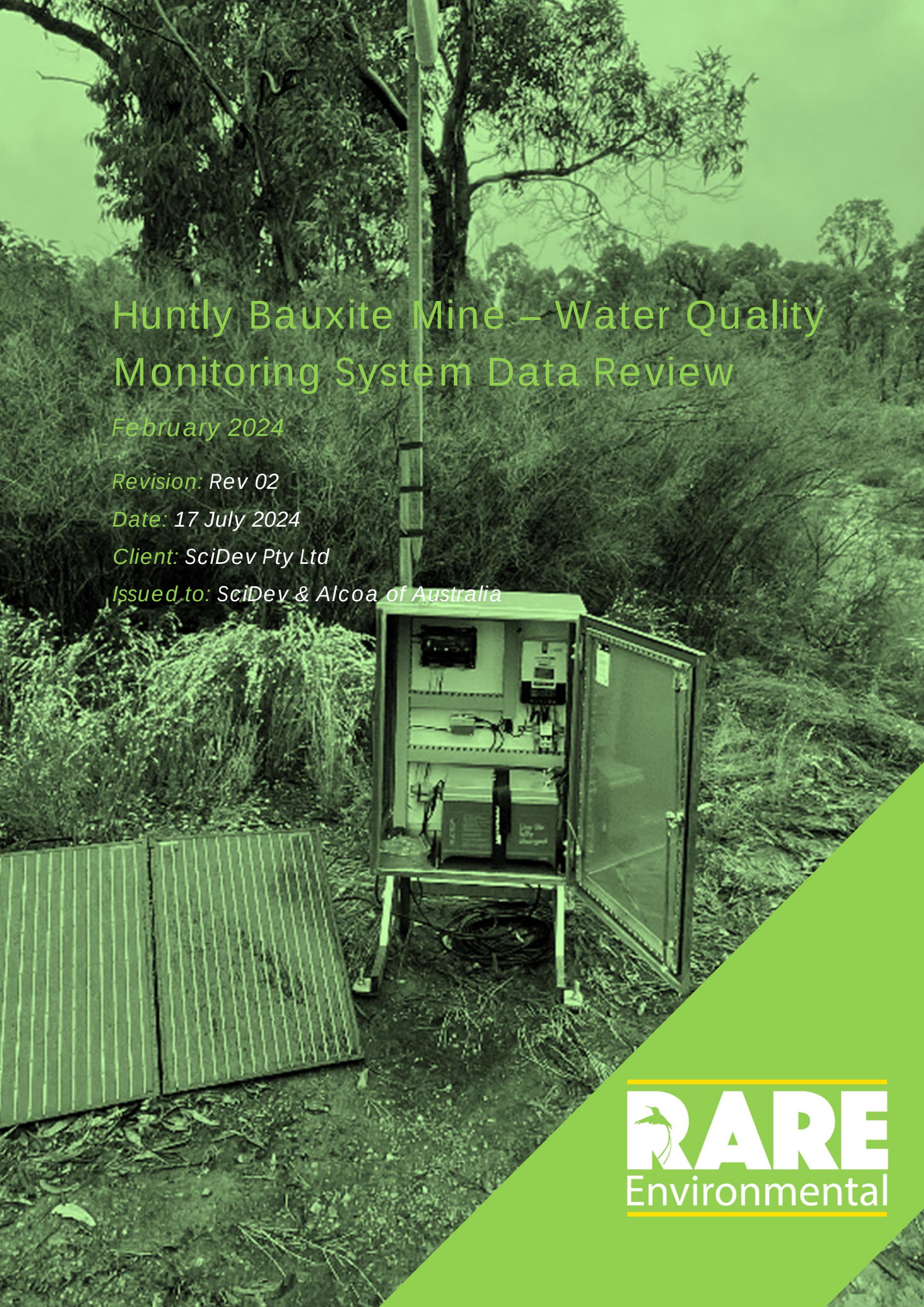

Huntly Bauxite Mine – Water Quality Monitoring System Data Review

February 2024

Revision: Rev 02

Date: 17 July 2024

Client: SciDev Pty Ltd

Issued to: SciDev & Alcoa of Australia

RARE Environmental

Document Control

Project Details	
Document Title	Huntly Bauxite Mine – Water Quality Monitoring System Data Review
Document No	RP24050 HUN WQMS Data Review - February 2024 Rev02.docx
Project Name	SciDev WQ Data Processing
Project Number	RP24050
Client	SciDev
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01	9/05/24	Issued for internal review	SM	RD	RD	SciDev
02	17/07/24	DWER feedback	SM	RD	RD	SciDev/Alcoa

Report Sign Off					
Report Version	02				
Prepared by		Technical Review		Approved for Issue	
					
Name	Sarah Mathew	Name	Rob Dwyer	Name	Rob Dwyer
Position	Env. Scientist	Position	Regional Manager	Position	Regional Manager
Date	17/07/2024	Date	17/07/2024	Date	17/07/2024

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Infrastructure Sustainability Council MEMBER

Contents

1. Introduction

1.1. Purpose

RARE Environmental Pty Ltd (RARE) was engaged by SciDev Pty Ltd (SciDev) to analyse and comment on raw turbidity monitoring data collected by their Water Quality Monitoring Systems (WQMSs) at the Huntly Bauxite Mine, owned and operated by Alcoa of Australia Limited (Alcoa). Stream turbidity monitoring is a core regulatory requirement stipulated as part of Alcoa's approvals and operating framework. The data for this reporting period was collected in February of 2024.

This report has been prepared to assess the quality of data provided and identify potential drainage incidents ('true' events) per the procedure detailed below within that data. Where possible recommendations are made for either WQMS network upgrades or further investigation of events identified within the data. This report should not be considered an assessment of the WQMS network and/or Alcoa's compliance to relevant legislation and requirements, nor should it be considered an assessment of the suitability of the adopted trigger level and event classification procedure.

1.2. Context

Data from each location has been collected and compared against the drainage incident trigger level outlined in the *Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023* Schedule 1 Division 2 Cl. 6. Trigger events have then been assessed against Alcoa's turbidity event classification guidelines to determine whether the event is true, i.e. caused by stream turbidity, or false, i.e. caused by stream debris, algae or other. For the purpose of this report a turbidity event is an event where turbidity levels, measured by a WQMS, are at least 25 nephelometric turbidity units (NTU) for a period of at least 1 hour.

A site map showing the WQMSs locations is provided in Appendix A.

1.3. Monitoring Requirements

Under Schedule 1, Division 2 ("Controls on activities"), of the Environmental Protection (Darling Range Bauxite Mining Proposals) Exemption Order 2023 a drainage incident is defined as:

a) *a runoff from a disturbance area to the surrounding environment of surface water that has a turbidity of at least 25 nephelometric turbidity units for a period of at least 1 hour; or*
b) *a discharge from containment infrastructure that includes or may include environmentally hazardous material;*

1.4. Water Quality Monitoring System (WQMS)

At the Huntly site, for this reporting period, 8 (eight) WQMSs have been installed in streams within or downstream of mining operations to monitor stream turbidity levels. Each turbidity monitoring station is fitted with an Aquas SMR10 turbidity probe. The Aquas probes are placed directly in the streams, mounted at 90 degrees to the flow of water. Each sensor has a guard to protect the lens from larger debris and the units are fitted with a lens screen wiper. Note: disruptions or errant readings can occur with smaller pieces of debris (leaves etc.).

Data is collected via a Data Taker DT82 logger. Data from each logger is linked to an IOT data modem to transmit to a cloud-based platform. Data is logged locally in 6 second intervals with a 6-minute average pushed into the cloud-based platform. A float switch or cell indicates sensor immersion or a dry stream.

1.5. Data Review & Event Classification Process

Data produced by the WQMSs is reviewed by RARE per the following procedure and in consultation with SciDev. This allows for the identification of true events that require investigation to determine whether the mining operations may have contributed to the elevated turbidity levels, and false events.

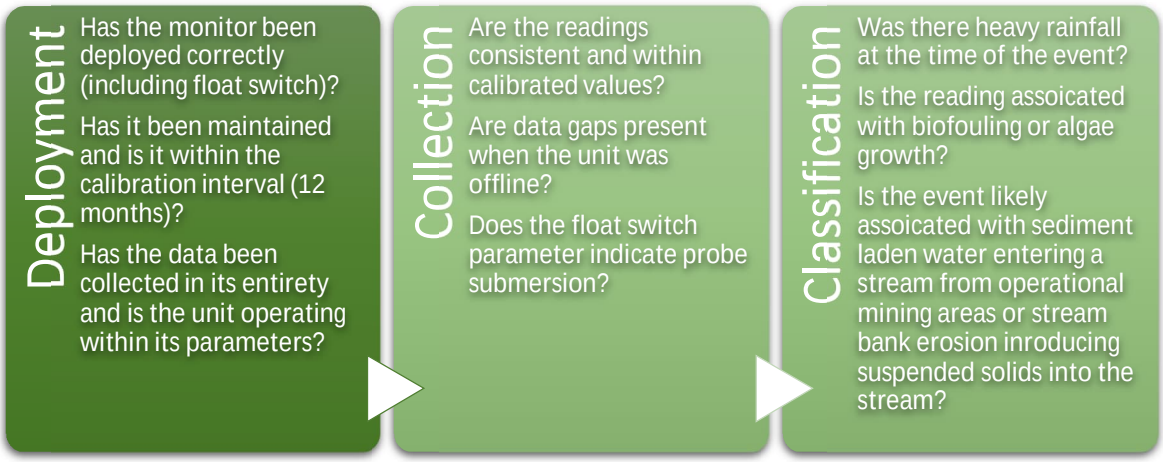


Figure 1: Data Review & Event Classification Process

The process considers the physical aspects of the WQMS deployment, the data collection by that monitor and finally classification of the events identified in that data. Classification of events is per Alcoa's procedure to identify events as true or false.

A 'true' stream turbidity exceedance event that is caused by an actual increase in stream water turbidity. Alcoa has identified that 'true' turbidity exceedance events typically show a sharp turbidity incline before gradually trailing off as the stream turbidity level returns to background.

Figure 2: Typical 'true' exceedance event showing the sharp incline and gradually return to background levels.

'False' stream turbidity exceedance events are caused by factors other than an actual increase in stream water turbidity (i.e. organic debris covering the monitor such as sticks/leaves/algae, stream water turbulence or air bubbles and fluctuating water levels that intermittently cover the monitor lens and then recede). Alcoa has identified that 'false' turbidity exceedance events typically illustrate sharp inclines and declines for turbidity when the data is graphed over time and lack the distinctive 'bell curve' shape that is associated with 'true' turbidity exceedance events.

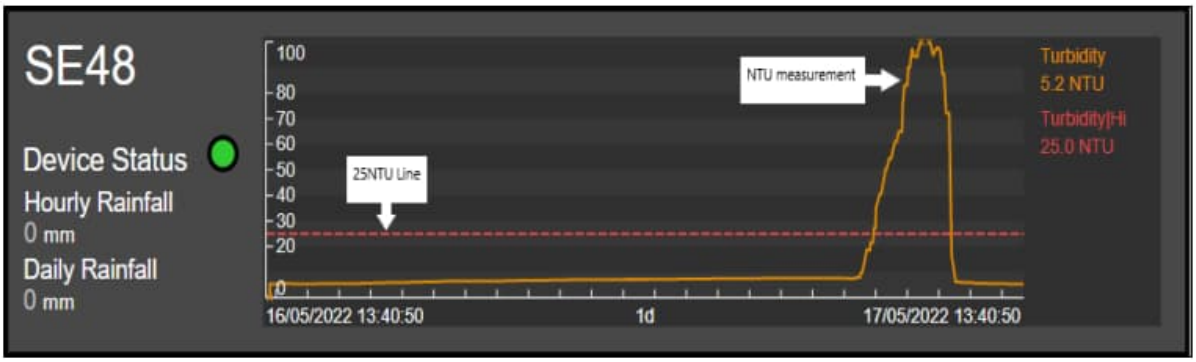


Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

Any 'true' events identified in this report have been listed in **Section 3**.

2. WQMS Data Review

For the reporting period of February 2024, 45,423 data points were collected by 8 (eight) WQMSs across the Huntly site. From this data a total of 160 events were flagged where turbidity levels above 25 were held for an hour or more. The following sections review this data, beginning with the deployment and operation of the WQMSs.

2.1. Deployment & Collection

From the data provided there were several units producing erroneous results, marked by spikes and/or non-sensical peaks. Furthermore, from information provided by SciDev, RARE understands the flow switch on several units was nonfunctional for the reporting period due to blockages or incorrect deployment.

RARE have identified WQMSs in Table 1 that require review in regards erroneous data. SciDev have confirmed that the data generated by these units is invalid and has been excluded from further analysis.

Excluding the data from these units leaves 24 (twenty-four) potential turbidity events during the reporting period across 5 (five) units as discussed in the following section.

Table 1: WQMS Requiring Review

Unit	Dates	Comment
ND07T	February 1st to 29th	All data is consistently sustained over 25 NTU suggesting incorrect deployment. Heavy algae has also been noted in this stream.
SE02T	February 1st to 29th	All data is consistently sustained over 25 NTU suggesting incorrect deployment. Sensor was noted to have been found lying in vegetation.
SE61T	February 1st to 29th	All data is consistently sustained over 25 NTU suggesting incorrect deployment. Stream level was noted to be repeatedly low.

2.2. Classification

Analysis of the data from the 5 (five) valid WQMSs identified 24 (twenty-four) potential turbidity events during the reporting period across 3 (three) units as summarised in Table 2. For this reporting period there were no 'true' turbidity events identified. Refer to the following section for analysis.

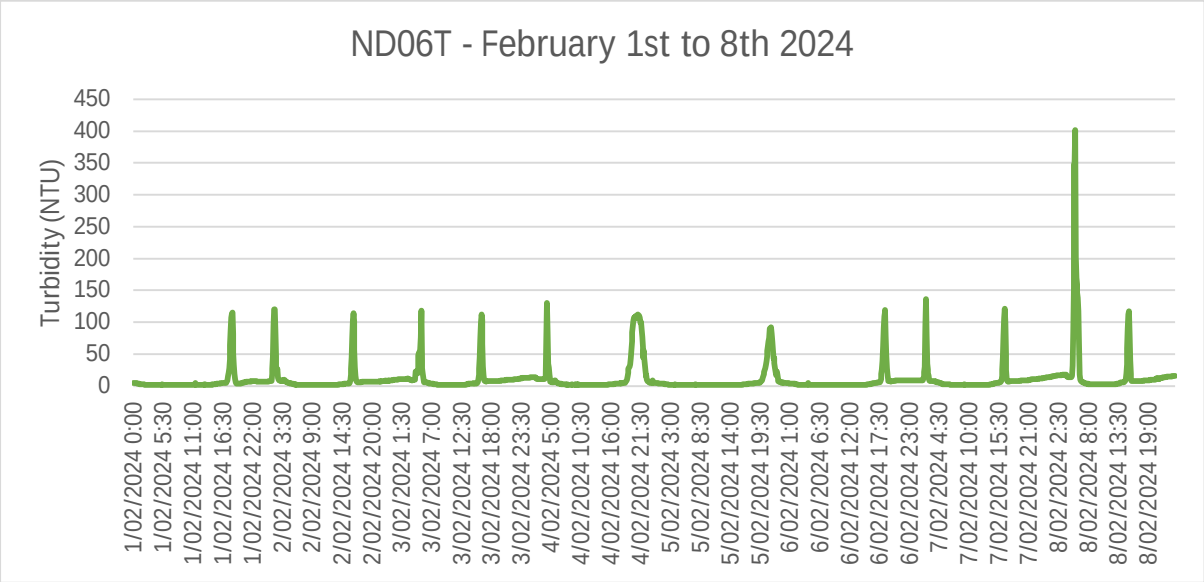
Table 2: Turbidity events summary

Date	Huntly WQMS Data - February 2024 - Events with turbidity > 25 NTU for an hour or more				
	ND06T	ND14T	PD01T	SE03T	SE51T
1/02/2024	1			1	
2/02/2024				1	
3/02/2024				1	
4/02/2024	1			1	
5/02/2024	1				
6/02/2024	1			1	
7/02/2024				1	
8/02/2024	1			1	
9/02/2024				1	
10/02/2024					
11/02/2024					
12/02/2024				1	
13/02/2024				1	
14/02/2024				1	
15/02/2024			1		
16/02/2024					
17/02/2024	1				
18/02/2024	1				
19/02/2024	2				
20/02/2024			1		
21/02/2024					
22/02/2024					
23/02/2024					
24/02/2024			1		
25/02/2024					
26/02/2024			1		
27/02/2024					
28/02/2024					
29/02/2024					

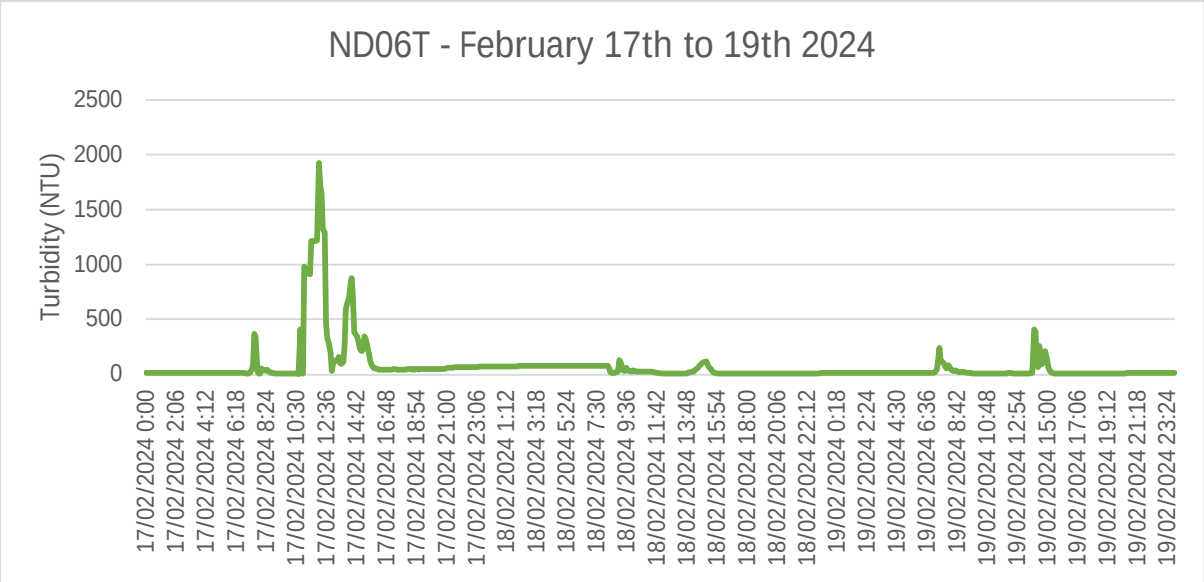
Note: False events have been annotated by black bold text. True events for further investigation are annotated by red bold text. See following section for analysis.

2.2.1. ND06T Potential Turbidity Events

Chart(s) for data flagged at monitor ND06T are shown below for the potential events identified in the reporting period.



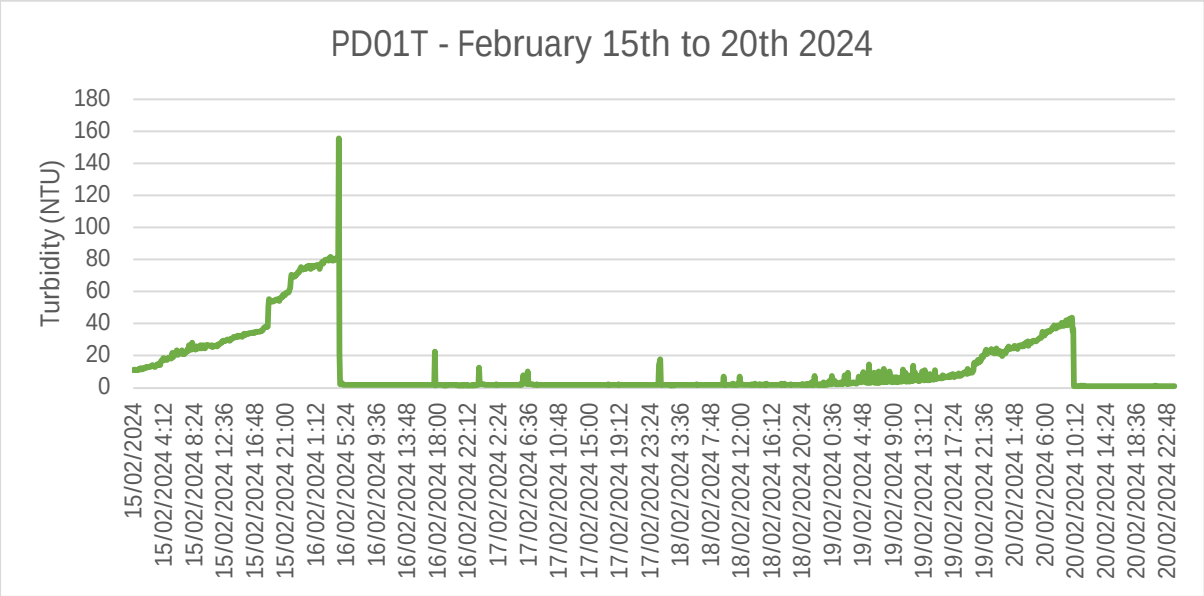
The events are marked by sporadic peaks indicative of a 'false' event.



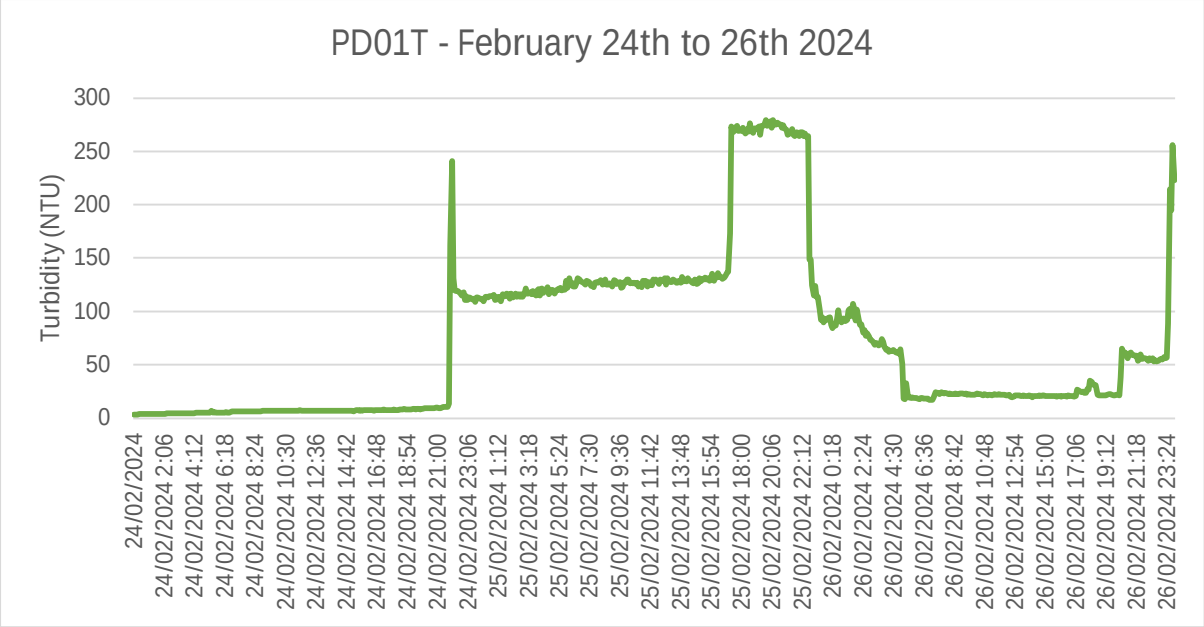
The events are marked by a sharp return to normal values indicative of a 'false' event.

2.2.2. PD01T Potential Turbidity Events

Chart(s) for data flagged at monitor PD01T are shown below for the potential events identified in the reporting period.



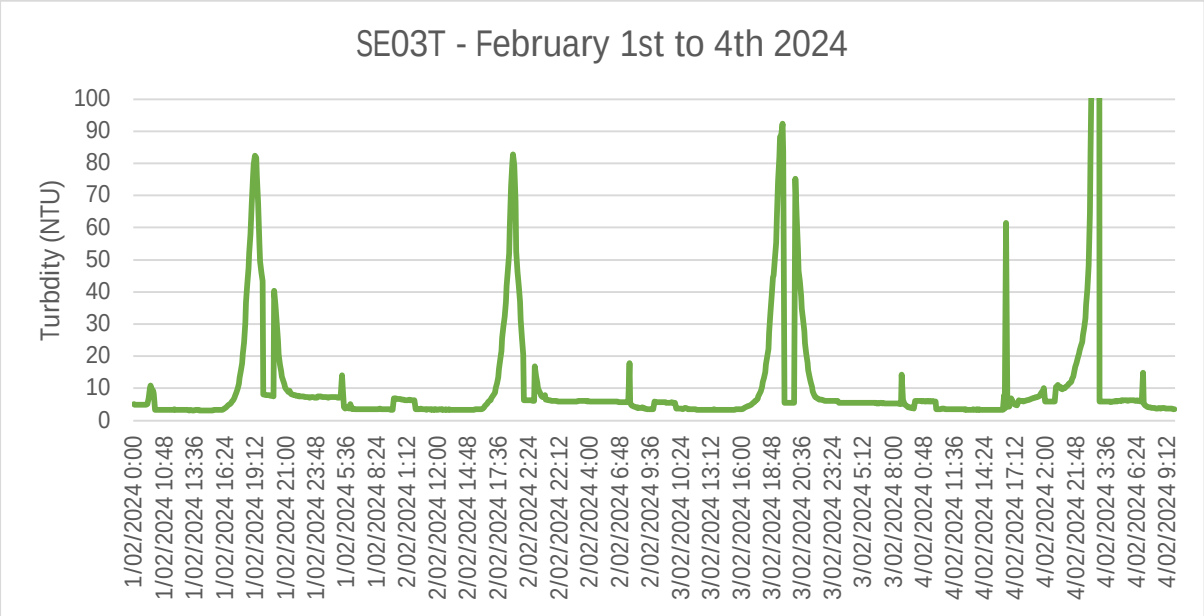
The events are marked by a sharp return to normal values indicative of a 'false' event.



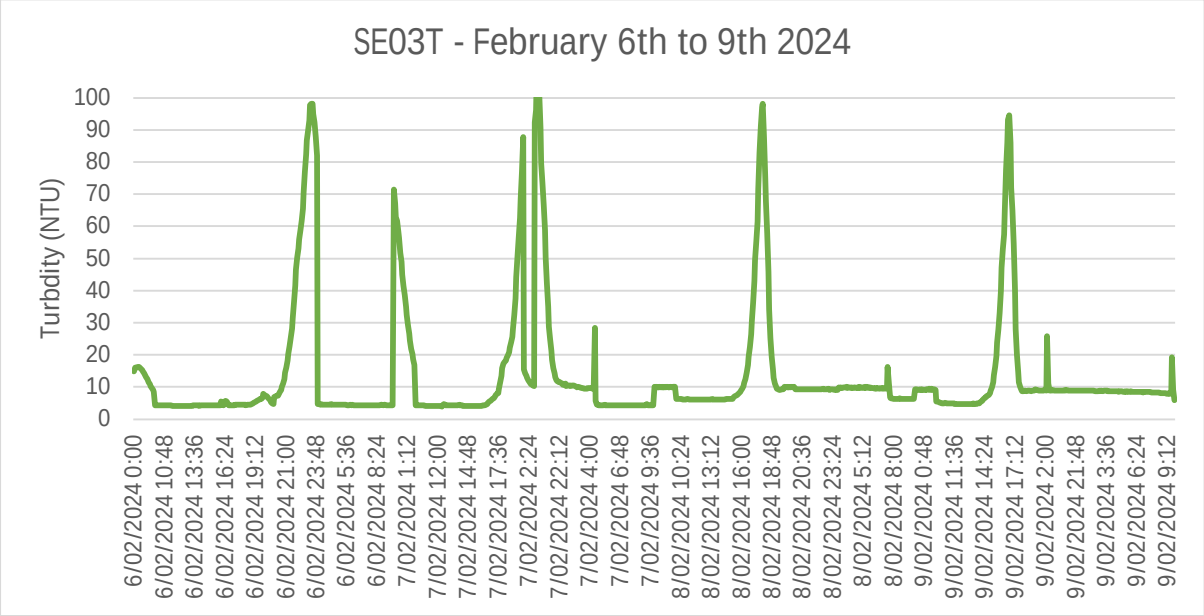
Given the gradual return to background readings, the event of the 24th February at PD01T requires further investigation.

2.2.3. SE03T Potential Turbidity Events

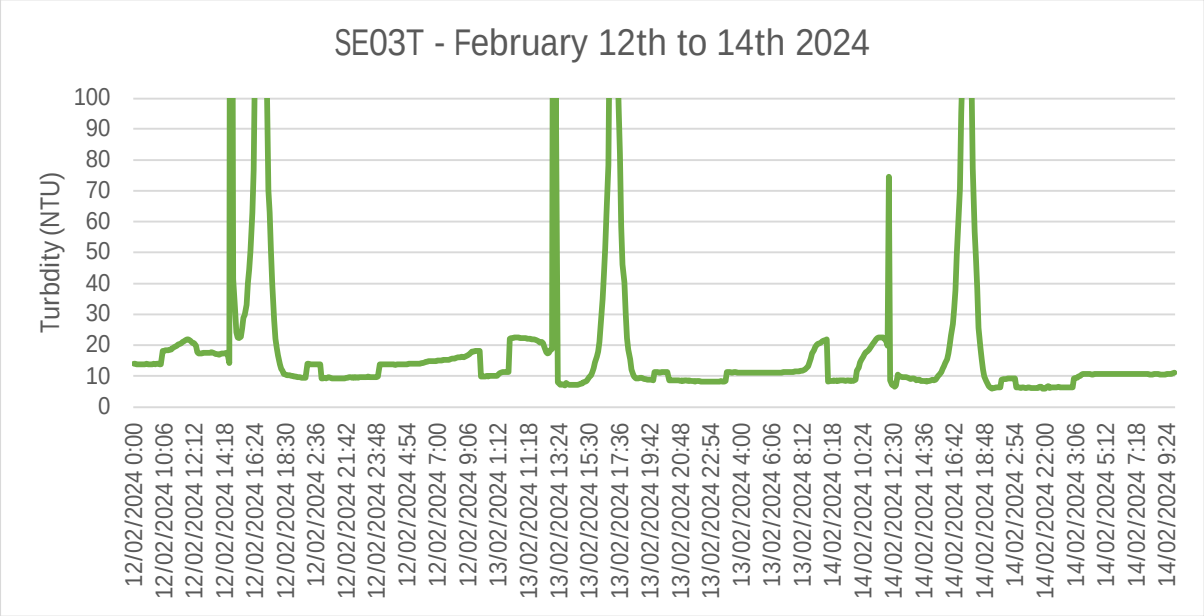
Chart(s) for data flagged at monitor SE03T are shown below for the potential events identified in the reporting period.



The events are marked by sporadic peaks indicative of 'false' events.



The events are marked by sporadic peaks indicative of 'false' events.



The events are marked by sporadic peaks indicative of 'false' events.

2.3. True Turbidity Events

For this reporting, period one (1) 'true' turbidity event(s) was identified.

Event ID	Monitor	Date	Start	End	Duration (hours)	Peak Turbidity (NTU)
HUN-2402-001	PD01T	24th February 2024	21:54	05:15 (26th February)	31.3	279

2.4. Investigation

Event ID	Monitor	Date	Results
HUN-2402-001	PD01T	24th February 2024	The following was provided by SciDev in regards to this event: *"Stream level is very low and sensor is sitting within layer of vegetation and algae on the stream bed. Data trend shows two rapid spikes followed by a rapid drop in NTU, indicating likely vegetation caught up around the sensor and then being dislodged. Stream level is being monitored, ongoing intermittent events are expected whilst stream is drying up."* No further investigation is required.

3. Recommendations

3.1. WQMS Network

RARE recommends:

- WQMSs include a flow switch or similar mechanism to detect when the stream is dry.
- Perform a maintenance and deployment review of all units to ensure their correct operation.

4. Raw WQMS Data

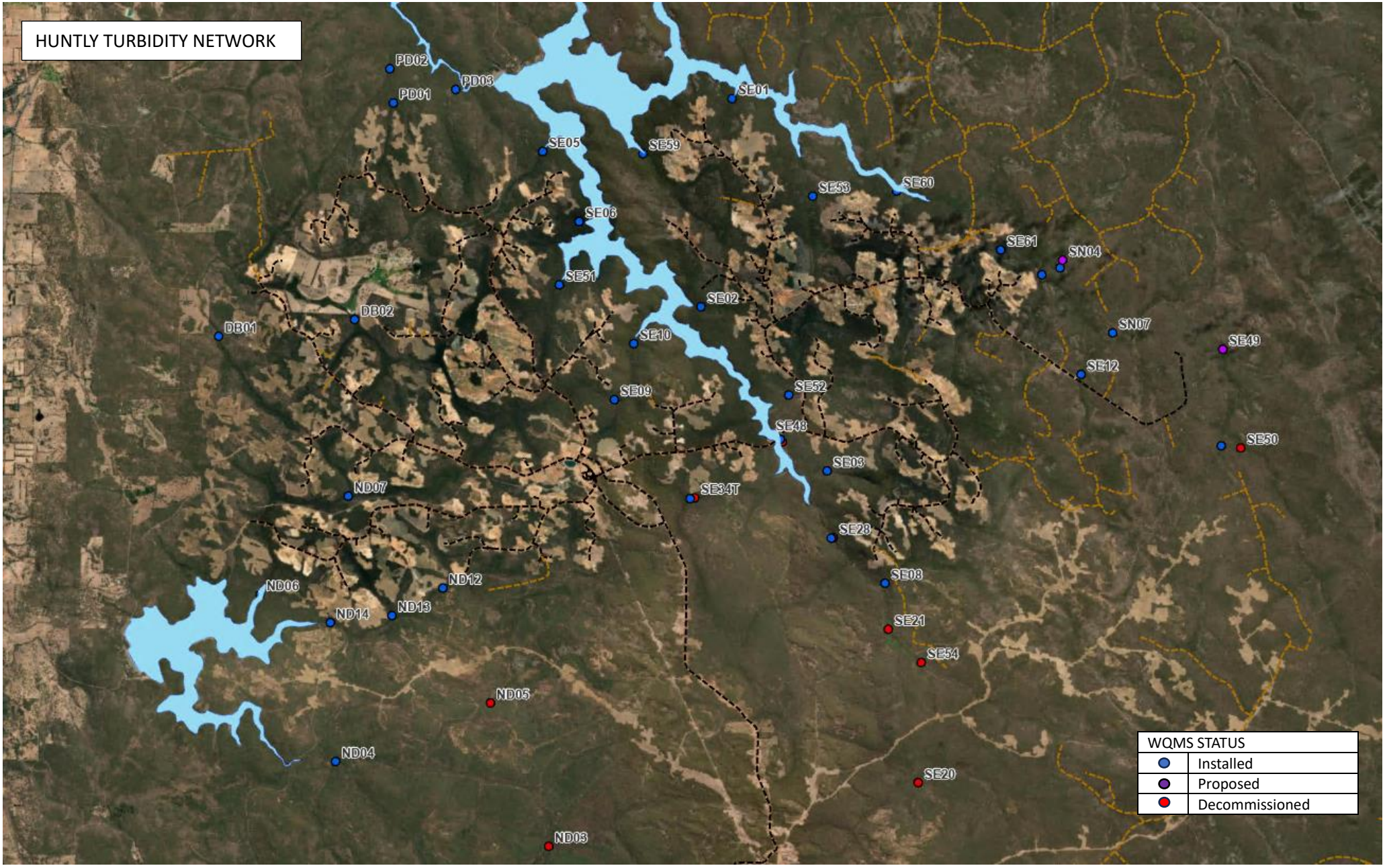
Date	Huntly WQMS Data - February 2024 - Events with turbidity > 25 NTU for an hour or more							
	ND06T	ND07T	ND14T	PD01T	SE02T	SE03T	SE51T	SE61T
1/02/2024	1				1	1		7
2/02/2024		1				1		7
3/02/2024		1				1		8
4/02/2024	1	2				1		7
5/02/2024	1	4						6
6/02/2024	1					1		8
7/02/2024						1		5
8/02/2024	1					1		10
9/02/2024						1		9
10/02/2024		2						9
11/02/2024		1						8
12/02/2024						1		7
13/02/2024						1		7
14/02/2024						1		1
15/02/2024				1				
16/02/2024								
17/02/2024	1	1						
18/02/2024	1							
19/02/2024	2				3			
20/02/2024				1	1			
21/02/2024								
22/02/2024					1			
23/02/2024					2			
24/02/2024				1	3			
25/02/2024								
26/02/2024				1	2			
27/02/2024					3			
28/02/2024					4			
29/02/2024					5			

Note: False events have been annotated by black bold text. True events for further investigation are annotated by red bold text.

Date	Huntly WQMS Data - February 2024 - Turbidity (Daily Average, NTU)							
	ND06T	ND07T	ND14T	PD01T	SE02T	SE03T	SE51T	SE61T
1/02/2024	6.3	6.6	0.8		30.6	10.1		39.9
2/02/2024	9.2	306.9	2.3		45.5	9.1		32.5
3/02/2024	10.5	2254.2	1.0		86.0	10.5		41.0
4/02/2024	17.0	533.9	3.8		198.1	11.7		47.1
5/02/2024	7.7	219.5	3.1		221.1	28.3		55.4
6/02/2024	6.6	418.5	0.8	2.1	235.8	10.9		46.3
7/02/2024	9.3	1076.3	0.8	1.9	260.5	17.6	1.3	40.4
8/02/2024	20.2	2732.3	6.0	1.8	287.6	12.7	1.3	78.2
9/02/2024	40.8	2011.5	0.9	1.8	326.4	12.0	1.5	333.9
10/02/2024	13.6	405.3	0.9	2.2	374.4	12.0	1.8	366.7
11/02/2024	13.5	43.8	1.9	4.2	443.0	18.1	1.7	249.9
12/02/2024	13.1	42.2	1.0	1.8	510.1	23.2	1.5	167.9
13/02/2024	15.1	36.0	1.1	1.9	573.2	18.3	1.7	212.5
14/02/2024	14.8	33.1	0.9	4.3		16.4	1.6	
15/02/2024	14.5	41.7	2.7	31.6	4.5	10.1	1.6	101.7
16/02/2024	13.9	157.0	1.4	17.7	5.3		1.9	92.3
17/02/2024	147.9	164.8	1.3	1.9	5.5		1.8	
18/02/2024	40.0	182.1	1.3	1.9	11.1		1.8	
19/02/2024	22.8	227.8	1.8	7.6	28.2		1.8	
20/02/2024	12.8	102.9	2.8	14.0	53.8		1.6	
21/02/2024	13.5	87.1	3.6	1.2	107.2		1.2	
22/02/2024			1.3	1.3	124.2		1.5	
23/02/2024			1.2	2.3	160.9		1.4	
24/02/2024			1.0	14.8	237.2		1.5	
25/02/2024			1.2	156.8	365.9		1.5	
26/02/2024			1.0	41.4	530.5		1.5	
27/02/2024			1.0	38.7	703.6		1.7	
28/02/2024			1.3	5.7	804.5		1.9	
29/02/2024			1.3	2.1	719.2		5.1	

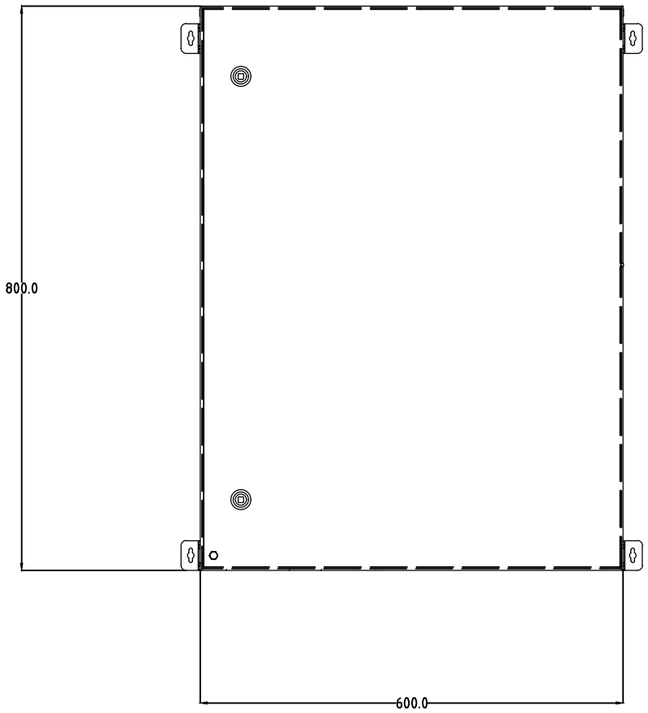
Note: Daily averages above 25 NTU have been annotated by black bold text. Daily averages inclusive of with true events for further investigation are annotated by red bold text. Grey shading indicates no data available for that day at that unit.

Appendix A. Huntly WQMS Locations

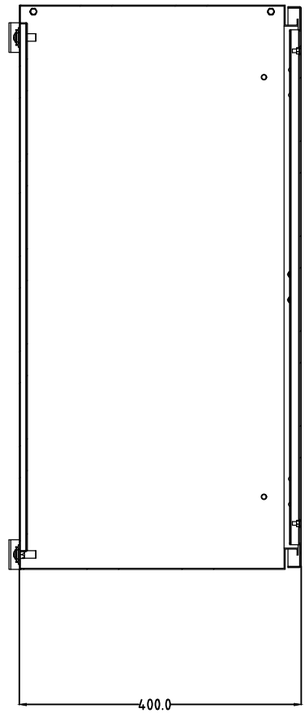

HUNTLY TURBIDITY NETWORK
PD02
PD03
PD01
SE01
SE05
SE59
SE53
SE60
SE06
SE61
SN04
SE51
SE02
DB02
DB01
SE10
SN07
SE49
SE12
SE09
SE52
SE48
SE50
SE03
ND07
SE34T
SE28
SE08
ND12
ND06
ND13
ND14
SE21
SE54
ND05
ND04
SE20
ND03
WQMS STATUS
Installed
Proposed
Decommissioned

Appendix B. WQMS General Arrangement

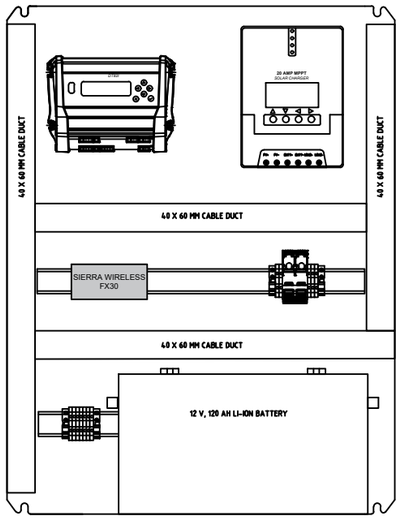
FRONT VIEW



SIDE VIEW



INTERNAL LAYOUT



MATERIAL LIST

ITEM NO.	DESCRIPTION	PART NO.	SUPPLIER	QUANTITY
1	20A CIRCUIT BREAKER - 2P	TBC	TBC	1
2	DATA TAKER	DT82I	TBC	1
3	LITHUM ION BATTERY 12VDC 120AH	TBC	TBC	1
4	20A SOLAR CHARGER	TBC	TBC	1
5	TERMINALS GREY 2.5MM	TBC	TBC	8
6	TERMINAL EARTH Y/G 2.5MM	TBC	TBC	2
7	TERMINALS GREY FUSED 2.5MM	TBC	TBC	3
8	HIGH GAIN ANTENNA	TBC	TBC	1
9	SIERRA WIRELESS UNIT	FX30	TBC	1

REV.	REMARKS	DATE	DESIGNED	DRAWN	CHECKED	APPROVED	REFERENCE DRAWINGS
0	ISSUE FOR APPROVAL	26.05.2023	A.K.	M.G	A.K.	A.K.	

ALL DIMENSIONS IN MILLIMETRES U.N.O.
LEVELS ARE IN METRES ON AHD U.N.O.
DO NOT SCALE DRAWING
IF IN DOUBT - ASK
TOLERANCES ISO2768-m U.N.O.

CLIENT

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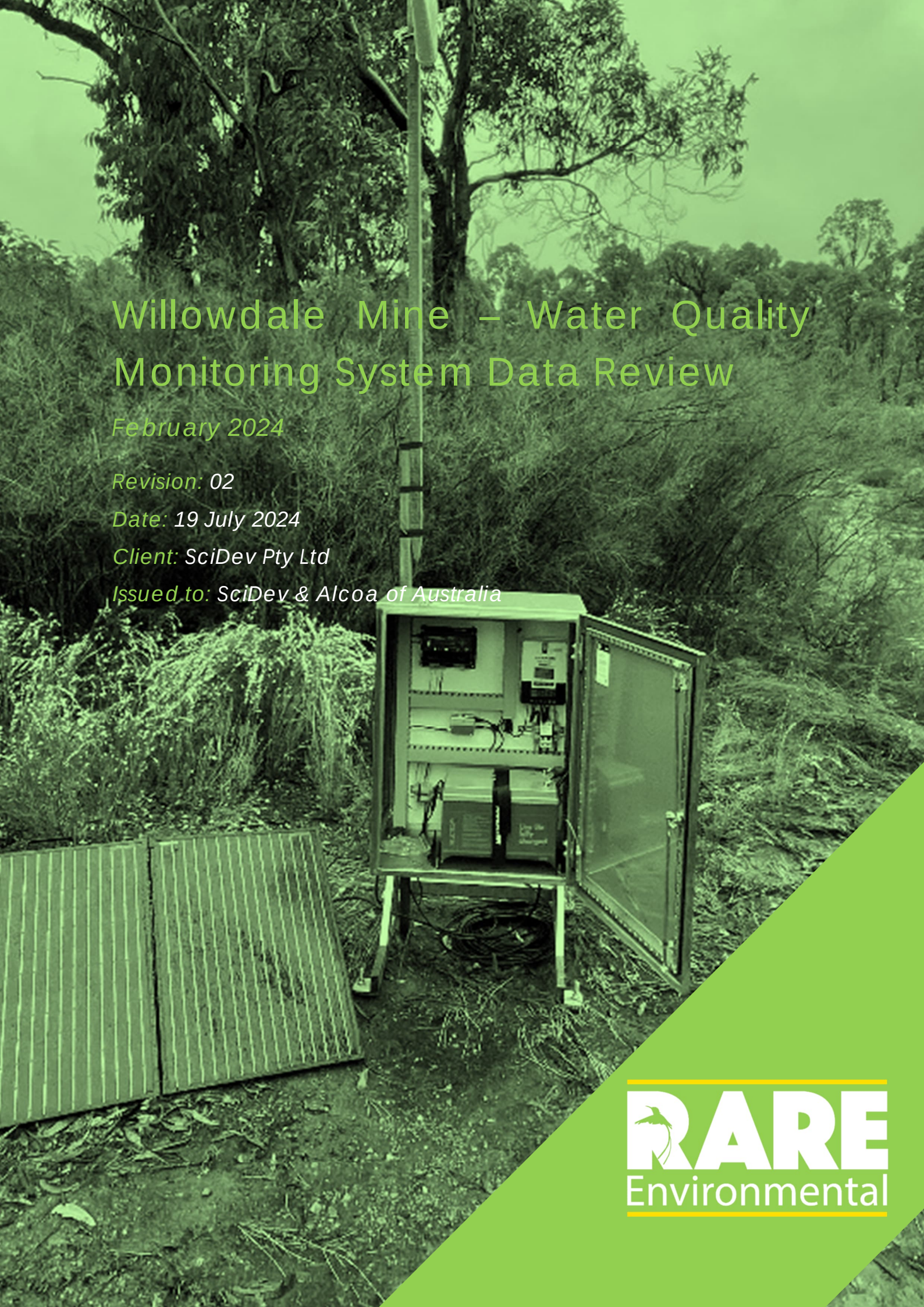
SCIDEV

TITLE
IOT TURBIDITY MONITORING STATION ELECTRICAL CONTROL SCHEMATICS / MATERIAL LIST

SHEET 1 OF 2
SCALE NTS OR AS SHOWN
DRAWING NO. HI0090 - ALCOA WQMS
SHEET SIZE A3
REV. 1



Willowdale Mine – Water Quality Monitoring System Data Review

February 2024

Revision: 02

Date: 19 July 2024

Client: SciDev Pty Ltd

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RARE Environmental

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Prepared by		Technical Review		Approved for Issue	
					
Name	Sarah Mathew	Name	Rob Dwyer	Name	Rob Dwyer
Position	Env. Scientist	Position	Regional Manager	Position	Regional Manager
Date	19/07/2024	Date	19/07/2024	Date	19/07/2024

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Contents

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1.1. Purpose

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b) *a discharge from containment infrastructure that includes or may include environmentally hazardous material;*

1.4. Water Quality Monitoring System (WQMS)

At the Willowdale site, for this reporting period, 2 (two) WQMSs has been installed in streams within or downstream of mining operations to monitor stream turbidity levels. Each turbidity monitoring station is fitted with an Aquas SMR10 turbidity probe. The Aquas probes are placed directly in the streams, mounted at 90 degrees to the flow of water. Each sensor has a guard to protect the lens from larger debris and the units are fitted with a lens screen wiper. Note: disruptions or errant readings can occur with smaller pieces of debris (leaves etc.).

Data is collected via a Data Taker DT82 logger. Data from each logger is linked to an IOT data modem to transmit to a cloud-based platform. Data is logged locally in 6 second intervals with a 6-minute average pushed into the cloud-based platform. A float switch or cell indicates sensor immersion or a dry stream.

1.5. Data Review & Event Classification Process

Data produced by the WQMSs is reviewed by RARE per the following procedure and in consultation with SciDev. This allows for the identification of true events that require investigation to determine whether the mining operations may have contributed to the elevated turbidity levels, and false events.

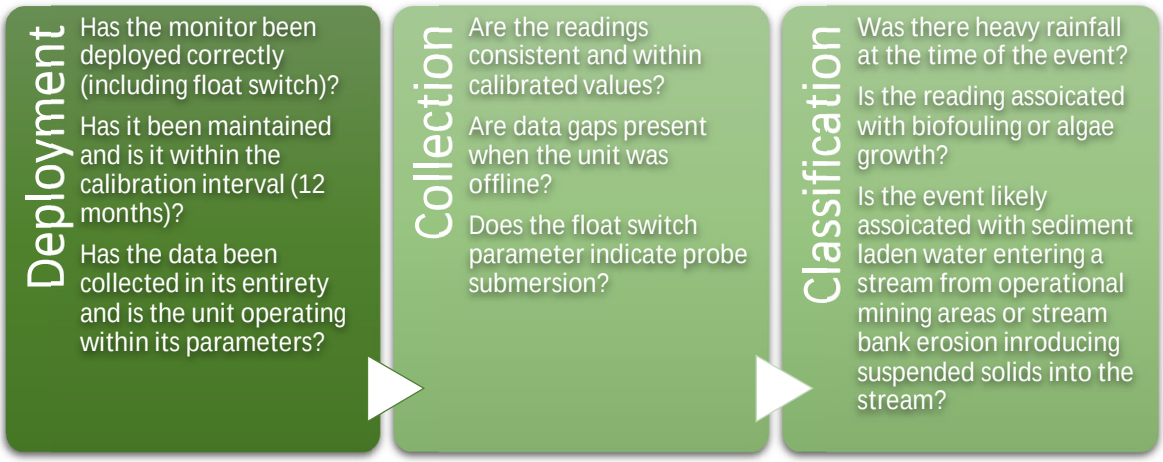

Figure 1: Data Review & Event Classification Process

The process considers the physical aspects of the WQMS deployment, the data collection by that monitor and finally classification of the events identified in that data. Classification of events is per Alcoa's procedure to identify events as true or false.

A 'true' stream turbidity exceedance event that is caused by an actual increase in stream water turbidity. Alcoa has identified that 'true' turbidity exceedance events typically show a sharp turbidity incline before gradually trailing off as the stream turbidity level returns to background.

Figure 2: Typical 'true' exceedance event showing the sharp incline and gradually return to background levels.

'False' stream turbidity exceedance events are caused by factors other than an actual increase in stream water turbidity (i.e. organic debris covering the monitor such as sticks/leaves/algae, stream water turbulence or air bubbles and fluctuating water levels that intermittently cover the monitor lens and then recede). Alcoa has identified that 'false' turbidity exceedance events typically illustrate sharp inclines and declines for turbidity when the data is graphed over time and lack the distinctive 'bell curve' shape that is associated with 'true' turbidity exceedance events.

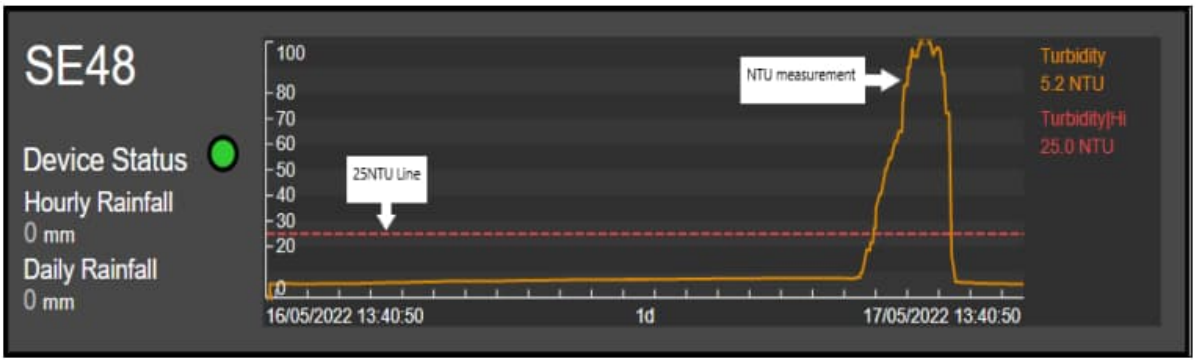

Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

Any 'true' events identified in this report have been listed in **Section 3**.

2. WQMS Data Review

For the reporting period of February 2024, 0 data points were collected by 2 (two) WQMSs across the Willowdale site. From this data a total of 0 events were flagged where turbidity levels above 25 were held for an hour or more. Due to dry streams, both WQMS probes switched off for the duration of the month. The following sections review this data, beginning with the deployment and operation of the WQMSs.

2.1. Deployment & Collection

RARE have identified that no WQMSs require review in regards erroneous data.

No potential turbidity events during the reporting period across the 2 (two) units were identified as discussed in the following section.

Table 1: WQMS Requiring Review

Unit	Dates	Comment
HV07	February 2024	Stream was dry. No valid data available for February 2024.
PTM01	February 2024	Stream was dry. No valid data available for February 2024.

2.2. Classification

Analysis of the data from the 2 (two) valid WQMSs identified no potential turbidity events during the reporting period. For this reporting period there were no 'true' turbidity events identified. Refer to the following section for analysis.

2.3. True Turbidity Events

For this reporting period, no 'true' turbidity events were identified.

3. Recommendations

3.1. WQMS Network

RARE recommends:

- Perform a maintenance and deployment review of all units to ensure their correct operation.

4. Raw WQMS Data

Date	Willowdale WQMS Data - February 2024 - Events with turbidity > 25 NTU for an hour or more	
	HV07	PTM01
1/02/2024		
2/02/2024		
3/02/2024		
4/02/2024		
5/02/2024		
6/02/2024		
7/02/2024		
8/02/2024		
9/02/2024		
10/02/2024		
11/02/2024		
12/02/2024		
13/02/2024		
14/02/2024		
15/02/2024		
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19/02/2024		
20/02/2024		
21/02/2024		
22/02/2024		
23/02/2024		
24/02/2024		
25/02/2024		
26/02/2024		
27/02/2024		
28/02/2024		
29/02/2024		

Note: False events have been annotated by black bold text. True events for further investigation are annotated by red bold text.

Date	Willowdale WQMS Data - February 2024 - Turbidity (Daily Average, NTU)	
	HV07	PTM01
1/02/2024		
2/02/2024		
3/02/2024		
4/02/2024		
5/02/2024		
6/02/2024		
7/02/2024		
8/02/2024		
9/02/2024		
10/02/2024		
11/02/2024		
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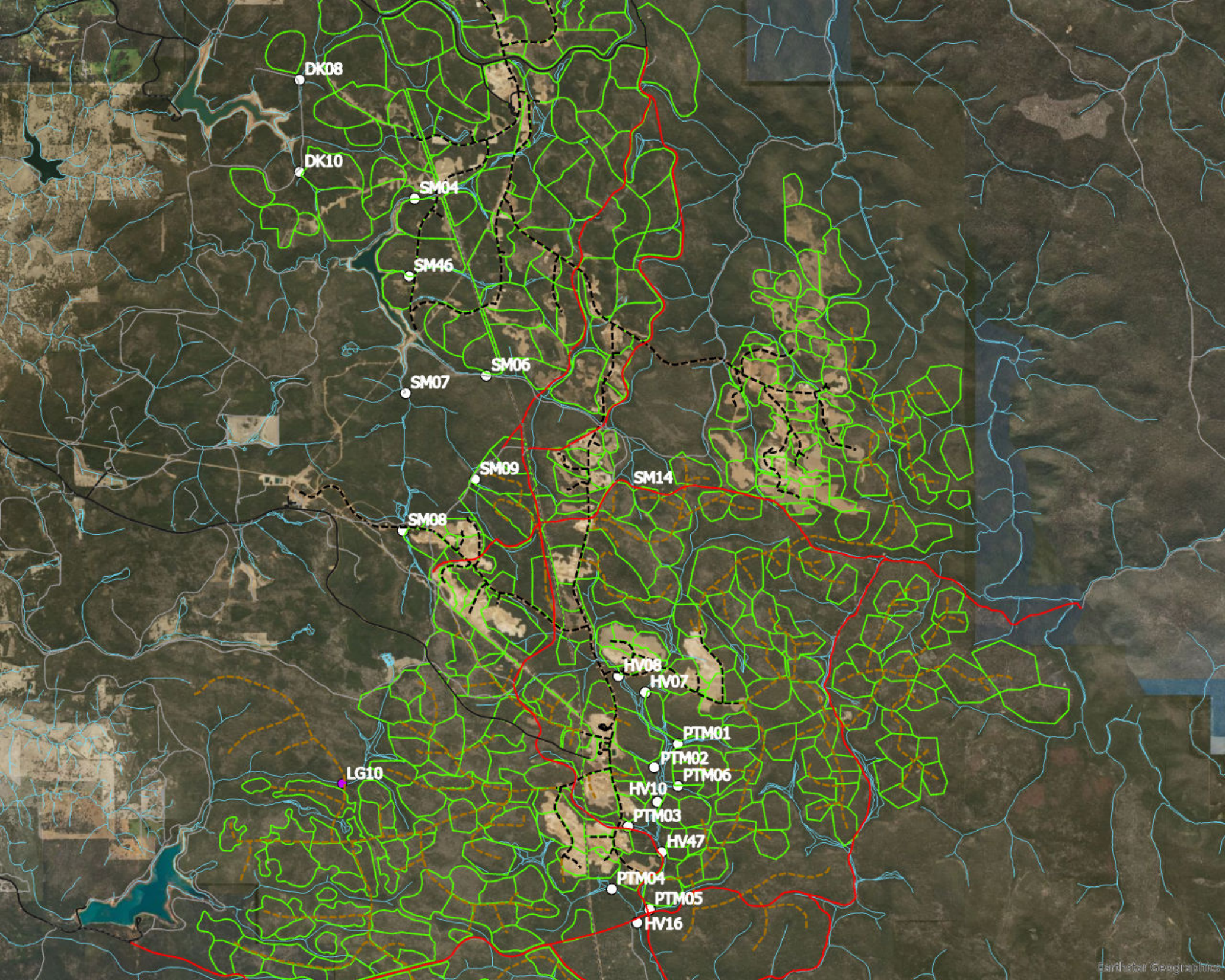
24/02/2024		
25/02/2024		
26/02/2024		
27/02/2024		
28/02/2024		
29/02/2024		

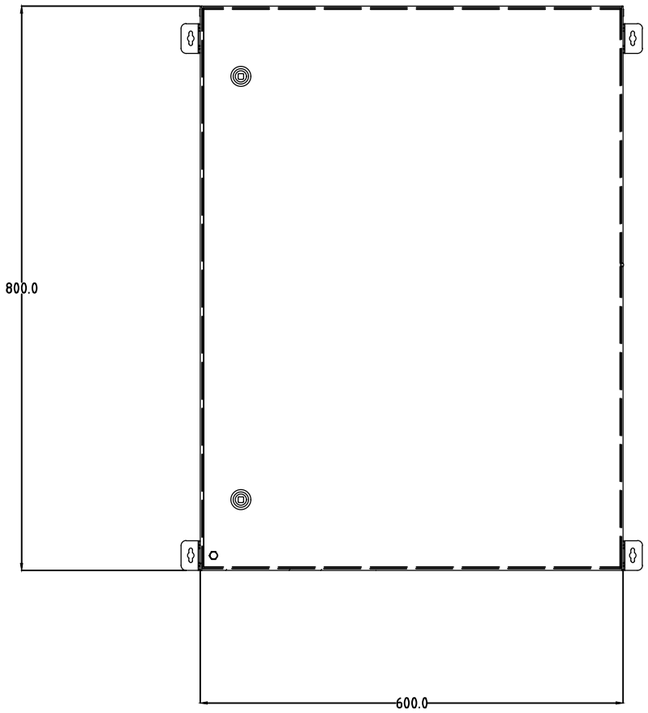
hntNote: Daily averages above 25 NTU have been annotated by black bold text. Daily averages inclusive of with true events for further investigation are annotated by red bold text. Grey shading indicates no data available for that day at that unit.

Appendix A. Willowdale WQMS Locations

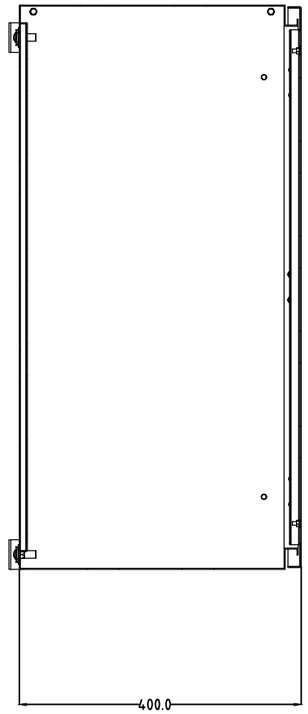

DK08
DK10
SM04
SM46
SM06
SM07
SM09
SM14
SM08
HV08
HV07
PTM01
PTM02
PTM06
LG10
HV10
PTM03
HV47
PTM04
PTM05
HV16

Appendix B. WQMS General Arrangement

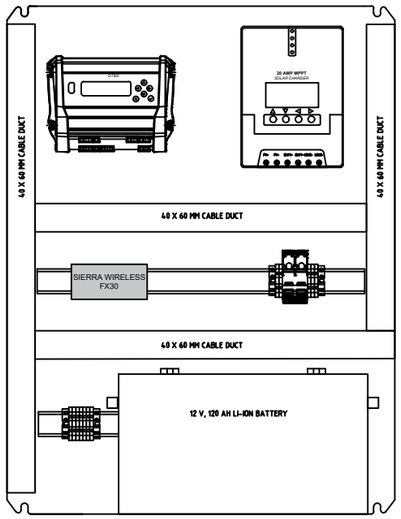
FRONT VIEW



SIDE VIEW



INTERNAL LAYOUT



MATERIAL LIST

ITEM NO.	DESCRIPTION	PART NO.	SUPPLIER	QUANTITY
1	20A CIRCUIT BREAKER - 2P	TBC	TBC	1
2	DATA TAKER	DT82I	TBC	1
3	LITHUM ION BATTERY 12VDC 120AH	TBC	TBC	1
4	20A SOLAR CHARGER	TBC	TBC	1
5	TERMINALS GREY 2.5MM	TBC	TBC	8
6	TERMINAL EARTH Y/G 2.5MM	TBC	TBC	2
7	TERMINALS GREY FUSED 2.5MM	TBC	TBC	3
8	HIGH GAIN ANTENNA	TBC	TBC	1
9	SIERRA WIRELESS UNIT	FX30	TBC	1

REV.	REMARKS	DATE	DESIGNED	DRAWN	CHECKED	APPROVED	REFERENCE DRAWINGS
0	ISSUE FOR APPROVAL	26.05.2023	A.K.	M.G	A.K.	A.K.	

ALL DIMENSIONS IN MILLIMETRES U.N.O.
LEVELS ARE IN METRES ON AHD U.N.O.
DO NOT SCALE DRAWING
IF IN DOUBT - ASK
TOLERANCES ISO2768-m U.N.O.

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SCIDEV

TITLE
IOT TURBIDITY MONITORING STATION ELECTRICAL CONTROL SCHEMATICS / MATERIAL LIST

SHEET 1 OF 2
SCALE NTS OR AS SHOWN
DRAWING NO. HI0090 - ALCOA WQMS
SHEET SIZE A3
REV. 1