Gatwick Airport Northern Runway Project

Environmental Statement
Appendix 11.9.4: Water Quality De-Icer Impact Assessment

Book 5

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0 Executive Summary

0.1.1 The proposal to make best use of London Gatwick Airport's existing runways and infrastructure will result in increased air traffic movements and potentially therefore an increased use in de-icer. Without mitigation this could increase the risk of discharge of contaminated runoff to receiving watercourses.

0.1.2 This appendix provides the technical information that supports the assessment of impact of the potential increased use of de-icer at Gatwick on the water quality of receiving watercourses reported in Chapter 11 of the Environmental Statement.

0.1.3 The assessment demonstrates that with the provision of a new treatment works the increased capacity provided mitigates the increased risk of contaminated water being discharged to the receiving watercourses.

1 Introduction

1.1 General

1.1.1 This document forms **ES Appendix 11.9.4: Water Quality De-Icer Impact Assessment** (Doc Ref. 5.3) of the Environmental Statement (ES) prepared on behalf of Gatwick Airport Limited (GAL) for the proposal to make best use of Gatwick Airport's existing runways and infrastructure (referred to within this report as 'the Project').

1.1.2 This document summarises the assessment of the impact of anticipated changes to air traffic movements ("ATM") as a result of the Project on the water quality of watercourses that receive runoff from the airfield. The document details the data, methodologies, and results from the water quality (de-icer) assessment that informed the assessment of potential environment effects reported in **ES Chapter 11: Water Environment** (Doc Ref. 5.1).

1.1.3 A separate assessment was undertaken of the effects of surface access (highways) improvement works and car parking provision on water quality which is documented in **ES Appendix 11.9.3: Water Quality HEWRAT Assessment** (Doc Ref. 5.3).

1.2 Purpose of modelling

1.2.1 There are multiple numerical models used to evaluate the impact of operations at Gatwick on the water environment. The numerical models are digital twins representing flood risk from rainfall, drainage networks, river, wastewater drainage and the transport and impact of pollutants from the airfield on the environment. Each are discrete, standalone models, although where they have common assets, updates made to that asset in one model are made in all of the models. Table 1.3.1 and **.2** detail the models and assets included in support of this ES.

1.3 Modelling overview

River impact modelling methodology

1.3.1 In order to evaluate the impact of the Project on water quality, the Urban Pollution Management (UPM) approach has been adopted as documented in the Urban Pollution Modelling Manual v3 (Foundation for Water Research, 2019). Each of the discharges that could potentially be contaminated with de-icer have been evaluated for the following parameters:

- Spill frequency – a count of the number of spills where Biochemical Oxygen Demand (BOD) in the discharge is >10mg/l, therefore indicating the potential presence of de-icer. We have used the UPM methodology procedure to define a spill.
- If the number of polluting spills is greater than 1.8 days (43.2 hours), i.e. greater than 1% of the time for the 180 day simulation period, we have calculated the river BOD water quality within InfoWorks™ ICM software (see Table 1.3.1) as mean, 90%ile and 99%ile quality immediately downstream of the discharge, which was only necessary for Pond D. The results are compared to the water quality standards shown in Table 1.3.3.

Model period

1.3.2 Winter 2017/18 has been selected as the water quality (de-icer) model calibration and baseline year. Winter 2017/18 was the period that had numerous polar vortex cold weather events, referred to colloquially as "beast from the east". 2017/18 was exceptionally cold, and hence had the greatest volume of de-icer applied compared to any other years within a 10-year period. Although greater volumes of de-icer might have been applied in the distant past, the baseline / calibration year had to be from within a 10-year period to ensure that good quality calibration data was available, and that the model represented modern de-icer operational practices and a representative volume of ATM. There have been no changes since 2017/18 that would have led to a worse impact on the environment.

Table 1.3.1 Numerical models used to support the Environmental Statement

Model	Uses	Software	Model Source
Surface water / drainage flood model	To develop surface water mitigations needed to satisfy National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2021)requirements through the **ES Appendix 11.9.6: Flood Risk Assessment** (Doc Ref. 5.3) for the Project.	InfoWorks ICM	InfoWorks drainage model, validated based on flow survey in 2018/19.
Pollution control and river impact model	To develop water quality mitigation to meet Environment Agency (EA) Water Framework Directive (European Parliament and Council, 2017) no deterioration requirement for the Project.	InfoWorks ICM	InfoWorks drainage model. Water quality model developed in 2013 for the Northern Runway project. Updated with drainage assets as per validated model above.
River flood model	To develop floodplain mitigations for the Project.	Flood Modeller software & Tuflow	Upper Mole River model, partnership project between Gatwick and EA, delivered in 2017.
Integrated river and drainage model	To understand integrated flood pathways to inform Flood Threat Plan	InfoWorks ICM	A combination of the River flood model and the surface water / drainage flood model.
Wastewater drainage model	To evaluate the impact of additional passengers on Thames Water Crawley and Horley Sewage Treatment works.	InfoWorks ICM	Gatwick asset data and available survey data.

Table 1.3.2 Features included in each model

Model	Surface water network	River network	Above ground flood routing	De-icer wash off	Water quality river impact	Foul drainage network
Surface water / drainage flood model	Y	-	Y	-	-	-
Pollution control and river impact model	Y	-	-	Y	Y	-
River flood model	-	Y	Y	-	-	-
Integrated river and drainage model	Y	Y	Y	-	-	-
Wastewater drainage model	-	-	-	-	-	Y

Table 1.3.3 Water quality standards used for water quality evaluation

WFD Threshold	90%ile threshold (mg/l BOD) [A]	99%ile threshold (mg/l BOD) [A]
High	4	9
Good	5	11
Moderate	6.5	14
Poor	9	19
Bad	>9	>19

Note A: Thresholds taken from Review of urban pollution management standards against WFD requirements (Environment Agency 2012).

1.4 Modelled assets in baseline model

1.4.1 Figure 1.4.1 details the study area and the key pollution control assets and how the drainage network connects to these assets. A full-size version of this figure is shown in Annex 1.

1.4.2 Figure 1.4.2 provides a schematic conceptual map of how the key pollution control structures and potential impact points are connected. A full-size version of this map is provided in Annex 2.

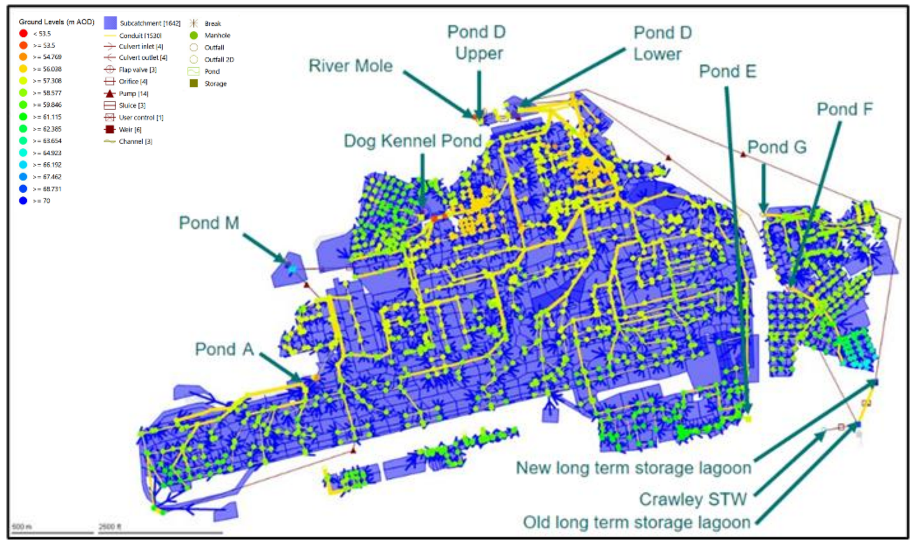

Figure 1.4.1 Pollution control drainage network

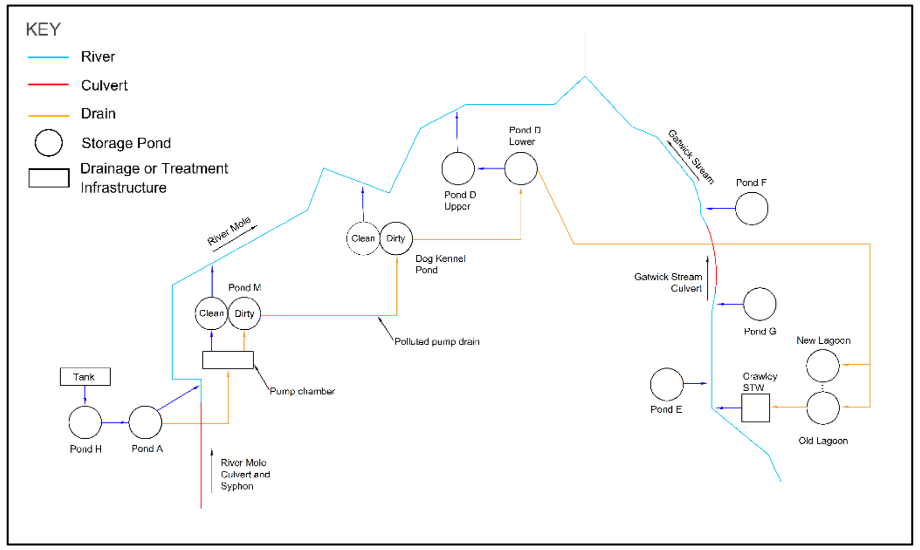

Figure 1.4.2 Pollution control drainage network schematic

2 Model build

2.1 Baseline model build

2.1.1 The Gatwick pollution control and river impact model represents all drainage assets that may contain de-icer contaminated runoff and simulates the operation of all Gatwick owned outfalls to the receiving watercourses.

2.1.2 The model is derived from the verified surface water drainage model. For full details of the surface water drainage model, please refer to **ES Appendix 11.9.6 Annex 3** (Doc Ref. 5.3). The model has been modified to model long durations (at least 6 months rainfall time series) by removing the above ground flood routing. This has no impact on the fate and transport of pollutant because during the baseline year there was no overground flooding that would have changed the fate of pollutant discharge.

2.1.3 Real-time control rules that mimic the operational rules and decisions made during de-icer management have been applied. These real-time control rules determine the ultimate destination of de-icer contaminated runoff, and in principle ensure that any de-icer contaminated runoff ends up at the long-term storage lagoons, with ultimate treatment at Thames Water's Crawley Sewage Treatment Works (STW). These real-time control rules are based on a range of variables including hydraulic parameters (such as level, flow, pump state), and chemical parameters (such as BOD, pH, Chemical Oxygen Demand).

2.1.4 Pollutograph loads and volumes have been applied to the model to represent de-icer use and runoff. Section 2.2 details how the de-icer loads have been calculated based on reported de-icer use for the baseline year.

2.2 De-icer volumes and concentrations

Baseline de-icer use

2.2.1 Daily de-icer use records are obtained from airline services and airfield operations and maintained by Gatwick. These records detail what type of de-icer (or anti-icer) is used and whether it is an aircraft or pavement de-icer. For the purposes of this report, both anti-icer and de-icer have been modelled using the same methodology as they have a similar polluting effect. We use the term de-icer in the rest of this report to mean both de-icer and anti-icer. In addition, the records detail how much de-icer is recovered for reuse and therefore prevented from potential impact on the environment. This recovered volume is subtracted from the usage to calculate the net de-icer volume after recovery.

2.2.2 These de-icer use records have been used to generate de-icer inflows and de-icer pollutograph inputs that are applied to a number of model nodes (in effect drainage network manholes) to represent where and when pavement and aircraft de-icer is applied over the baseline 2017/18 winter. Total modelled de-icer volume and net load from pavement de-icer is detailed in .1, and the total modelled volume and load of aircraft de-icer is detailed in Table 2.2.2.

Table 2.2.1 Modelled pavement de-icer volumes derived from Gatwick records for 2017 / 18

De-icer	Net volume after recovery (l)	Net load after recovery (kg)
Safegrip Eco 2	897,760	197,507
Konsin	66,945	66,945
Mix Eco 2 / Konsin (1)	148,168	148,168

Note (1) No samples were available to determine the load of the mix, therefore a conservative assumption was used to keep the load at the highest load of the two, which is Konsin.

Table 2.2.2 Input parameters used to calculate aircraft de-icer volume and load used in modelling. Derived from Gatwick records for 2017 / 18

Parameter	Value
Air traffic movements (ATMs)	283,312
Winter ATMs	148,262
Total departures (50% of ATMs)	74,131
No. ATMs deiced (1)	5,789
Volume of aircraft de-icer used (Propylene Glycol from Gatwick records) and used in modelling (l)	948,089
Total load aircraft de-icer BOD (assuming no losses) (kg)	189,618

3 Model proving

3.1 Calibration and verification / validation

3.1.1 The model has been validated for flow, volume, and de-icer concentration at Pond D Lower.

3.1.2 Table 3.1.1 shows observed and modelled flows arriving at Pond D Lower. **Annex 3** provides plots showing how observed flow validates against modelled flow for rainfall events during six month the model period.

3.1.3 Analysis undertaken shows that the volume monitored leaving Pond D is at least 15% less than the modelled, based on the monitored discharges from Pond D Upper plus the volume reaching the long term storage lagoons. Therefore it is concluded that that the inflow monitor is underpredicting total volume by approximately 15%. This is consistent with the total model overprediction of volume by 17% compared to the monitored values.

Table 3.1.1 Pond D Lower Inflow Volume

Rainfall event	Observed volume (m^3)	Modelled volume (m^3)	Difference
27/09 to 29/09	48,210	36,411	-24%
19/10 to 22/10	40,853	37,969	-7%
10/12 to 12/12	52,369	44,627	-15%
12/12 to 14/12	27,304	33,821	24%
26/12 to 28/12	63,378	55,351	-13%
29/12 to 01/01	90,453	75,360	-17%
02/01 to 06/01	64,158	54,441	-15%
12/01 to 17/01	28,587	41,975	47%
21/01 to 23/01	32,576	33,975	4%
24/01 to 25/01	31,812	30,540	-4%
15/03 to 16/03 (1)	38,352	3,413	-91%
28/03 to 30/03	37,159	41,810	13%
30/03 to 01/04 (1)	34,400	9,782	-72%
02/04 to 03/04 (1)	50,356	6,503	-87%
01/04 to 11/04 (1)	36,896	7,976	-78%
29/04 to 01/05 (1)	43,280	5,241	-88%
Total for all events >30,000m^3	671,933	482,784	-28%
Total for all events >30,000m^3 excluding rain gauge failure period	507,001	453,282	-4%
Total volume for full simulation	1,157,400	1,356,100	17%

Note (1) These events suffered a rain gauge failure, therefore the model significantly underpredicted monitored inflow for these events.

3.1.4 As seen in Table 3.1.1, the model overpredicts inflow to Pond D during some rainfall events and underpredicts inflow in other rainfall events. Event duration and event peak timing is good during rainfall events as seen in **Figures A.3.1 to A.3.16** in **Annex 3.** When rainfall events with known monitor outage are removed from the calibration events, then the model underpredicts observed volumes by only 4% on average. Across the entire simulation period, the modelled inflow overpredicts observed inflow by 17%.

3.1.5 The calibration quality is acceptable given the complexity of the model and known issues with monitor data.

3.1.6 Water quality calibration compares the modelled BOD against the observed BOD in Pond D Lower, to ensure that de-icer load is modelled appropriately. This is shown in **Figure 3.1.1.** It must be noted that the BOD sensor in Pond D Lower records a maximum value of 1,000mg/l BOD and is therefore capped in **Figure 3.1.1.**

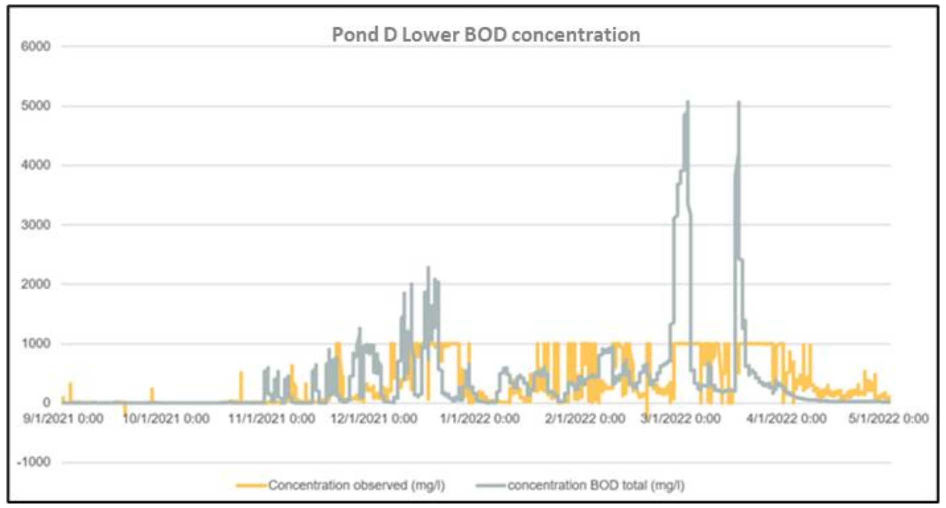

Figure 3.1.1 Pond D Lower BOD concentration model validation against observed sensor data

3.1.7 The model is considered to be acceptable for use in a water quality Urban Pollution Modelling (UPM) assessment – that is for determining the impact of discharges over a long duration on river water quality.

3.1.8 Care should be taken if the model is to look at the impact of any single rainfall event.

4 With Project model build

4.1 Model updates – hydraulic mitigations

4.1.1 A scenario of the existing drainage network model was created and updated to include the new and amended areas of hardstanding, roof areas and surface areas that would be delivered by the Project.

4.1.2 This scenario was then further updated with combinations of mitigation storage as listed in Table 4.1.1. The additional storage was assumed to comprise attenuation crates or similar structures. The underground storage areas were added to the model as storage nodes on an existing link (pipe), the link downstream of the node was then deleted and an orifice draining the storage added as a link.

4.1.3 Mitigation measures are proposed in each sub-catchment draining to Ponds M and D, local to the amended pavement areas. Mitigation storage volumes have been sized to limit runoff from the additional net paved area to greenfield runoff rates during the median annual flood (the 50% (1 in 2) AEP event). This measure is directed to events up to and including the 1% (1 in 100) AEP, plus an allowance for climate change event.

4.1.4 Greenfield runoff rates were estimated (from existing gauged flow data on the River Mole at Horley and the Gatwick Stream at the Gatwick Link), to be approximately 2.9l/s/ha.

4.1.5 Climate change impacts for the purposes of surface water flooding modelling (see **ES Appendix 11.9.6 Annex 3** (Doc Ref. 5.3)) are assumed to increase runoff volumes from surface water drainage systems by 25% in accordance with current climate change guidance, Rainfall runoff management for developments (Environment Agency, 2022), for increases in rainfall intensity. Using these criteria, the attenuation storage required is estimated to be approximately 850m^3 for each net additional hectare of paved area (850m^3/ha). It is assumed the volume would be provided via underground storage measures.

The proposed mitigations are summarised in Table 4.1.1, see **ES Appendix 11.9.6 Annex 3** (Doc Ref. 5.3) for more detail. All mitigation measures proposed for inclusion within the Project are secured as a DCO requirement in **Design and Access Statement** (Doc Ref. 7.3).

Table 4.1.1. Proposed Surface water drainage flood mitigations

Storage Reference Number (Pond Sub-Catchment)	Mitigation Volume modelled (m^3)	Discharge Limit (m^3/s)
B (Dog Kennel Pond)	754	No restriction
J (Pond D)	635	0.3
K (Pond D)	175	0.05
L (Pond D)	1267	0.35
N (Dog Kennel Pond)	1267	0.05
O (Pond M)	1387	0.05
P (Pond D)	574	0.05
Q (Pond M)	496	No restriction
E (Pond M)	2,800	0.009 (pumped)
New Pond A (Pond A)	0 to 16,000	N/A
Car Park Y (CPY)	10,000, 32,000 and 61,000	No restriction

4.1.6 The new Storage E, which receives flows from the new hardstanding for the end around taxiway West, has been proposed. This storage facility holds up to 2,800m^3 of runoff and would be pumped directly into the upstream end of Pond M at a rate of 0.009m^3/s.

4.1.7 The changes in airfield hardstanding and greenfield areas for the Project against the baseline are listed in Table 4.3.1. Where there is existing hardstanding that impacts the drainage system that has not been depicted in the baseline model, it has been added into the mitigation model scenarios.

4.1.8 A key assumption whilst undertaking the modelling was that existing airfield hardstanding, no longer required by Gatwick, would be removed and reinstated as greenfield area to minimise additional attenuation needed.

4.2 Model updated – De-icer modelling

4.2.1 De-icer applied was increased based on pavement increase and forecast winter ATMs as follows:

- New aircraft de-icer nodes have been created to represent additional winter ATMs to represent the increase in aircraft de-icer forecast in Table 4.2.1.
- New pavement de-icer application nodes have been created to represent new Rapid Exit and Entry taxiways (RETs) and other taxiways in the Project and model the increase in pavement de-icer forecast in .1.

4.2.2 A figure identifying the nodes where de-icer is applied in the model is included in Annex 4.

Table 4.2.1 Forecast aircraft de-icer volume and loads compared to baseline actuals

	Baseline Winter 2017/18	2038 and 2047 forecast
ATM	283,312	381,000
Winter ATM	148,262	199,384
Total departures (50% of ATM)	74,131	99,962
No. ATM deiced [1]	5,789	7,785
Modelled de-icer use [i]	948,089	1,264,958
Total load kg BOD (assuming no losses)	189,618	252,922

4.3 Project Scenarios Modelled

4.3.1 The attenuation storage mitigation scenarios tested using the hydraulic model are the same mitigations that have been developed for the surface water modelling report in **ES Appendix 11.9.6 Annex 3** (Doc Ref. 5.3).

4.3.2 A further mitigation measure has been tested, the addition of a new water treatment system close to the Long Term Storage Lagoons and Crawley Sewage Treatment works. This system would be sized to provide 100l/s treatment in addition to the current 65l/s provided by Crawley Treatment Works. The system would treat to a very high effluent quality to permit discharge to the Gatwick Stream upstream of Crawley Sewage Treatment Works.

4.3.3 Two variations of mitigation modelling have been undertaken. Gatwick has committed to curtailing the use of one of the more polluting types of de-icer, which has not been used since 2017/18. There are small volumes of Konsin remaining on site, and Gatwick have committed to disposing of this in a safe manner.

4.3.4 The two variations of modelling undertaken are: 'with Konsin' where Konsin is used in the same proportion relative to impermeable area as it was in 2017/18; and, 'No Konsin' where the Konsin used in 2017/18 is replaced with Safegrip Eco2 which presents a lower BOD demand on the receiving watercourse.

4.3.5 The mitigation scenarios modelled are detailed in Table 4.3.2 and Table 4.3.3.

4.3.6 The impact of the mitigations modelled on the River Mole are detailed in Table 5.1.1 and Annex 4 Tables A5.1 to A5.5.

Table 4.3.1 Pavement De-icer Catchment Area Differences Calculations

Catchment	Baseline Scenario			Project with Mitigation			Change from Baseline (%)		
	Total area (m^2)	Hardstanding and roof (m^2)	Greenfield (m^2)	Total area (m^2)	Hardstanding and roof (m^2)	Greenfield (m^2)	Total change in Area	Total increase in Hardstanding	Total increase in Greenfield
Pond D (2)	336.3	214.0	122.3	337.5	220.8	116.7	0.4%	2%	-2%
Pond M	42.8	31.1	11.7	53.7	37.2	16.5	26%	14%	11%
Pond A (1)	44.6	24.4	20.2	49.6	30.5	19.1	11%	14%	-2%
Dog kennel pond dirty side	35.8	30.1	5.8	35.3	32.5	2.8	-1%	7%	-8%
Dog kennel pond clean side	16.3	14.8	1.5	16.3	15.0	1.3	0%	1%	-1%

(1) Where Pond A is removed in NRP scenario modelling, the catchment still exists, but has been transferred to a new location.

(2) Where Car Park Y storage is added in future NRP scenario modelling, some of Pond D catchment drains first to Car Park Y facility before drainage to Pond D.

Table 4.3.2 Model Scenarios – Without Konsin

Scenario	Project land use changes	Project mitigations	New Pond A?	Car park Y Facility (area m^2 (m^3))	100l/s treatment system	Konsin
1	Y	Y	Y	-	-	-
2	Y	Y	Y	1,563 (10,160)	-	-
3	Y	Y	Y	9,375 (60,973)	-	-
4	Y	Y	Y	1,563 (10,160)	Y	-
5	Y	Y	Y	9,375 (60,973)	Y	-
6	Y	Y	-	1,563 (10,160)	Y	-
7	Y	Y	-	9,375 (60,973)	Y	-
8	Y	Y	-	-	Y	-
9	-	-	-	-	Y	-
10	Y	Y	Y	-	Y	-
11	Y	Y	-	5,000 (32,000)	Y	-

Table 4.3.3 Model Scenarios – With Konsin

Scenario	Project land use changes	Project mitigations	New Pond A?	Car park Y Facility (area m^2 (m^3))	100l/s treatment system	Konsin
1	Y	Y	Y	-	-	Y
2	Y	Y	Y	1,563 (10,160)	-	Y
3	Y	Y	Y	9,375 (60,973)	-	Y
4	Y	Y	Y	1,563 (10,160)	Y	Y
5	Y	Y	Y	9,375 (60,973)	Y	Y
6	Y	Y	-	1,563 (10,160)	Y	Y
7	Y	Y	-	9,375 (60,973)	Y	Y
8	Y	Y	-	-	Y	Y
9	-	-	-	-	Y	Y
10	Y	Y	Y	-	Y	Y
11	Y	Y	-	5,000 (32,000)	Y	Y

5 Assessment results

5.1 Assessment with the Proposed Mitigation Results

5.1.1 The water quality assessment with the proposed mitigation results are detailed in Table 5.1.1. Annex 4 Tables A5.1 to A5.5 contains full results at each of the discharge locations modelled. The number of spills presented is a sum of all spills to river greater than 10mg/l. This includes all spills from Pond A, Pond M, Dog Kennel Pond and Pond D. Ponds E, F and G did not have any qualifying spills. The river quality impact assessment is undertaken at the point where Pond D Upper discharges mixes with the River Mole.

Table 5.1.1: UPM assessment summary for each scenario modelled

Scenario components						Without Konsin				With Konsin			
Scenario	**Project Land Use Changes**	**Core Airfield Mitigations**	**New Pond A**	**Car Park Y Facility (area m^2(m^3))**	**100l/s treatment system**	**Total number of spills (1)**	**Modelled river quality - 90%ile BOD mg/l (2)**	**Modelled river quality - 99%ile BOD mg/l (3)**	**Impact Evaluation**	**Total number of spills (1)**	**Modelled river quality - 90%ile BOD mg/l (2)**	**Modelled river quality - 99%ile BOD mg/l (3)**	**Impact Evaluation**
Baseline	-	-	-	-	-	NA	NA	NA	NA	144	4.81 (Good)	23.9 (Bad)	
1	Y	Y	Y	-	-	130	5.15 (Moderate)	17.35 (Poor)	Significant adverse (class deterioration of 90%ile, class improvement of 99%ile)	142	4.91 (Good)	45.3 (Bad)	Significant adverse (within class but significant deterioration of 99%ile, within class deterioration of 90%ile)
2	Y	Y	Y	1,563 (10,160)	-	143	5.91 (Moderate)	20.96 (Bad)	Significant adverse (class deterioration of 90%ile within class improvement 99%ile)	148	5.21 (Moderate)	55.06 (Bad)	Significant adverse (class deterioration of both 90%ile and 99%ile)
3	Y	Y	Y	9,375 (60,973)	-	143	6.53 (Poor)	22.53 (Bad)	Significant adverse (class deterioration of 90%ile within class improvement 99%ile)	149	4.75 (Good)	91.6 (Bad)	Significant adverse (class deterioration of 99%ile, within class improvement of 90%ile)
4	Y	Y	Y	1,563 (10,160)	Y	12	3.65 (High)	9.63 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	12	3.62 (High)	9.62 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)
5	Y	Y	Y	9,375 (60,973)	Y	4	3.65 (High)	9.63 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	4	3.64 (High)	9.62 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)
6	Y	Y	-	1,563 (10,160)	Y	2	3.65 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	12	3.57 (High)	9.63 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)
7	Y	Y	-	9,375 (60,973)	Y	2	3.65 (High)	9.65 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	2	3.65 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)

Scenario components						Without Konsin				With Konsin			
Scenario	Project Land Use Changes	Core Airfield Mitigations	New Pond A	Car Park Y Facility (area $m^2(m^3)$)	100l/s treatment system	Total number of spills (1)	Modelled river quality - 90%ile BOD mg/l (2)	Modelled river quality - 99%ile BOD mg/l (3)	Impact Evaluation	Total number of spills (1)	Modelled river quality - 90%ile BOD mg/l (2)	Modelled river quality - 99%ile BOD mg/l (3)	Impact Evaluation
8	Y	Y	-	-	Y	12	3.65 (High)	9.66 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	32	3.58 (High)	9.73 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)
9	-	-	-	-	Y	13	3.65 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	13	3.58 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)
10	Y	Y	Y	-	Y	12	3.65 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	13	3.60 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)
11	Y	Y	-	5,000 (32,000)	Y	2	3.65 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)	2	3.65 (High)	9.64 (Good)	Significant beneficial (class improvement of both 90%ile and 99%ile)

(1) This is the sum of all spills >10mg/l from Pond A, Pond M, Dog Kennel Pond and Pond D Upper.

(2) This is the modelled river water quality in BOD mg/l at the point of discharge from Pond D Upper into the River Mole presented as a 90%ile (i.e. the modelled water quality is below than this value for 90% of the model period).

(3) This is the modelled river water quality in BOD mg/l at the point of discharge from Pond D Upper into the River Mole presented as a 99%ile (i.e. the modelled water quality is below than this value for 99% of the model period).

5.2 Preferred option

Preferred mitigation strategy

5.2.1 Based on the river impact modelling, the recommended mitigation strategy compared to current baseline is Scenario 11, as below:

- Remove Pond A.
- No changes to Dog Kennel Pond, Pond M or Pond D.
- A new attenuation storage facility is provided at Car Park Y. This is sized as 5,000m^2 (32,000m^3 volume), of which 22,664m^3 max volume is utilised by this scenario.
- 100l/s discharge from long-term storage lagoon to a new water treatment system.
- Konsin is no longer used as a pavement de-icer.

5.2.2 The impact of the preferred mitigation strategy on water quality is detailed in Table 5.2.1.

Table 5.2.1: Impact of preferred mitigation strategy on water quality

Model run	Number of spills	River quality BOD 90%ile in mg/l	River quality BOD 99%ile in mg/l	Impact on water quality
Pond A	0	N/A	N/A	No impact
Pond M	0	N/A	N/A	No impact
Dog Kennel Pond	2	N/A	N/A	No impact
Pond D	0	3.65	9.64	Significant beneficial (Bad to Good)
Pond E	0	N/A	N/A	No impact
Pond F	0	N/A	N/A	No impact
Pond G	0	N/A	N/A	No impact

6 Model assumptions and limitations

6.1 Hydrology/runoff modelling

6.1.1 The 1D model was based on the 1D model validated in 2019, and hydrology and runoff rates remain the same as that validated model.

6.1.2 Default InfoWorks ICM washoff pollutant concentrations were adopted to account for BOD load from non de-icer airfield operations.

6.2 Water quality evaluation assumptions

6.2.1 If there is no discharge from a storage pond to receiving water with a BOD greater than 10mg/l, no river impact evaluation is needed.

6.2.2 River flow for the River Mole at Pond D has been applied as a timeseries based on observed data.

6.2.3 BOD upstream quality data for the River Mole at Pond D has been derived from observed sample data, and then applied stochastically.

7 References

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Environment Agency (2022) Rainfall runoff management for developments. Available at: https://assets.publishing.service.gov.uk/media/602e7158d3bf7f7220fe109d/_Rainfall_Runoff_Management_for_Developments_-_Revision_E.pdf

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Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government (2021) National Planning Practice Guidance (NPPG). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

8 Glossary

8.1 Glossary of Terms

Table 8.1.1: Glossary of Terms

Term	Description
BOD	Biochemical Oxygen Demand - Measure of the amount of oxygen required to breakdown organic matter from water in the process of decomposition by aerobic bacteria (bacteria that require oxygen to respire)
Crawley Sewage Treatment Works	Crawley sewage treatment works (STW) is owned and managed by Thames Water. The treatment train at the plant comprises primary treatment, biological treatment using the activated sludge process, and tertiary treatment using disc filters.
RETs	Rapid Exit and Entry taxiways - A taxiway connected to a runway designed to allow landing planes to turn off at higher speeds therefore minimizing runway occupancy times.
UPM	Urban Pollution Management - The management of wastewater discharges from sewer and sewage treatment systems under wet weather conditions such that the requirements of the receiving water are met in a cost effective way.

Annex 1

Pollution control network and key assets

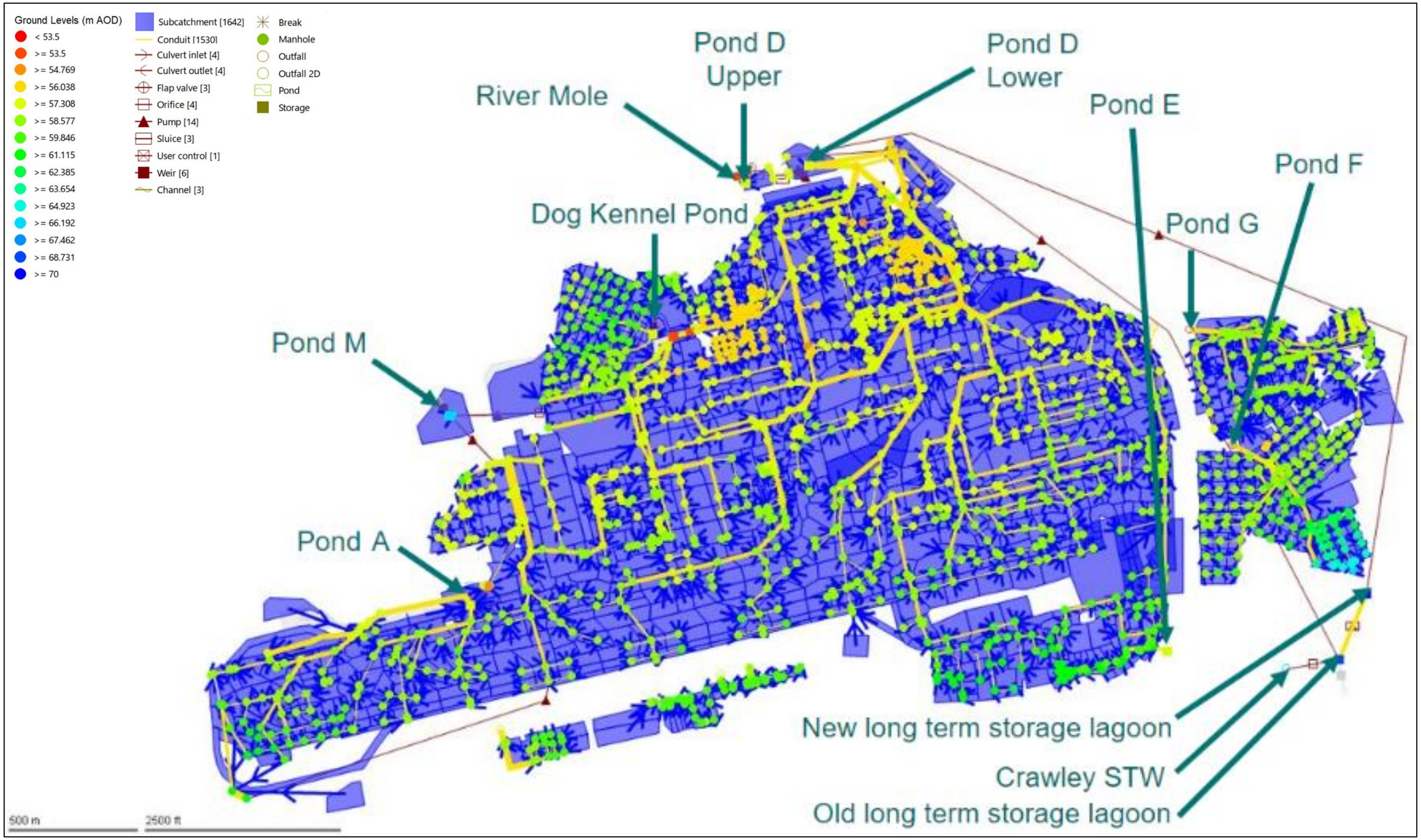


Figure A.1.1: Pollution control drainage network

Annex 2

Pollution control schematic

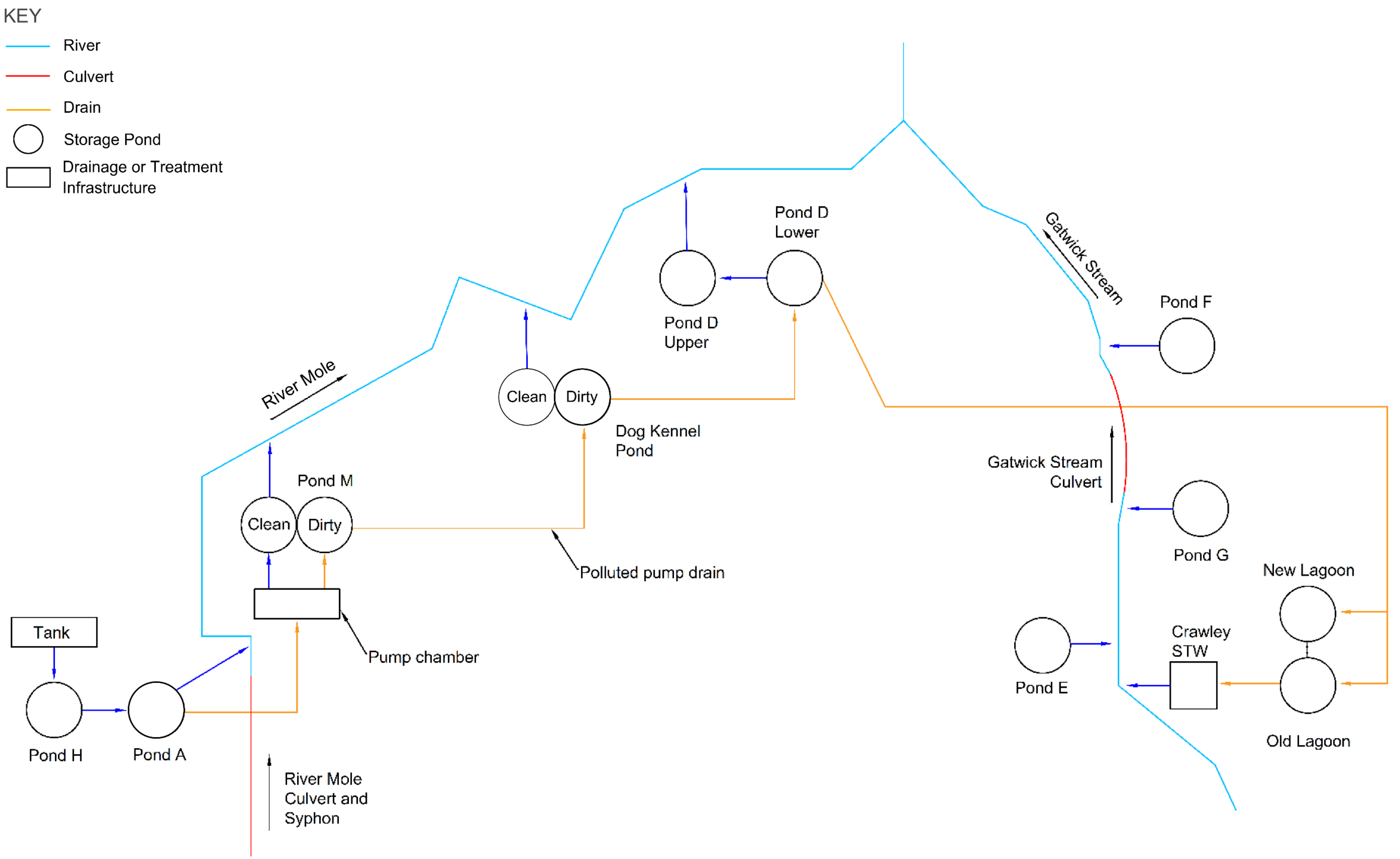
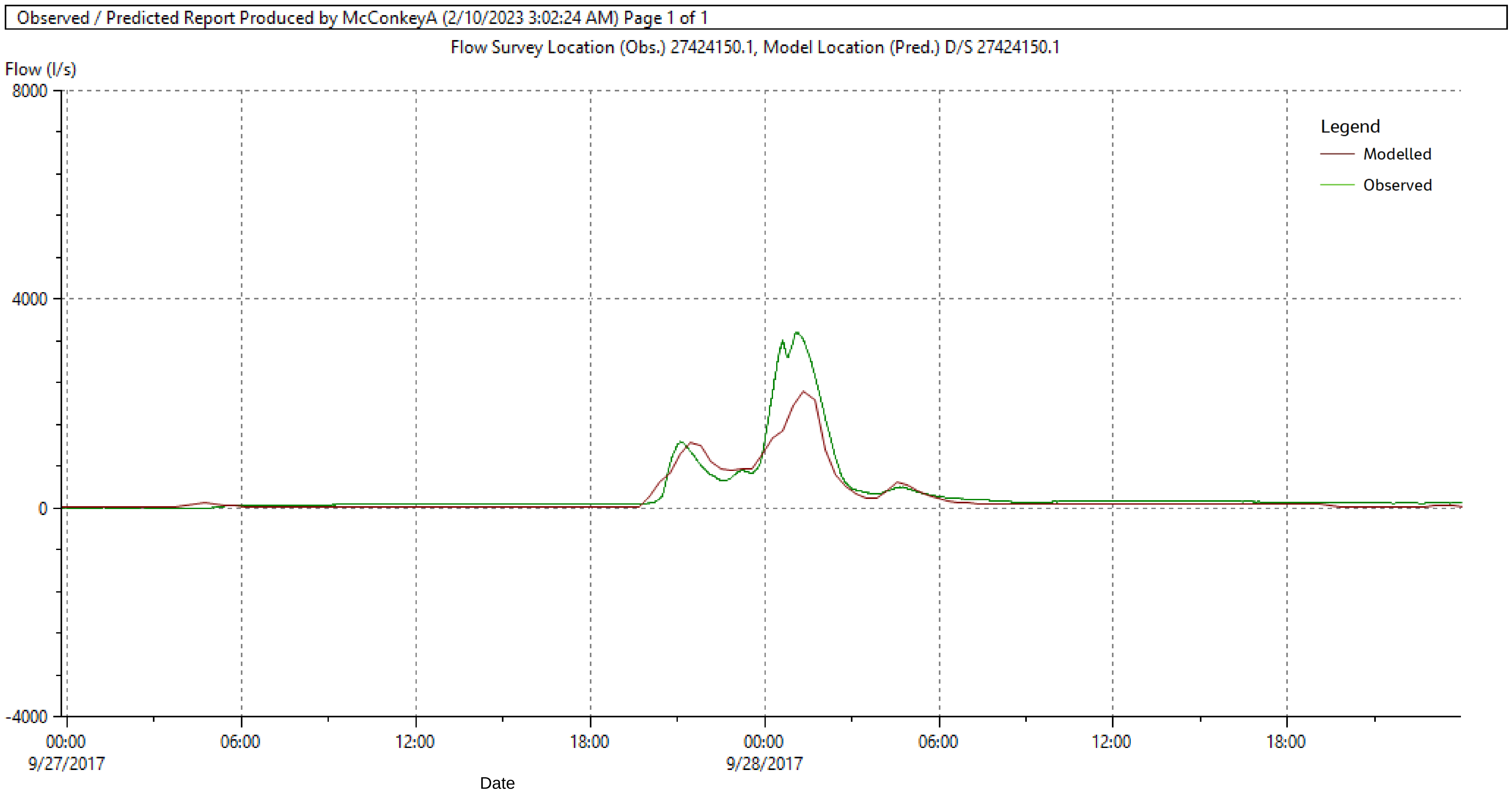


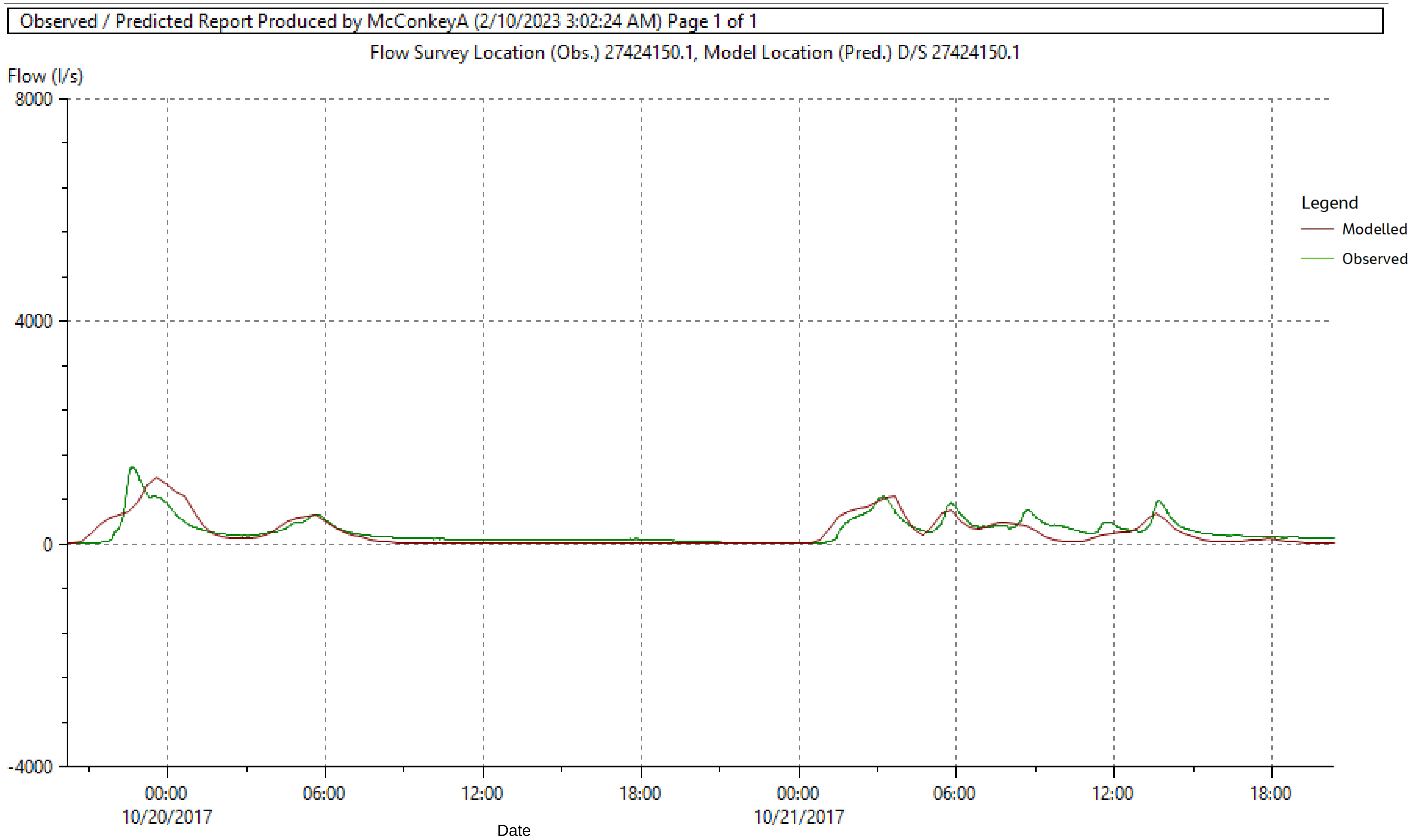
Figure A.2.1: Pollution control drainage network schematic

Baseline flow validation results at inlet to Pond D



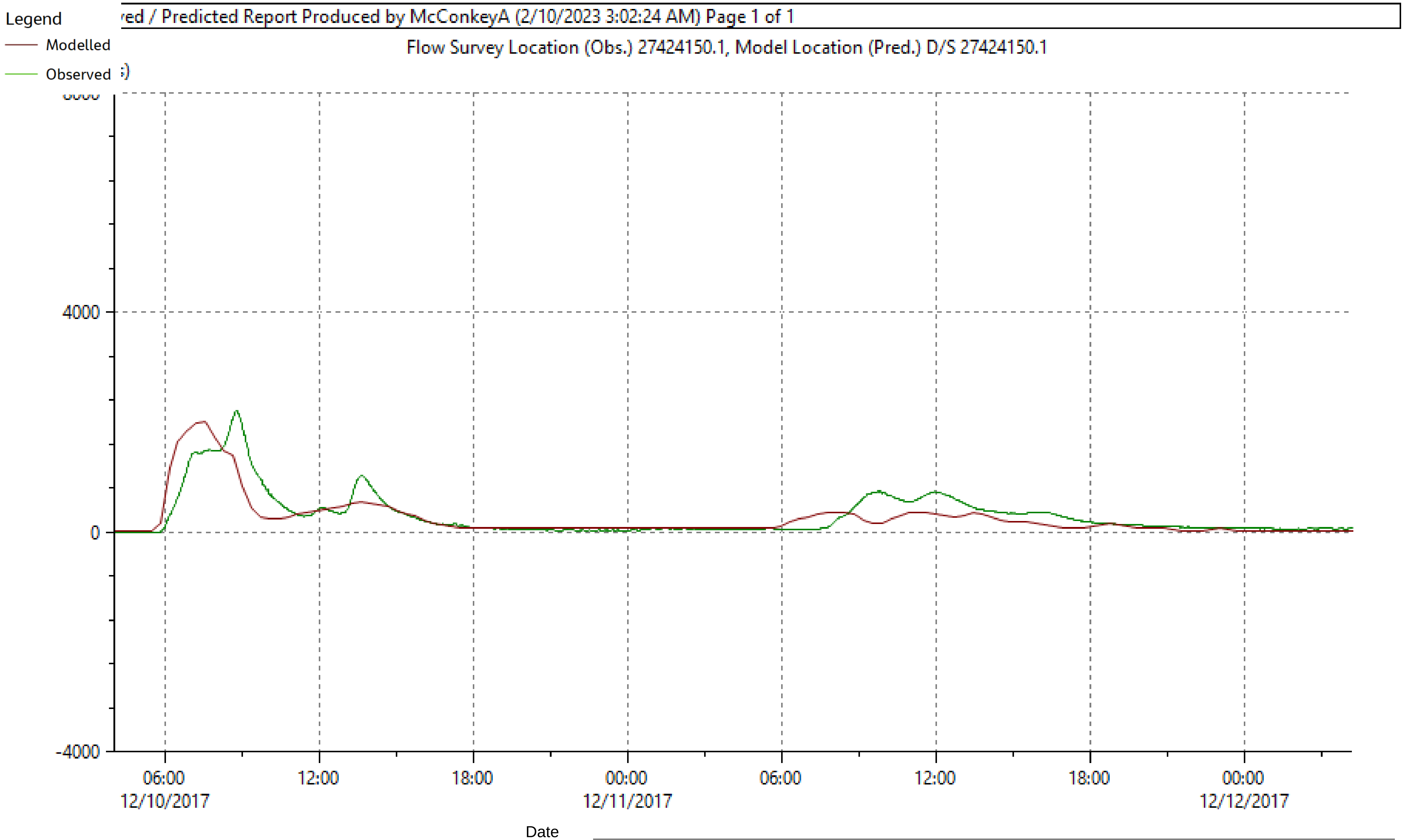
	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	-1.860	3358.371	48209.908
...0ls Rainfall event2017_2018 GAL data	22.908	2229.107	36410.518

Figure A.3.1: Observed and predicted inflow to Pond D Lower for event 1



	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	10.881	1387.494	40852.538
...infall event2017_2018 GAL data	23.054	1207.109	37968.985

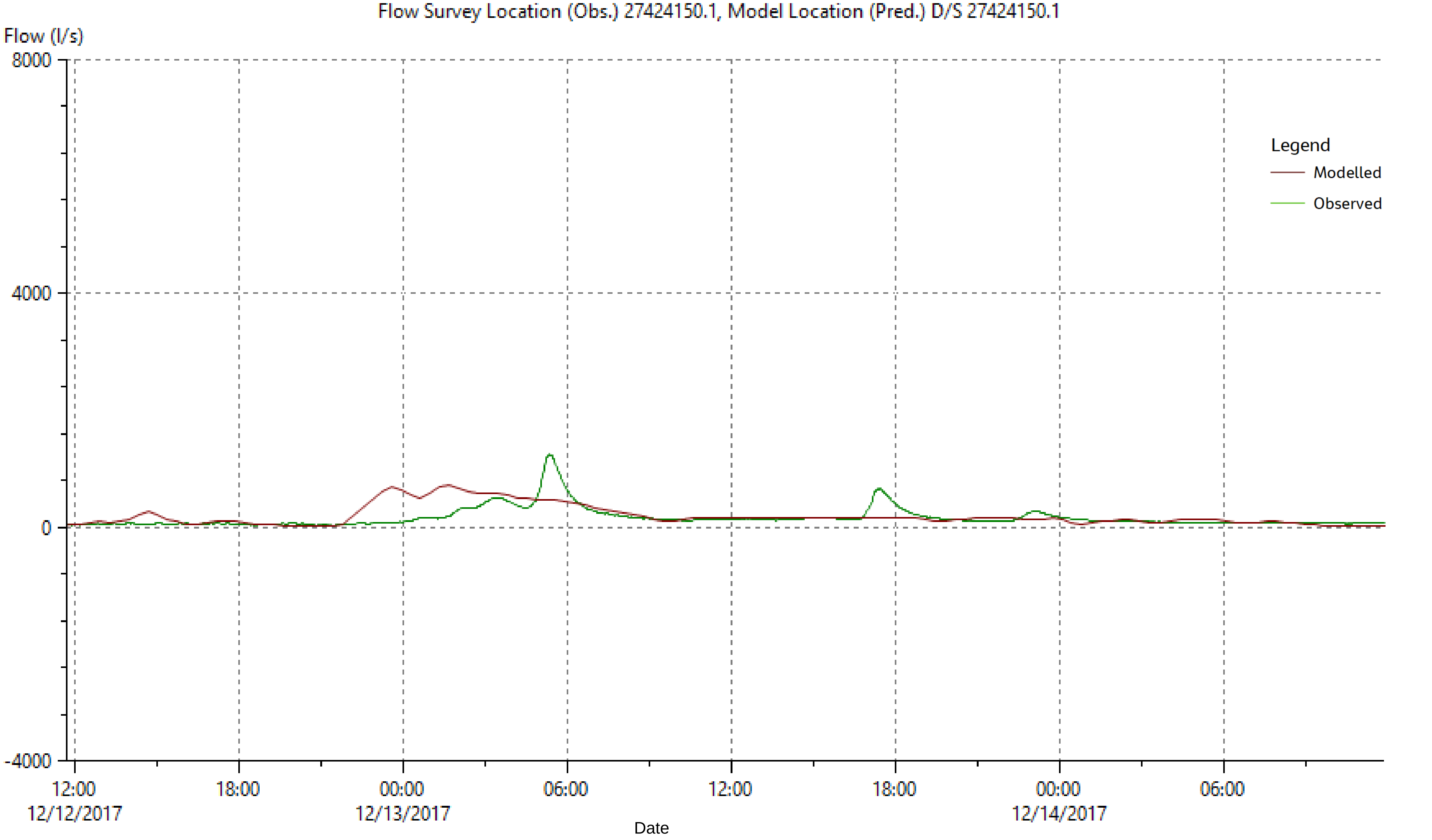
Figure A.3.2: Observed and predicted inflow to Pond D Lower for event 2



Date		Flow		
		Min (l/s)	Max (l/s)	Volume (m3)
Observed		-10.410	2224.141	52369.141
...infall event2017_2018 GAL data		23.628	2024.523	44627.244

Figure A.3.3: Observed and predicted inflow to Pond D Lower for event 3

Observed / Predicted Report Produced by McConkeyA (2/10/2023 3:02:24 AM) Page 1 of 1

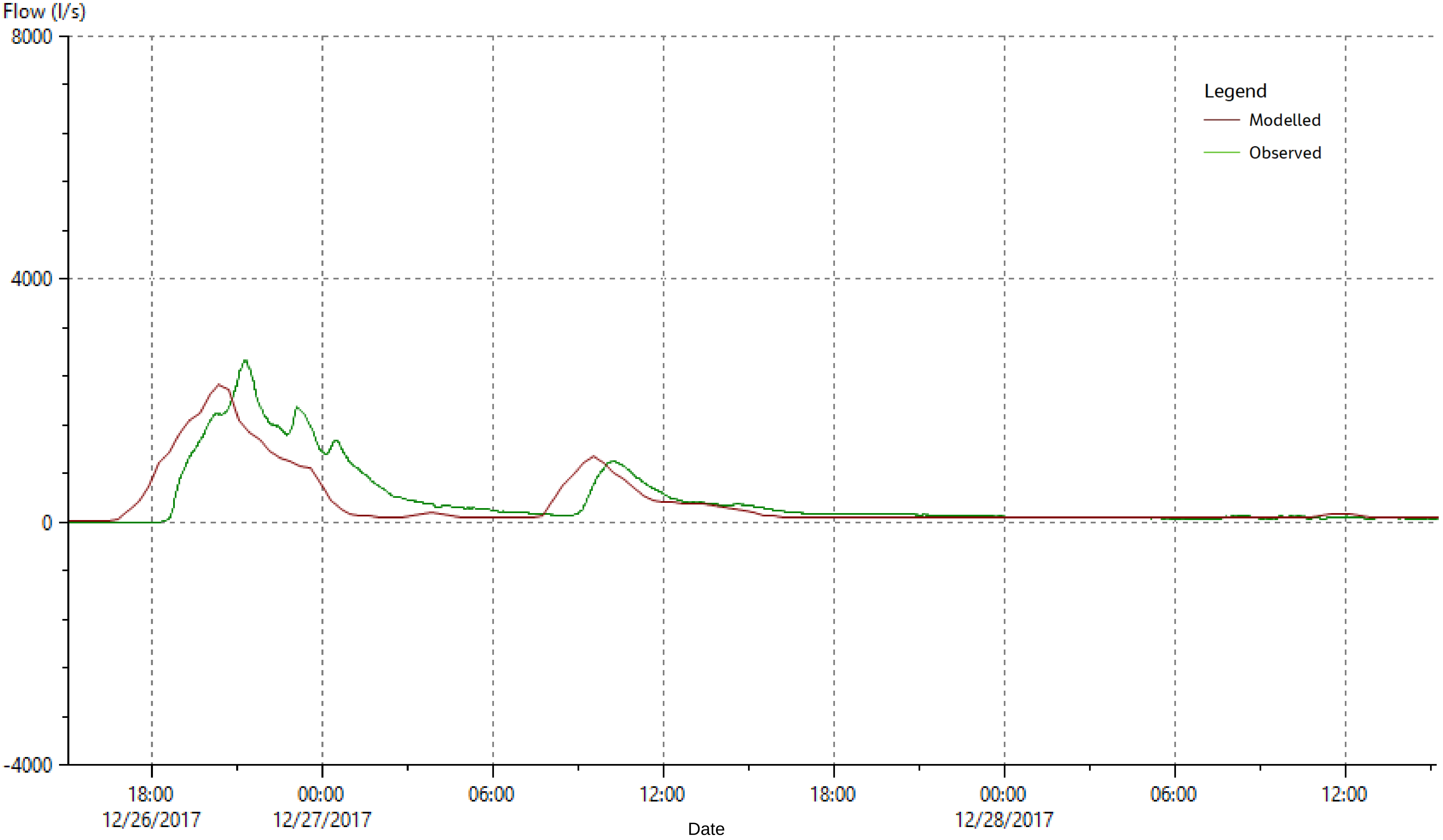


Date		Flow		
		Min (l/s)	Max (l/s)	Volume (m3)
Observed		30.456	1256.377	27303.833
...infall event2017_2018 GAL data		24.357	723.106	33821.356

Figure A.3.4: Observed and predicted inflow to Pond D Lower for event 4

Observed / Predicted Report Produced by McConkeyA (2/10/2023 3:02:24 AM) Page 1 of 1

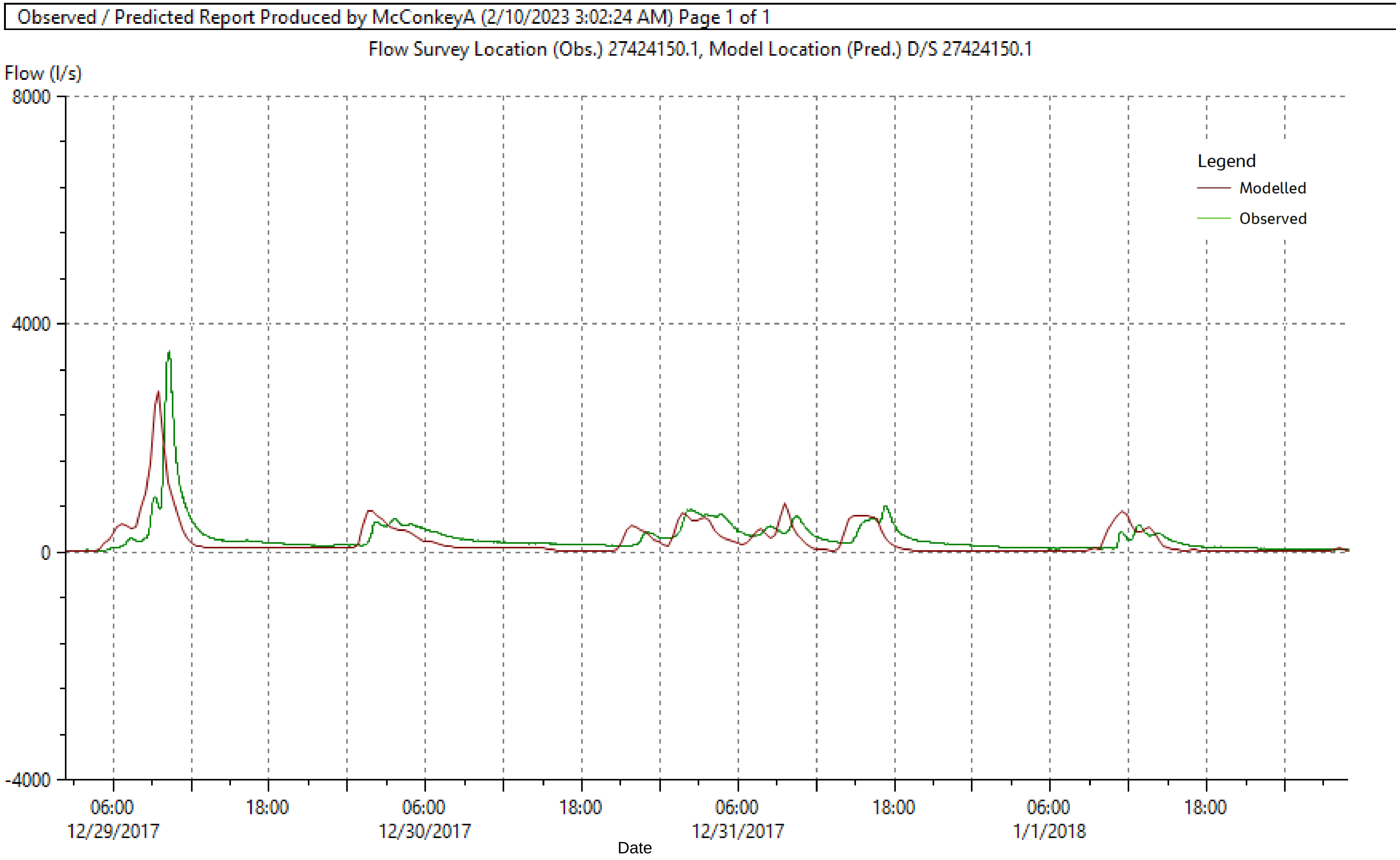
Flow Survey Location (Obs.) 27424150.1, Model Location (Pred.) D/S 27424150.1



Date

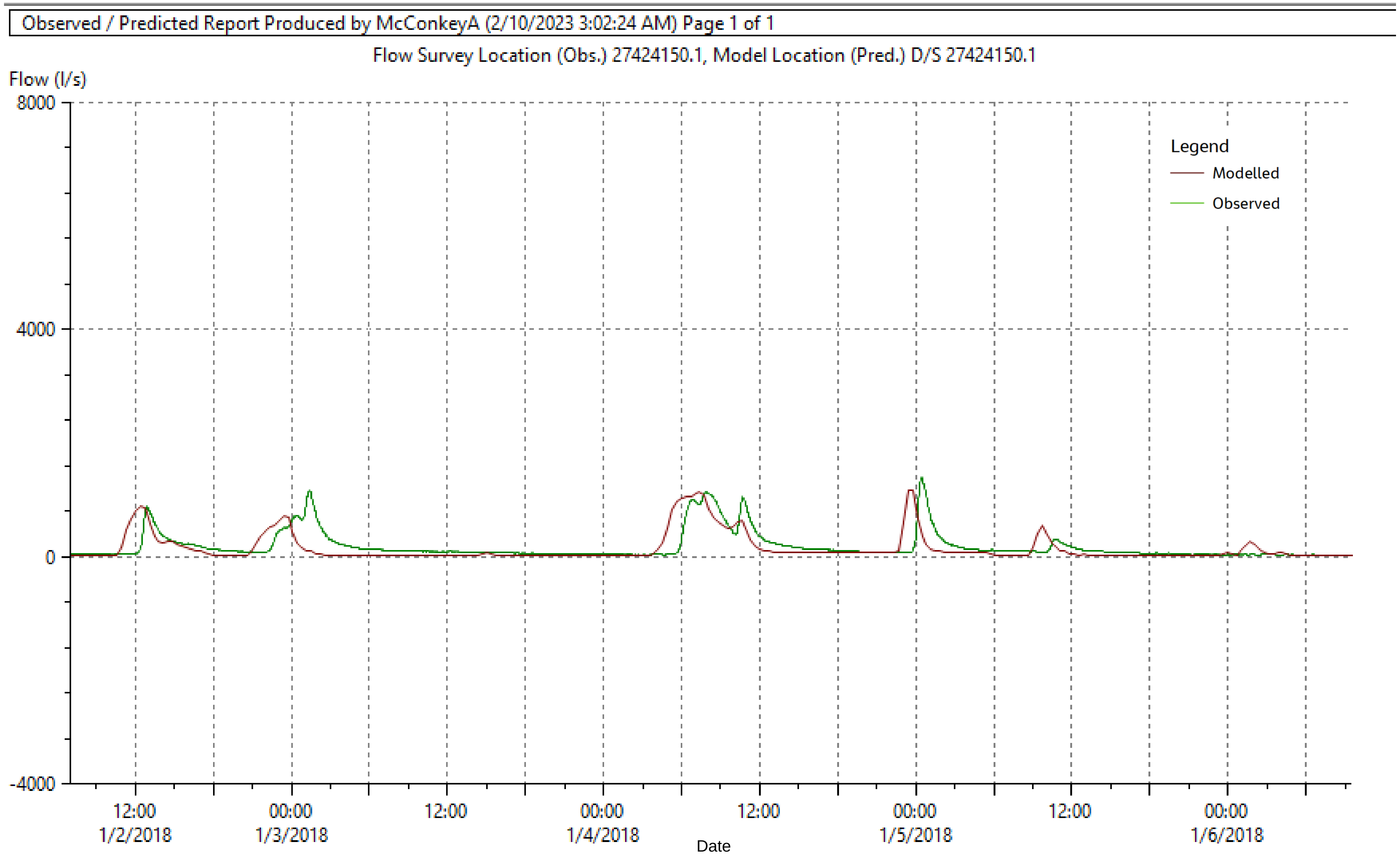
		Flow		
		Min (l/s)	Max (l/s)	Volume (m3)
Observed		-2.400	2654.673	63378.125
...infall event2017_2018 GAL data		23.171	2269.517	55350.812

Figure A.3.5: Observed and predicted inflow to Pond D Lower for event 5



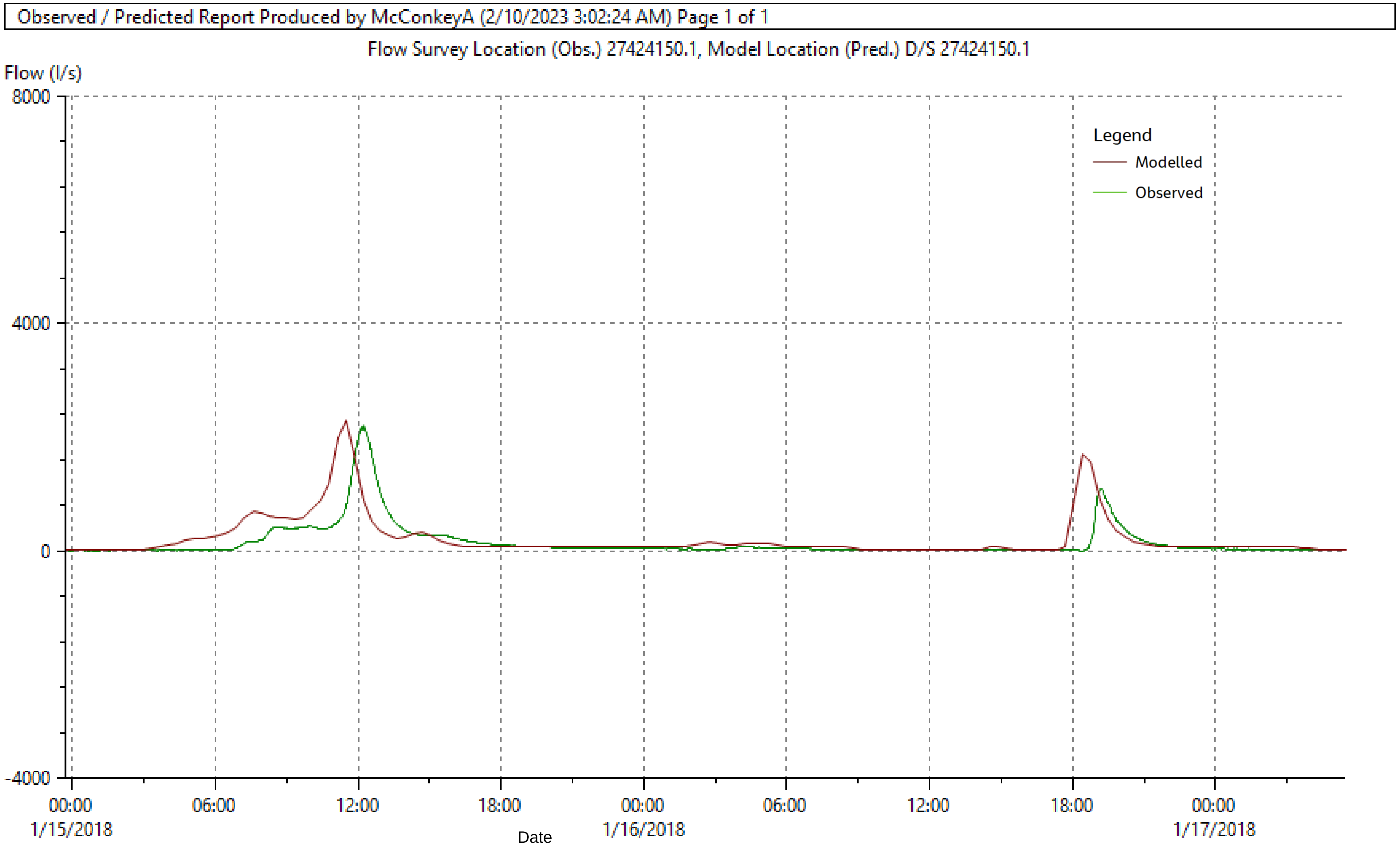
	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	9.380	3533.861	90452.654
...infall event2017_2018 GAL data	23.077	2842.909	75360.152

Figure A.3.6: Observed and predicted inflow to Pond D Lower for event 6



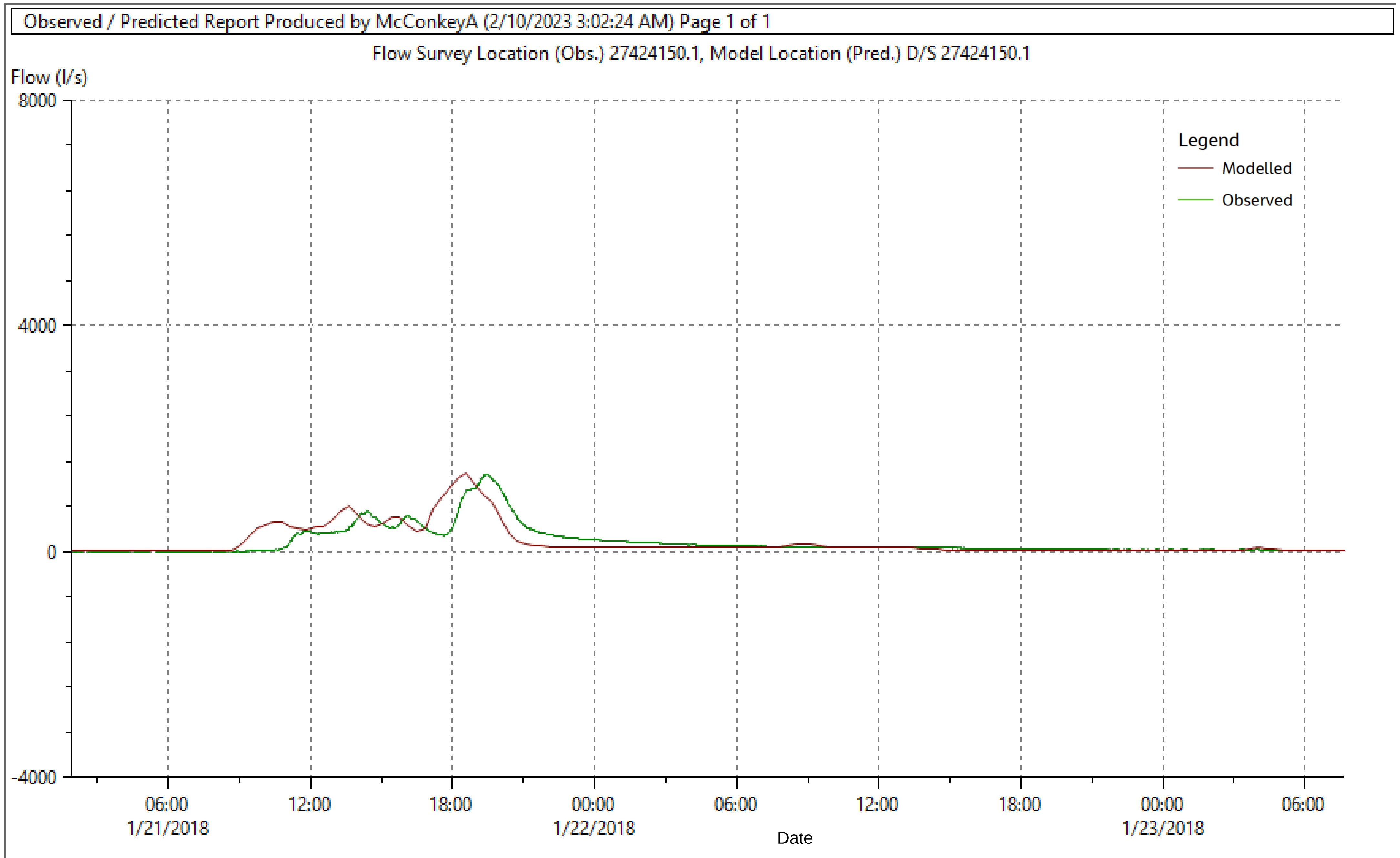
	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	15.256	1397.198	64157.806
...infall event2017_2018 GAL data	22.925	1180.385	54441.033

Figure A.3.7: Observed and predicted inflow to Pond D Lower for event 7



	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	-2.230	2207.593	28586.726
...infall event2017_2018 GAL data	23.098	2301.211	41974.796

Figure A.3.8: Observed and predicted inflow to Pond D Lower for event 8

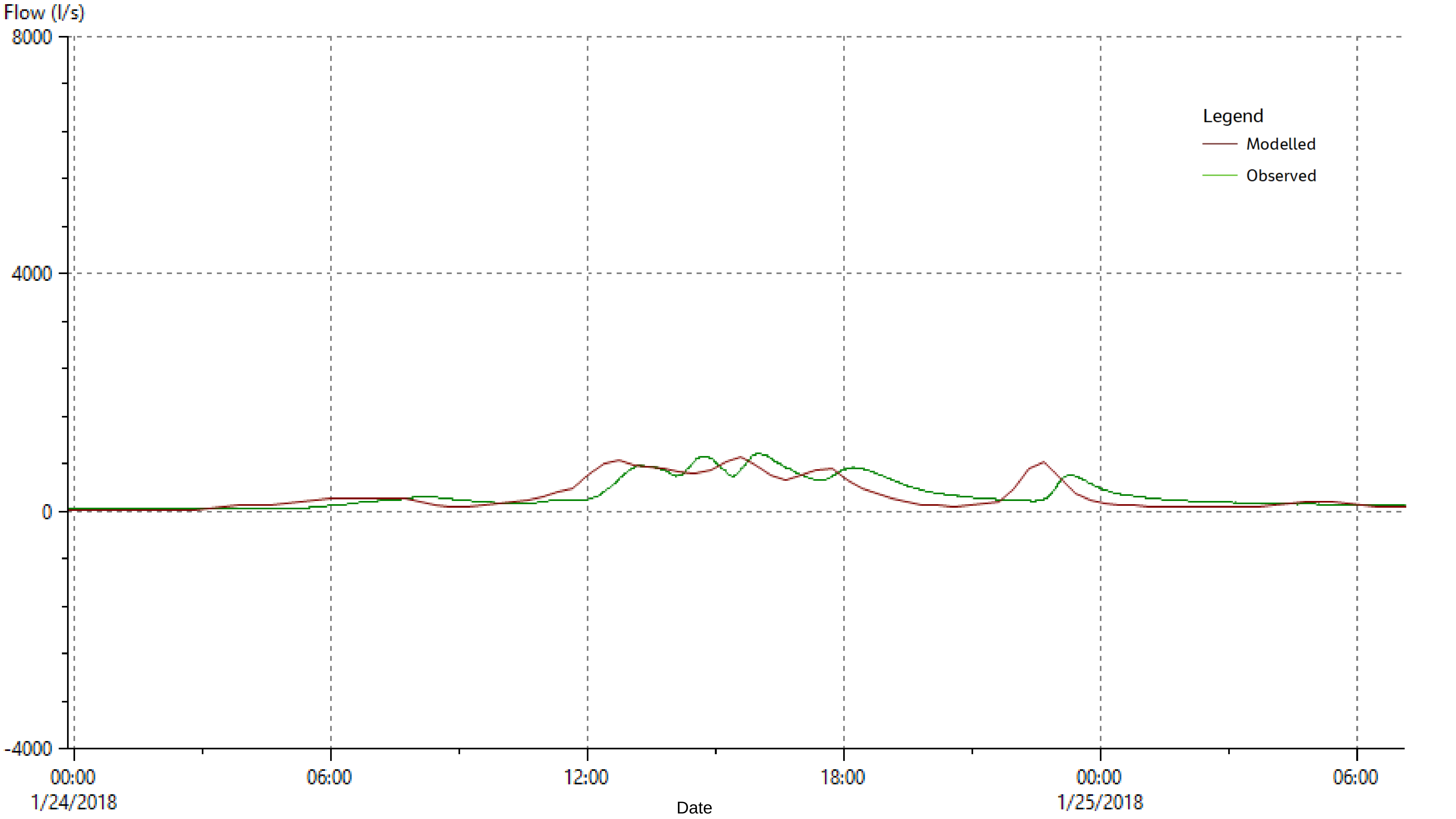


	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	-3.690	1364.983	32575.886
...infall event2017_2018 GAL data	23.023	1392.850	33974.715

Figure A.3.9: Observed and predicted inflow to Pond D Lower for event 9

Observed / Predicted Report Produced by McConkeyA (2/10/2023 3:02:24 AM) Page 1 of 1

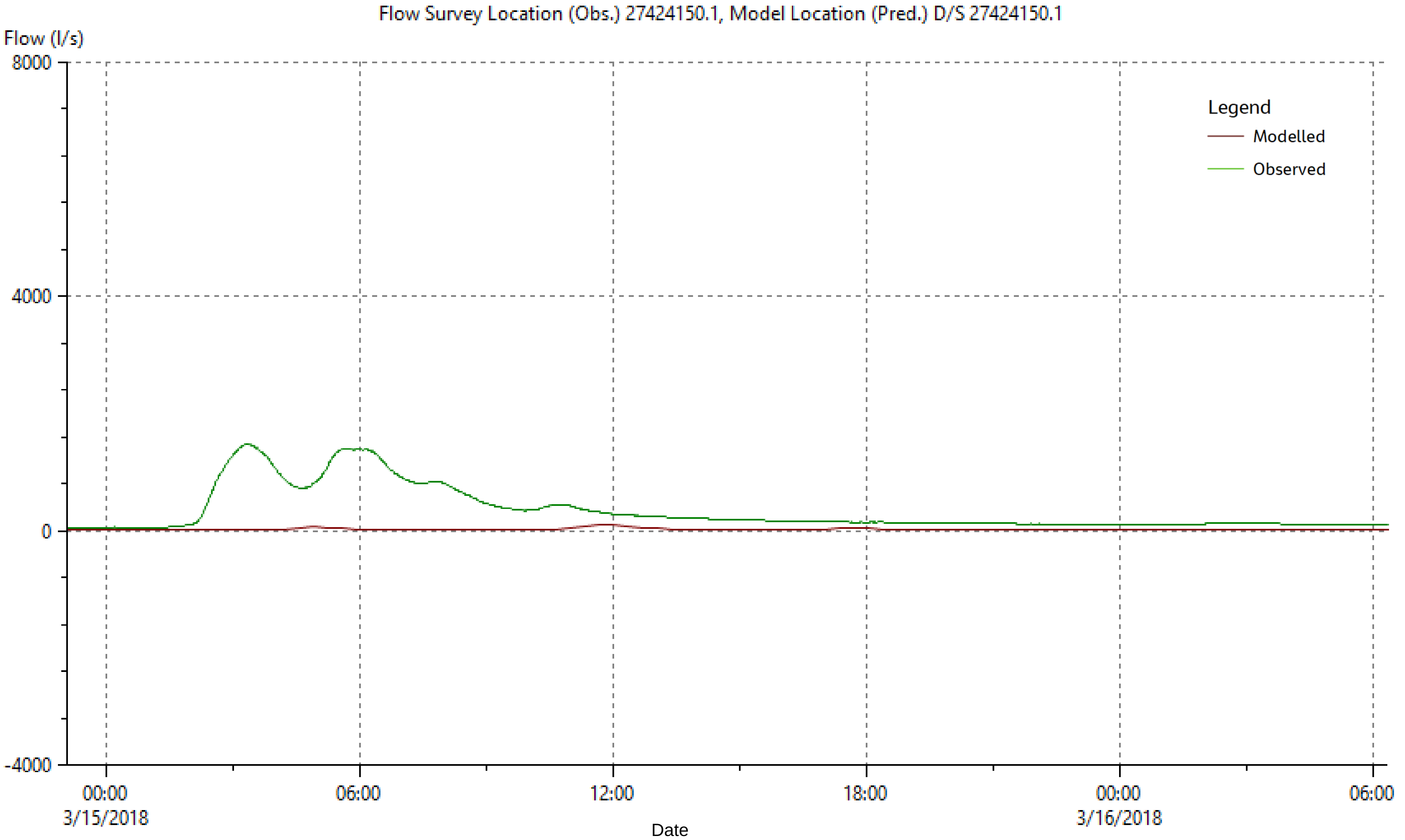
Flow Survey Location (Obs.) 27424150.1, Model Location (Pred.) D/S 27424150.1



	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	33.396	975.867	31812.081
...infall event2017_2018 GAL data	23.113	919.801	30539.902

Figure A.3.10: Observed and predicted inflow to Pond D Lower for event 10

Observed / Predicted Report Produced by McConkeyA (2/10/2023 3:02:24 AM) Page 1 of 1

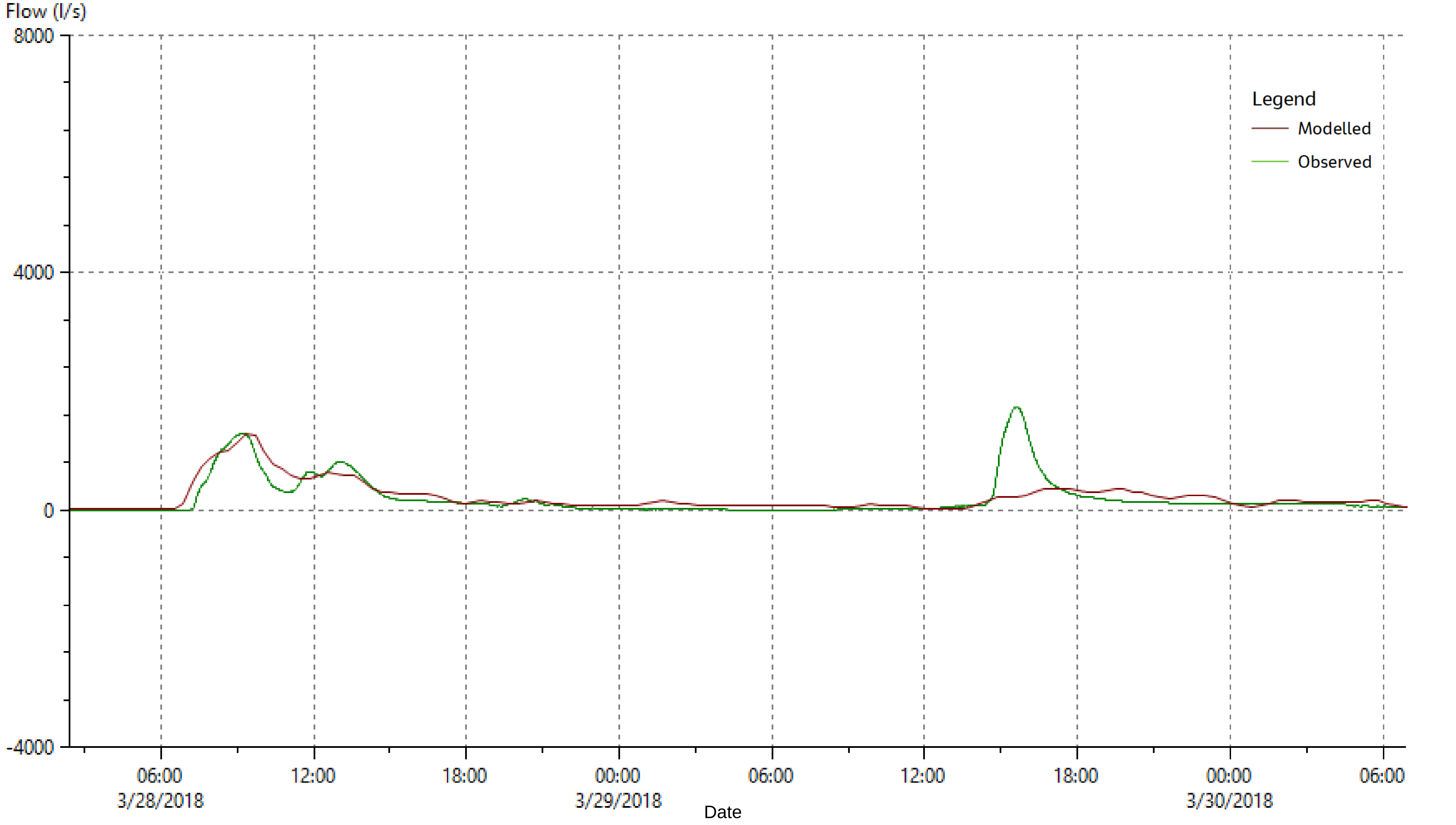


	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	56.128	1481.794	38361.917
...infall event2017_2018 GAL data	23.036	95.139	3412.549

Figure A.3.11: Observed and predicted inflow to Pond D Lower for event 11

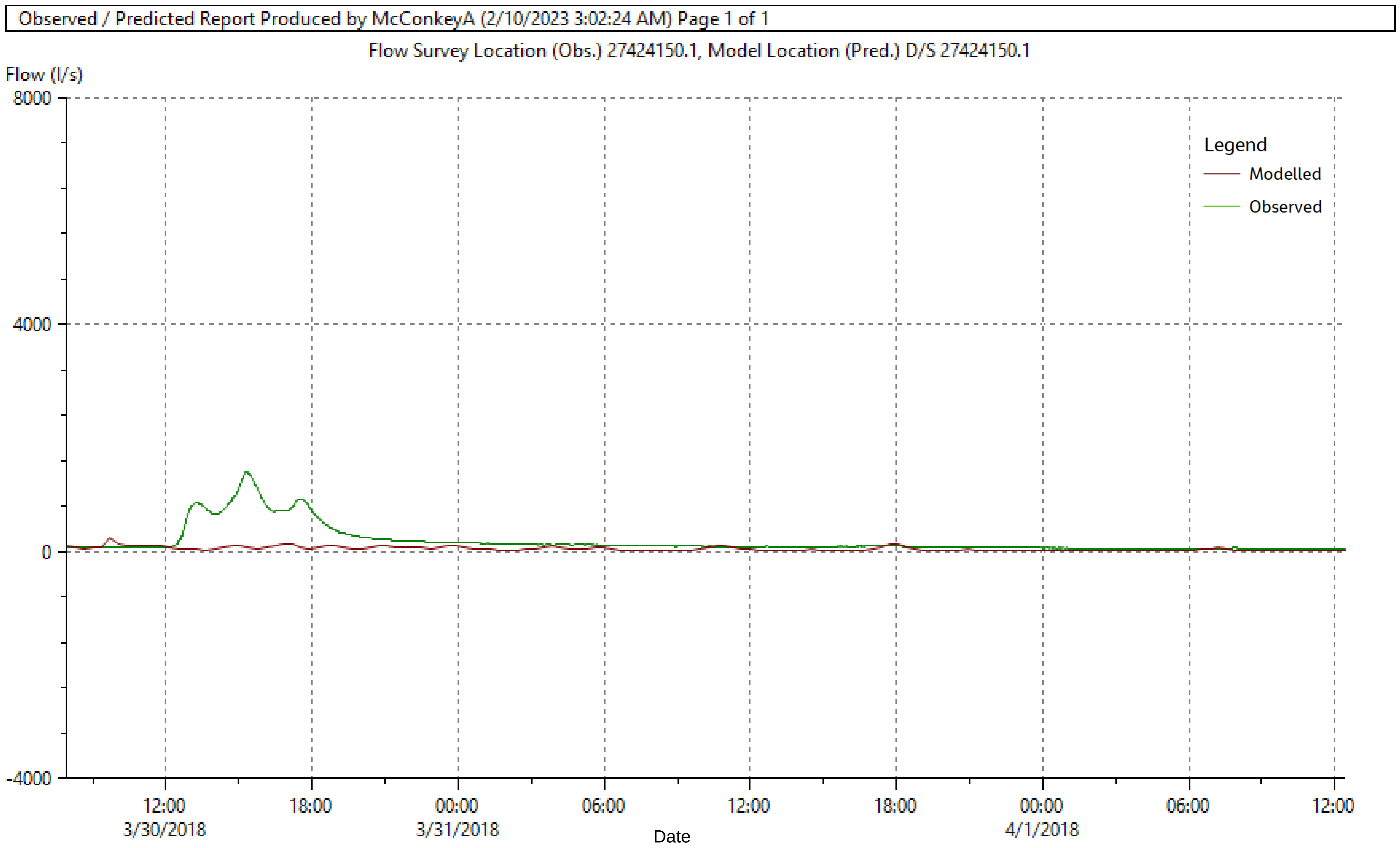
Observed / Predicted Report Produced by McConkeyA (2/10/2023 3:02:24 AM) Page 1 of 1

Flow Survey Location (Obs.) 27424150.1, Model Location (Pred.) D/S 27424150.1



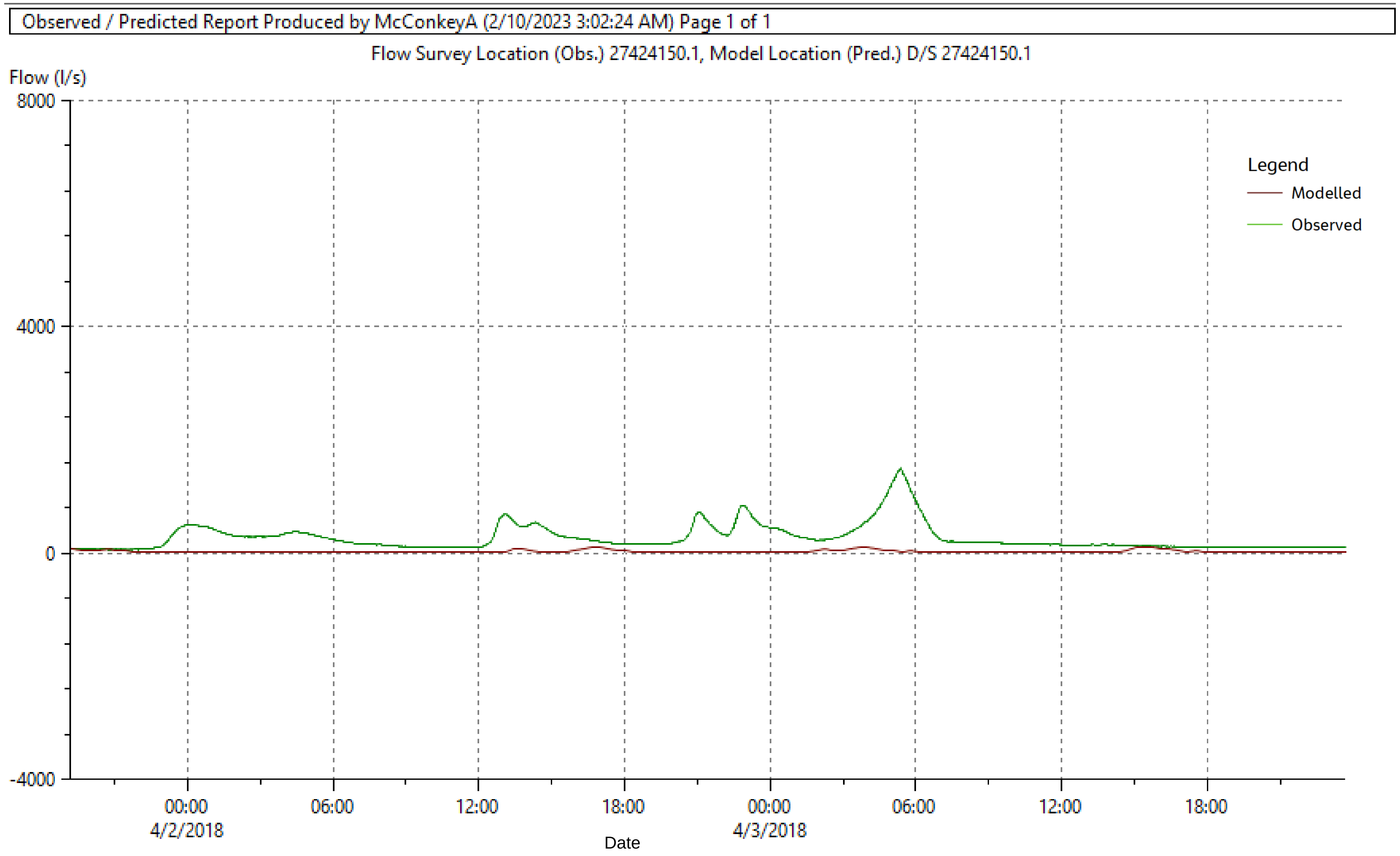
	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	-10.260	1739.773	37159.159
...infall event2017_2018 GAL data	23.436	1277.936	41810.289

Figure A.3.12: Observed and predicted inflow to Pond D Lower for event 12



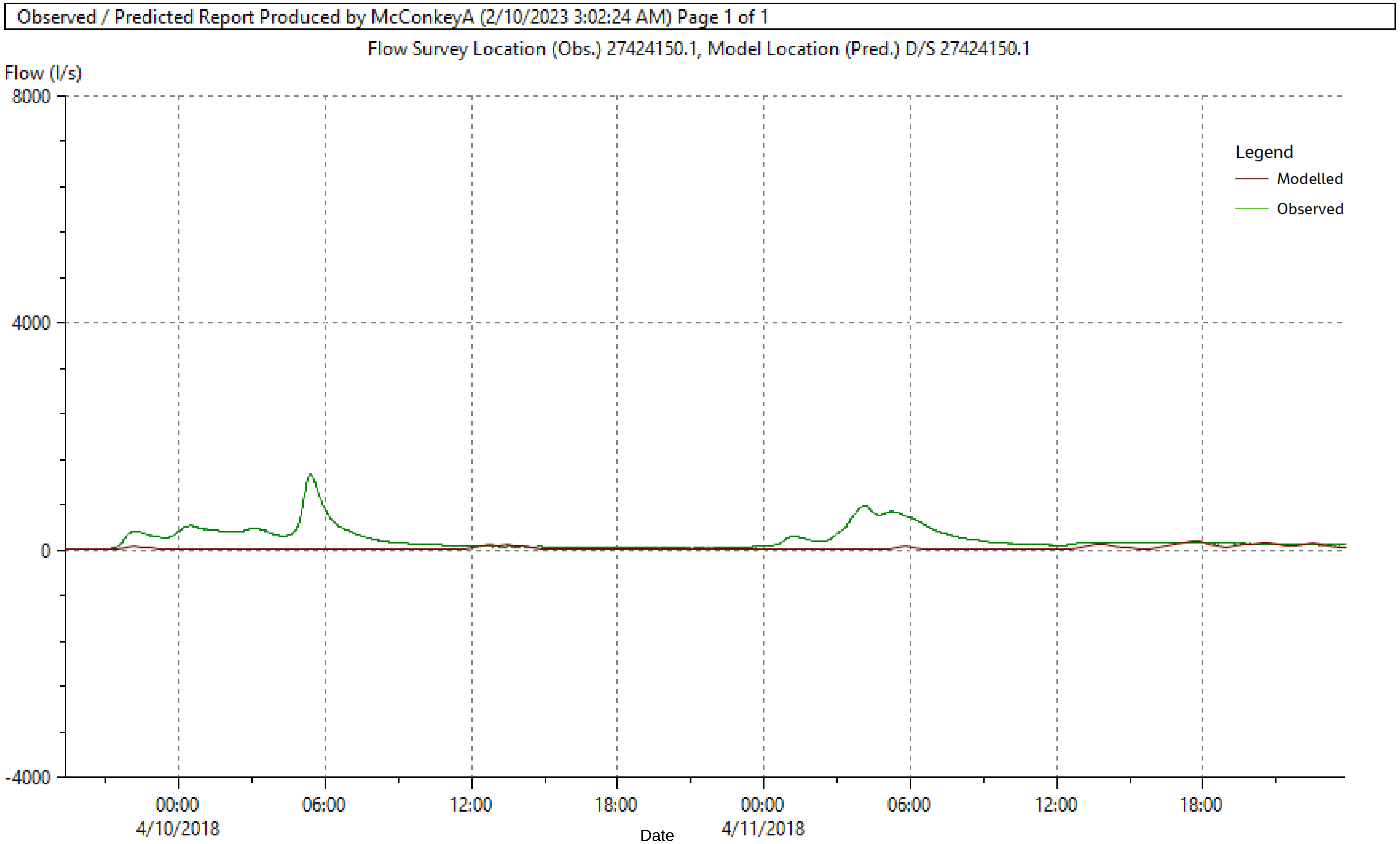
	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	45.795	1403.751	34400.227
...infall event2017_2018 GAL data	22.685	234.719	9782.271

Figure A.3.13: Observed and predicted inflow to Pond D Lower for event 13



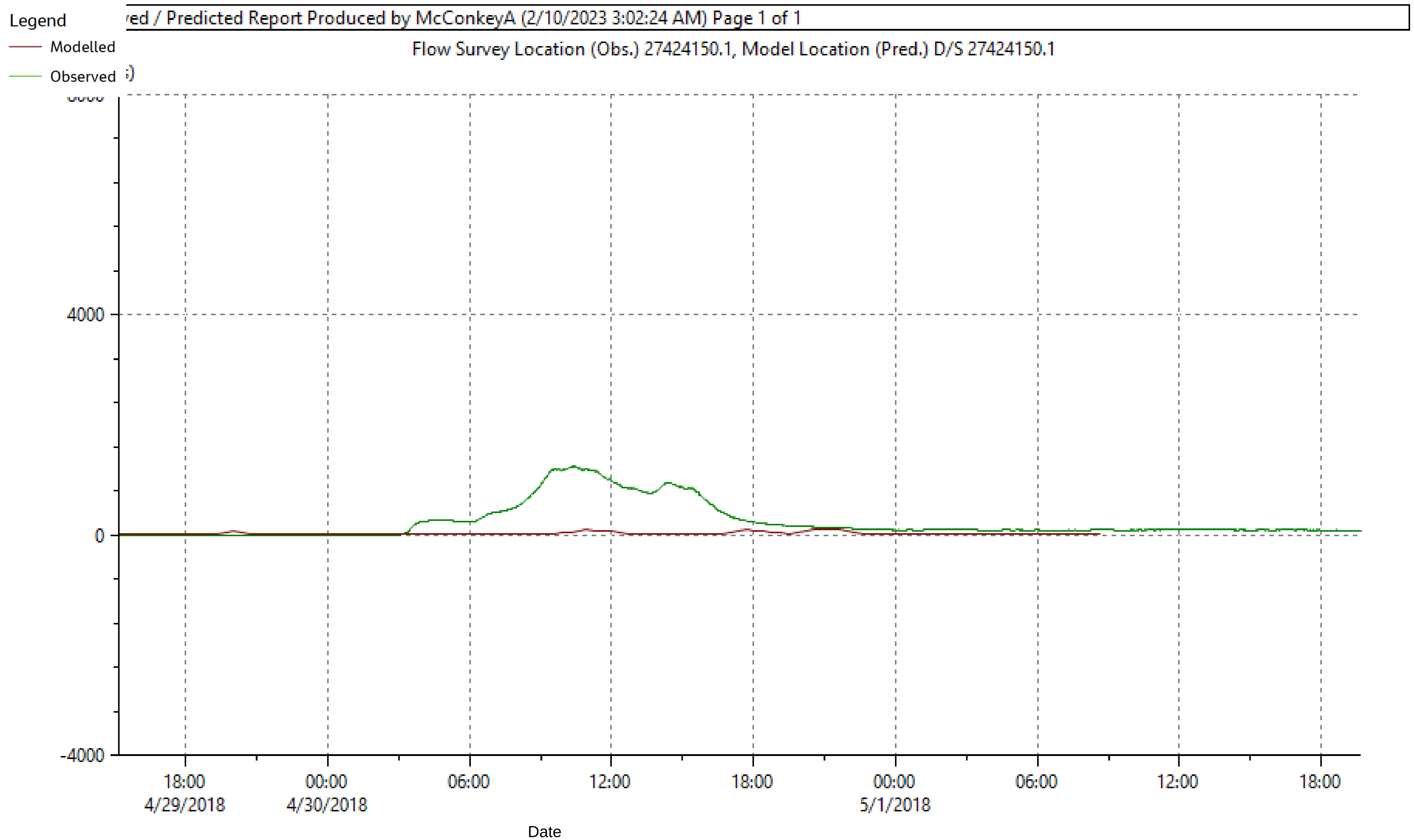
	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	58.562	1504.737	50355.512
...infall event2017_2018 GAL data	23.026	105.641	6503.179

Figure A.3.14: Observed and predicted inflow to Pond D Lower for event 14



	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	12.206	1331.924	36895.694
...infall event2017_2018 GAL data	23.031	159.826	7976.085

Figure A.3.15: Observed and predicted inflow to Pond D Lower for event 15

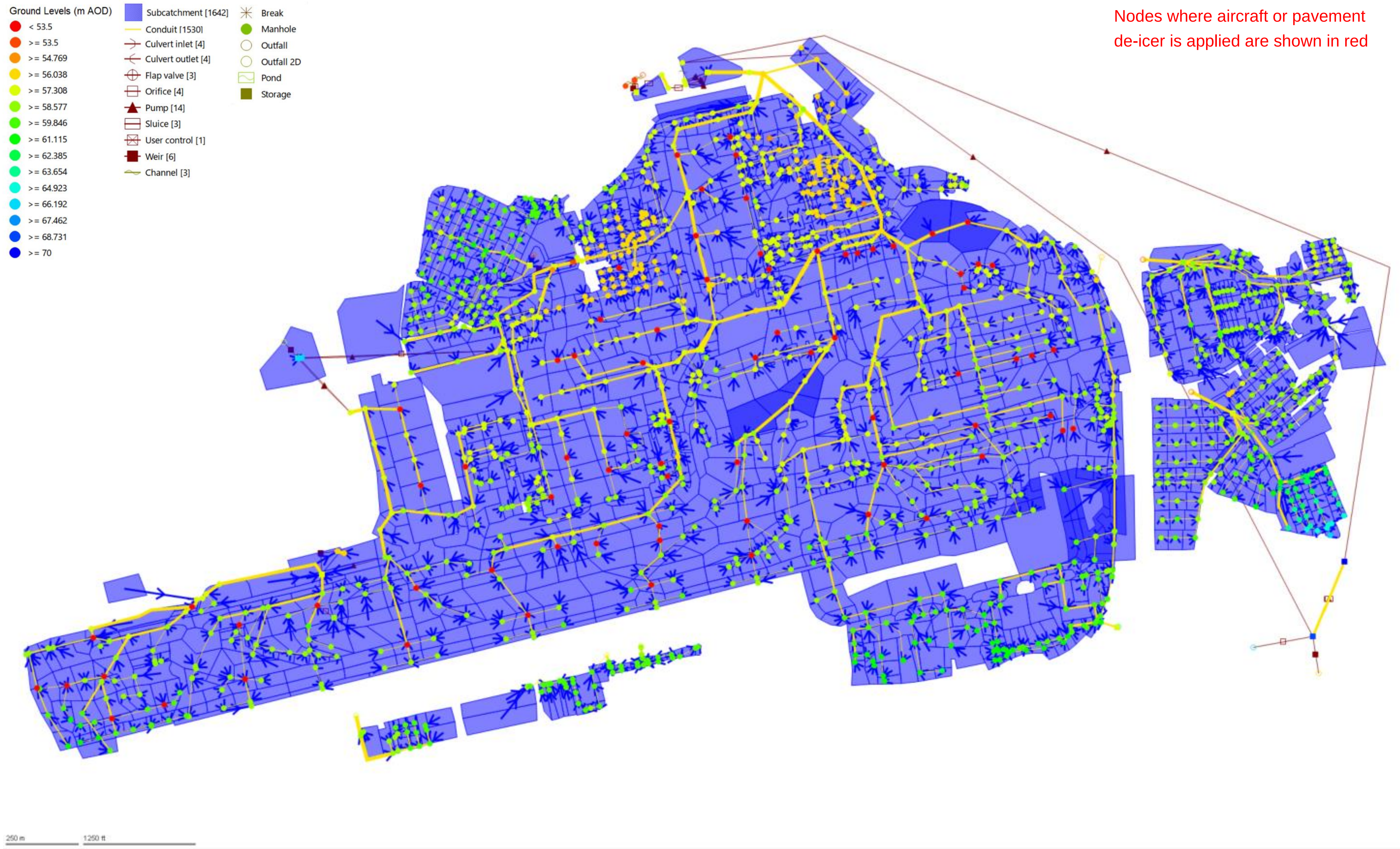


	Flow		
	Min (l/s)	Max (l/s)	Volume (m3)
Observed	-10.200	1253.120	43820.236
Date ...infall event2017_2018 GAL data	23.016	94.248	5241.127

Figure A.3.16: Observed and predicted inflow to Pond D Lower for event 16

Annex 4 –

De-icer application in model


Ground Levels (m AOD)
< 53.5
>= 53.5
>= 54.769
>= 56.038
>= 57.308
>= 58.577
>= 59.846
>= 61.115
>= 62.385
>= 63.654
>= 64.923
>= 66.192
>= 67.462
>= 68.731
>= 70
Subcatchment [1642]
Conduit [1530]
Culvert inlet [4]
Culvert outlet [4]
Flap valve [3]
Orifice [4]
Pump [14]
Sluice [3]
User control [1]
Weir [6]
Channel [3]
Break
Manhole
Outfall
Outfall 2D
Pond
Storage
Nodes where aircraft or pavement de-icer is applied are shown in red
250 m
1250 ft

Annex 5

UPM impact assessment results

Table A.5.1 Water quality impact evaluation at Pond A

Scenario	Project land use changes	Airfield Mitigations	New Pond A	Car park Y Facility (area m^2)	100l/s treatment system	Without Konsin	With Konsin
						Number of spills	Number of spills
Baseline	-	-	-	-	-		0
1	Y	Y	Y	-	-	2	1
2	Y	Y	Y	1,563 (10,160)	-	4	2
3	Y	Y	Y	9,375 (60,973)	-	2	0
4	Y	Y	Y	1,563 (10,160)	Y	0	3
5	Y	Y	Y	9,375 (60,973)	Y	2	2
6	Y	Y	-	1,563 (10,160)	Y	0	0
7	Y	Y	-	9,375 (60,973)	Y	0	0
8	Y	Y	-	-	Y	0	0
9	-	-	-	-	Y	1	1
10	Y	Y	Y	-	Y	1	0
11	Y	Y	-	5,000 (32,000)	Y	0	0

Table A.5.2 Water quality impact evaluation at Pond M

Scenario	Project land use changes	Airfield Mitigations	New Pond A	Car park Y Facility (area m^2 (volume m^3))	100l/s treatment system	Without Konsin	With Konsin
						Number of spills	Number of spills
Baseline	-	-	-	-	-		1
1	Y	Y	Y	-	-	1	1
2	Y	Y	Y	1,563 (10,160)	-	1	1
3	Y	Y	Y	9,375 (60,973)	-	1	1
4	Y	Y	Y	1,563 (10,160)	Y	1	2
5	Y	Y	Y	9,375 (60,973)	Y	2	0
6	Y	Y	-	1,563 (10,160)	Y	0	0
7	Y	Y	-	9,375 (60,973)	Y	0	0
8	Y	Y	-	-	Y	0	4
9	-	-	-	-	Y	4	1
10	Y	Y	Y	-	Y	1	0
11	Y	Y	-	5,000 (32,000)	Y	0	1

Table A.5.3 Water quality impact evaluation at Dog Kennel Pond

Scenario	Project land use changes	Airfield Mitigations	New Pond A	Car park Y Facility (area m^2 (volume m^3))	100l/s treatment system	Without Konsin	With Konsin
						Number of spills	Number of spills
Baseline	-	-	-	-	-		2
1	Y	Y	Y	-	-	2	2
2	Y	Y	Y	1,563 (10,160)	-	2	2
3	Y	Y	Y	9,375 (60,973)	-	2	2
4	Y	Y	Y	1,563 (10,160)	Y	2	2
5	Y	Y	Y	9,375 (60,973)	Y	2	2
6	Y	Y	-	1,563 (10,160)	Y	2	2
7	Y	Y	-	9,375 (60,973)	Y	2	2
8	Y	Y	-	-	Y	2	2
9	-	-	-	-	Y	2	2
10	Y	Y	Y	-	Y	2	2
11	Y	Y	-	5,000 (32,000)	Y	2	2

Table A.5.4 Water quality impact evaluation at Pond D

Scenario	Project land use changes	Airfield Mitigations	New Pond A	Car park Y Facility (area m^2(volume m^3))	100l/s treatment system	Without Konsin	With Konsin
						Number of spills	Number of spills
Baseline	-	-	-	-	-		140
1	Y	Y	Y	-	-	127	139
2	Y	Y	Y	1,563 (10,160)	-	140	145
3	Y	Y	Y	9,375 (60,973)	-	140	146
4	Y	Y	Y	1,563 (10,160)	Y	9	9
5	Y	Y	Y	9,375 (60,973)	Y	0	0
6	Y	Y	-	1,563 (10,160)	Y	0	10
7	Y	Y	-	9,375 (60,973)	Y	0	0
8	Y	Y	-	-	Y	10	30
9	-	-	-	-	Y	7	7
10	Y	Y	Y	-	Y	9	10
11	Y	Y	-	5,000 (32,000)	Y	0	0

Table A.5.5 Water quality impact evaluation at Pond E

Scenario	Project land use changes	Airfield Mitigations	New Pond A	Car park Y Facility (area m^2 (volume m^3))	100l/s treatment system	Without Konsin	With Konsin
						Number of spills	Number of spills
Baseline	-	-	-	-	-		0
1	Y	Y	Y	-	-	0	0
2	Y	Y	Y	1,563 (10,160)	-	0	0
3	Y	Y	Y	9,375 (60,973)	-	0	0
4	Y	Y	Y	1,563 (10,160)	Y	0	0
5	Y	Y	Y	9,375 (60,973)	Y	0	0
6	Y	Y	-	1,563 (10,160)	Y	0	0
7	Y	Y	-	9,375 (60,973)	Y	0	0
8	Y	Y	-	-	Y	0	0
9	-	-	-	-	Y	0	0
10	Y	Y	Y	-	Y	0	0
11	Y	Y	-	5,000 (32,000)	Y	0	0

Annex 6

New Water Treatment Works

NOTES

1. WORKING AREAS FOR CONSTRUCTION ARE NOT SHOWN WITHIN THE DRAWING.
2. ALL BASE MAPPING AND TOPOGRAPHICAL SURVEY INFORMATION HAS BEEN PROVIDED BY GAL. NO GUARANTEE CAN BE GIVEN BY JACOBS AS TO ACCURACY OR COMPLETENESS. THE LOCATION OF ALL UNDERGROUND SERVICES SHOULD BE VERIFIED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
3. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE. ALL LEVELS ARE TO METRES A.O.D.
4. DO NOT SCALE FROM THIS DRAWING.
5. THIS DRAWING TO BE READ IN COLOUR.
6. PROPOSED WORKS FOR WATER REUSE ARE INDICATIVE AND SUBJECT TO CHANGE AS A RESULT OF FURTHER HYDRAULIC MODELLING. AREAS AND OPERATION OF THE STORAGE AREAS TO BE CONFIRMED AND SUBJECT TO AGREEMENT WITH ENVIRONMENT AGENCY.
7. DETAILS OF NEW PUMPING STATION, CONNECTION TO THE NEW GREYWATER SYSTEM, BUNDING OF LAGOON TO BE CONFIRMED.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

1. IDENTIFY AND LOCATE EXISTING SERVICES. ALL BURIED SERVICES TO BE ISOLATED/PROTECTED PRIOR TO START OF WORKS
2. IMPLEMENT SAFETY MEASURES FOR WORKING NEAR WATER.

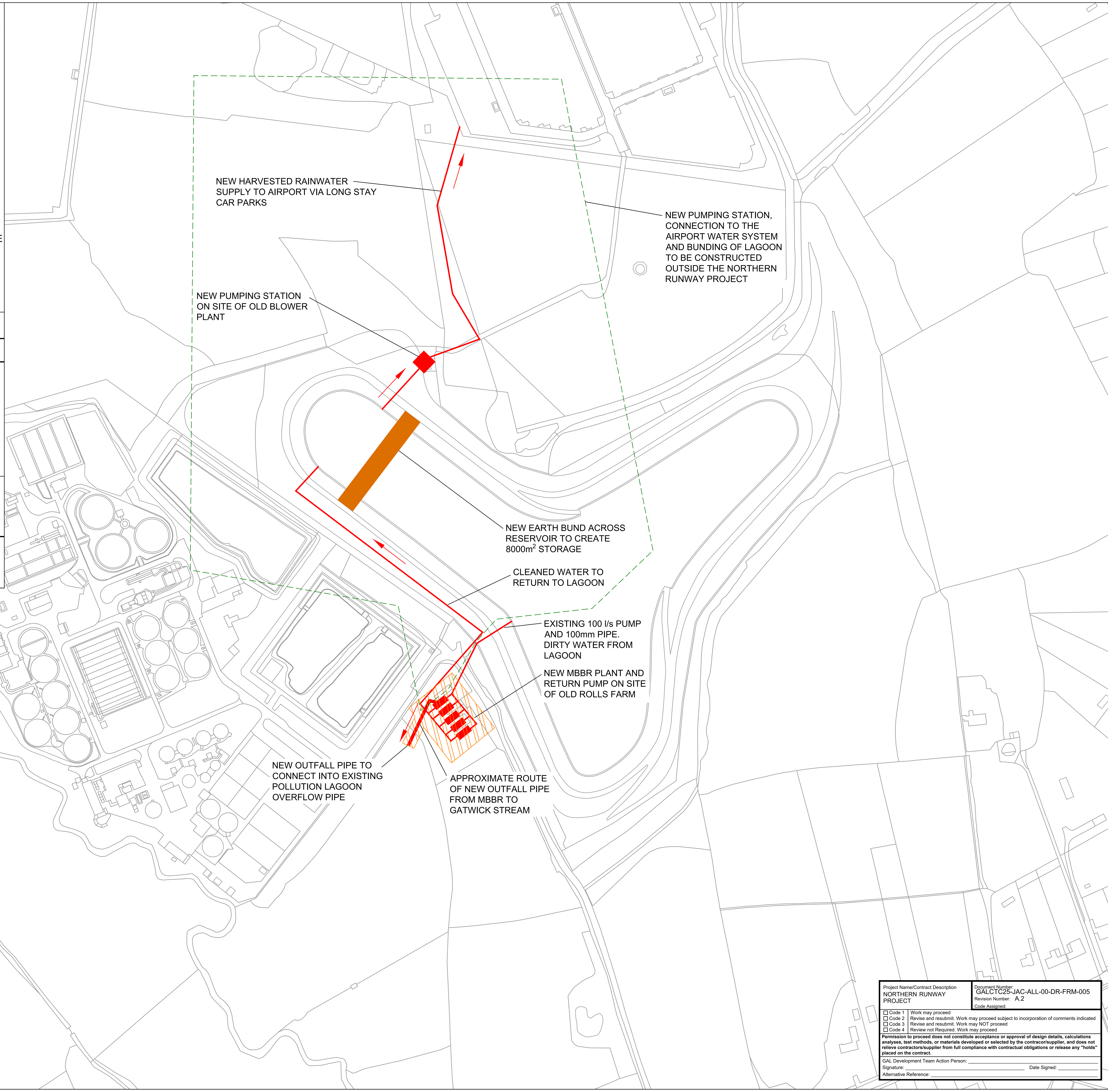
MAINTENANCE / CLEANING

- HAZARDS 1 AND 3 AS ABOVE.

DECOMMISSIONING / DEMOLITION

- HAZARDS 1, 2 AND 3 AS ABOVE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement



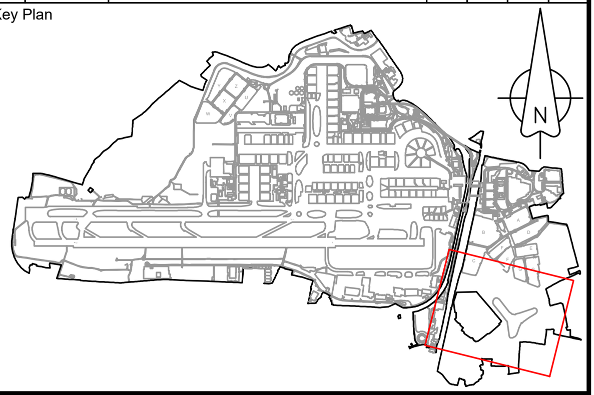
Model File References List - XRef Model Name (excluding path), Version & Status:
OS Mastermap - March 2016

LEGEND

- NEW BUND
- CLEAN WATER RETURN
- EXISTING PIPEWORK
- 10M CONSTRUCTION EASEMENT

Rev	Date	Revision Description	Drn	Chk	Rvd	App
A2	10/06/2022	FOR CLIENT COMMENT	RT	MS	MS	RC
A1	31/03/2022	FOR CLIENT COMMENT	RT	MS	MS	RC

Key Plan



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YOUR LONDON AIRPORT Gatwick

Project Name
NORTHERN RUNWAY PROJECT

Title
WATER REUSE LAYOUT

Project Name/Contract Description
NORTHERN RUNWAY PROJECT

Document Number: GALCTC25-JAC-ALL-00-DR-FRM-005
Revision Number: A.2
Code Assigned:

- ☐ Code 1 Work may proceed
- ☐ Code 2 Revise and resubmit. Work may proceed subject to incorporation of comments indicated
- ☐ Code 3 Revise and resubmit. Work may NOT proceed
- ☐ Code 4 Review not Required. Work may proceed

Permission to proceed does not constitute acceptance or approval of design details, calculations analyses, test methods, or materials developed or selected by the contracor/supplier, and does not relieve contractors/supplier from full compliance with contractual obligations or release any "holds" placed on the contract.

GAL Development Team Action Person: ______
Signature: ______ Date Signed: ______
Alternative Reference: ______

Common Language Series: -	GAL Project No.: GALCTC12
Common Language System: -	Originator's Job No.: GALCTC12
Drawing Originator: JACOBS	Drawn Date: 31/03/2022

Checked By	Checked Date	Drawn By	Status
MS	10/06/2022	RT	

Approved By	Approval Date	Scale	Reason for Issue
RC	10/06/2022	N/A	IFI

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