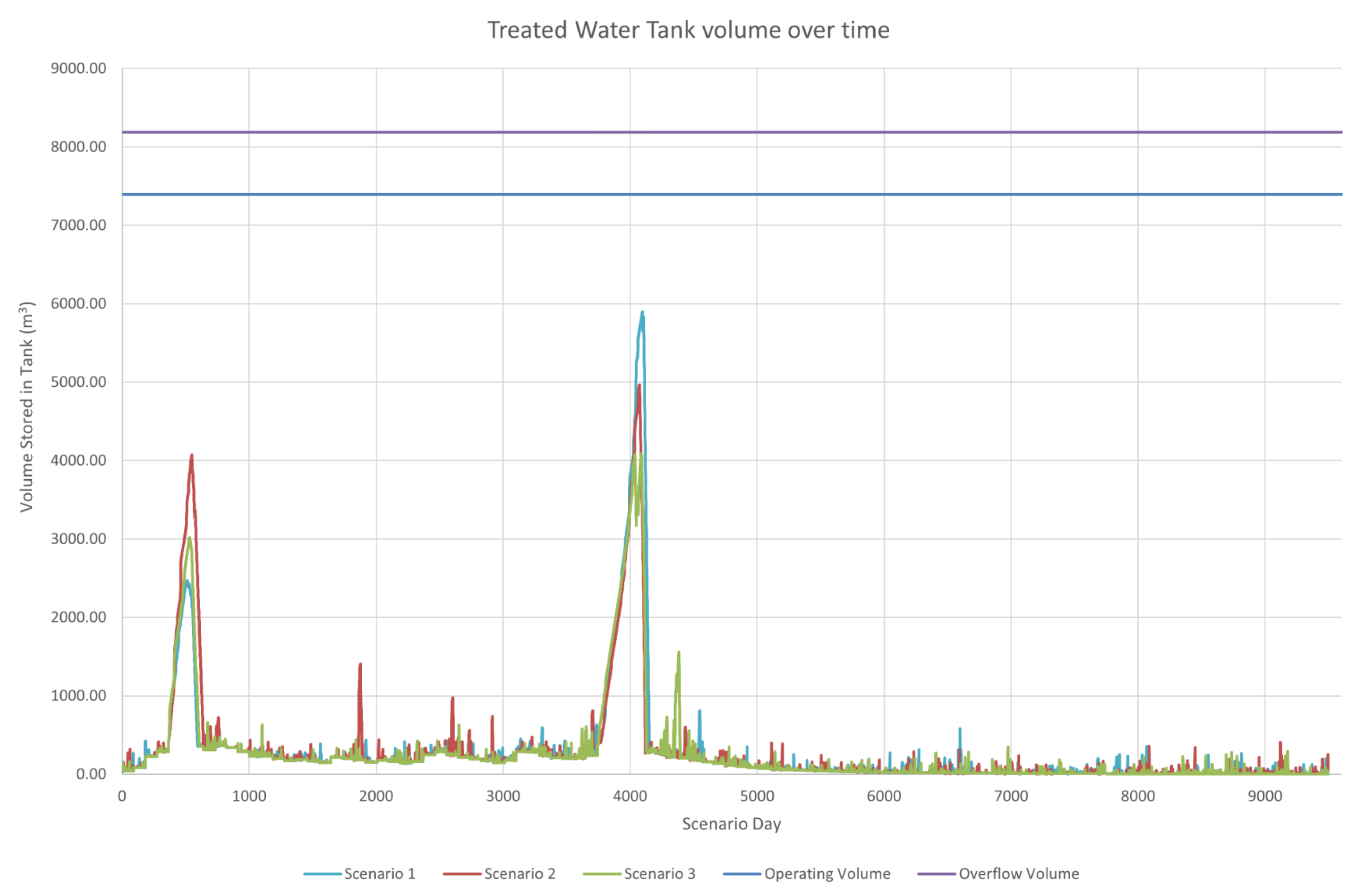
Model Scenario 4 – climate change and 10% increase in production flows.

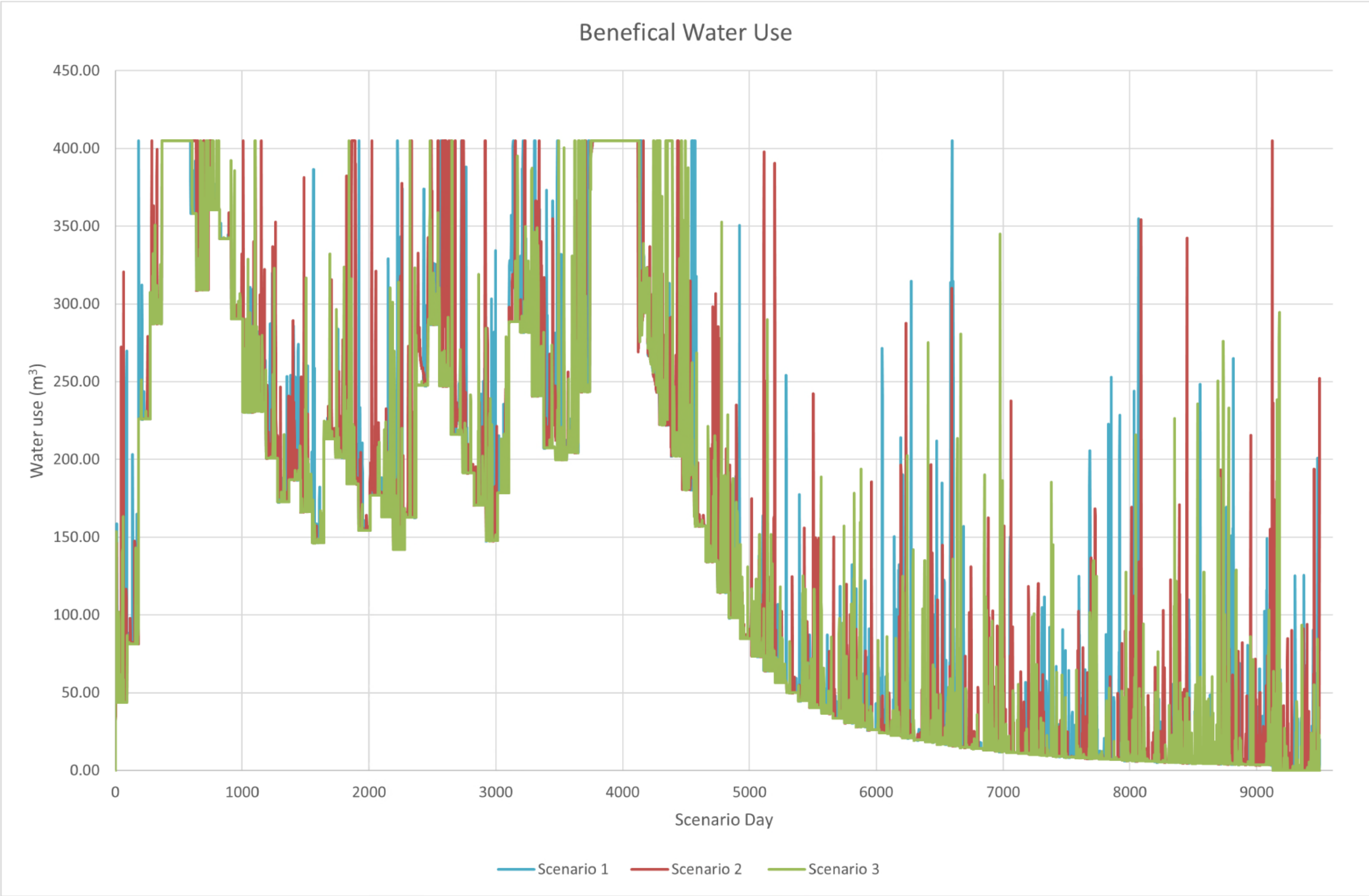


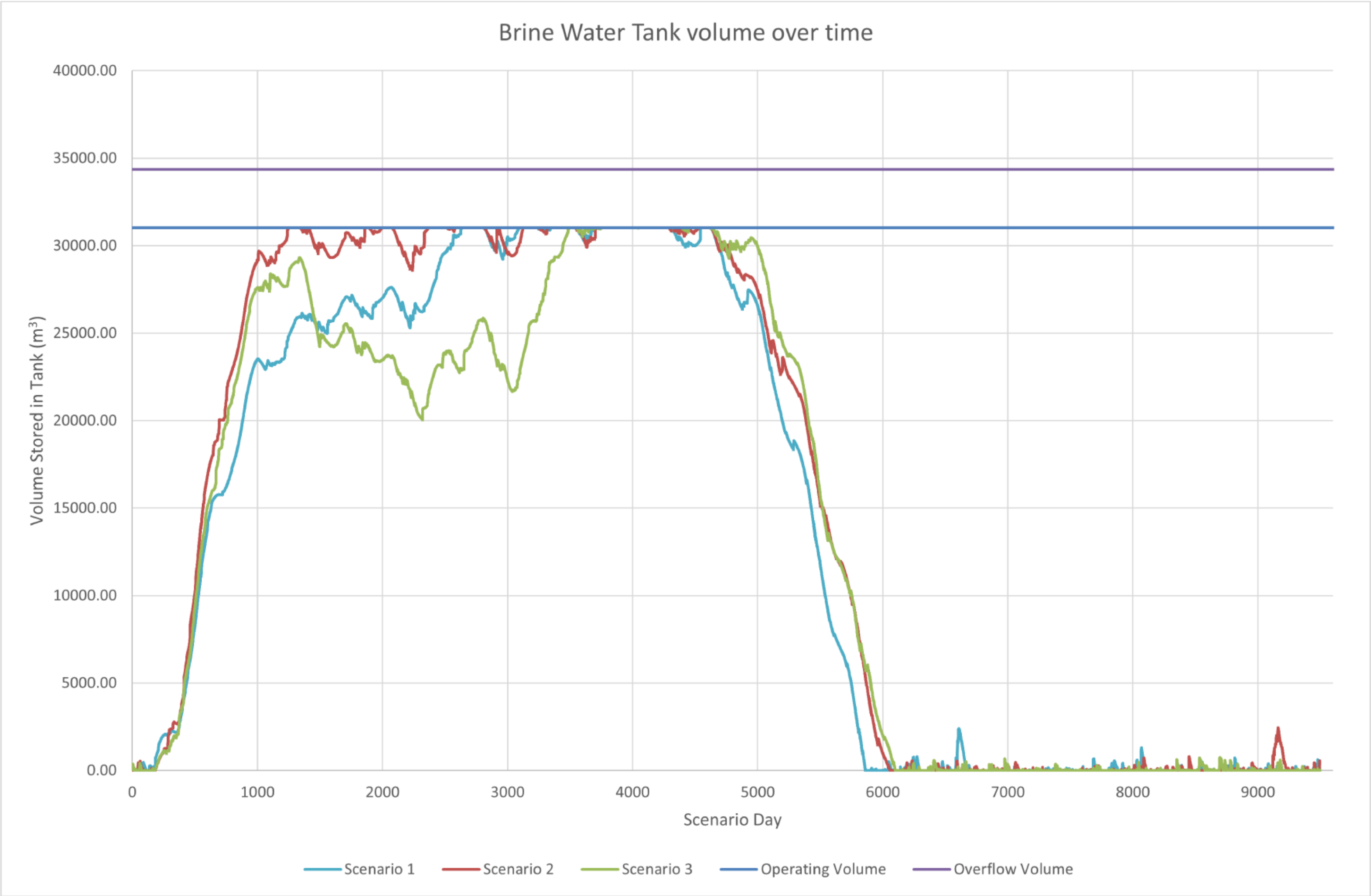
Produced water tank volume over time
Volume Stored in Tank (m3)
10000.00
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume



Daily volume of water treated
Water treated (m3)
0
50
100
150
200
250
300
350
400
450
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3


Treated Water Tank volume over time
Volume Stored in Tank (m³)
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume


Benefical Water Use
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Water use (m3)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3


Brine Water Tank volume over time
40000.00
35000.00
30000.00
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
Volume Stored in Tank (m3)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Scenario Day
Scenario 1
Scenario 2
Scenario 3
Operating Volume
Overflow Volume