CORK CITY COUNCIL

KINSALE ROAD LANDFILL SITE

Waste Licence Register No: W0012-03

Annual Environmental Report

January 2016 – December 2016

Prepared by:-

Cork City Council,
Kinsale Road Landfill Site,
Cork.

June 2017

DOCUMENT CONTROL SHEET

Kinsale Road Landfill Site Annual Report

Reporting Period January 2016 to December 2016

User is Responsible for the Revision Status of this Document

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1 INTRODUCTION

1.1 Scope and Purpose of the Report

Cork City Council holds a Waste Licence (Register No. W0012-03) to operate a landfill site at the Kinsale Road, Cork. The aim of this Annual Environmental Report is to provide a review of activities at Kinsale Road landfill site within the past 12 months.

1.2 Background to the Report

The Landfill site at Kinsale Road has been in operation since the 1960's. The site was issued with a waste licence by the Environmental Protection Agency (EPA) on 2nd February 2000 (Register No. 12-1), with a new licence issued on 29th November 2002 (Register No. W0012-02). The most recent licence was issued on 3rd May 2011 (Register No. W0012-03).

In accordance with Condition 11.10 of the Waste Licence, Cork City Council is required to submit to the Agency for its agreement, an Annual Environmental Report for its activities during the previous 12 months.

This report covers the period from January 2016 to December 2016.

1.3 Site Location and Operator details

The landfill is owned and operated by Cork City Council, City Hall, Cork. The address of the facility is as follows.

Kinsale Road Landfill Site,
Ballyphehane,
Curraghconway,
Inchisarsfield,
South City Link Road,
Cork.
The National Grid Reference for the site is 168033E 069658N.

The facility contact details are as below

- Facility Manger: Kevin Ryan
- Contact No: 021 4705913
- Fax No: 021 4319930

- Landfill Technicians: Fiona O'Connor / Liam Brick
- Contact No: 021 4705914 / 4705911

- Supervisor: Michael Rawley

- Junior Foreman: Michael Reck

- Weighbridge Operator
- Contact No: 021 4705920

- Environment Department,
  City Hall,
  Cork
- Contact No: 021 4924726
- Fax No: 021 4924054

- City Hall
- Contact No. 021 4924000 / 4966222

2 SITE DESCRIPTION AND ACTIVITIES

2.1 Description of the Site

The facility was a municipal solid waste and non-hazardous industrial waste disposal facility. The site (including former land filling areas) is approximately 72 hectares.
Landfilling at the site ceased on the 15th July 2009.
Up to the 15th July 2009, the facility accepted domestic and commercial MSW and limited quantities of approved non-hazardous industrial sludges. The facility also includes a Civic Amenity Site and a Landfill Gas Combustion plant that operates on site.

The facility is located within 3 km of Cork City at the South City Link Road, in the townlands of Ballyphehane, Curraghconway and Inchisarsfield. The site occupies a large expanse of low-lying peat bog, bounded by the north and east by the Trabeg River, to the west by the South City Link Road and on the south by the Tramore River and South Ring Road.

The site has been operational since the early 1960's. The majority of the developments (commercial and residential) within 500m of the landfill have occurred subsequent to the commencement of waste disposal operations.

Works are ongoing at the site to upgrade the facility in accordance with the conditions of the Waste Licence. These works include leachate collection and treatment system, surface water collection, road infrastructure as well as final capping and restoration of the site.

2.2 Waste Management activities at the Facility

Waste Activities Licensed at the Kinsale Road Landfill Site are restricted to those outlined in the Waste Licence as outlined below in Tables 2.1 and 2.2.

Table 2.1 Licensed Waste Disposal Activities, in accordance with the Third Schedule of the Waste Management Acts 1996 – 2010.

Class 1.	Deposit on, in or under land (including landfill) [Principal Activity].
Class 2.	Land treatment, including biodegradation of liquid or sludge discards in soils
Class 4.	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
Class 5.	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.
Class 7.	Physico-chemical treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 5 or paragraphs 8 to 10 of this Schedule (including evaporation, drying and calcination).
Class 11.	Blending or mixture prior to submission to any activity referred to in a preceding paragraph of this Schedule.
Class 12.	Repacking prior to submission to any activity referred to in a preceding paragraph of this Schedule.
Class 13.	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.

Table 2.2 Licensed Waste Recovery Activities, in accordance with the Fourth Schedule of the Waste Management Acts 1996 – 2010.

Class 2.	Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological processes).
Class 3.	Recycling or reclamation of metals and metal compounds.
Class 4.	Recycling or reclamation of other inorganic materials.
Class 10.	The treatment of any waste on land with a consequential benefit for an agricultural activity or ecological system.
Class 11.	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.
Class 12.	Exchange of waste for submission to any activity referred to in a preceding paragraph of this Schedule.
Class 13.	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.

2.3 Quantities and Composition of Waste Received, Disposed of and Recovered.

Kinsale Road landfill site is licensed to send municipal waste off site for disposal / recovery up to a maximum of 22,000 tonnes of per annum.
Other waste types and quantities allowed for disposal as per Schedule A of the Waste Licence are as per Table 2.3 below.

Table 2.3 Waste Acceptance Criteria

Waste Type			Maximum [Note 2] (Tonnes Per Annum)
Non-Hazardous Wastes Note 1	Mixed Municipal Waste for recovery/disposal off-site *Accepted at Civic Waste Facility*		5,000
	Storage of Waste prior to Recovery *(including glass, beverage/food cans, textiles, paper and cardboard, plastics, timber, metals, non-hazardous batteries, non-hazardous WEEE accepted at the Civic Waste Facility)*		
	Construction & Demolition Waste *Accepted at the facility for recovery and use in site construction works and landfill restoration.*		300,000 [Note 3]
	Residual Municipal Waste for off–site recovery and/or disposal *Accepted at Waste Transfer Station*		22,000 [Note 4]
	Green Waste (for Composting) *Accepted at Civic Waste Facility*		**Note 5**
	Inert Waste - Imported for restoration purposes		**Note 6**
Non-Hazardous Waste Total			**327,000**
Hazardous Wastes **Note 7**	20 01 21	Fluorescent Tubes and other mercury-containing waste	6
	20 01 27 16 05 04	Paints, inks, adhesives and resins containing dangerous substances Gases in pressure containers (including halons) containing dangerous substances)	20
	20 01 34	Batteries and accumulators other than those mentioned in 20 01 33	12
	All Chapter 13 Wastes [Note 8]	Waste Oils	12
	20 01 35	Discarded electrical and electronic equipment other that those mentioned in 20 01 21 & 20 01 23 containing hazardous components.	1,000
Hazardous Waste Total			**1,050**
TOTAL INCLUDING DISPOSAL AND RECOVERY			**328,050**

Note 1: Any proposals to accept other compatible non-hazardous waste types must be agreed in advance by the Agency.
Note 2: The limitation on individual non-hazardous waste types may be varied with the agreement of the Agency subject to the total limit for non-hazardous waste staying the same.
Note 3: The maximum tonnage to be processed at the Construction and Demolition Waste Recovery Area shall not exceed 2,000 tonnes per day, unless subject to the prior agreement of the Agency, subject to Condition 3.27.
Note 4: Acceptance of Residual Municipal Waste at the facility for off-site disposal, other than that received at the Civic Waste Facility from members of the public, shall not take place until such time as the Waste Transfer Station infrastructure has been installed to the satisfaction of the Agency in accordance with Condition 8.2 of this licence.
Note 5: Quantity of Green Waste/ Compost at the facility is limited to a maximum of 2,400m^3 at any one time.
Note 6: Quantity of waste imported for restoration purposes is limited to 100,000 tonnes per annum for a period of two years from the date of grant of licence, unless otherwise agreed by the Agency.
Note 7: Hazardous waste types as detailed, or as may otherwise be agreed in advance by the Agency.
Note 8: All Chapter 13 wastes: *Oil Wastes and Wastes of Liquid Fuels* (except, 13 01 01, 13 03 01, 13 05 01, 13 05 02, 13 05 03, 13 07 01, 13 07 02, 13 07 03 and 13 08 01) of the *European Waste Catalogue and Hazardous Waste List.*

Table 2.3.1 Quantities of Waste received prior to reporting period.

	Non-Hazardous Waste	*Hazardous Waste*
Deposited in landfill prior to report period.	2.737 million tonnes estimated	Not known if any
C&D waste stored at C&D facility prior to report period.	200 tonnes	Nil

No waste was landfilled at the site during the reporting period.

Table 2.3.2 Quantities of Waste transferred offsite during the reporting period

	Waste transferred off site in 2016 (tonnes)
Total	1264

Table 2.3.3 Classes of Waste received for recovery / recycling off site.

Waste Description	*EWC Code*	*Name of Recovery Company*
Paper	20 01 01	Cork Recycling
Metal	20 01 06	Pouladuff Dismantlers
Timber	20 01 07	Cork Recycling
Plastic	20 01 03	Cork Recycling
Glass Bottles	20 01 02	Rehab Recycling Partnership
Aluminium Cans	20 01 05	Rehab Recycling Partnership
Oil	13 00 00	ENVA
Green Waste	20 02 01	Cork Recycling
Cardboard	20 01 01	Cork Recycling
WEEE	20 01 35	KMK
Aerosols	16 05 04	SLR
Paints	20 01 27	SLR
Car Batteries	16 06 01	KMK
Household Batteries	16 06 01 / 16 06 02 16 06 04 / 20 01 34	KMK

2.3.4 Landfill Inputs and Outputs (Waste and Recycling)

2.4 Landfill Capacity

2.4.1 The landfilling of waste at the facility ceased as of 15th July 2009.

2.5 Economic Contribution

Provision made for Site Operations expenditure in the reporting period was €1,179,000

Waste Totals for Kinsale Road Landfill Site - 2016

All weights in tonnes

Commodity	Total
Municipal	1,094
Non Levy	0
Waste Rubble	170
Total Transferred Off Site	**1,264**

Domestic Recycling	Total
WEEE Out	471
Plastic Bottles	19
Plastic Wrappers	29
Cardboard	87
Paper	121
Metal	122
Green Waste	300
Timber	234
Glass	39
Drink Cans	1.70
Oil	3.26
Paint & Aerosols	29
Batteries	3.38
Clothes	13
Food Waste	2.30
Bulbs	1.76
CA Site Recycling Total inc. WEEE Out	1476

3 SITE DEVELOPMENT WORKS

3.1 Site Development Works during the Reporting Period.

The Waste Licence sets out conditions relating to the completion of certain works within the designated periods following the date of grant of the licence. The works referred to generally formed part of site development works.

M&E works for landfill gas and leachate management

M & E works are ongoing. These include maintenance of the Leachate Conditioning Plant and the continued balancing of the landfill gas field.

Miscellaneous Works Completed in 2016:

1. Ongoing maintenance of Site Roads.
2. Regular cleaning of the Gravel Trap at the Leachate Conditioning Plant with replacement of gravel as required.
3. Tree planting in peripheral areas

Final Capping and Restoration Works

Site capping works were completed in February 2015.

Other planned works for 2017 are as follows:

- SCADA system upgrades (reporting/management system)
- Upgrading of site roadways
- Miscellaneous minor capital works and works arising from Operational Procedures
- Phased implementation of landscape design plan for the Tramore Valley Park.

4 ENVIRONMENTAL INCIDENTS AND COMPLAINTS

4.1.1 Incidents

All Incidents, Non-Conformances and Non–Compliances are uploaded to the EDEN/ALDER System.

4.2 Complaints

There was one complaint during 2016 referring to weed growth on the site. This issue has been resolved.

4.3 Review of Nuisance Controls

In accordance with Condition 6 of the Waste License Cork City Council are required to ensure that vermin, birds, flies, mud, dust and litter do not give rise to nuisances at the facility or in the immediate area of the facility.
Cork City Council ensures that the activities are carried out in a manner such that odours do not result in significant impairment or interference with amenities or the environment beyond the facility boundary.
The road network in the vicinity of the facility is kept free from any debris caused by vehicles entering or leaving the facility. Any such debris or deposited materials is removed without delay.

Litter Control
Litter fencing is no longer required at the facility as landfilling has ceased (July 2009).
Litter picking teams are organised as required to collect any wind blown litter or other waste, placed on or in the vicinity of the facility.
All vehicles removing waste and materials from the facility (Civic Amenity Site) are appropriately covered.

Dust Control
In dry weather, site roads and any other areas used by vehicles are sprayed with water as and when required to minimise airborne dust nuisance.

Bird Control
This is no longer an issue as all the waste has been covered and final capping of the site is complete.

Odour
Odour from the landfill site is minimised through the extraction of landfill gas and through the application of odour control substances as required.
No odour complaints were received during the reporting period.

Flies
Flies are controlled through the use of control substances as deemed necessary by the pest control experts.

Vermin
Vermin are controlled through the use of baiting as deemed necessary by the pest control experts.

Noise

Noise is minimised / controlled by operating the facility between the hours of 8am – 4pm. Contractors may operate between the hours of 8am – 6pm in agreement with the City Council.

5 ENVIRONMENTAL MANAGEMENT PROGRAMME

5.1 Environmental Objectives

1 Environmental Objective 1: Amenity Park Development

Environmental Objectives and Targets

Management Programme

Objective 1: Amenity Park Development				
Responsibility: Facility Management & appointed contractor			**Start Date:** April 2012 **Revised Date:** April 2017	
Target: To incrementally develop a regional amenity park				
Task	**Details**	**Due Date**	**By Whom**	**Status**
1	Phase 1 site landscaping works and associated works	Q3 2014	CCC / BSM	Complete
2	Completion of final phase of capping works	Q1 2015	Wills Bros. Contractor	Complete
3	Opening of regional park to the public	Q 1 2016		Complete
4	Ongoing phased delivery of landscaping Tree Planting Minor Safety Works SWALE Fencing Installation of traffic barriers	2016 - 2018	Site Staff & appointed contractors	 Complete Ongoing Ongoing Due Autumn 2017
Objective Complete: Signed: _____ Date: _____				

5.2 Site Management Structure

The Staff Management Structure for the facility is detailed in the Organisational Chart (Section 5.2.1).
The responsibilities of the site staff are listed below.

Facility Manager

The Facility Manager has overall responsibility for operation of the facility in accordance with the conditions of the Waste Licence and best operational practices.

The Facility Manager co-ordinates all of the activities and contractors on site and implements procedures and practices in accordance with the Environmental Management Programme.

Landfill Technicians

The Environmental Technicians carry out monitoring, sampling and analysis at the facility under the supervision of the facility manager and are based at the landfill site.

Site Foreman

The Site Foreman is responsible for ensuring that the site staff carry out their designated duties, and liaises with the Facility Manager in the implementation of procedures and practices at the facility. The foreman has completed the certified "Waste Management" course.

Relief Site Supervisor

The Relief Site Supervisor performs the functions of the Site Supervisor in the event of his / her absence. The Relief Site Supervisor has also completed the certified "Waste Management" course.

Weighbridge Operator

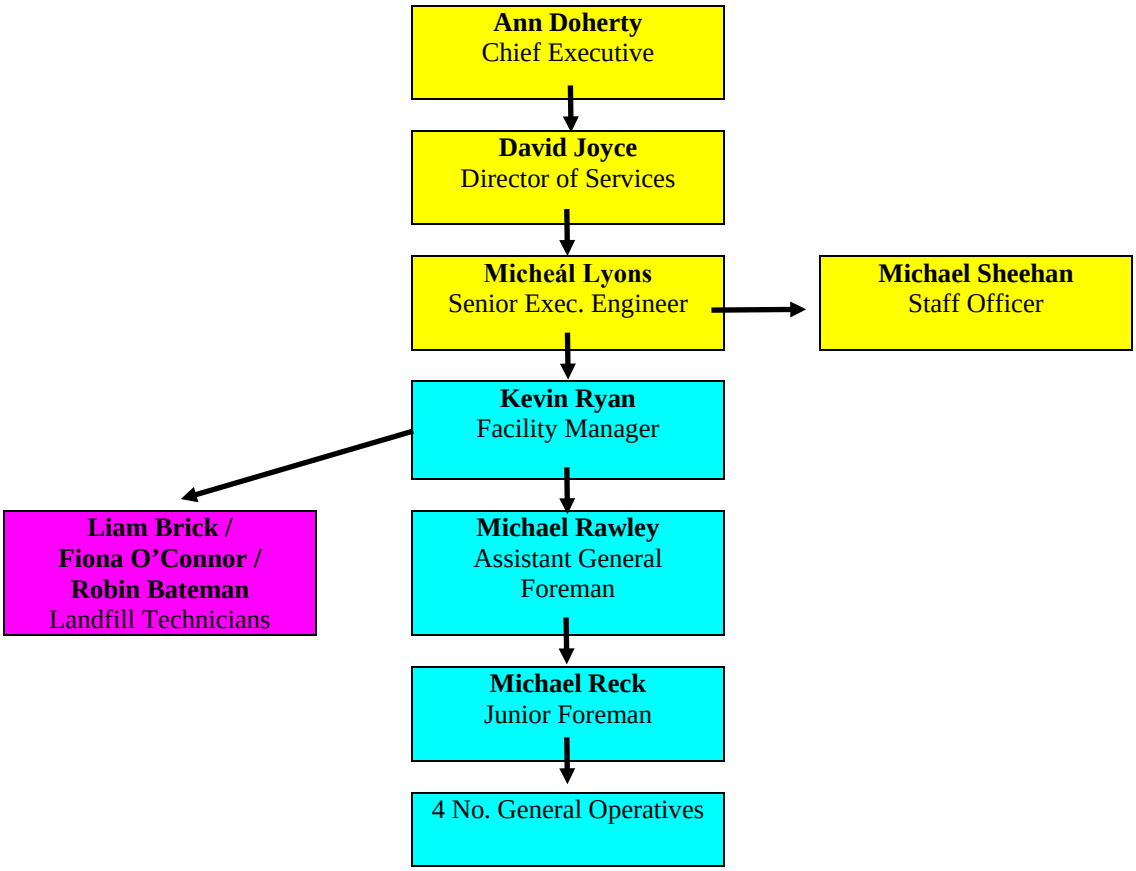
The Weighbridge Operator records incoming waste and controls access to the facility.

Staff Officer Environment

The Staff Officer Environment (not based on site) is responsible for the maintenance of the Waste Licence public file as well as dealing with queries from the public.

5.2.1 Organisational Chart

The Management Structure of Kinsale Road Landfill Site, including Environmental Monitoring (Site Technicians and Laboratory Analysis) and Administration (City Hall).



6 ENVIRONMENTAL MONITORING AND CONTROL

The following areas were monitored during the reporting period:

6 (a) Summary Report on Emissions

6.1 Dust

6.2 PM_{10}

6.3 Landfill Gas Monitoring

6.4 Groundwater

- Overburden Wells
- Deep Wells (NW)
- Greenhills & Nemo Rangers Wells
- Bedrock Wells (BR)

6.5 Surface Water Monitoring

6.6 Emissions to Sewer

- Selected Parameters
- Dissolved Methane

6.7 Discharge from Storm Water Pond and Reed Beds

External Reports

- Biological Survey of Streams Report
- Air Emissions testing of the Landfill Gas Flare Unit and Generation Unit
- PRTR Table for Flare Unit & Gas Utilisation Engine
- Landfill Gas Surface Emissions Survey
- Meteorological Data

Parameter: **Dust Monitoring**
Frequency: **Quarterly**
Guide Limit: **350 (mg/m^2/day)**

Quarter 1

Location	Grid Co-Ordinates	Date	mg/m2/day
D1	168081E,069747N	No Access	
D2	168373E,070046N	22 Feb 2016 to 23rd Mar 2016	63
D3	168600E,069691N	22 Feb 2016 to 23rd Mar 2016	117
D4	168178E,069276N	22 Feb 2016 to 23rd Mar 2016	117
D5	167982E,069648N	22 Feb 2016 to 23rd Mar 2016	116

Quarter 2

Location	Grid Co-Ordinates	Date	mg/m2/day
D1	168081E,069747N	No Access	
D2	168373E,070046N	28th Jun 2016 to 28 Jul 2016	16
D3	168600E,069691N	28th Jun 2016 to 28 Jul 2016	94
D4	168178E,069276N	28th Jun 2016 to 28 Jul 2016	48
D5	167982E,069648N	28th Jun 2016 to 28 Jul 2016	45

Quarter 3

Location	Grid Co-Ordinates	Date	mg/m2/day
D1	168081E,069747N	No Access	
D2	168373E,070046N	29th Aug 2016 to 28th Sept 2016	65
D3	168600E,069691N	29th Aug 2016 to 28th Sept 2016	75
D4	168178E,069276N	29th Aug 2016 to 28th Sept 2016	114
D5	167982E,069648N	29th Aug 2016 to 28th Sept 2016	30

Quarter 4

Location	Grid Co-Ordinates	Date	mg/m2/day
D1	168081E,069747N	No Access	
D2	168373E,070046N	1st Nov 2016 to 1st Dec 2016	95
D3	168600E,069691N	1st Nov 2016 to 1st Dec 2016	24
D4	168178E,069276N	1st Nov 2016 to 1st Dec 2016	114
D5	167982E,069648N	1st Nov 2016 to 1st Dec 2016	54

Ambient Monitoring

Parameter: PM_{10} ($\mu g/m^3$)

Frequency: Quarterly

24 hour limit value of 50 µg/m3

Quarter 1

Location	Grid Co-Ordinates	Date	PM_{10} $\mu g/m^3$
S1	168399E,069753N	15/03/2016	22
S2	168222E,069651N	Removed	Removed
S4	167982E,069648N	31/03/2016	22

Quarter 2

Location	Grid Co-Ordinates	Date	PM_{10} $\mu g/m^3$
S1	168399E,069753N	19/04/2016	24
S2	168222E,069651N	Removed	Removed
S4	167982E,069648N	31/05/2016	19

Quarter 3

Location	Grid Co-Ordinates	Date	PM_{10} $\mu g/m^3$
S1	168399E,069753N	15/08/2016	40
S2	168222E,069651N	Removed	Removed
S4	167982E,069648N	20/09/2016	36

Quarter 4

Location	Grid Co-Ordinates	Date	PM_{10} $\mu g/m^3$
S1	168399E,069753N	17/10/2016	33
S2	168222E,069651N	Removed	Removed
S4	167982E,069648N	15/11/2016	36

Parameter: Total Suspended Particulates
Frequency: Quarterly
Guide Limit: 150(µg/m3)

Quarter 1

Location	Grid Co-Ordinates	Date	µg/m^3
D1	168081E,069747N	21/03/2016	19
D2	168373E,070046N	23/03/2016	25
D3	168600E,069691N	09/03/2016	25
D4	168178E,069276N	29/03/2016	15
D5	167982E,069648N	31/03/2016	22

Quarter 2

Location	Grid Co-Ordinates	Date	µg/m^3
D1	168081E,069747N	12/04/2016	32
D2	168373E,070046N	10/05/2016	32
D3	168600E,069691N	17/05/2016	26
D4	168178E,069276N	24/05/2016	13
D5	167982E,069648N	31/05/2016	19

Quarter 3

Location	Grid Co-Ordinates	Date	µg/m^3
D1	168081E,069747N	02/08/2016	15
D2	168373E,070046N	22/08/2016	17
D3	168600E,069691N	29/08/2016	42
D4	168178E,069276N	06/09/2016	44
D5	167982E,069648N	20/09/2016	36

Quarter 4

Location	Grid Co-Ordinates	Date	µg/m^3
D1	168081E,069747N	10/10/2016	21
D2	168373E,070046N	24/10/2016	22
D3	168600E,069691N	01/11/2016	36
D4	168178E,069276N	09/11/2016	22
D5	167982E,069648N	15/11/2016	36

Landfill Gas Monitoring Report

AER gas well data compilation

Gas Well Graphs

- Blue Demons Gas Wells
- Perimeter and Greenhills Estate Gas Wells
- Park and Ride Gas Wells

Perimeter Gas Monitoring Wells

WELL NO.	DP3	
LOCATION	BLUEDEMONS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	5.70
Mean	0.00	1.12
n	36	36
Over limit	0	22

WELL NO.	DP4	
LOCATION	BLUEDEMONS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	65.00	8.10
Mean	7.61	2.16
n	36	36
Over limit	7	17

WELL NO.	DP3A	
LOCATION	BLUEDEMONS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	7.60
Mean	0.00	1.70
n	36	36
Over limit	0	12

WELL NO.	DP4A	
LOCATION	BLUEDEMONS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.60	9.40
Mean	0.02	2.71
n	36	36
Over limit	0	19

WELL NO.	DP3 OLD	
LOCATION	BLUEDEMONS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	32.90	1.30
Max	75.70	40.10
Mean	62.46	21.69
n	36	36
Over limit	29	29

WELL NO.	DP4 OLD	
LOCATION	BLUEDEMONS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	65.70	10.60
Mean	12.48	4.44
n	36	36
Over limit	16	23

WELL NO.	LG2	
LOCATION	LANDFILL NORTH	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	2.40
Max	2.90	12.00
Mean	0.00	6.91
n	47	
Over limit	1	47

WELL NO.	LG3	
LOCATION	LANDFILL NORTH	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.70
Max	0.00	7.90
Mean	0.00	4.30
n	47	
Over limit	0	47

WELL NO.	LG4	
LOCATION	LANDFILL NORTH	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.00
Max	0.00	7.00
Mean	0.00	4.02
n	47	
Over limit	0	44

WELL NO.	LG5	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	1.20
Mean	0.00	0.35
n	221	
Over limit	0	0

WELL NO.	LG5A	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.60	0.90
Max	20.60	18.10
Mean	6.98	7.83
n	221	
Over limit	74	74

WELL NO.	LG6	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	6.10
Mean	0.00	2.82
n	221	
Over limit	0	15

WELL NO.	LG6A	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	4.20
Max	0.00	7.80
Mean	0.00	5.65
n	221	
Over limit	0	8

WELL NO.	LG7A	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.70
Max	0.00	1.90
Mean	0.00	1.22
n	221	
Over limit	0	10

WELL NO.	LG8A	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	6.80
Max	0.00	0.00
Mean	0.00	12.11
n	221	
Over limit	0	30

WELL NO.	LG8	**Well Flooded**
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	6.90
Max	0.00	6.90
Mean	0.00	6.90
n	1	
Over limit	0	1

WELL NO.	LG12	
LOCATION	LANDFILL SOUTH	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.90
Max	0.80	5.20
Mean	0.14	3.69
n	47	
Over limit	0	46

WELL NO.	LG13	
LOCATION	LANDFILL SOUTH	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.90
Mean	0.00	0.15
n	47	
Over limit	0	0

WELL NO.	LG14	
LOCATION	LANDFILL SOUTH	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	3.70
Max	0.00	10.10
Mean	0.00	6.20
n	47	
Over limit	0	47

WELL NO.	LG46	**Broken Well**
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.00
Mean	0.00	0.00
n	0	
Over limit	0	0

WELL NO.	LG47	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	6.20
Mean	0.00	0.58
n	221	
Over limit	0	14

WELL NO.	LG48	**Broken Well**
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.00
Mean	0.00	0.00
n	0	
Over limit	0	0

WELL NO.	LG49	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.40
Max	0.00	6.70
Mean	0.00	2.87
n	221	
Over limit	0	119

WELL NO.	LG51	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	3.10
Mean	0.00	0.42
n	221	
Over limit	0	3

WELL NO.	LG52	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	8.90
Mean	0.00	4.39
n	221	
Over limit	0	129

WELL NO.	LG53	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.60
Mean	0.00	0.17
n	221	
Over limit	0	0

WELL NO.	LG54	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.10
Max	0.00	6.80
Mean	0.00	4.70
n	221	
Over limit	0	25

WELL NO.	LG55	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	3.70
Mean	0.00	0.87
n	221	
Over limit	0	48

WELL NO.	LG58	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.30
Max	0.00	2.70
Mean	0.00	1.20
n	226	
Over limit	0	56

WELL NO.	TP9	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.10
Max	0.00	13.00
Mean	0.00	6.24
n	221	
Over limit	0	98

WELL NO.	TP12	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	5.80
Mean	0.00	1.60
n	221	
Over limit	0	86

WELL NO.	TP17	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	2.10
Mean	0.00	0.45
n	221	
Over limit	0	1

WELL NO.	TP21	**Broken Well**
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.00
Mean	0.00	0.00
n	0	
Over limit	0	0

WELL NO.	TP27	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	3.50
Mean	0.00	1.51
n	221	
Over limit	0	107

WELL NO.	TP32	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.90
Max	0.00	11.00
Mean	0.00	5.79
n	221	
Over limit	0	227

WELL NO.	TP33	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.70
Max	0.00	7.90
Mean	0.00	5.57
n	221	
Over limit	0	225

WELL NO.	GH1	
LOCATION	GREENHILLS	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	1.10
Mean	0.00	0.40
n	221	
Over limit	0	0

WELL NO.	GH2	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	0.01	0.02
	CH4 %	CO2 %
Min	0.00	0.00
Max	0	4.3
Mean	0	1.80
n	221	
Over limit	0	81

WELL NO.	GH3	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.10
Max	0.00	9.20
Mean	0.00	3.07
n	221	
Over limit	0	117

WELL NO.	GH4	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.20
Max	0.00	9.00
Mean	0.00	5.20
n	221	
Over limit	0	138

WELL NO.	GH5	
LOCATION	GREENHILLS	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	4.10
Mean	0.00	0.59
n	221	
Over limit	0	7

WELL NO.	137	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.21	0.01
Max	41.00	21.00
Mean	1.58	1.58
n	221	221
Over limit	25	33

WELL NO.	138	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.86	0.28
Mean	0.01	0.01
n	221	221
Over limit	0	0

WELL NO.	139	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	25.60	21.30
Mean	0.34	0.59
n	221	221
Over limit	16	31

WELL NO.	140	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.39	0.00
Max	2.46	3.39
Mean	0.63	0.29
n	221	221
Over limit	3	19

WELL NO.	141	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.05	0.04
Max	0.46	1.94
Mean	0.24	0.19
n	221	221
Over limit	0	8

WELL NO.	142	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	2.79
Mean	0.00	0.93
n	221	221
Over limit	0	65

WELL NO.	143	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	0.01	0.015
	CH4 %	CO2 %
Min	0.00	0.01
Max	24.30	16.00
Mean	2.03	1.99
n	36	36
Over limit	6	12

WELL NO.	144	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.40
Mean	0.00	4.27
n	36	36
Over limit	0	0

WELL NO.	145	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.20
Max	0.00	2.70
Mean	0.00	1.94
n	36	36
Over limit	0	25

WELL NO.	146	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.10
Max	0.00	0.90
Mean	0.00	0.39
n	36	36
Over limit	0	0

WELL NO.	171	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.20
Max	0.00	0.70
Mean	0.00	0.47
n	36	36
Over limit	0	0

WELL NO.	172	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.10
Max	0.00	0.70
Mean	0.00	0.46
n	36	36
Over limit	0	0

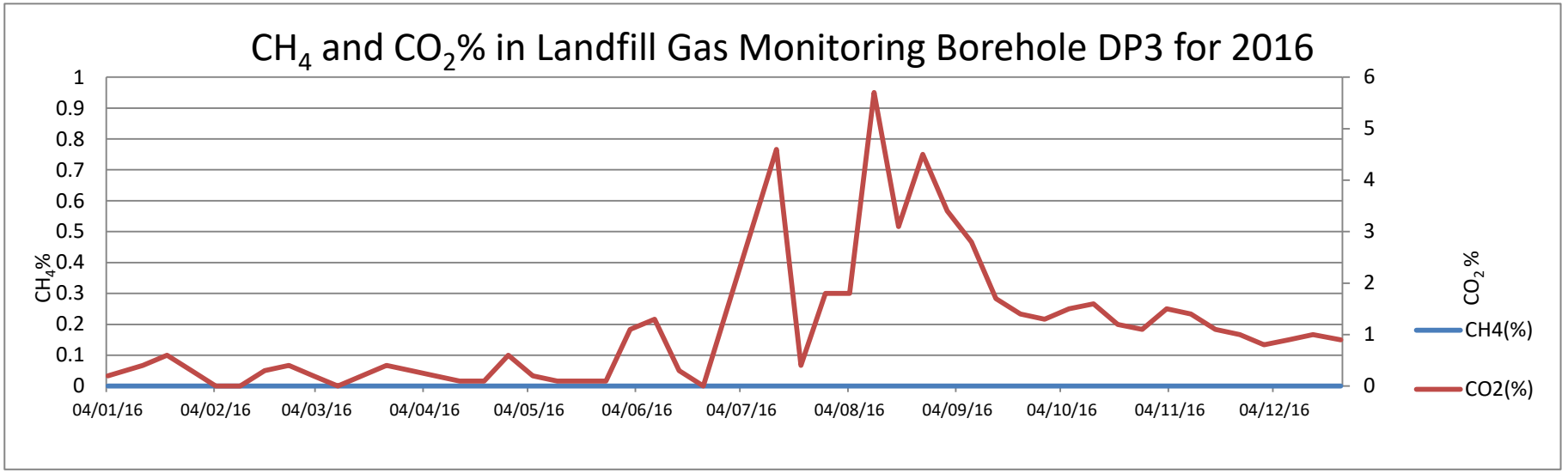
WELL NO.	173	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.40
Max	0.00	1.70
Mean	0.00	0.97
n	36	36
Over limit	0	2

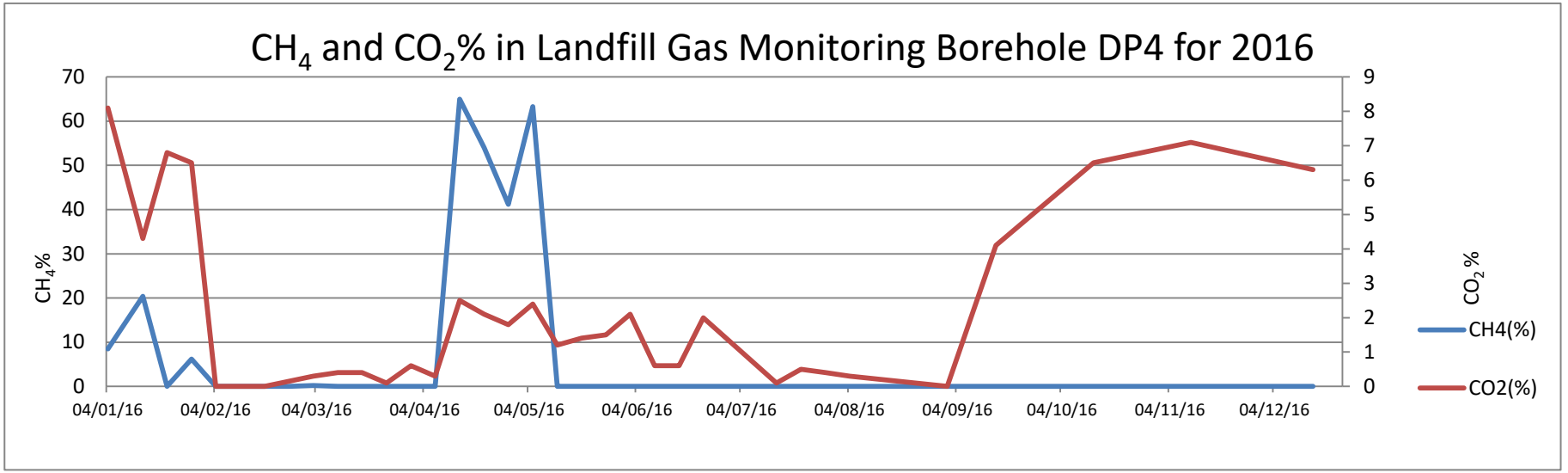
WELL NO.	174	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.40
Max	0.00	1.00
Mean	0.00	0.67
n	36	36
Over limit	0	0

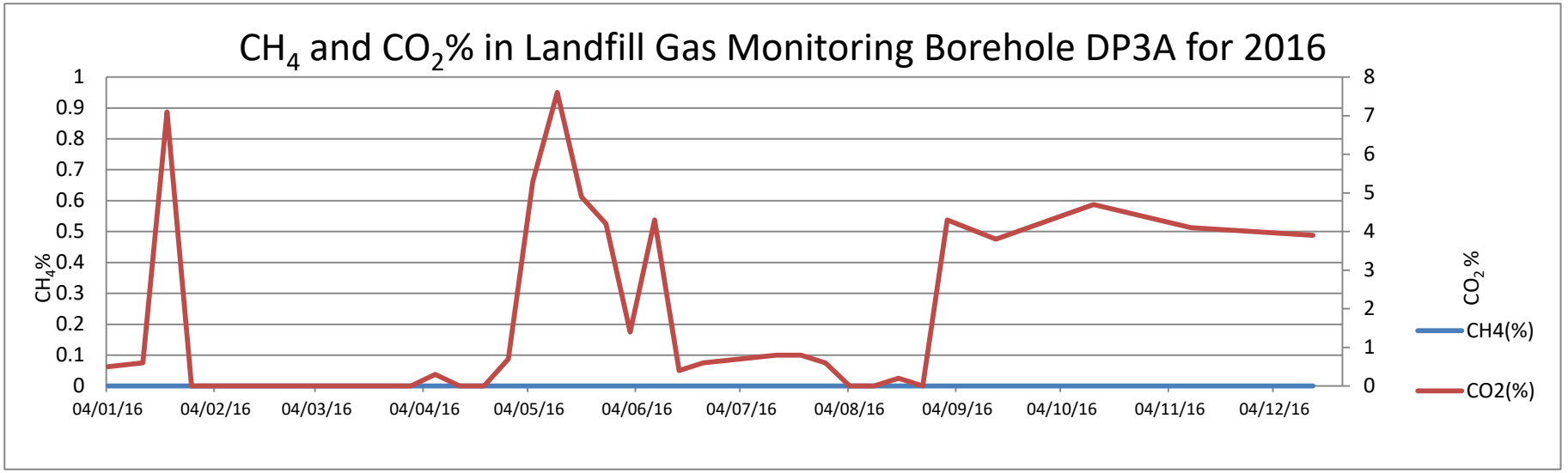
WELL NO.	175	
LOCATION	PARK AND RIDE	
LICENSED	Y	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	1.30
Max	0.00	2.40
Mean	0.00	1.91
n	36	36
Over limit	0	13

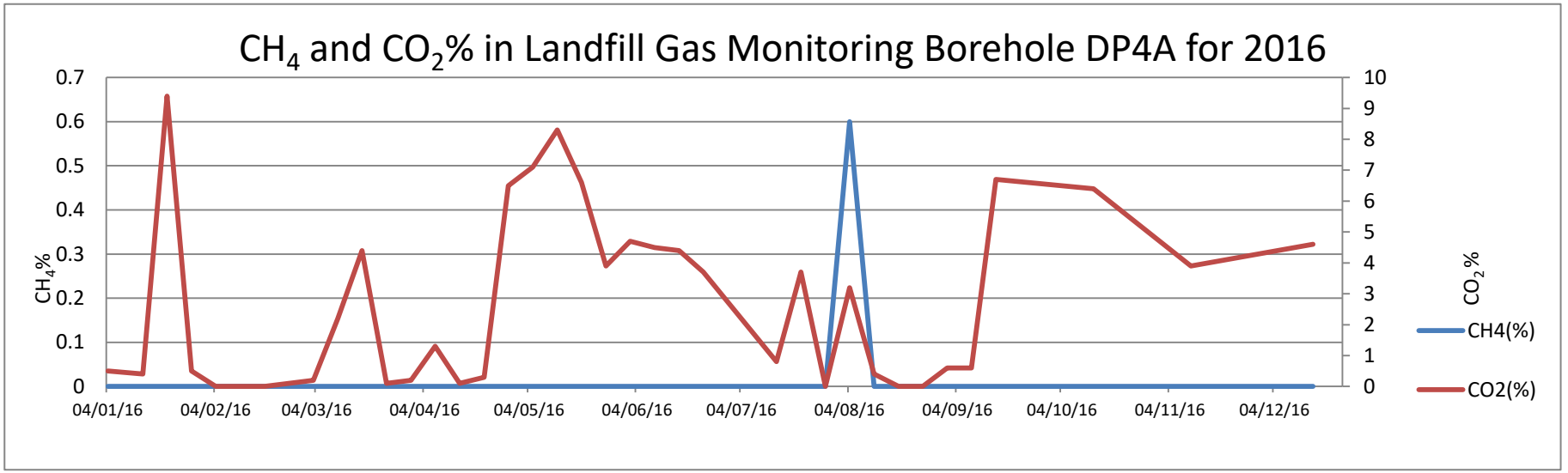
WELL NO.	TERMINAL	
LOCATION	PARK AND RIDE	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.00
Mean	0.00	0.00
n	36	36
Over limit	0	0

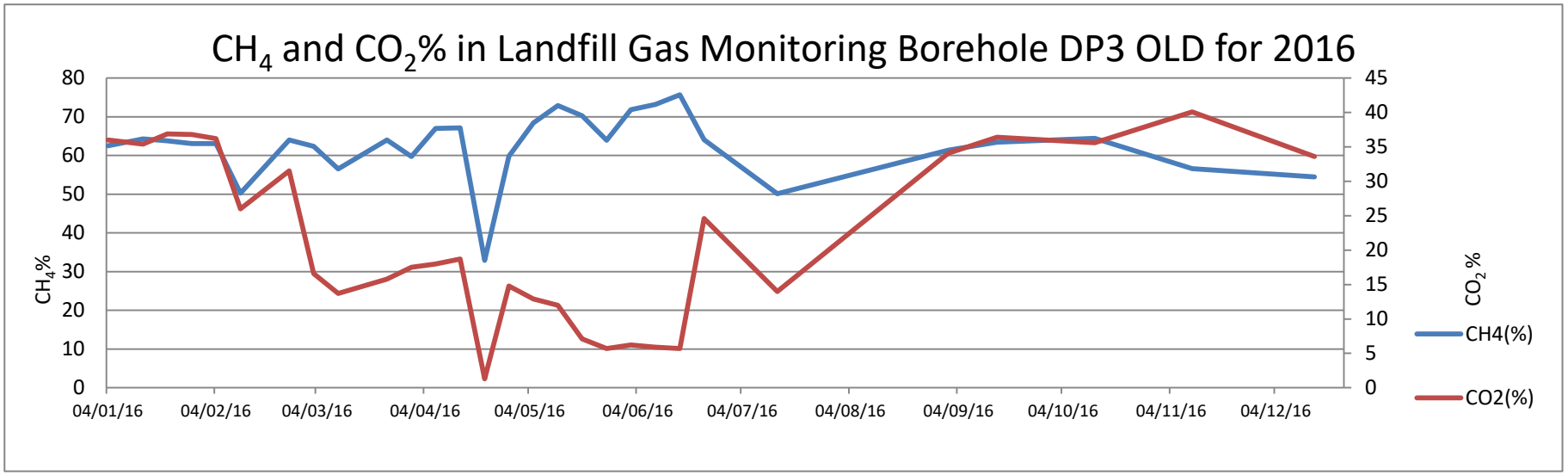
WELL NO.	KITCHEN	
LOCATION	PARK AND RIDE	
LICENSED	N	
License Limit	1%	1.50%
	CH4 %	CO2 %
Min	0.00	0.00
Max	0.00	0.00
Mean	0.00	0.00
n	36	36
Over limit	0	0

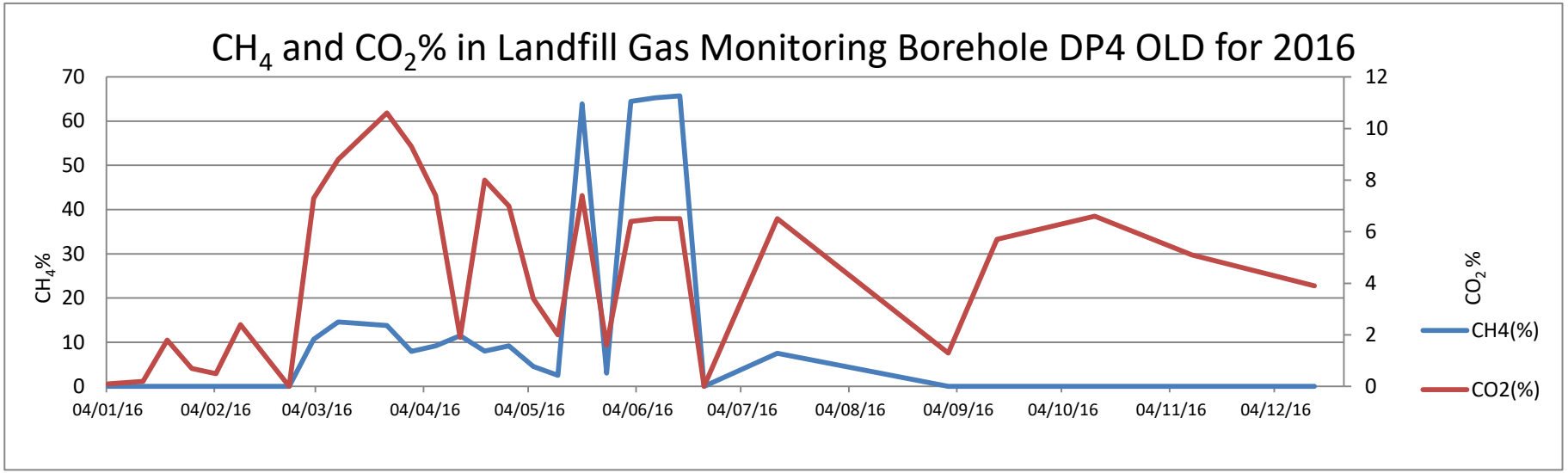

CH4 and CO2% in Landfill Gas Monitoring Borehole DP3 for 2016
CH4%
CO2 %
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6
5
4
3
2
1
0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16
CH4(%)
CO2(%)

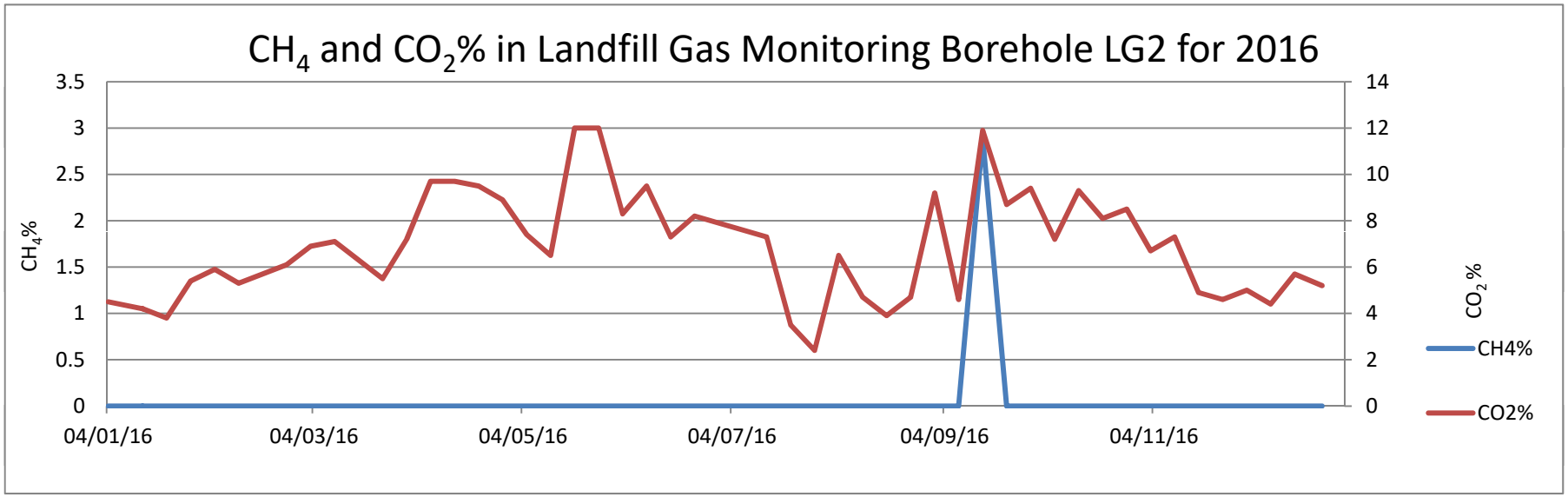

CH4 and CO2% in Landfill Gas Monitoring Borehole DP4 for 2016
CH4%
CO2 %
70
60
50
40
30
20
10
0
9
8
7
6
5
4
3
2
1
0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16
CH4(%)
CO2(%)

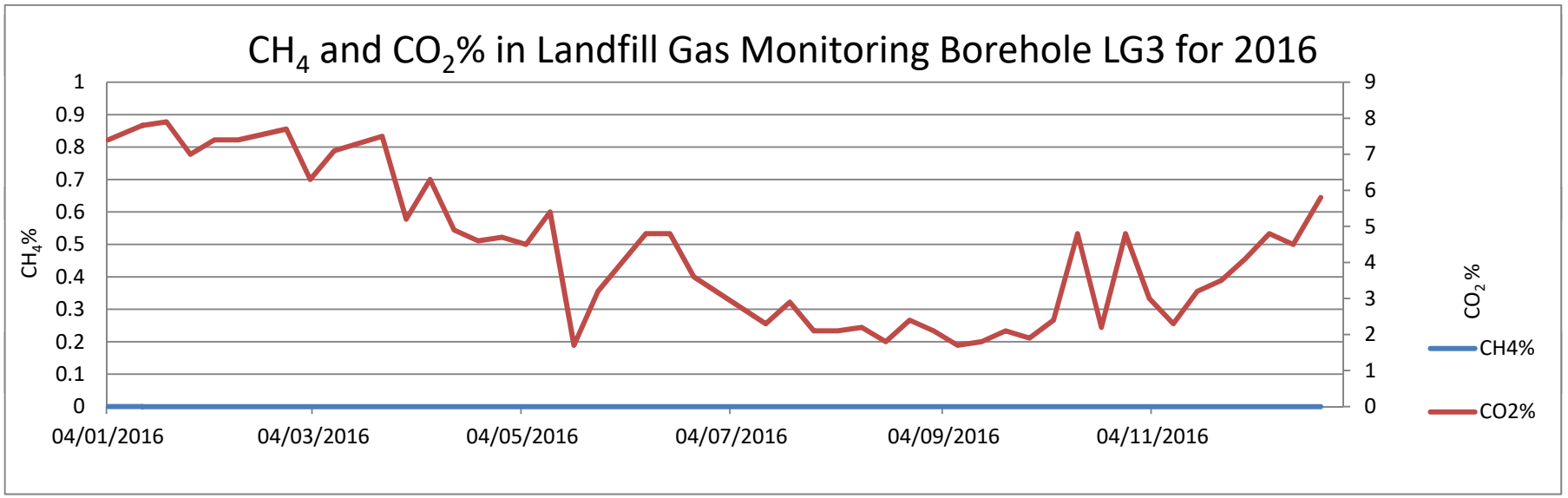

CH4 and CO2% in Landfill Gas Monitoring Borehole DP3A for 2016
CH4%
CO2%
CH4(%)
CO2(%)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8
7
6
5
4
3
2
1
0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16

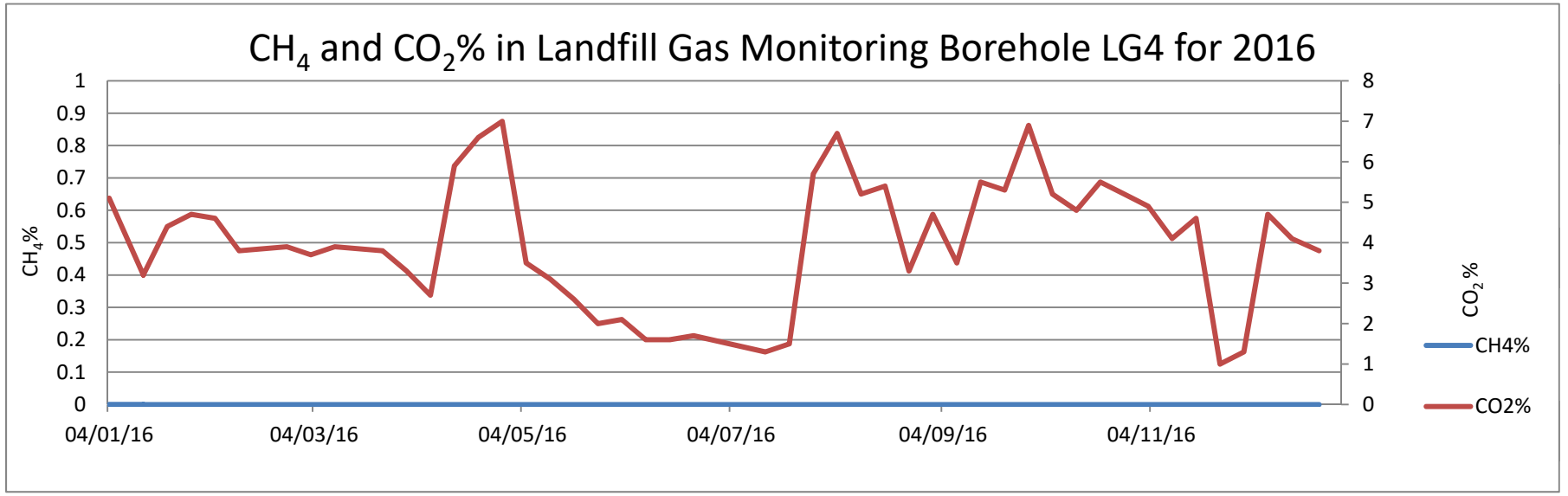

CH4 and CO2% in Landfill Gas Monitoring Borehole DP4A for 2016
CH4%
CO2%
CH4(%)
CO2(%)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
9
8
7
6
5
4
3
2
1
0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16

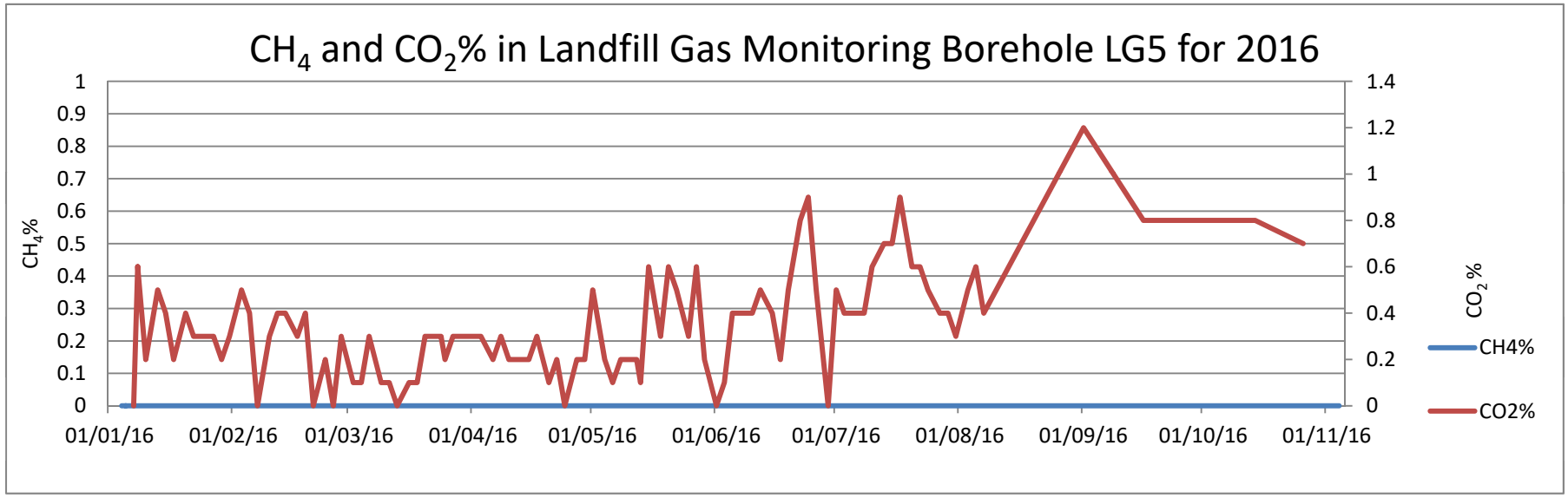

CH4 and CO2% in Landfill Gas Monitoring Borehole DP3 OLD for 2016
CH4%
CO2%
80
70
60
50
40
30
20
10
0
45
40
35
30
25
20
15
10
5
0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16
CH4(%)
CO2(%)

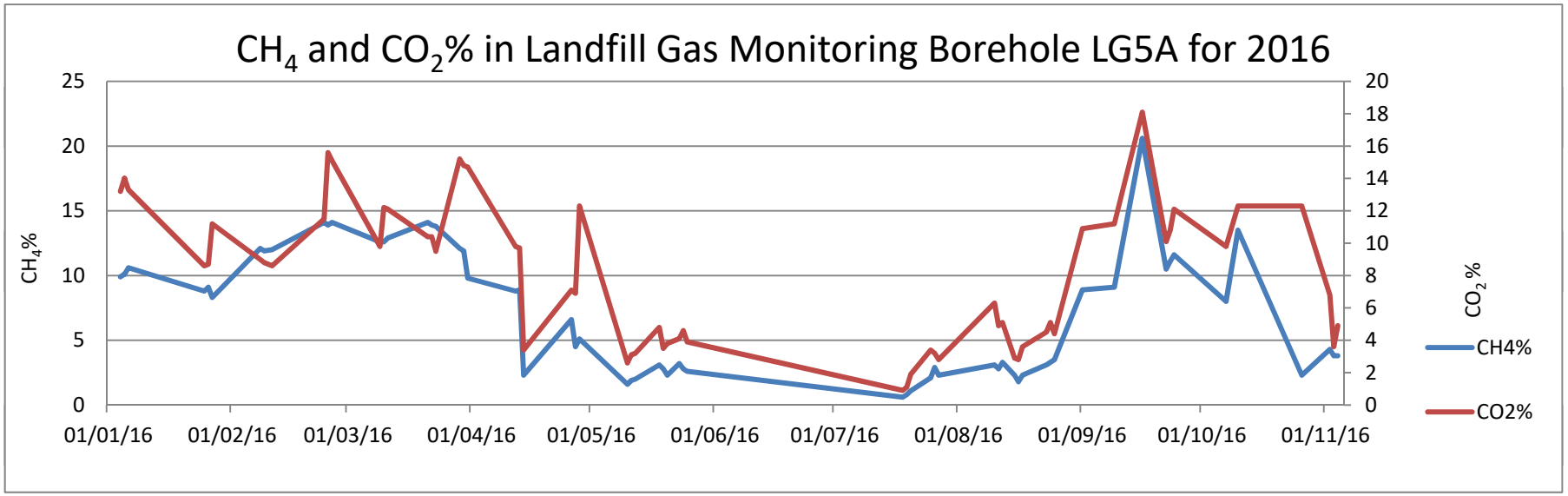

CH4 and CO2% in Landfill Gas Monitoring Borehole DP4 OLD for 2016
CH4%
CO2%
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16
CH4(%)
CO2(%)

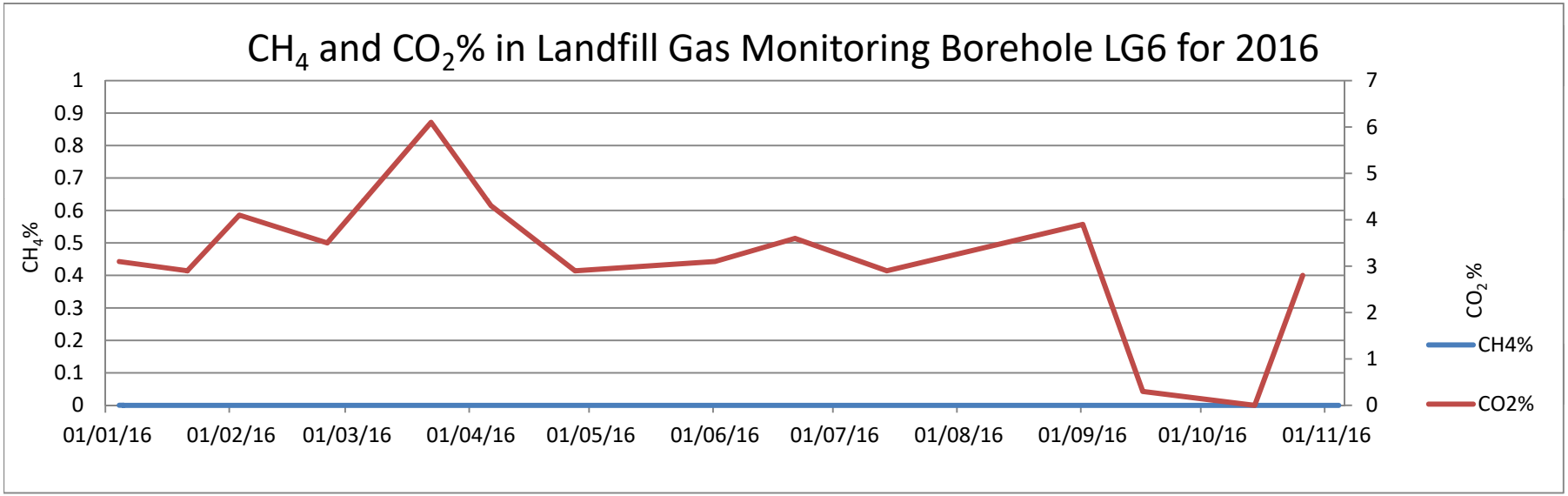

CH4 and CO2% in Landfill Gas Monitoring Borehole LG2 for 2016
CH4%
CO2%
3.5
3
2.5
2
1.5
1
0.5
0
14
12
10
8
6
4
2
0
04/01/16
04/03/16
04/05/16
04/07/16
04/09/16
04/11/16
CH4%
CO2%

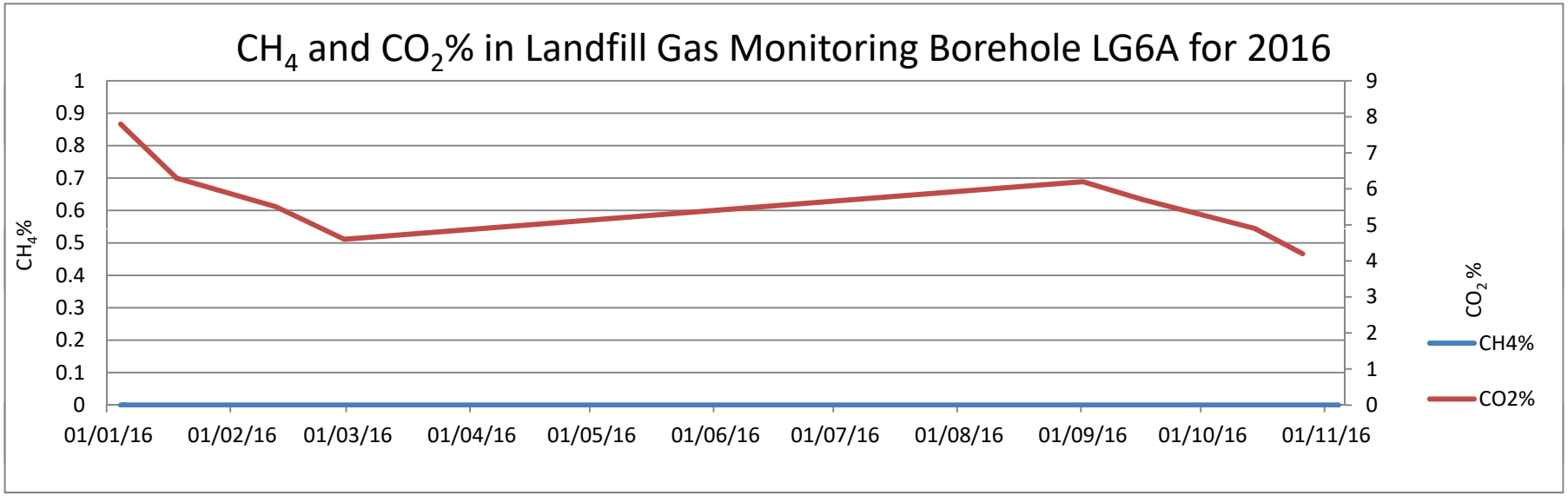

CH4 and CO2% in Landfill Gas Monitoring Borehole LG3 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9
8
7
6
5
4
3
2
1
0
04/01/2016
04/03/2016
04/05/2016
04/07/2016
04/09/2016
04/11/2016
CH4%
CO2%

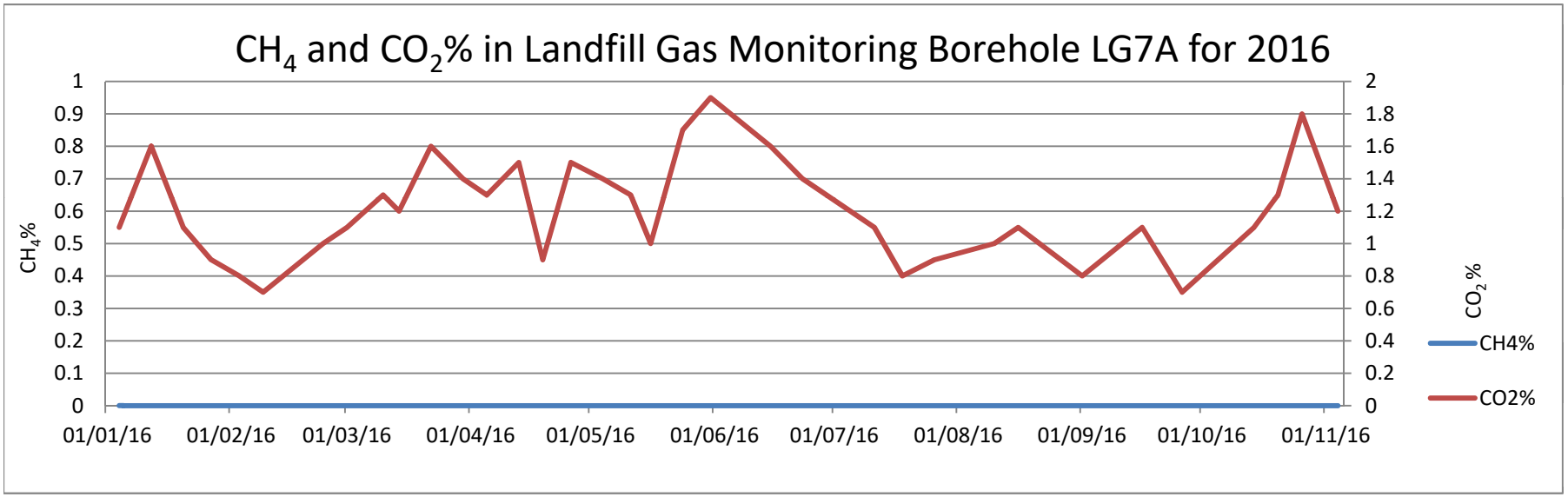

CH4 and CO2% in Landfill Gas Monitoring Borehole LG4 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8
7
6
5
4
3
2
1
0
04/01/16
04/03/16
04/05/16
04/07/16
04/09/16
04/11/16
CH4%
CO2%

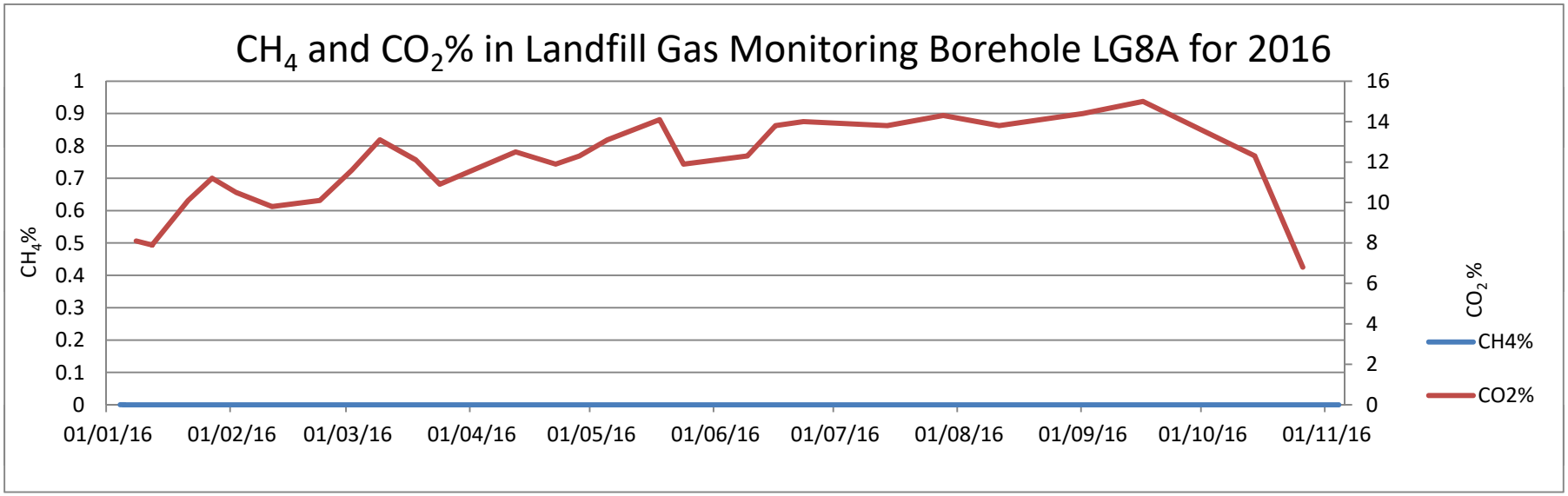

CH4 and CO2% in Landfill Gas Monitoring Borehole LG5 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

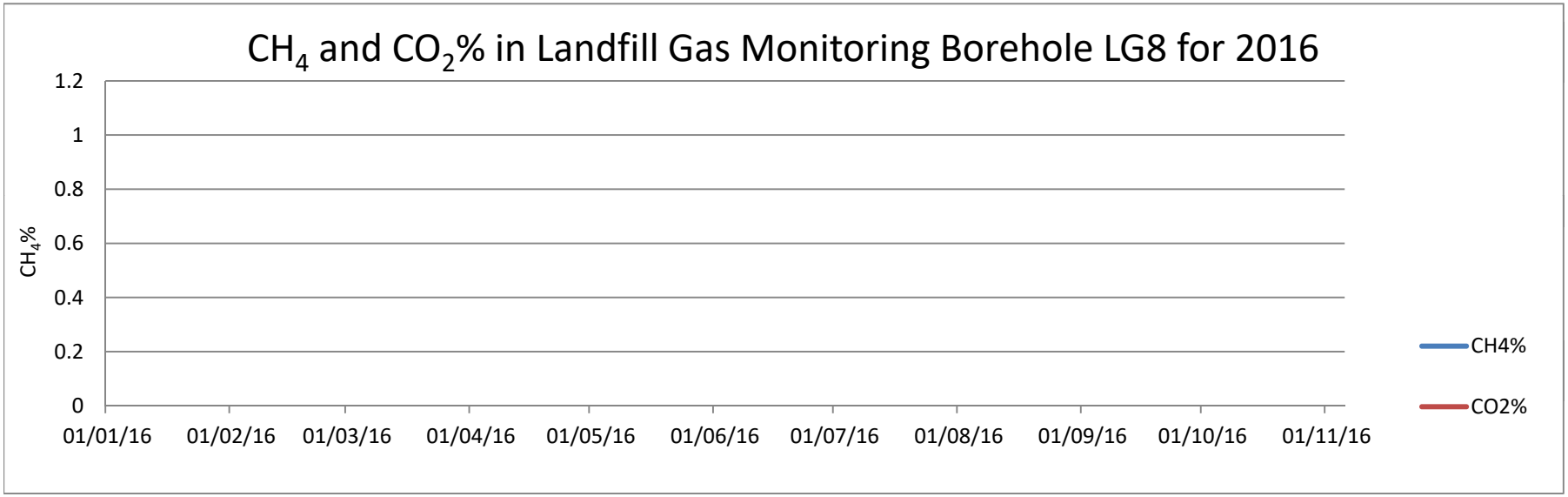

CH4 and CO2% in Landfill Gas Monitoring Borehole LG5A for 2016
CH4%
CO2%
25
20
15
10
5
0
20
18
16
14
12
10
8
6
4
2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

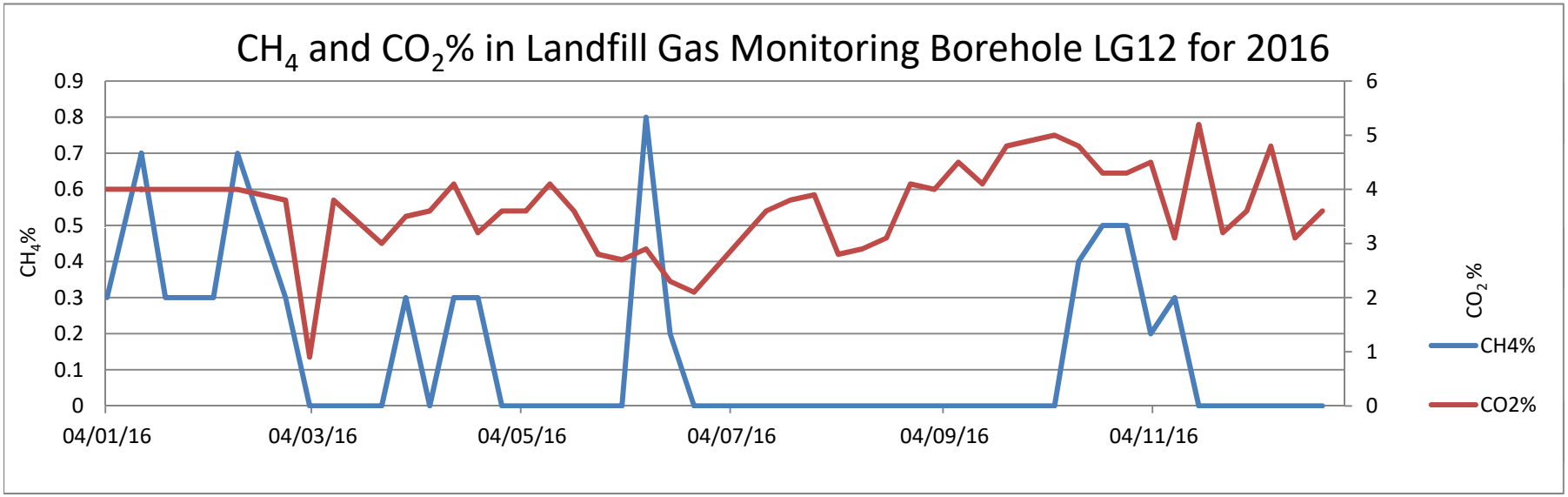

CH4 and CO2% in Landfill Gas Monitoring Borehole LG6 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

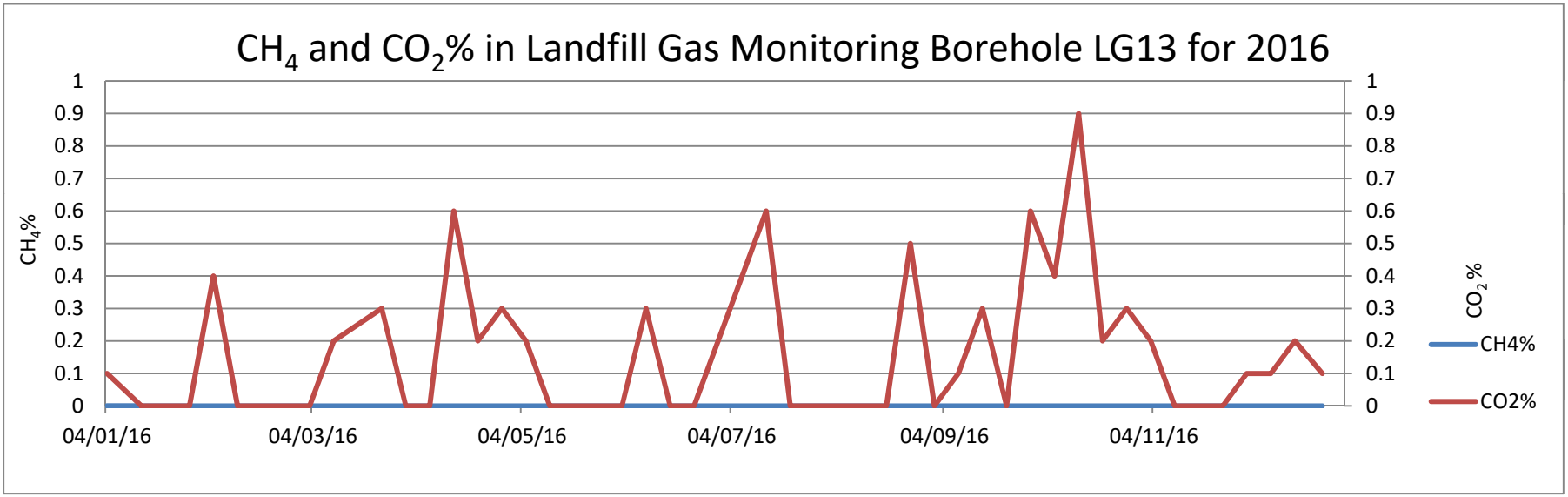

CH4 and CO2% in Landfill Gas Monitoring Borehole LG6A for 2016
CH4%
CO2 %
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

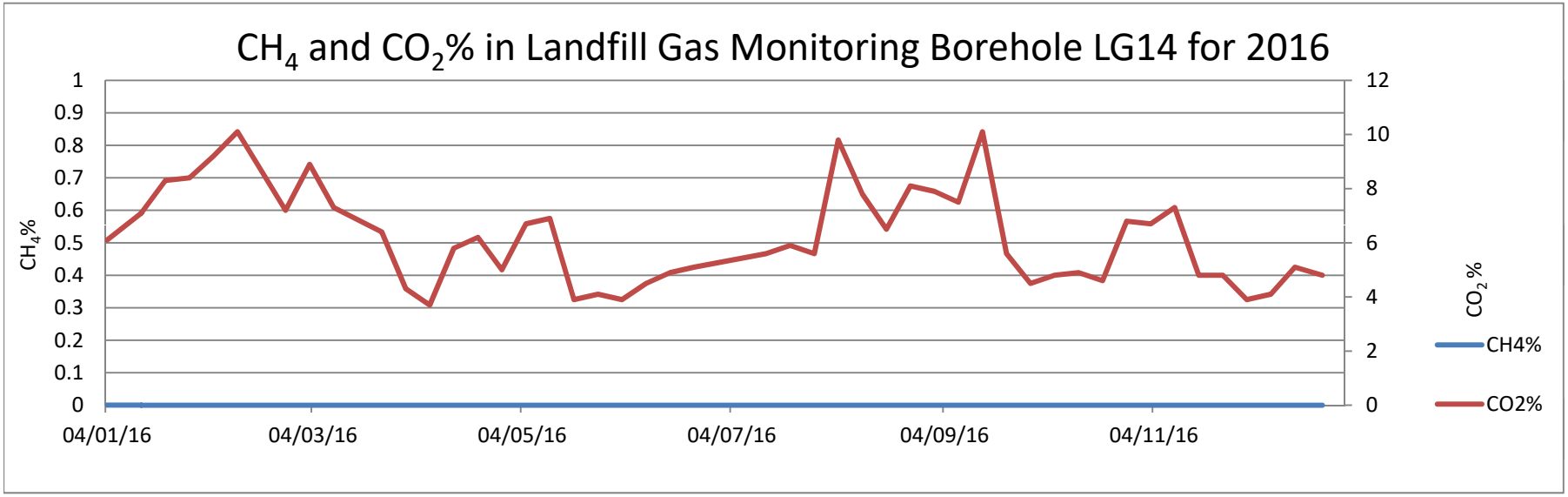

CH4 and CO2% in Landfill Gas Monitoring Borehole LG7A for 2016
CH4%
CO2 %
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

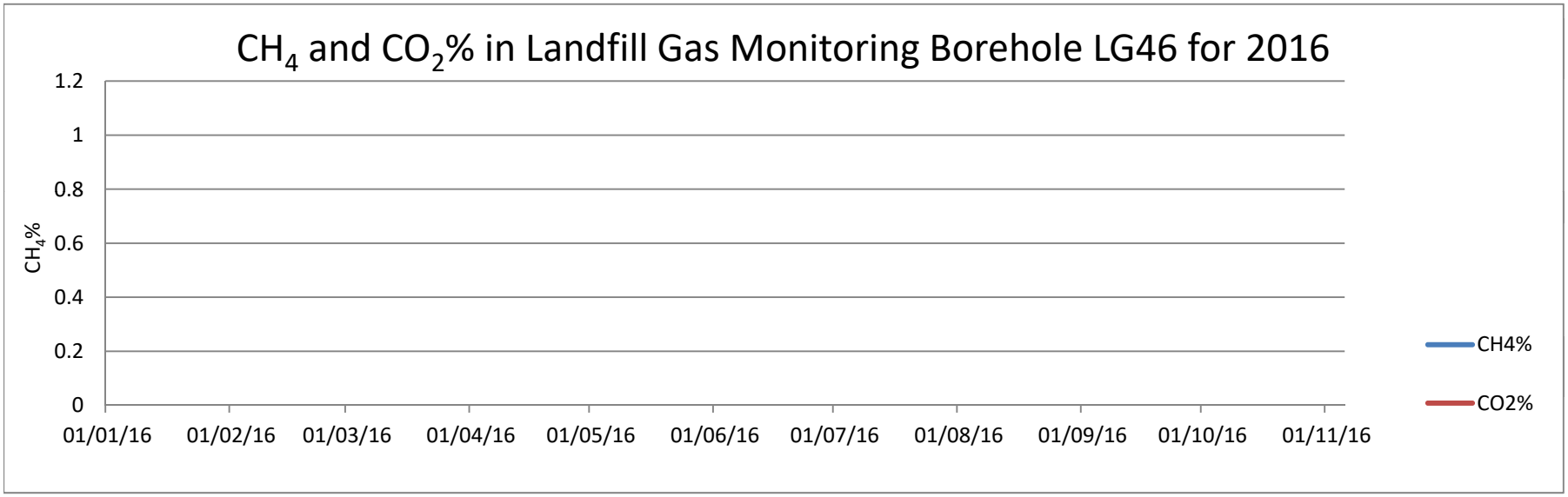

CH4 and CO2% in Landfill Gas Monitoring Borehole LG8A for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
16
14
12
10
8
6
4
2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

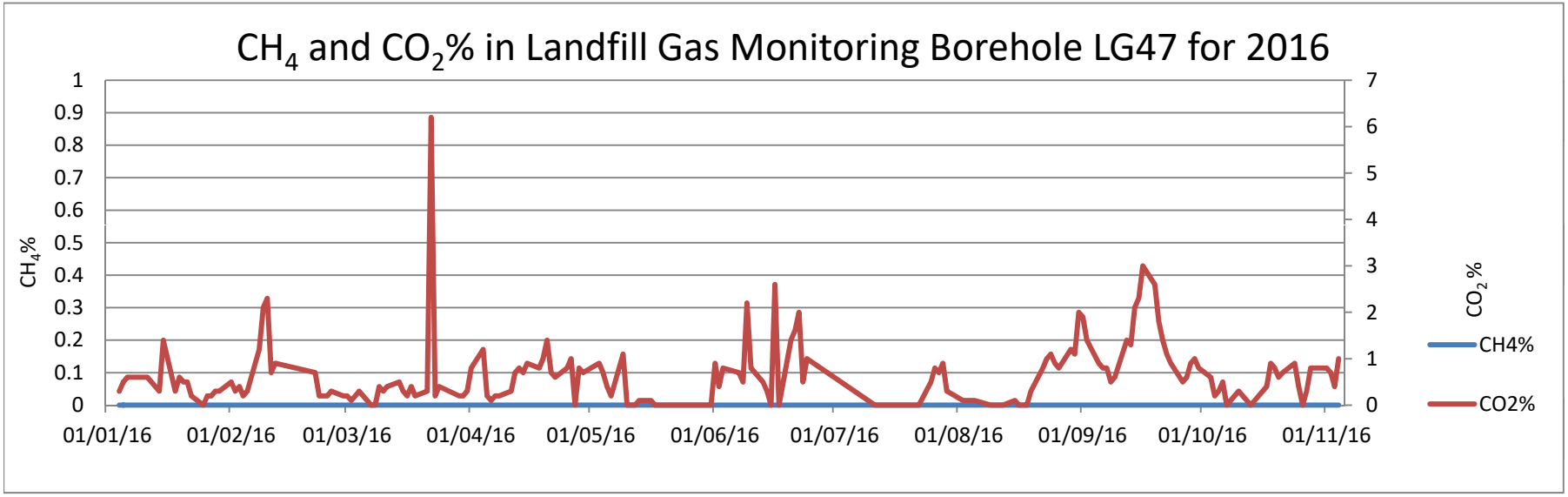

CH4 and CO2% in Landfill Gas Monitoring Borehole LG8 for 2016
CH4%
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

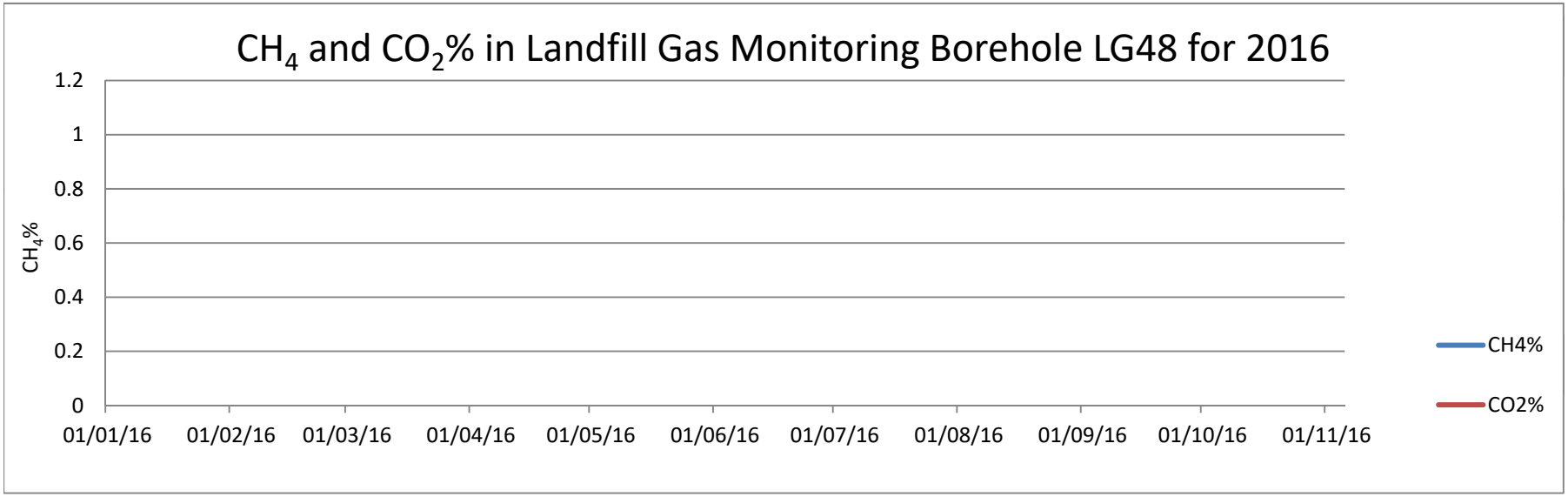

CH4 and CO2% in Landfill Gas Monitoring Borehole LG12 for 2016
CH4%
CO2 %
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6
5
4
3
2
1
0
04/01/16
04/03/16
04/05/16
04/07/16
04/09/16
04/11/16
CH4%
CO2%

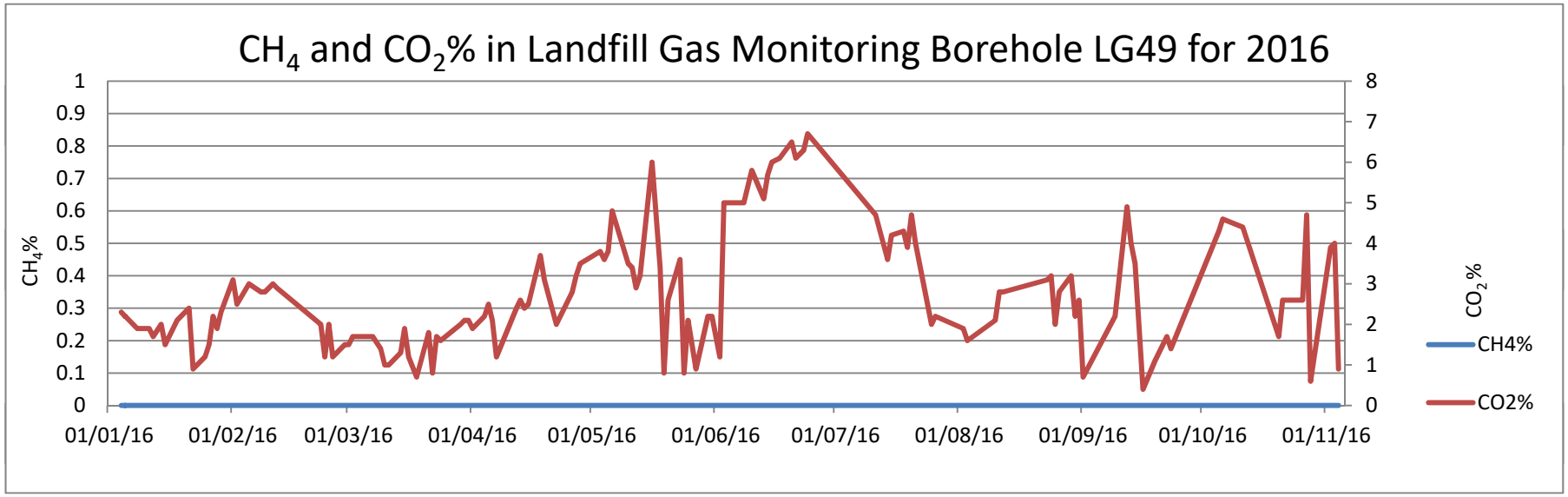

CH4 and CO2% in Landfill Gas Monitoring Borehole LG13 for 2016
CH4%
CO2 %
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
04/01/16
04/03/16
04/05/16
04/07/16
04/09/16
04/11/16
CH4%
CO2%

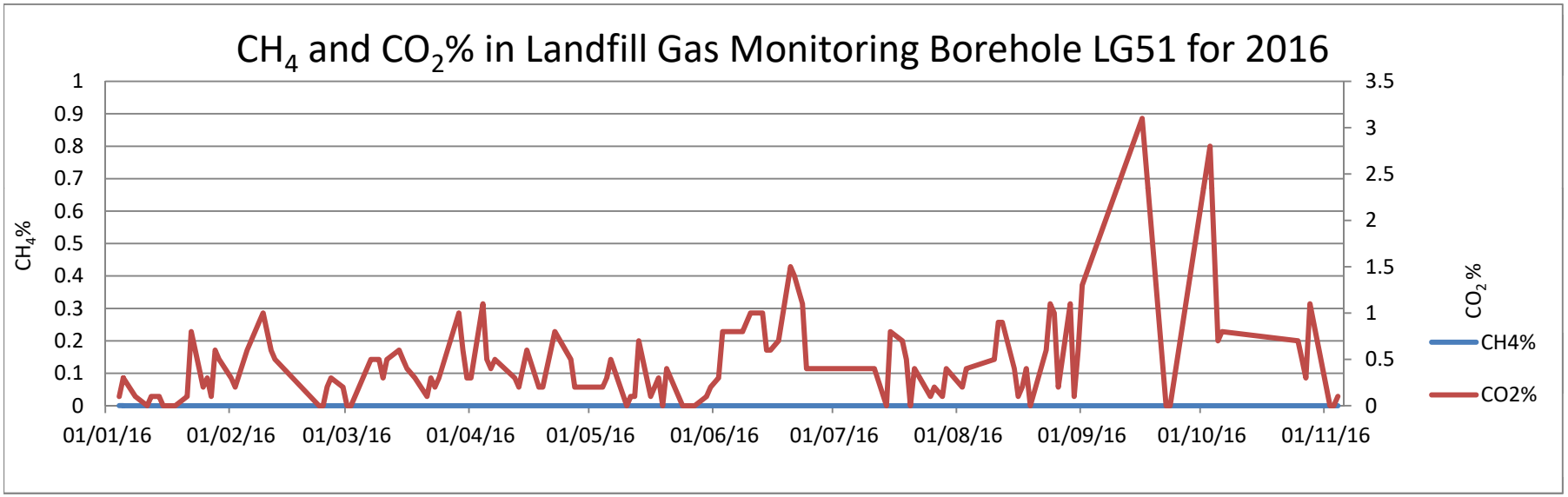

CH4 and CO2% in Landfill Gas Monitoring Borehole LG14 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
10
8
6
4
2
0
04/01/16
04/03/16
04/05/16
04/07/16
04/09/16
04/11/16
CH4%
CO2%

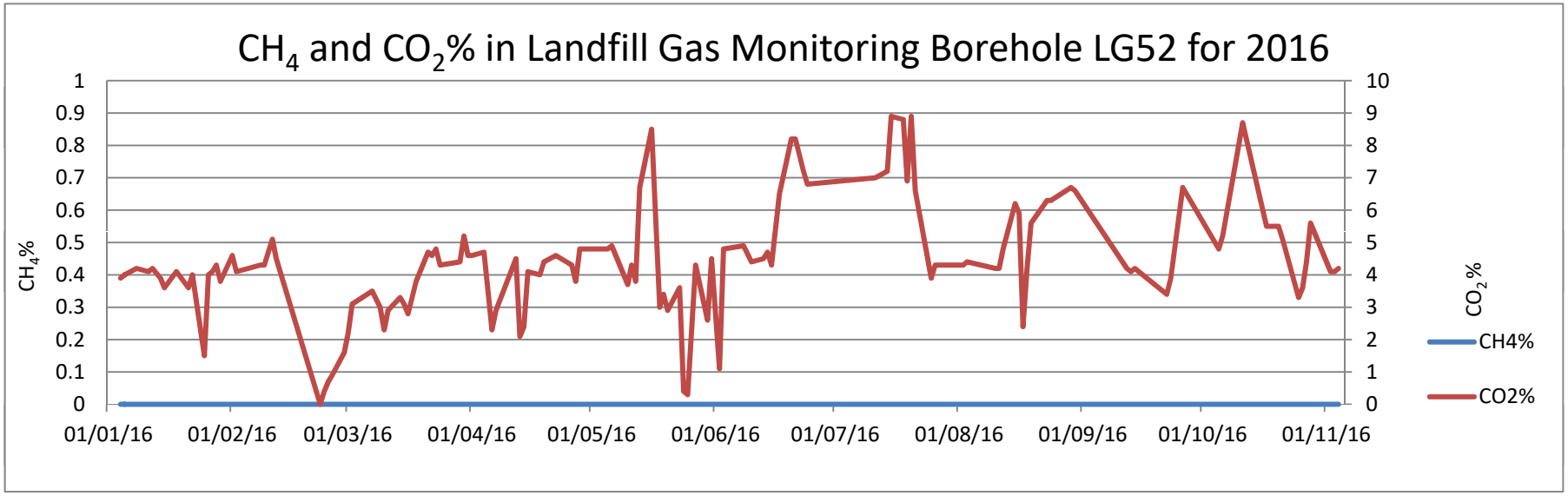

CH4 and CO2% in Landfill Gas Monitoring Borehole LG46 for 2016
CH4%
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

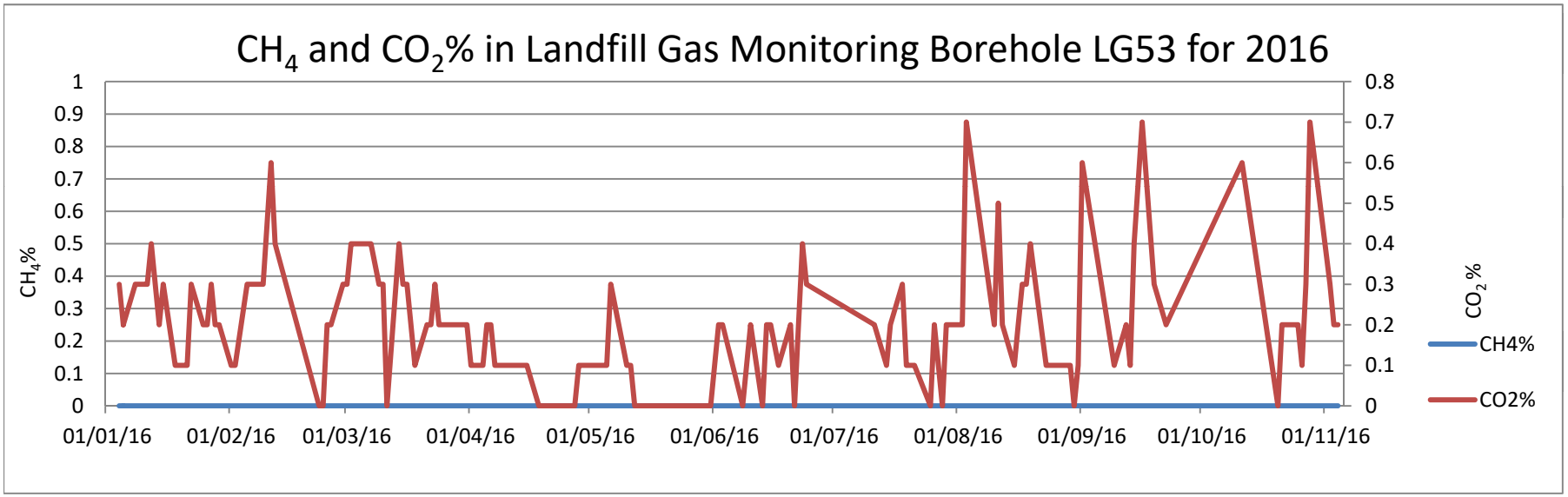

CH4 and CO2% in Landfill Gas Monitoring Borehole LG47 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

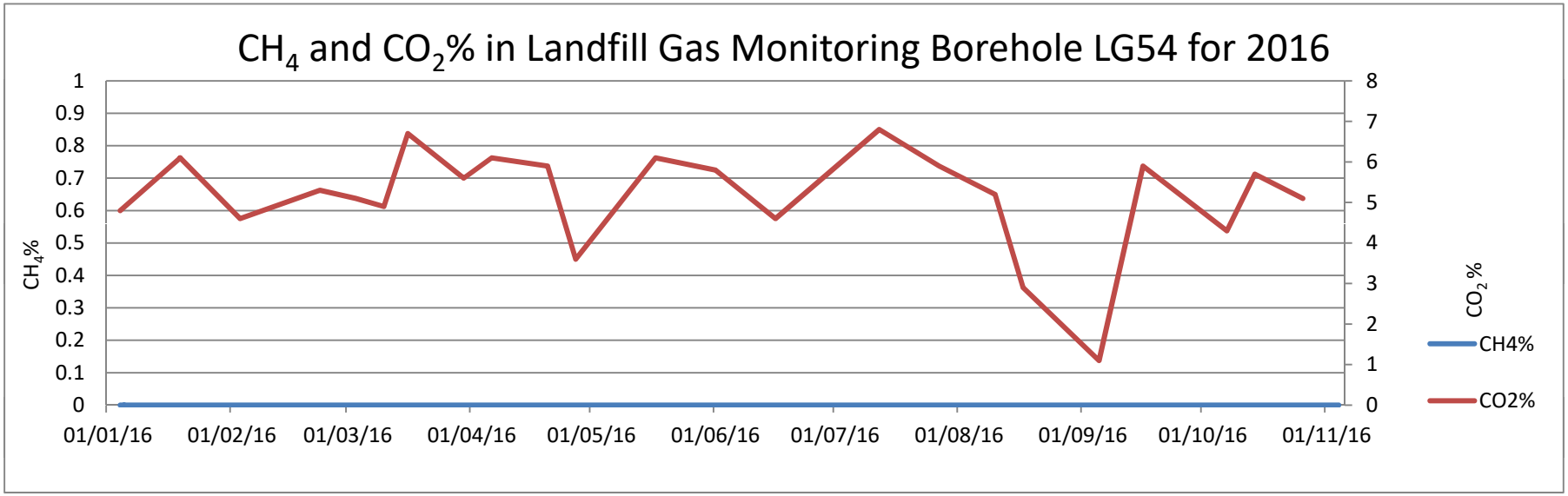

CH4 and CO2% in Landfill Gas Monitoring Borehole LG48 for 2016
CH4%
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

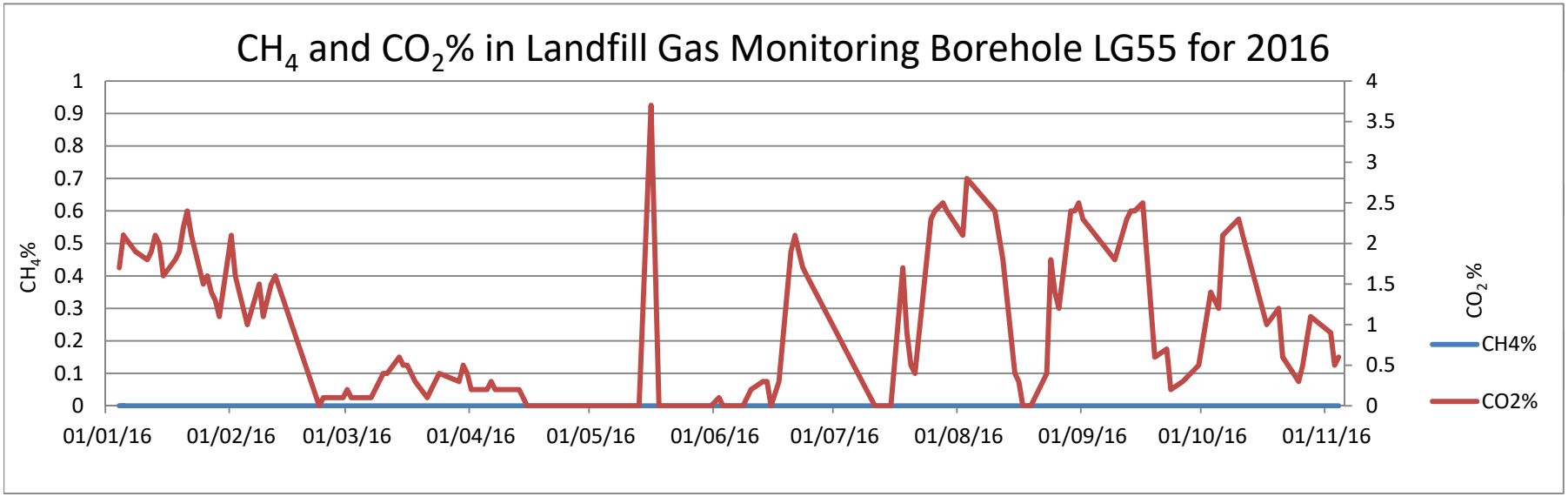

CH4 and CO2% in Landfill Gas Monitoring Borehole LG49 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

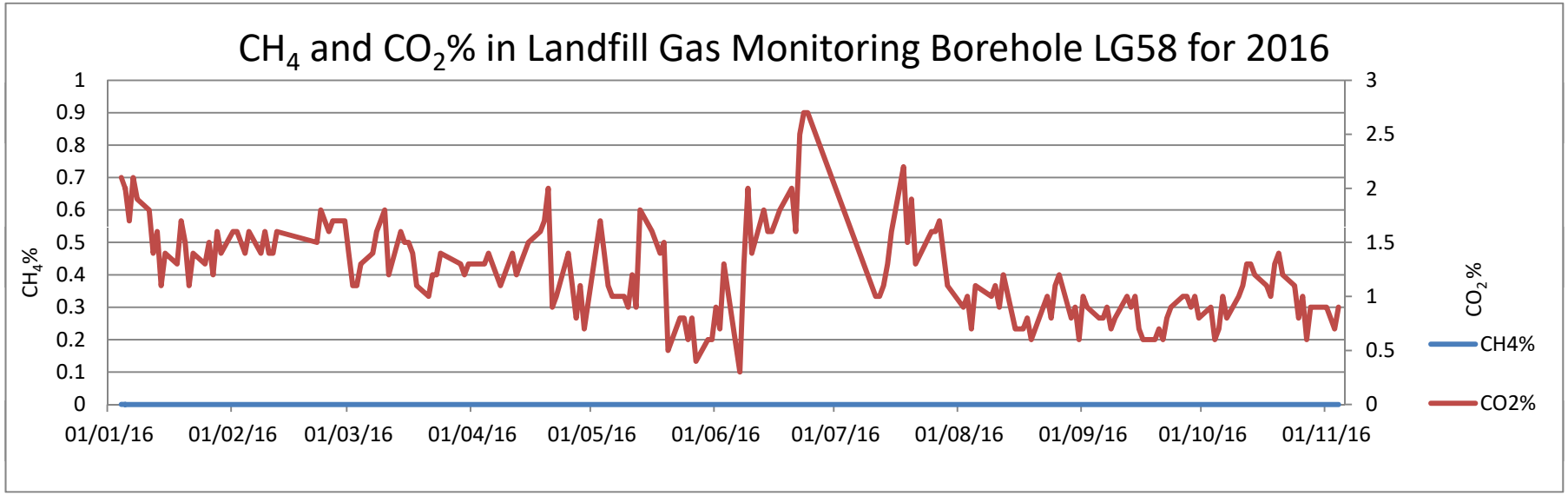

CH4 and CO2% in Landfill Gas Monitoring Borehole LG51 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3.5
3
2.5
2
1.5
1
0.5
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

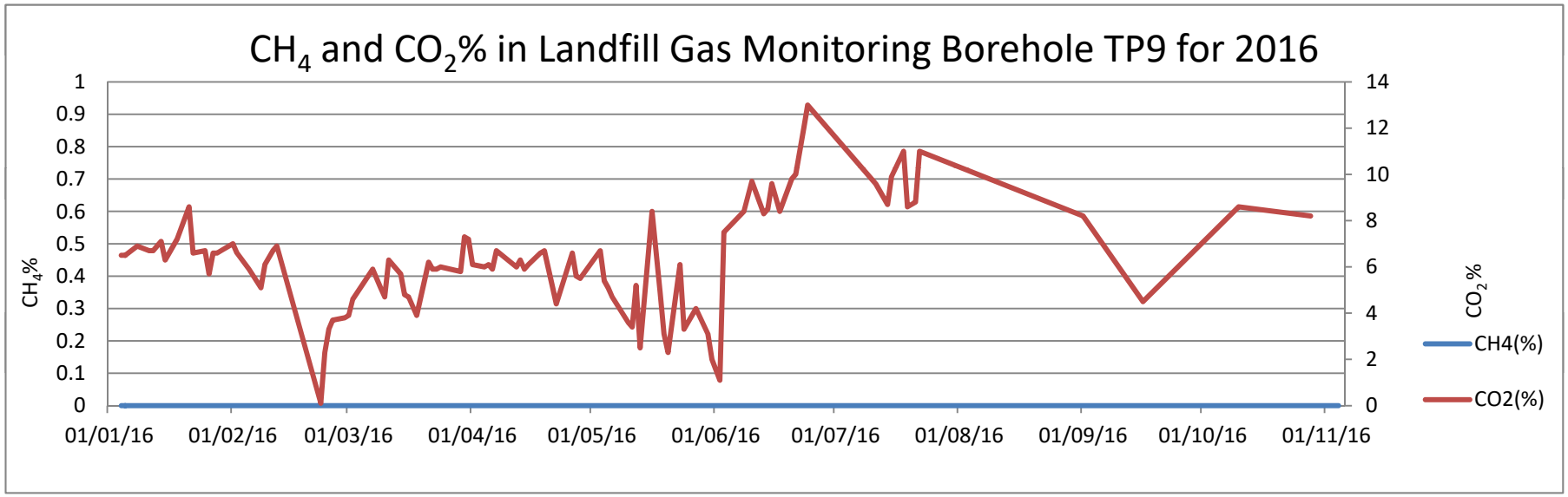

CH4 and CO2% in Landfill Gas Monitoring Borehole LG52 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
9
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

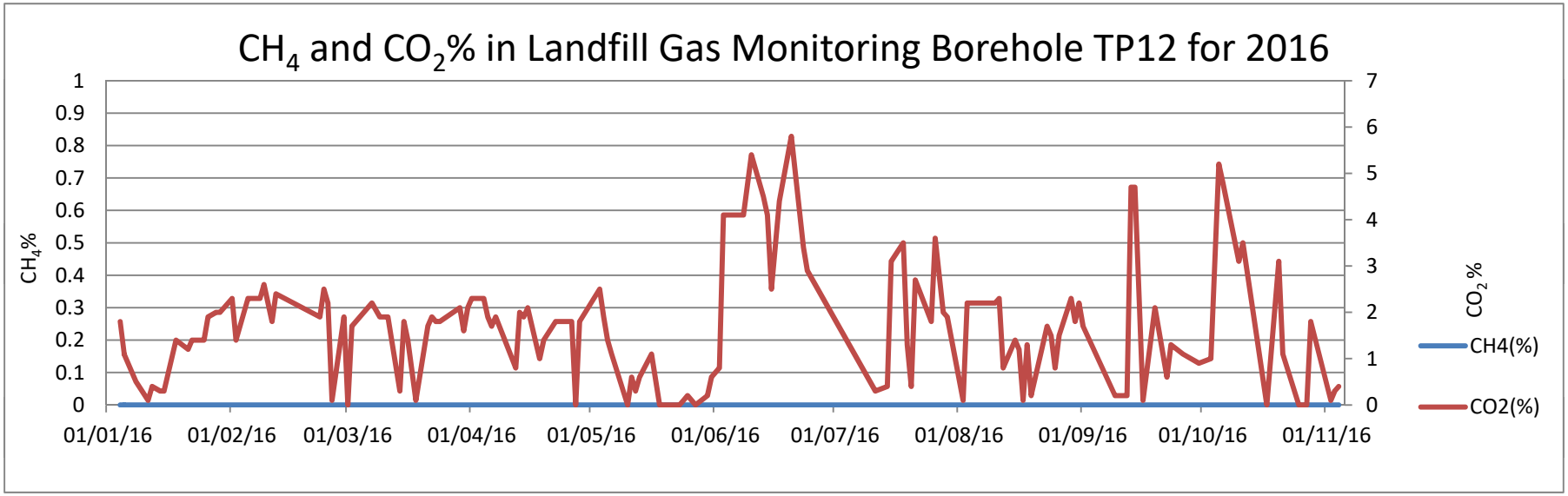

CH4 and CO2% in Landfill Gas Monitoring Borehole LG53 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

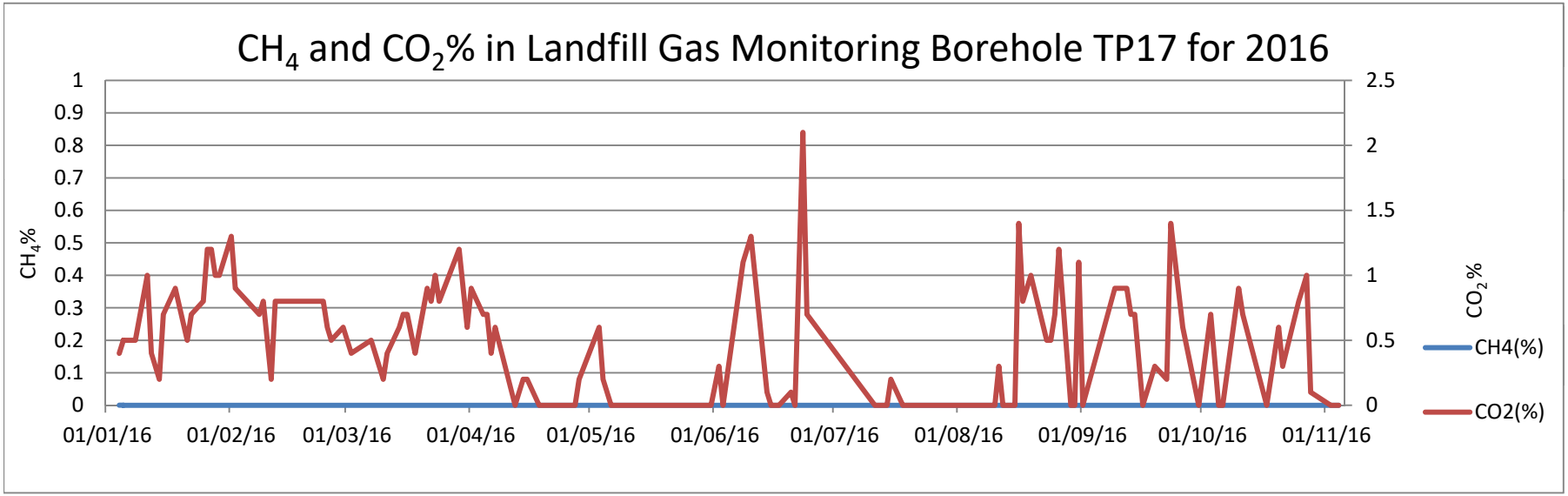

CH4 and CO2% in Landfill Gas Monitoring Borehole LG54 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

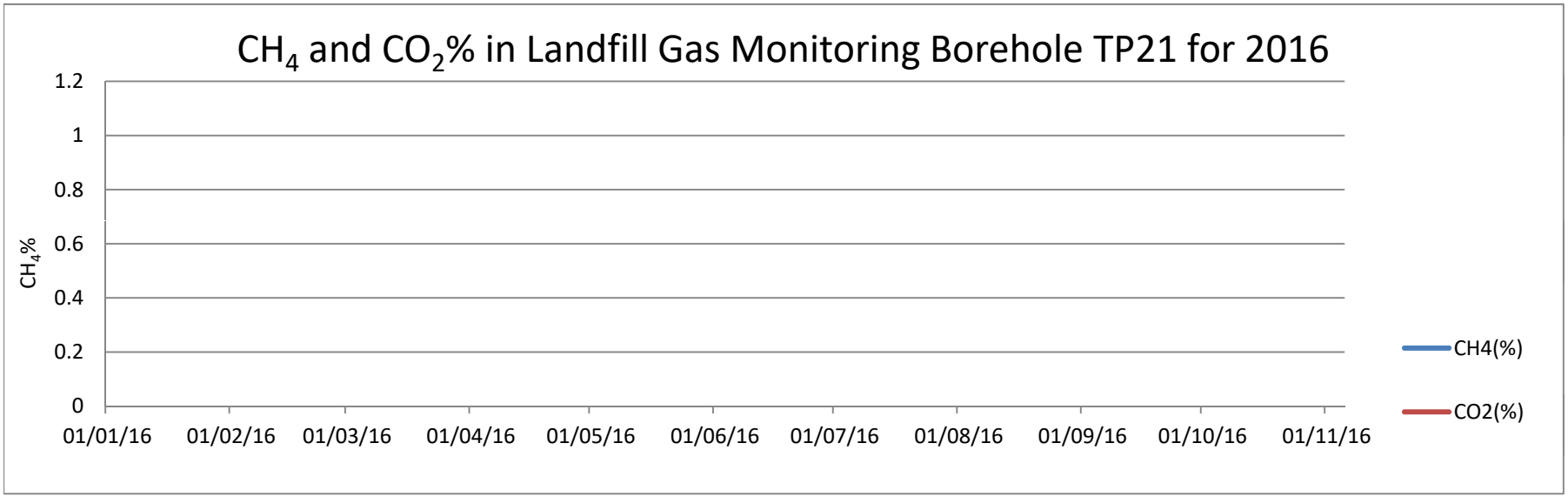

CH4 and CO2% in Landfill Gas Monitoring Borehole LG55 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4
3.5
3
2.5
2
1.5
1
0.5
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

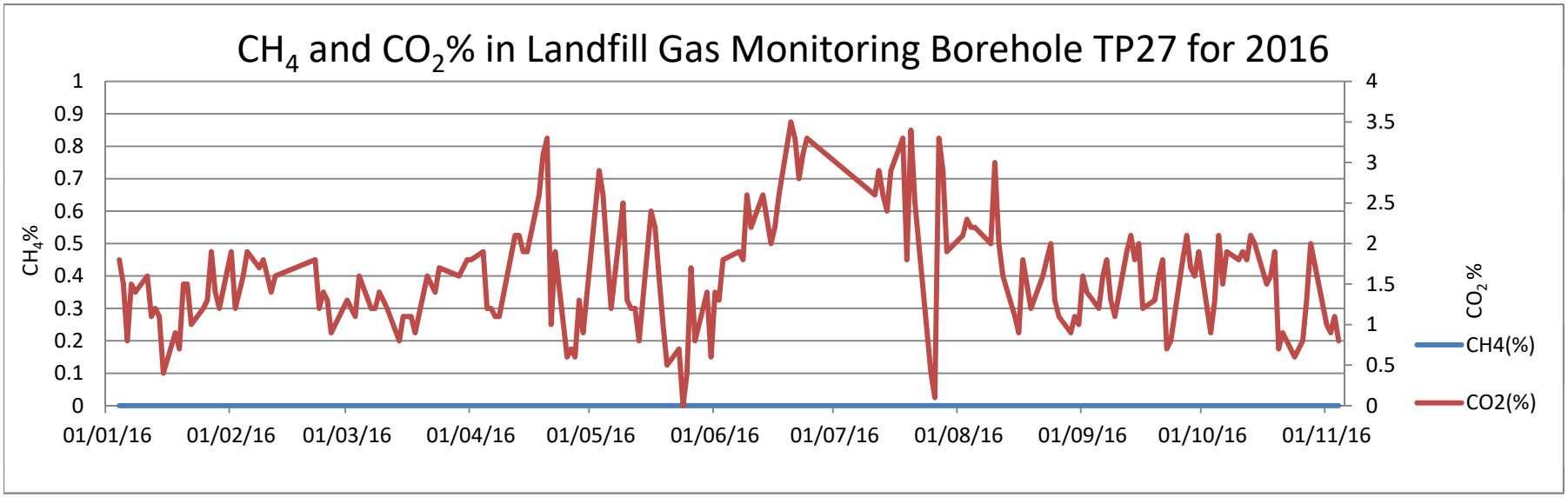

CH4 and CO2% in Landfill Gas Monitoring Borehole LG58 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
2.5
2
1.5
1
0.5
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

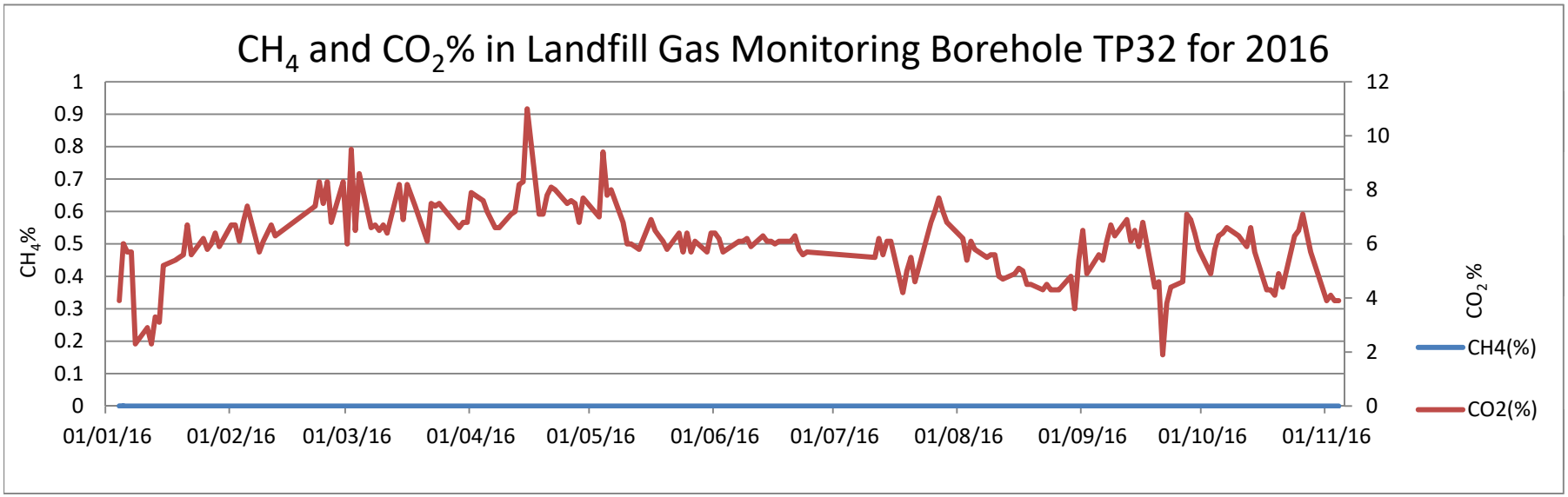

CH4 and CO2% in Landfill Gas Monitoring Borehole TP9 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
14
12
10
8
6
4
2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

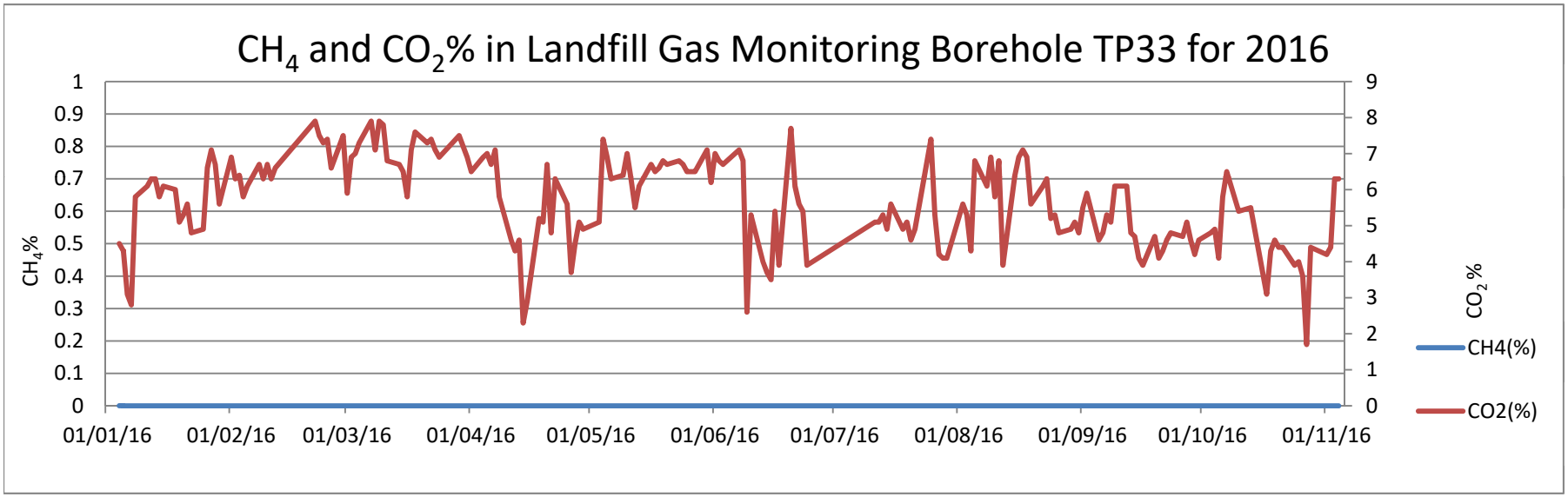

CH4 and CO2% in Landfill Gas Monitoring Borehole TP12 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

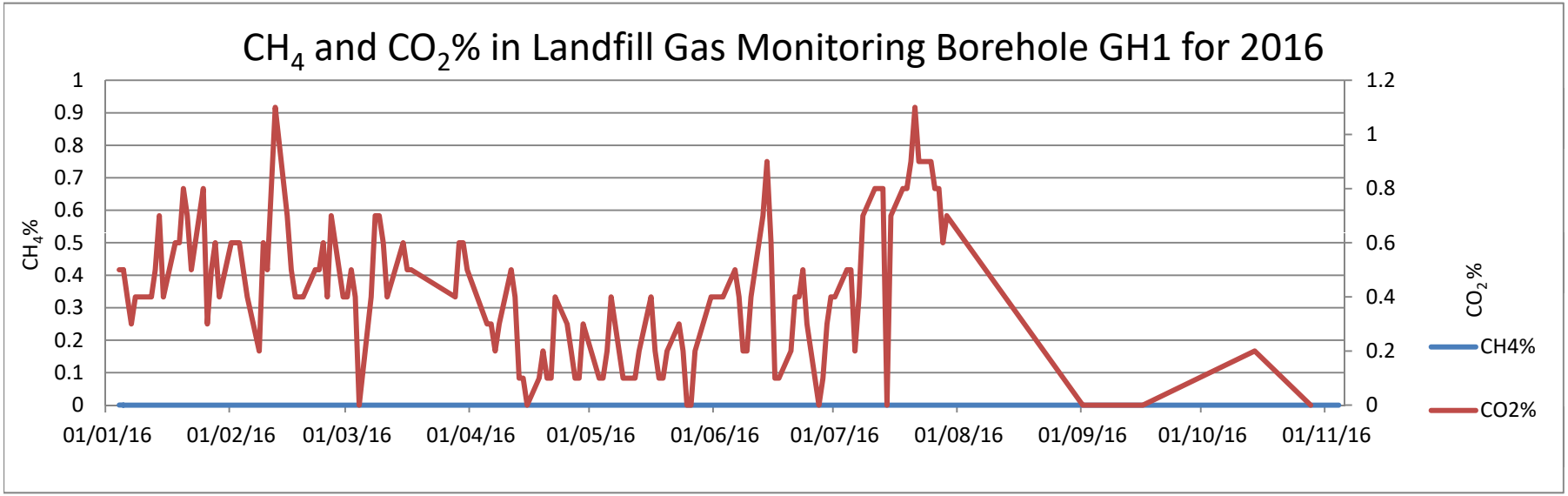

CH4 and CO2% in Landfill Gas Monitoring Borehole TP17 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2.5
2
1.5
1
0.5
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

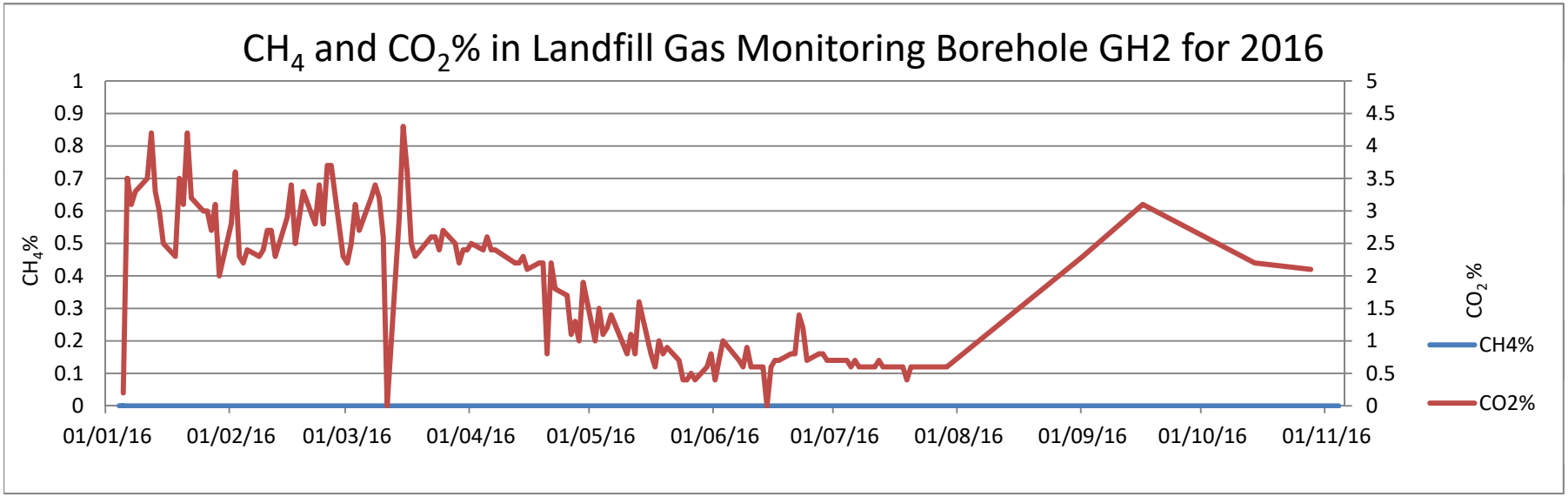

CH4 and CO2% in Landfill Gas Monitoring Borehole TP21 for 2016
CH4%
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

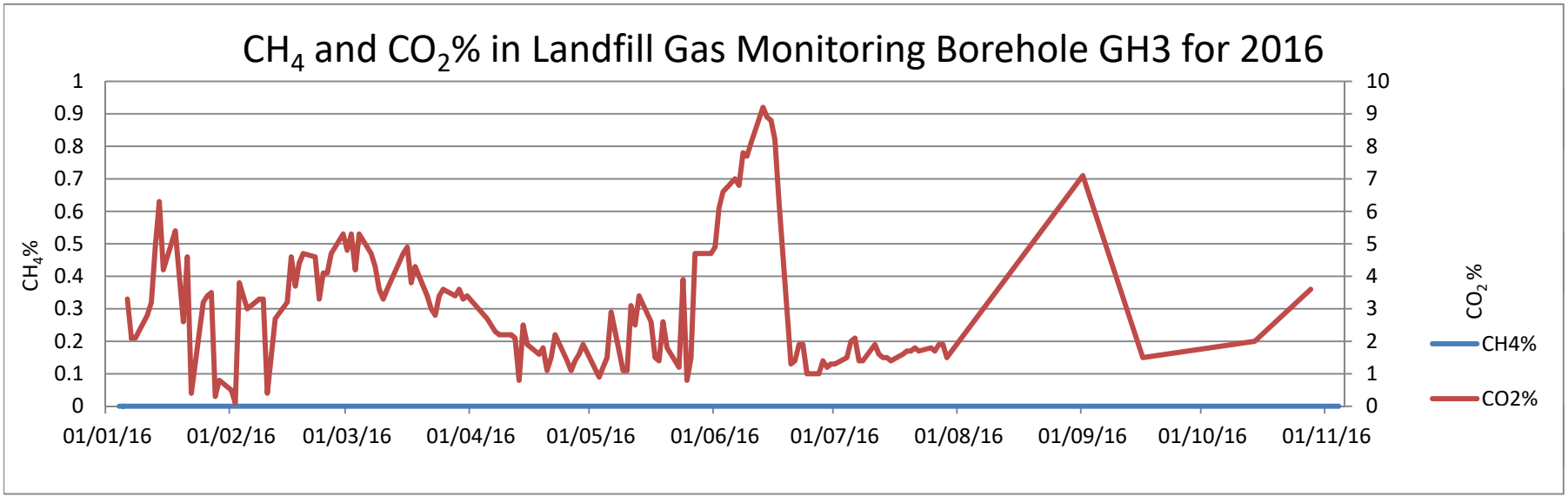

CH4 and CO2% in Landfill Gas Monitoring Borehole TP27 for 2016
CH4%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4
3.5
3
2.5
2
1.5
1
0.5
0
CO2 %
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

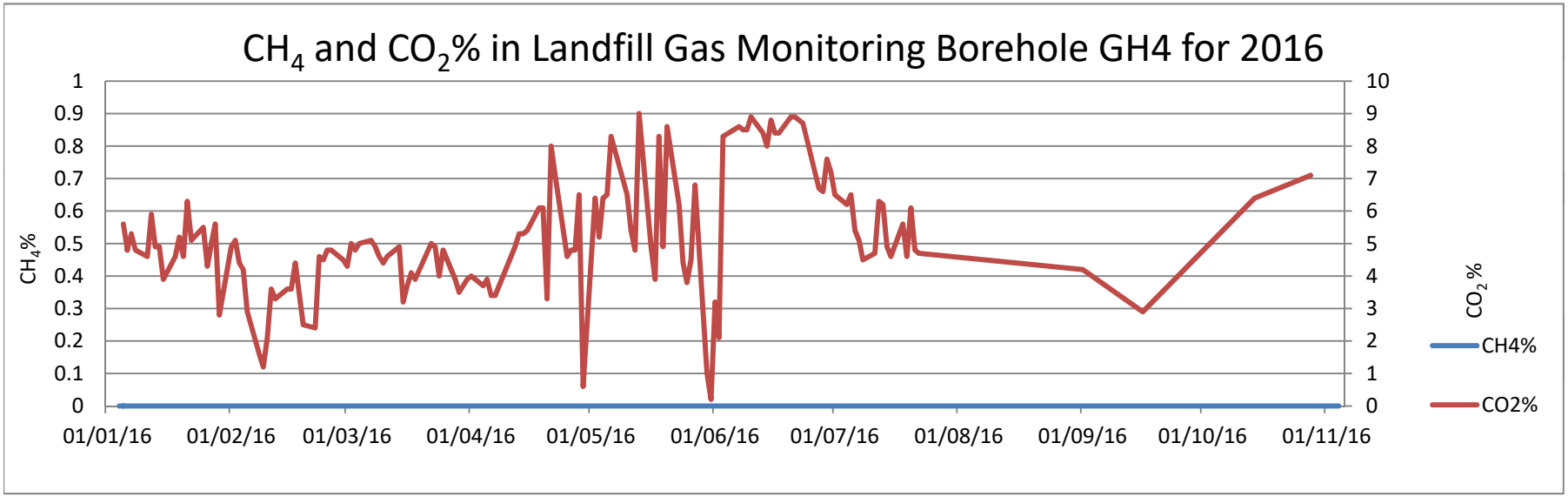

CH4 and CO2% in Landfill Gas Monitoring Borehole TP32 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
10
8
6
4
2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

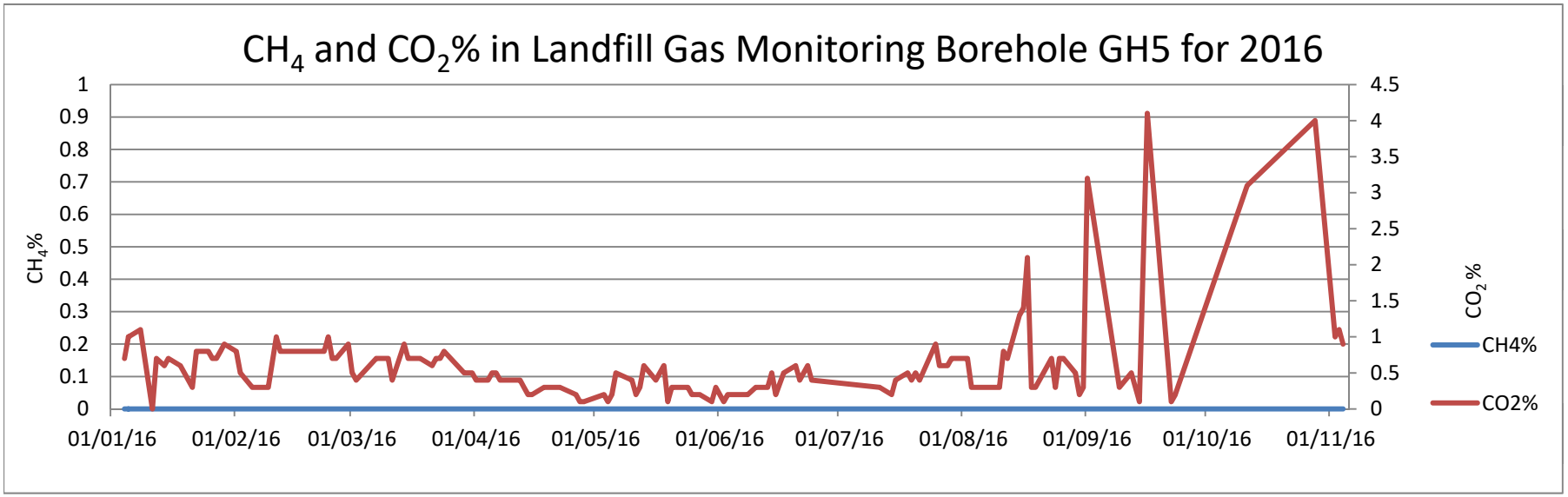

CH4 and CO2% in Landfill Gas Monitoring Borehole TP33 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4(%)
CO2(%)

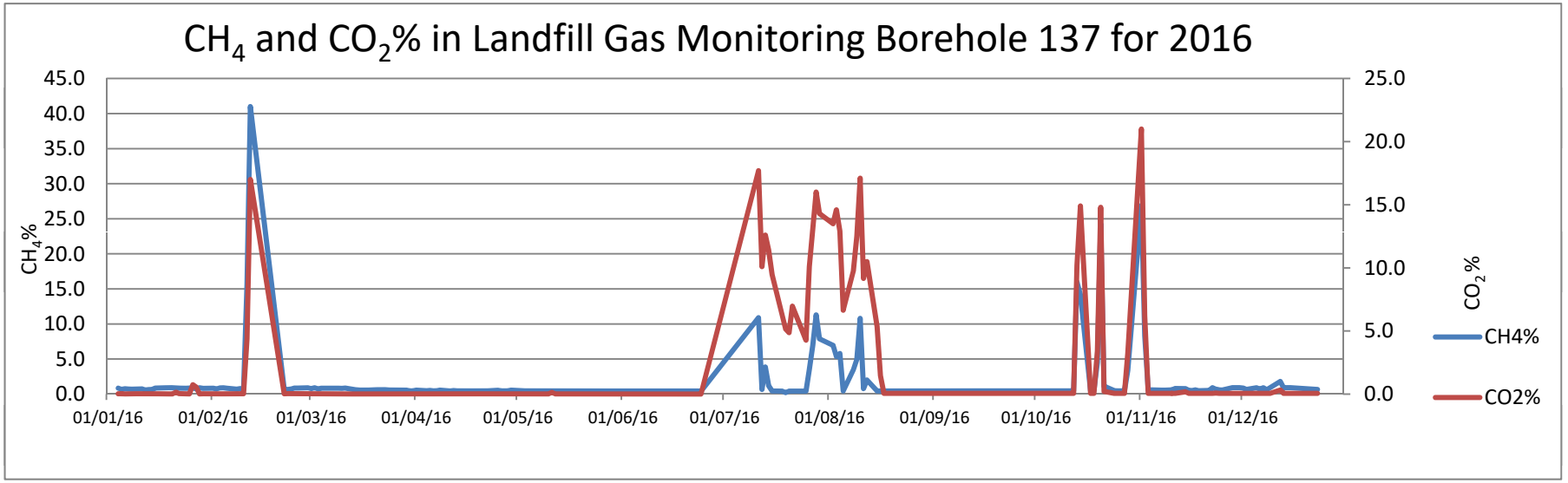

CH4 and CO2% in Landfill Gas Monitoring Borehole GH1 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.2
1
0.8
0.6
0.4
0.2
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

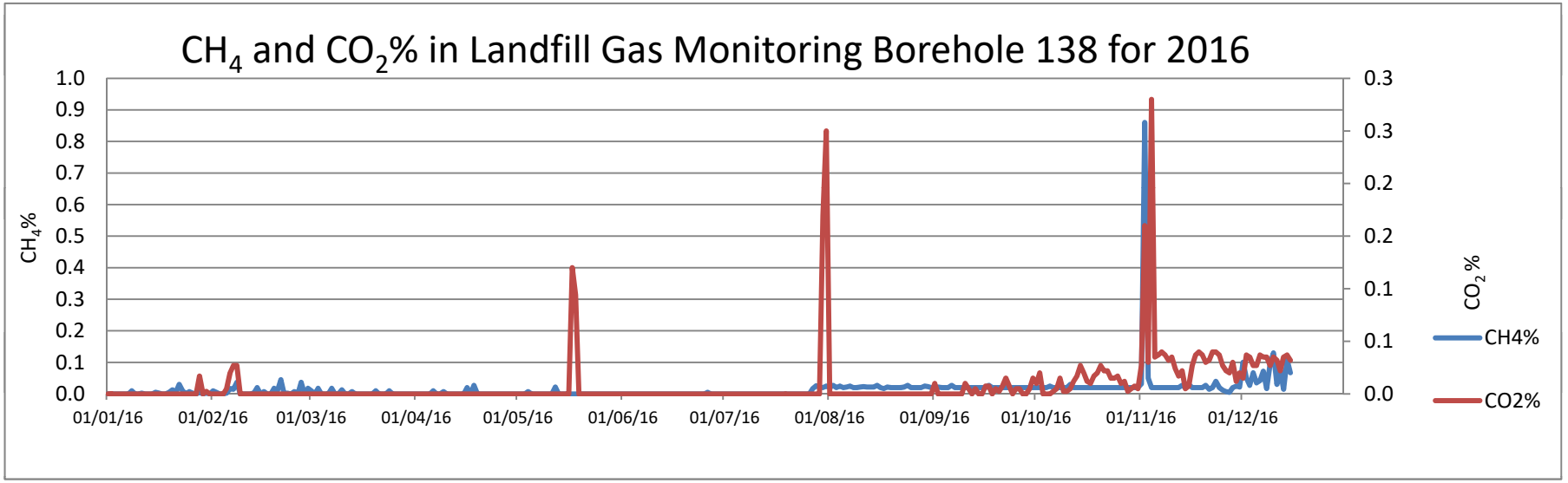

CH4 and CO2% in Landfill Gas Monitoring Borehole GH2 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

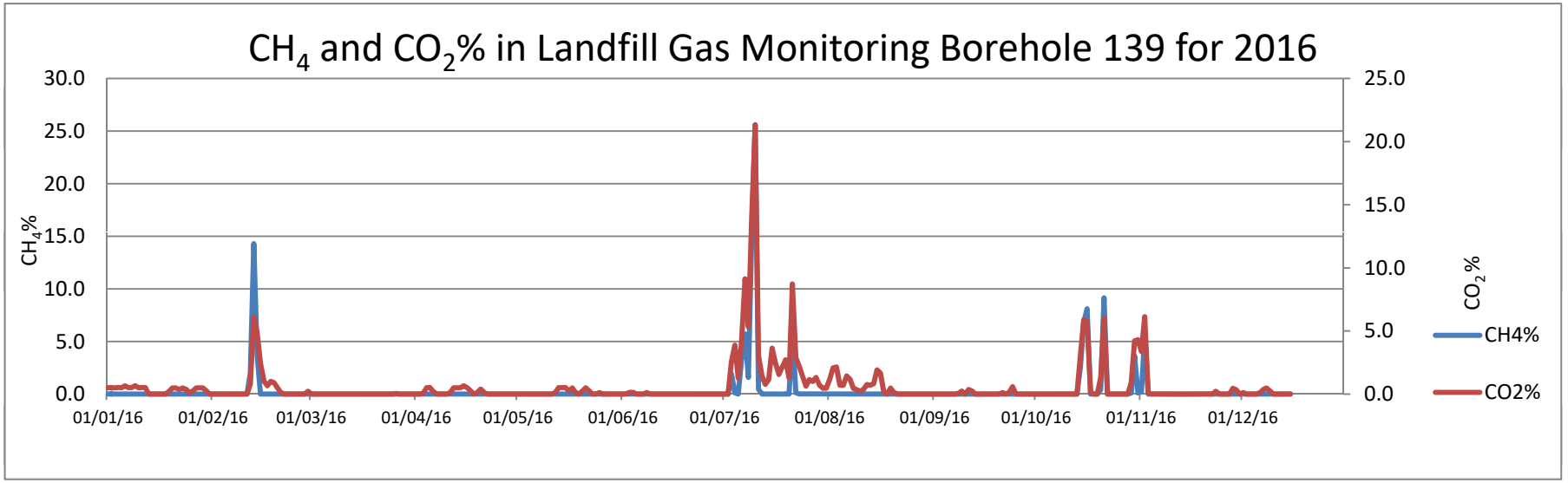

CH4 and CO2% in Landfill Gas Monitoring Borehole GH3 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
9
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

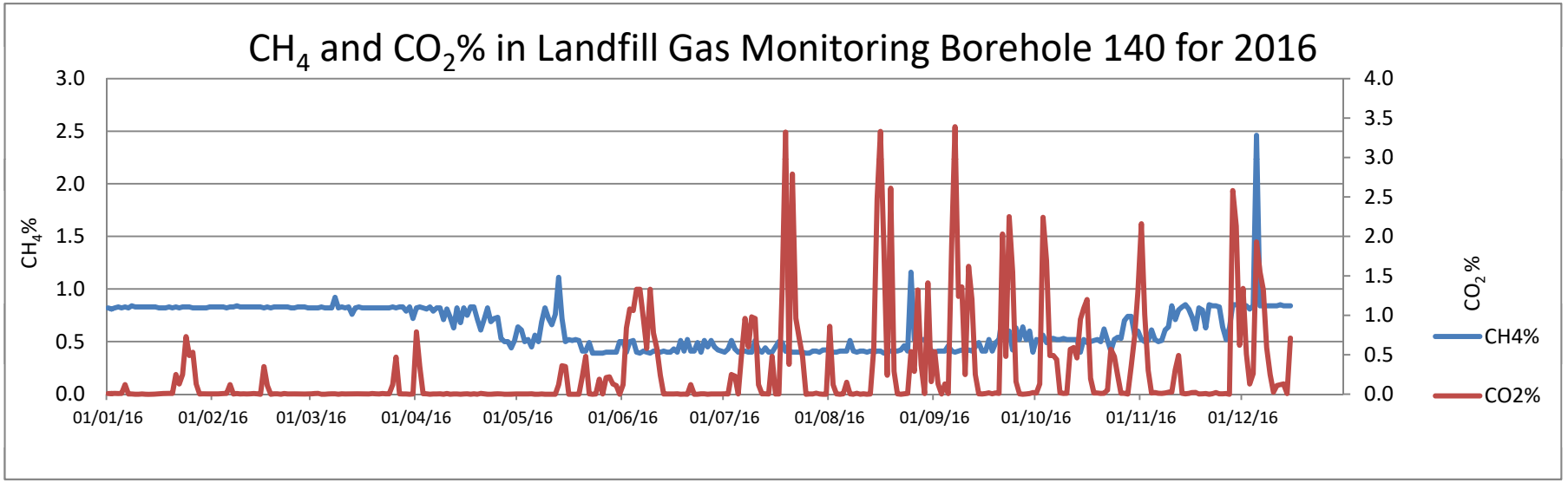

CH4 and CO2% in Landfill Gas Monitoring Borehole GH4 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
9
8
7
6
5
4
3
2
1
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

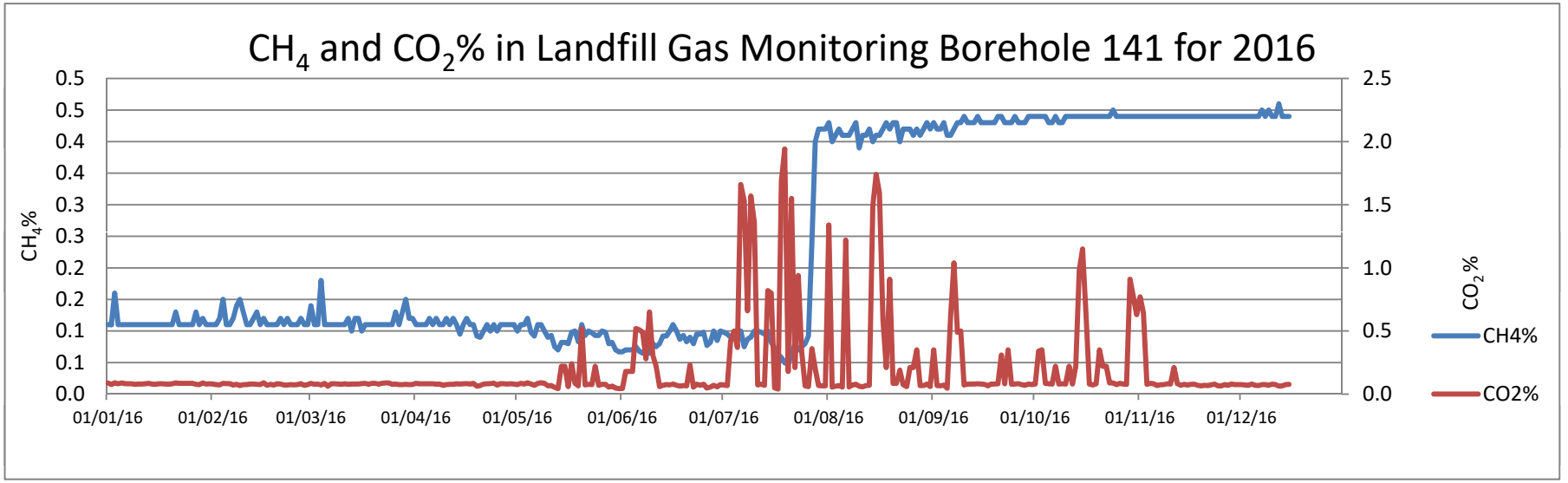

CH4 and CO2% in Landfill Gas Monitoring Borehole GH5 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
CH4%
CO2%

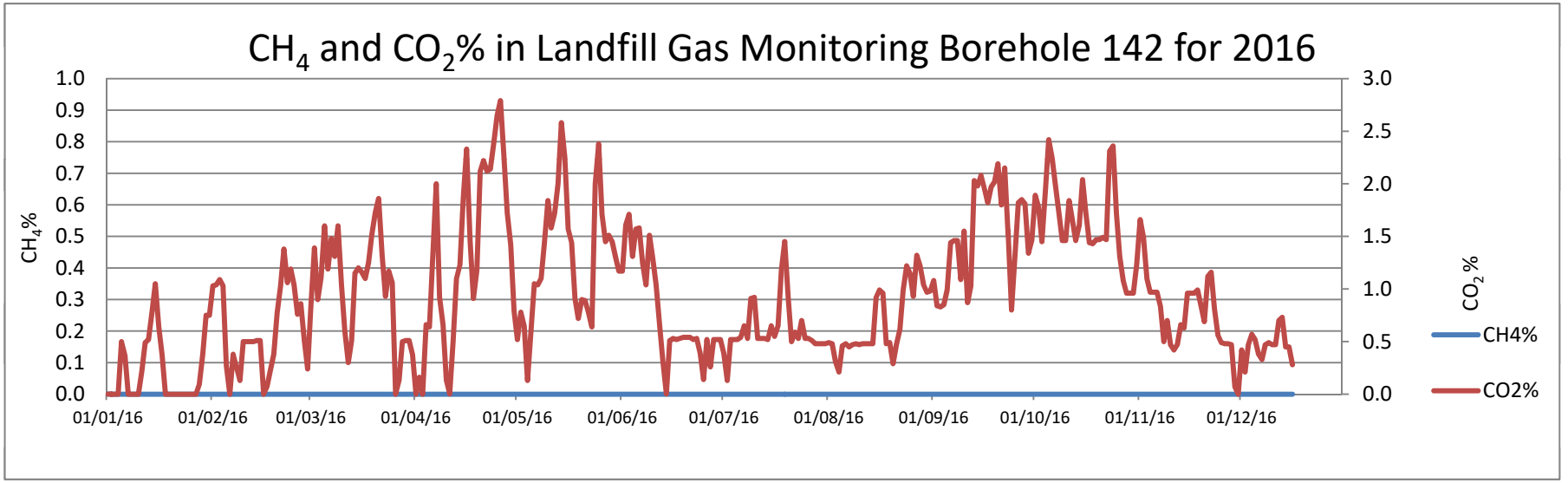

CH4 and CO2% in Landfill Gas Monitoring Borehole 137 for 2016
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
CH4%
25.0
20.0
15.0
10.0
5.0
0.0
CO2%
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
01/12/16
CH4%
CO2%

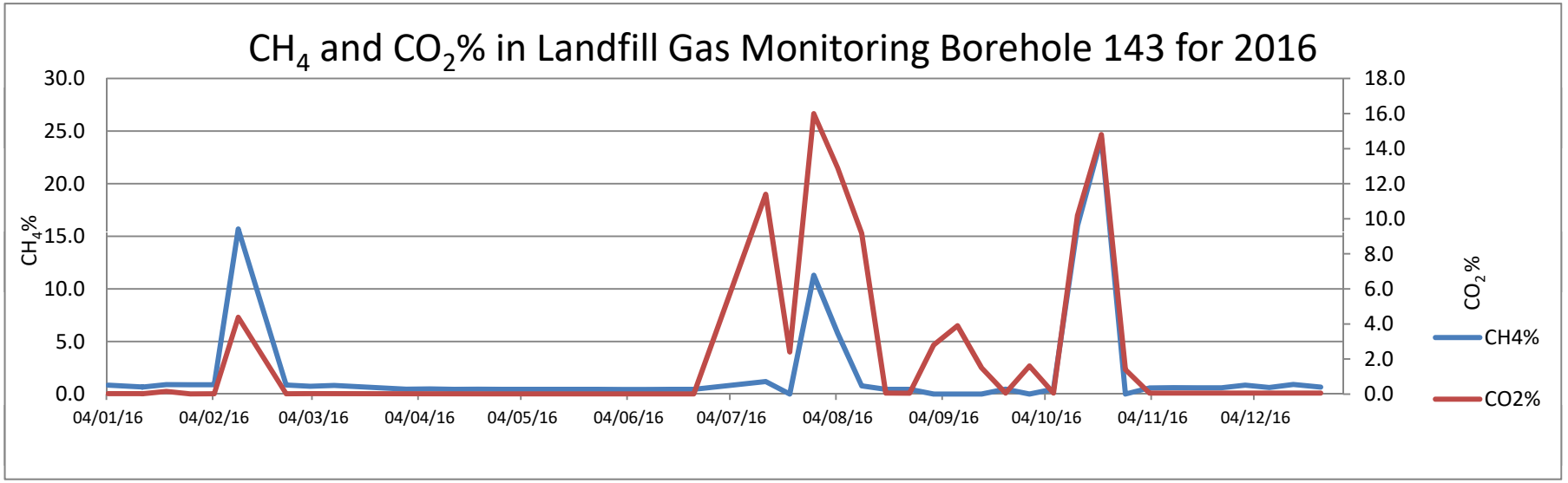

CH4 and CO2% in Landfill Gas Monitoring Borehole 138 for 2016
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
CH4%
0.3
0.3
0.2
0.2
0.1
0.1
0.0
CO2%
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
01/12/16
CH4%
CO2%

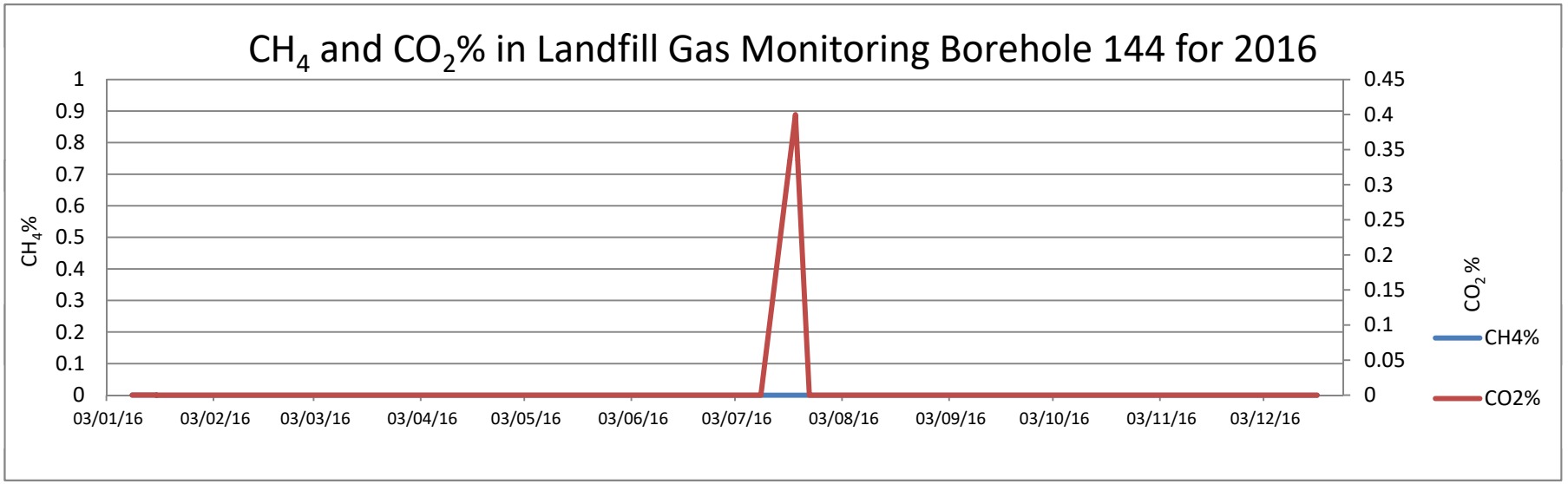

CH4 and CO2% in Landfill Gas Monitoring Borehole 139 for 2016
CH4%
CO2%
30.0
25.0
20.0
15.0
10.0
5.0
0.0
25.0
20.0
15.0
10.0
5.0
0.0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
01/12/16
CH4%
CO2%

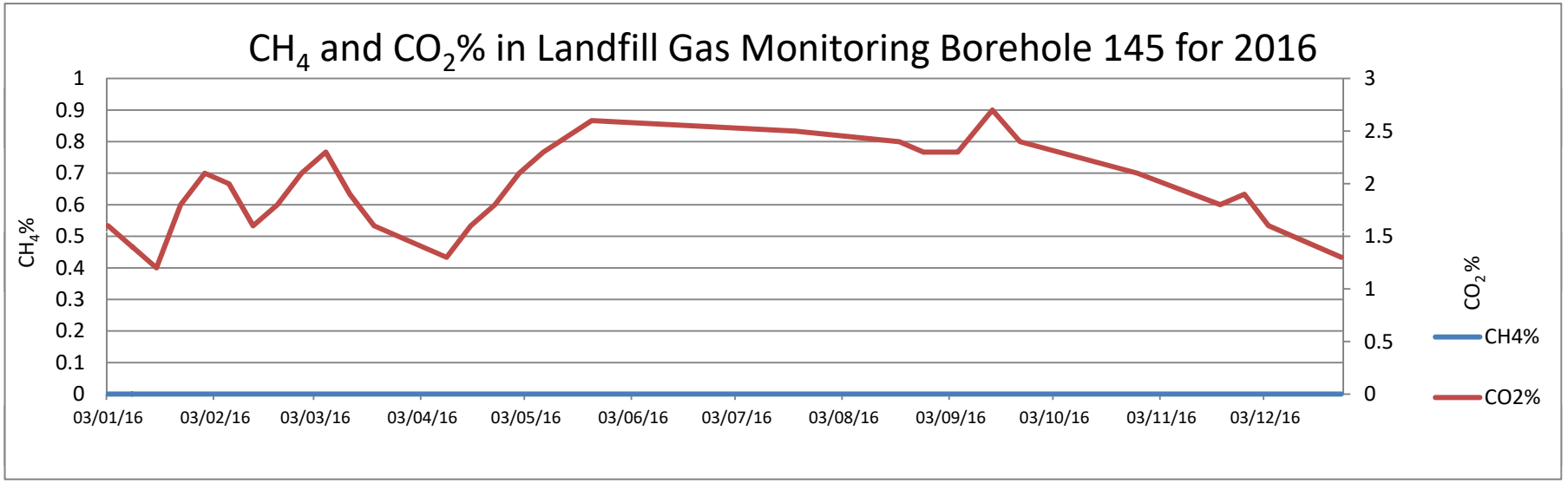

CH4 and CO2% in Landfill Gas Monitoring Borehole 140 for 2016
CH4%
CO2%
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
01/12/16
CH4%
CO2%

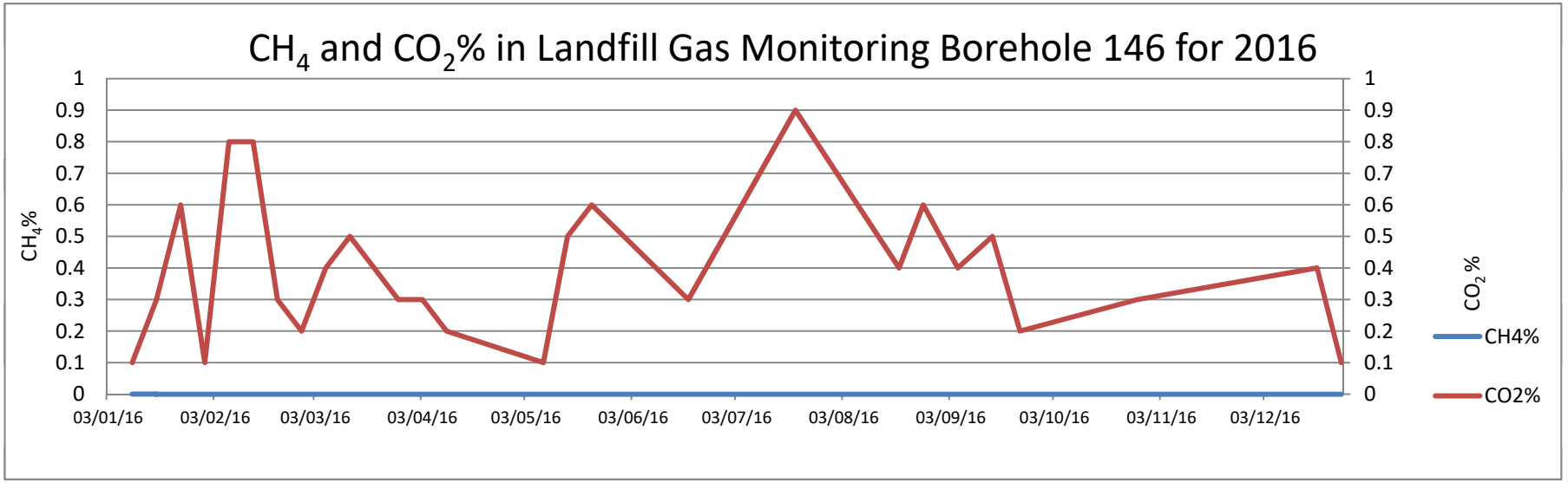

CH4 and CO2% in Landfill Gas Monitoring Borehole 141 for 2016
CH4%
CO2%
0.5
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
2.5
2.0
1.5
1.0
0.5
0.0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
01/12/16
CH4%
CO2%

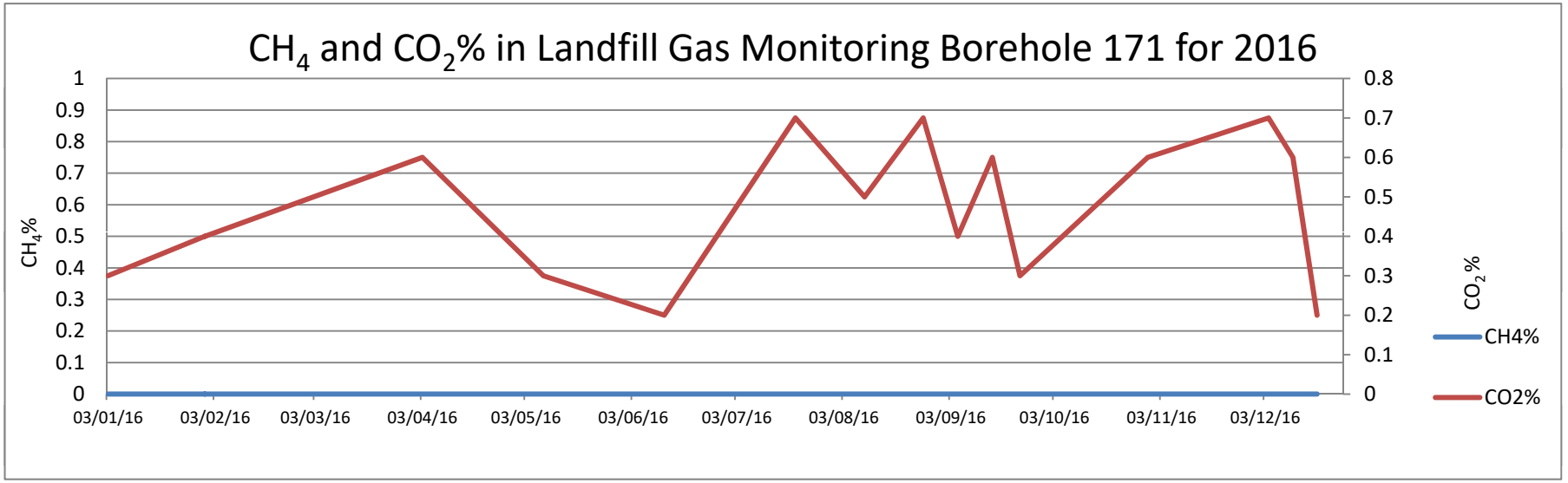

CH4 and CO2% in Landfill Gas Monitoring Borehole 142 for 2016
CH4%
CO2%
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01/01/16
01/02/16
01/03/16
01/04/16
01/05/16
01/06/16
01/07/16
01/08/16
01/09/16
01/10/16
01/11/16
01/12/16
CH4%
CO2%

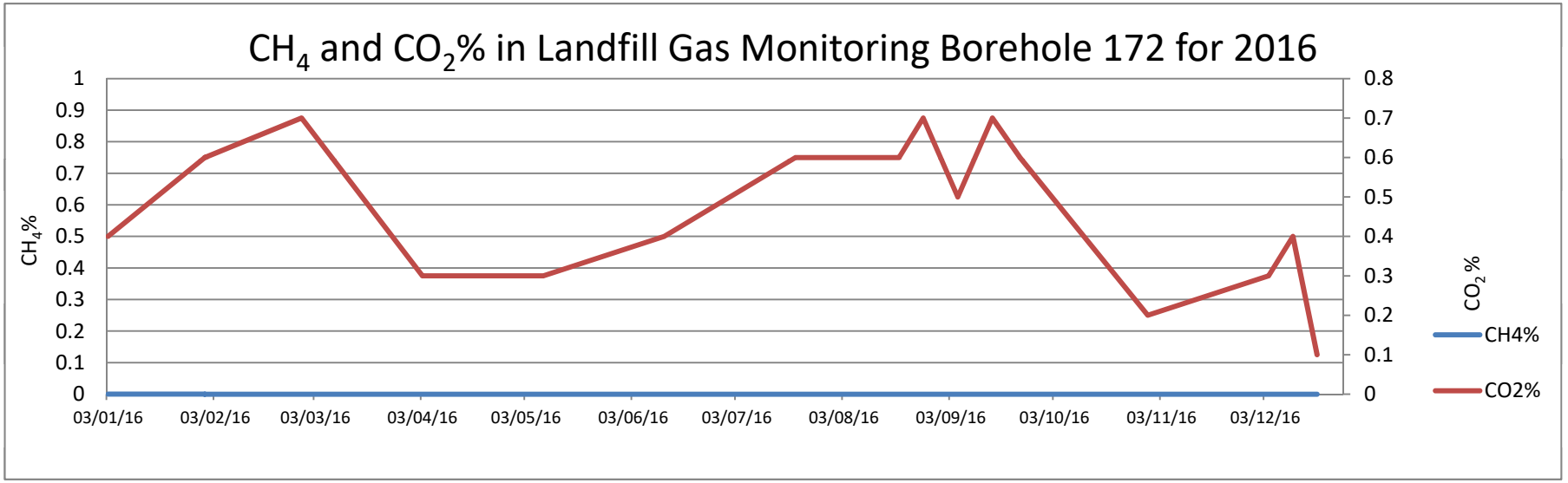

CH4 and CO2% in Landfill Gas Monitoring Borehole 143 for 2016
CH4%
CO2%
30.0
25.0
20.0
15.0
10.0
5.0
0.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
04/01/16
04/02/16
04/03/16
04/04/16
04/05/16
04/06/16
04/07/16
04/08/16
04/09/16
04/10/16
04/11/16
04/12/16
CH4%
CO2%

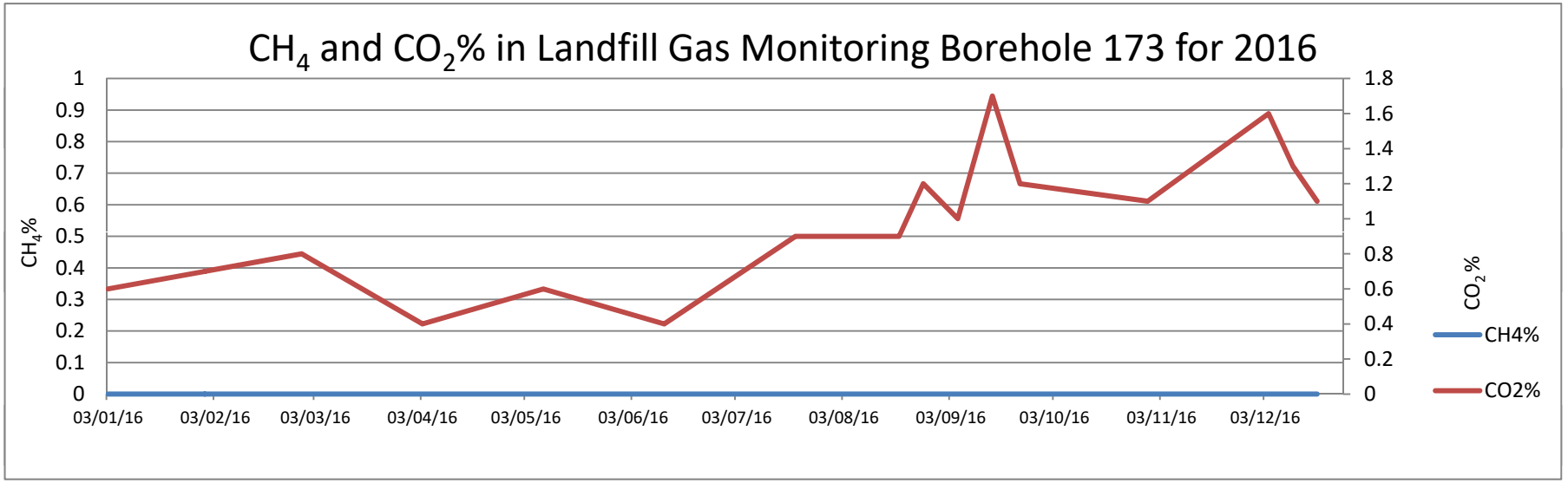

CH4 and CO2% in Landfill Gas Monitoring Borehole 144 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%

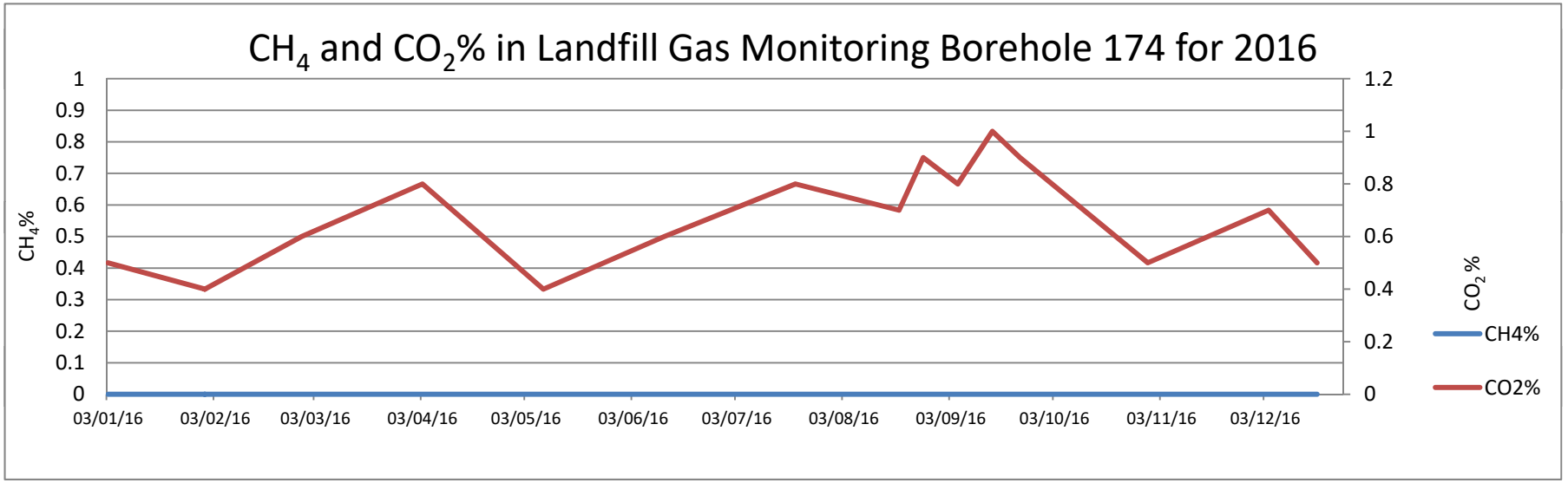

CH4 and CO2% in Landfill Gas Monitoring Borehole 145 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
2.5
2
1.5
1
0.5
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%

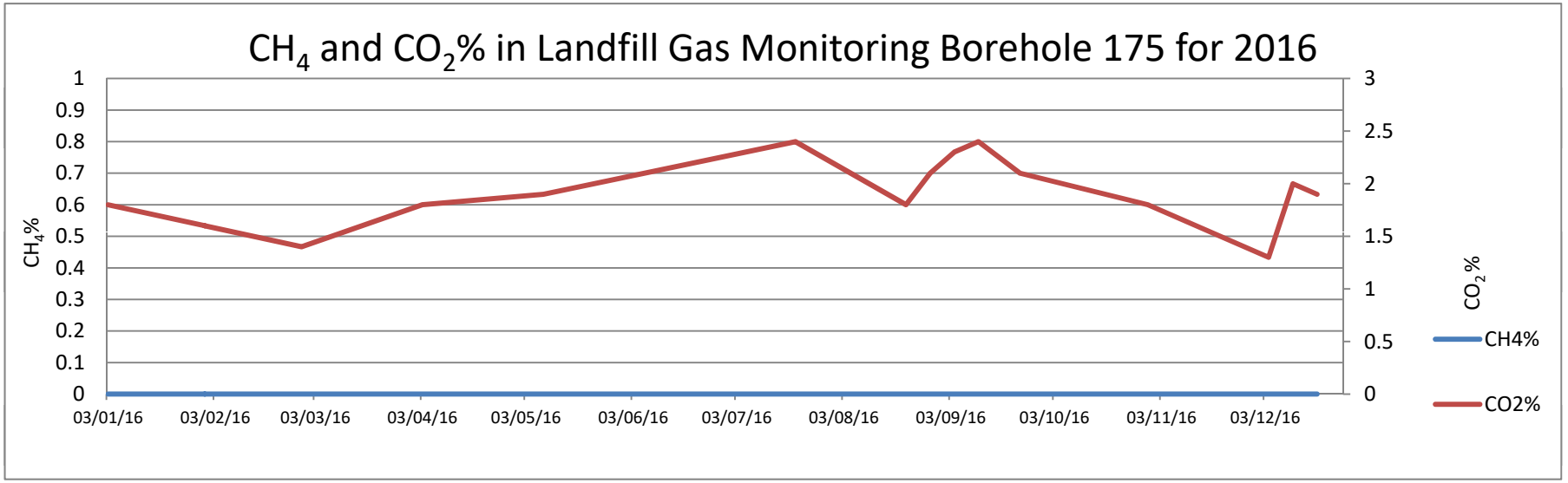

CH4 and CO2% in Landfill Gas Monitoring Borehole 146 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%


CH4 and CO2% in Landfill Gas Monitoring Borehole 171 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%


CH4 and CO2% in Landfill Gas Monitoring Borehole 172 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%


CH4 and CO2% in Landfill Gas Monitoring Borehole 173 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%


CH4 and CO2% in Landfill Gas Monitoring Borehole 174 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.2
1
0.8
0.6
0.4
0.2
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%


CH4 and CO2% in Landfill Gas Monitoring Borehole 175 for 2016
CH4%
CO2%
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
2.5
2
1.5
1
0.5
0
03/01/16
03/02/16
03/03/16
03/04/16
03/05/16
03/06/16
03/07/16
03/08/16
03/09/16
03/10/16
03/11/16
03/12/16
CH4%
CO2%

OverBurden Wells
Location: Landfill
Parameters: all data in mg/l unless stated otherwise

Well No.	OB1									
DATE	**pH.**	**Temp.**	**Cond**	**NH_4**	**NH_4 (as N)**	**Vis/Od**	**Cl**	**O2**	**TOC**	**TON**
			uS/cm							
08/03/16	7.83	12.4.C	493	0.03	0.02334	GOOD	21	3.7	1	3
12/09/16	7.96	17.7.C	530	0.01	0.00778	POOR	24	5.6	2	3
06/12/16	7.2	11.2.C	576	0.07	0.05446	POOR	22	6.1	1	3

Well No.	OB2									
DATE	**pH.**	**Temp.**	**Cond**	**NH_4**	**NH_4 (as N)**	**Vis/Od**	**Cl**	**O2**	**TOC**	**TON**
			uS/cm							
08/03/16	7.29	10.5.C	432	0.04	0.03112	POOR	31	1	1	3
12/09/16	7.53	15.7	600	0.007	0.005446	POOR	35	3	4	2
06/12/16	7.4	11.5.C	413	20	15.56	POOR	25	6	1	1

Well No.	OB3									
DATE	**pH**	**Temp.**	**Cond**	**NH_4**	**NH_4 (as N)**	**Vis/Od**	**Cl**	**O2**	**TOC**	**TON**
			uS/cm							
08/03/16	7.22	11.C	5,250	340	264.52	POOR	468	2.5	71	7
12/09/16	7.55	14.C	4,700	380	295.64	POOR	354	1.5	68	2
06/12/16	7.01	12.4.C	5,190	350	272.3	POOR	340	2.6	74	2

Well No.	OB7									
DATE	**pH**	**Temp**	**Cond**	**NH_4**	**NH_4 (as N)**	**Vis/Od**	**Cl**	**O2**	**TOC**	**TON**
			uS/cm							
08/03/16	6.65	10.5.C	1,160	50	38.9	GOOD	113	1.5	23	2
12/09/16	6.64	18.9.C	861	46	35.788	POOR	57	1.7	14	1
06/12/16	6.33	10.3.C	982	60	46.68	POOR	71	2.5	7	1

OverBurden Wells
Location: Landfill
Parameters: all data in mg/l unless stated otherwise

	Frequency	Method	Range	Sample	**OB1**		**OB2**		**OB3**		**OB7**
Vis/Odour	q			Grab	GOOD		FAIR		POOR		POOR
Amonium	m	ISE	0.01-10		0.1		0.1		430		25
Chloride	q	ArgentSM	1-100		21		28		425		113
D.O.	q	Meter	0.1-20		7.6		2.3		2.8		1.3
Cond.us/cm	m	Meter	1-200000		514		585		5,300		1,188
pH	m	Meter	1.0-14.0		8.1		8.24		7.65		6.84
Temp	m	Meter	1.0-100		11.5.C		9.6.C		12.3.C		10.1.C
Boron	a	GFAA	0.01-1.0		0.05		0.04		1.4		0.08
Cadmium	a	GFAA	0.001-0.5		<0.002		<0.001		<0.002		<0.002
Calcium	a	Titre SM	1-100		60		96		15		60
Chromium	a	GFAA	0.001-0.2		<0.002		<0.002		0.003		<0.002
Copper	a	AA	0.001-1.0		0.01		0.01		0.01		0.01
Cyanide	a	ISE	0.005-1.0		<0.001		<0.001		0.005		0.008
Fluoride	a	ISE	0.5-1.0		0.11		0.12		0.14		0.07

OverBurden Wells
Location: Landfill
Parameters: all data in mg/l unless stated otherwise

	Frequency	Method	Range	Sample	**OB1**		**OB2**		**OB3**		**OB7**
Iron	a	AA	0.01-5.0		0.005		<0.002		0.4		2.4
Lead	a	GFAA	0.001-0.1		<0.002		<0.002		<0.002		<0.002
Magnesium	a	AA	0.01-5.0		3.6		6.6		90		17
Manganese	a	AA	0.01-3.0		0.002		0.1		0.03		0.75
Mercury	a	Hydride-AA			0.00002		0.00002		<0.00002		<0.00002
Potassium	q	AA	0.1-5.0		6.6		5.6		250		30
Sulphate	a	Turb. SM	1.0-30		30		7		7		7
Sodium	q	AA	0.1-3.0		27		31		370		100
Tot Phos	a	Stann.SM	0.05-0.25		0.02		0.5		0.2		0.5
T.O.N.	q	SM			4		4		3		3
T.O.C.	q	SM	1-100		2		4		90		25
Res/Evap	a	SM	1.0-5000		282		582		3,064		1,978
Zinc	a	AA	0.01-5.0		0.005		0.005		0.002		0.002
Alkalinity	a	SM	1-1000		160		280		2,150		350
Nickel	a	GFFA	0.002-1		<0.002		<0.002		<0.002		<0.002

Overburden Wells - Depth 2016

	Jan	Feb	Mar	Apr	May	June	July	August	September	October	November	December
BOREHOLE	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)	Depth (m)
OB1	0.87	0.17	1.27	1.34	1.51	1.58	1.55	1.17	1.82	1.53	1.69	1.52
OB2	Flooded	0.67	0.72	0.9	0.96	0.95	0.99	0.96	1.23	Flooded	0.95	0.82
OB3	0.99	1.56	1.17	1.13	1.38	1.33	1.52	1.38	1.83	1.32	1.27	1.21
OB7	Flooded	Flooded	Flooded	0.52	0.58	0.81	0.98	0.79	0.93	0.7	0.71	0.69
BR1	0.63	0.99	1.1	1.27	1.51	1.63	1.61	1.71	1.78	1.53	1.75	1.63
BR2	Flooded	Flooded	Flooded	flooded	0.86	0.67	6.9	6.2	0.97	Flooded	0.69	0.61
BR3	1.04	1.16	1.13	1.17	1.36	1.47	1.62	11.77	1.64	1.39	1.41	1.39
BR7	1.1	1.36	1.44	1.42	1.69	1.69	2.43	1.82	1.94	1.6	1.78	1.51
KC8	Flooded	Flooded	3.97	4.13	4.47	4.65	4.72	4.92	4.63	4.43	4.7	4.25

Groundwater: NW Wells

Location: Landfill

Parameters: All data in mg/l unless stated otherwise

Well No.	NW1			
DATE	**pH.**	**Cond uS/cm**	**NH4.**	**TOC.**
26/01/16	7.31	728	0.14	27
16/02/16	7.04	830	15	26
08/03/16	6.78	1104	21	44
05/04/16		ANNUAL		
24/05/16		N/D		
21/06/16		N/D		
12/07/16	6.52	865	35	58
16/08/16	6.91	854	29	43
12/09/16	6.74	1,002	26	47
17/10/16	7.1	835	30	42
07/11/16	7.18	856	40	41
06/12/16	6.53	1,050	30	40

Well No.	NW2			
DATE	**pH.**	**Cond uS/cm**	**NH4.**	**TOC.**
26/01/16	7.45	630	22	6
16/02/16	7.54	768	42	4
08/03/16	6.97	865	40	5
05/04/16				
24/05/16	7.12	630	20	5
21/06/16	7.32	730	37	8
12/07/16	7.01	430	52	5
16/08/16	7.24	540	25	4
12/09/16	7.47	640	30	5
17/10/16	7.05	470	6	4
07/11/16	6.97	500	0.1	6
06/12/16	6.78	790	56	4

Well No.	NW3			
DATE	**pH.**	**Cond uS/cm**	**NH4.**	**TOC.**
Trigger levels	5.6-9.0	1500	60	100
26/01/16	6.55	740	43	13
16/02/16	6.93	740	52	9
08/03/16	6.46	720	44	13
05/04/16				
24/05/16	6.84	600	28	11
21/06/16	6.88	562	22	13
12/07/16	6.24	438	45	9
16/08/16	6.62	570	38	8
12/09/16	6.43	680	36	11
17/10/16	7.01	631	34	11
07/11/16	6.95	656	30	14
06/12/16	6.28	810	40	6

Well No.	NW4			
DATE.	**pH**	**Cond uS/cm**	**NH4.**	**TOC.**
26/01/16	6.61	730	24	14
16/02/16	6.74	670	27	9
08/03/16	6.66	780	28	16
05/04/16		ANNUAL		
24/05/16	6.84	540	7	13
21/06/16	6.68	565	23	17
12/07/16	6.26	426	42	15
16/08/16	6.63	517	23	13
12/09/16	6.48	666	35	17
17/10/16	6.54	730	0.15	15
07/11/16	6.88	550	20	15
06/12/16	6.33	690	46	15

Well No.	NW5			
DATE	**pH.**	**Cond uS/cm**	**NH4.**	**TOC.**
26/01/16	8.15	585	0.08	15
16/02/16	7.27	582	2	9
08/03/16	6.77	615	3	15
05/04/16				
24/05/16	7.88	540	0.1	13
21/06/16	8.15	545	0.11	13
12/07/16	6.61	450	1	11
16/08/16	7.68	575	0.01	11
12/09/16	6.93	630	1.7	15
17/10/16	7.84	62	50	20
07/11/16	7.94	626	0.07	15
06/12/16	6.61	690	1	16

Well No.	NW6			
DATE.	**pH.**	**Cond uS/cm**	**NH4.**	**TOC.**
26/01/16	7.39	1,680	80	22
16/02/16	7	1,721	85	14
08/03/16	6.96	1960	80	22
05/04/16				
24/05/16	7.31	1130	24	14
21/06/16	7.31	1,300	46	21
12/07/16	6.77	1,450	71	20
16/08/16	7.21	1700	68	22
12/09/16	7.03	1820	57	24
17/10/16	7.41	500	0.11	21
07/11/16	7.4	1,525	30	19
06/12/16	6.86	1780	45	19

Well No.	NW7			
DATE	**pH.**	**Cond uS/cm**	**NH4.**	**TOC.**
Trigger levels	5.6-9.0	6000	500	200
26/01/16	7.78	284	0.11	2
16/02/16	8	294	0.15	3
08/03/16	7.03	352	0.1	1
05/04/16		ANNUAL		
24/05/16	7.92	312	0.03	4
21/06/16	7.69	308	0.09	3
12/07/16	6.94	300	10	2
16/08/16	7.59	314	0.07	3
12/09/16	7.03	335	1.5	4
17/10/16	7.95	301	0.11	5
07/11/16	7.42	290	0.6	2
06/12/16	7.04	350	12	2

Well No.	NW8			
DATE	**pH.**	**Cond uS/cm**	**NH4**	**TOC.**
26/01/16	5.99	313	13	6
16/02/16	6.64	327	20	3
08/03/16	6.33	443	17	4
05/04/16				
24/05/16	6.06	280	8	5
21/06/16	6.28	333	19	7
12/07/16	6.12	310	20	6
16/08/16	6.54	383	26	6
12/09/16	6.4	495	26	7
17/10/16	6.5	320	12	6
07/11/16	6.37	290	10	7
06/12/16	6.13	470	26	4

Well No.	NW9			
DATE	**pH**	**Cond uS/cm**	**NH4**	**TOC**
Trigger levels	5.6-9.0	1500	5	35
26/01/16	7.34	1,400	20	12
16/02/16	6.92	1,635	37	7
08/03/16	6.97	1,730	29	8
05/04/16				
24/05/16	7.39	1,330	21	8
21/06/16	7.27	1,400	27	12
12/07/16	6.97	1,250	30	9
16/08/16	7.28	1,300	26	8
12/09/16	7.2	1,320	17	10
17/10/16	7.33	1,300	25	9
07/11/16	7.08	1,425	10	11
06/12/16	7.09	1,130	9	5

Groundwater: NW Wells

Location: Landfill

Parameters: All data in mg/l unless stated otherwise

	Frequency	Method	Range	**NW1**	**NW2**	**NW3**	**NW4**	**NW5**	**NW6**	**NW7**	**NW8**	**NW9**
Vis/Odour	q			POOR	POOR	POOR	POOR	POOR	POOR	POOR	POOR	FAIR
Amonium	m	ISE	0.01-10	0.11	15	22	1	1.1	1.3	0.12	5	15
Chloride	q	Argent SM	1-100	85	25	78	49	28	68	28	42	177
D.O.	q	Meter	0.1-20	2.3	<1.0	1.5	1.4	1.3	3.3	2.8	1.2	2
Cond.us/cm	m	Meter	1-200000	980us	694us	732us	643us	500us	921us	300us	370us	1,386us
pH	m	Meter	1.0-11	7.5	7.4	6.6	7.1	7.4	7.5	7.5	6.3	7.2
Temp	m	Meter	1.0-50	12.C	11.2.C	10.7.C	11.3.C	12.C	10.1.C	12.C	11.9.C	10.C
Boron	a	GFAA	0.01-1.0	0.2	0.06	<0.02	0.07	0.03	0.1	<0.02	<0.02	0.1
Cadmium	a	GFAA	0.001-0.5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Calcium	a	Titre SM	1.0-100	100	56	32	56	68	112	32	24	144
Copper	a	AA	0.001-1.0	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02
Cyanide	a	ISE	0.01-1.0	<0.001	<0.001	<0.001	0.01	<0.001	<0.001	<0.001	0.5	<0.001
Fluoride	a	ISE	0.5-1.0	0.12	0.1	0.05	0.06	0.07	0.09	0.09	0.03	0.05

	Frequency	Method	Range	**NW1**	**NW2**	**NW3**	**NW4**	**NW5**	**NW6**	**NW7**	**NW8**	**NW9**
Iron	q	AA	0.01-5.0	0.32	1.2	4.5	12.5	0.35	0.32	0.56	6.6	0.05
Lead	a	GFFA	0.001-0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium	a	AA	0.01-5.0	14	14	6	8	10	13	7	2	27
Manganese	a	AA	0.01-3.0	2.6	0.8	1	2	0.16	3.9	0.25	0.8	2.6
Mercury	a	GFFA		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Potassium	q	AA	0.1-5.0	32	2	15	15	6	26	2	1	19
Sulphate	a	Turb SM	1.0-30	<5	40	<5	<5	<5	48	<5	<5	58
Sodium	q	AA	0.1-3.0	125	100	120	115	110	140	125	125	180
TotPhos	a	Stann SM	0.05-0.25	0.04	0.45	0.1	0.24	0.03	0.02	0.15	0.07	0.07
T.O.N.	q	SM		10	4	1	1	4	2	1	2	2
Res/Evap	a	SM	1.0-5000	1,144	387	818	912	463	676	412	9,372	196
Zinc	a	AA	0.01-5.0	<0.002	<0.002	0.003	0.004	0.007	0.007	0.007	0.01	0.007
T.O.C.	q	HACH	15-150	15	6	11	15	10	11	4	5	8
Alkalinity	a	SM	1-1000	340	300	260	176	220	380	110	120	440
Ni	a	GFFA	.002-1	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.02
Cr	a	GFFA	.002-1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

NW Wells - Depth 2016

Jan-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
27/01/2016	NW1	5.38	1.69	3.69
27/01/2016	NW2	5.4	0.93	4.47
27/01/2016	NW3	4.18	0.63	3.55
27/01/2016	NW4	4.6	0.87	3.73
27/01/2016	NW5	15	2.53	12.47
27/01/2016	NW6	3.79	0	3.79
27/01/2016	NW7	4.26	0.67	3.59
27/01/2016	NW8	4.2	0.87	3.33
27/01/2016	NW9	3.5	0	3.5

Feb-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
16/02/2016	NW1	5.38	1.67	3.71
16/02/2016	NW2	5.4	1.19	4.21
16/02/2016	NW3	4.18	0.63	3.55
16/02/2016	NW4	4.6	2.1	2.5
16/02/2016	NW5	15	2.63	12.37
16/02/2016	NW6	3.79	0	3.79
16/02/2016	NW7	4.26	0.67	3.59
16/02/2016	NW8	4.2	1.07	3.13
16/02/2016	NW9	3.5	0	3.5

Mar-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
08/03/2016	NW1	5.38	2.05	3.33
08/03/2016	NW2	5.4	1.32	4.08
08/03/2016	NW3	4.18	0.67	3.51
08/03/2016	NW4	4.6	1.08	3.52
08/03/2016	NW5	15	2.82	12.18
08/03/2016	NW6	3.79	0	3.79
08/03/2016	NW7	4.26	0.88	3.38
08/03/2016	NW8	4.2	0.99	3.21
08/03/2016	NW9	3.5	0	3.5

Apr-15

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
07/04/2015	NW1	5.38	1.95	3.43
07/04/2015	NW2	5.4	1.72	3.68
07/04/2015	NW3	4.18	1.58	2.6
07/04/2015	NW4	4.6	1.45	3.15
07/04/2015	NW5	15	3.08	11.92
07/04/2015	NW6	3.79	0.82	2.97
07/04/2015	NW7	4.26	1.3	2.96
07/04/2015	NW8	4.2	1.3	2.9
07/04/2015	NW9	3.5	0.39	3.11

NW Wells - Depth 2016

May-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
24/05/2016	NW1	5.38	No access	
24/05/2016	NW2	5.4	1.64	3.76
24/05/2016	NW3	4.18	0.68	3.5
24/05/2016	NW4	4.6	1.78	2.82
24/05/2016	NW5	15	3.12	11.88
24/05/2016	NW6	3.79	1.52	2.27
24/05/2016	NW7	4.26	1.28	2.98
24/05/2016	NW8	4.2	1.09	3.11
24/05/2016	NW9	3.5	0	3.5

Jun-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
21/06/2016	NW1	5.38	No access	
21/06/2016	NW2	5.4	1.86	3.54
21/06/2016	NW3	4.18	0.83	3.35
21/06/2016	NW4	4.6	1.66	2.94
21/06/2016	NW5	15	3.2	11.8
21/06/2016	NW6	3.79	0.72	3.07
21/06/2016	NW7	4.26	1.41	2.85
21/06/2016	NW8	4.2	1.17	3.03
21/06/2016	NW9	3.5	2.19	1.31

Jul-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
12/07/2016	NW1	5.38	2.08	3.3
12/07/2016	NW2	5.4	1.74	3.66
12/07/2016	NW3	4.18	1.04	3.14
12/07/2016	NW4	4.6	1.89	2.71
12/07/2016	NW5	15	3.25	11.75
12/07/2016	NW6	3.79	0.92	2.87
12/07/2016	NW7	4.26	1.55	2.71
12/07/2016	NW8	4.2	1.24	2.96
12/07/2016	NW9	3.5	0.68	2.82

Aug-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
16/08/2016	NW1	5.38	2.21	3.17
16/08/2016	NW2	5.4	2.01	3.39
16/08/2016	NW3	4.18	1.12	3.06
16/08/2016	NW4	4.6	1.87	2.73
16/08/2016	NW5	15	3.51	11.49
16/08/2016	NW6	3.79	0.98	2.81
16/08/2016	NW7	4.26	1.59	2.67
16/08/2016	NW8	4.2	1.32	2.88
16/08/2016	NW9	3.5	1.38	2.12

NW Wells - Depth 2016

Sep-16

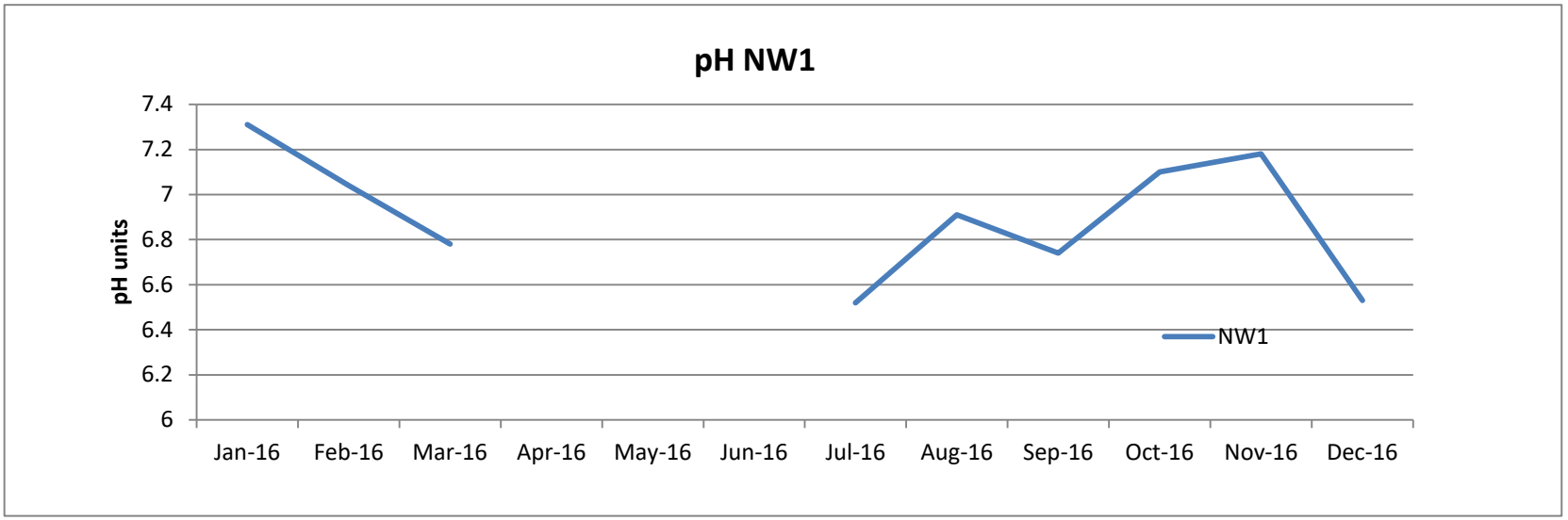
Oct-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
16/09/2016	NW1	5.38	1.68	3.7
16/09/2016	NW2	5.4	2.12	3.28
16/09/2016	NW3	4.18	0.76	3.42
16/09/2016	NW4	4.6	0.66	3.94
16/09/2016	NW5	15	3.05	11.95
16/09/2016	NW6	3.79	0.43	3.36
16/09/2016	NW7	4.26	1.48	2.78
16/09/2016	NW8	4.2	1.24	2.96
16/09/2016	NW9	3.5	0.52	2.98

Nov-16

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
07/11/2016	NW1	5.38	2.21	3.17
07/11/2016	NW2	5.4	1.61	3.79
07/11/2016	NW3	4.18	0.87	3.31
07/11/2016	NW4	4.6	1.26	3.34
07/11/2016	NW5	15	3.26	11.74
07/11/2016	NW6	3.79	0	3.79
07/11/2016	NW7	4.26	1.57	2.69
07/11/2016	NW8	4.2	1.25	2.95
07/11/2016	NW9	3.5	0	3.5

Date	LOCATION	WELL HEIGHT (m)	Depth to Ground water (m)	Water Height in Well (m)
17/10/2016	NW1	5.38	2.05	3.33
17/10/2016	NW2	5.4	1.13	4.27
17/10/2016	NW3	4.18	0.85	3.33
17/10/2016	NW4	4.6	0.87	3.73
17/10/2016	NW5	15	3.11	11.89
17/10/2016	NW6	3.79	0	3.79
17/10/2016	NW7	4.26	1.22	3.04
17/10/2016	NW8	4.2	1.2	3
17/10/2016	NW9	3.5	0	3.5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7
6.8
6.6
6.4
6.2
6
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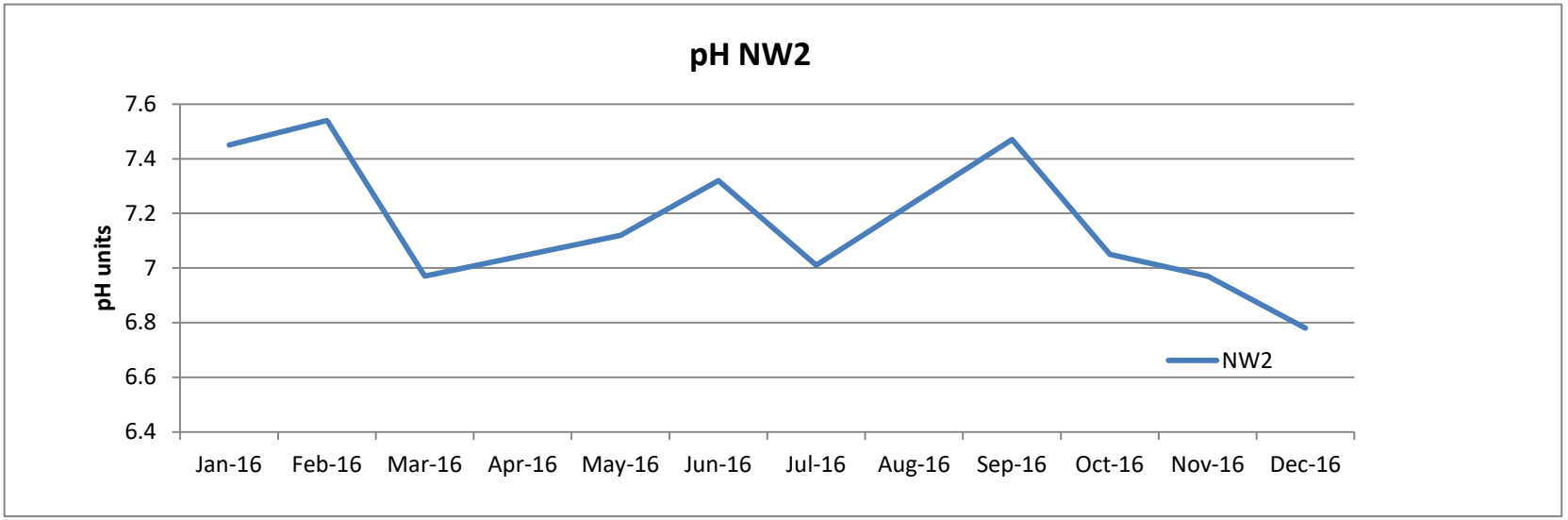
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW1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7
6.8
6.6
6.4
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Jan-16
Feb-16
Mar-16
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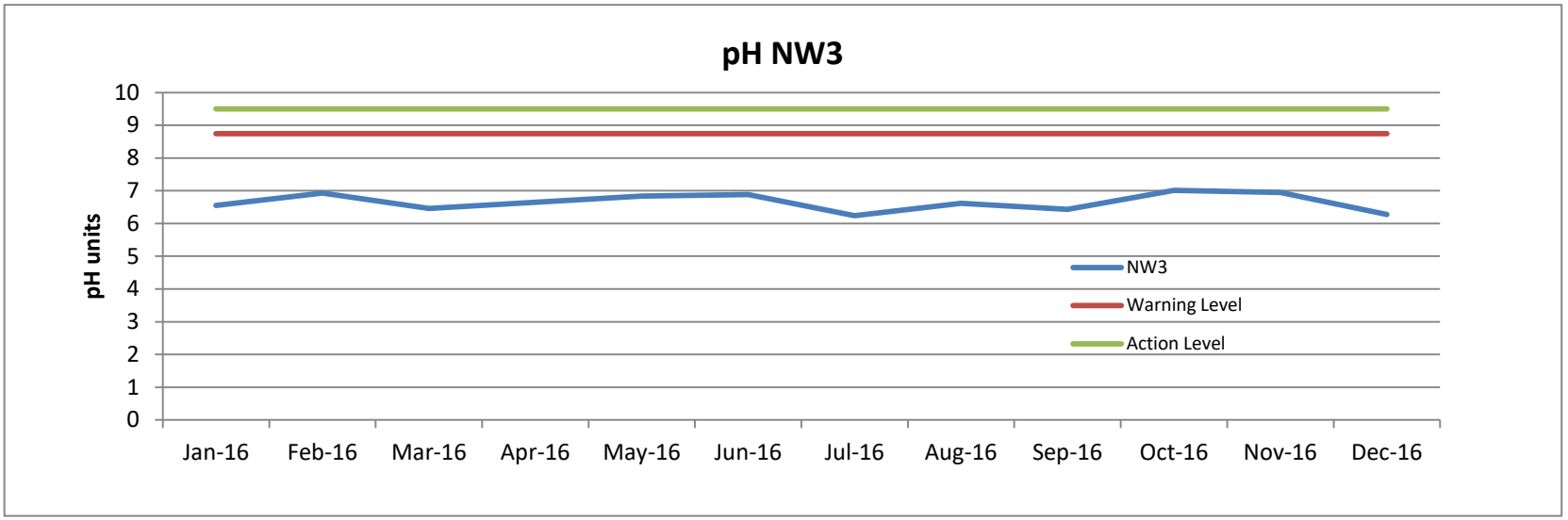
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW2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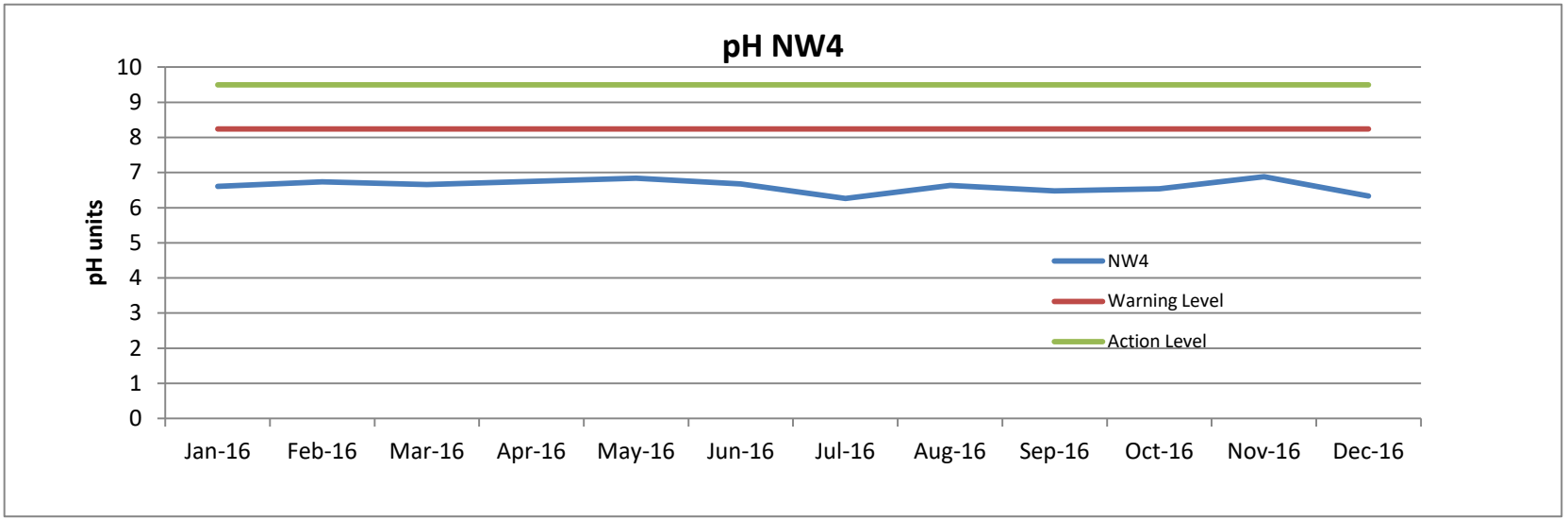
9
8
7
6
5
4
3
2
1
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW3
Warning Level
Action Level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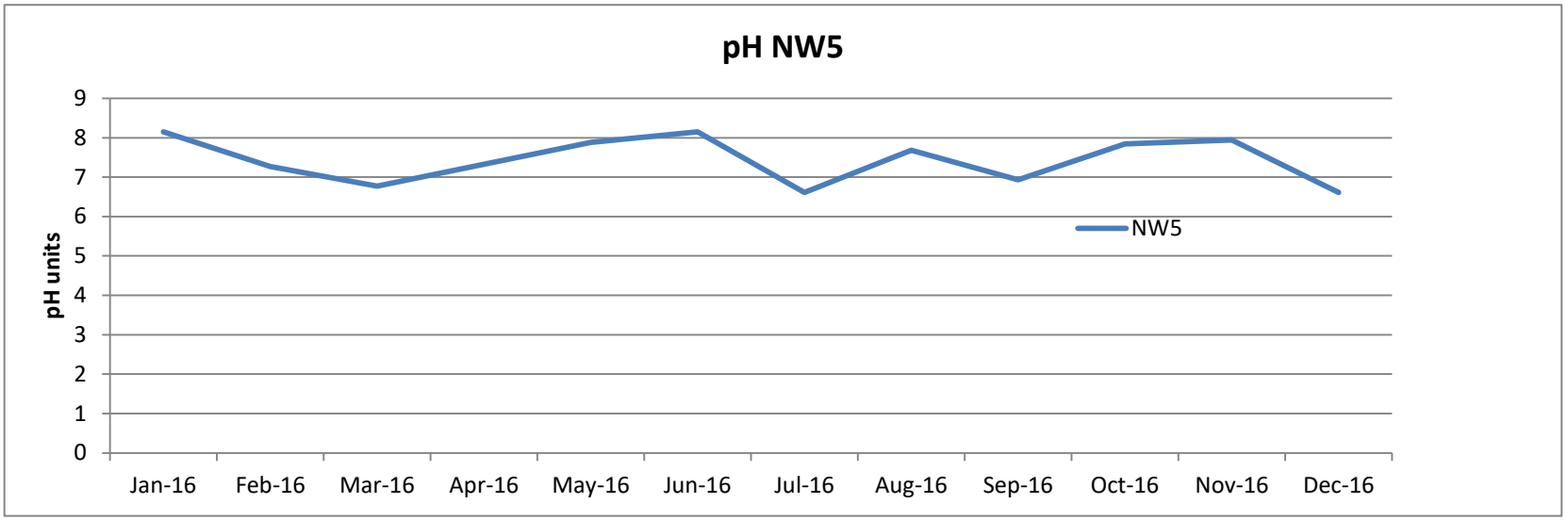
10
9
8
7
6
5
4
3
2
1
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW4
Warning Level
Action Level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8
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6
5
4
3
2
1
0
Jan-16
Feb-16
Mar-16
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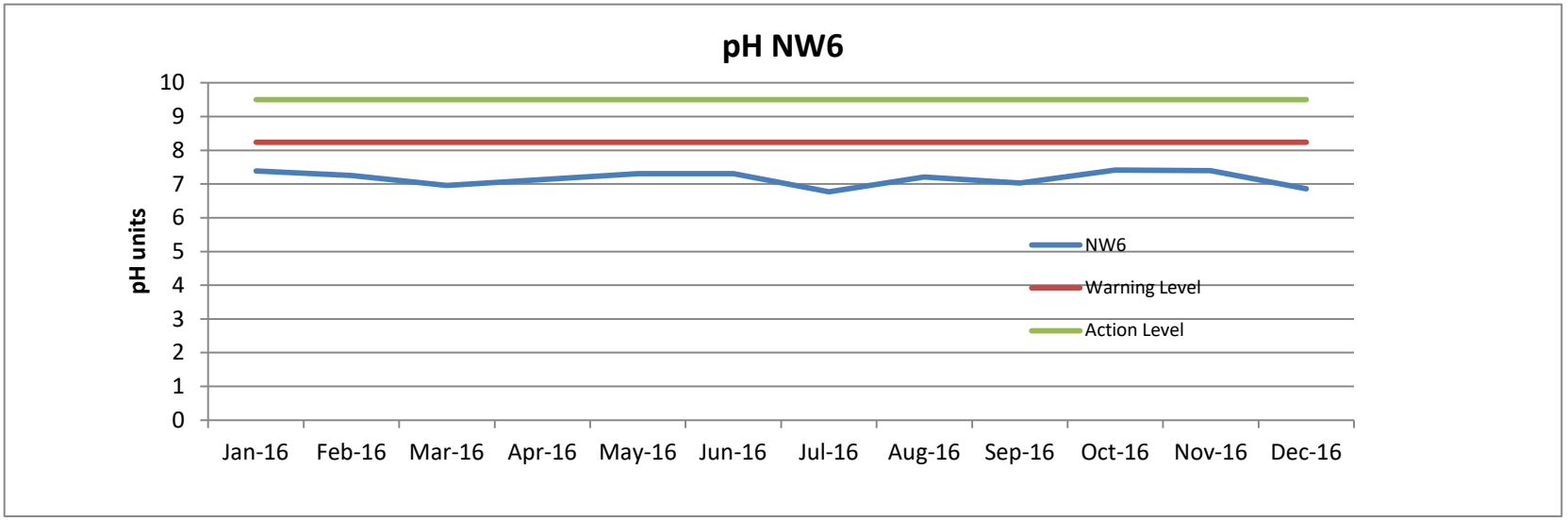
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW5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8
7
6
5
4
3
2
1
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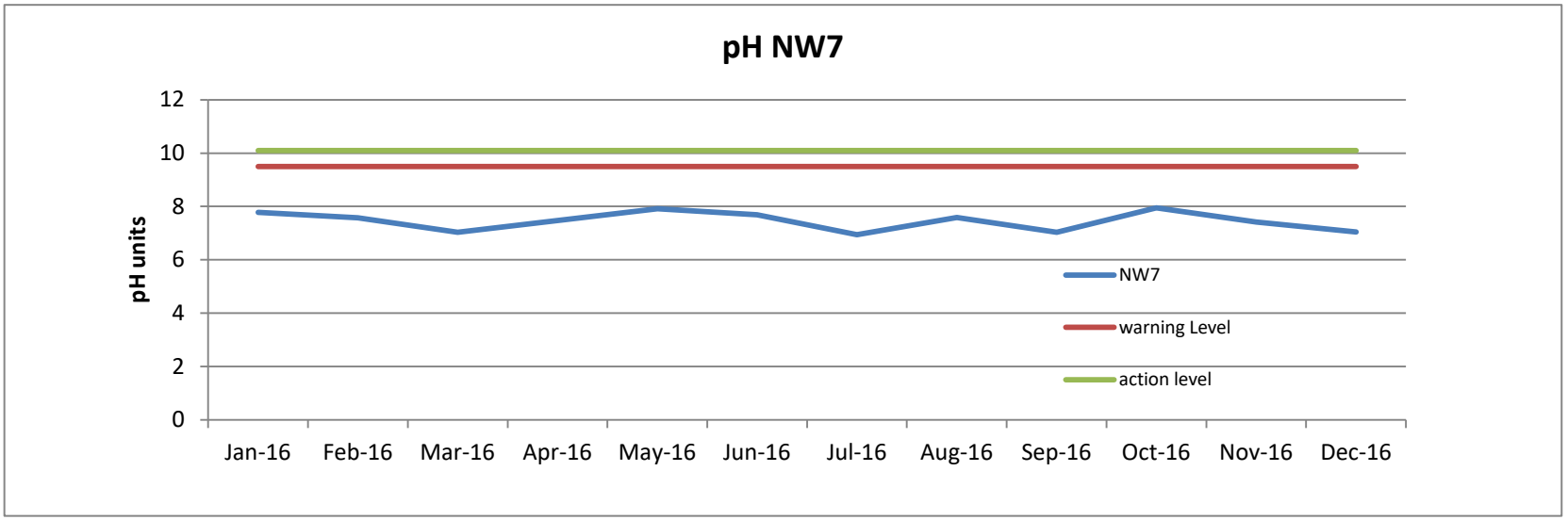
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW6
Warning Level
Action Level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6
4
2
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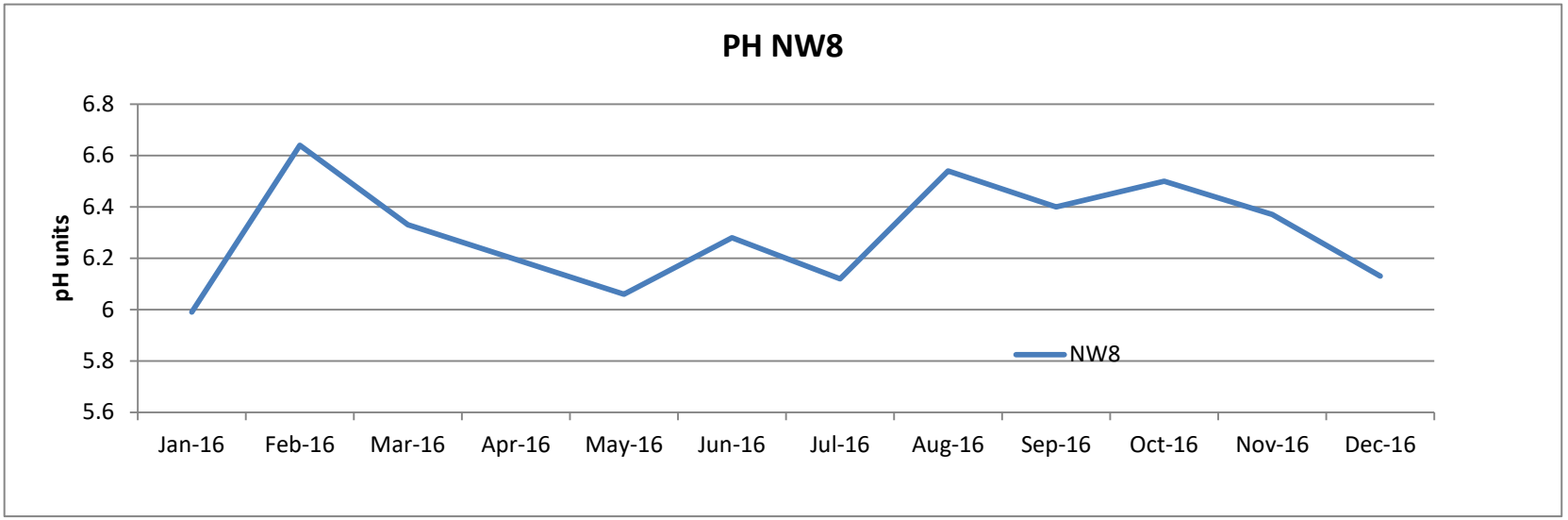
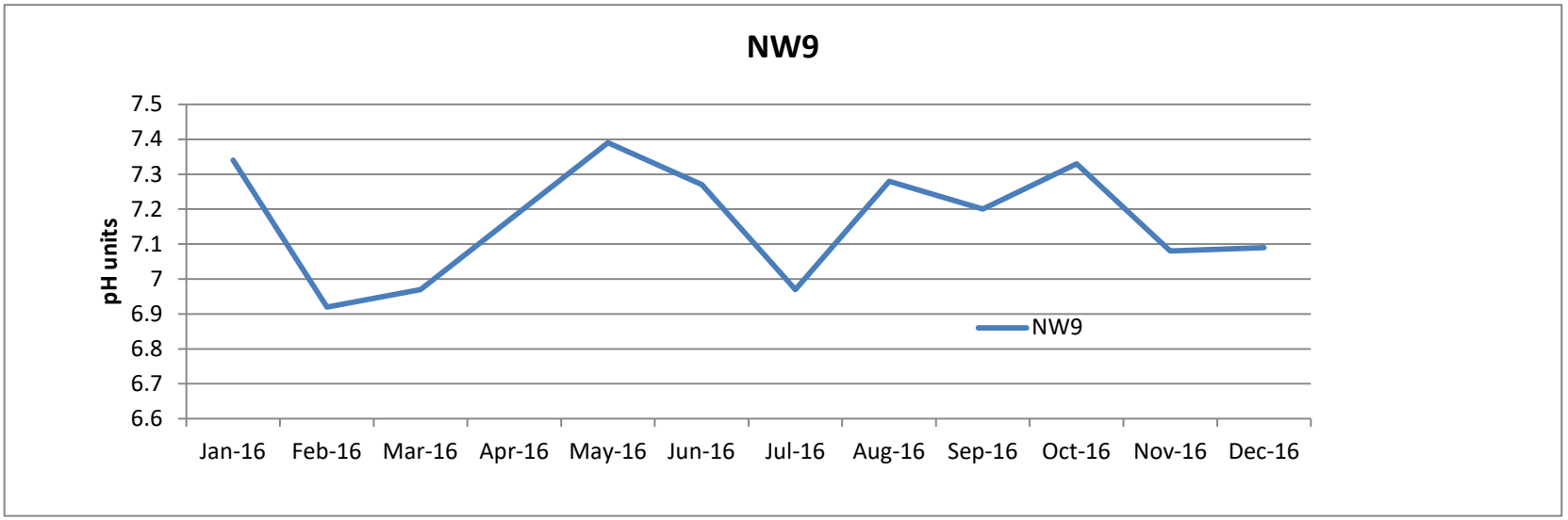
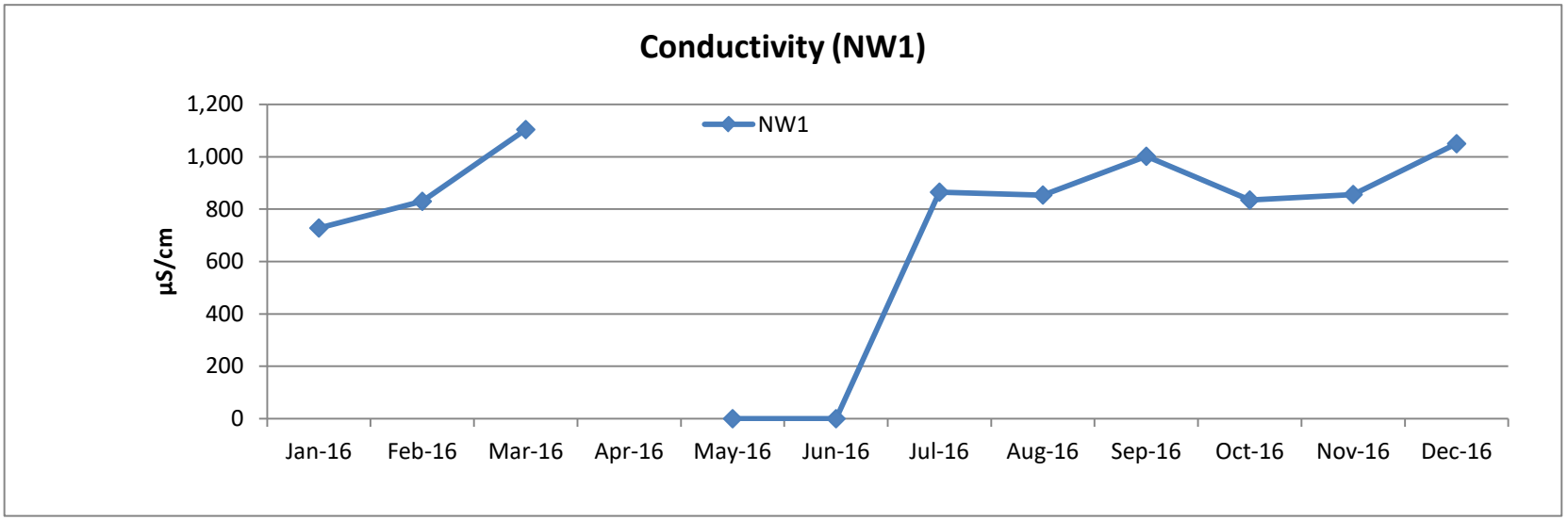
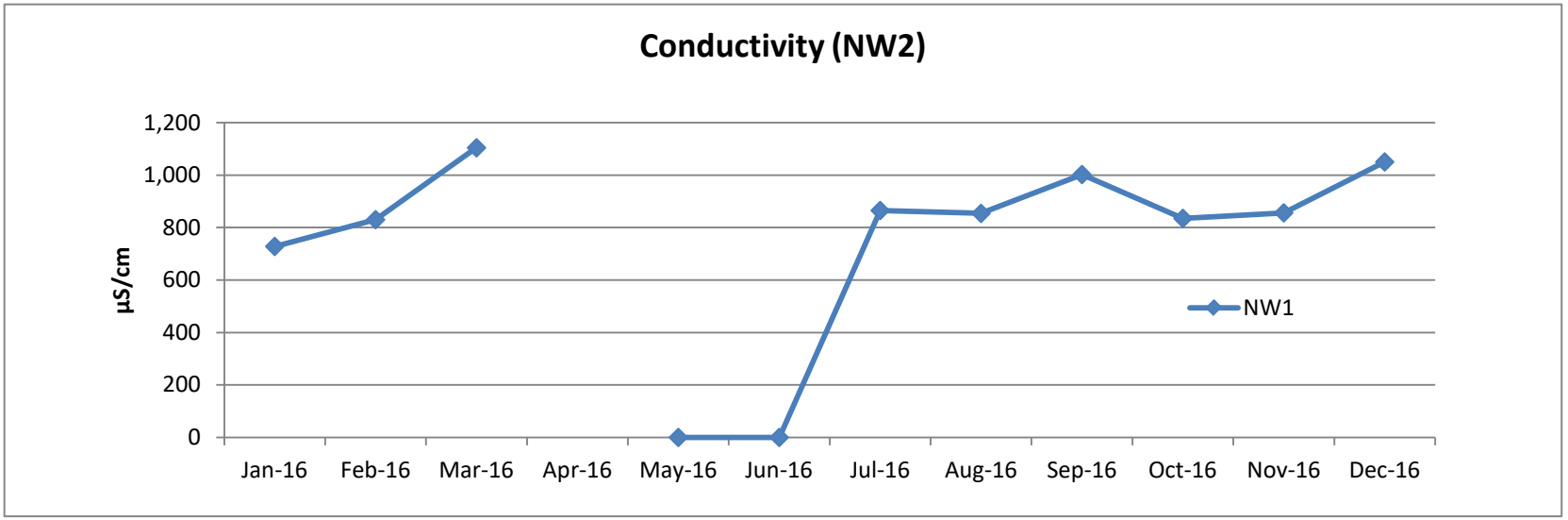
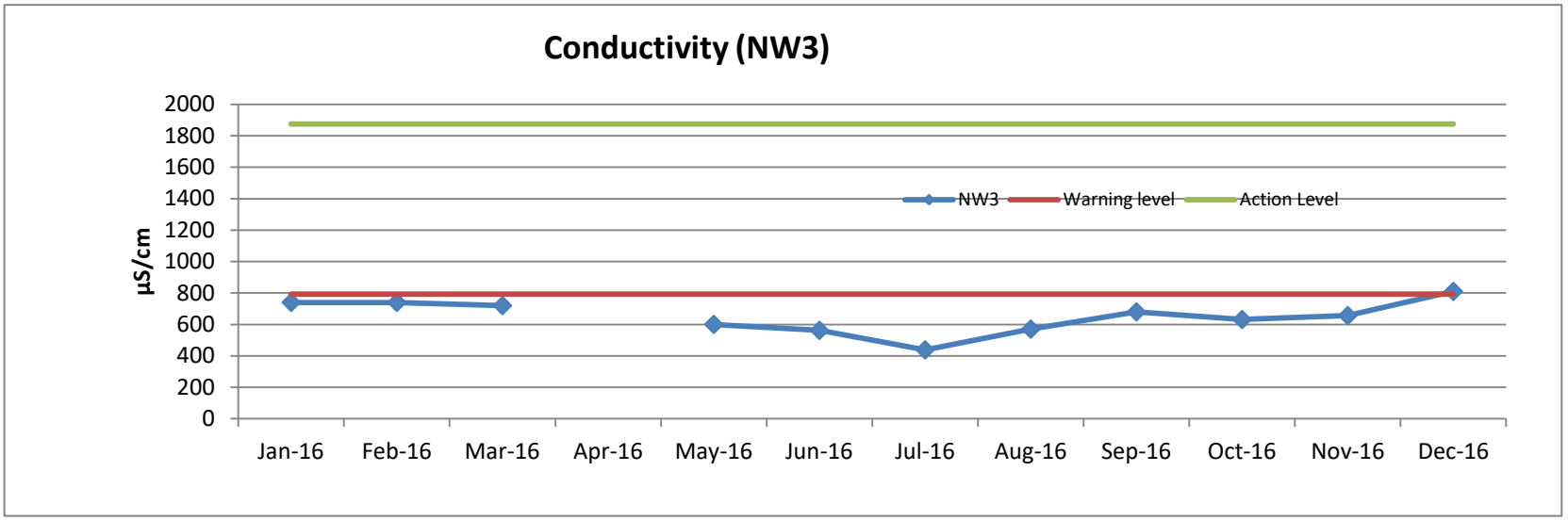
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW7
warning Level
action level

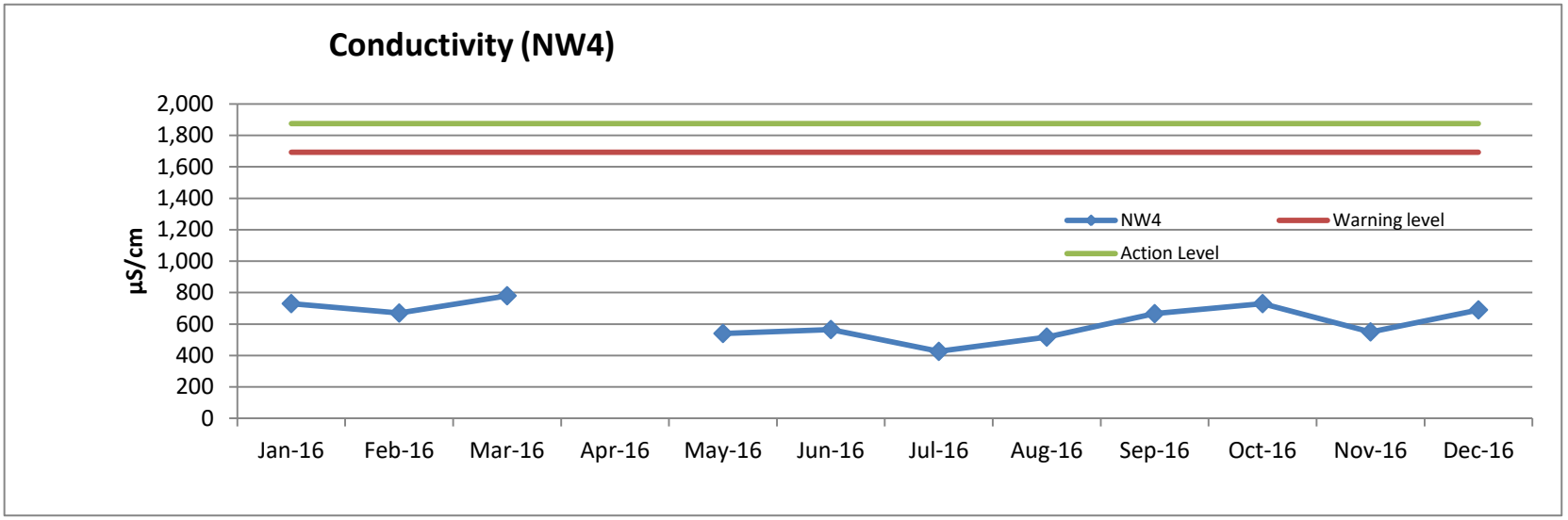

PH NW8
6.8
6.6
6.4
6.2
6
5.8
5.6
pH units
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW8

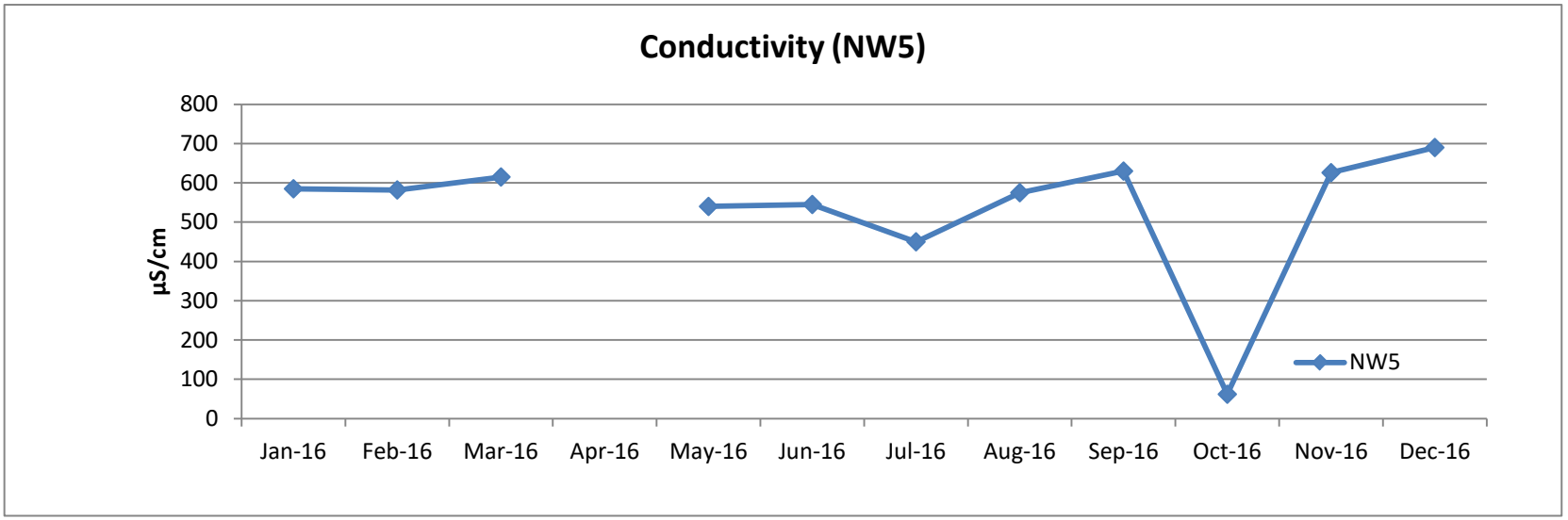

NW9
pH units
7.5
7.4
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW9

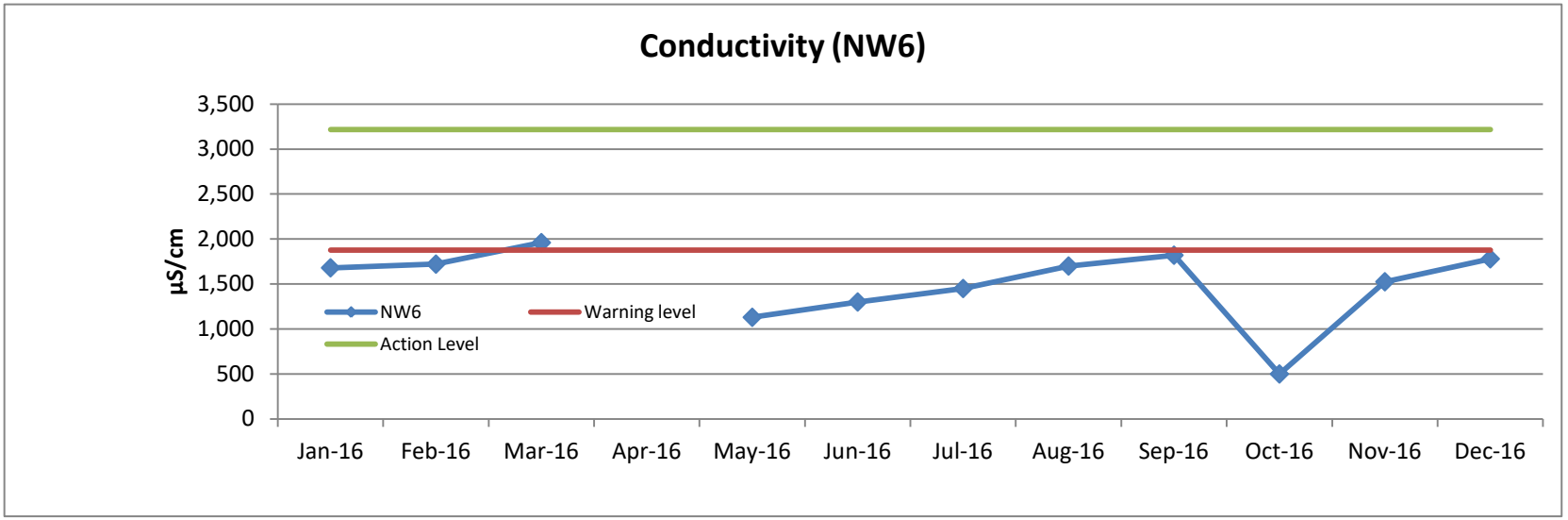

Conductivity (NW1)
1,200
1,000
800
600
400
200
0
µS/cm
NW1
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

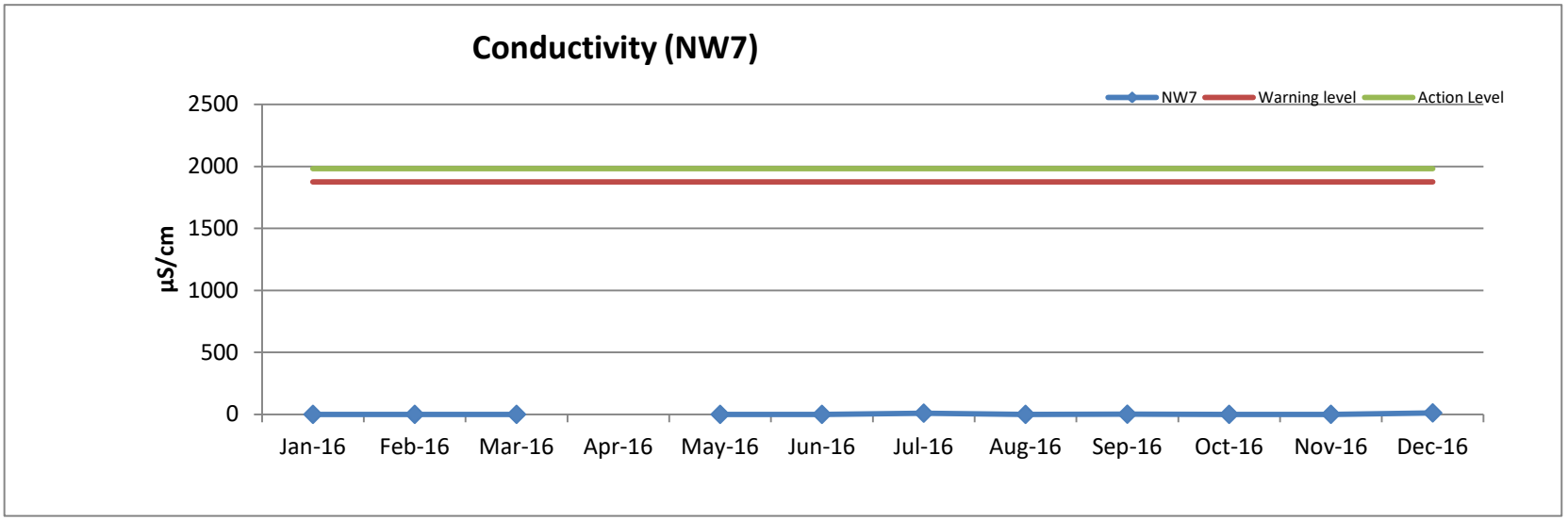

Conductivity (NW2)
1,200
1,000
800
600
400
200
0
µS/cm
NW1
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

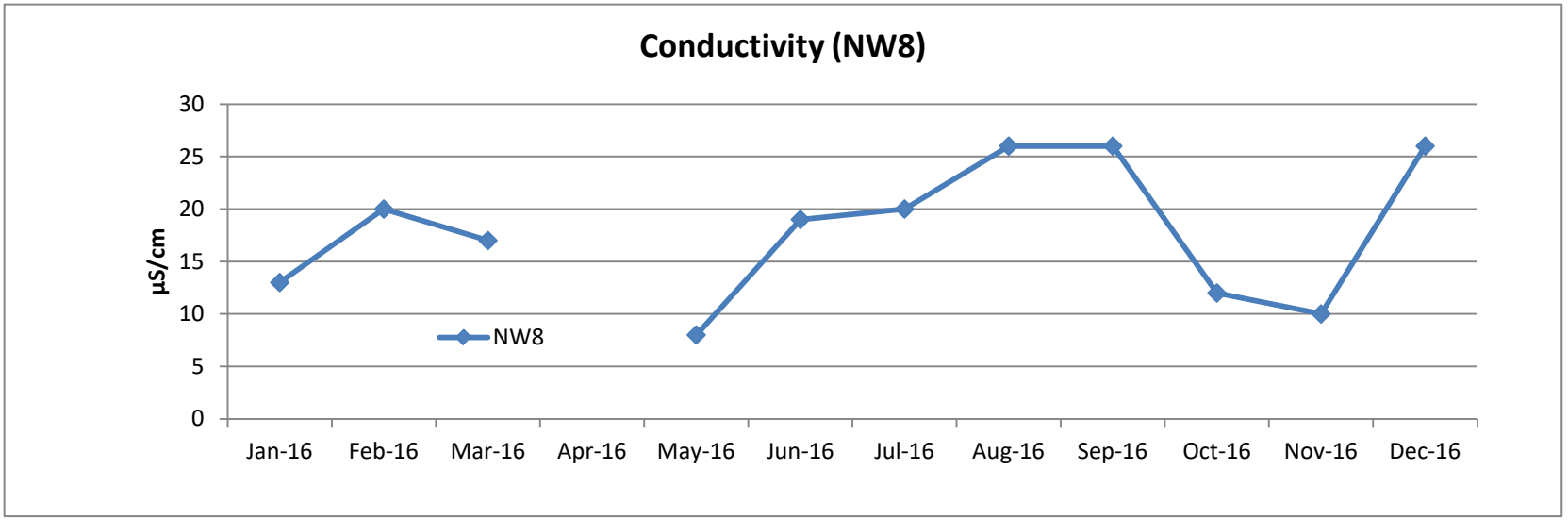

Conductivity (NW3)
µS/cm
2000
1800
1600
1400
1200
1000
800
600
400
200
0
NW3
Warning level
Action Level
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

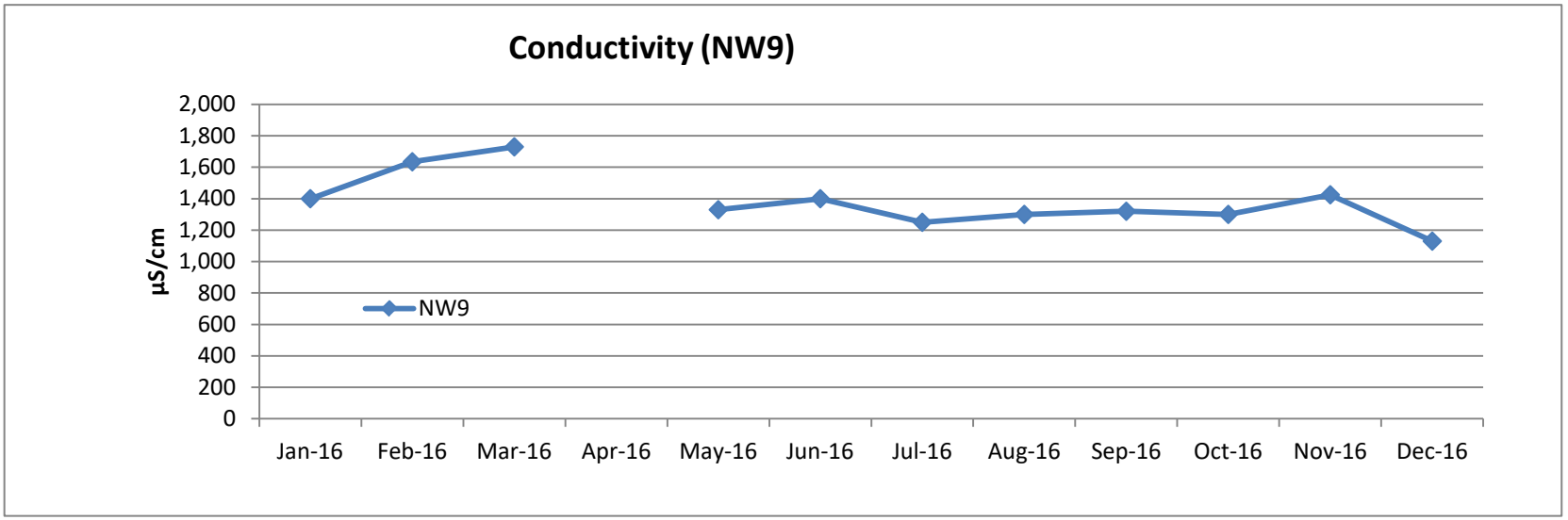

Conductivity (NW4)
µS/cm
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
NW4
Warning level
Action Level
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

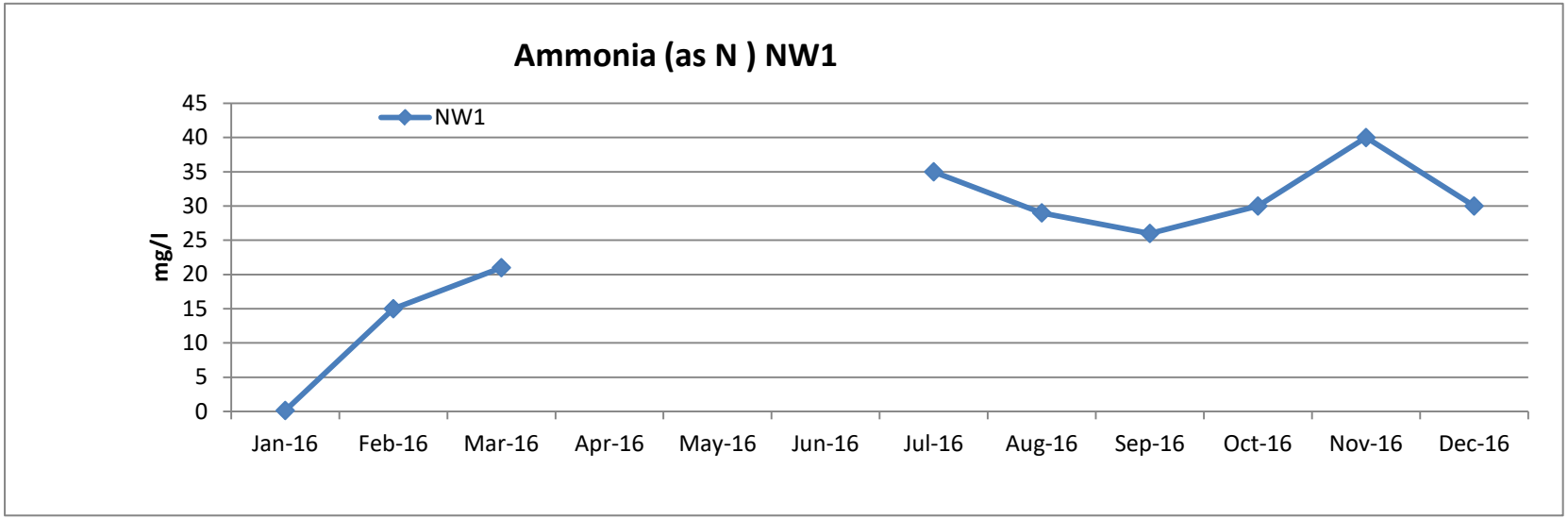

Conductivity (NW5)
800
700
600
500
400
300
200
100
0
µS/cm
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW5

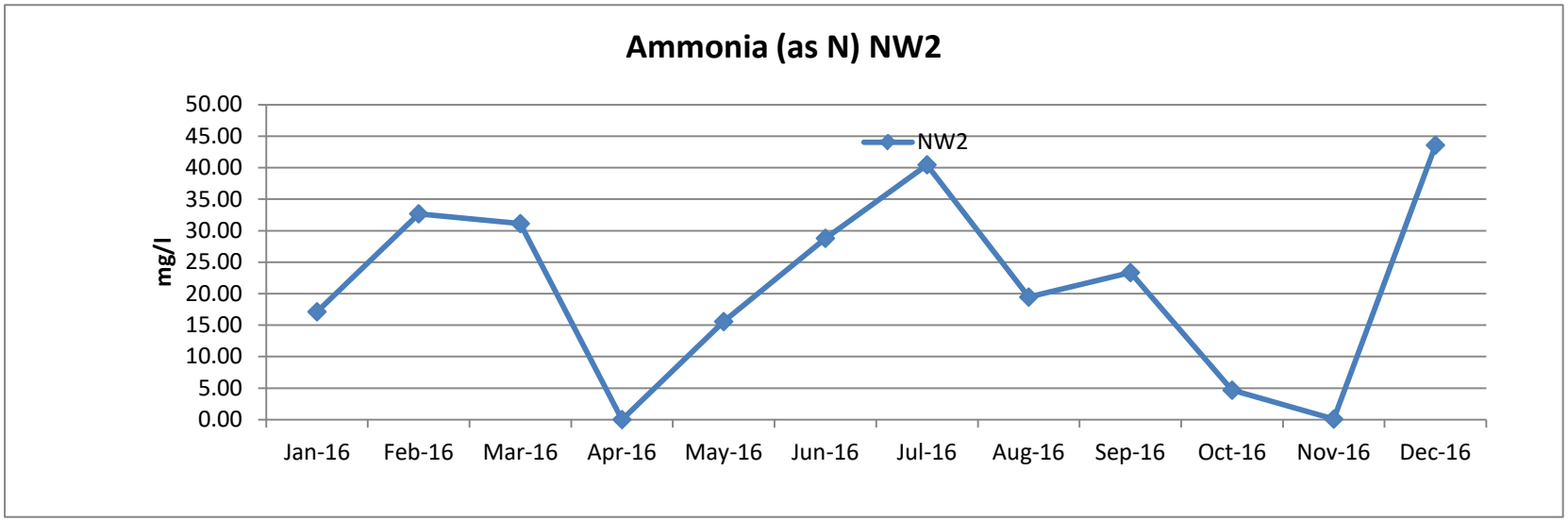

Conductivity (NW6)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
µS/cm
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW6
Warning level
Action Level

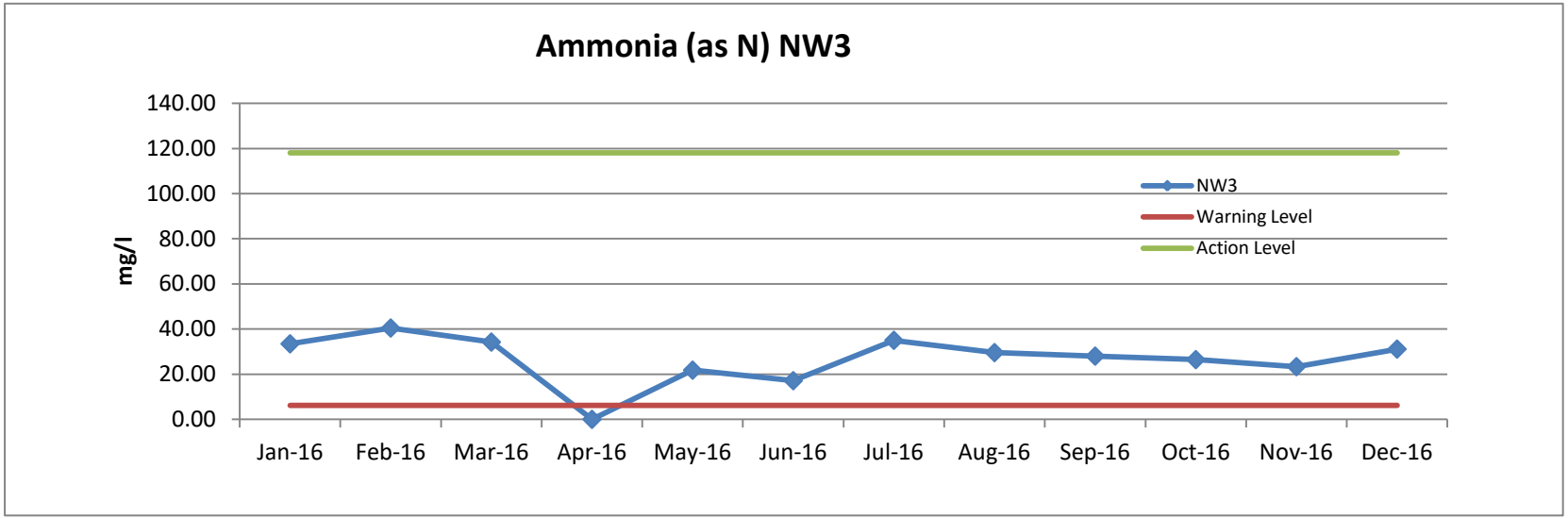

Conductivity (NW7)
NW7
Warning level
Action Level
2500
2000
1500
1000
500
0
µS/cm
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

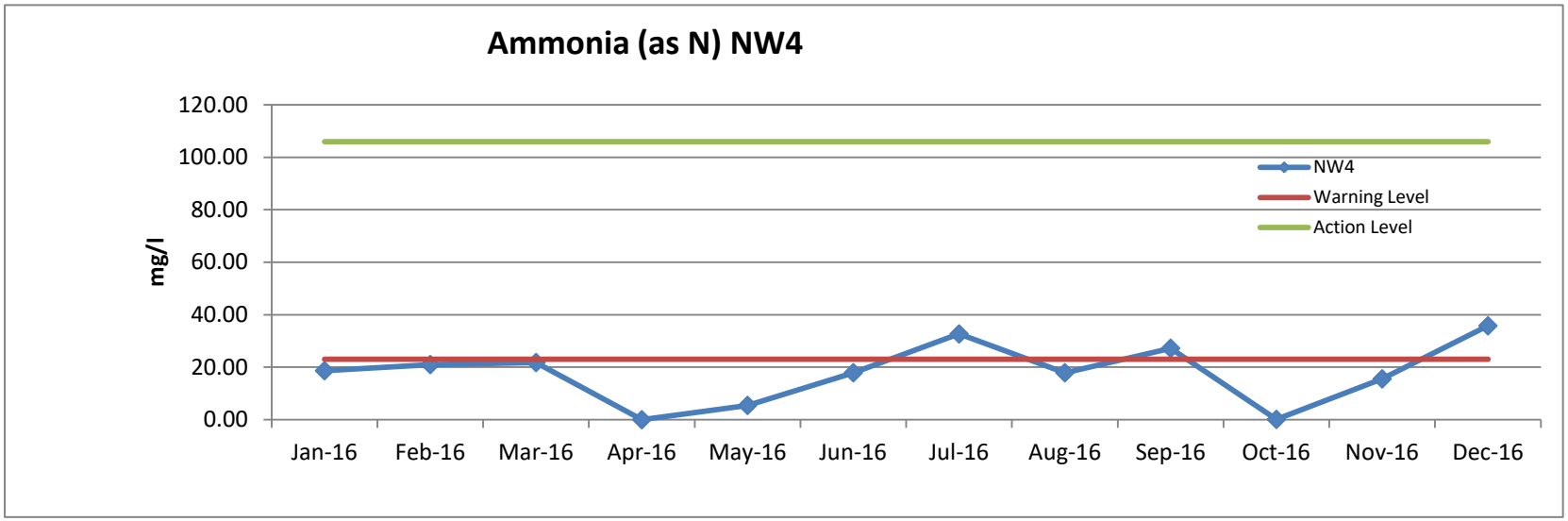

Conductivity (NW8)
30
25
20
15
10
5
0
µS/cm
NW8
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

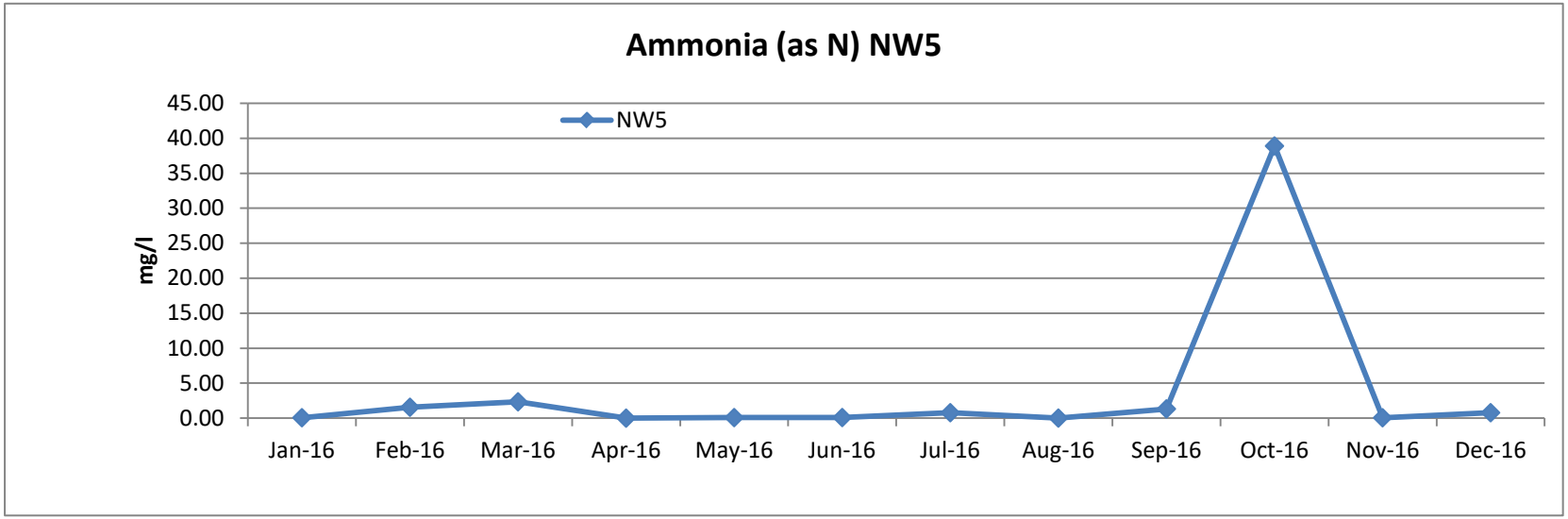

Conductivity (NW9)
µS/cm
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
NW9
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

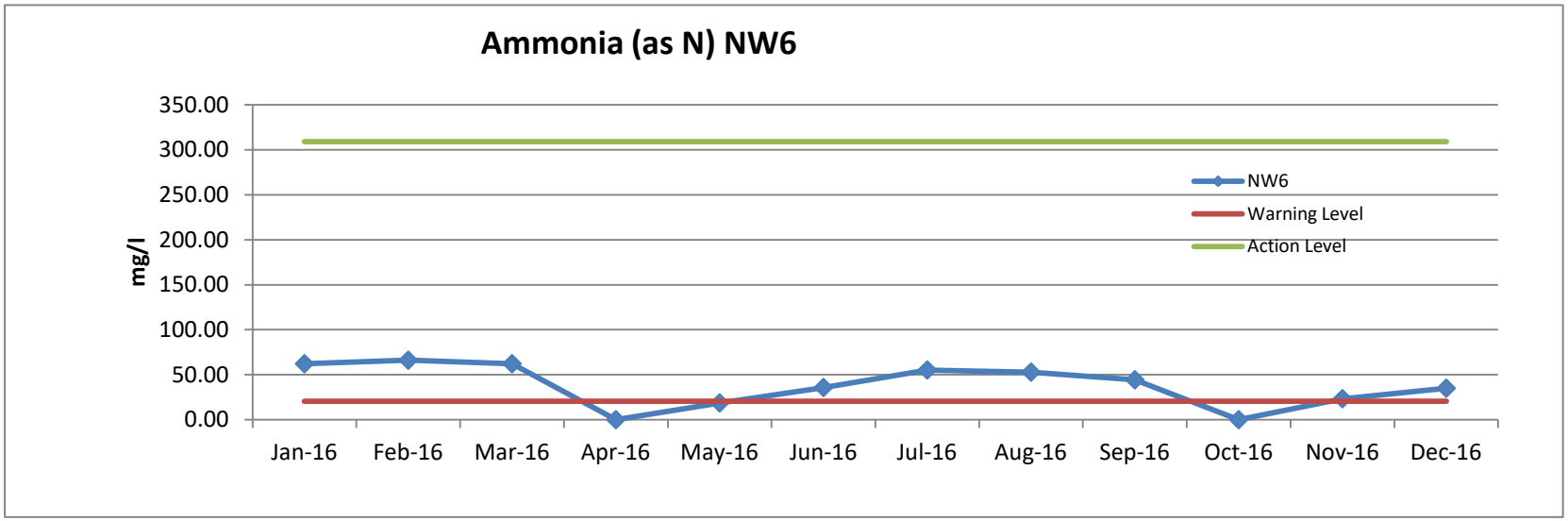

Ammonia (as N) NW1
NW1
mg/l
45
40
35
30
25
20
15
10
5
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

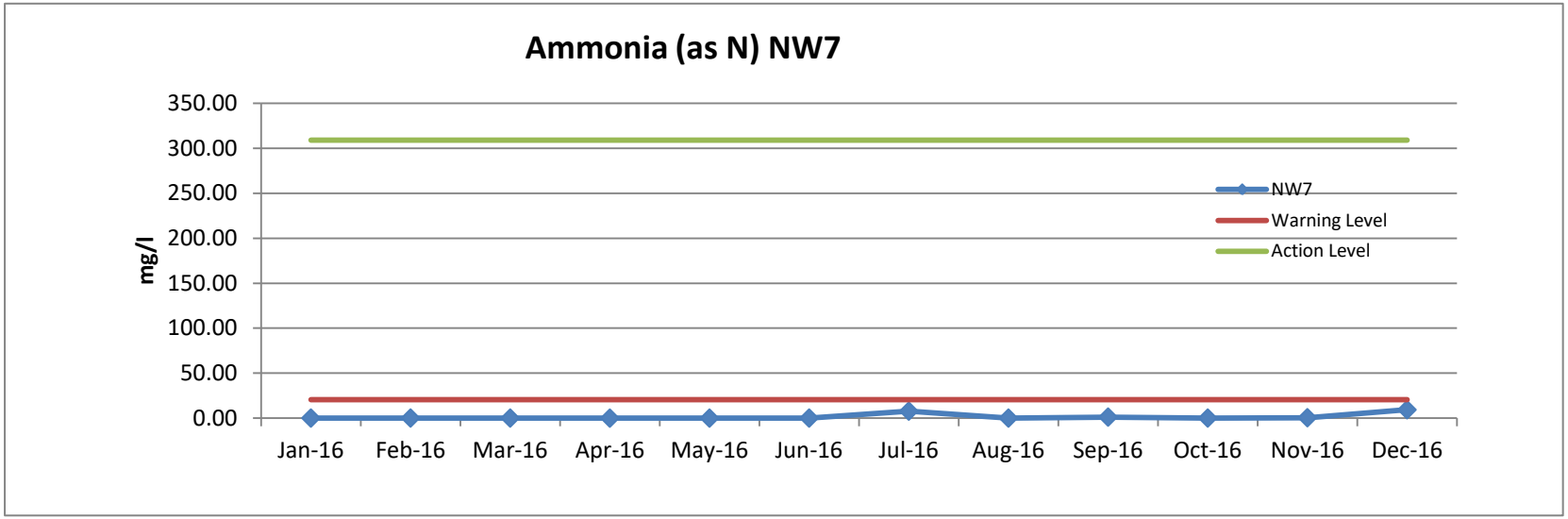

Ammonia (as N) NW2
NW2
mg/l
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

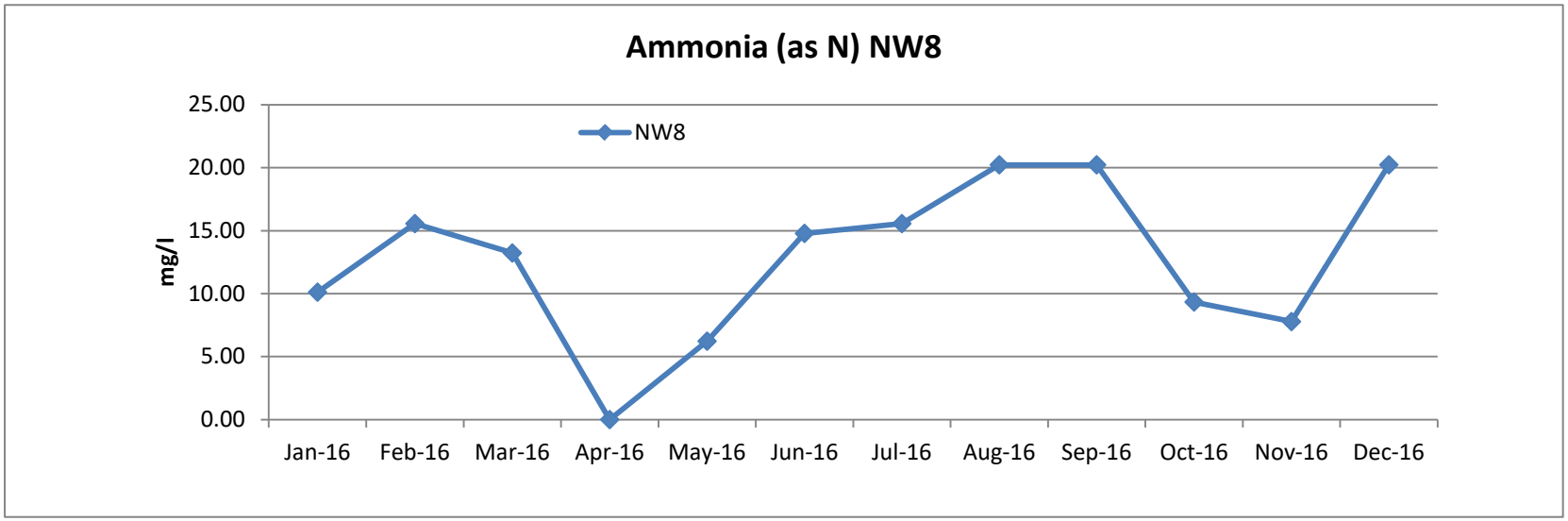

Ammonia (as N) NW3
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
mg/l
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW3
Warning Level
Action Level

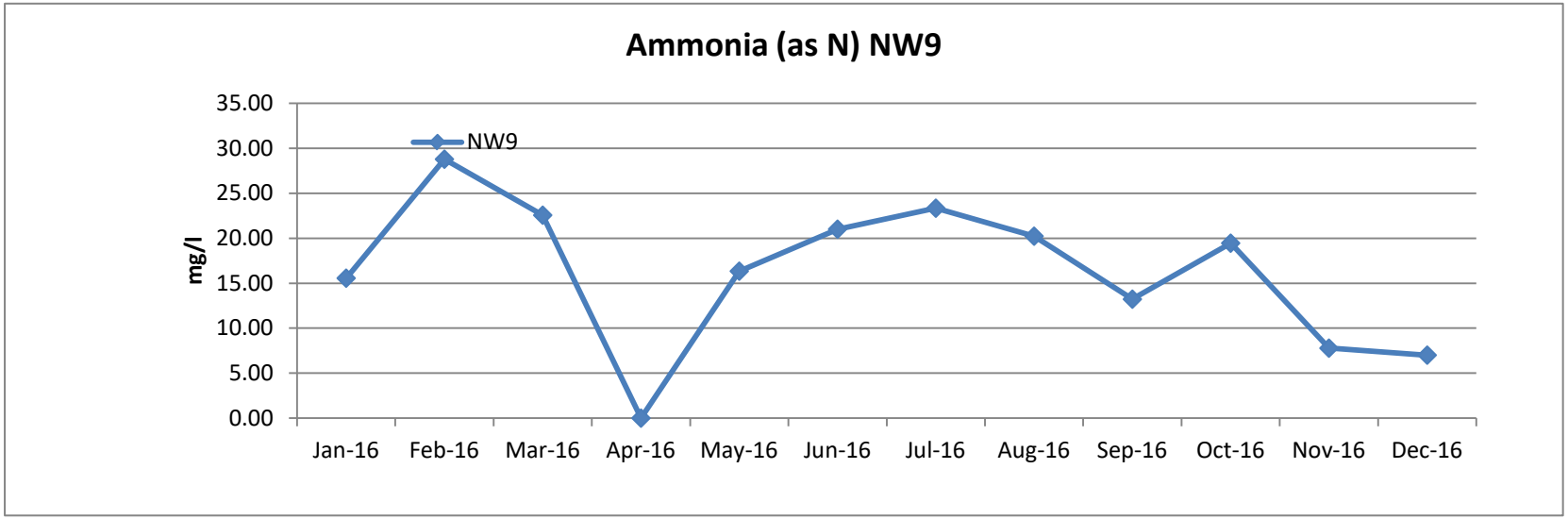

Ammonia (as N) NW4
120.00
100.00
80.00
60.00
40.00
20.00
0.00
mg/l
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW4
Warning Level
Action Level

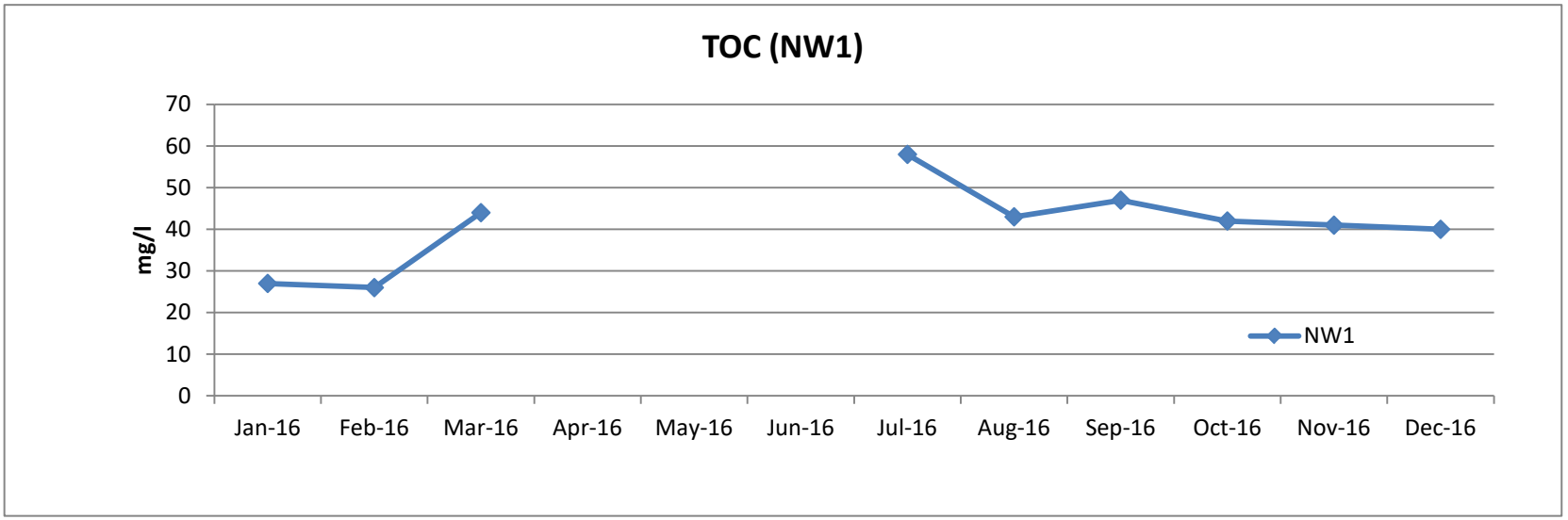

Ammonia (as N) NW5
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
mg/l
NW5
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

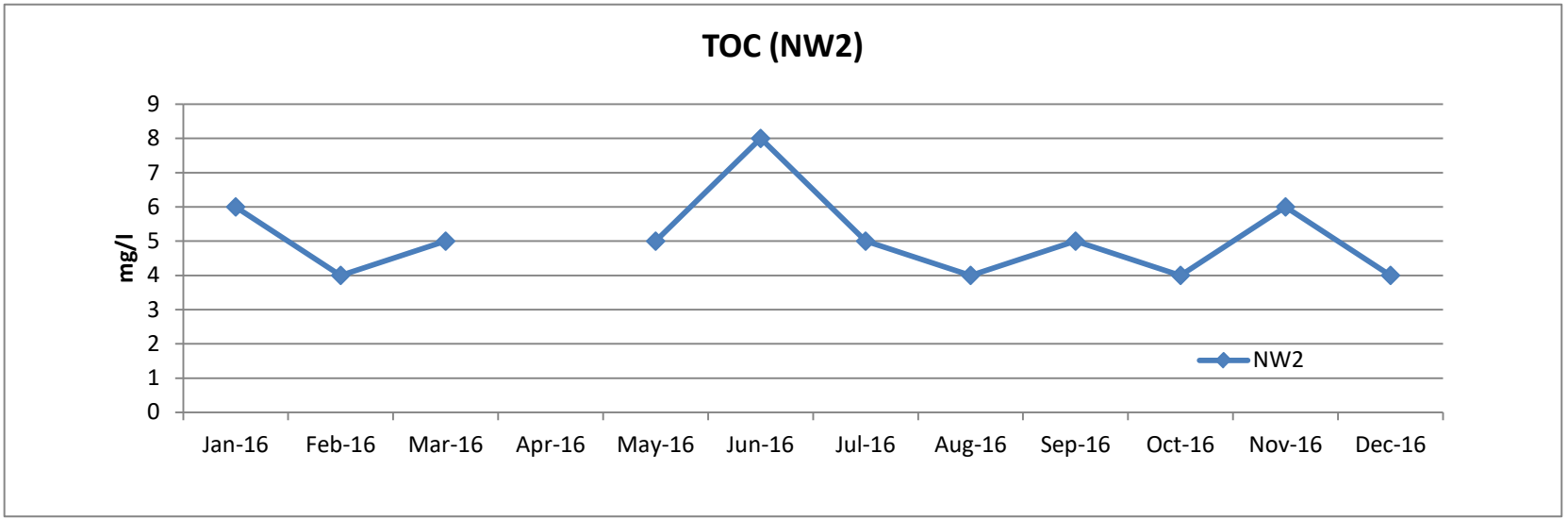

Ammonia (as N) NW6
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
mg/l
NW6
Warning Level
Action Level
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

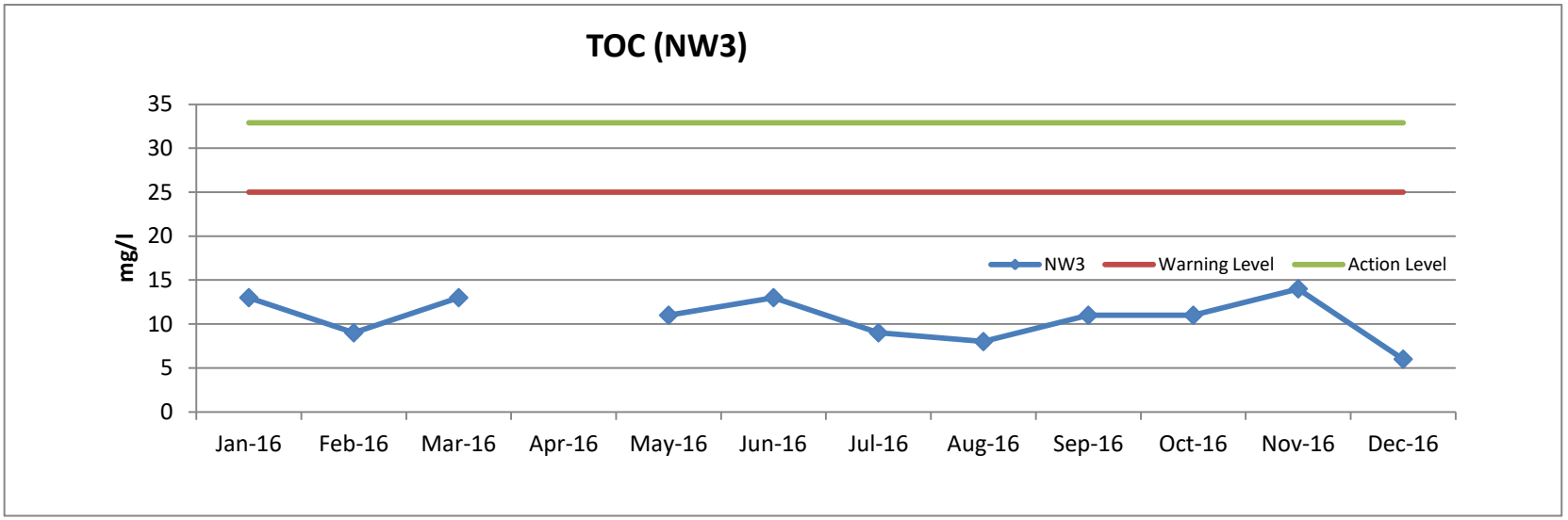

Ammonia (as N) NW7
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
mg/l
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW7
Warning Level
Action Level

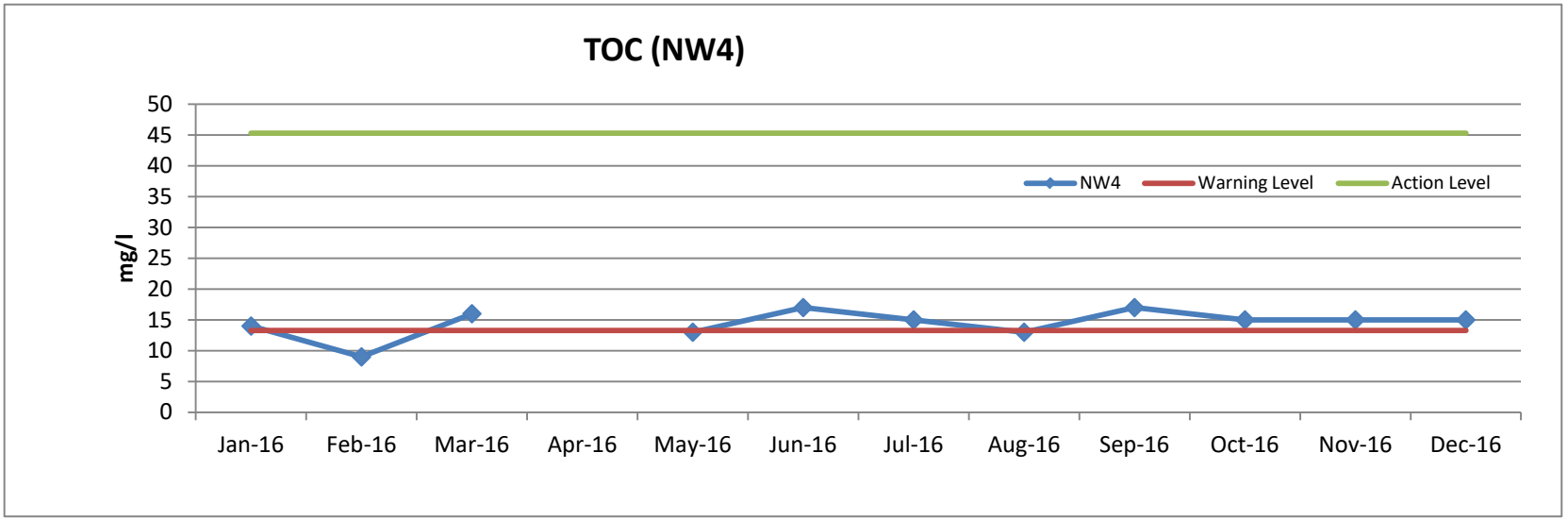

Ammonia (as N) NW8
25.00
20.00
15.00
10.00
5.00
0.00
mg/l
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW8

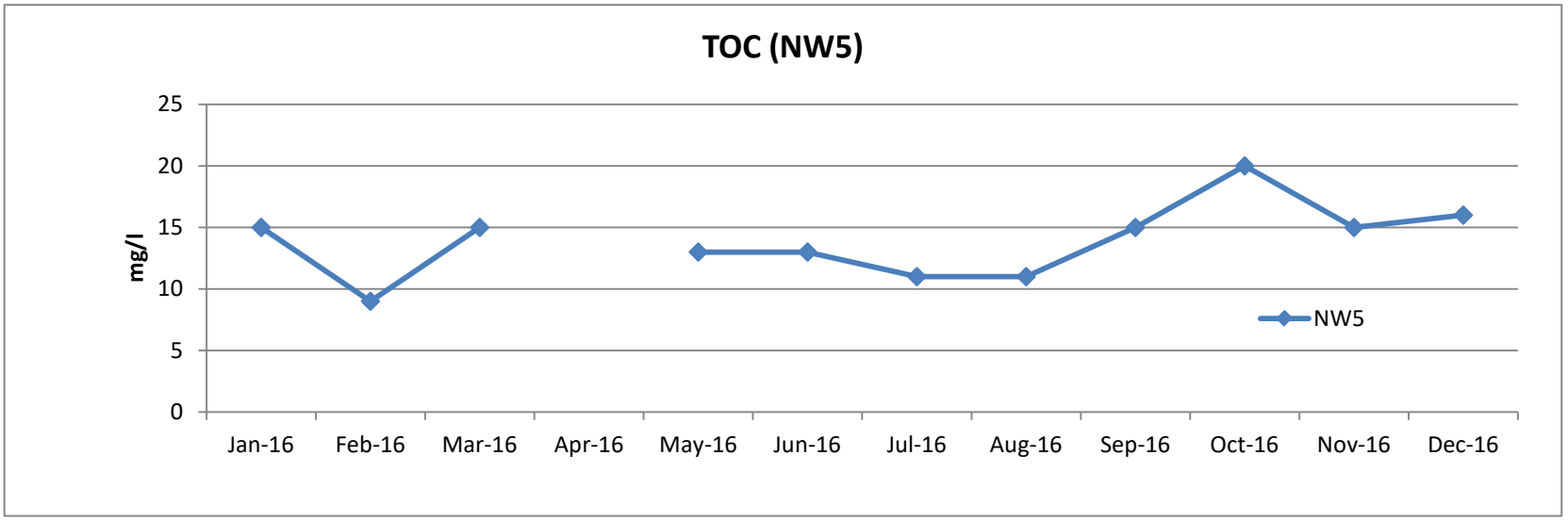

Ammonia (as N) NW9
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
mg/l
NW9
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

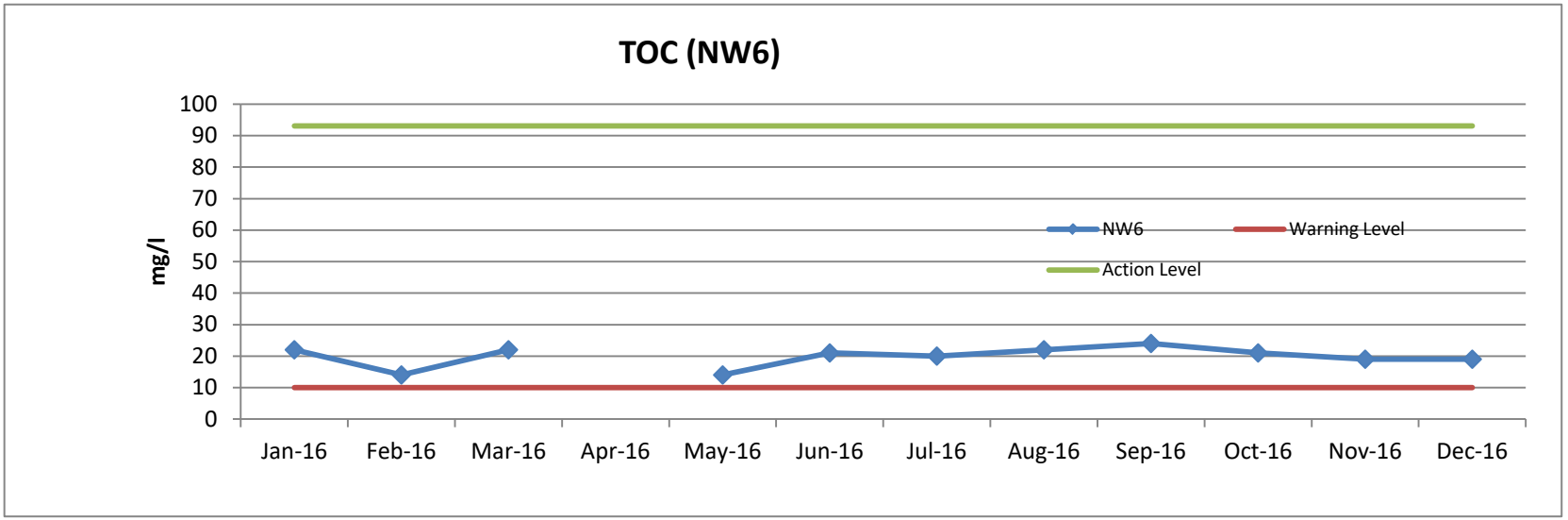

TOC (NW1)
mg/l
70
60
50
40
30
20
10
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW1

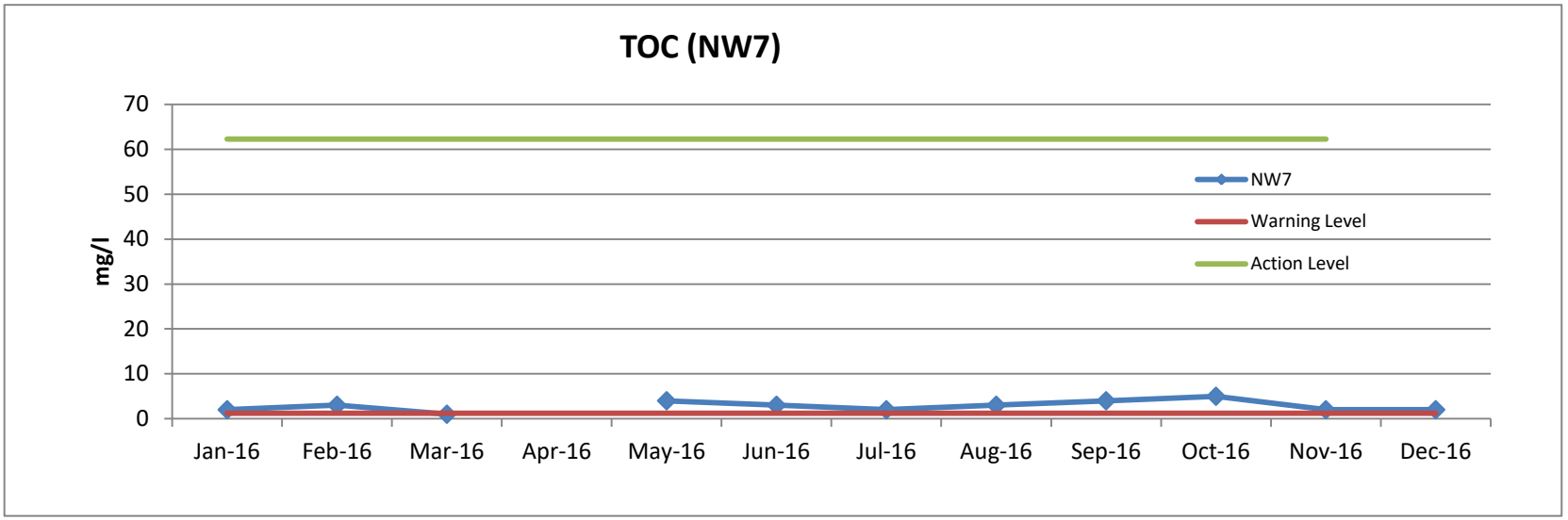

TOC (NW2)
mg/l
9
8
7
6
5
4
3
2
1
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW2

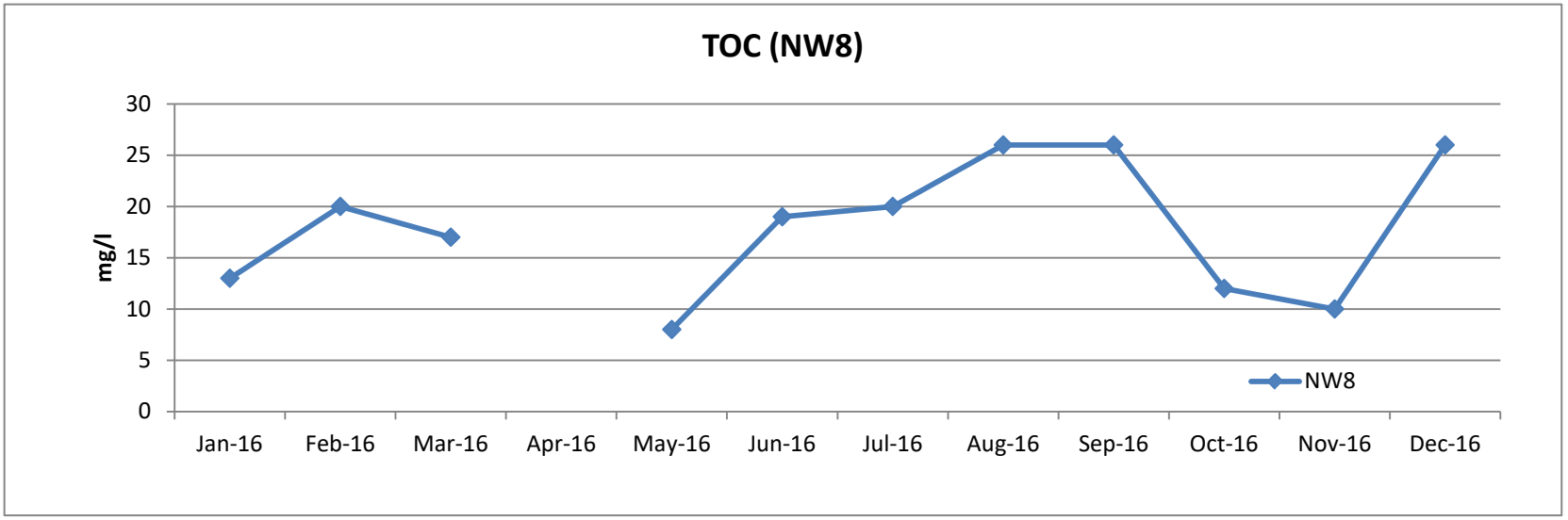

TOC (NW3)
mg/l
35
30
25
20
15
10
5
0
NW3
Warning Level
Action Level
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

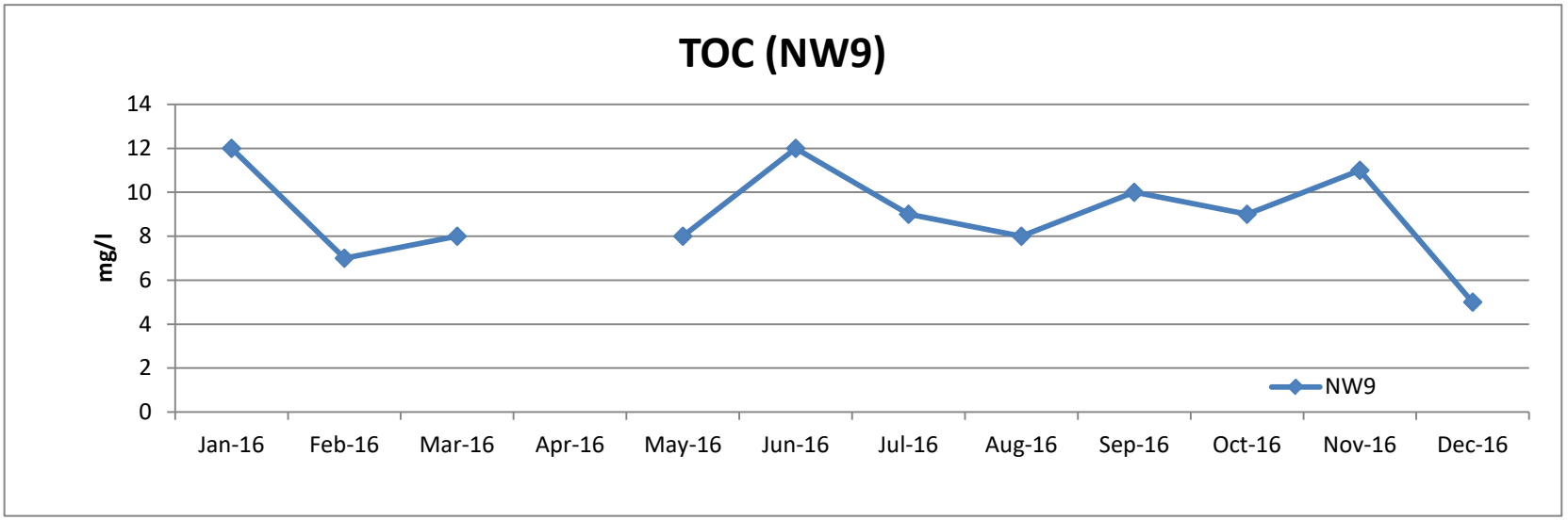

TOC (NW4)
mg/l
50
45
40
35
30
25
20
15
10
5
0
NW4
Warning Level
Action Level
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16


TOC (NW5)
mg/l
25
20
15
10
5
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW5


TOC (NW6)
mg/l
100
90
80
70
60
50
40
30
20
10
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW6
Warning Level
Action Level


TOC (NW7)
70
60
50
40
30
20
10
0
mg/l
NW7
Warning Level
Action Level
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

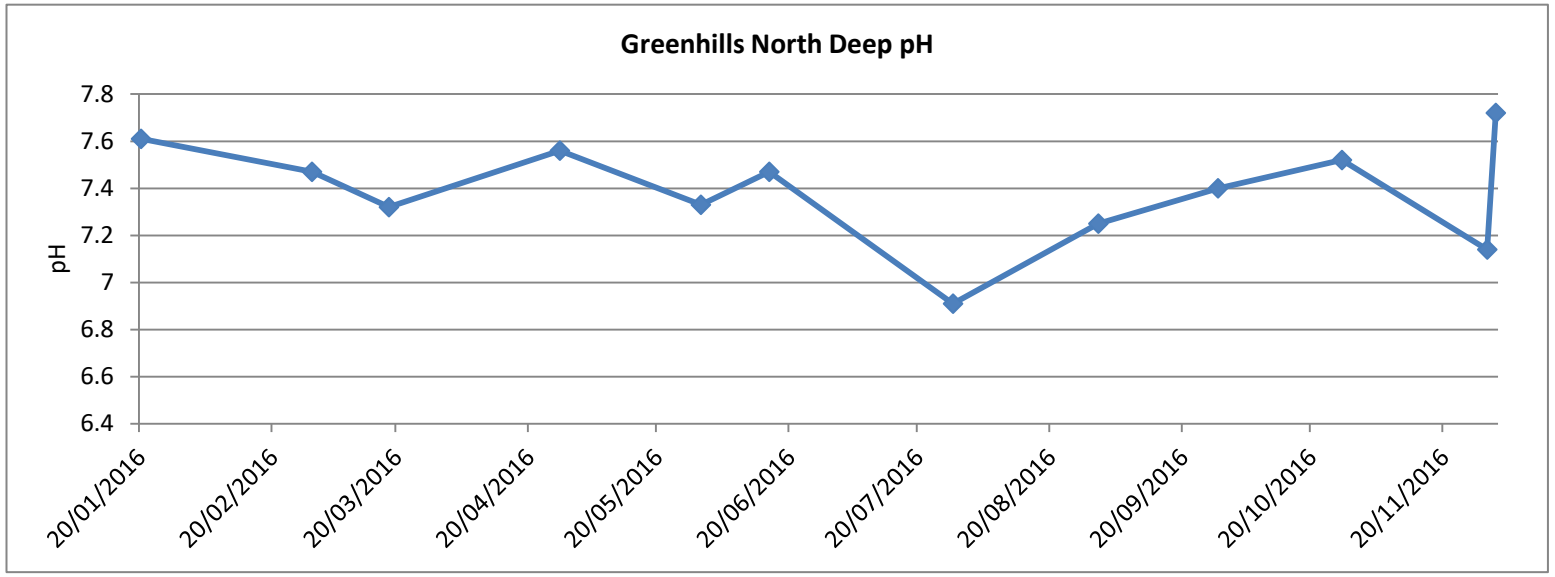

TOC (NW8)
30
25
20
15
10
5
0
mg/l
NW8
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16

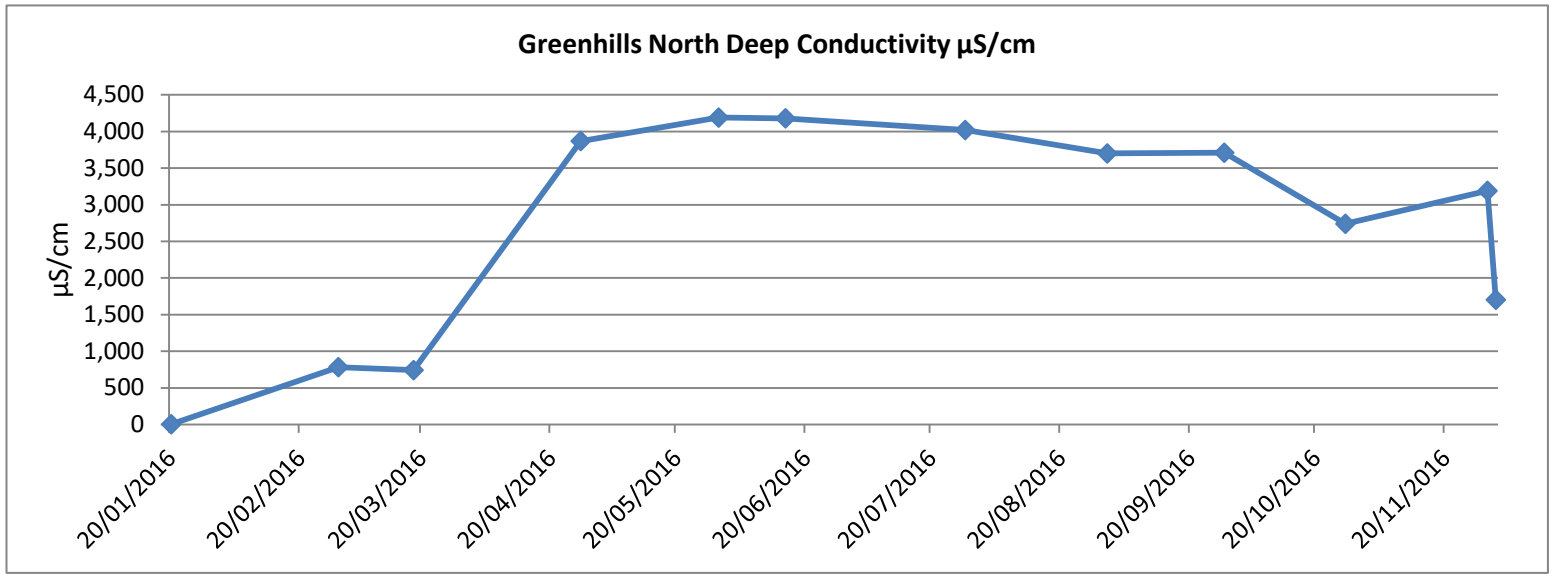

TOC (NW9)
mg/l
14
12
10
8
6
4
2
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
NW9

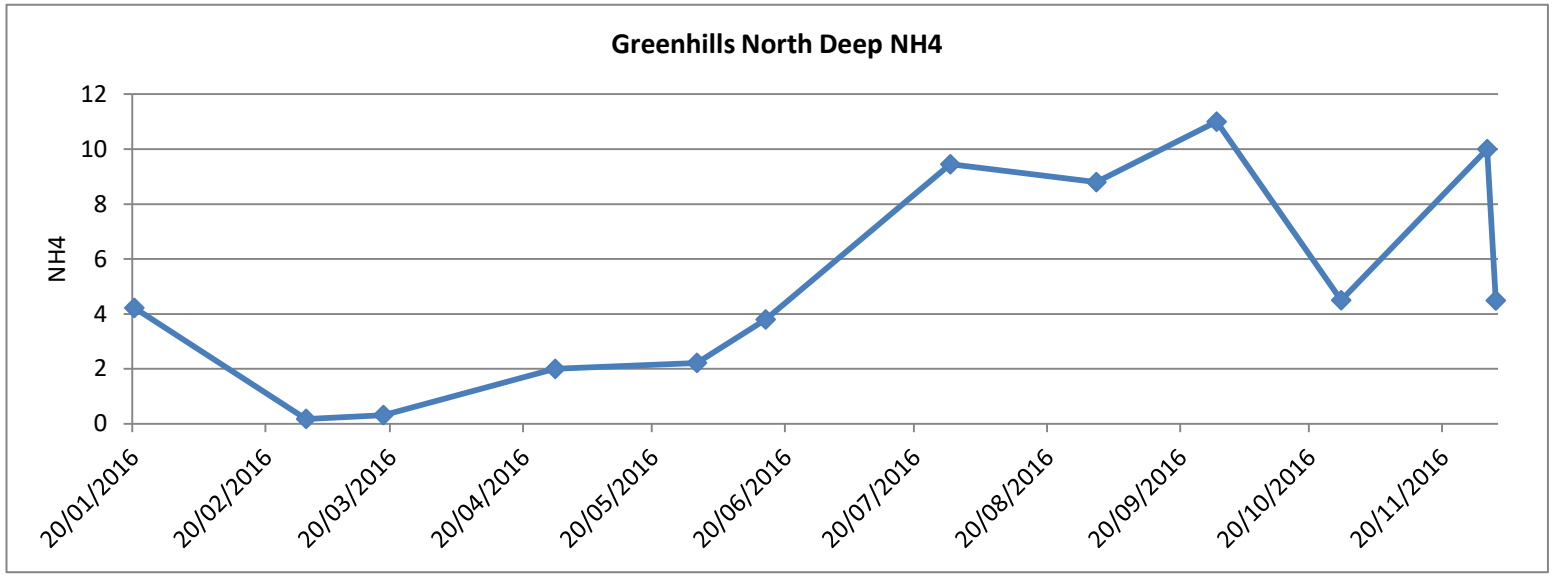
Well: Greenhills & Nemo Groundwater Wells (mg/l)
Location: Greenhills Green and Nemo Rangers GAA Pitch
All parameter data in mg/l unless stated otherwise

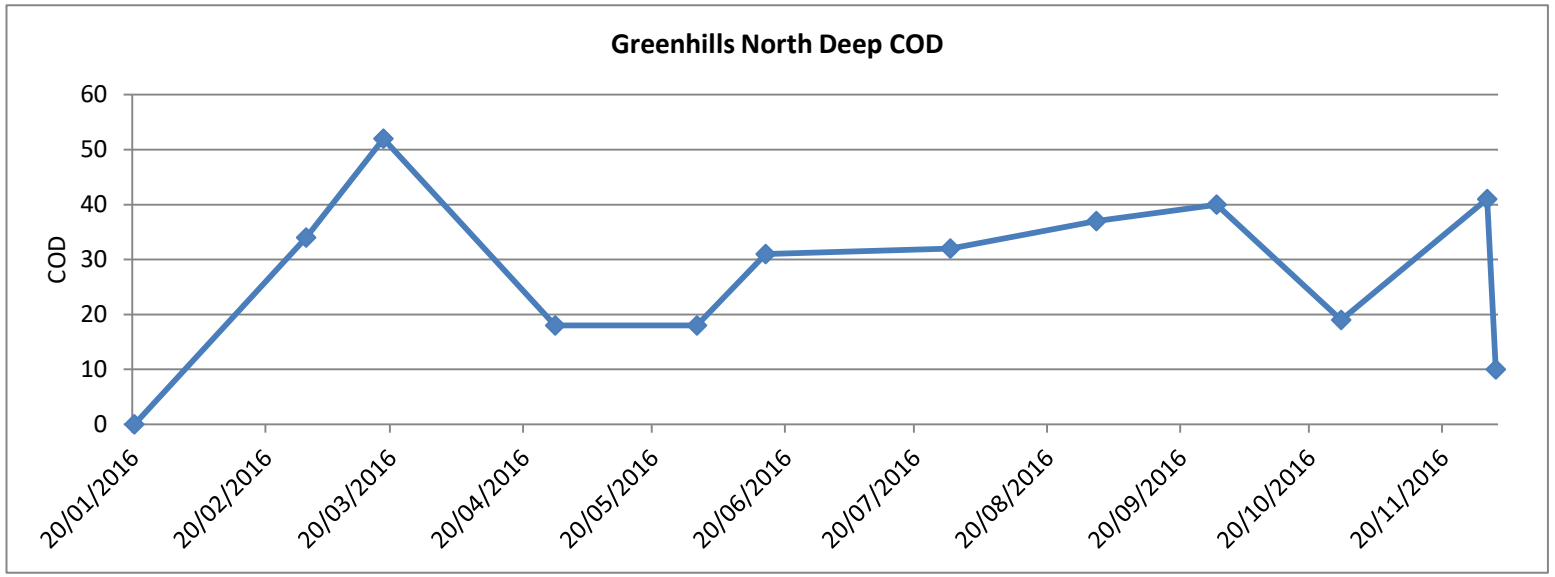
Greenhills North Deep 2016

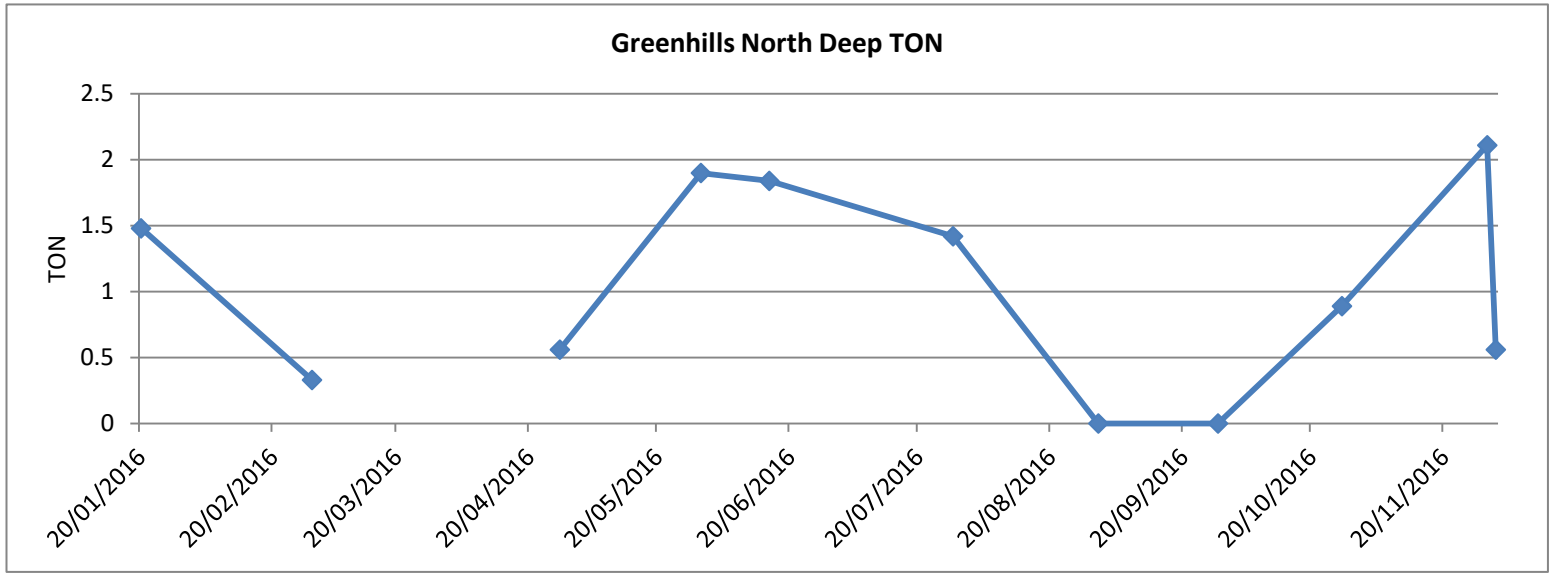
Date	Temp *C	pH	Conductivity µS/cm	NH4	Ammonia (as N)	Chloride	Oxygen	COD	TON	TOC	S. Solids	Well Depth (m)	Depth to Water (m)	Water Height in Well (m)
20/01/2016	11.3	7.61	3	4.22	3.28	824	0.96	<1	1.48	7.2	22	35	0	35
29/02/2016	16.7	7.47	783	0.18	0.14	108	7.33	34	0.33	8.4	633	35	0.61	34.39
18/03/2016	17.6	7.32	742	0.32	0.25	132	2.24	52		4	11.2	35	0.86	34.14
27/04/2016	17.6	7.56	3,870	2	1.56	1,282	9.68	18	0.56	18.7	140	35	1.18	33.82
30/05/2016	24.8	7.33	4,190	2.22	1.73	1,227	7.98	18	1.9	19.8	232	35	1.62	33.38
15/06/2016	24.3	7.47	4,180	3.8	2.96	1188	6.47	31	1.84	20.1	1056	35	1.74	33.26
28/07/2016	23.8	6.91	4,020	9.45	7.35	1347	4.2	32	1.42	20	156	35	1.9	33.1
31/08/2016	21.8	7.25	3,700	8.8	6.85	1156	7.58	37	0	18.4	52	35	1.84	33.16
28/09/2016	20.9	7.4	3,710	11	8.56	638	5.4	40	0	19.4	1524	35	0.7	34.3
27/10/2016	19.1	7.52	2,740	4.5	3.50	886	9.62	19	0.89	19	72	35	1.66	33.34
30/11/2016	16.1	7.14	3,190	10	7.78	922	3.3	41	2.11	19.6	1200	35	0.84	34.16
02/12/2016	15.1	7.72	1,703	4.49	3.49	406	6.02	10	0.56	2	26	35	1.12	33.88

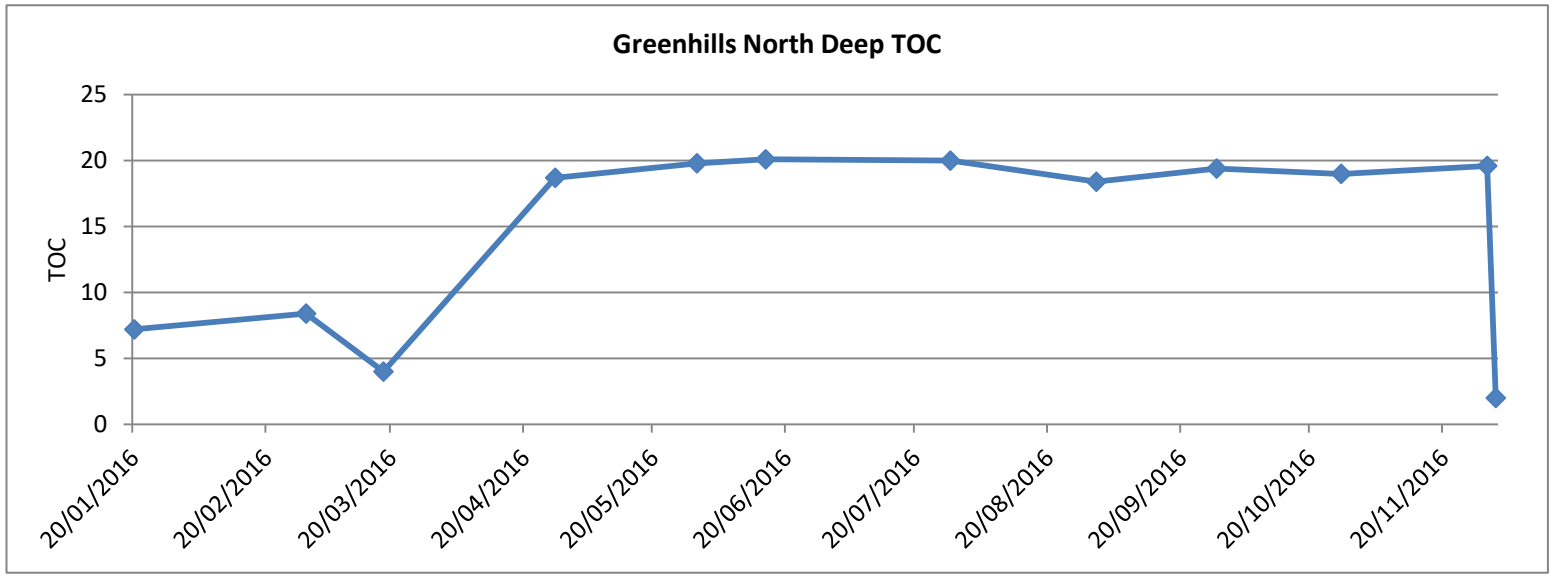

Greenhills North Deep pH
pH
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

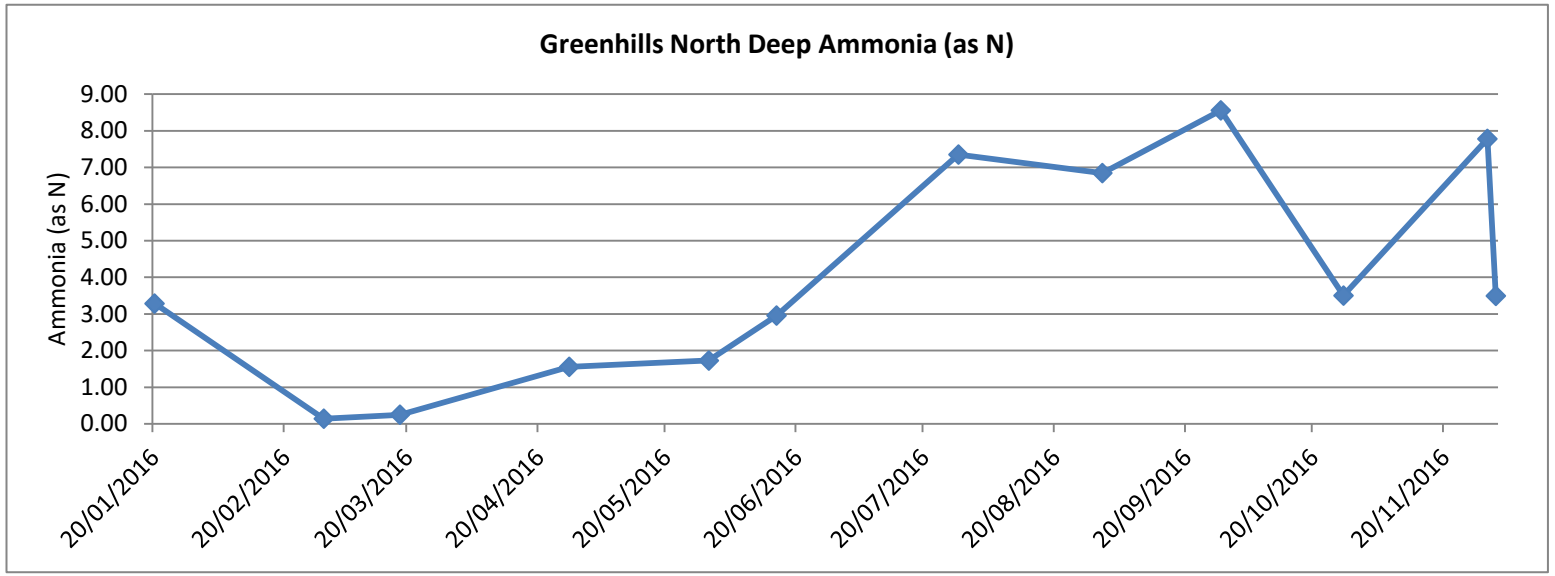

Greenhills North Deep Conductivity µS/cm
µS/cm
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

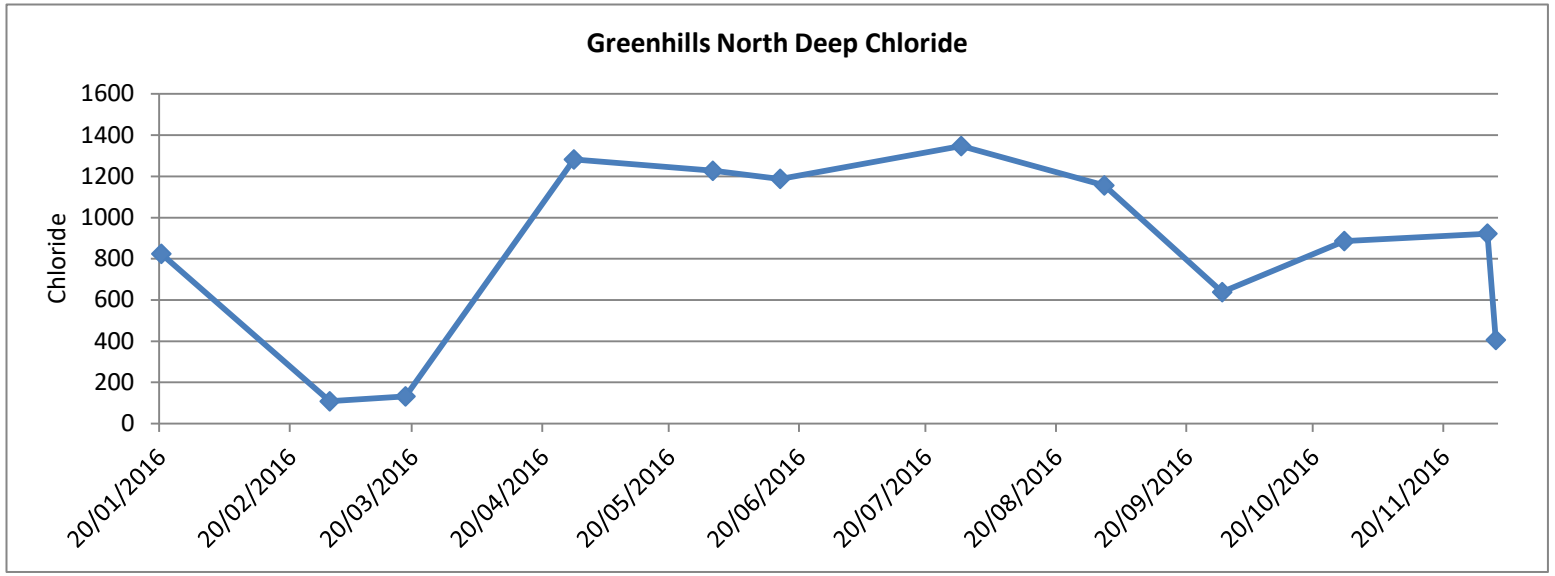

Greenhills North Deep NH4
NH4
12
10
8
6
4
2
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

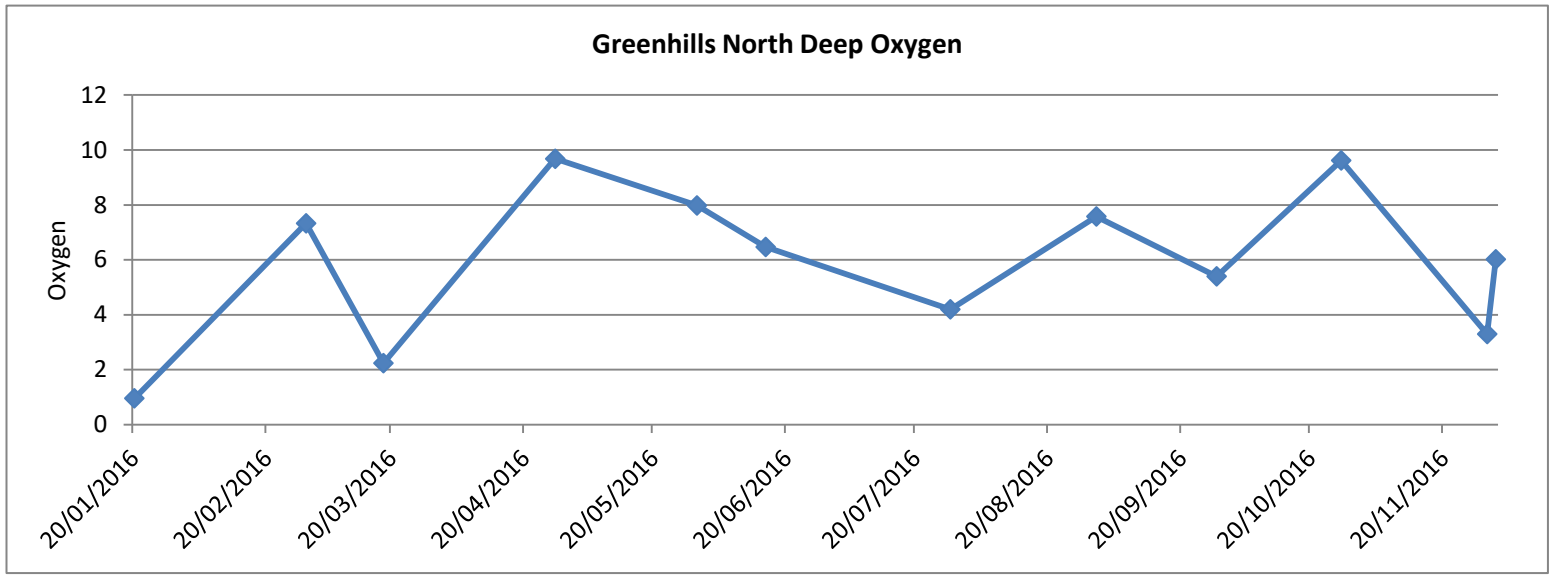

Greenhills North Deep COD
COD
60
50
40
30
20
10
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

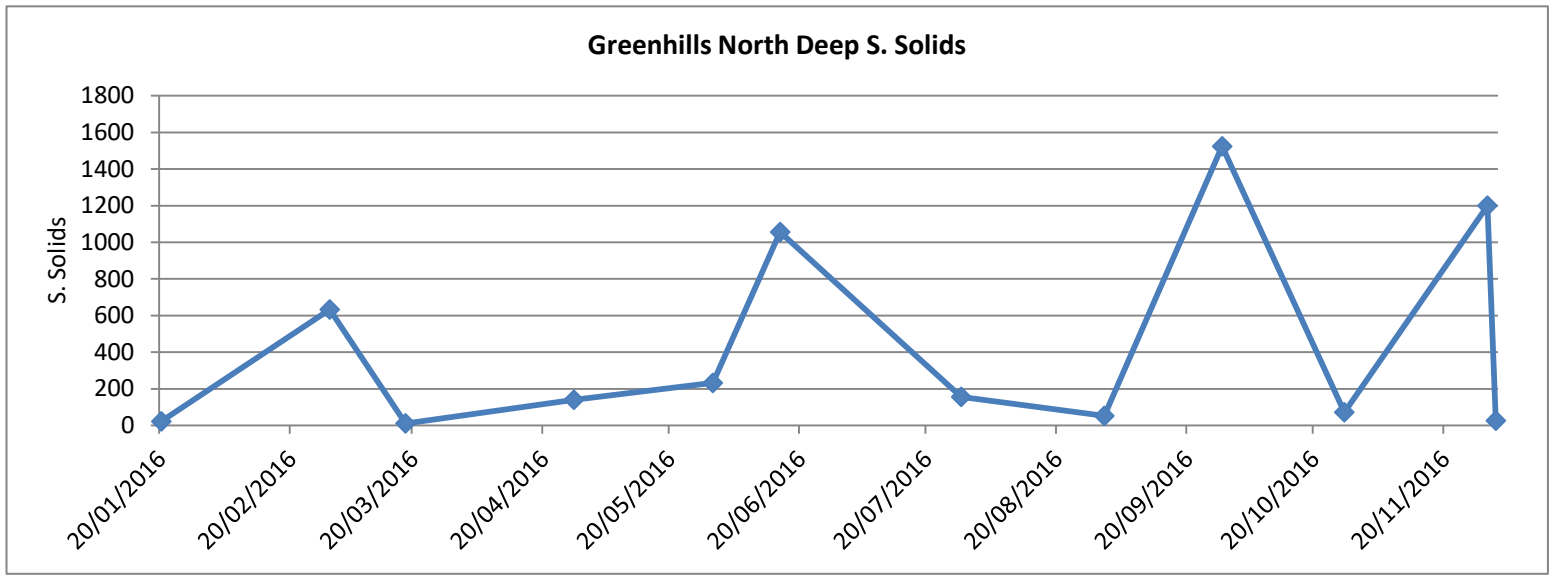

Greenhills North Deep TON
TON
2.5
2
1.5
1
0.5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills North Deep TOC
TOC
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills North Deep Ammonia (as N)
Ammonia (as N)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills North Deep Chloride
Chloride
1600
1400
1200
1000
800
600
400
200
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

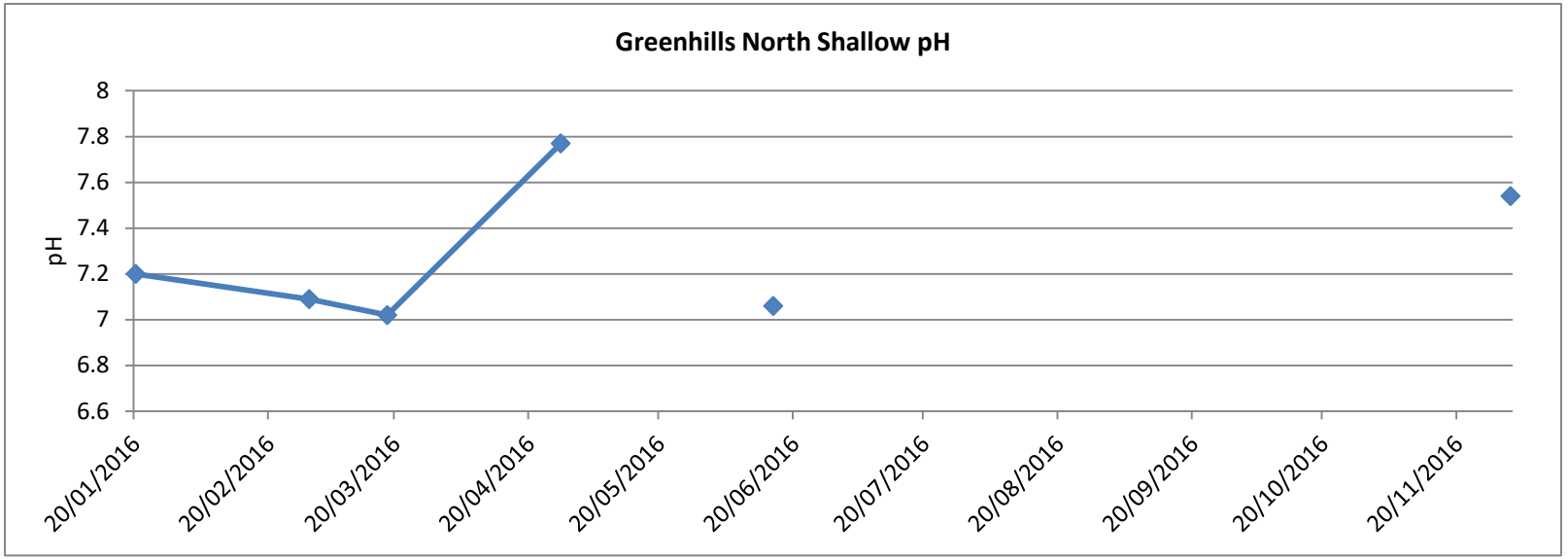

Greenhills North Deep Oxygen
Oxygen
12
10
8
6
4
2
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

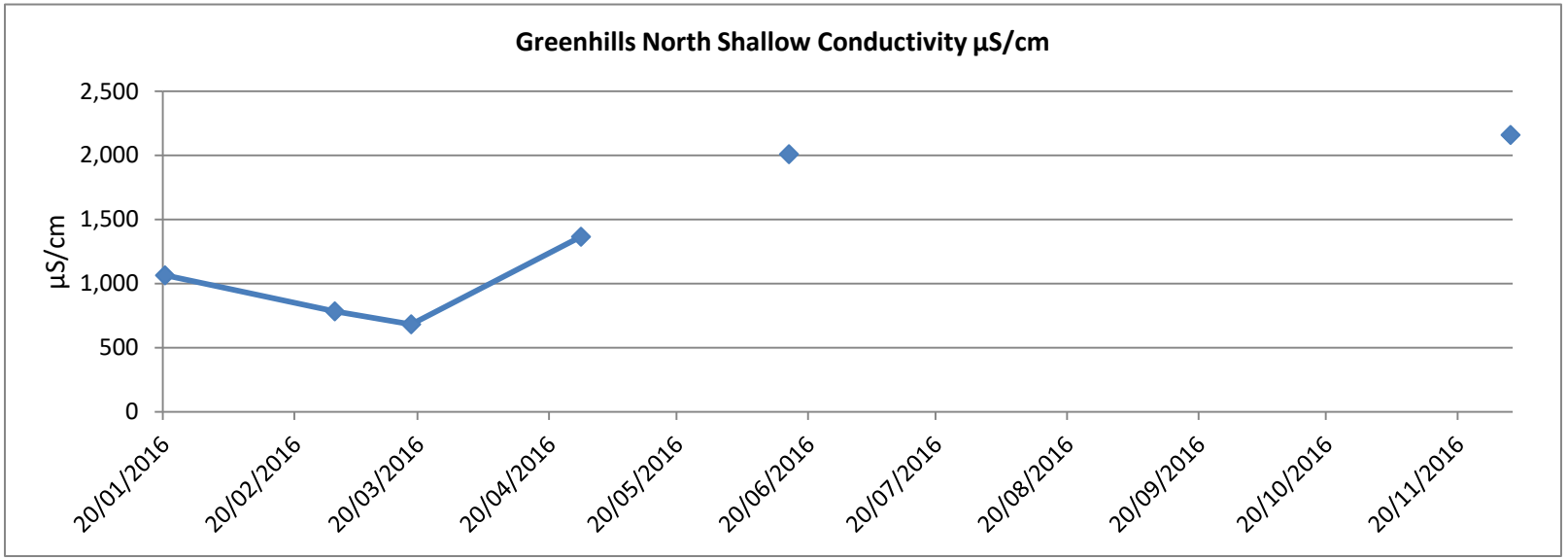

Greenhills North Deep S. Solids
S. Solids
1800
1600
1400
1200
1000
800
600
400
200
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

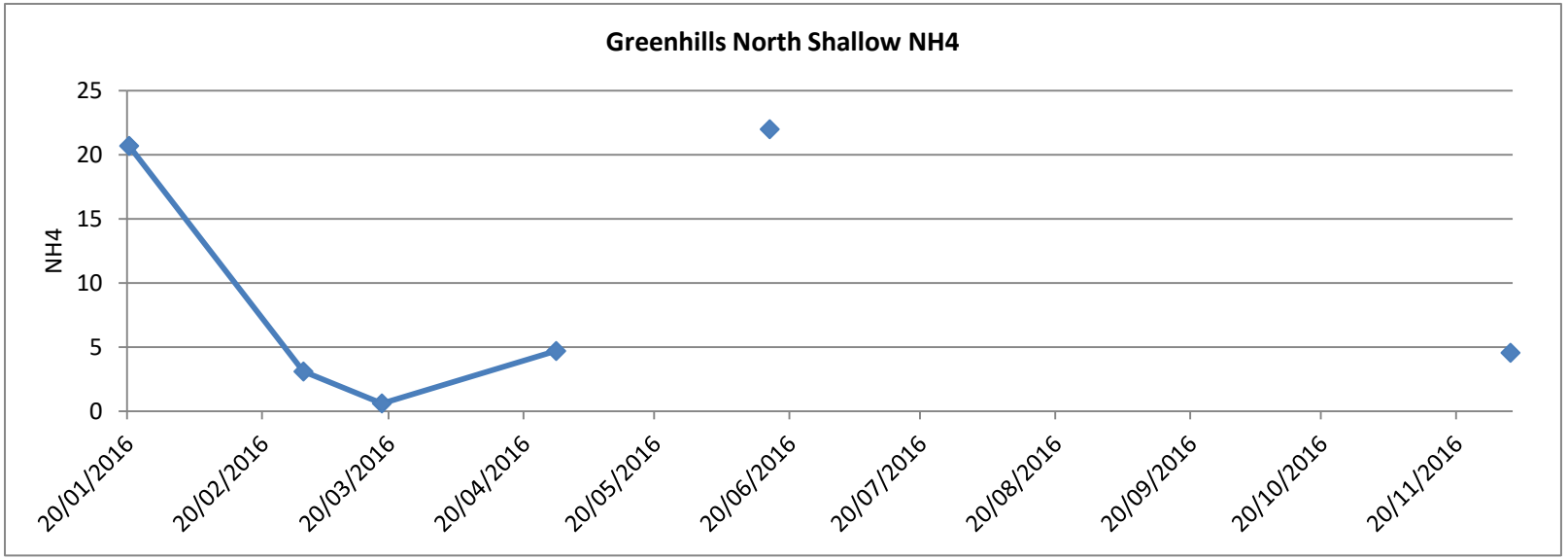
Well: Greenhills & Nemo Groundwater Wells (mg/l)
Location: Greenhills Green and Nemo Rangers GAA Pitch
All parameter data in mg/l unless stated otherwise

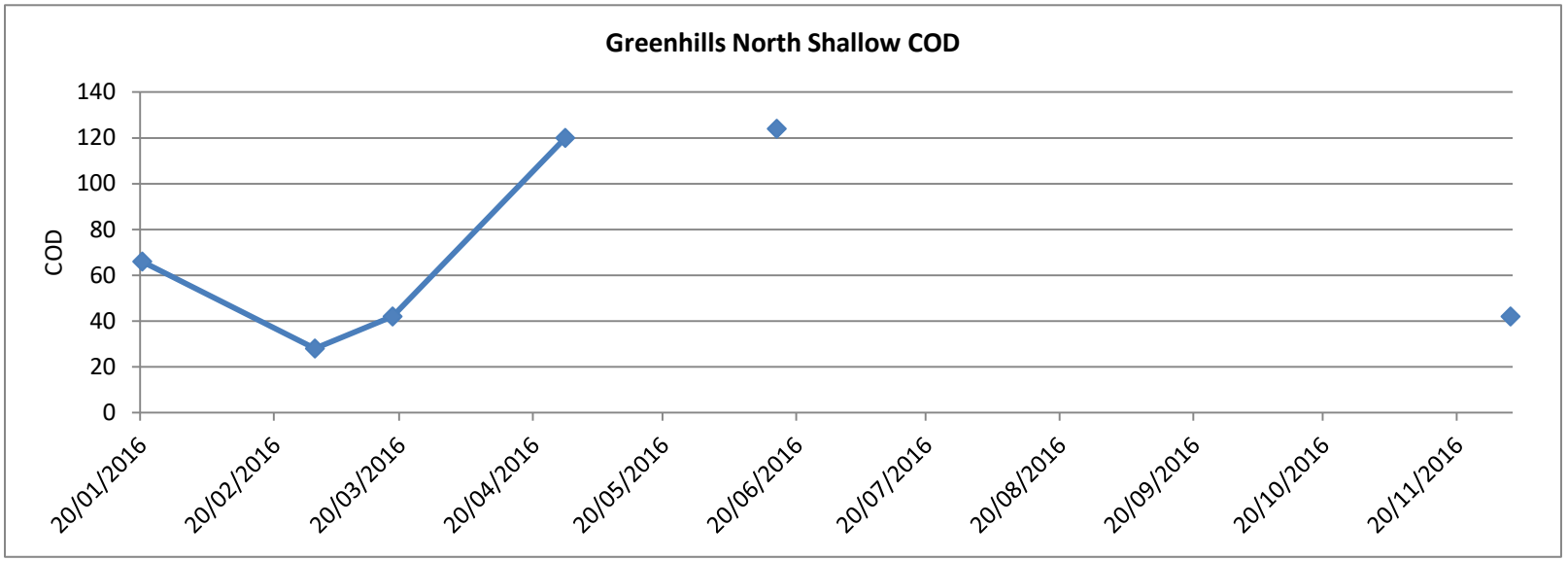
Greenhills North Shallow 2016

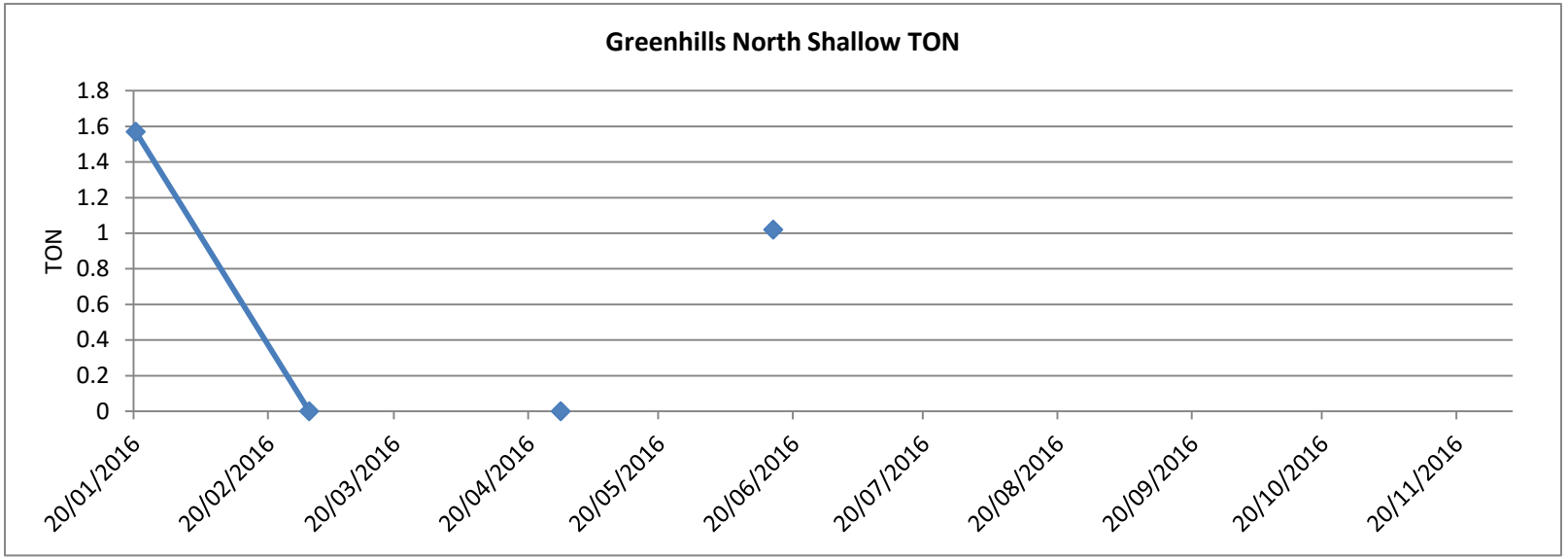
Date	Temp *C	pH	Conductivity µS/cm	NH4	Ammonia (as N)	Chloride	Oxygen	COD	TON	TOC	S. Solids	Well Depth (m)	Depth to Water (m)
20/01/2016	9.7	7.2	1,065	20.7	16.10	22	2.08	66	1.57	19.8	78	2.61	0.99
29/02/2016	14.3	7.09	784	3.1	2.41	7.09	3.92	28	0	9.4	1128	2.61	1.01
18/03/2016	15.2	7.02	683	0.61	0.47	12	3.89	42		4	15	2.61	1.43
27/04/2016	18.9	7.77	1,366	4.7	3.66	118	7.09	120	0	20.1	7644	2.61	2.12
30/05/2016	Dry											2.61	1.6
15/06/2016	25.2	7.06	2,010	22	17.12	479	3.39	124	1.02	20.1	2340	2.61	1.67
28/07/2016	Dry											2.61	1.79
31/08/2016	Dry											2.61	1.61
28/09/2016	Dry											2.61	1.44
27/10/2016	Dry											2.61	1.58
30/11/2016	Dry											2.61	1.72
02/12/2016	16.2	7.54	2,160	4.56	3.55	51	8.32	42		13	1004	2.61	1.42

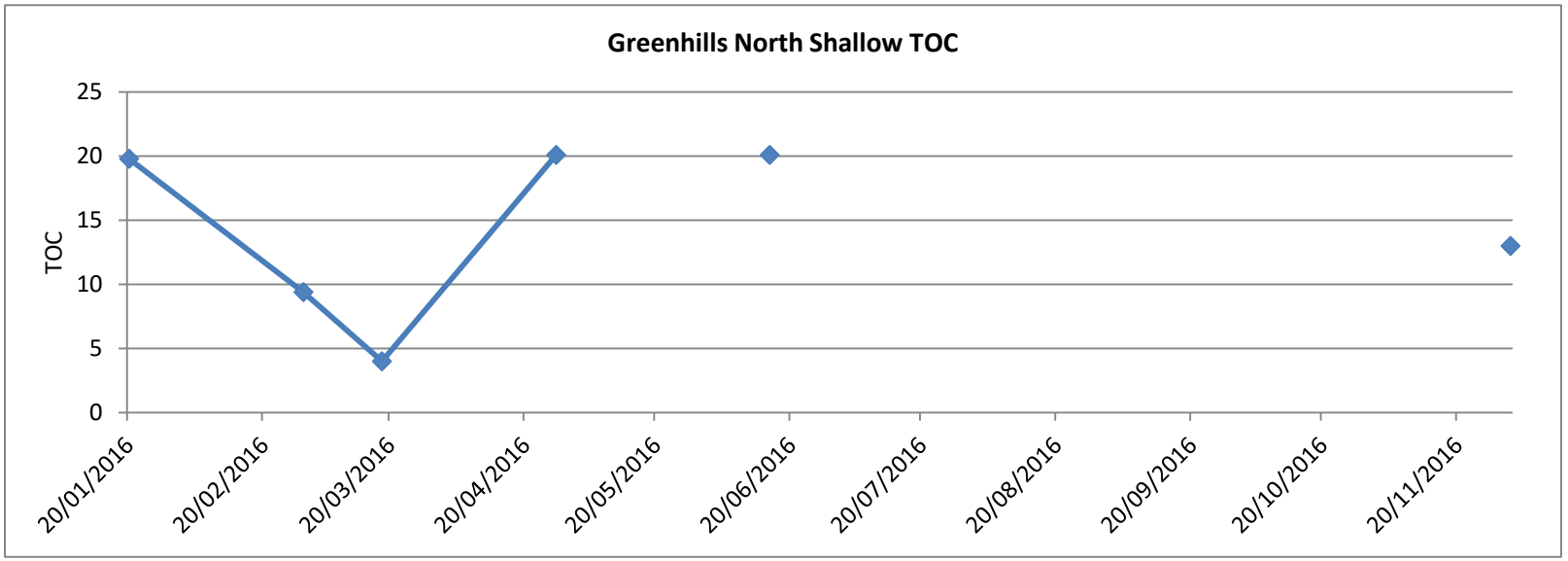

Greenhills North Shallow pH
pH
8
7.8
7.6
7.4
7.2
7
6.8
6.6
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

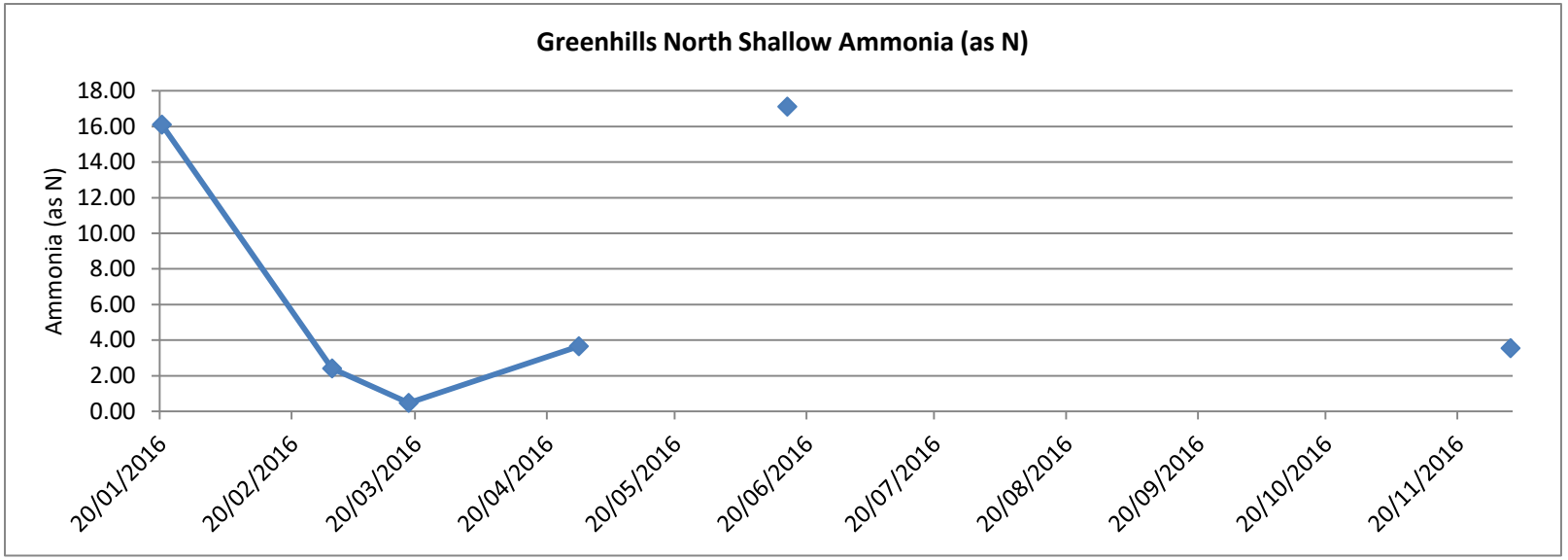

Greenhills North Shallow Conductivity µS/cm
µS/cm
2,500
2,000
1,500
1,000
500
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

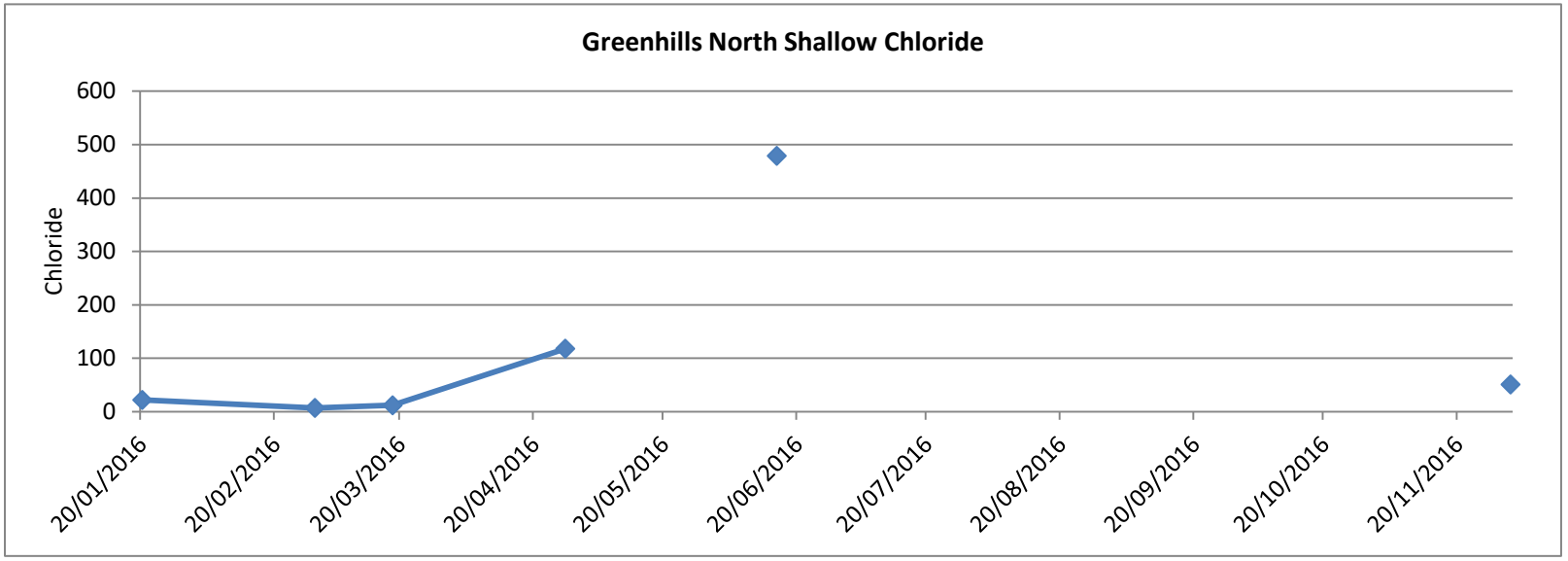

Greenhills North Shallow NH4
NH4
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

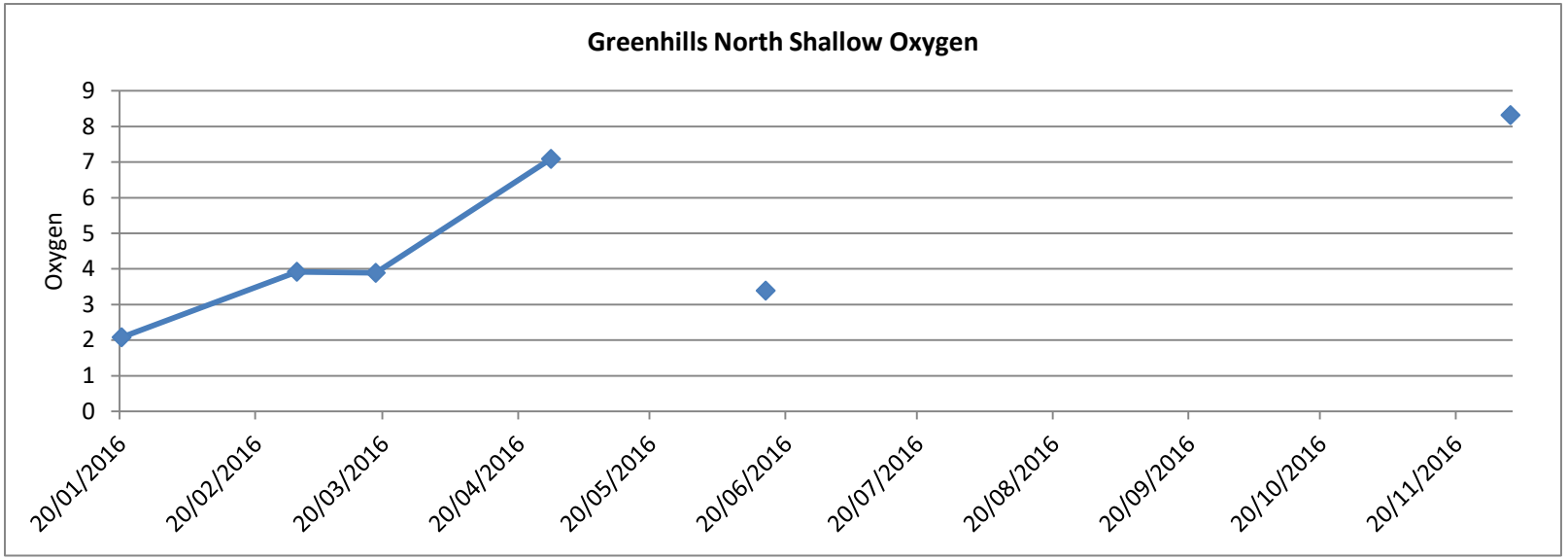

Greenhills North Shallow COD
COD
140
120
100
80
60
40
20
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

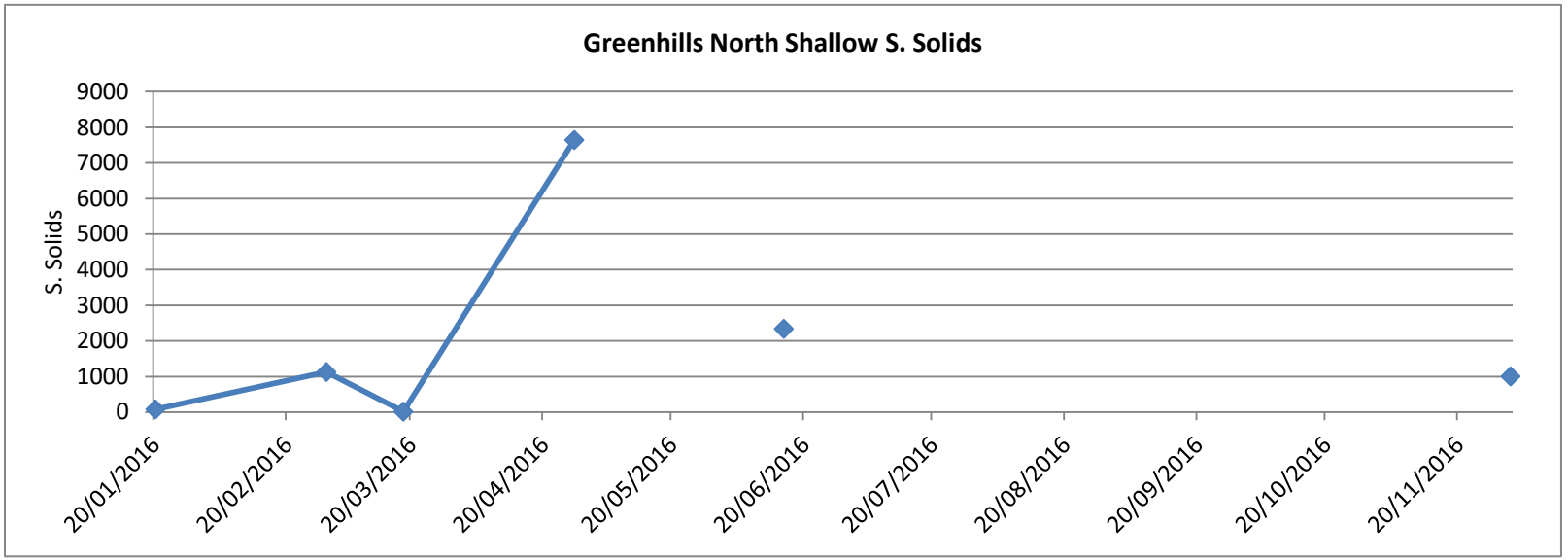

Greenhills North Shallow TON
TON
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills North Shallow TOC
TOC
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills North Shallow Ammonia (as N)
Ammonia (as N)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills North Shallow Chloride
Chloride
600
500
400
300
200
100
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

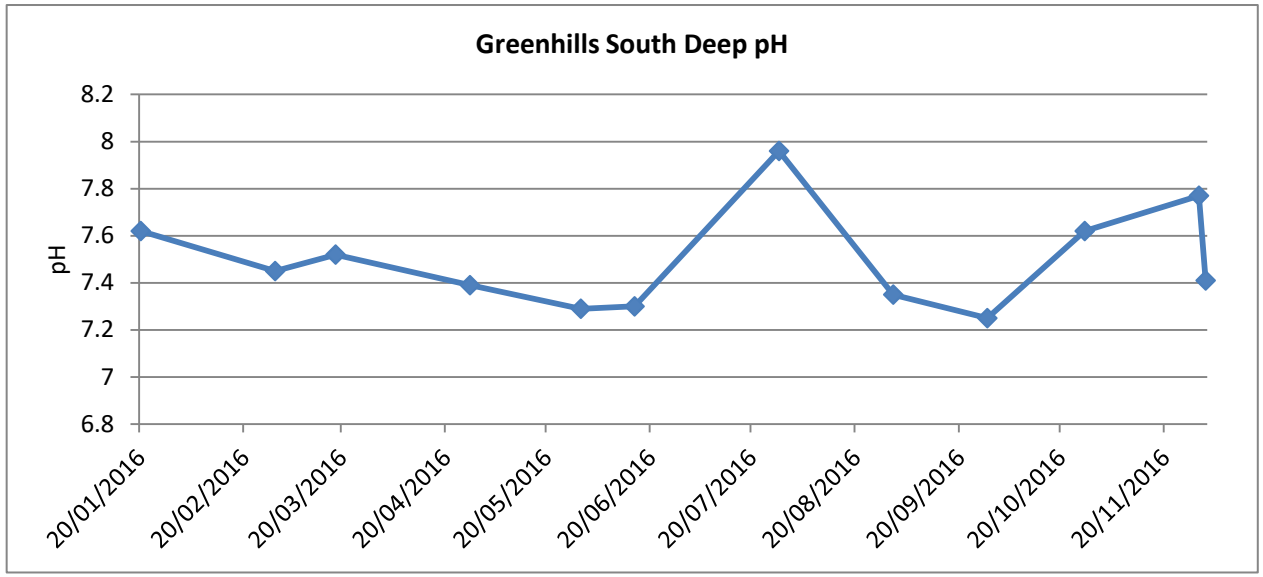

Greenhills North Shallow Oxygen
Oxygen
9
8
7
6
5
4
3
2
1
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

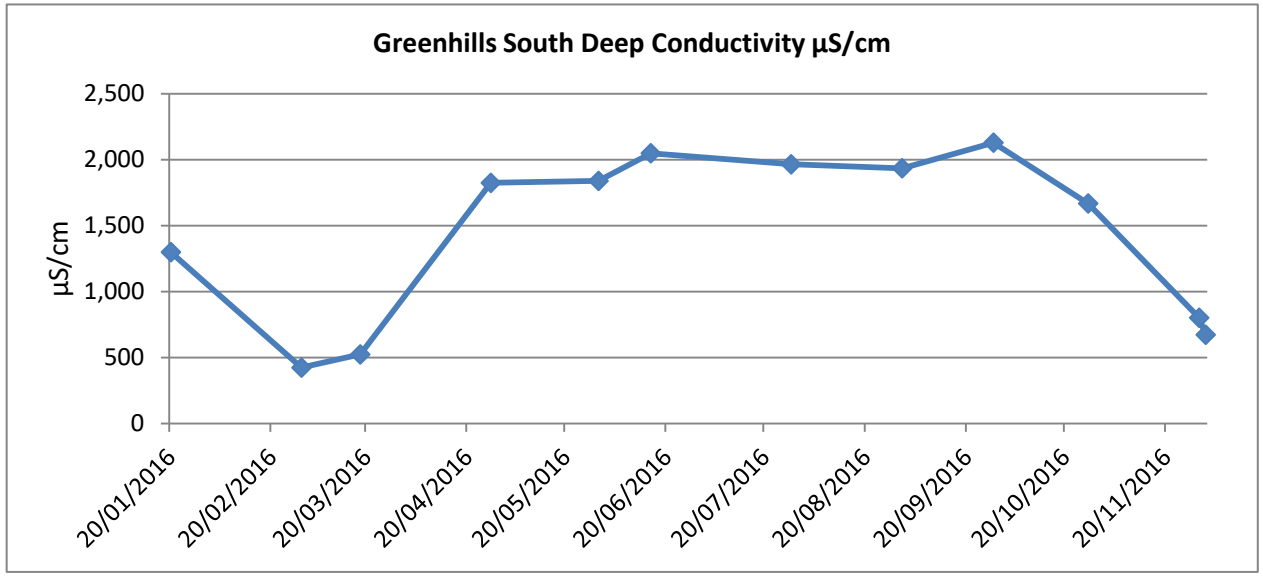

Greenhills North Shallow S. Solids
S. Solids
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

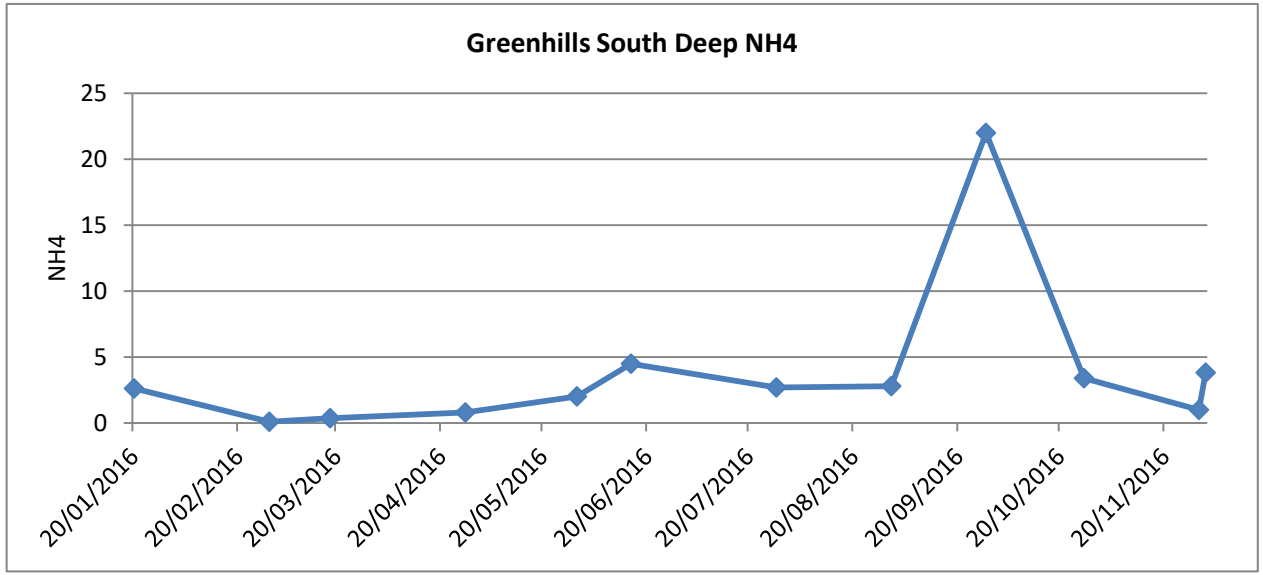
Well: Greenhills & Nemo Groundwater Wells (mg/l)
Location: Greenhills Green and Nemo Rangers GAA Pitch
All parameter data in mg/l unless stated otherwise

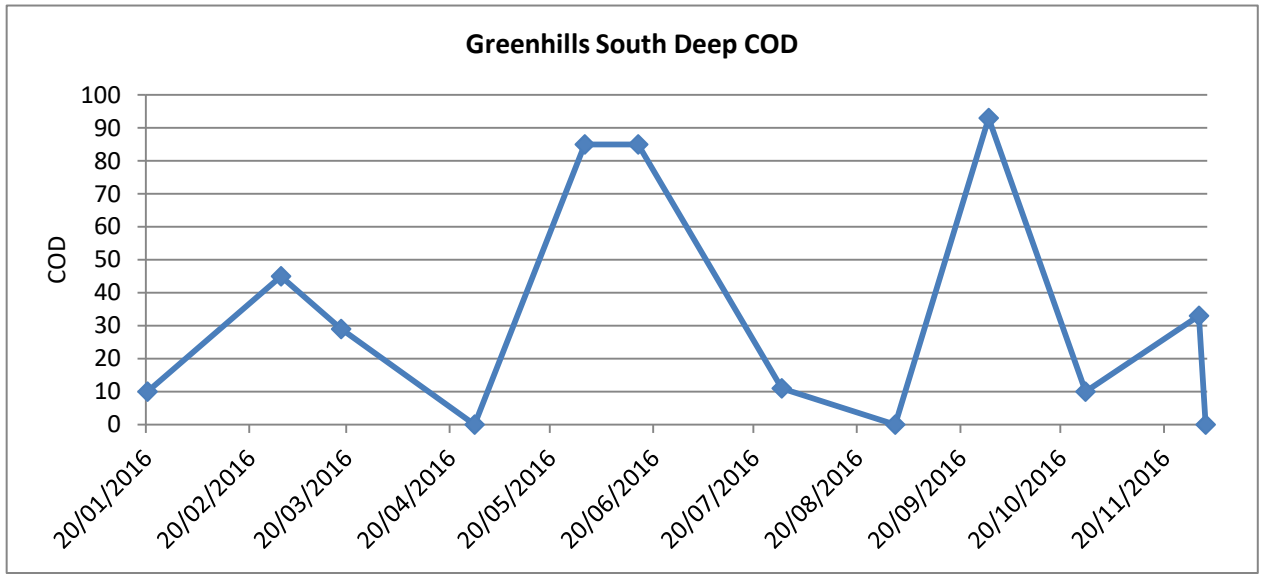
Greenhills South Deep 2016

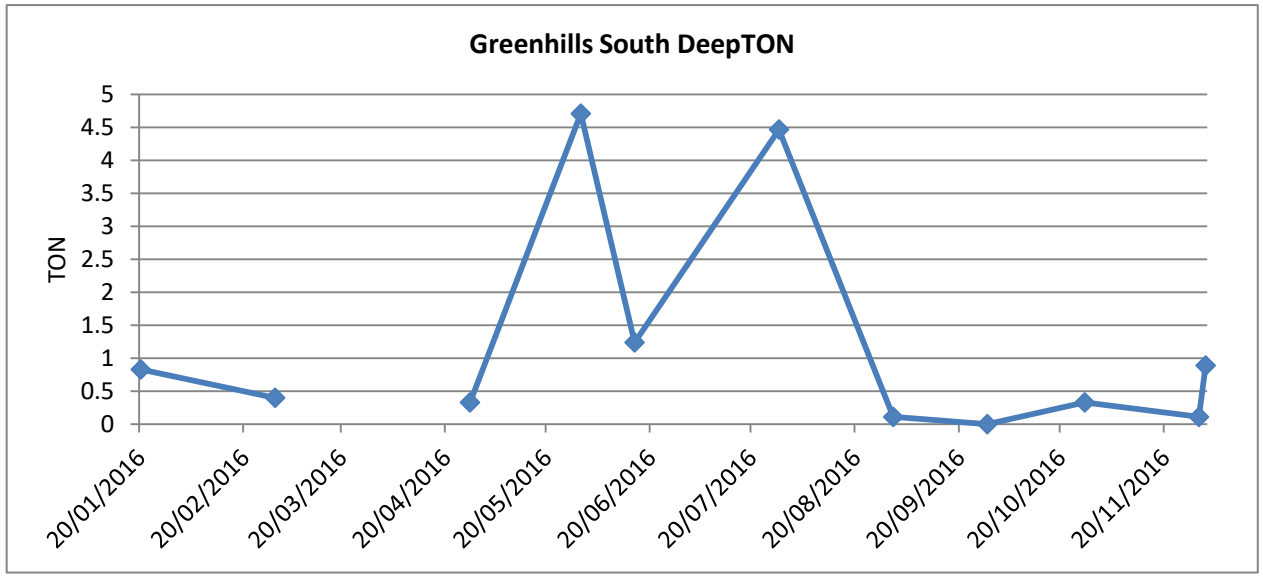
Date	Temp *C	pH	Conductivity µ	NH4	mmonia (as N	Chloride	Oxygen	COD	TON	TOC	S. Solids	Well Depth (m)	Depth to Wat	Depth to Water (m)	Water Height in Well (m)
20/01/2016	11.4	7.62	1,300	2.62	2.04	269	2.28	10	0.83	9.2	86	34.7	0.49	0.49	33.72
29/02/2016	17	7.45	424	0.1	0.08	8.51	8.26	45	0.4	8.8	460	34.7	0.99	0.99	32.72
18/03/2016	17.9	7.52	524	0.37	0.29	74	3.99	29		3	10	34.7	1.22	1.22	32.26
27/04/2016	17	7.39	1,825	0.8	0.62	532	3.87	<1	0.33	8.2	76	34.7	1.4	1.4	31.9
30/05/2016	24	7.29	1,840	2.02	1.57	518	7.02	85	4.71	20	1692	34.7	1.68	1.68	31.34
15/06/2016	23.4	7.3	2,050	4.5	3.50	798	5.92	85	1.24	17	1172	34.7	1.8	1.8	31.1
28/07/2016	23.7	7.96	1,966	2.7	2.10	603	7.96	11	4.47	8	1944	34.7	1.92	1.92	30.86
31/08/2016	23.8	7.35	1,936	2.8	2.18	487	7.79	<1	0.11	6.8	83	34.7	1.84	1.84	31.02
28/09/2016	22.1	7.25	2,130	22	17.12	691	7.04	93	0	20	1432	34.7	0.63	0.63	33.44
27/10/2016	19.9	7.62	1,669	3.4	2.65	461	7.87	10	0.33	9.4	1680	34.7	1.68	1.68	31.34
30/11/2016	17.2	7.77	802	1	0.78	142	7.92	33	0.11	12.2	400	34.7	0.83	0.83	33.04
02/12/2016	13.9	7.41	673	3.82	2.97	43	4.86	<1	0.89	12	15.2	34.7	1.6	1.6	31.5

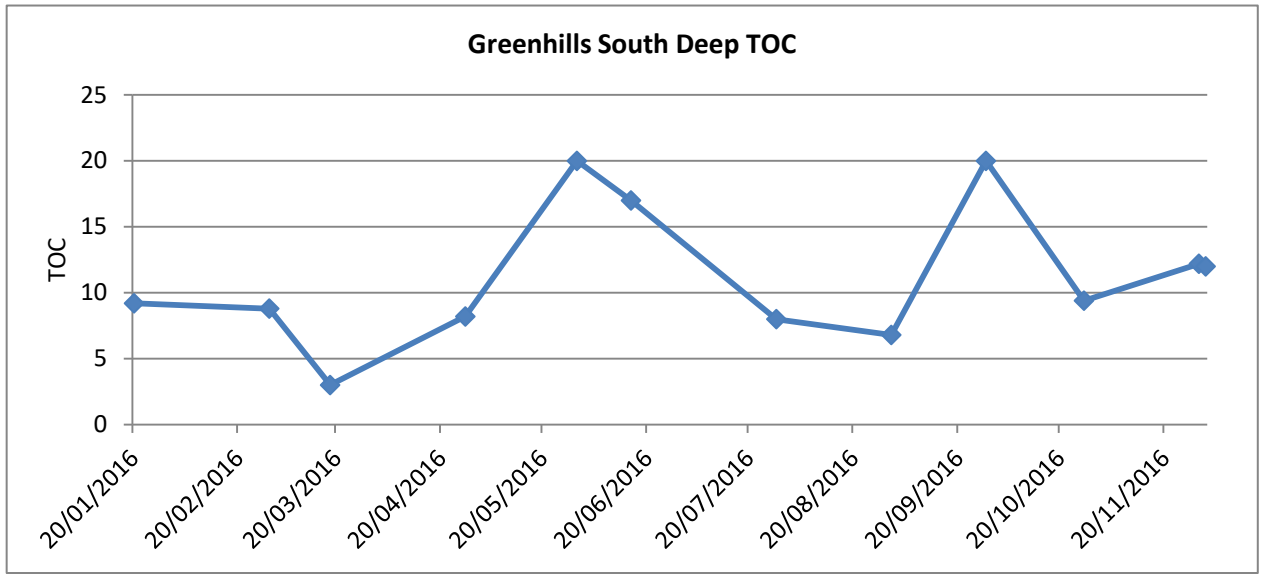

Greenhills South Deep pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
pH
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

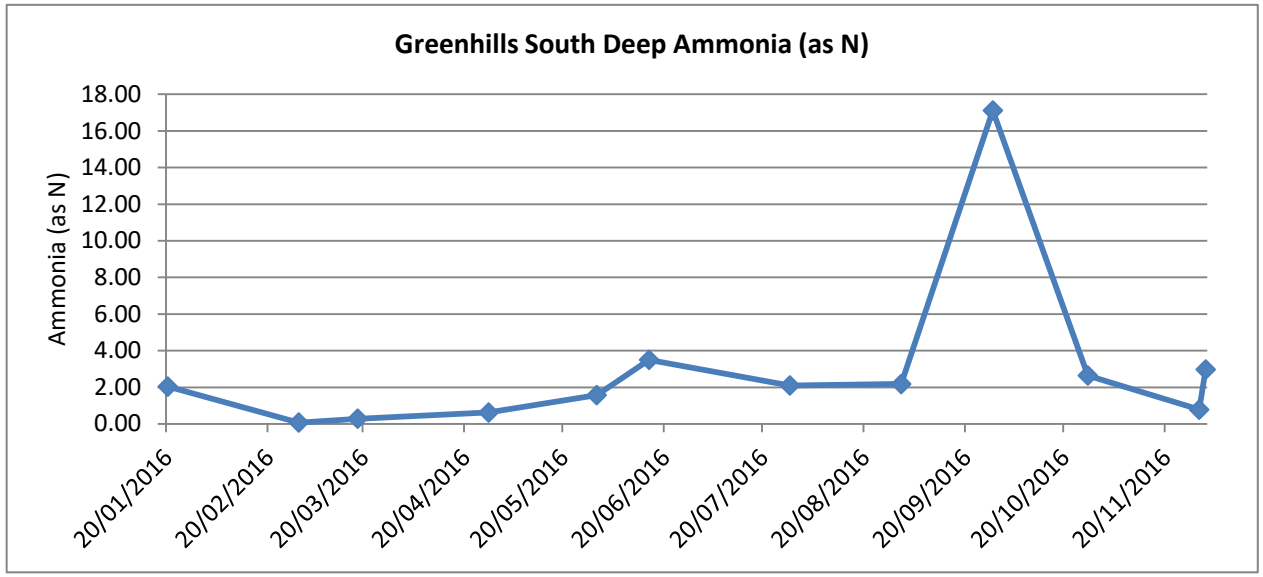

Greenhills South Deep Conductivity µS/cm
2,500
2,000
1,500
1,000
500
0
µS/cm
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

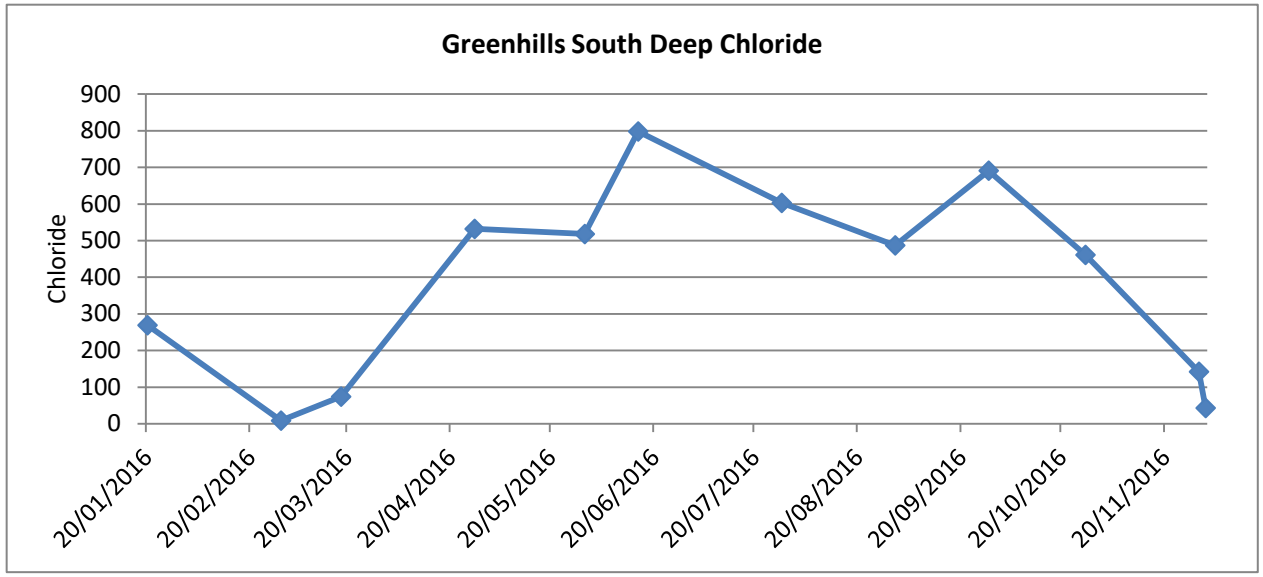

Greenhills South Deep NH4
NH4
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

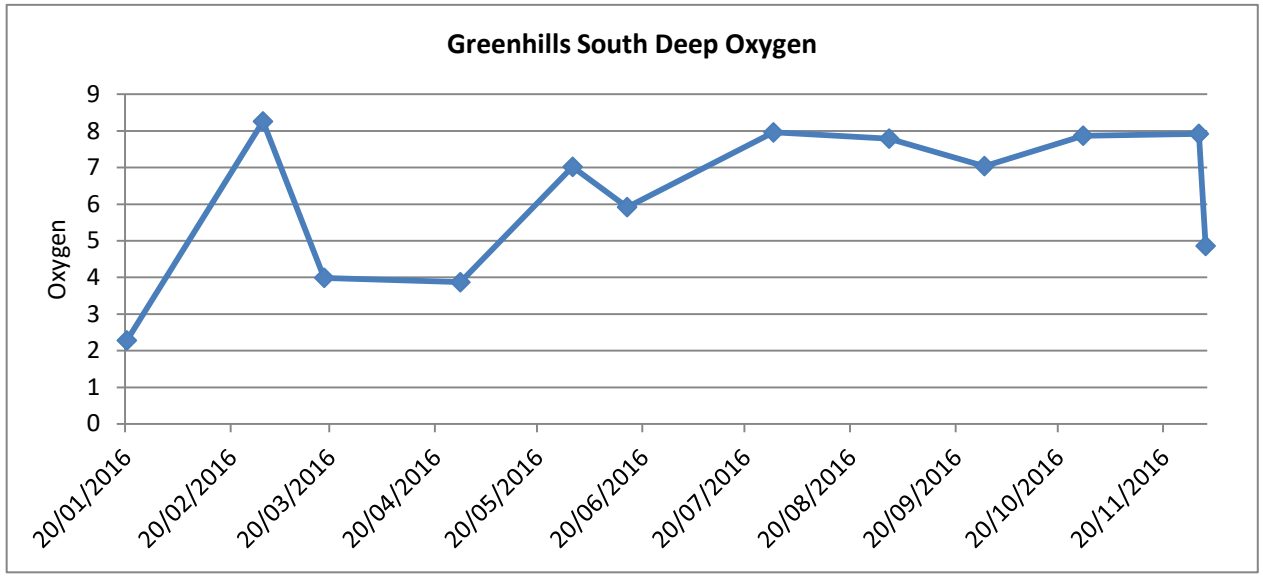

Greenhills South Deep COD
COD
100
90
80
70
60
50
40
30
20
10
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

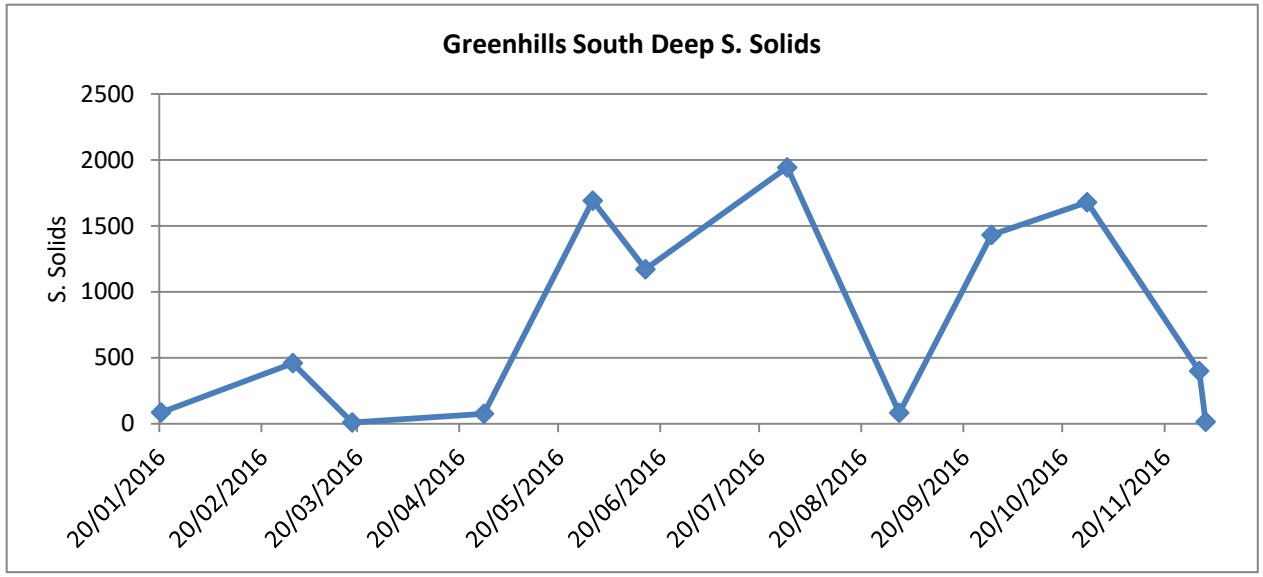

Greenhills South DeepTON
TON
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Deep TOC
TOC
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Deep Ammonia (as N)
Ammonia (as N)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Deep Chloride
Chloride
900
800
700
600
500
400
300
200
100
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

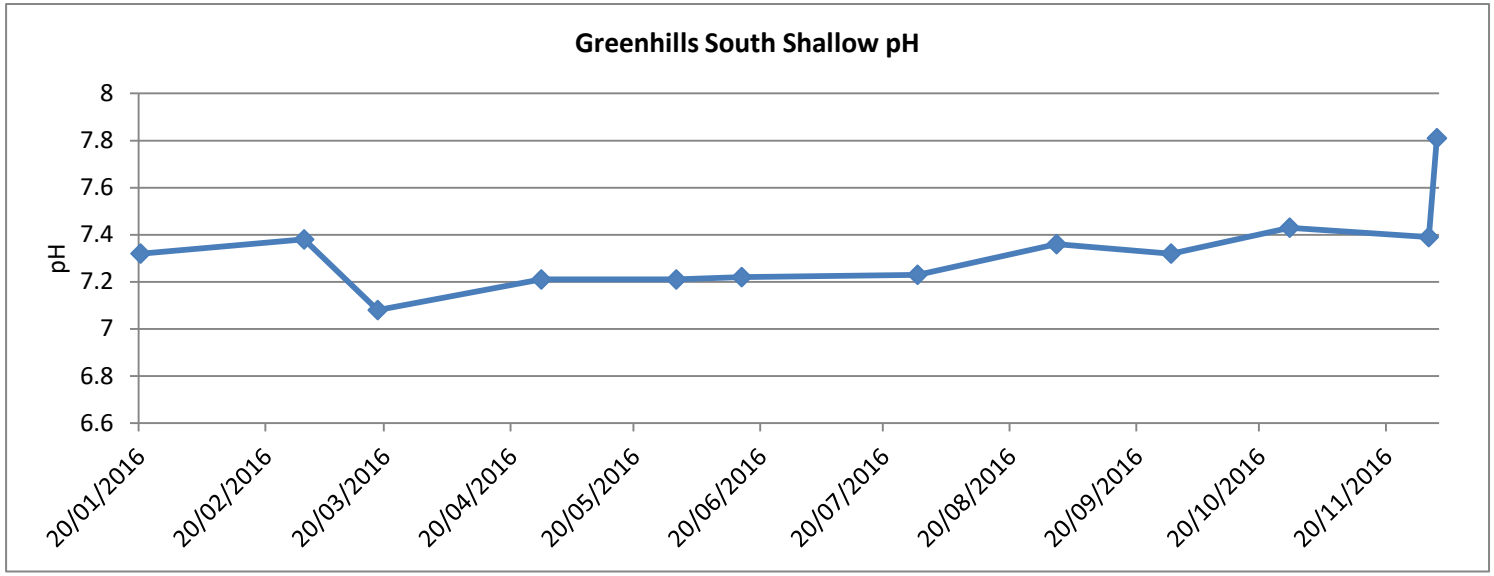

Greenhills South Deep Oxygen
Oxygen
9
8
7
6
5
4
3
2
1
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

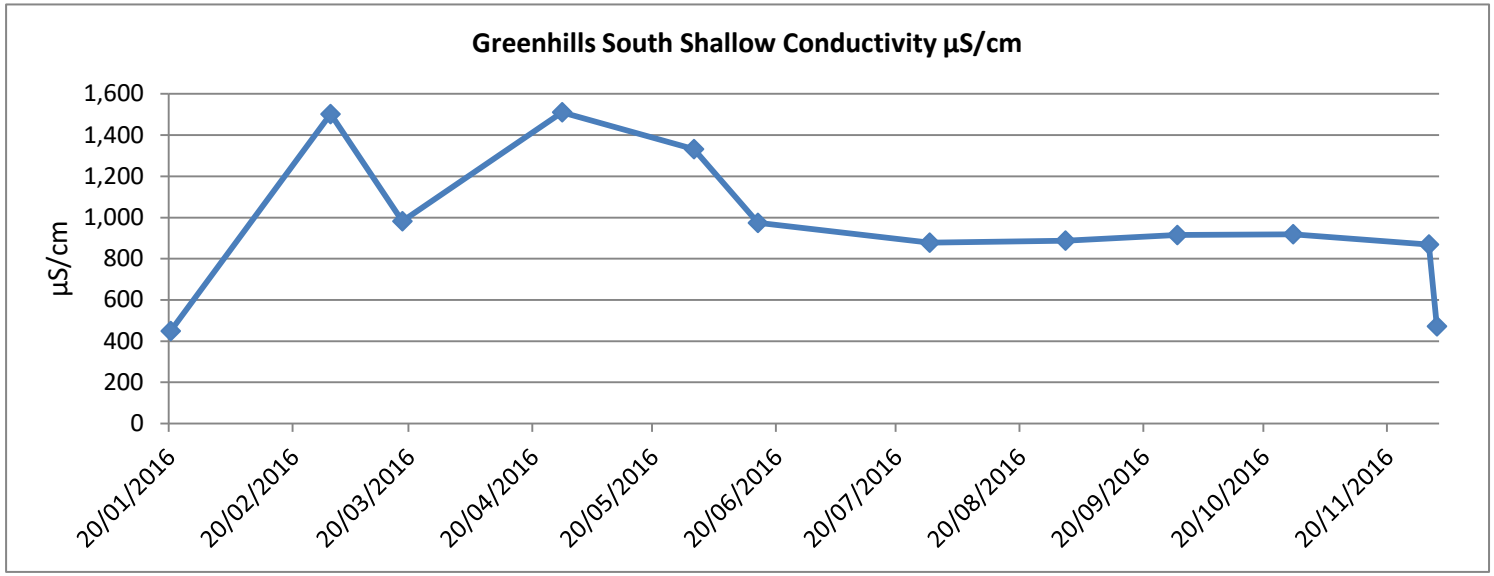

Greenhills South Deep S. Solids
S. Solids
2500
2000
1500
1000
500
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

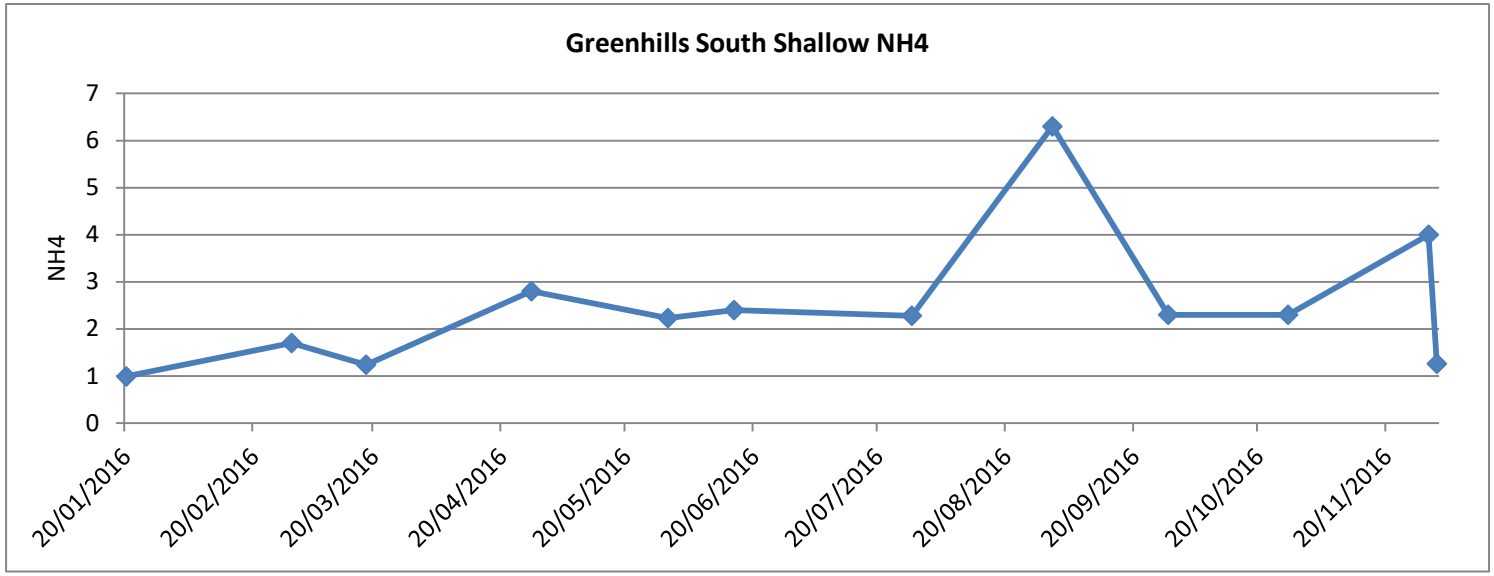
Well: Greenhills & Nemo Groundwater Wells (mg/l)
Location: Greenhills Green and Nemo Rangers GAA Pitch
All parameter data in mg/l unless stated otherwise

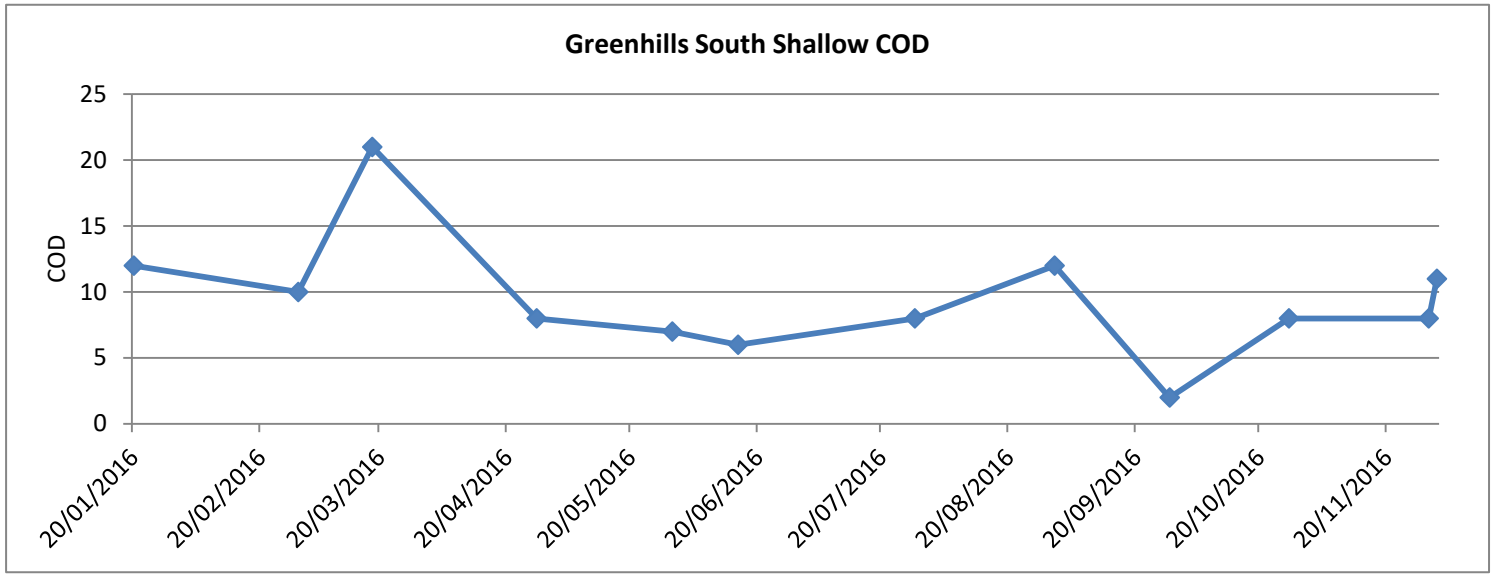
Greenhills South Shallow 2016

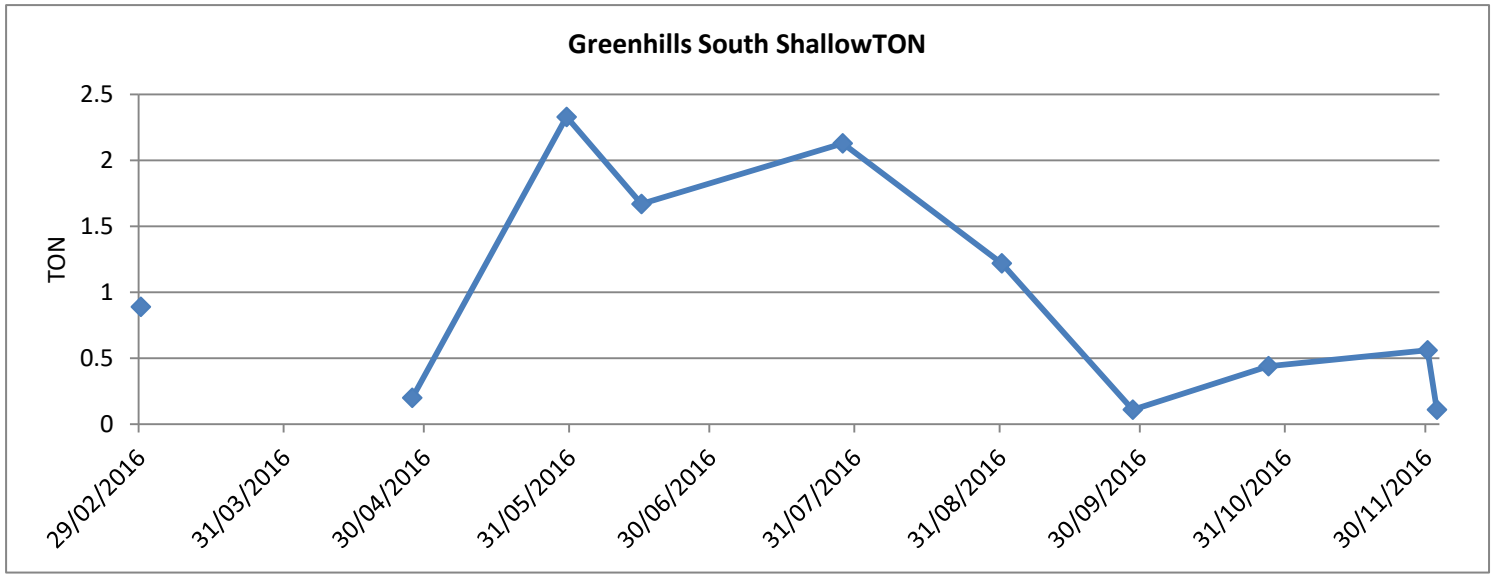
Date	Temp *C	pH	Conductivity µS/cm	NH4	Ammonia (as N)	Chloride	Oxygen	COD	TON	TOC	S. Solids	Well Depth (m)	Depth to Water (m)	Water Height in Well (m)
20/01/2016	11.4	7.32	449	0.99	0.77	86	2.12	12	1.33	9.2	21	11.94	0.91	11.03
29/02/2016	16.4	7.38	1,502	1.7	1.32	383	2.36	10	0.89	1.9	415	11.94	1.11	10.83
18/03/2016	17.2	7.08	982	1.24	0.96	45	2.16	21		2	42	11.94	1.23	10.71
27/04/2016	16.8	7.21	1,511	2.8	2.18	417	3.6	8	0.2	2.8	12	11.94	1.43	10.51
30/05/2016	22.5	7.21	1,332	2.23	1.73	347	7.19	7	2.33	20.1	64	11.94	1.66	10.28
15/06/2016	21.7	7.22	974	2.4	1.87	202	6.43	6	1.67	1.1	128	11.94	1.8	10.14
28/07/2016	20.2	7.23	878	2.28	1.77	195	5.87	8	2.13	1.4	480	11.94	1.86	10.08
31/08/2016	23.8	7.36	888	6.3	4.90	177	7.46	12	1.22	5.6	8	11.94	1.79	10.15
28/09/2016	20.6	7.32	915	2.3	1.79	195	8.85	2	0.11	0.4	152	11.94	0.64	11.3
27/10/2016	19.5	7.43	919	2.3	1.79	213	7.91	8	0.44	9.1	304	11.94	1.67	10.27
30/11/2016	17.4	7.39	869	4	3.11	177	4.93	8	0.56	2.9	1600	11.94	0.84	11.1
02/12/2016	13.6	7.81	472	1.26	0.98	32	7.24	11	0.11	3	1006	11.94	1.62	10.32

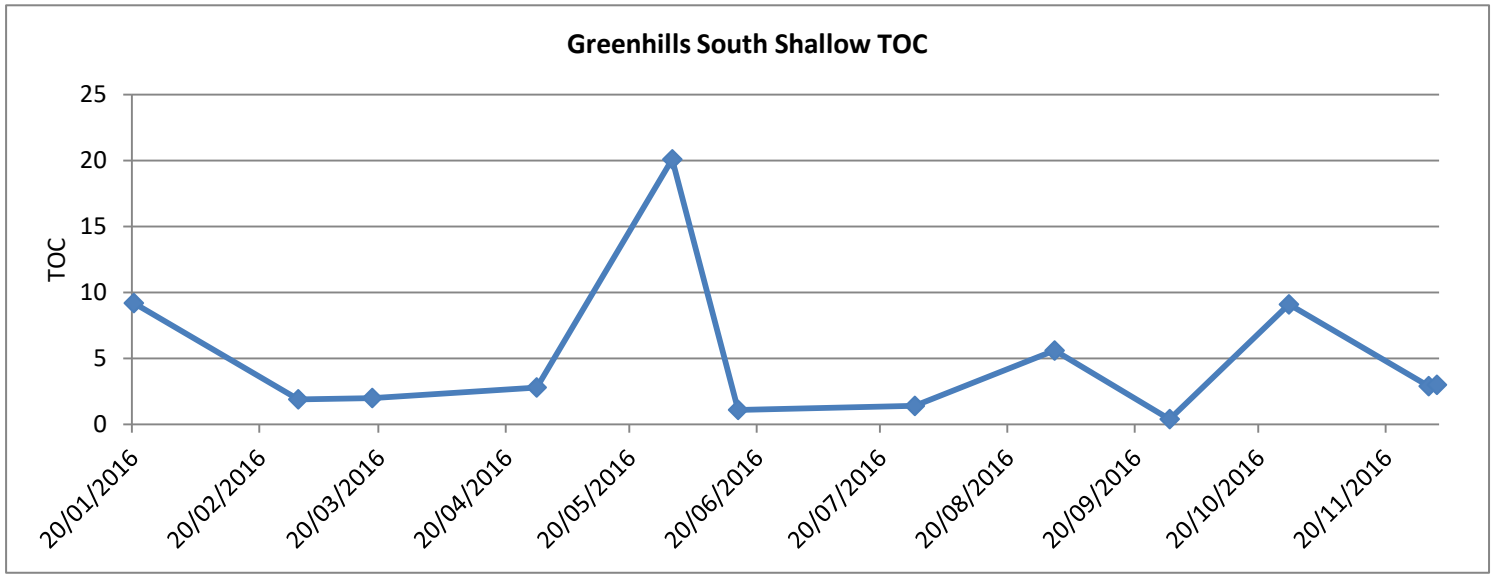

Greenhills South Shallow pH
pH
8
7.8
7.6
7.4
7.2
7
6.8
6.6
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

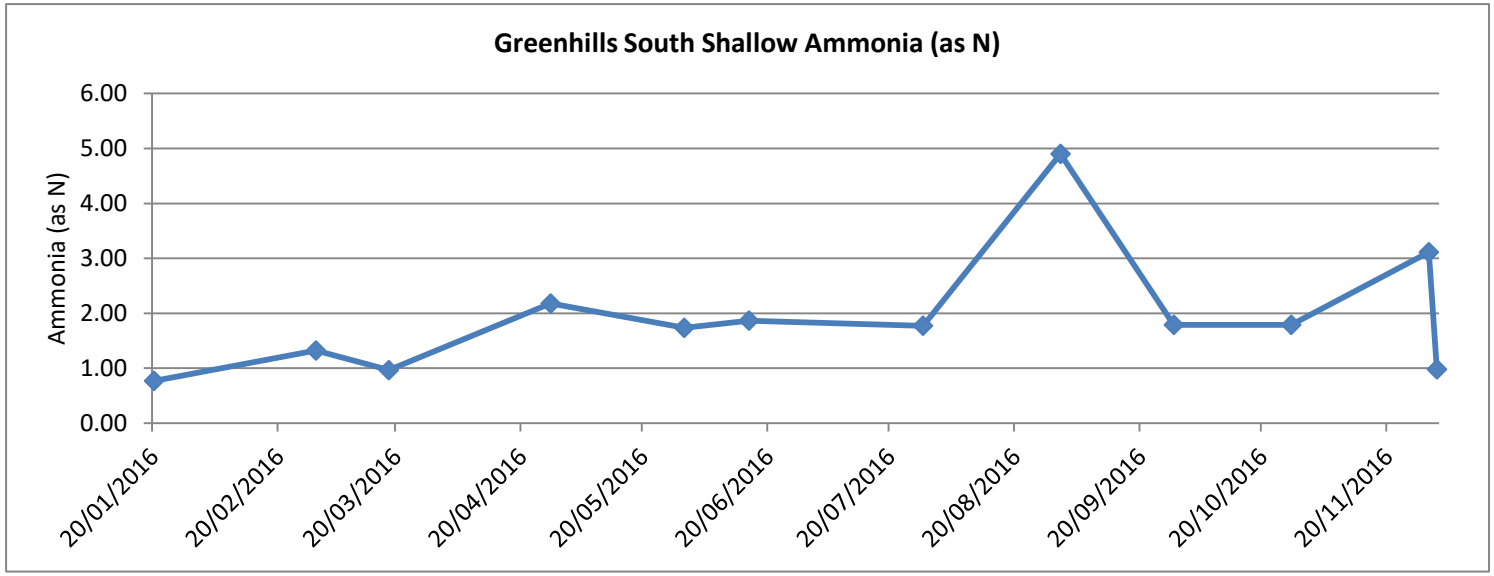

Greenhills South Shallow Conductivity µS/cm
µS/cm
1,600
1,400
1,200
1,000
800
600
400
200
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

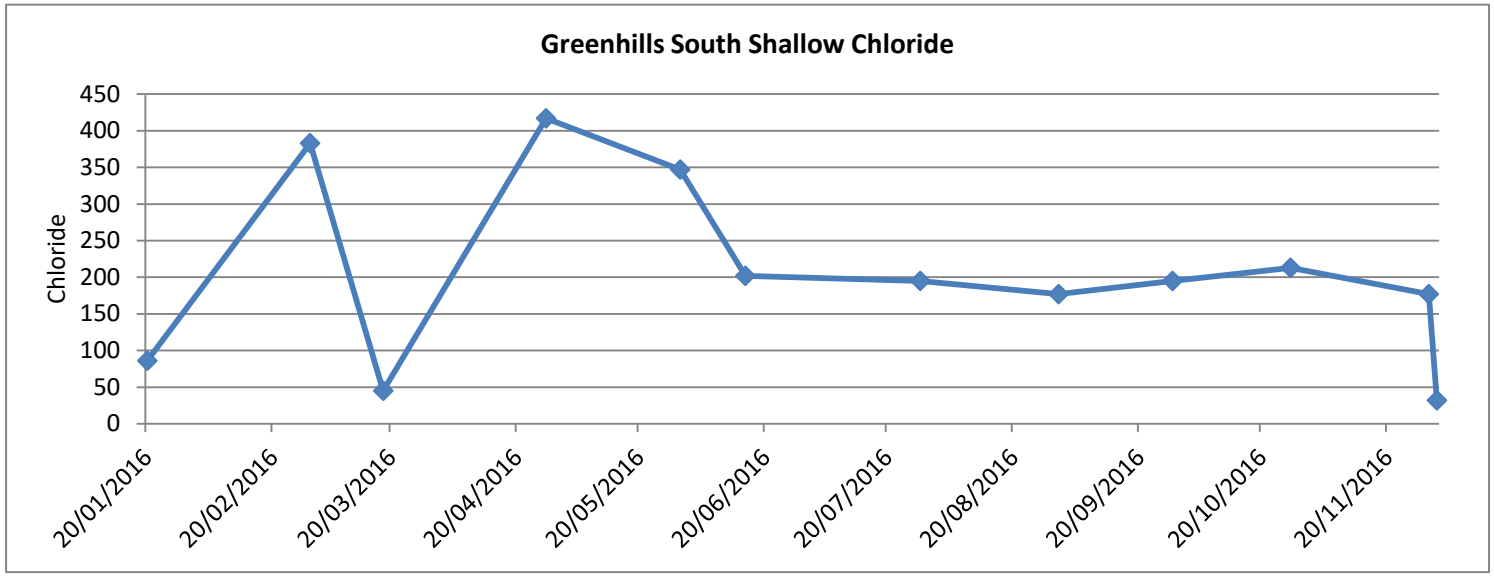

Greenhills South Shallow NH4
NH4
7
6
5
4
3
2
1
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

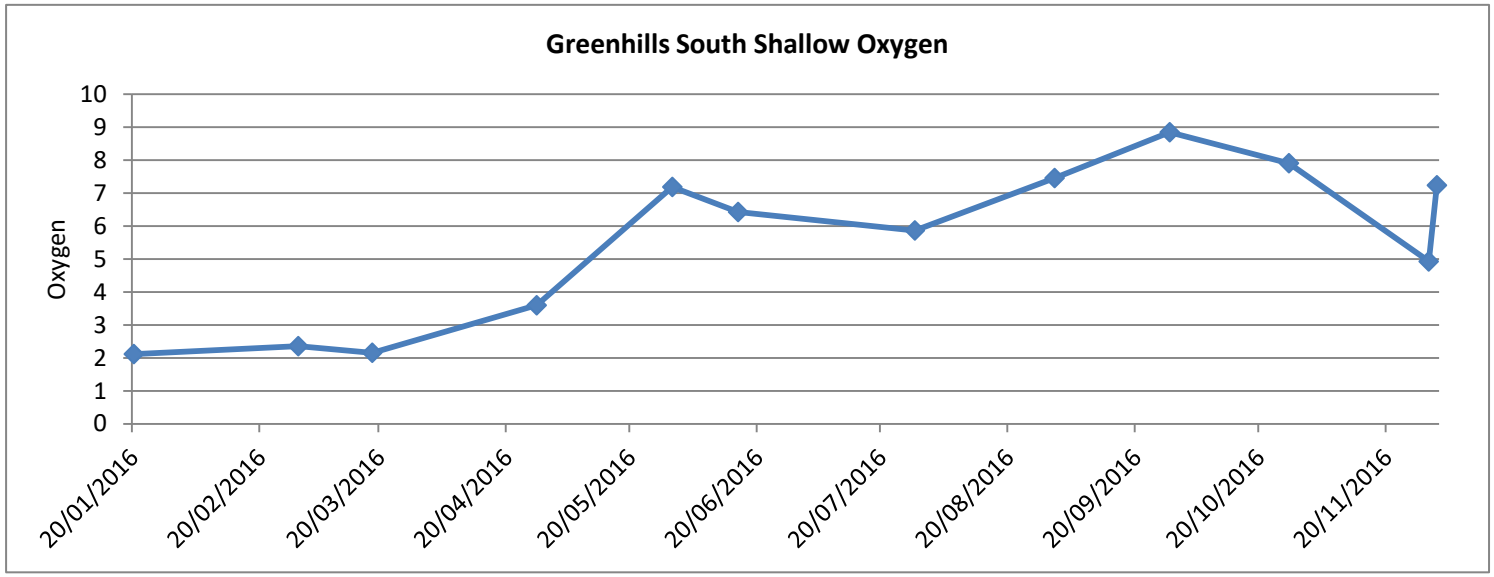

Greenhills South Shallow COD
COD
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

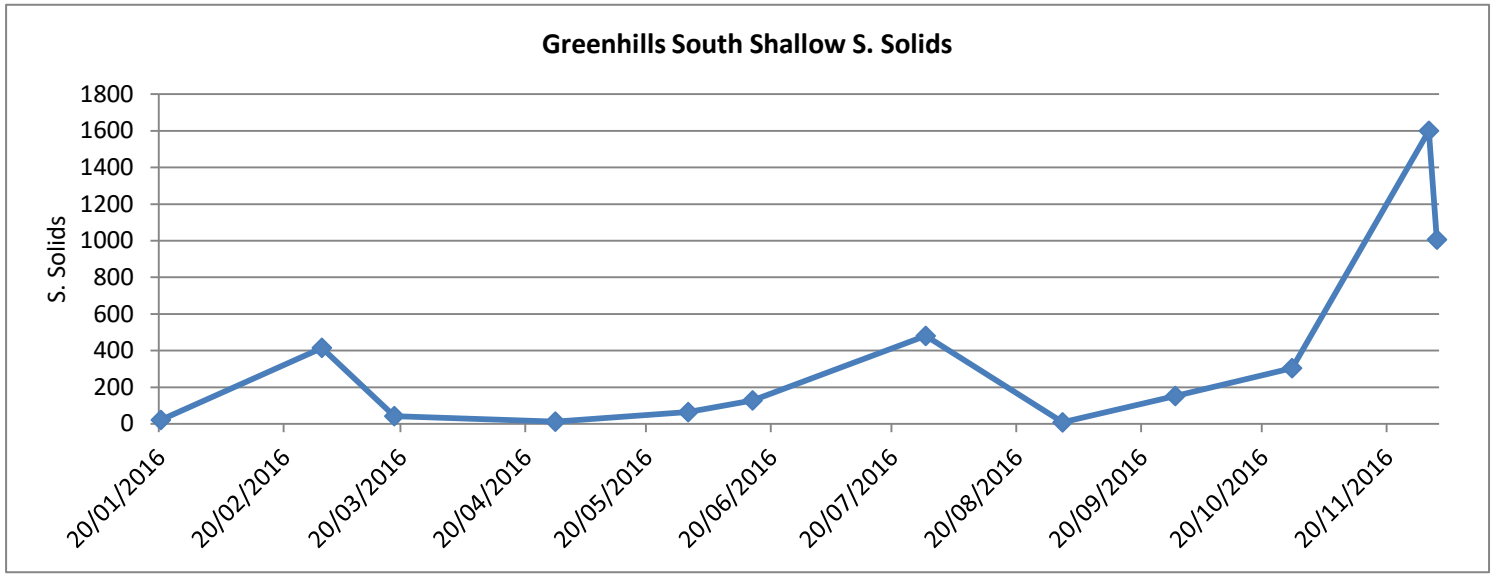

Greenhills South ShallowTON
TON
2.5
2
1.5
1
0.5
0
29/02/2016
31/03/2016
30/04/2016
31/05/2016
30/06/2016
31/07/2016
31/08/2016
30/09/2016
31/10/2016
30/11/2016


Greenhills South Shallow TOC
TOC
25
20
15
10
5
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Shallow Ammonia (as N)
Ammonia (as N)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Shallow Chloride
Chloride
450
400
350
300
250
200
150
100
50
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Shallow Oxygen
Oxygen
10
9
8
7
6
5
4
3
2
1
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016


Greenhills South Shallow S. Solids
S. Solids
1800
1600
1400
1200
1000
800
600
400
200
0
20/01/2016
20/02/2016
20/03/2016
20/04/2016
20/05/2016
20/06/2016
20/07/2016
20/08/2016
20/09/2016
20/10/2016
20/11/2016

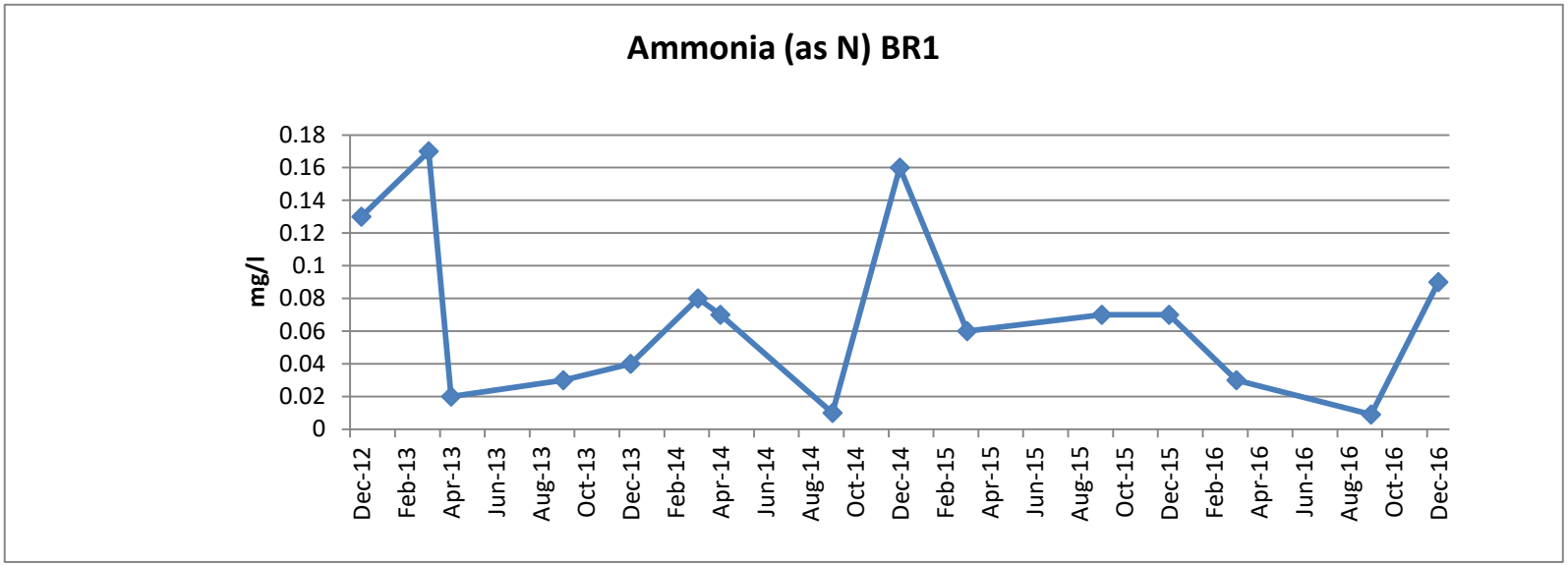
Well: Greenhills & Nemo Groundwater Wells (mg/l)
Location: Greenhills Green and Nemo Rangers GAA Pitch
All parameter data in mg/l unless stated otherwise

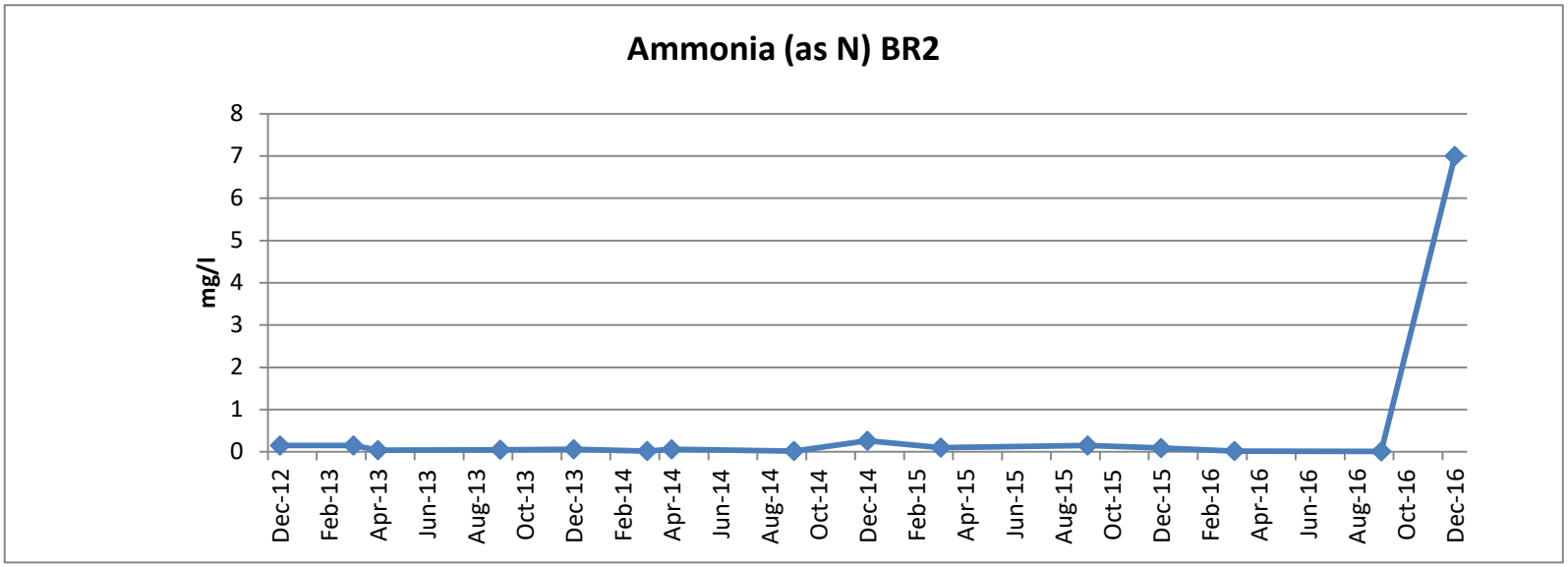
Nemo Shallow (NR1) 2016 - No access, works at Nemo Rangers

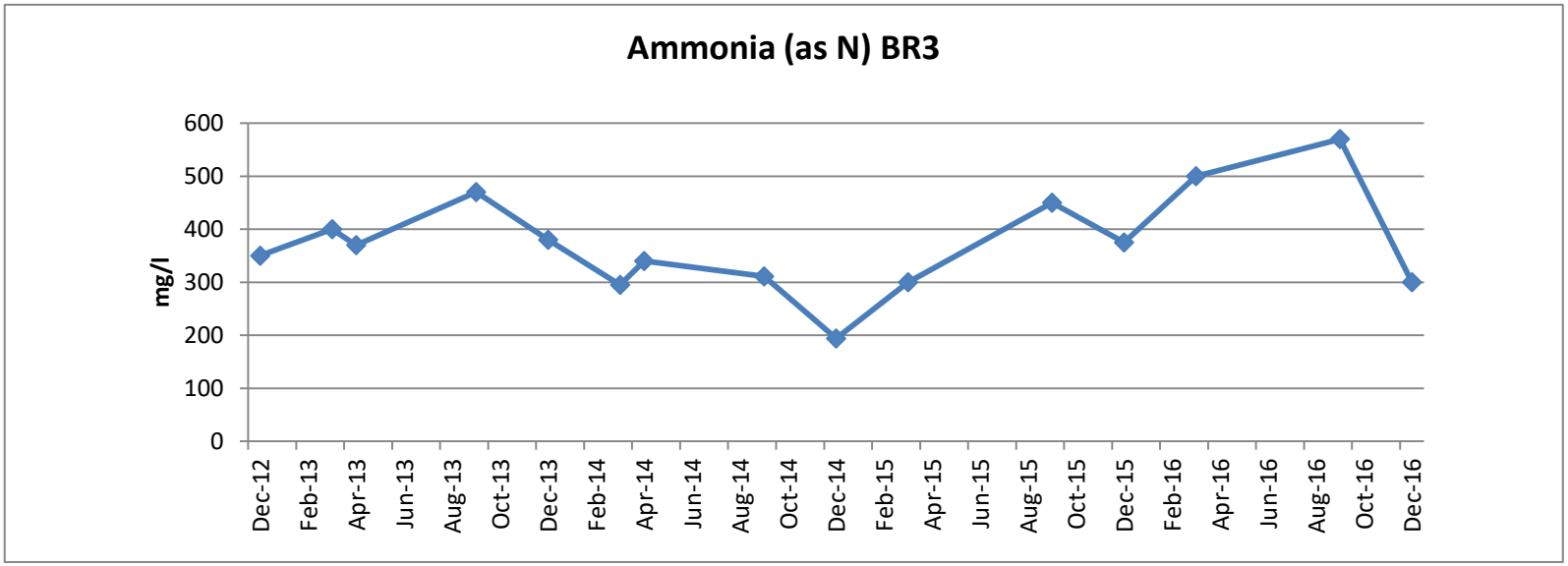
Date	Temp *C	pH	Conductivity µS/cm	NH4	Ammonia (as N)	Chloride	Oxygen	COD	TON	TOC	S. Solids	Well Depth (m)	Depth to Water (m)	Water Height in Well (m)
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		
												5.9		

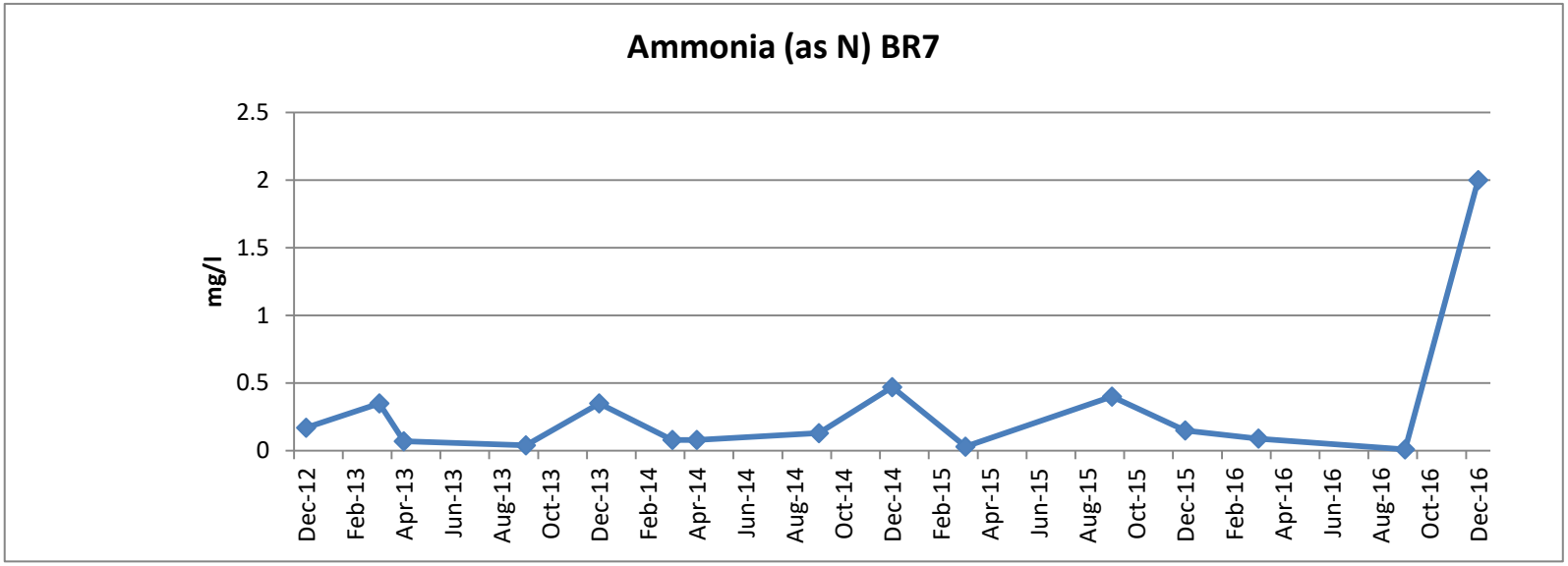
Bedrock Wells

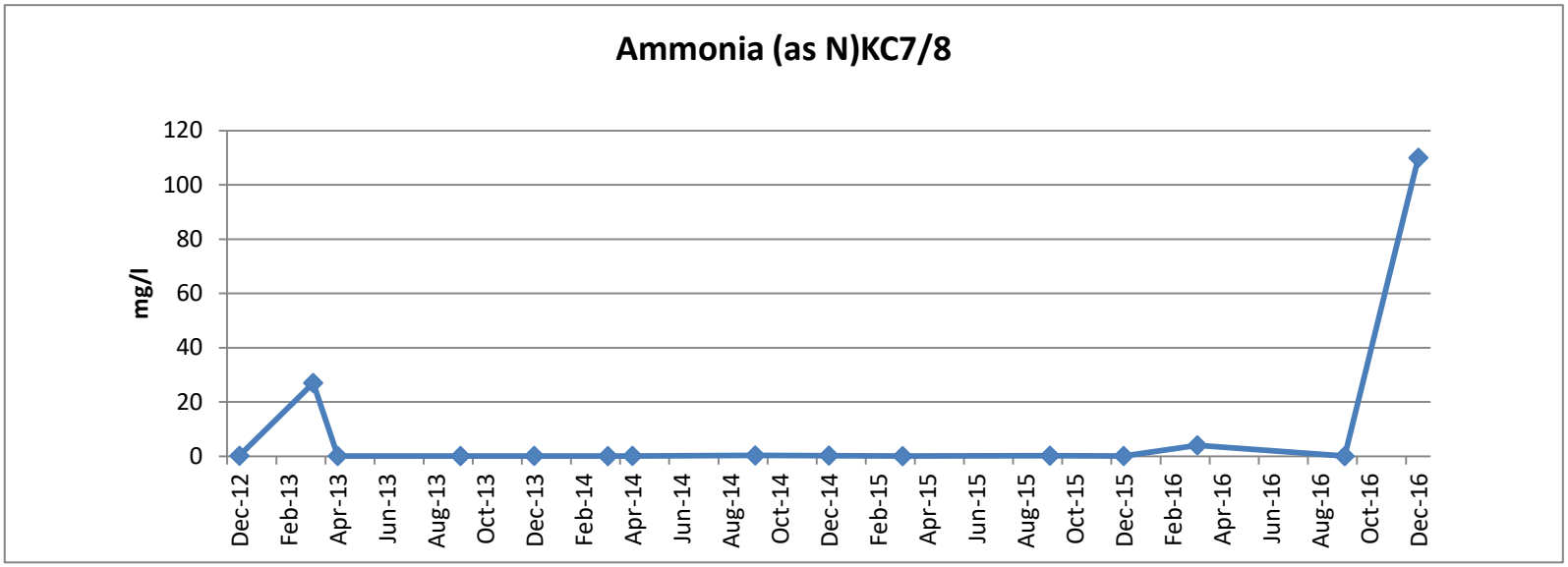
Ammonia (N) (mg/l)					
Date	BR1	BR2	BR3	BR7	KC7/8
Dec-12	0.13	0.15	350	0.17	0.14
Mar-13	0.17	0.15	400	0.35	27
Apr-13	0.02	0.04	370	0.07	0.07
Sep-13	0.03	0.05	470	0.04	0.05
Dec-13	0.04	0.06	380	0.35	0.11
Mar-14	0.08	0.02	295	0.08	0.04
Apr-14	0.07	0.06	340	0.08	0.1
Sep-14	0.01	0.02	311	0.13	0.27
Dec-14	0.16	0.26	194	0.47	0.23
Mar-15	0.06	0.1	300	0.03	0.01
Sep-15	0.07	0.15	450	0.4	0.17
Dec-15	0.07	0.09	375	0.15	0.08
Mar-16	0.03	0.02	500	0.09	4
Sep-16	0.009	0.01	570	0.01	0.009
Dec-16	0.09	7	300	2	110


Ammonia (as N) BR1
mg/l
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Ammonia (as N) BR2
mg/l
8
7
6
5
4
3
2
1
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

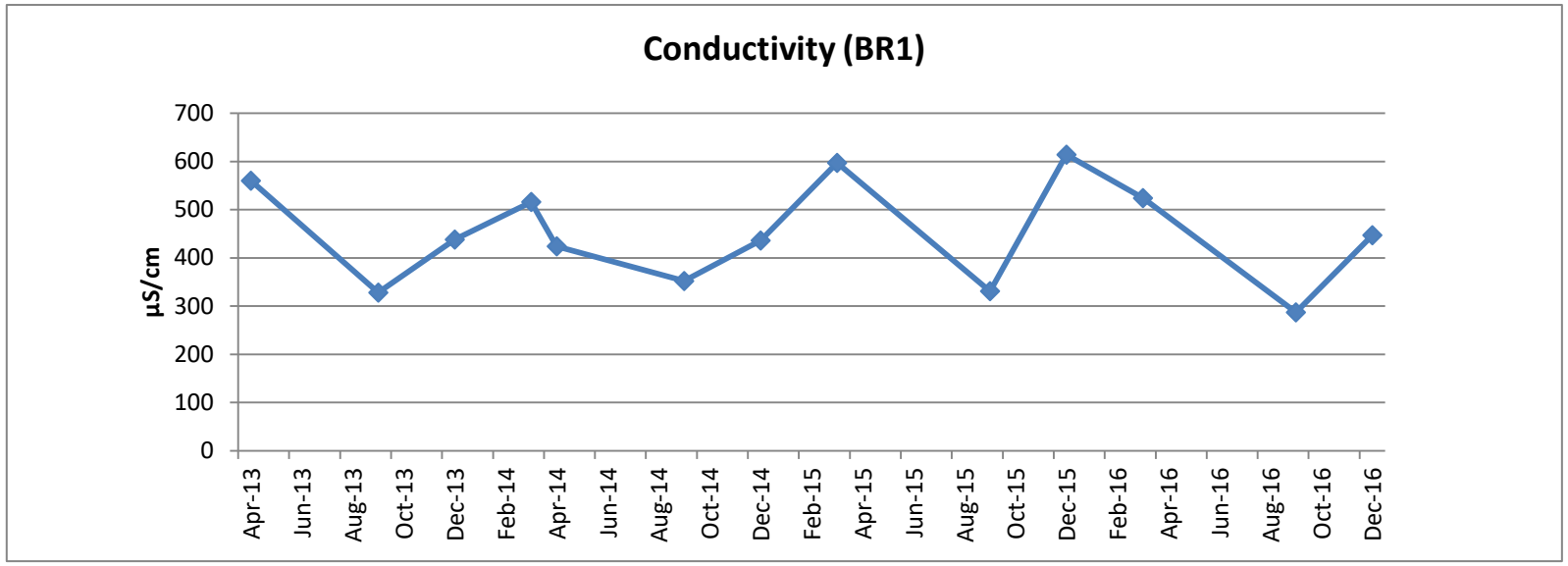

Ammonia (as N) BR3
mg/l
600
500
400
300
200
100
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

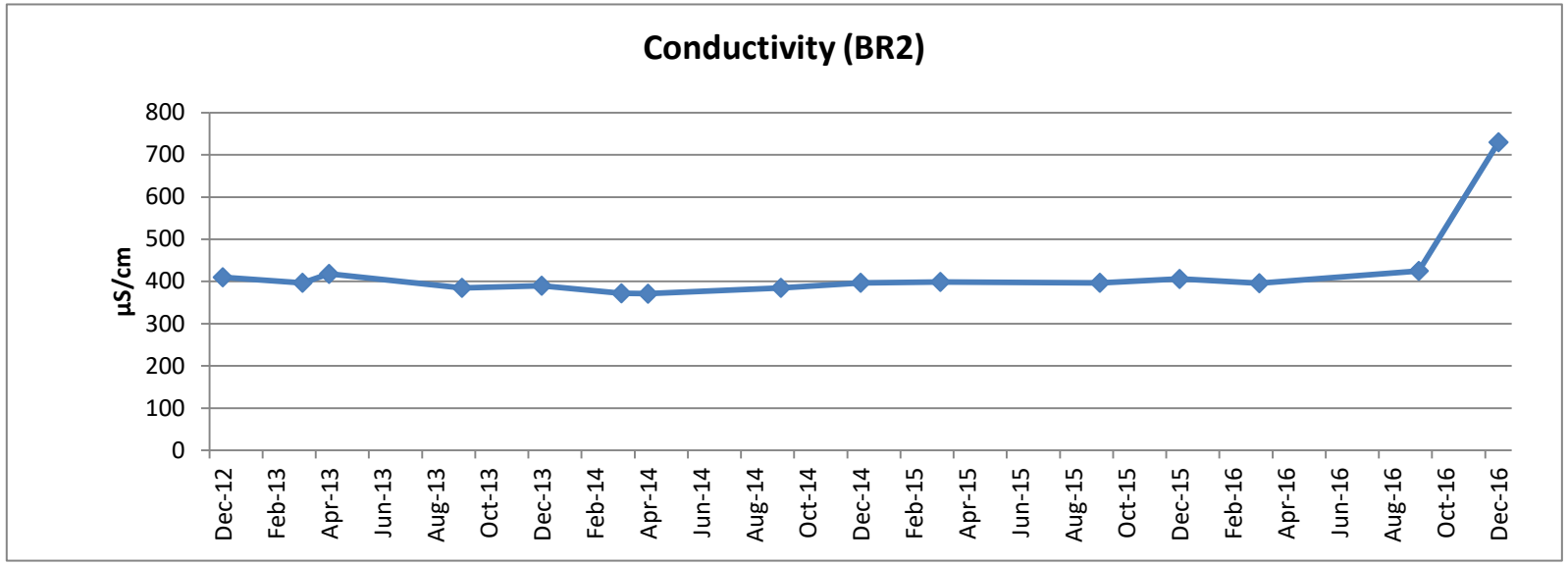

Ammonia (as N) BR7
mg/l
2.5
2
1.5
1
0.5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

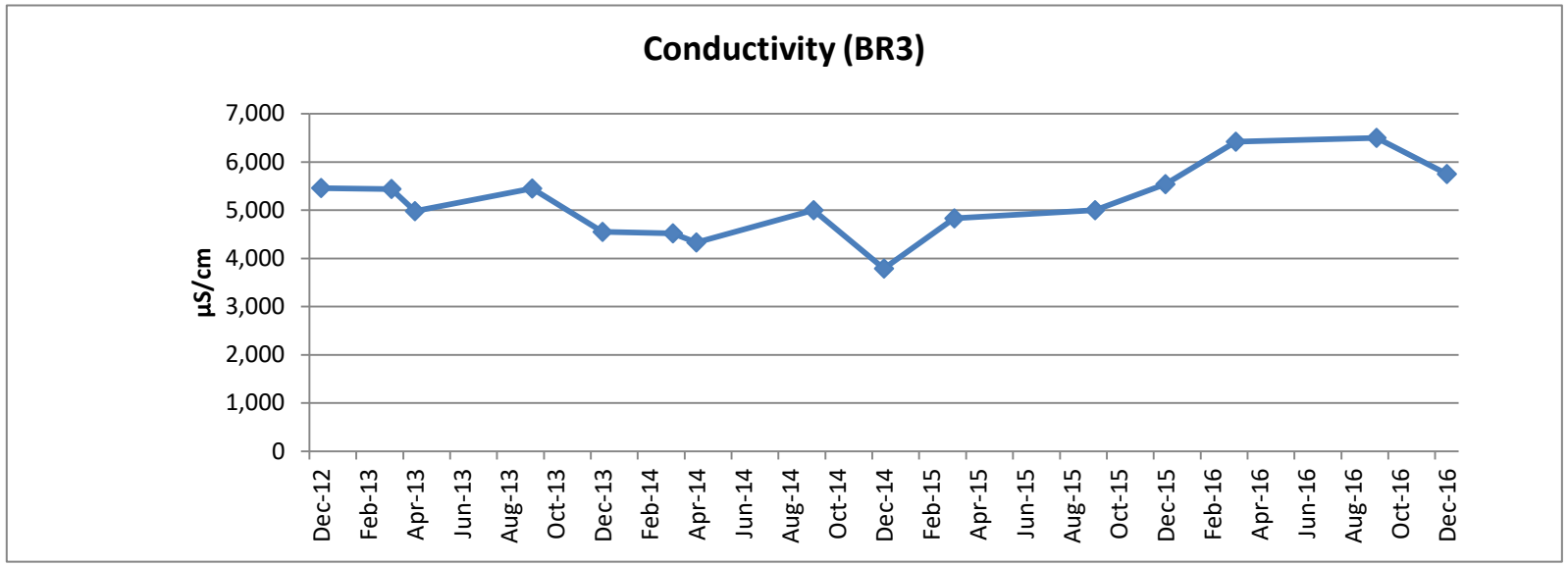

Ammonia (as N)KC7/8
mg/l
120
100
80
60
40
20
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

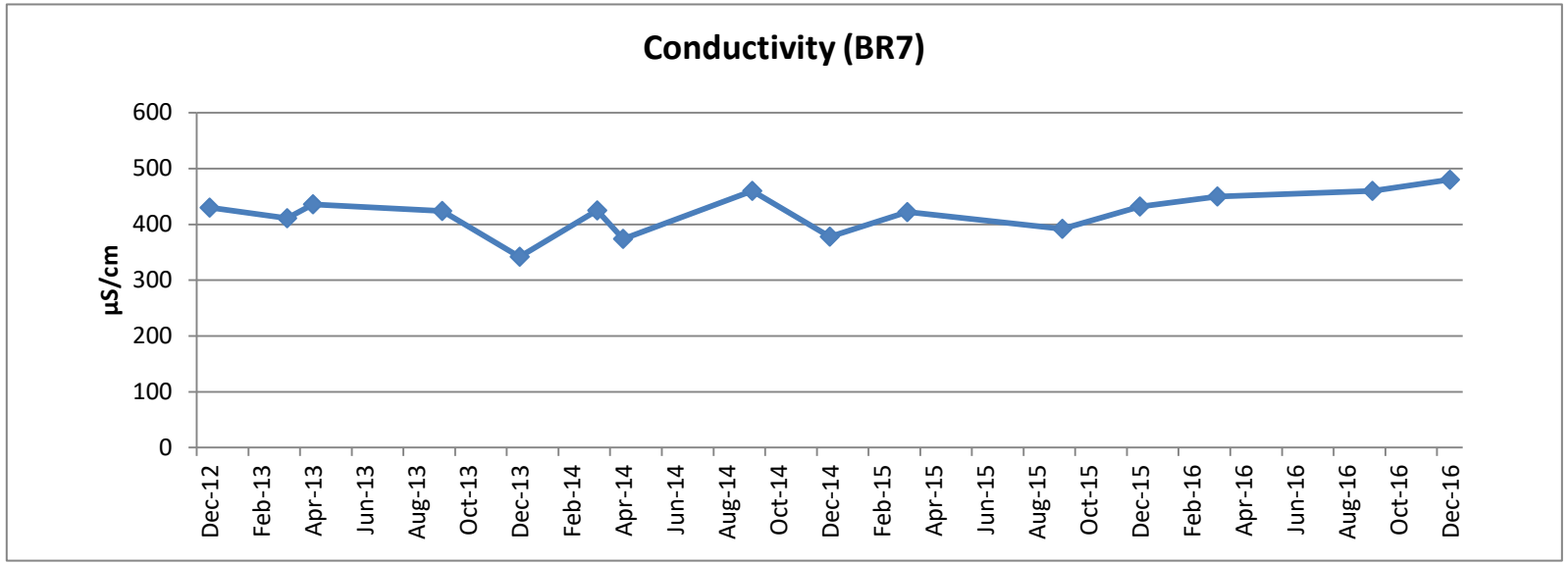
Bedrock Wells

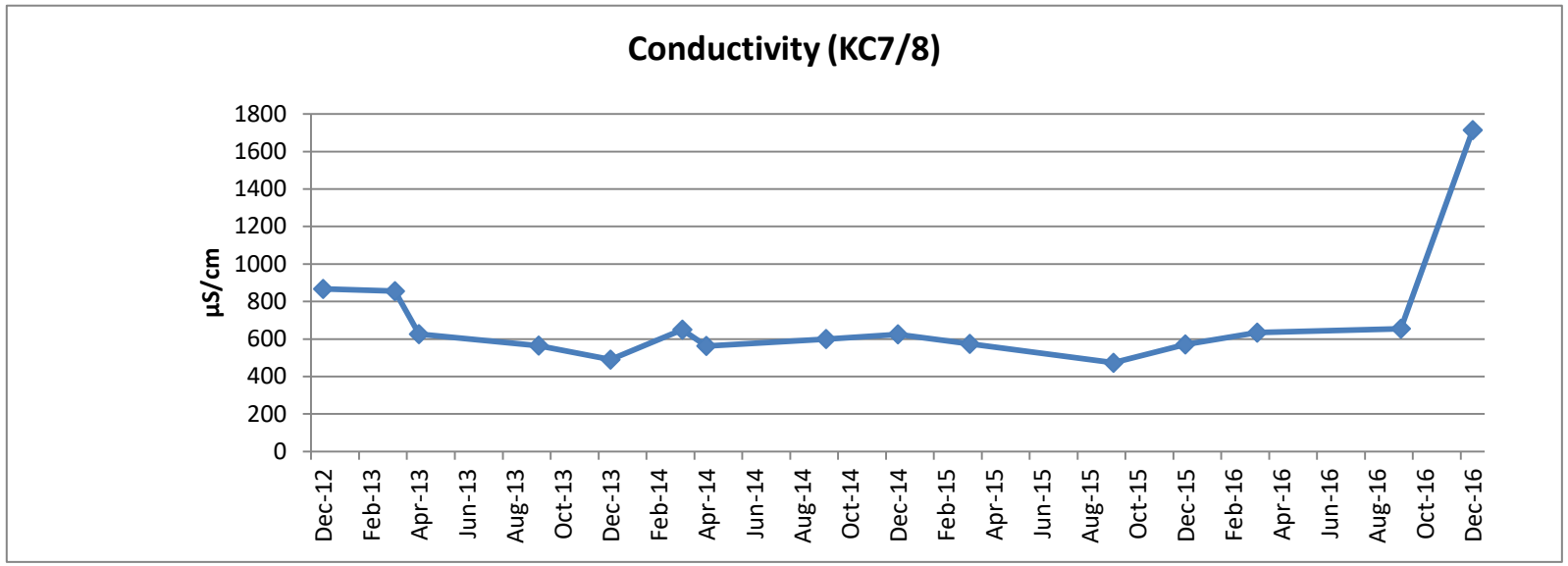
Conductivity (µS/cm)					
Date	BR1	BR2	BR3	BR7	KC7/8
Dec-12	474	410	5,460	430	867
Mar-13	540	397	5,440	411	855
Apr-13	560	418	4,980	436	626
Sep-13	328	385	5,450	424	565
Dec-13	438	390	4,550	342	490
Mar-14	516	372	4,520	425	650
Apr-14	424	371	4,331	374	563
Sep-14	352	385	5,000	460	600
Dec-14	436	397	3,790	378	625
Mar-15	597	399	4,830	422	574
Sep-15	331	397	5,000	392	473
Dec-15	614	406	5,540	432	571
Mar-16	524	396	6,420	450	634
Sep-16	287	425	6,500	460	655
Dec-16	447	730	5,750	480	1714


Conductivity (BR1)
µS/cm
700
600
500
400
300
200
100
0
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Conductivity (BR2)
µS/cm
800
700
600
500
400
300
200
100
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

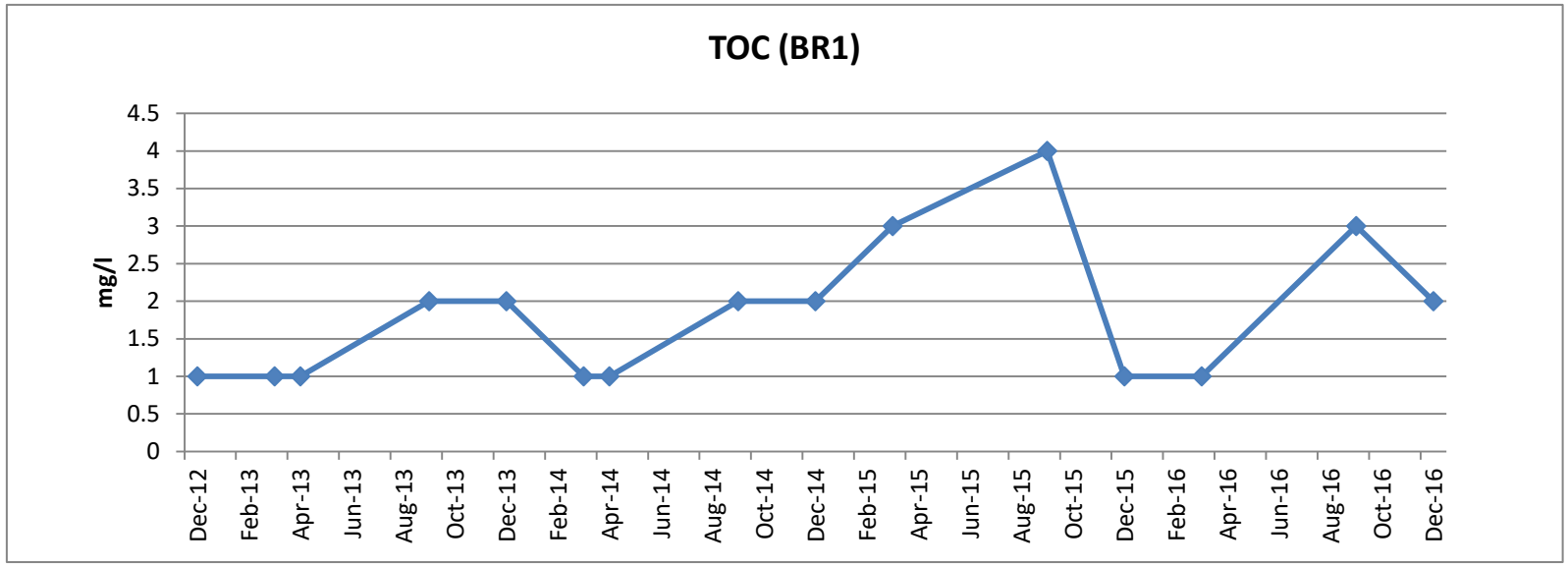

Conductivity (BR3)
µS/cm
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

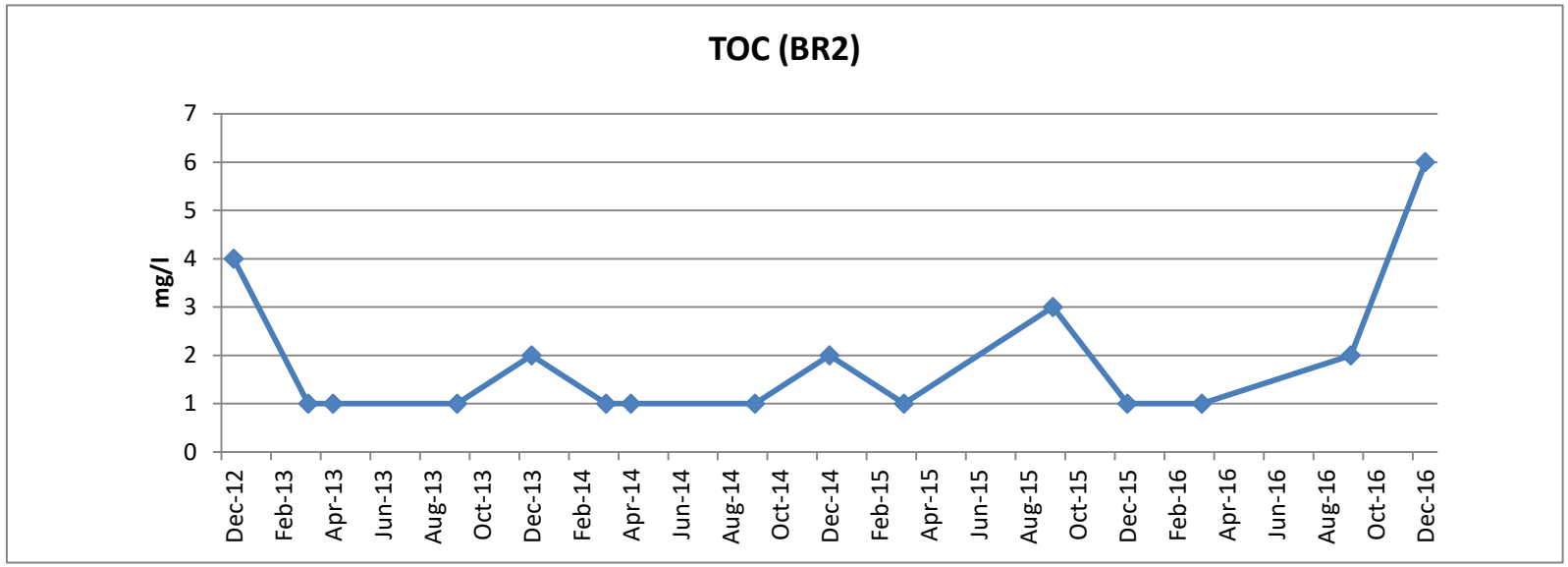

Conductivity (BR7)
µS/cm
600
500
400
300
200
100
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

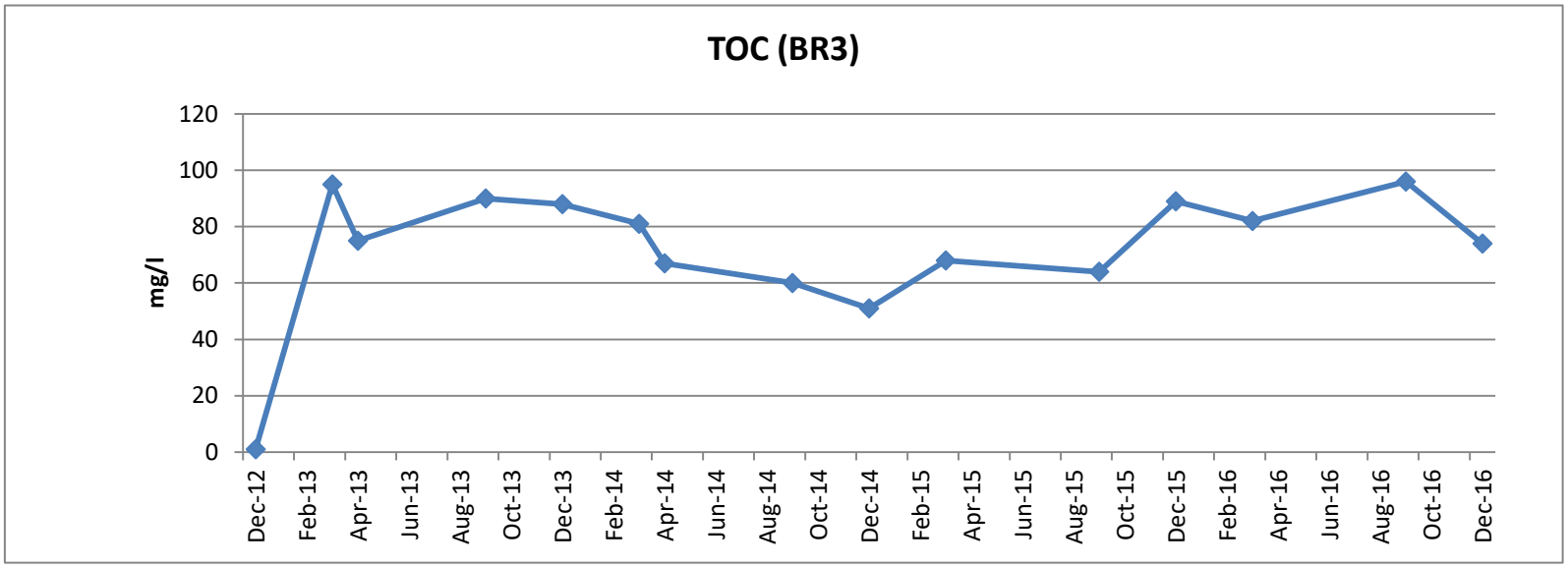

Conductivity (KC7/8)
µS/cm
1800
1600
1400
1200
1000
800
600
400
200
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

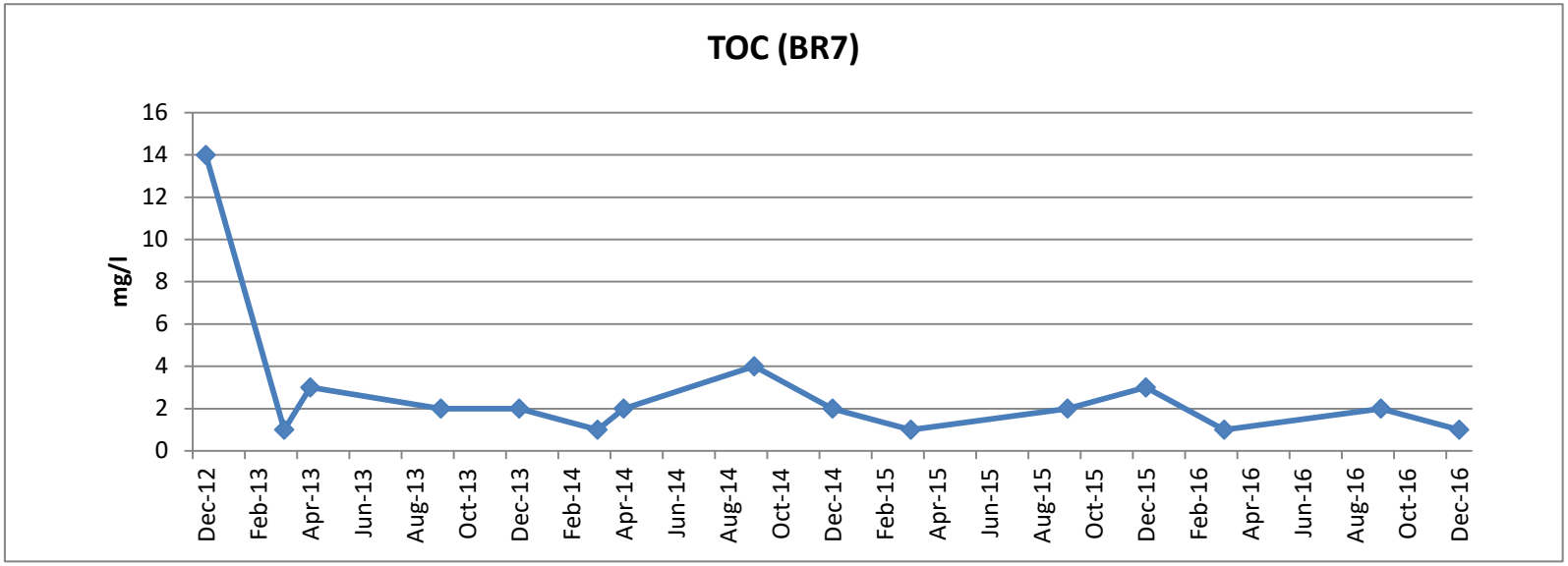
Bedrock Wells

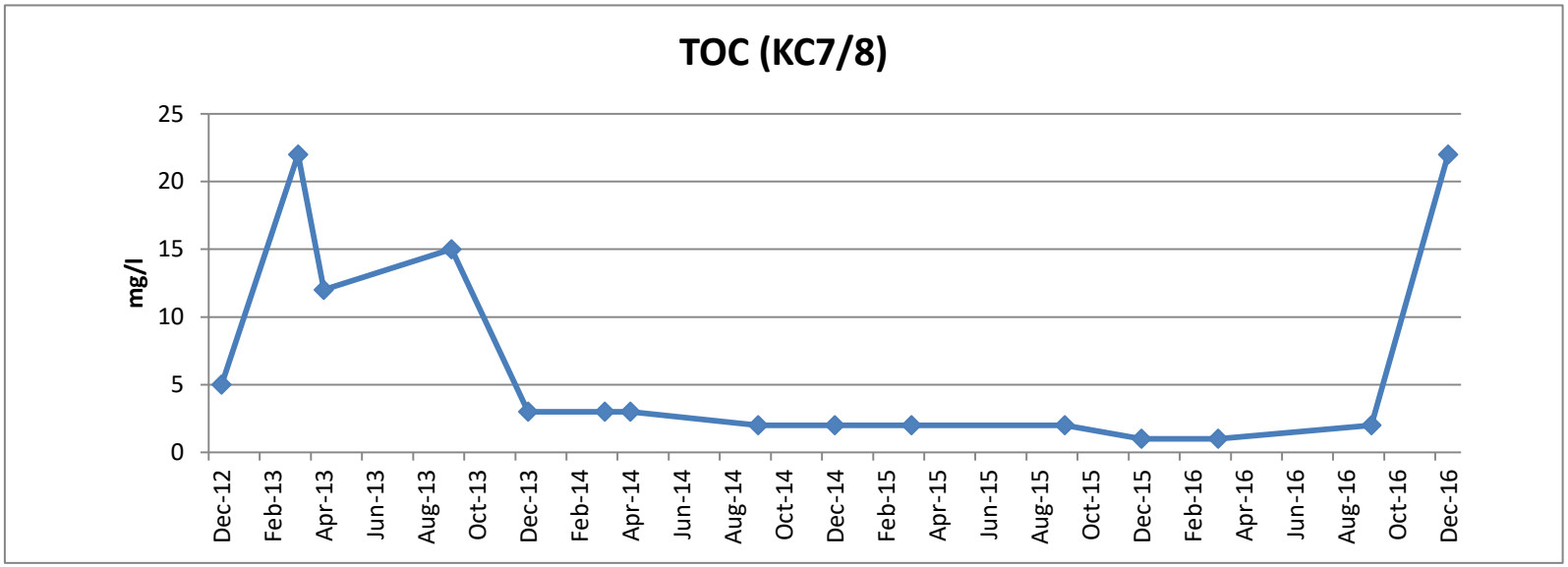
TOC (mg/l)					
Date	BR1	BR2	BR3	BR7	KC7/8
Dec-12	1	4	1	14	5
Mar-13	1	1	95	1	22
Apr-13	1	1	75	3	12
Sep-13	2	1	90	2	15
Dec-13	2	2	88	2	3
Mar-14	1	1	81	1	3
Apr-14	1	1	67	2	3
Sep-14	2	1	60	4	2
Dec-14	2	2	51	2	2
Mar-15	3	1	68	1	2
Sep-15	4	3	64	2	2
Dec-15	1	1	89	3	1
Mar-16	1	1	82	1	1
Sep-16	3	2	96	2	2
Dec-16	2	6	74	1	22


TOC (BR1)
mg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


TOC (BR2)
mg/l
7
6
5
4
3
2
1
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

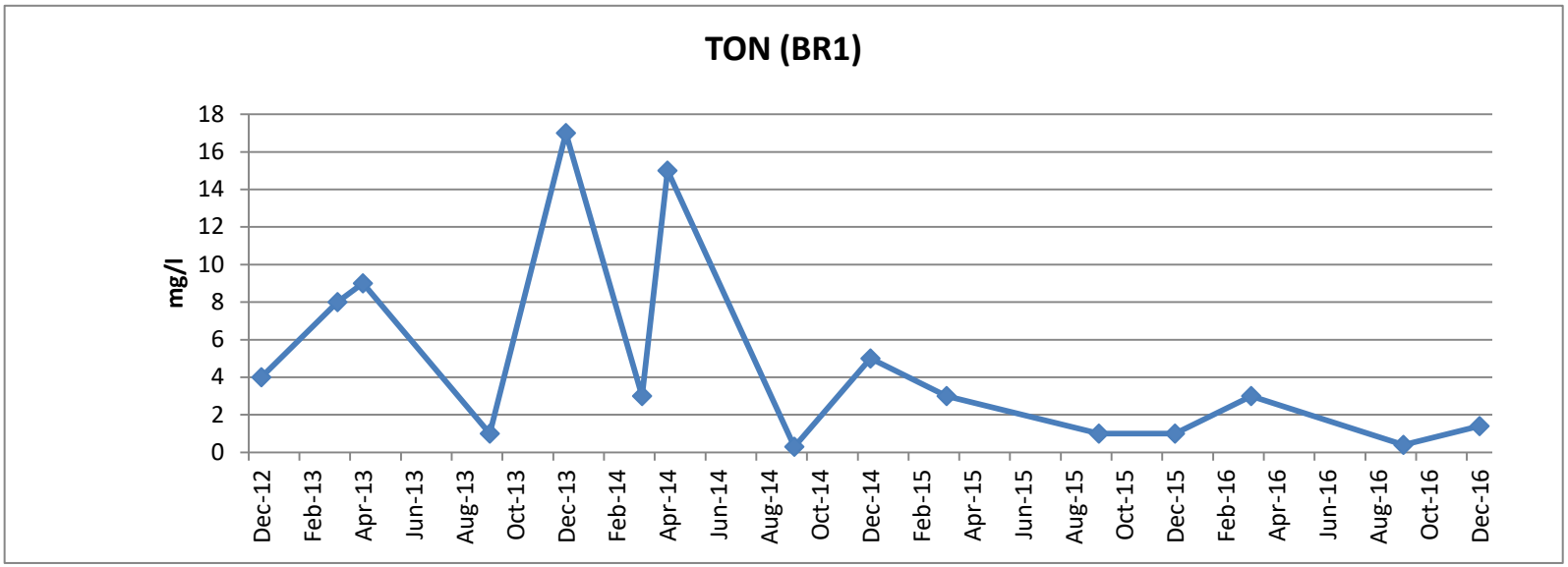

TOC (BR3)
mg/l
120
100
80
60
40
20
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

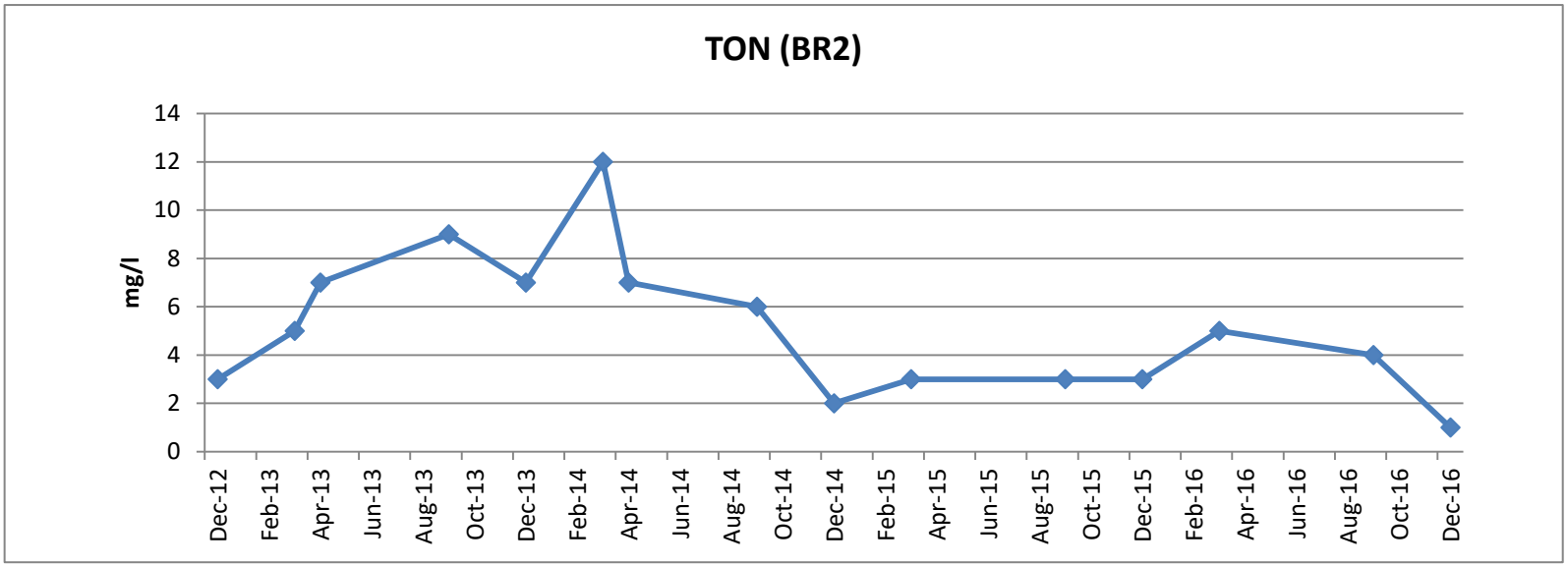

TOC (BR7)
mg/l
16
14
12
10
8
6
4
2
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

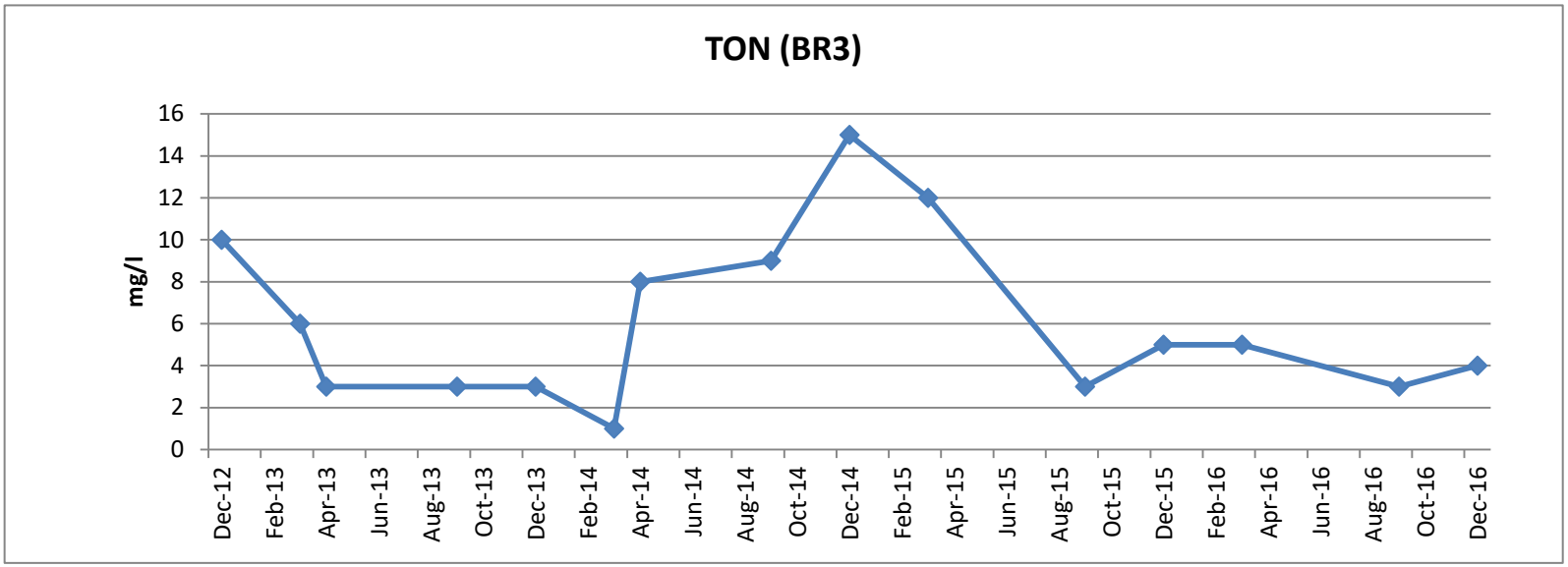

TOC (KC7/8)
mg/l
25
20
15
10
5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

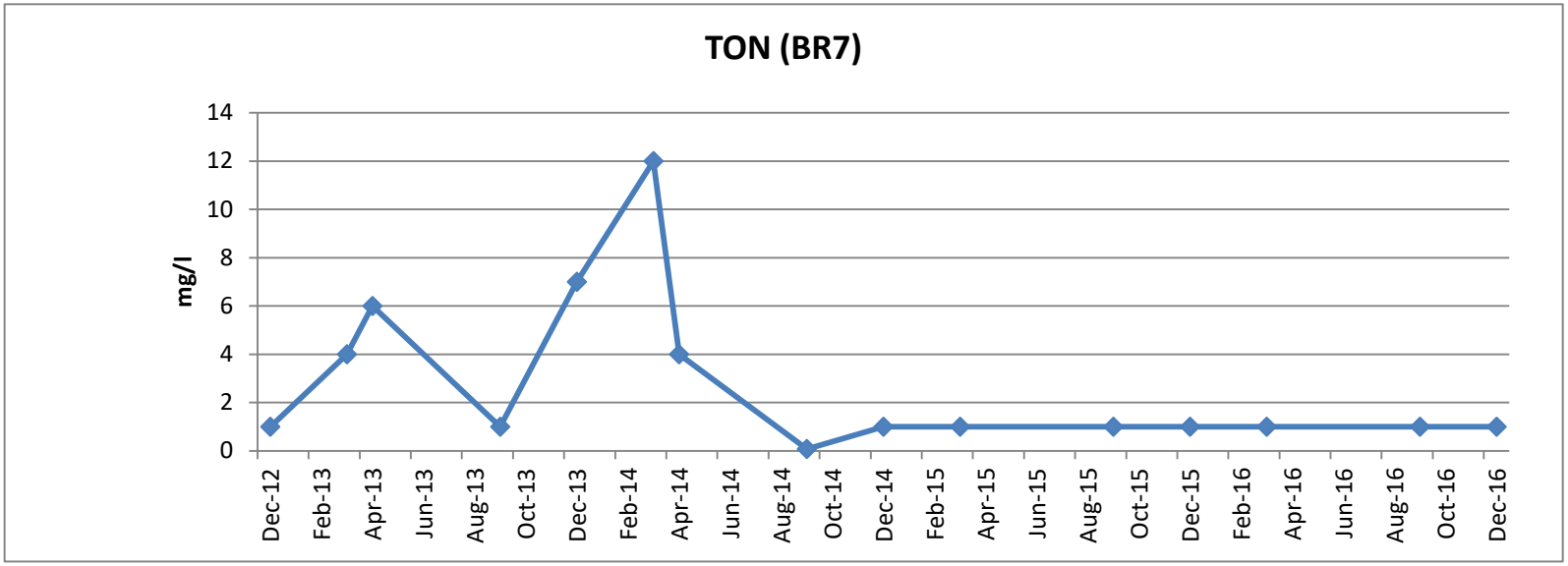
Bedrock Wells

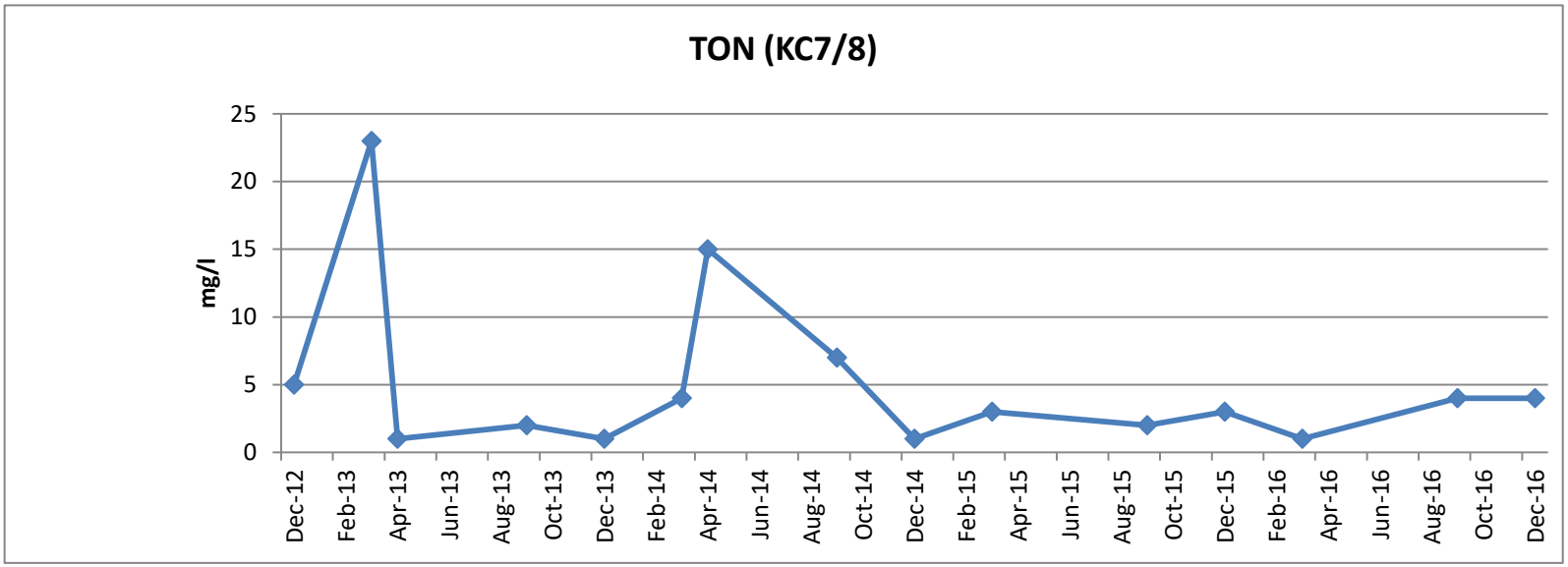
TON (mg/l)					
Date	BR1	BR2	BR3	BR7	KC7/8
Dec-12	4	3	10	1	5
Mar-13	8	5	6	4	23
Apr-13	9	7	3	6	1
Sep-13	1	9	3	1	2
Dec-13	17	7	3	7	1
Mar-14	3	12	1	12	4
Apr-14	15	7	8	4	15
Sep-14	0.3	6	9	0.08	7
Dec-14	5	2	15	1	1
Mar-15	3	3	12	1	3
Sep-15	1	3	3	1	2
Dec-15	1	3	5	1	3
Mar-16	3	5	5	1	1
Sep-16	0.4	4	3	1	4
Dec-16	1.4	1	4	1	4


TON (BR1)
mg/l
18
16
14
12
10
8
6
4
2
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


TON (BR2)
mg/l
14
12
10
8
6
4
2
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

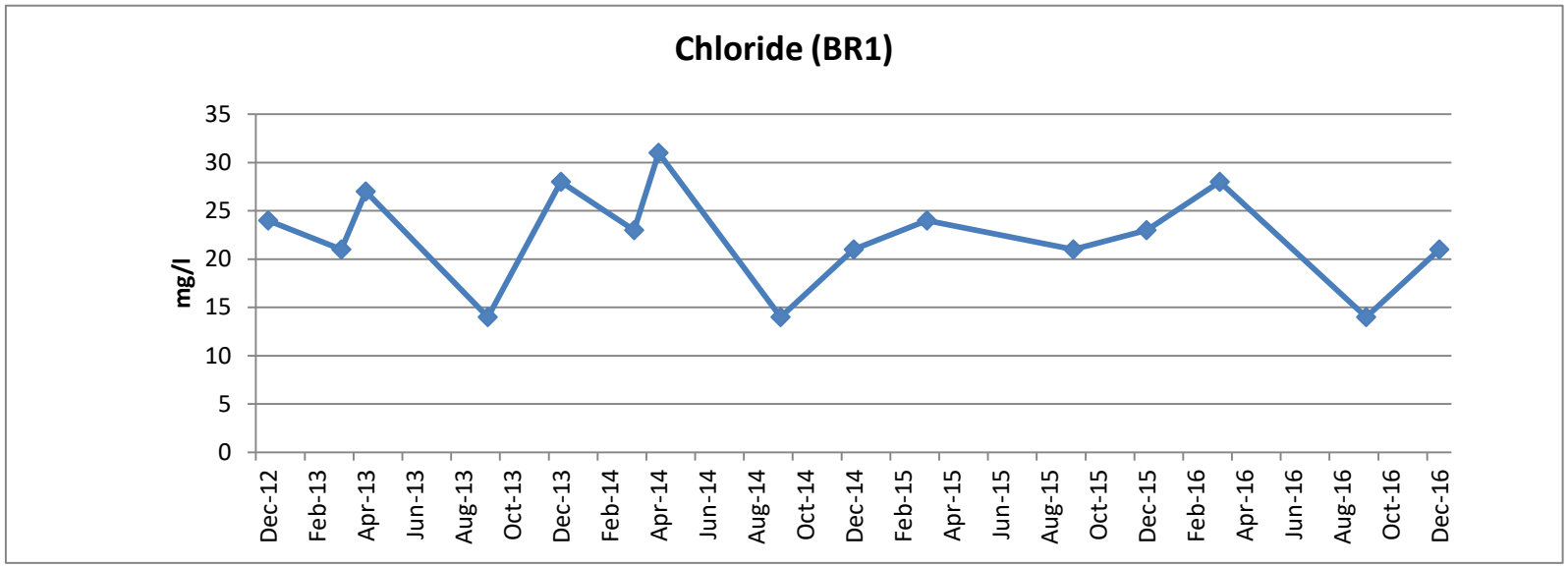

TON (BR3)
mg/l
16
14
12
10
8
6
4
2
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

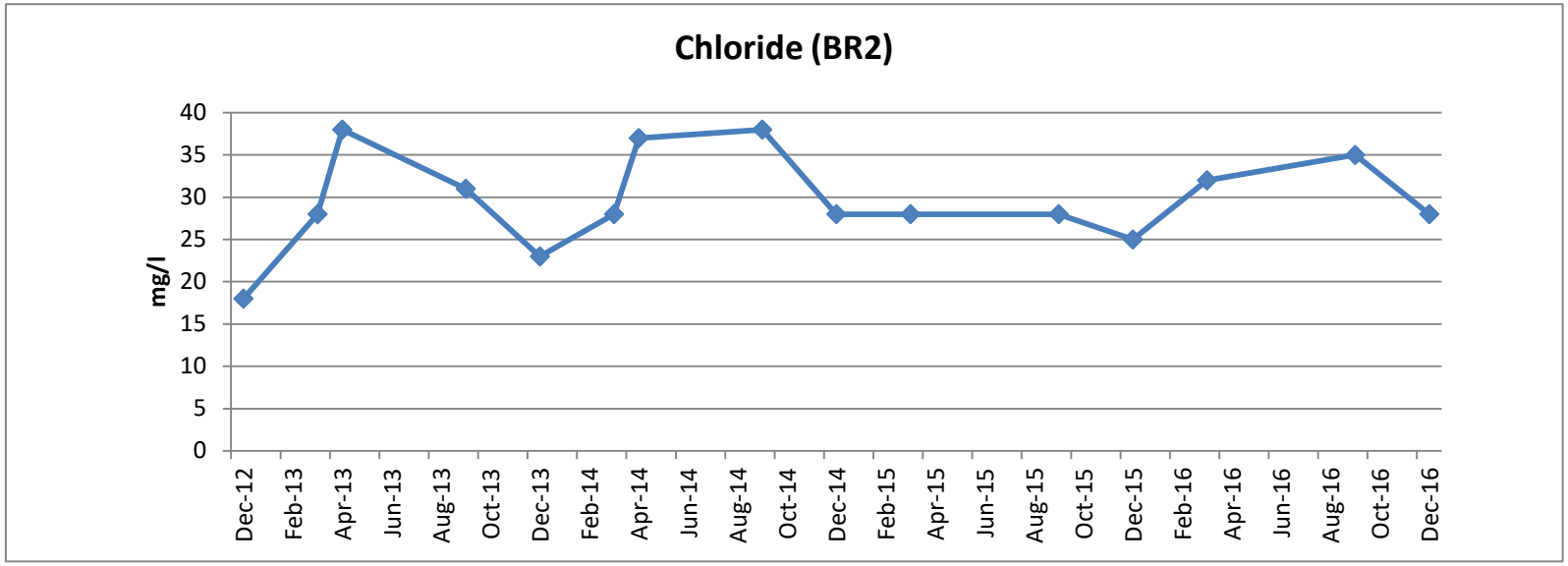

TON (BR7)
mg/l
14
12
10
8
6
4
2
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

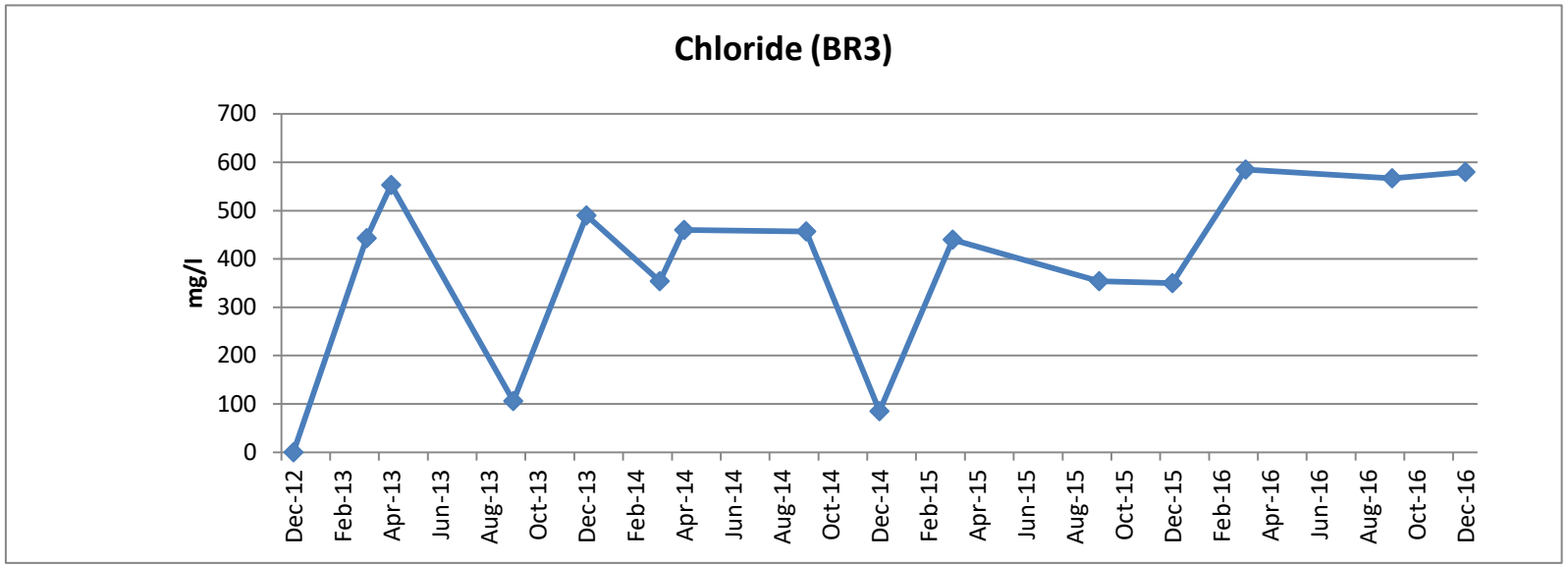

TON (KC7/8)
mg/l
25
20
15
10
5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

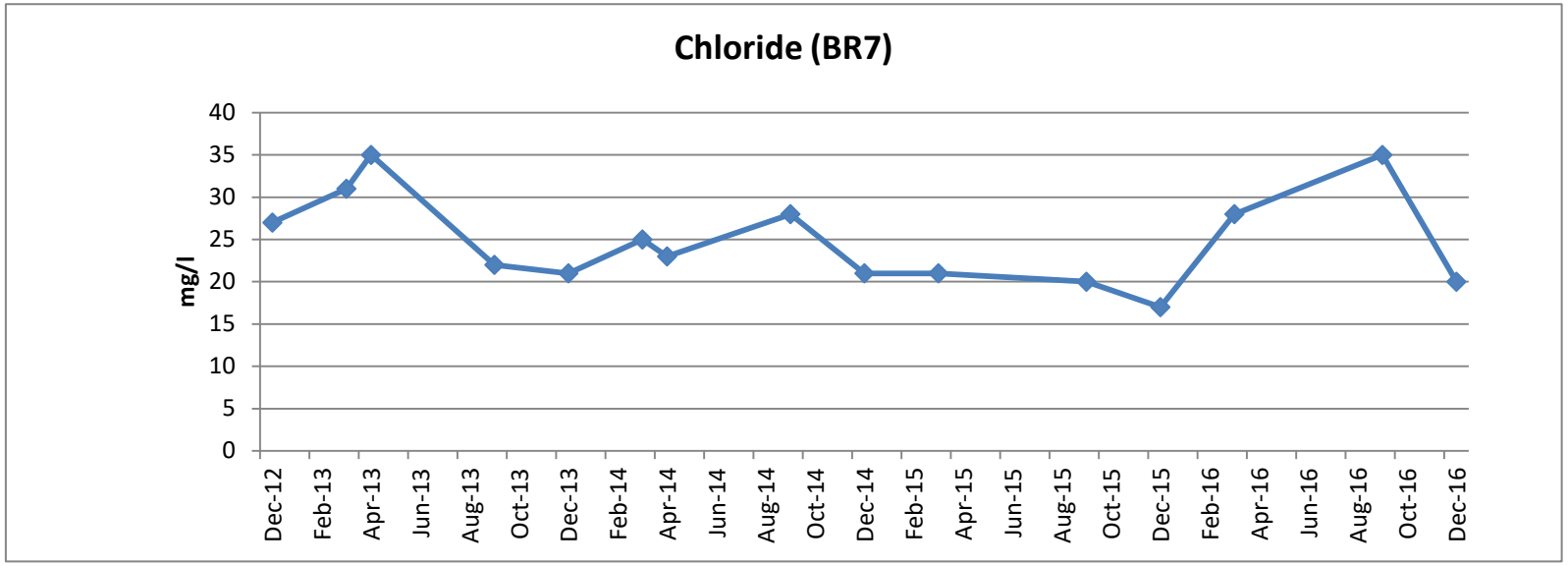
Bedrock Wells

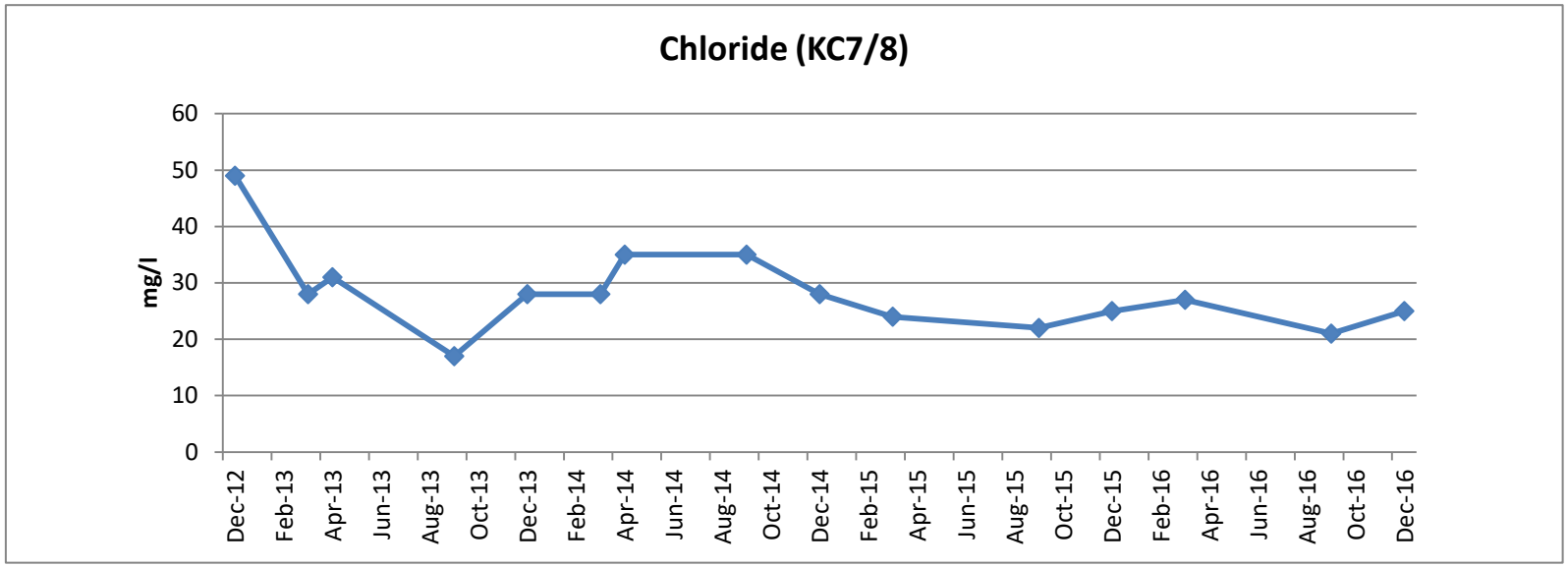
Chloride (mg/l)					
Date	BR1	BR2	BR3	BR7	KC7/8
Dec-12	24	18	1,770	27	49
Mar-13	21	28	443	31	28
Apr-13	27	38	553	35	31
Sep-13	14	31	106	22	17
Dec-13	28	23	490	21	28
Mar-14	23	28	354	25	28
Apr-14	31	37	460	23	35
Sep-14	14	38	457	28	35
Dec-14	21	28	85	21	28
Mar-15	24	28	440	21	24
Sep-15	21	28	354	20	22
Dec-15	23	25	350	17	25
Mar-16	28	32	585	28	27
Sep-16	14	35	567	35	21
Dec-16	21	28	580	20	25


Chloride (BR1)
mg/l
35
30
25
20
15
10
5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Chloride (BR2)
mg/l
40
35
30
25
20
15
10
5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

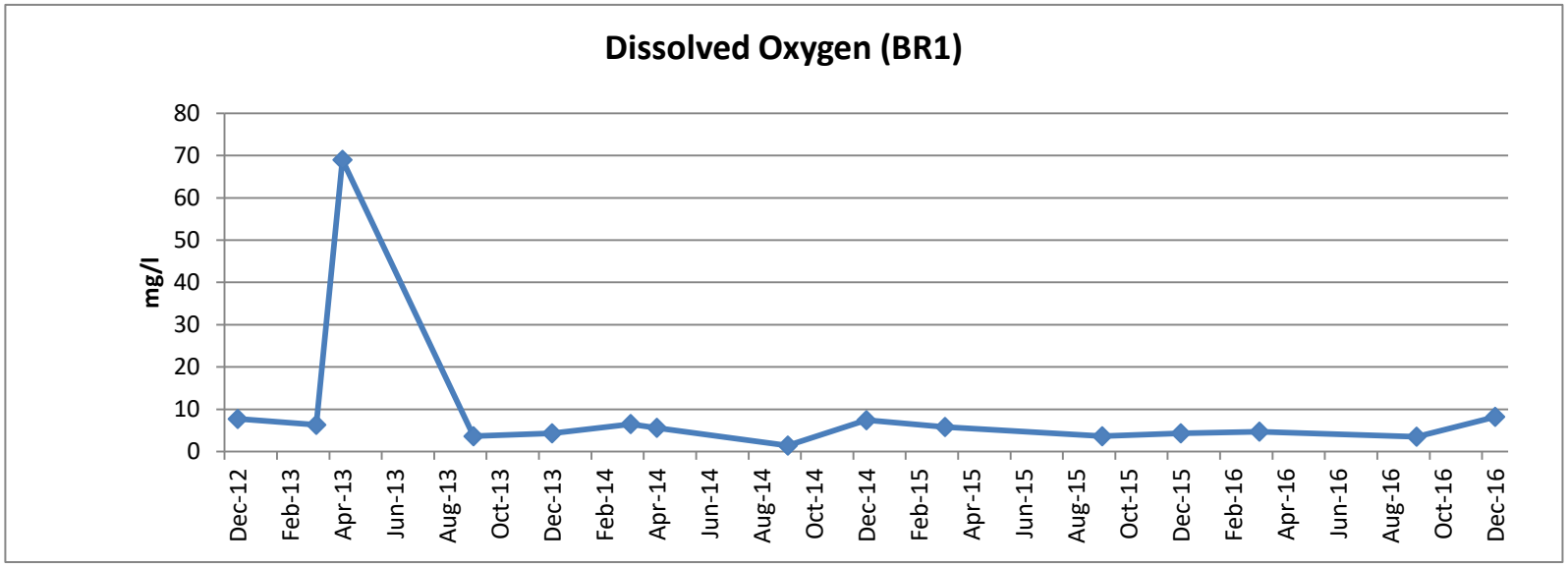

Chloride (BR3)
mg/l
700
600
500
400
300
200
100
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

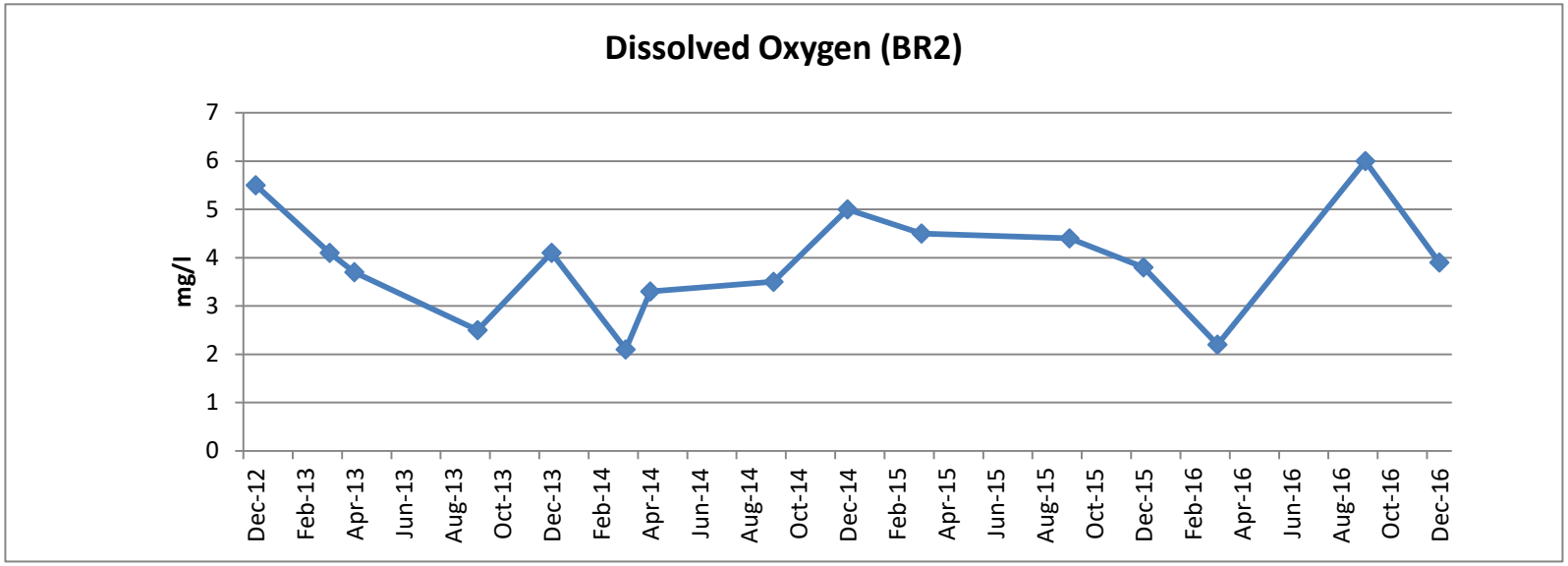

Chloride (BR7)
mg/l
40
35
30
25
20
15
10
5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

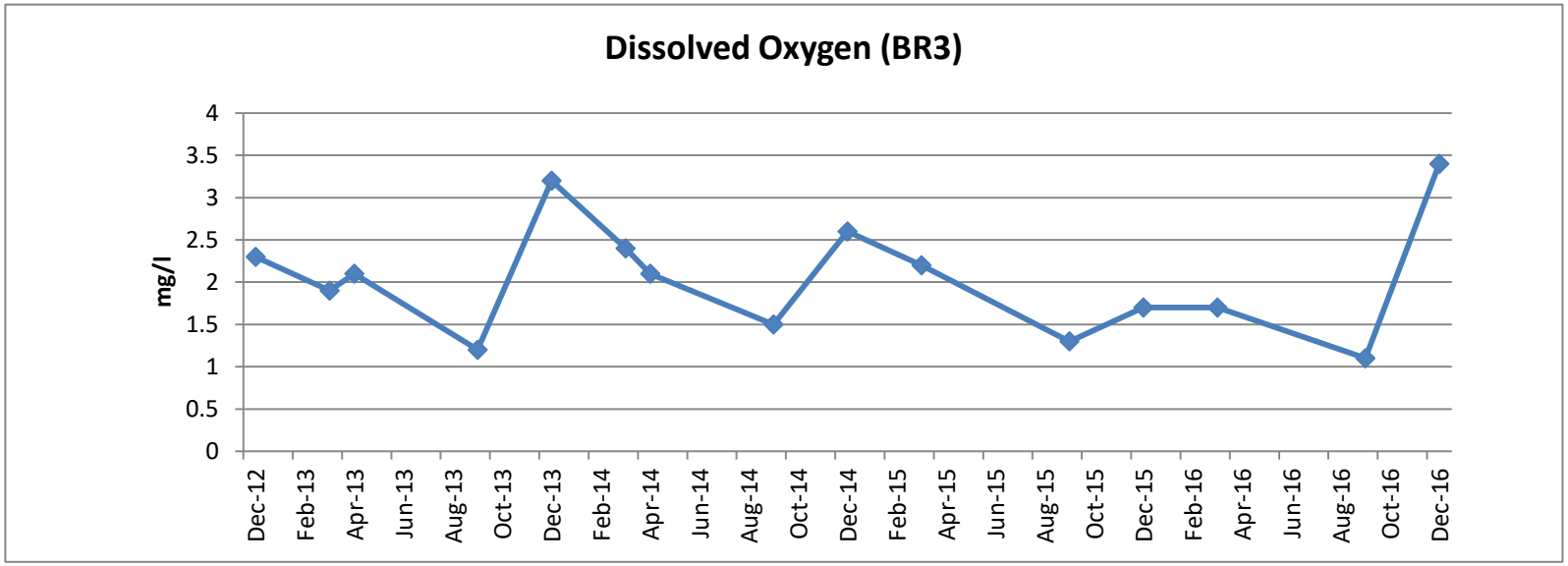

Chloride (KC7/8)
mg/l
60
50
40
30
20
10
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

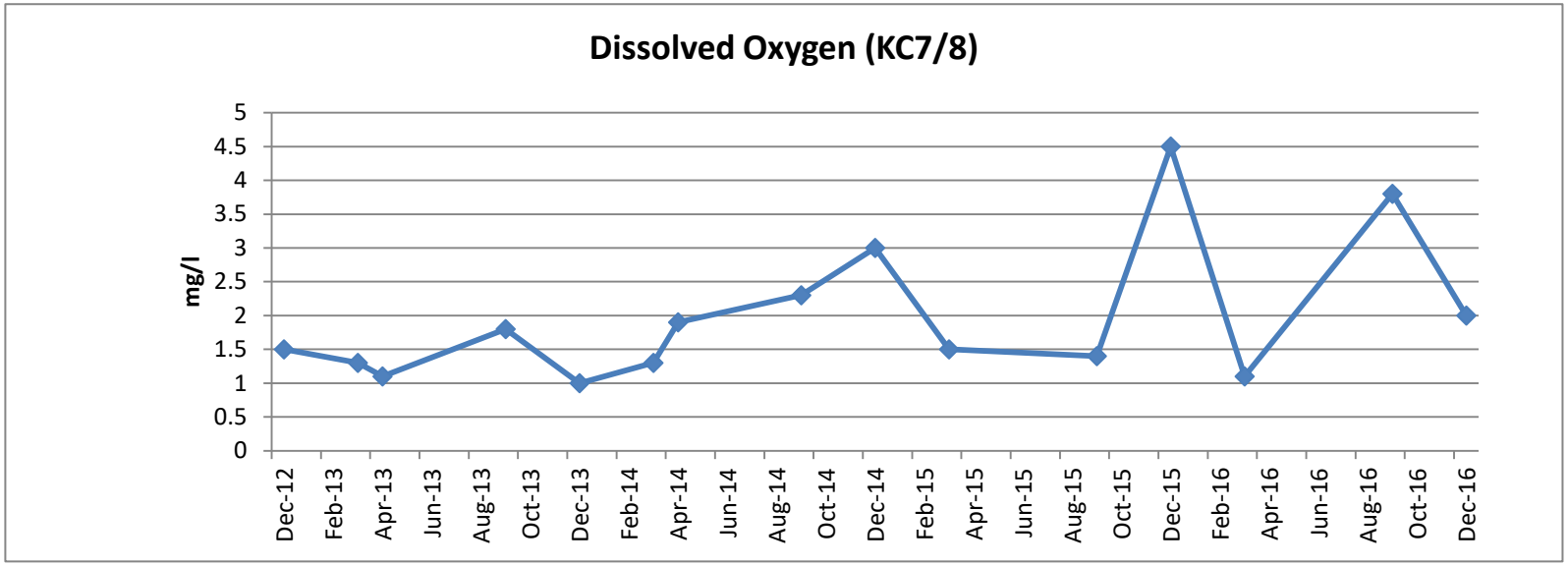
Bedrock Wells

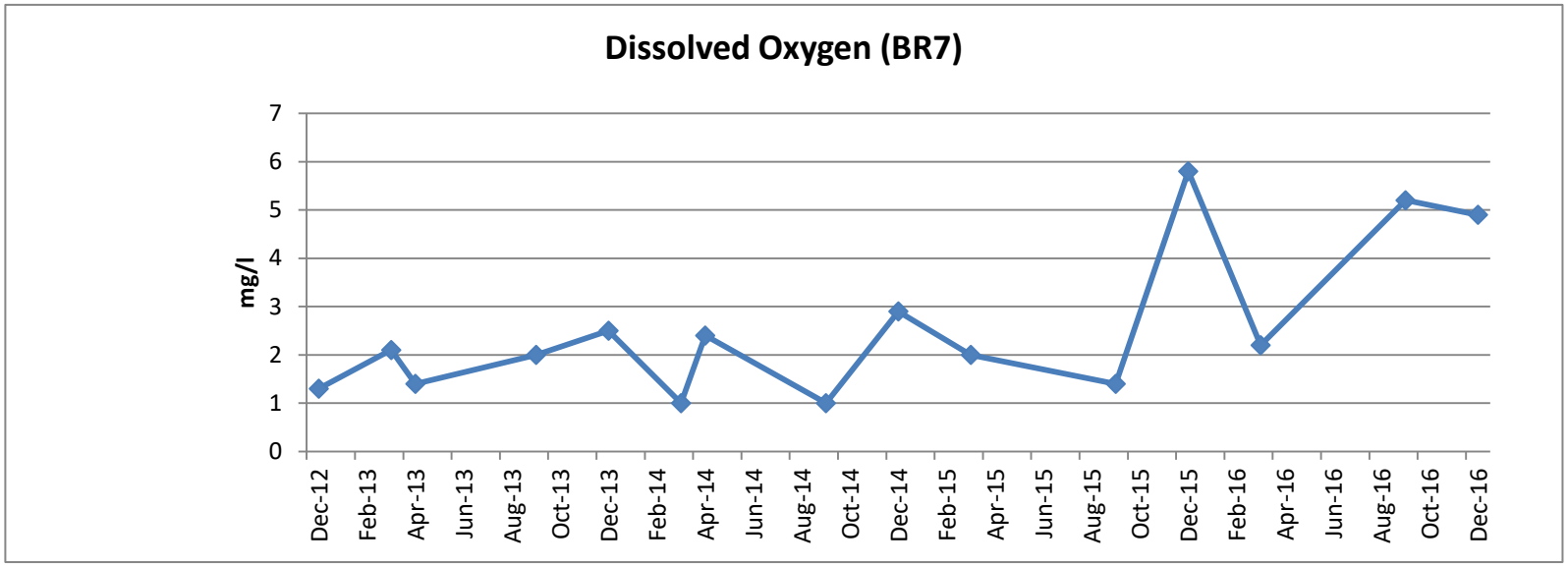
Dissolved Oxygen (mg/l)					
Date	BR1	BR2	BR3	BR7	KC7/8
Dec-12	7.7	5.5	2.3	1.3	1.5
Mar-13	6.3	4.1	1.9	2.1	1.3
Apr-13	69	3.7	2.1	1.4	1.1
Sep-13	3.6	2.5	1.2	2	1.8
Dec-13	4.3	4.1	3.2	2.5	1
Mar-14	6.5	2.1	2.4	1	1.3
Apr-14	5.6	3.3	2.1	2.4	1.9
Sep-14	1.4	3.5	1.5	1	2.3
Dec-14	7.4	5	2.6	2.9	3
Mar-15	5.8	4.5	2.2	2	1.5
Sep-15	3.6	4.4	1.3	1.4	1.4
Dec-15	4.3	3.8	1.7	5.8	4.5
Mar-16	4.7	2.2	1.7	2.2	1.1
Sep-16	3.5	6	1.1	5.2	3.8
Dec-16	8.2	3.9	3.4	4.9	2


Dissolved Oxygen (BR1)
mg/l
80
70
60
50
40
30
20
10
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Dissolved Oxygen (BR2)
mg/l
7
6
5
4
3
2
1
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Dissolved Oxygen (BR3)
mg/l
4
3.5
3
2.5
2
1.5
1
0.5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Dissolved Oxygen (KC7/8)
mg/l
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16


Dissolved Oxygen (BR7)
mg/l
0
1
2
3
4
5
6
7
Dec-12
Feb-13
Apr-13
Jun-13
Aug-13
Oct-13
Dec-13
Feb-14
Apr-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16

Surface Water:
Location: Trabeg Stream & Tramore river
Parameters: see below mg/l

Sampling Point:		EM7								
DATE	pH	Temp.C	DO	Cond.	NH4	Ammonia (as N)	BOD	COD	Sus.Sol	Chloride
				uS/cm						
08/03/16	7.41	11.C	8.8	656	0.01	0.00778	12	15	6	28
12/09/16		UNABLE TO OBTAIN								

Sampling Point:		EM8								
DATE	pH	Temp.C	DO	Cond.	NH4	Ammonia (as N)	BOD	COD	Sus Sol	Chloride
				uS/cm						
08/03/16	7.7	8.5.C	6.5	666	0.01	0.00778	10	13	14	42
12/09/16	7.95	16.5.C	3.2	588	0.007	0.005446	2	5	4	30

Sampling Point:		EM0								
DATE	pH	Temp.C	D.O.	Cond.	NH4	Ammonia (as N)	BOD	COD	Sus.Sol	Chloride
				uS/cm						
11/03/2015	7.13	10.8.C	9.1	212	0.18	0.14004	4.8	12	199*	17
08/09/2015	8.36	13.C	8.1	389	0.13	0.10114	<1	2	6	21

Sampling Point:		EM1								
DATE	pH	Temp.C	D.O.	Cond.	NH4	Ammonia (as N)	BOD	COD	Sus.Sol.	Chloride
				uS/cm						
08/03/16	7.95	9.6.C	10.7	350	0.02	0.01556	<1	6	2	28
12/09/16	7.87	17.1.C	4.7	395	0.01	0.00778	2.4	3	6	21

Sampling Point:		EM2									
DATE	pH	Temp.C	D.O.	Cond	NH4	Ammonia (as N)	BOD	COD	Sus.Sol	Chloride	TOC
				uS/cm							
08/03/16	7.4	10.C	9	376	0.02	0.01556	1	3	5	28	1
12/09/16	7.44	14.C	3.3	375	0.2	0.1556	2	11	4	21	2

Sampling Point:		EM11									
DATE	pH	TEMP.C	D.O.	COND	NH4	Ammonia (as N)	BOD	COD	Sus.Sol	Chloride	TOC
				uS/cm							
08/03/16	7.67	9.1.C	9.5	357	0.02	0.01556	1.1	4	9	25	1
12/09/16	7.67	17.C	4.8	310	0.007	0.005446	2.4	8	2	21	2

Sampling Point:		EM6/10								
DATE	pH	TEMP.C	D.O.	COND	NH4	Ammonia (as N)	BOD	COD	Sus.Sol	Chloride
				uS/cm						
08/03/16	7.91	9.6.C	9.8	385	0.01	0.00778	12	15	6	28
12/09/16	7.74	17.2.C	6.1	630	0.005	0.00389	1.2	8	5	25

Surface Water:
Location: Trabeg Stream & Tramore river
Parameters: see below mg/l

	Frequency	Method		Range	Sample	**EM0**	**EM1**	**EM2**	**EM11**	**EM6/10**	**EM7**	**EM8**
Vis/Odour	W				Grab	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
Ammonium	q	ISE		0.01-10		0.02	0.02	0.02	0.02	0.02	0.02	0.02
B.O.D.	q	Meter Brit		0.1-8.0		<1	1.8	<1	<1	1.1	8.8	5.6
C.O.D.	q	Closed Tube		1-500		5	14	15	5	8	14	19
Chloride	q	Argent SM		1-100		21	21	23	21	21	28	28
D.O.	q	Meter		0.1-20		11	11	7.8	8.5	11.6	6	3.5
Cond.us/cm	q	Meter		1-200000		320us	323us	334us	337us	385us	656us	690us
pH	q	Meter		05-Nov		8.05	8.1	8.15	8.22	8.27	7.98	8.21
Sus.Sol.	q	Grav		0.1-200		8	12	16	12	25	14	11
Temp.	q	Meter		0-50		11.6.C	12.5.C	10.7.C	9.2.C	12.4.C	10.9.C	9.4.C
Cadmium	a	GFAA		0.001-0.5		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Calcium	a	AA		1-100		45	40	40	43	50	50	60
Chromium	a	GFAA		0.001-0.2		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Copper	a	AA		0.001-1.0		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

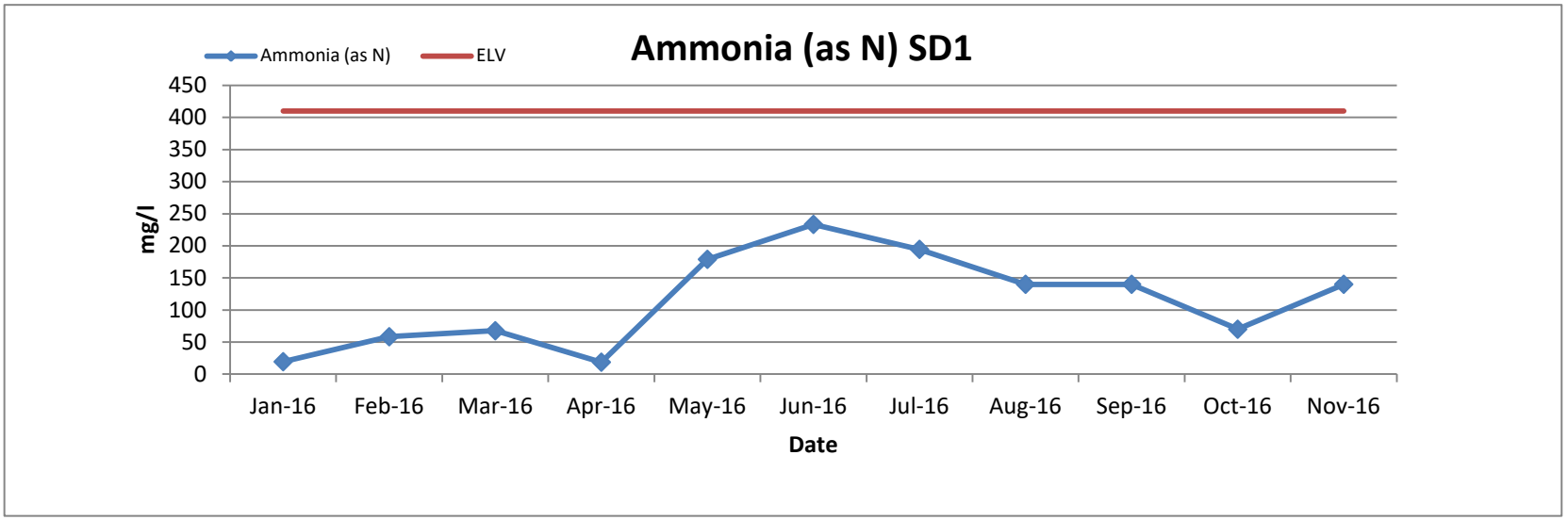
Surface Water:
Location: Trabeg Stream & Tramore river
Parameters: see below mg/l

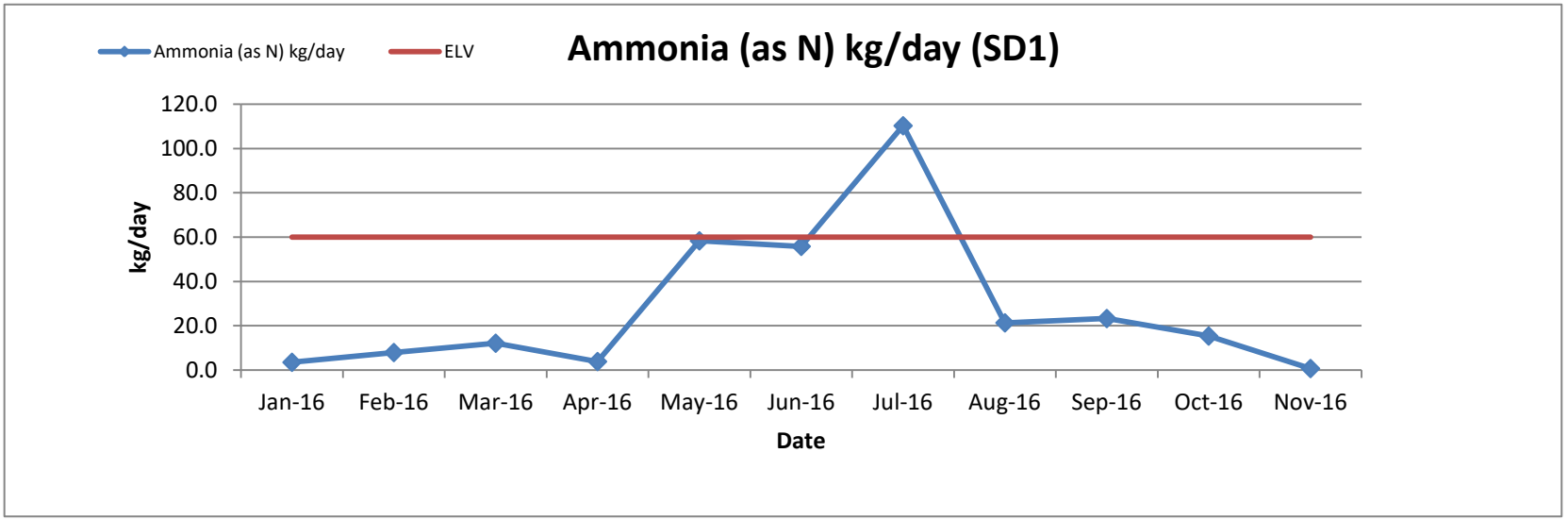
	Frequency		Method	Range	Sample	**EM0**	**EM1**	**EM2**	**EM11**	**EM6/10**	**EM7**	**EM8**
					Grab							
Iron	a		AA	0.01-5.0		0.02	0.03	0.04	0.03	0.03	0.02	0.03
Lead	a		GFAA	0.001-0.1		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Magnesium	a		AA	0.01-5.0		6.2	6.4	6.7	6.8	6.9	7.5	7.5
Manganese	a		AA	0.01-3.0		0.01	0.006	0.01	0.006	0.01	0.01	0.02
Mercury	a		GFAA			<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Potassium	a		AA	0.1-5.0		15	15	15	14	18	19	21
Sulphate	a		Turb. SM	1.0-3.0		11	14	15	13	17	28	30
Sodium	a		AA	0.1-3.0		13	14	15	15	18	20	27
Tot Phos	a		Stann SM	0.05-0.25		0.07	0.06	0.05	0.12	0.22	0.03	0.03
T.O.N.	a		SM			3	3	3	3	5	6	4
Zinc	a		AA	0.01-5.0		0.002	0.004	0.002	0.003	0.002	0.003	0.003
Ni	a		GFFA	0.002-1		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Alk	a		SM	1-1000		160	125	125	130	160	160	200
Boron	a		GFFA	0.01-1.0		0.03	0.03	0.03	0.03	0.03	0.09	0.08
T.O.C								2	2			

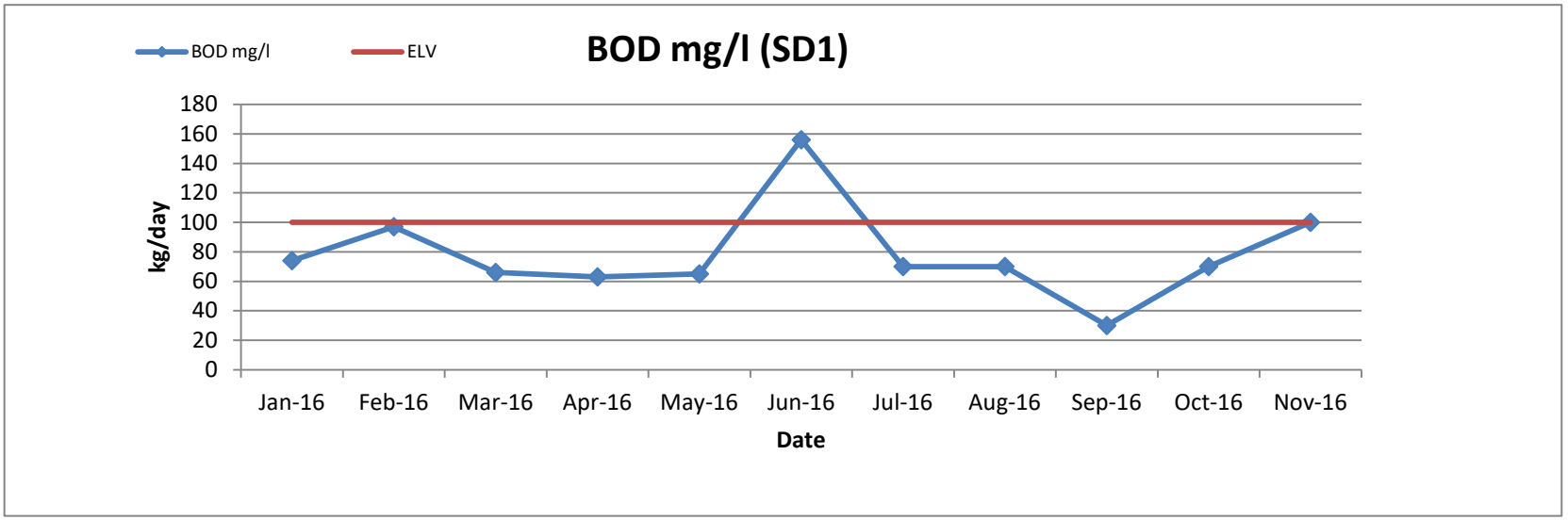
Emission Poi SD1
Location: Sewer Outlet
Year: 2016

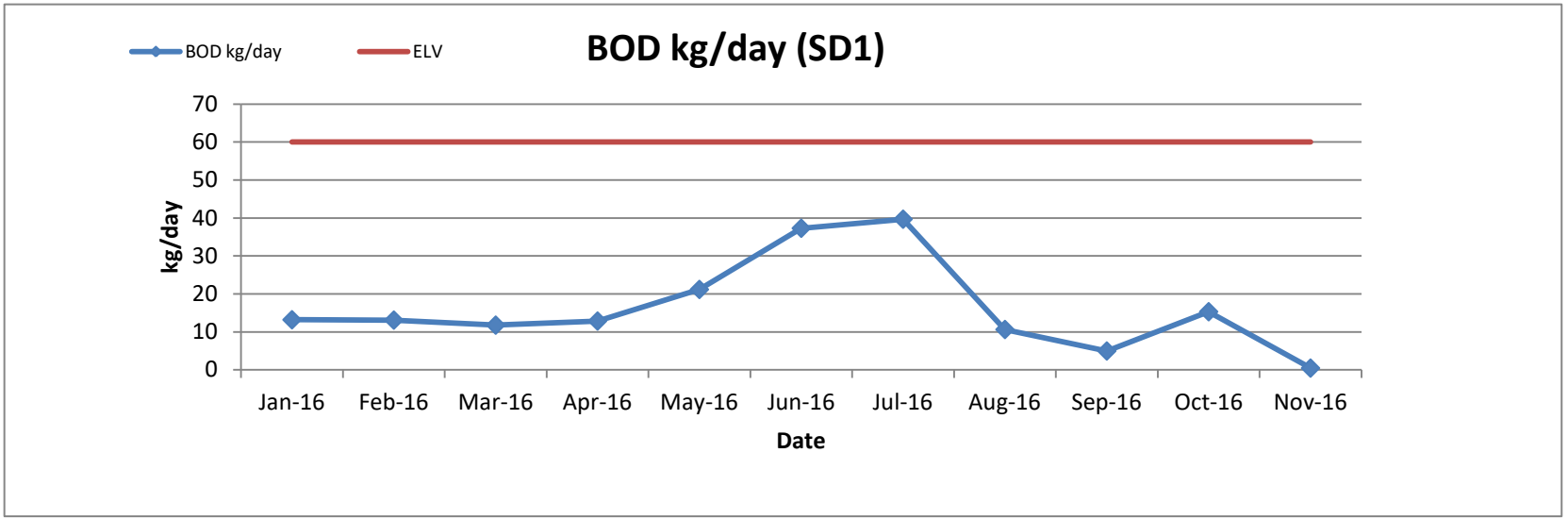
EMISSIONS TO SEWER 2016 (mg/l)

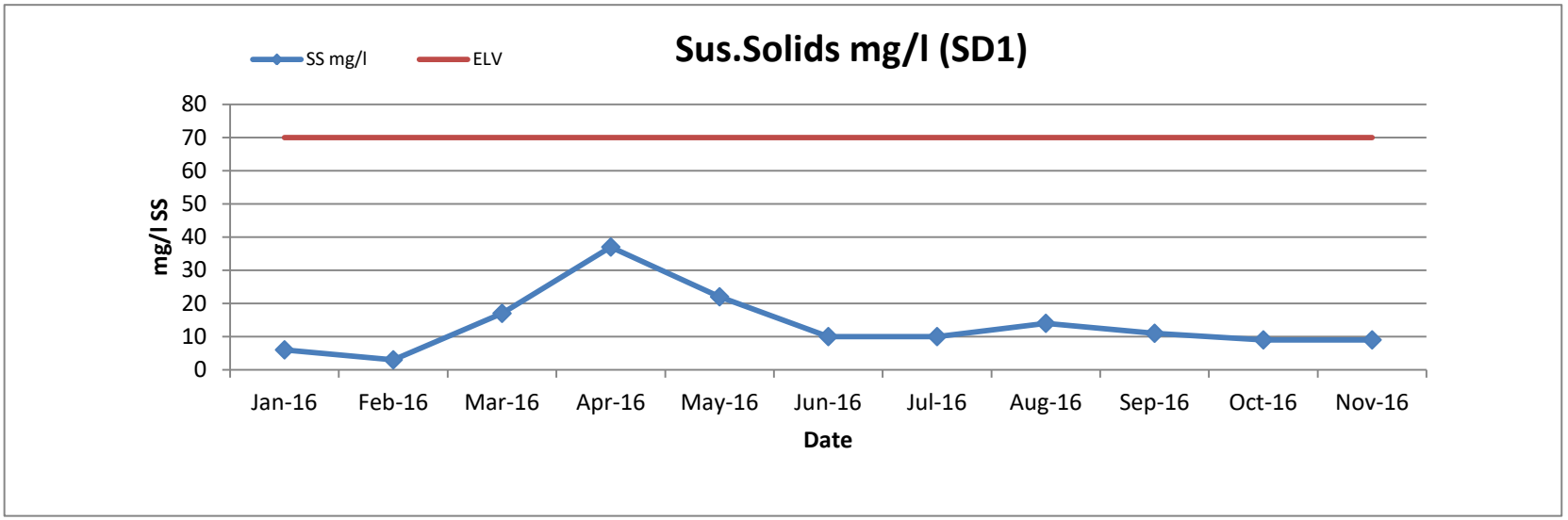
			mg/l	kg/d	mg/l	kg/d	mg/l	kg/d	mg/l	kg/d
DATE	M^3/day	pH	NH_4 mg/l	NH_4 kg/day	BOD mg/l	BOD kg/day	Sulphate mg/l	Sulphate kg/day	SS mg/l	SS kg/day
04/12/15	251	7.6	90	22.6	35	8.8	5	1.26	5	1.26
17/02/15	178.419	7.26	25	4.5	74	13.203006	5	0.9	6	1.1
11/03/15	135.178	7.1	75	10.1	97	13.112266	5	0.7	3	0.4
07/04/15	178.569	7.8	87	15.5	66	11.785554	5	0.9	17	3.0
19/05/15	204.131	7.4	24	4.9	63	12.860253	5	1.0	37	7.6
09/06/15	325.89	7.9	230	75.0	65	21.18285	5	1.6	22	7.2
15/07/15	239.091	7.9	300	71.7	156	37.298196	5	1.2	10	2.4
25/08/15	566.894	7.7	250	141.7	70	39.68258	5	2.8	10	5.7
08/09/15	151.992	7.5	180	27.4	70	10.63944	5	0.8	14	2.1
22/10/15	165.884	8.1	180	29.9	30	4.97652	5	0.8	11	1.8
10/11/15	218.863	7.8	90	19.7	70	15.32041	5	1.1	9	2.0
04/12/15	4.73	7.9	180	0.9	100	0.473	5	0.0	9	0.0

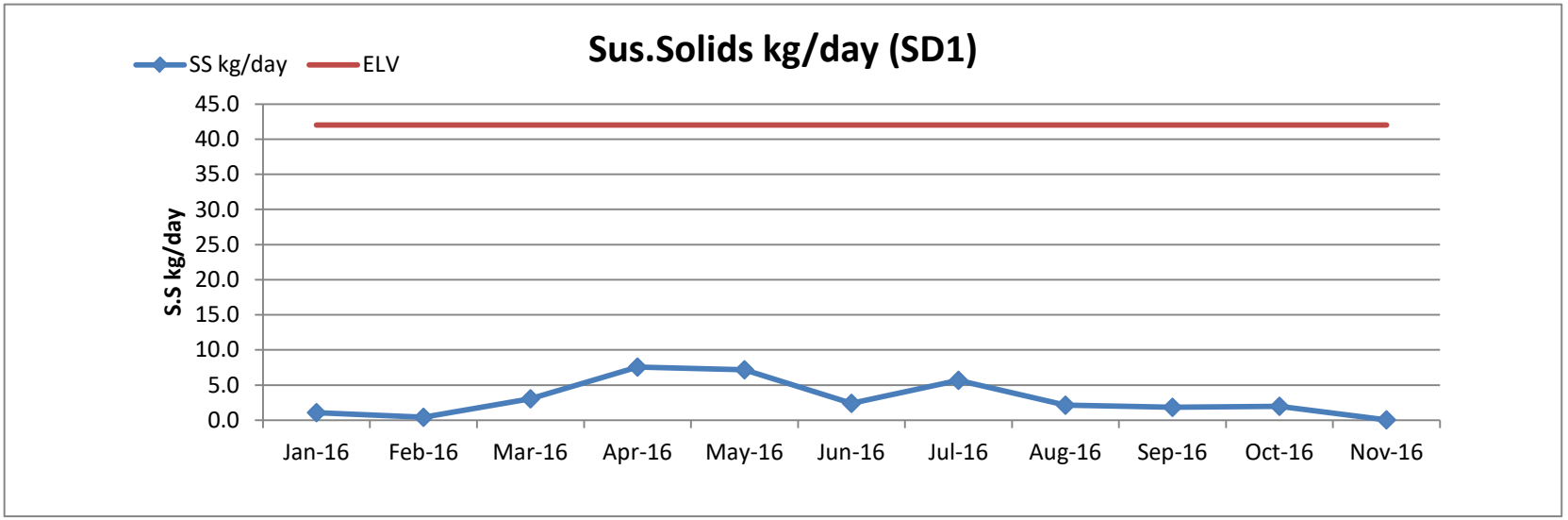

Ammonia (as N)
ELV
Ammonia (as N) SD1
450
400
350
300
250
200
150
100
50
0
mg/l
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Date

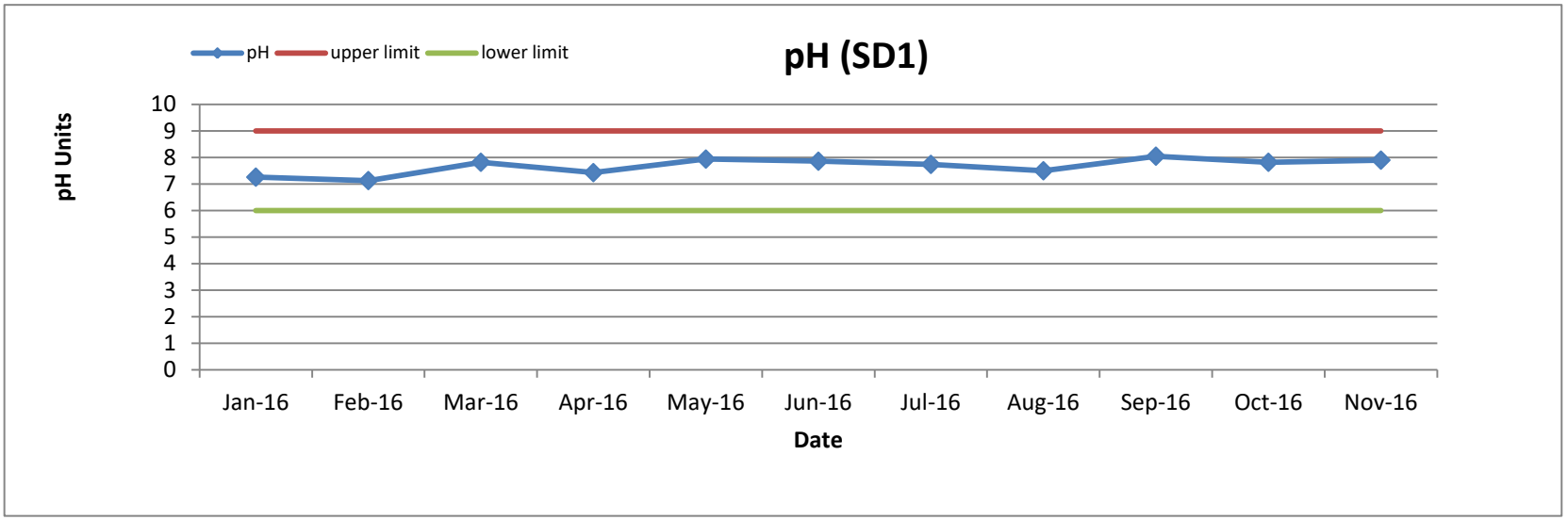

Ammonia (as N) kg/day
ELV
Ammonia (as N) kg/day (SD1)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
kg/day
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Date


BOD mg/l
ELV
BOD mg/l (SD1)
180
160
140
120
100
80
60
40
20
0
kg/day
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Date


BOD kg/day
ELV
BOD kg/day (SD1)
70
60
50
40
30
20
10
0
kg/day
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Date


Sus.Solids mg/l (SD1)
SS mg/l
ELV
80
70
60
50
40
30
20
10
0
mg/l SS
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Date

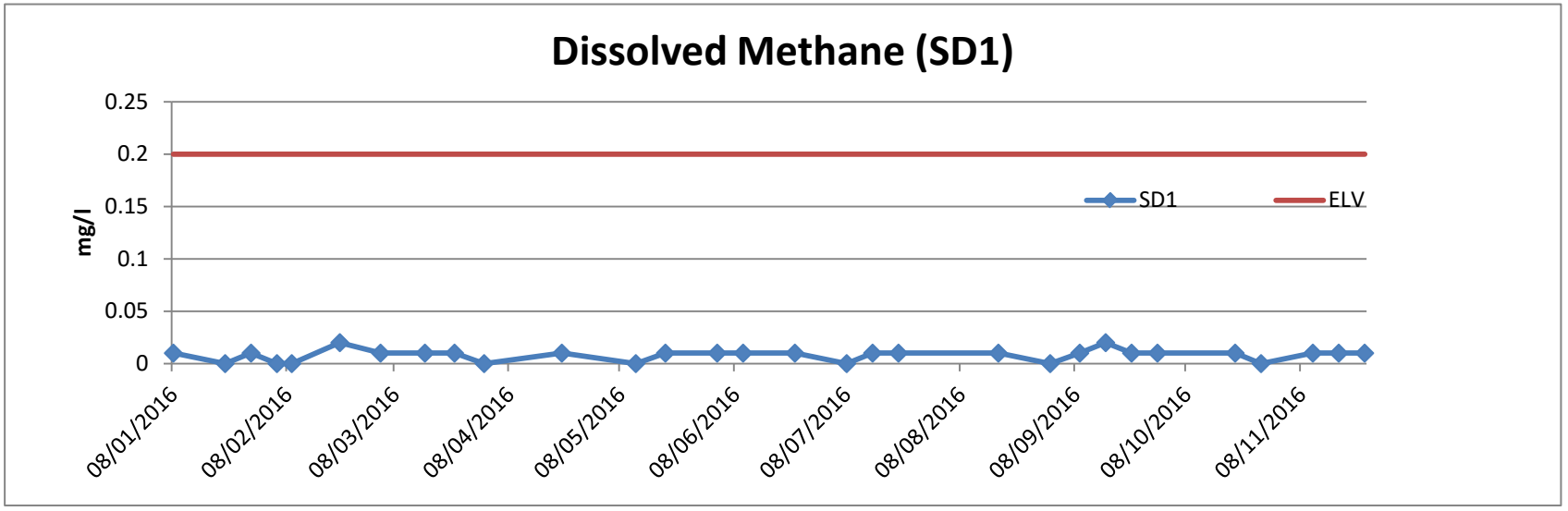

Sus.Solids kg/day (SD1)
SS kg/day
ELV
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
S.S kg/day
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16


pH
upper limit
lower limit
pH (SD1)
pH Units
10
9
8
7
6
5
4
3
2
1
0
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Date

Emission Point: **SD1**
Location: **Sewer Outlet** **Parameter:** **Dissolved Methane**
Parameter: **Dissolved Methane**

Date	Inlet (Balance Tank)(mg/l)	FHS Tank (mg/l)	SD1	ELV
08/01/2016	0.37	0.01	0.01	0.2
22/01/2016	0.33	<0.01	<0.01	0.2
29/01/2016	0.88	0.01	0.01	0.2
05/02/2016	0.55	<0.01	<0.01	0.2
09/02/2016	0.03	<0.01	<0.01	0.2
22/02/2016	0.05	0.01	0.02	0.2
04/03/2016	0.56	0.01	0.01	0.2
16/03/2016	1.6	0.02	0.01	0.2
24/03/2016	0.81	0.02	0.01	0.2
01/04/2016	0.47	0.01	0	0.2
22/04/2016	0.61	0.01	0.01	0.2
12/05/2016	0.65	0.01	0	0.2
20/05/2016	0.78	0.02	0.01	0.2
03/06/2016	1.36	0.02	0.01	0.2
10/06/2016	1.31	0.01	0.01	0.2
24/06/2016	1.07	0.02	0.01	0.2
08/07/2016	1.6	0.02	0	0.2
15/07/2016	2.96	0.03	0.01	0.2
22/07/2016	0.59	0.02	0.01	0.2
18/08/2016	0.58	0.02	0.01	0.2
01/09/2016	0.56	0.01	0	0.2
09/09/2016	1.18	0.02	0.01	0.2
16/09/2016	0.36	0.01	0.02	0.2
23/09/2016	0.77	0.02	0.01	0.2

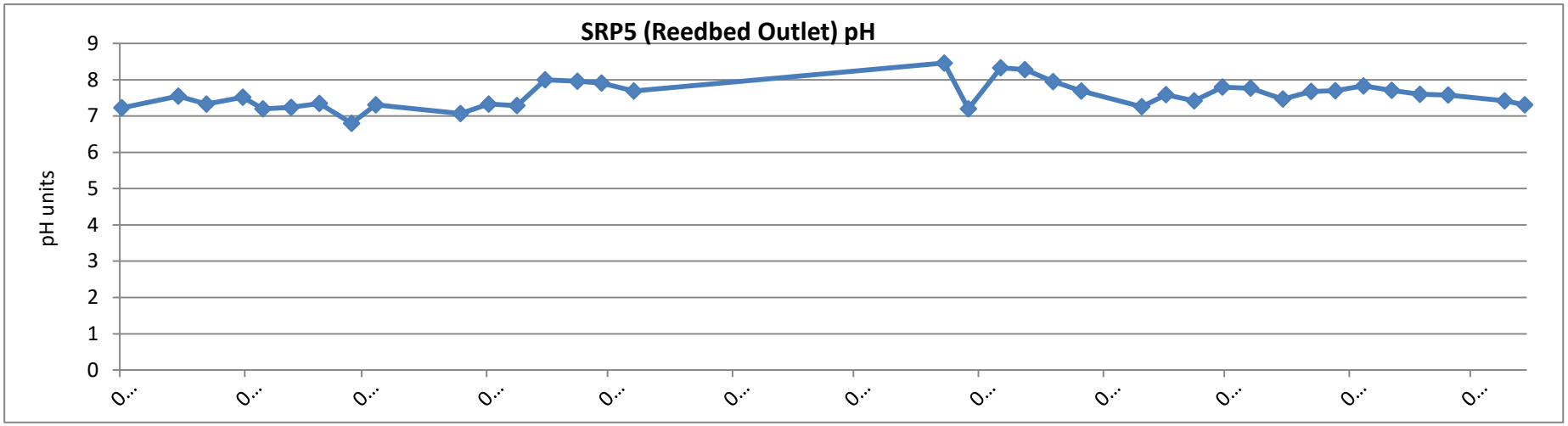
30/09/2016	1.04	0.02	0.01	0.2
21/10/2016	0.64	0.02	0.01	0.2
28/10/2016	1.71	0.03	0	0.2
11/11/2016	1.26	0.01	0.01	0.2
18/11/2016	0.04	0.01	0.01	0.2
25/11/2016	0.98	0.01	0.01	0.2

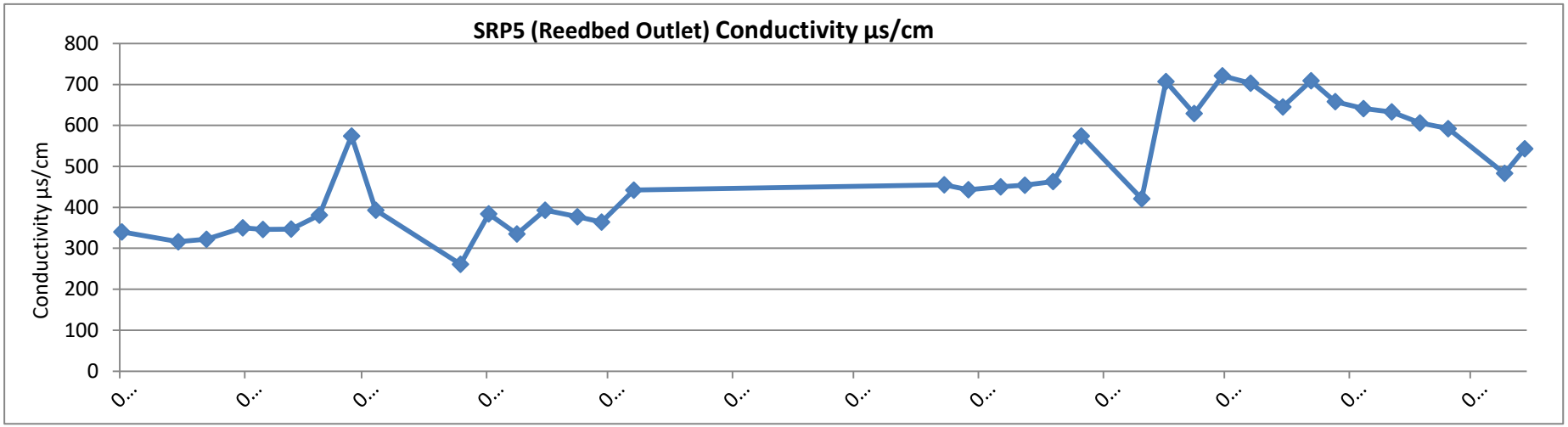


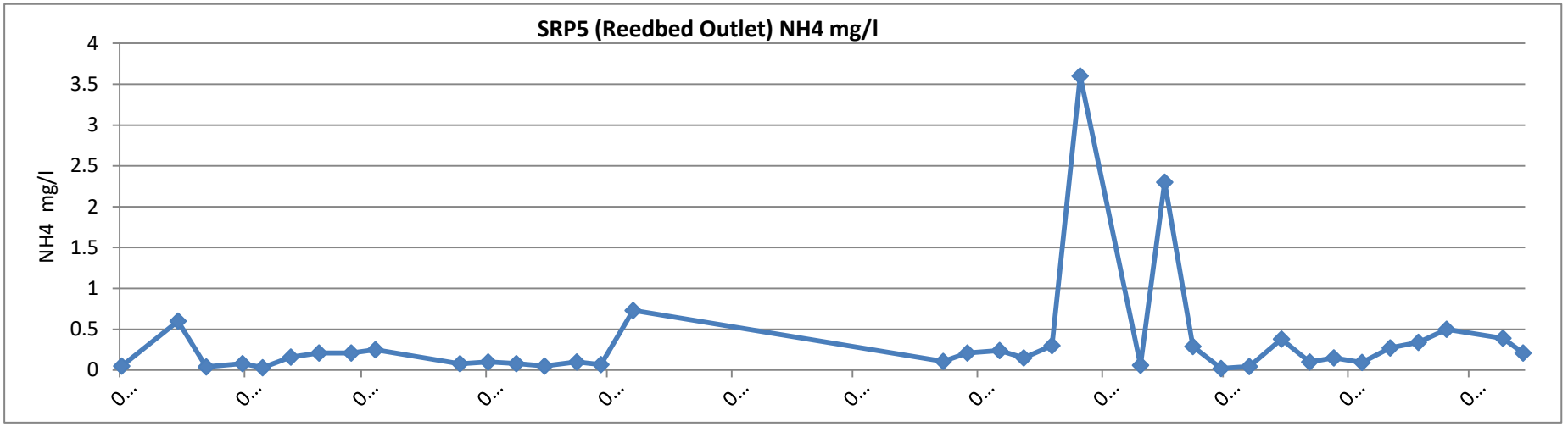
Stormpond Reedbed Outlet Parameter Data

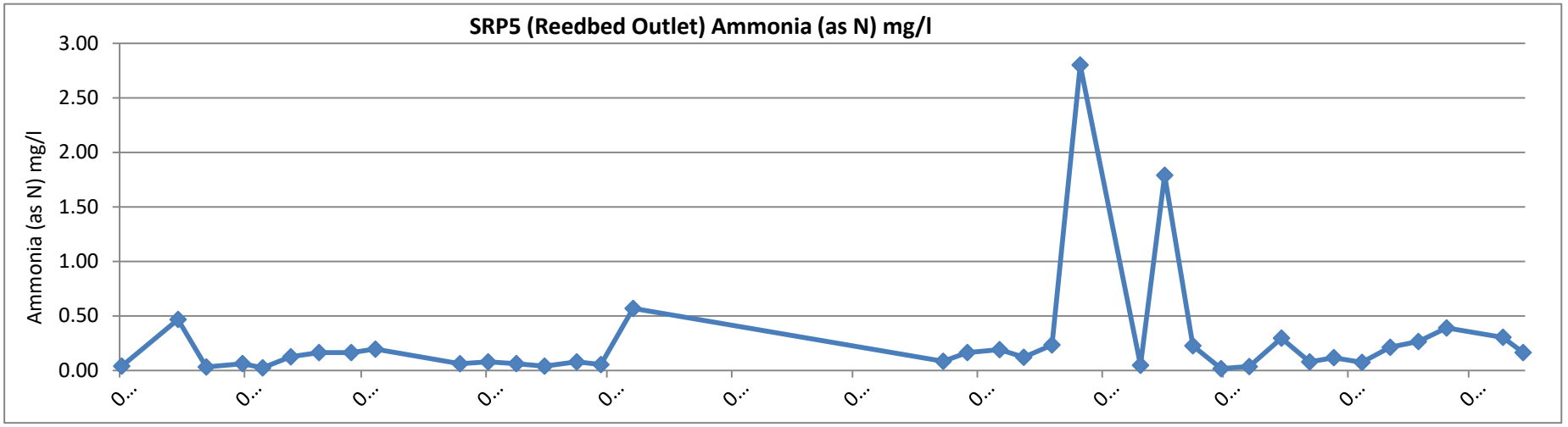
All data in mg/l unless stated otherwise

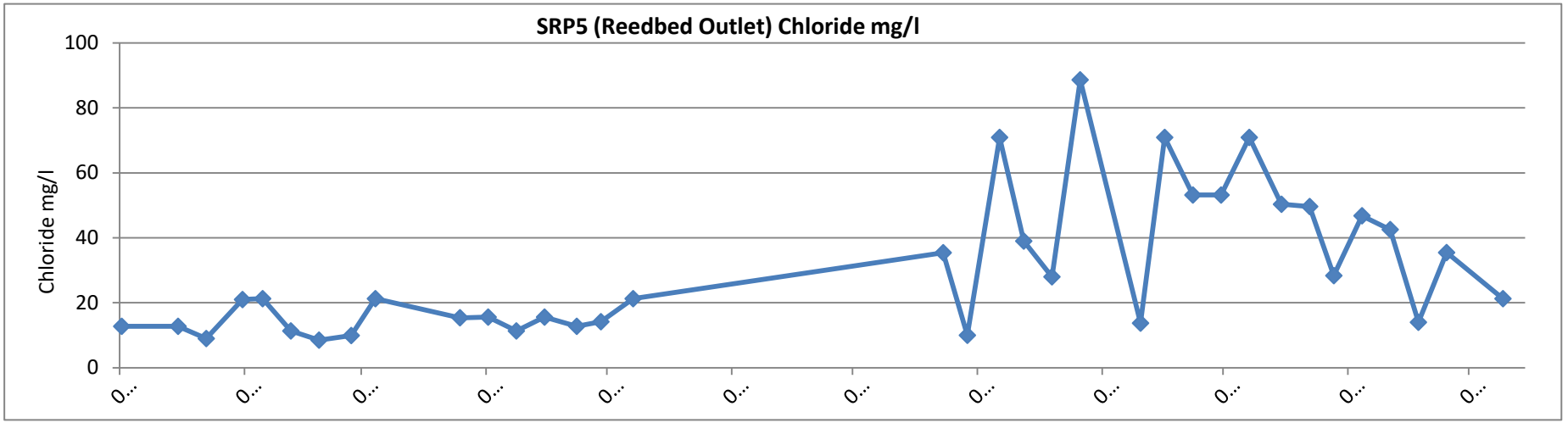
Date	Temp *C	pH	Conductivity µs/cm	NH4	Ammonia (as N)	Chloride	COD	TOC	BOD	Suspended solids
06/01/2016	8.1	7.23	340	0.05	0.04	12.76	0	6.1	1	1.2
20/01/2016	8.3	7.55	316	0.6	0.47	12.76	0	6.5	0.6	3.2
27/01/2016	10.3	7.33	322	0.04	0.03	9	30	6.7	1.38	2.4
05/02/2016	10.2	7.52	350	0.08	0.06	21	12	6.2	1.11	0.8
10/02/2016	11.4	7.2	346	0.03	0.02	21.27	38	7.1	1.64	4
17/02/2016	12.8	7.24	347	0.16	0.12	11.34	17	6.5	1.91	4
24/02/2016	12.7	7.35	381	0.21	0.16	8.51	30	10.8	2.1	4
03/03/2016	15.8	6.8	574	0.21	0.16	9.93	93	9.6	1.54	4
09/03/2016	14.2	7.31	393	0.25	0.19	21.27	31	12.2	2.69	4
30/03/2016	6.2	7.07	261	0.079	0.06	15.4	12	5.6	1.86	0.4
06/04/2016	13.7	7.33	384	0.1	0.08	15.6	15	8	1.24	0
13/04/2016	15.4	7.29	335	0.08	0.06	11.34	18	7	1.01	4
20/04/2016	15.8	8	393	0.05	0.04	15.6	16	8.3	2.02	8
28/04/2016	15.4	7.96	377	0.1	0.08	12.76	20	11.1	1.92	8
04/05/2016	17.4	7.91	364	0.068	0.05	14.18	17	4.9	1.54	0
12/05/2016	17.6	7.69	442	0.73	0.57	21.27	34	6.6	3.02	0
28/07/2016	22.6	8.46	455	0.107	0.08	35.42	48	3	1.22	4
03/08/2016	17.5	7.2	443	0.21	0.16	10	36	5.2	1.11	1.2
11/08/2016	21	8.33	450	0.24	0.19	70.9	38	16.4	3.16	0
17/08/2016	20.9	8.28	454	0.15	0.12	39	54	17.6	6.12	4
24/08/2016	19.5	7.95	463	0.3	0.23	28	39	5.4	1.95	2.4
31/08/2016	23.8	7.69	574	3.6	2.80	88.62	45	17.5	4.01	4
15/09/2016	20.6	7.26	421	0.06	0.05	13.74	16	4.2		3.2
21/09/2016	18.8	7.59	707	2.3	1.79	70.9	31	14.9	7.59	4
28/09/2016	20.4	7.42	629	0.29	0.23	53.18	54	18.2	1.82	4
05/10/2016	18.6	7.8	721	0.02	0.02	53.17	43	14.6	1.42	4
12/10/2016	17.3	7.77	703	0.045	0.04	70.9	33	3	1.56	4
20/10/2016	11.7	7.47	645	0.38	0.30	50.33	4	15.1	0.93	0.8
27/10/2016	16.9	7.68	709	0.1	0.08	49.63	28	12.4	1.51	4
02/11/2016	15	7.7	658	0.15	0.12	28.36	32	13.6	2.42	8
09/11/2016	10.1	7.83	641	0.0944	0.07	46.79	29	13.7	2.51	2.4
16/11/2016	15.8	7.71	633	0.272	0.21	42.54	32	13.2	2.26	0
23/11/2016	8.1	7.6	606	0.34	0.26	14	51	11.8	3.07	1.6
30/11/2016	10.9	7.58	592	0.5	0.39	35.46	36	11.1	2.44	0
14/12/2016	15.6	7.42	483	0.39	0.30	21.27	54	17.9	2.42	4
19/12/2016	13.4	7.31	543	0.21	0.2		29	11.7		0

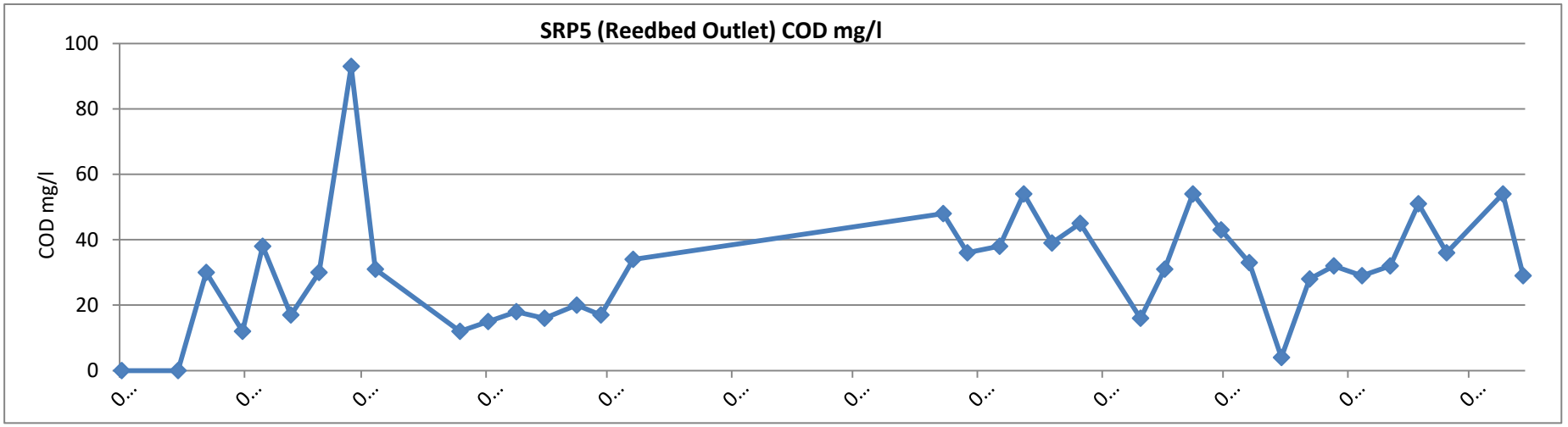

SRP5 (Reedbed Outlet) pH
pH units
9
8
7
6
5
4
3
2
1
0

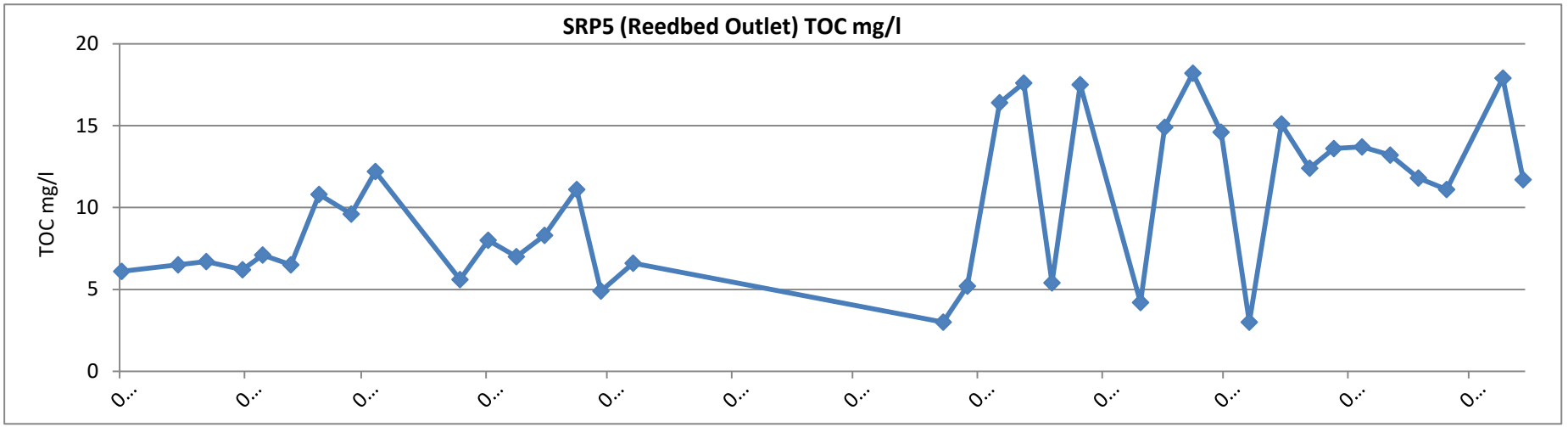

SRP5 (Reedbed Outlet) Conductivity µs/cm
Conductivity µs/cm
800
700
600
500
400
300
200
100
0

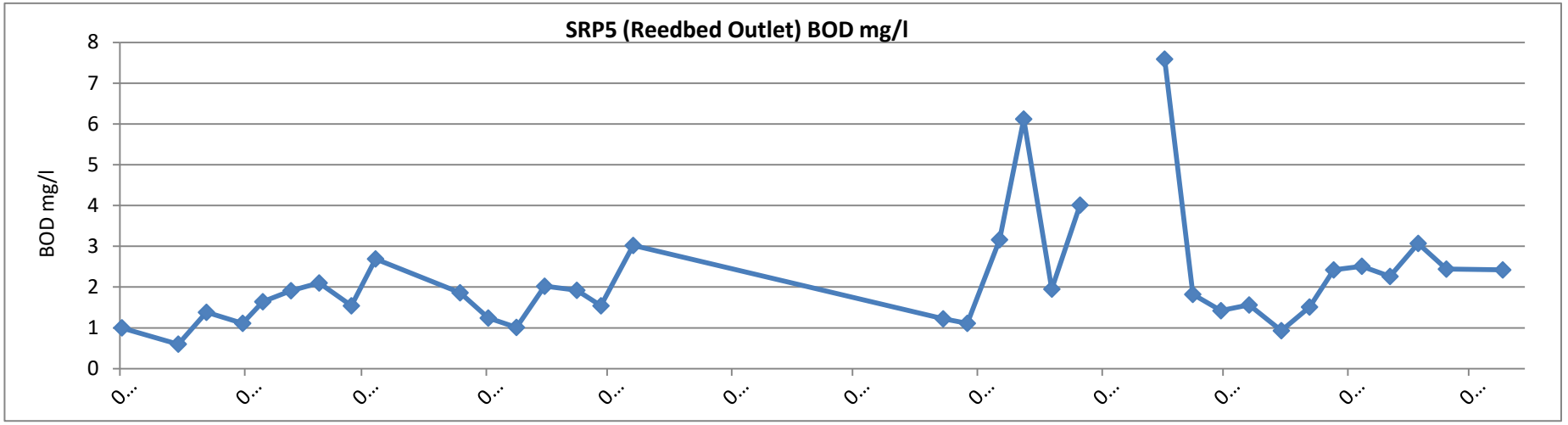

SRP5 (Reedbed Outlet) NH4 mg/l
NH4 mg/l
4
3.5
3
2.5
2
1.5
1
0.5
0

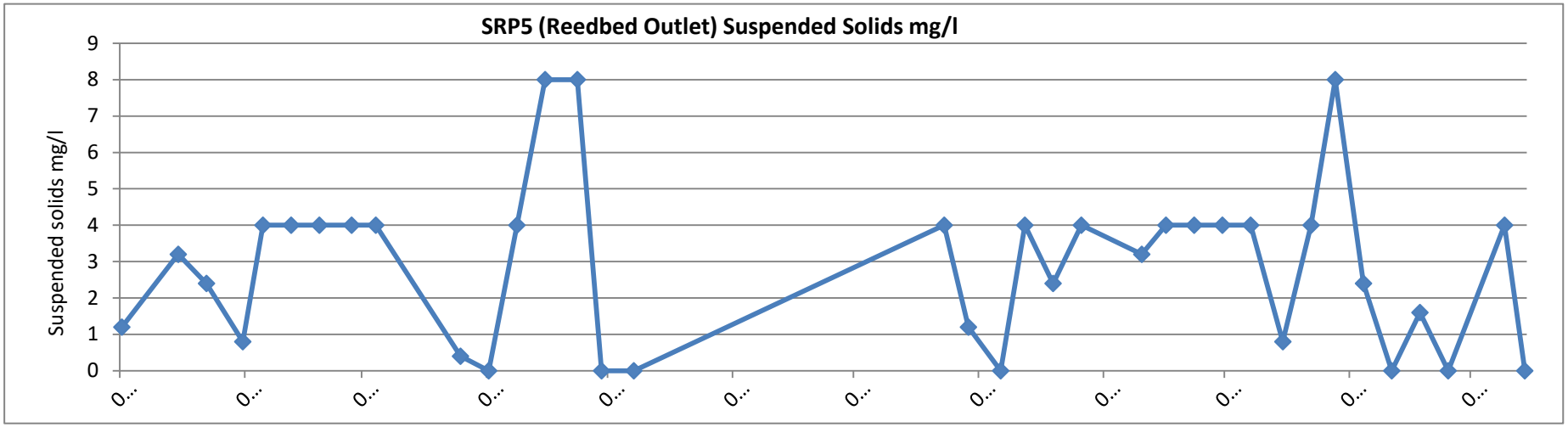

SRP5 (Reedbed Outlet) Ammonia (as N) mg/l
Ammonia (as N) mg/l
3.00
2.50
2.00
1.50
1.00
0.50
0.00


SRP5 (Reedbed Outlet) Chloride mg/l
Chloride mg/l
100
80
60
40
20
0


SRP5 (Reedbed Outlet) COD mg/l
COD mg/l
100
80
60
40
20
0


SRP5 (Reedbed Outlet) TOC mg/l
TOC mg/l
20
15
10
5
0

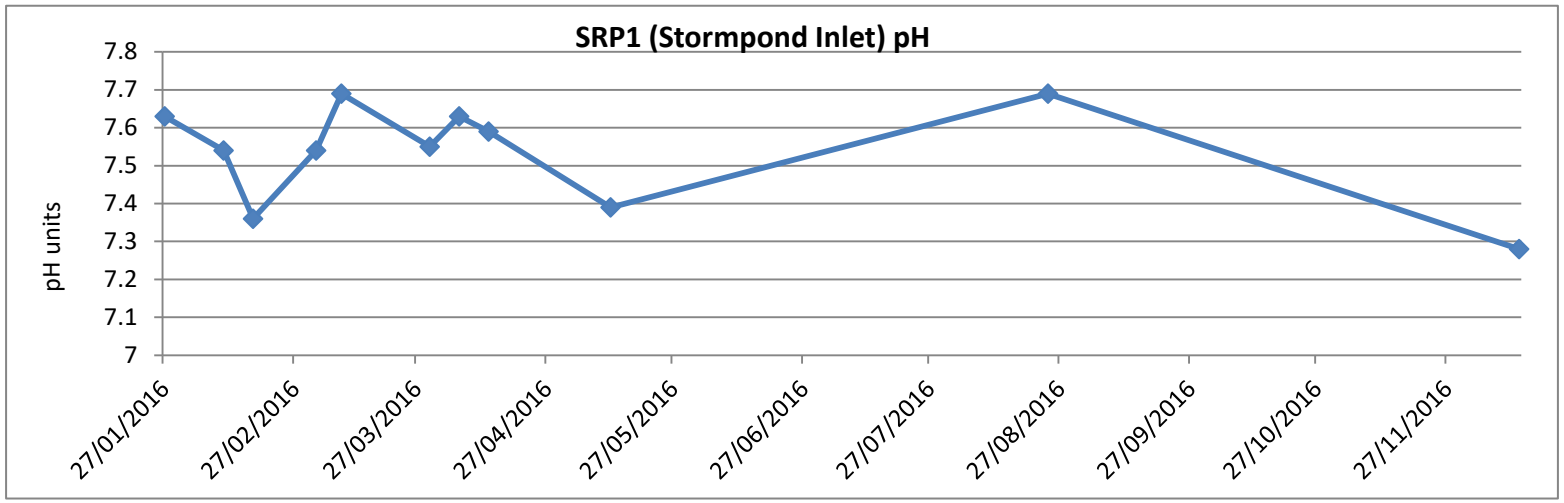

SRP5 (Reedbed Outlet) BOD mg/l
BOD mg/l
8
7
6
5
4
3
2
1
0

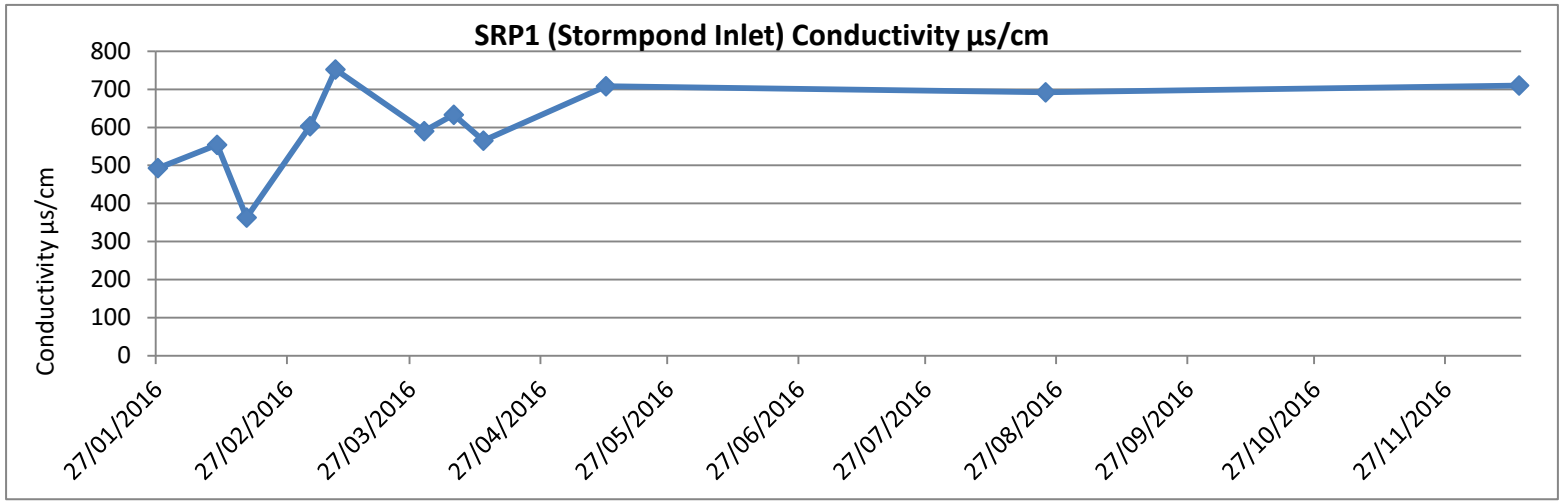

SRP5 (Reedbed Outlet) Suspended Solids mg/l
Suspended solids mg/l
9
8
7
6
5
4
3
2
1
0
0...
0...
0...
0...
0...
0...
0...
0...
0...
0...
0...
0...

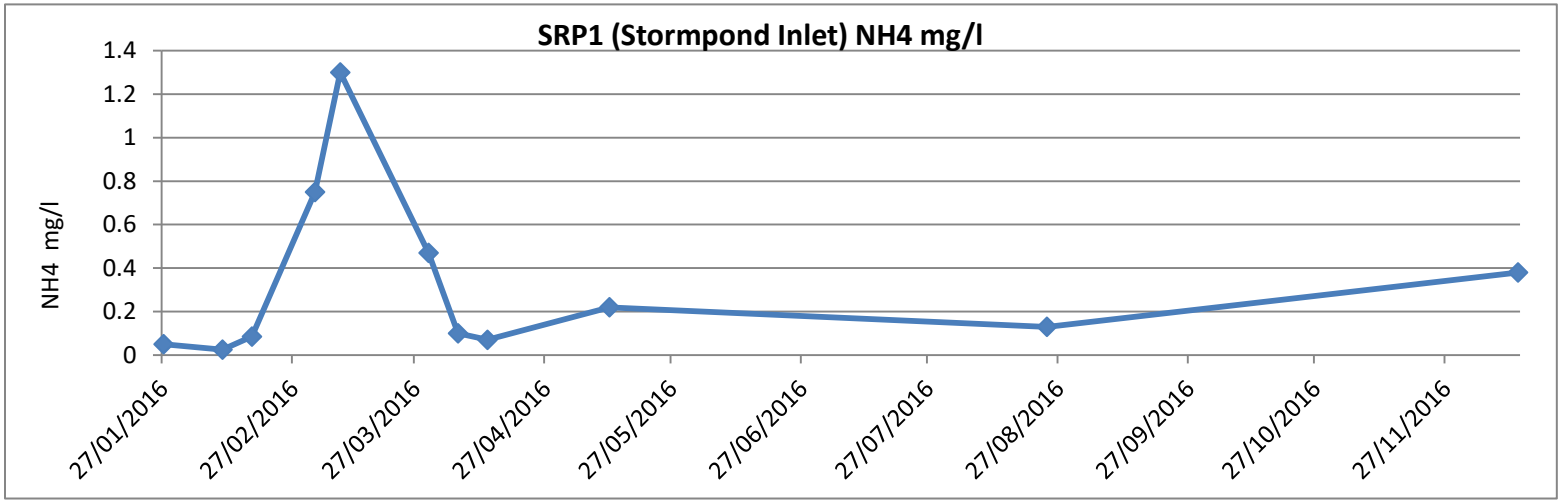
Stormpond Inlet Parameter Data

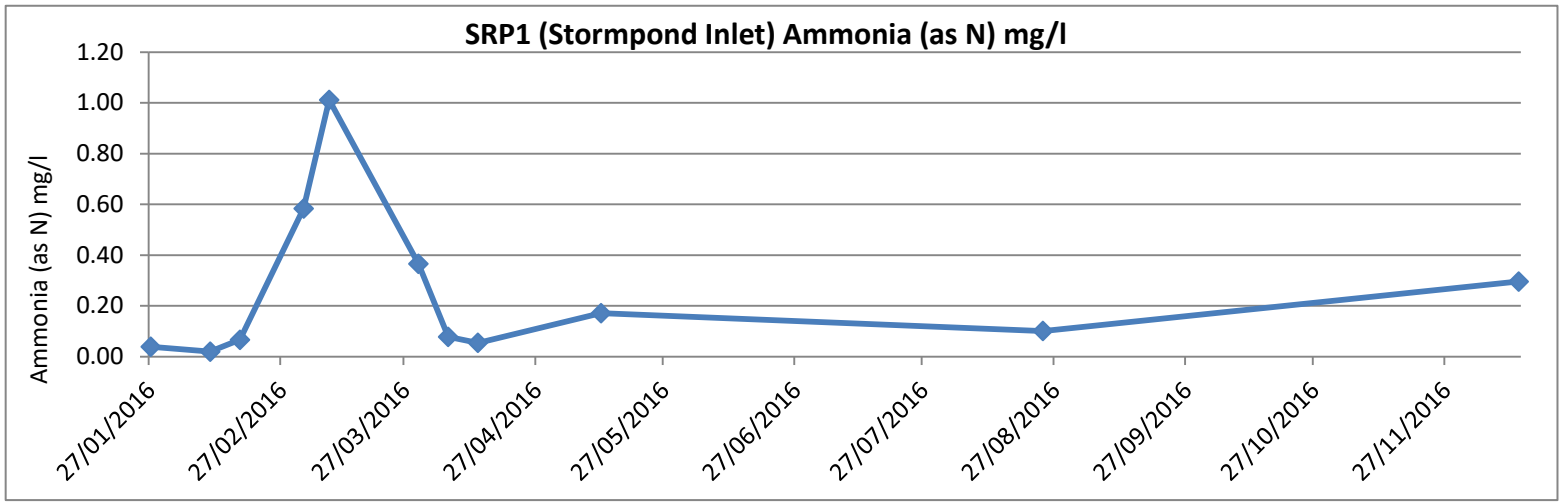
All data in mg/l unless stated otherwise

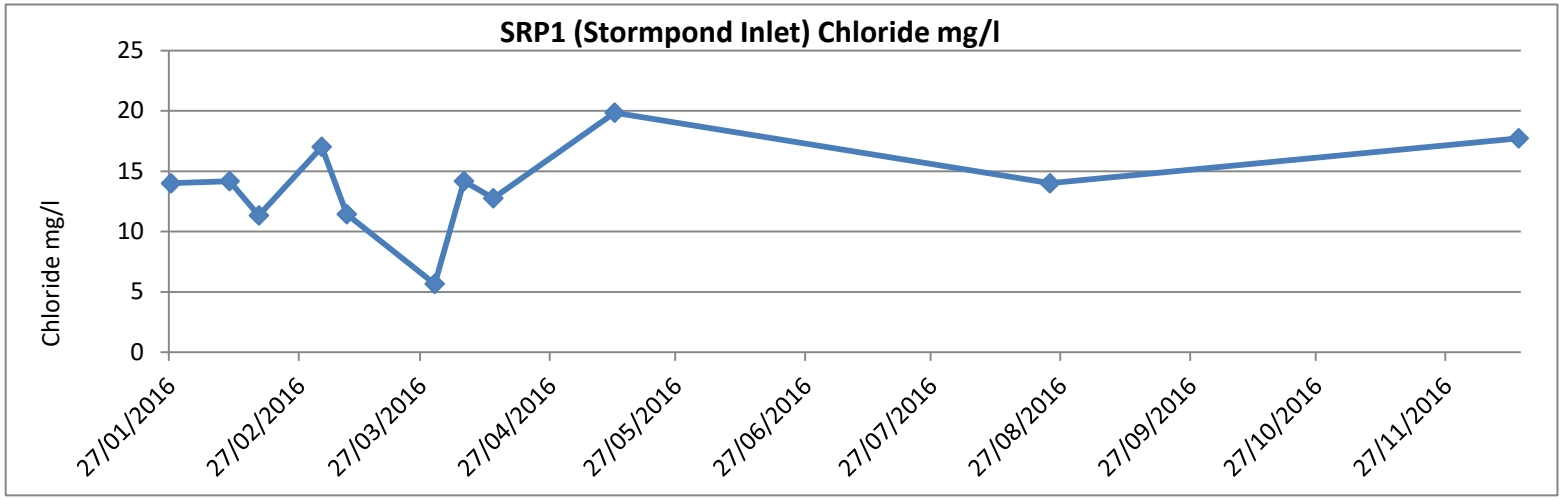
Date	Temp *C	pH	Conductivity µs/cm	NH4	Ammonia (as N)	Chloride	COD	TOC	BOD	Suspended solids
06/01/2016	8.3	7.62	547	0.03	0.02	12	24	4.8	0.65	2.8
20/01/2016	8.7	7.75	642	1.19	0.93	17	0	9.1	0.23	4
27/01/2016	10.3	7.63	493	0.05	0.04	14	22	3.6	0.89	0.8
10/02/2016	11.2	7.54	554	0.025	0.02	14.18	25	4.5	1.56	0
17/02/2016	12.8	7.36	363	0.085	0.07	11.34	14	2.6	1.65	8
03/03/2016	13.1	7.54	603	0.75	0.58	17.02	82	1.1	0.78	4
09/03/2016	11.9	7.69	752	1.3	1.01	11.44	38	14	4.15	8
30/03/2016	7.2	7.55	590	0.47	0.37	5.67	16	6.8	2.63	0.8
06/04/2016	14.8	7.63	633	0.1	0.08	14.18	14	7	1.01	4
13/04/2016	16.3	7.59	565	0.07	0.05	12.76	18	4.5	2.05	8
12/05/2016	18.8	7.39	708	0.22	0.17	19.85	45	12.5	3.02	4
24/08/2016	19.1	7.69	692	0.13	0.10	14	21	8.3	1.35	0.8
14/12/2016	15.5	7.28	710	0.38	0.30	17.73	21	11	1.86	4

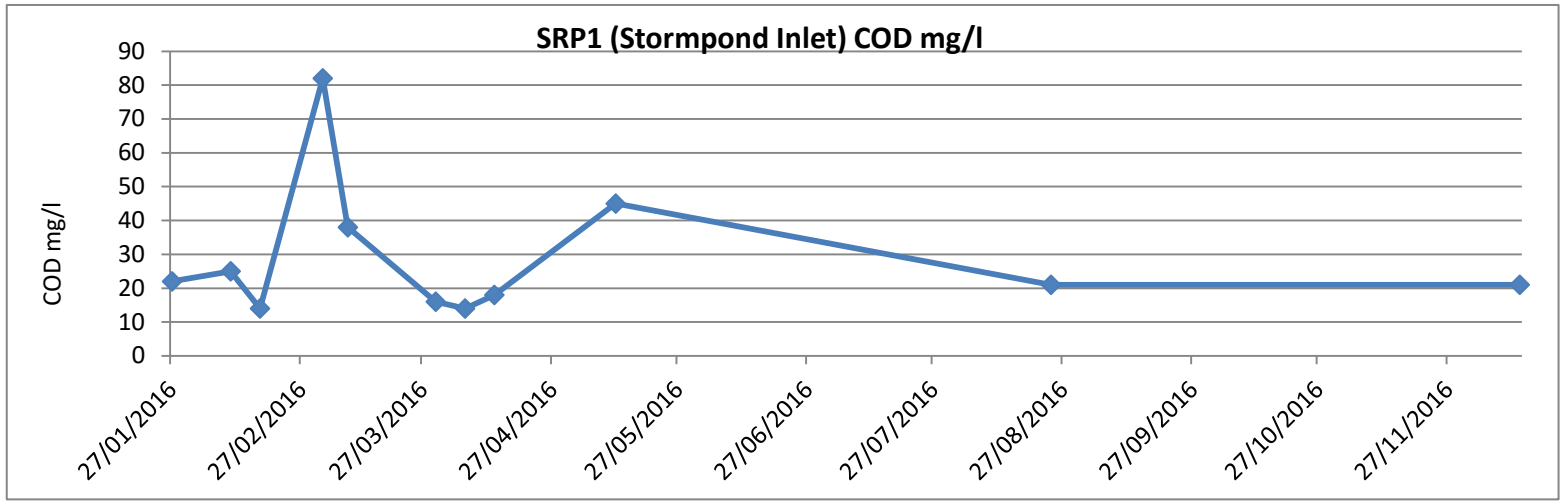


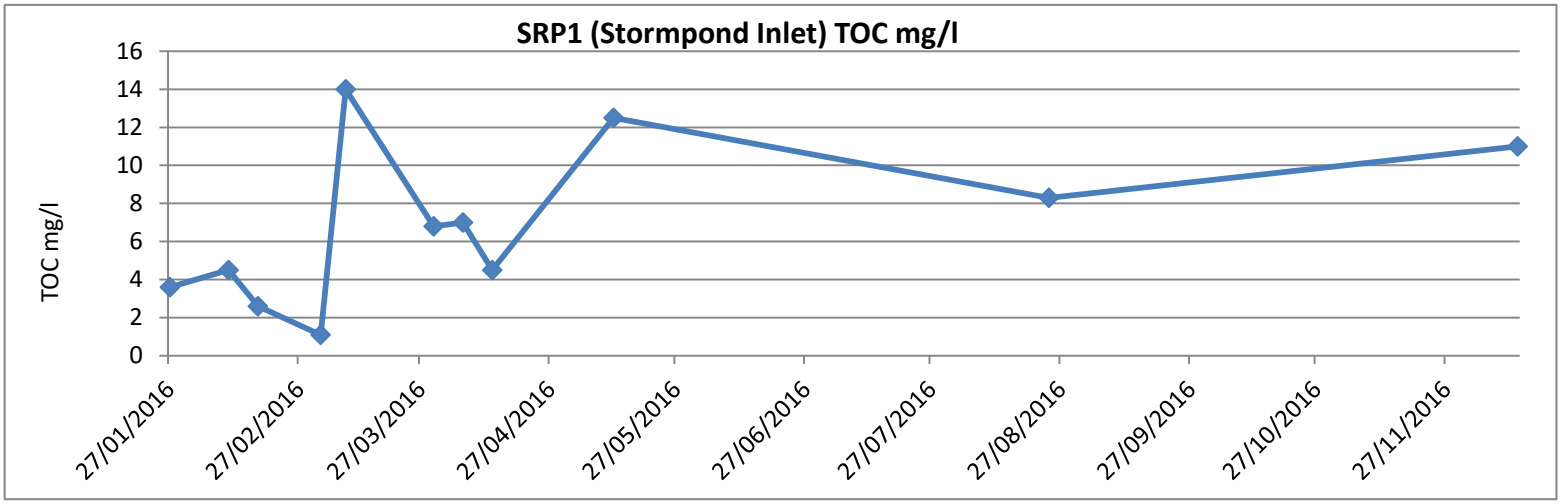

SRP1 (Stormpond Inlet) Conductivity µs/cm
Conductivity µs/cm
800
700
600
500
400
300
200
100
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016

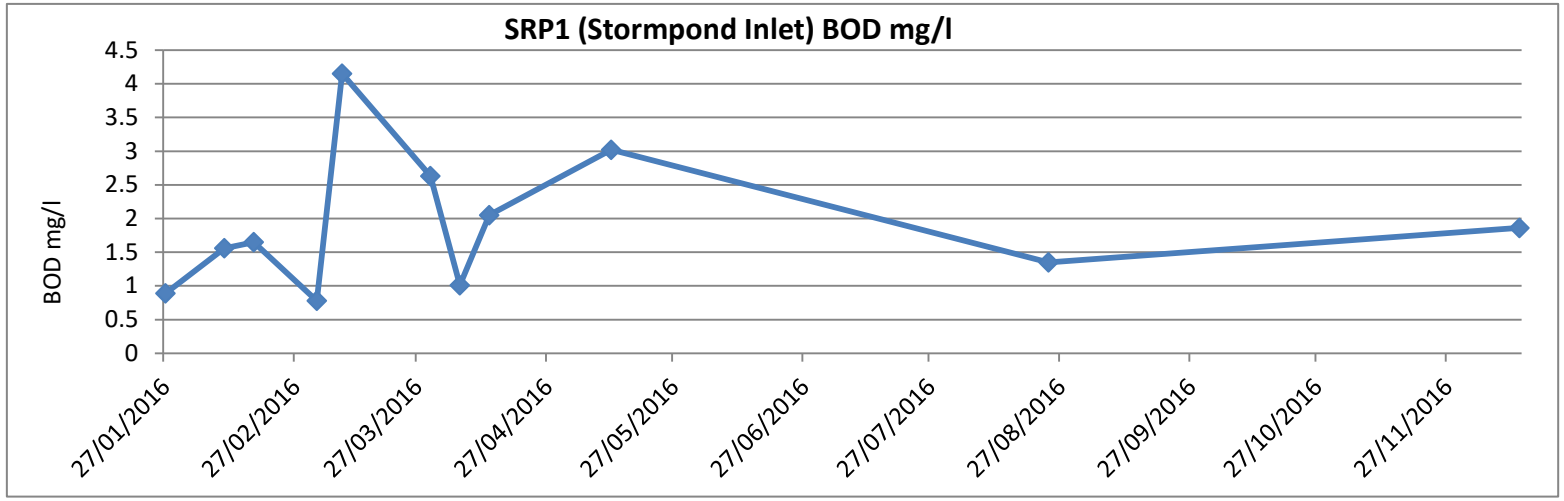

SRP1 (Stormpond Inlet) NH4 mg/l
NH4 mg/l
1.4
1.2
1
0.8
0.6
0.4
0.2
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016

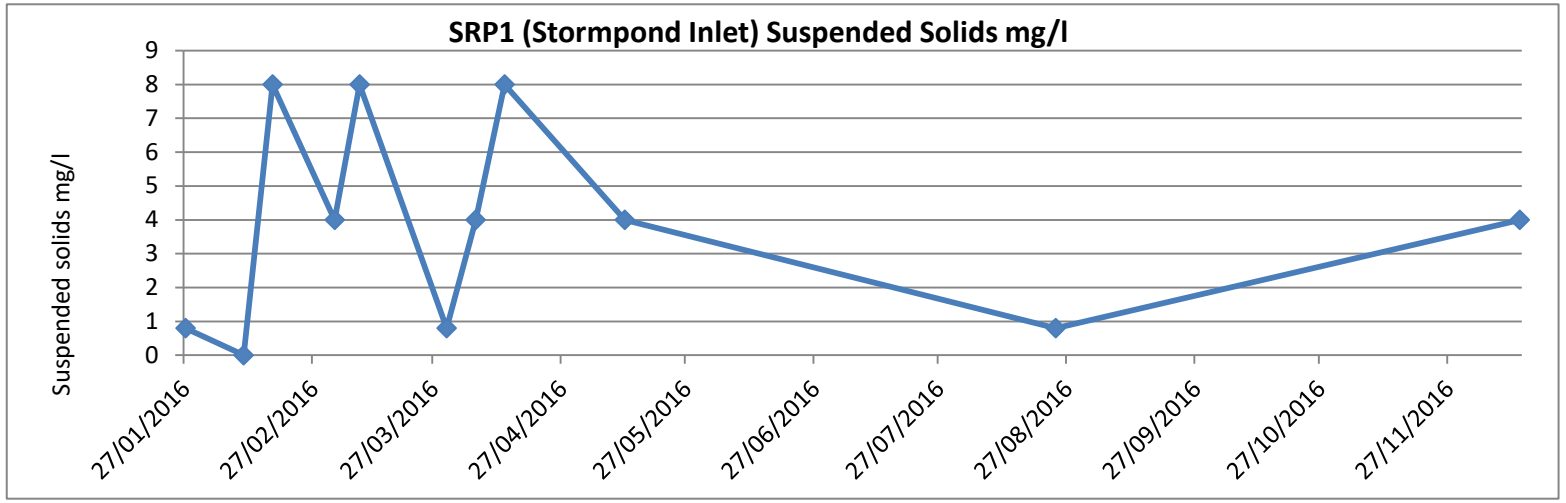

SRP1 (Stormpond Inlet) Ammonia (as N) mg/l
Ammonia (as N) mg/l
1.20
1.00
0.80
0.60
0.40
0.20
0.00
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016


SRP1 (Stormpond Inlet) Chloride mg/l
Chloride mg/l
25
20
15
10
5
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016


SRP1 (Stormpond Inlet) COD mg/l
COD mg/l
90
80
70
60
50
40
30
20
10
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016


SRP1 (Stormpond Inlet) TOC mg/l
TOC mg/l
16
14
12
10
8
6
4
2
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016


SRP1 (Stormpond Inlet) BOD mg/l
BOD mg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016


SRP1 (Stormpond Inlet) Suspended Solids mg/l
Suspended solids mg/l
9
8
7
6
5
4
3
2
1
0
27/01/2016
27/02/2016
27/03/2016
27/04/2016
27/05/2016
27/06/2016
27/07/2016
27/08/2016
27/09/2016
27/10/2016
27/11/2016

AN ASSESSMENT OF THE WATER QUALITY STATUS OF SELECTED SITES ON THE TRAMORE AND TRABEG RIVERS USING BIOLOGICAL METHODS

(December - 2016)

Commissioned by: Cork City Council
Carried out by: Aquatic Services Unit – UCC.
(January 2017)

Introduction

As part of the their waste licence conditions for the Kinsale Road Landfill, Cork City Council commissioned the Aquatic Services Unit, to undertake a biological assessment of the water quality status of selected sites on the Tramore and Trabeg rivers. Both rivers flow adjacent to or through the site of the landfill and have in the past, at least, been impacted by leachate from the landfill. Due to a misunderstanding this year about the go-ahead for the work, the fieldwork for the 2016 monitoring was not undertaken until December 22nd 2016.

Methods

Two samples (combined as one composite) were taken at each site using a kick-sample technique, where this was possible. Each sample was collected in areas of moderate to shallow swift current in coarse substrate usually comprising small to large stones and cobbles. The samples were then sieved to remove silt and poured into a white sorting tray. There the macroinvertebrates present are identified and their notional abundance estimated. The macroinvertebrate data arising is then assessed using the same biotic index system used by the Environmental Protection Agency (EPA) in their ongoing monitoring of biological quality in Irish rivers. The index assigns a score to the macroinvertebrate collection at a given site depending on the relative proportion of pollution sensitive and pollution tolerant organisms present. The greater the number and diversity of pollution sensitive types present (particularly, certain mayflies, stoneflies and cased caddis flies) the higher the score or quality class assigned to a given site. The highest score category is Q5 which indicates pristine water quality conditions and is recognised by having a high proportion of pollution sensitive species and very few or any pollution tolerant forms, whereas Q1 at the other end of the scale indicates gross pollution. The table below indicates the Q-value scores, which can be assigned and the corresponding degree of pollution associated with them.

Q-Value	**Degree of Pollution**
Q5, Q4-5, Q4	Unpolluted
Q3-4	Slightly Polluted
Q3, Q2-3	Moderately Polluted
Q2, Q 1-2, Q1	Serious to Gross Pollution

It's important to point out that few sites on the Tramore and Trabeg rivers have sites, which could be said to be ideal for this system of biological monitoring, and some are completely un-suitable (e.g. Sites A and B). In the latter cases the flow is very sluggish and the bottom material consists mainly of mud and submerged macrophytes. In these cases the samples are collected as nets weeps through submerged macrophytes and surface sweeps through the underlying mud, and general observations and experience are used in order to gauge the likely biological water quality status. Furthermore, the second most upstream site on the Tramore River at the 'ford' within the landfill was partially modified since the survey in 2009 by the installation of a crump weir for discharge gauging. This weir has resulted in the water upstream becoming stiller and more sluggish than usual and this appears

to be increasing the rate of siltation and plant encroachment at Site C upstream of the landfill, which in 2013 was even more pronounced. However, in 2015 this weir was undercut and there is now a strong flow at this point again and no ponding in the immediate upstream stretch.

Results

Samples were taken on December 22nd 2016 at sites the positions for which were agreed with the EPA and listed in the conditions of the licence.

Site A *(Trabeg River: Upstream Site*)

At the time of sampling this site had been completely altered since recent previous surveys in that all the right bank vegetation had been removed and the channel widened and dredged (Plate 1). There were almost no instream macrophytes in evidence apart from a few scattered plants of Water starwort (*Callitriche* sp.), and Watercress (?) and a small amount of Duckweed (*Lemna* sp.). The flow was extremely slow, turbid and grey and the bottom was soft. There was virtually no shade as the banks were open. The left bank was dominated by bramble with an understory of winter heliotrope (*Petasites fragrans*), while there was no vegetation along the right bank after this had been levelled. The sample comprised a net sweep through the water column marginally and the shallow surface mud. The Q-rating was the same as in 2015.

Common Name of Group	**Scientific Name**	**Notional Abundance**
Non-biting Midges	*Chironomus*	+
Non-biting Midges	Chironomidae	++
Water boatmen	Corixidae	+/+
FW Shrimp	*Gammarus*	++/+
Water Hoglouse	*Asellus aquaticus*	++/+++
Wandering snail	*Lymnea peregra*	+
Pea mussels	*Sphaeridae*	++++D
Flat worms	*Polycelis nigra*	+
Segmented worms	*Lumbriculidae*	+/+
EPA Q-value		**Q2-3**

Site B *(Trabeg River: 2nd Site Downstream)*

Like Site A, this site had also been drained and the right bank levelled. Again, submerged macrophytes had been removed and only a small amount of *Lemna* was noted marginally. All the Common reed (*Phragmites*) that had previously grown along the right bank had been levelled, whereas the left bank was still dominated by the species as previously (Plate 2) Like Site A, the conditions were unsuitable for Q-ratings because of the muddy substrate and almost standing water conditions.

Conditions as revealed in the kick-sample were similar to last year although again with a lower diversity, and a Q-rating of Q2 is suggested.

Common Name of Group	Scientific Name	Notional Abundance
Non-biting Midges	*Chironomus*	++
Non-biting Midges	Chironomidae	+++
Back swimmer (water bug)	Notonecta	+
FW Shrimp	*Gammarus*	++/+
Water Hoglouse	*Asellus aquaticus*	++++
Segmented worms	*Tubificidae*	+/+
EPA Q-value		**Q2**

Site C *(Tramore River: most upstream site within the landfill boundary)*

This site is at a fording point in the Tramore River within the precincts of landfill and at the same point is crossed by a kind of bridge for carrying pipes. In 2009 a crump weir was built at this site for flow gauging and this had the effect of creating a very shallow stilling basin immediately upstream, with water backed-up and very laminar. However, in 2015, the weir was undercut and the water level upstream has clearly dropped, which remained the case in 2016 (Plate 3), creating faster shallower flows and giving rise to an 8m length of riffle/run habitat over the limestone cobble substrate upstream of the weir. Upstream, instream and marginal stands of *Typha* and *Sparganium erectum* had seasonally died back (Plate 4) and so also was the normally heavy cover of *Potamogeton natans* immediately upstream of these tall herb stands, which was completely absent due to the late season sampling. Some marginal Brooklime (*Veronica beccabunga*) was in evidence. The kick-samples were taken in the main flow immediately upstream of the weir in a spot with a moderate to swift flow over gravel and cobble. At and immediately upstream of this point the substrate had an extensive cover of sewage fungus and algal scum and there was a strong smell of sewage at the site. The results are at presented in the table below. They indicate marginally more impaired conditions compared to 2015.

Macroinvertebrates in Site C kick-samples

Common Name of Group	Scientific Name	Notional Abundance
Non-biting Midges	Chironomidae	+++/++++
Non-biting Midges	*Chironomus*	+++/++++
Wandering Snail	*Lymnaea peregra*	++/+++
Water Hoglouse	*Asellus aquaticus*	++++D
EPA Q-value		**Q2**

Site D *(Tramore River: 2nd site downstream of boundary)*

The sampling point is at a constriction in the river where the channel flows over a small loose limestone cobble-boulder weir (Plate 5) immediately downstream of a sluggish stretch, which is normally dominated by Broad-leaved Pondweed which was absent at the time of sampling due to the December sampling date. The coarse angular cobble at and immediately upstream and downstream of the weir had a moderate growth of sewage fungus but no algae. Due to the seasonal die-back the banks were open and the channel unshaded. The right bank was dominated by bramble, grass and Hemlock water dropwort (*Oenanthe crocata*) along the bank's margin backed by Willow and Alder, while the left bank had grass, creeping buttercup, nettle and *O. crocata* in the foreground backed by Willow and Alder.

In channel, the substrate of the kick-sampling area just upstream of the weir comprised small angular limestone cobbles and gravel in moderate to swift turbulent flow. The water was very cloudy and turbid the assigned Q-rating was the same as in 2015, although the quality was considered to be marginally more impaired.

Kick-sample results Site D:

Common Name of Group	**Scientific Name**	**Notional Abundance**
Mayflies	*Baetis*	+
Non-biting Midges	Chironomidae	++
Blackfly larvae	Simuliidae	+
Freshwater shrimp	*Gammarus*	+
Water Hoglouse	*Asellus aquaticus*	++++D
Pea mussels	Sphaeridae	++
Leeches	*Helobdella stagnalis*	+/+
Leeches	*Erpobdellidae*	+/+
Leeches	*Glossiphonia complanata*	+/+
Segmented worms	*Lumbriculus*	++++D
Segmented worms	*Tufidicidae*	++/+++
EPA Q-value		**Q2-3**

Site E *(Tramore River upstream of the landfill: outside the boundary to the west)*

This sampling site is immediately downstream of Black Ash Bridge. The substrate here was coarse comprising boulders, small cobbles, gravel and coarse sand, with the larger elements at the time of sampling covered in sewage fungus (Plate 6), and no other instream vegetation present. At the time of sampling the flow was swift turbid and smelt of sewage.

The channel here is 2-3m wide and less shaded than usual because of a seasonal die-back of bankside vegetation, which was dominated on both sides by bramble, gorse and nettles. Water quality was similar to 2015.

Kick-sample results Site E:

Common Name of Group	Scientific Name	Notional Abundance
Non-biting Midges	*Chironomus*	+
Non-biting Midges	*Chironomidae*	+++/++++
Blackfly larvae	Simuliidae	+
Water Hoglouse	*Asellus aquaticus*	++
Segmented worms	Lumbriculidae	++++D
Leeches	Glossiphonia	+
Leeches	Erpobdellidae	+
EPA Q-value		**Q2**

Site F *(150m downstream of the confluence of the Tramore and Trabeg Rivers)*

This site was 150m to 200m downstream of the confluence of the Tramore and Trabeg Rivers. Samples were taken in a shallow riffle where the substrate comprised a mixture of small cobble and fine and coarse gravel in a moderate to swift flow. Due to the season, the normal cover of trailing filamentous algae was absent but a fine silted cover of sewage fungus was evident on larger substrate elements along with an underlying algal scum. There was much die-back in aquatic vegetation normally present along the low inundated bankside berms which are more developed along the left bank. Here stands of *Tyhpa* and *Phalaris* had died back and there was also *Apium* and Watercress present but in much reduced amounts, backed at the fence line by Bramble. On the right bank the marginal aquatics were very sparse and comprised occasional *Phalaris*, *O. crocata* and *Apium* along the bank's edge backed by Willow on the upper slopes. The water was greyish and turbid.

Kick-sample results indicate a fairly similar mix of species to previous years with the same Q rating as in 2015. There was one unusual macroinvertebrate record at the site in 2016, namely the comparatively sensitive stone fly nypmh of the genus *Leuctra*. These were not taken into account however when assigning a Q-rating as their presence is considered to only have arisen due to chance

Kick-sample results Site F:

Common Name of Group	Scientific Name	Notional Abundance
Stone fly nymphs	*Leuctra* sp.	+/+
Mayfly nymhs	*Baetis*	++
Non-biting Midges	Chironomidae	+++/++++
Water Hoglouse	*Asellus aquaticus*	++++D
Freshwater shrimp	*Gammarus* sp.	+++
Jenkin's Spire shell	*Potamopyrgus jenkinsi*	+++/++++
Wandering snail	*Lymnaea peregra*	+
Pea mussels	Sphaeridae	+++
Leeches	*Erpobdellidae*	++
Leeches	*Helobdella stagnalis*	+
Segmented worms	Oligochaetes	+++
EPA Q-value		**Q2-3**

Conclusion

The 2016 survey produced very similar results to 2015 with only marginal differences in macroinvertebrate communities. There was a noticeable die-back in both algae and macrophytes at most sites, which was due to the late sampling date. This also accounted for the greater prominence of sewage fungus at most on the Tramore River, because during the summer sewage fungus tends to be out-competed in many cases by filamentous algae, with sewage fungus gaining more prominence in the winter. Overall the water quality was very similar at all sites to that noted in 2015 with a very marginal deterioration noted, which can in large part be attributed to the late season sampling. Channel drainage at Trabeg Sites A and B doesn't appear to have had much impact on the water quality at these sites, which can be expected to develop abundant instream macrophyte cover again in the coming summers.

Plate 1 Trabeg River: Site A viewed toward downstream showing vegetation clearance along the right bank (22-12-2016).

Plate 2 Trabeg River: Site B - view of channel toward upstream with *Phragmites* along left bank and a levelled right ban (22-12-2016).

Plate 3 Tramore River: Site C – showing undercut crump weir (22-12-2016).

Plate 4 Tramore River: Site C - view upstream showing reduced water levels and died-back marginal stand of *Typha* (22-12-2016).

Plate 5 Tramore River: Site D – showing natural cobble boulder weirs just above which kick samples were taken (22-12-2016).

Plate 6 Tramore River: Site E showing kick-sampling site just d/s Black Ash Bridge (22-12-2016)

Plate 7 Tramore River Site F: kick-sampling site – view upstream (22-12-2016)

Report Title	Air Emissions Compliance Monitoring Emissions Report
Company address	Air Scientific Ltd., 32 DeGranville Court, Dublin road, Trim, Co. Meath
Stack Emissions Testing Report Commissioned by	Cork City Council
Facility Name	Kinsale Road Facility
Contact Person	Mr Kevin Ryan
EPA Licence Number	WL012-03
Licence Holder	Cork City Council Kinsale F1
Stack Reference Number	F1
Dates of the Monitoring Campaign	13/01/2017
Job Reference Number	KIRDTL1130117 / 2016528
Report Written By	Dr. John Casey
Report Approved by	Dr. Brian Sheridan
Stack Testing Team	Dr. John Casey
Report Date	30/01/2017
Report Type	Test Report Compliance Monitoring
Version	1
Signature of Approver	Brian Sheridan Technical Manager

Contents

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1. Executive Summary

I. Monitoring Objectives

Overall Aim of the monitoring Campaign

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values as specified in the site licence.

Special Requirements

There were no special requirements.

Target Parameters

Carbon Monoxide (CO)
Oxides of Nitrogen (NOx) as NO_2
Total Volatile Organic Carbon (TOC)
Hydrogen Chloride (HCL)
Hydrogen Fluoride (HF)
Sulphur Dioxide (SO_2)
Stack Gas Temperature
Volume ($m^3.h^{-1}$)

Emission Limit Values

Emission Limit Values / Mass Emissions Limit Values	$mg.m^{-3}$	$kg.h^{-1}$
CO	50	-
NOx as NO_2	150	-
TOC	10	-
HCL	50	-
HF	5	-

Reference Conditions

Reference Conditions	Value
Oxygen Reference %	3
Temperature ^oC	273.15
Total Pressure kPa	101.3
Moisture %	Yes

Executive Summary

Overall Results

	Concentration				
Parameter	**Units**	**Result**	**MU +/-**	**Limit**	**Compliant**
Carbon Monoxide (CO)	$mg.m^{-3}$	2.32	2.84	50	Yes
Oxides of Nitrogen (NOx) as NO_2	$mg.m^{-3}$	93.53	7.91	150	Yes
Total Volatile Organic Carbon (VOC)	$mgC.m^{-3}$	4.34	0.60	10	Yes
Hydrogen Chloride (HCL)	$mg.m^{-3}$	1.33	0.01	50	Yes
Hydrogen Fluoride (HF)	$mg.m^{-3}$	2.80	0.09	5	Yes
Sulphur Dioxide (SO_2)	$mg.m^{-3}$	22.51	8.54	-	N/A
Oxygen (%)	% v/v	8.56	0.15	-	N/A
Stack Gas Temperature	K	1283.15	-	-	N/A

Accreditation details

Air Scientific Limited	INAB319T
External Analytical Laboratory	UKAS1549
Other	-

Executive Summary

Monitoring Dates & Times

Parameter	Run	Location ID	Sampling Dates	Sampling Time On	Sampling Time Off	Duration (mins.)
Carbon Monoxide (CO)	Run 1	F1	13/01/2017	13:16:00	13:46:00	00:30:00
	Run 2					
	Run 3					
Oxides of Nitrogen (NOx) as NO_2	Run 1	F1	13/01/2017	13:16:00	13:46:00	00:30:00
	Run 2					
	Run 3					
Total Volatile Organic Carbon (VOC)	Run 1	F1	13/01/2017	12:33:14	13:00:14	00:27:00
	Run 2					
	Run 3					
Hydrogen Chloride (HCL)	Run 1	F1	13/01/2017	13:55:00	14:26:00	00:31:00
	Run 2					
	Run 3					
Hydrogen Fluoride (HF)	Run 1	F1	13/01/2017	13:58:00	14:28:00	00:30:00
	Run 2					
	Run 3					
Sulphur Dioxide (SO_2)	Run 1	F1	13/01/2017	13:16:00	13:46:00	00:30:00
	Run 2					
	Run 3					
Oxygen (%)		F1	13/01/2017	13:16:00	13:46:00	00:30:00

Executive Summary

Process details

Parameter	
Process status	Normal
Capacity (per/hour) (if applicable)	N/A
Continuous or Batch Process	Continuous
Feedstock	LFG
Abatement System	No
Abatement Systems Running Status	N/A
Fuel	LFG
Plume Appearance	Yes
Other information	None

Monitoring, Equipment & Analytical Methods

	Monitoring				Analysis	
Parameter	**Standard**	**Technical Procedure**	**Accredited Testing**	**Testing Lab**	**Analytical Technique**	**Analysis Lab**
Carbon Monoxide (CO)	EN15058:2006	SOP 2004	Yes	AirSci	NCIR By Horiba PG-250	AirSci
Oxides of Nitrogen (NOx)	EN14792:2006	SOP 2002	Yes	AirSci	Chemiluminescence	AirSci
Total Volatile Organic Carbon (TOC)	EN12619:2013	SOP 2009	Yes	AirSci	Flame Ionisation Detection	AirSci
Hydrogen Chloride (HCL)	EN1911:2010	SOP 2014	Yes	AirSci	Ion Chromatography	SAL
Hydrogen Fluoride (HF)	EN15713:2006	SOP 2024	No	AirSci	Ion Chromatography	SAL
Sulphur Dioxide (SO2)	TGN 21	SOP 2012	Yes	AirSci	NDIR Absorption	AirSci
Oxygen (%)	EN14789:2005	SOP 2008	Yes	AirSci	Paramagnetic	AirSci
Stack Gas Temperature	EN16911:2013	SOP 2005	No	AirSci	Thermocouple	AirSci

List of Equipment

ID	Item of Equipment	Manufacturer	Serial No.
ASLTM12EQ508	DryCal DC Lite Primary Flow Metre	BIOS	7298
ASLTM12EQ509	3010 MinfiFID	Signal Instruments	16764
ASLTM12EQ517	Testo 400 Gas Pressure Vacumn and Flow	Testo	00828828/305
ASLTM12EQ520	Buhler Sample Gas Cooler	Buhler Technologies	100063602044367-001
ASLTM13EQ504	Horiba PG2500 Portable Flue Gas Analzer	Horiba	41432840053
ASLTM13EQ509	10 metre industrial heated sample line (Temp controller box 1 & 2)	Neptech	13B088
ASLTM14EQ512	GemRed Electronic Level 0 to 180 Degrees	GemRed	8088
ASLTM15EQ504	Mass flow meter	Siargo	B3J04198
ASLTM15EQ505	Mass flow meter	Siargo	A1K05286

Sampling Deviations

Parameter	Deviation
Standard ID	-
Standard ID	-
Standard ID	-
Standard ID	-

Reference Documents

Risk Assessment (RA)	SOP1011
Site Review (SR)	SOP1015
Site Specific Protocol (SSP)	SOP1015

Executive Summary

Suitability of sampling location

General Information	Value
Permanent/Temporary	Temporary
Inside/ Outside	Outside

Platform Details		
Irish EPA Technical Guidance Note AG1 / BS EN 15259 Platform Requirements	**Value**	**Comment**
Sufficient Working area to manipulate probe and measuring instruments	Yes	-
Platform has 2 handrails (approx. 0.5m & 1.0 m high)	Yes	-
Platform has vertical base boards (approx. 0.25 m high)	Yes	-
Platform has chains / self closing gates at top of ladders	Yes	-
There are no obstructions present which hamper insertion of sampling equipment	No	-
Safe Access Available	Yes	-
Easy Access Available	Yes	-

Sampling Location / Platform Improvement Recommendations
None

BSEN 15259 Homogeneity Test Requirements
1: There is no requirement to perform a BSEN15259 Homogenity Test on this stack
E.g. Select Option **1: There is no requirement to perform a BSEN15259 Homogenity Test on this stack** **2: Test results were obtained from previous Homogeneity test carried out by ASL** **3: Test results were obtained from previous Homogeneity test carried out by Alternative contractor** **4: Other: Enter Description**

Stack diagram

APPENDICES

II. Appendix I Monitoring Personnel & Equipment

Stack Emissions Monitoring Personnel

Team Leader	**Name**	John Casey
	Qualifications	PhD. (Eng.), MSc. (Agr.), B. Agr. Sc.
	System approval	Air Scientific Limited Approved
		-

III. Appendix II Stack Details & flow characteristics

Preliminary stack survey calculations

General Stack Details		
Stack details	**Units**	**Value**
Date of survey		13/01/2017
Time of survey		13:12
Type		Circular
Stack Diameter / Depth, D	m	-
Stack Width, W	m	-
Average Stack Gas Temp., Ta	C	1010
Average Static Pressure, P static	kPa	-
Average Barometric Pressure, Pb	kPa	-
Type of Pitot		-
Are Water Droplets Present ?		-
Average Pitot Tube Calibration Coeff, Cp		-
Negative flow		-
Highly homogeneous flow stream/gas velocity		Yes

Sample Port Size	mm	-
Initial Pitot Leak Check	Pa	-
Final Pitot Leak Check	Pa	-
Orientation of Duct		Vertical
Pitot Tube Cp		0.998
Number of Lines Available		1
Number of Lines Used		1

Sampling Line A						
Point	**Distance to duct (m)**	**Pa**	**Temp ºC**	**Velocity (m/s)**	**Oxygen (%)**	**Angle of Swirl**
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
Average	-	-	-	-	-	-
Min	-	-	-	-	-	-
Max	-	-	-	-	-	-

Sampling Line B						
Point	**Distance to duct (m)**	**Pa**	**Temp °C**	**Velocity (m/s)**	**Oxygen (%)**	**Angle of Swirl**
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
Average	-	-	-	-	-	-
Min	-	-	-	-	-	-
Max	-	-	-	-	-	-

Component	Conc. ppm	Conc. Dry % v/v	Conc. Wet % v/v	Molar Mass
Carbon Dioxide CO_2	-	10.3	-	44.01
Oxygen O_2	-	8.3	-	32
Nitrogen N_2	-	81.4	-	28.1
Moisture (H_2O)	-	-	9	18.02
Reference Conditions	**Units**	**Numbers**		
Temperature	^oC	273.15		
Total Pressure	kPa	101.3		
Moisture	%	-		
Oxygen (Dry)	%	3		

Stack Gas Composition & Molecular Weights								
Component	**Molar Mass M**	**Density Kg/m^3 p**	**Conc. Dry % v/v**	**Dry Volume Fraction r**	**Dry Conc. kg/m^3 pi**	**Conc. wet % v/v**	**Wet Volume Fraction r**	**Wet Conc.kg/m^3 pi**
Carbon Dioxide CO_2	44.01	1.96	10.3	0.103	0.20	9.37	0.09	0.18
Oxygen O_2	32	1.43	8.3	0.083	0.12	7.55	0.08	0.11
Nitrogen N_2	28.1	1.25	81.4	0.814	1.02	74.07	0.74	0.93
Moisture (H_2O)	18.02	0.80	-	-	-	9	0.09	0.07
	-	-	-	-	-	-	-	-
where p=M/22.41	-	-	-	-	-	-	-	-
pi = r x p	-	-	-	-	-	-	-	-

Calculation of Stack Gas Densities		
Determinand	**Units**	**Result**
Dry Density (STP), P STD	$kg.m^{-3}$	1.341
Wet Density (STP), P STW	$kg.m^{-3}$	1.297
Dry Density (Actual), P Actual	$kg.m^{-3}$	-
Average wet Density (Actual), P ActualW	$kg.m^{-3}$	-
Where		
P STD = sum of component concentrations, kg/m3 (excluding water vapour)	-	-
P STW = (P STD + pi of H2O) / (1 + (pi of H2O / 0.8036))	-	-
P actual = P STD x (T STP / (P STP)) x (Pa / Ta)	-	-
P actual W (at each sampling point) = P STW x (Ts / Ps) x (Pa / Ta)	-	-

Sampling Plane Validation Criteria	Value	Units	Requirement	Compliance	Method
Lowest Differential Pressure	-	Pa	>5 Pa	N/A	EN16911:2013
Lowest Gas Velocity	-	m/s	-	N/A	-
Highest Gas Velocity	-	m/s	-	N/A	-
Ratio of Above	-	:1	<3:1	N/A	EN16911:2013
Mean Velocity	-	m/s	-	N/A	-
Angle of flow with regard to duct axis	-	degrees	< 15	N/A	EN16911:2013
No local negative flow	-	-	-	N/A	-
Homogeneous flow stream/gas velocity	-	-	-	N/A	-

Calculation of stack Gas Velocity, V	
Velocity at Traverse Point, V = Kcp * Sqroot ((2 * DP) / Density)	-
Where	
Kpt = Pitot tube calibration coefficient	-
Compressibility correction factor, assumed at a constant 0.998	0.998

Gas Volumetric Flowrate	Units	Result
Gas Volumetric Flow Rate (Actual)	$m^3.h^{-1}$	-
Gas Volumetric Flow Rate (STP, Wet)	$m^3. h^{-1}$	-
Gas Volumetric Flowrate (STP, Dry)	$m^3. h^{-1}$	-
Gas Volumetric Flowrate REF to Oxygen	$m^3. h^{-1}$	-

IV. Appendix III Individual parameter sampling details and results

Carbon Monoxide Quality Assurance

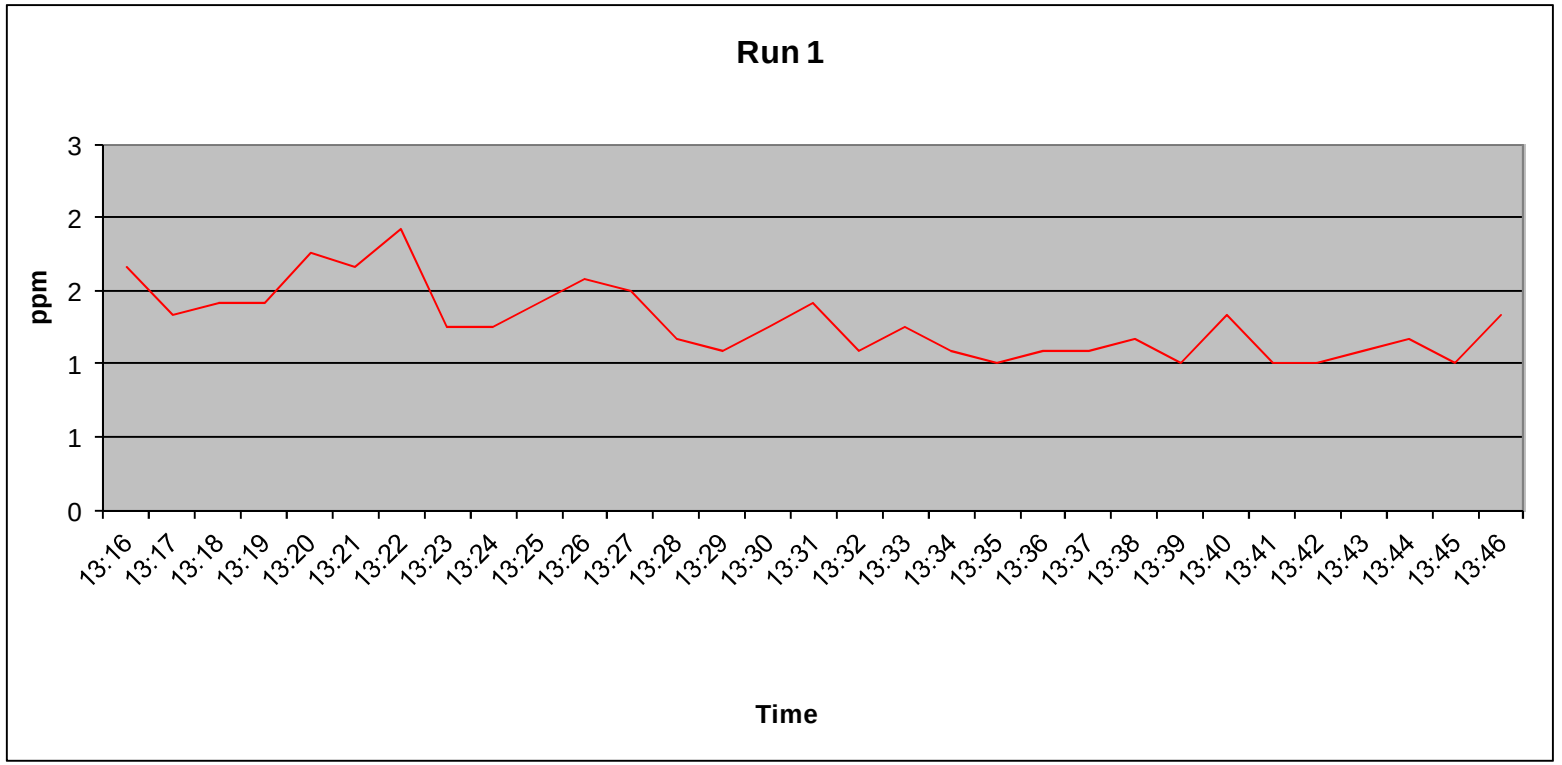
Sampling Details		
Stack ID	F1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	13:15
Sampling Dates	-	13/01/2017
Instrument Range	ppm	200
Span Gas Value	ppm	161
Acceptable Gas Range	-	Yes
Quality Assurance	**Units**	**Run 1**
Conditioning Unit Temperature	C	2
Average Temperature	< C	2
Allowable Temperature	-	4
Temperature Acceptable	-	Yes
Pump flow rate	l/min.	0.6
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	0.1
Zero Down Sampling Line (Post)	ppm	0.4
Zero drift	ppm	0.3
Allowable Zero Drift	ppm	3.2
Zero Drift Acceptable	-	Yes
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	160.8
Span Down Sampling Line (Post)	ppm	160.4
Span Drift	ppm	0.4
Allowable Span Drift	ppm	3.2
Span Drift Acceptable (Y/N)	-	Yes
Leak Check		
Span Gas Conc.	ppm	161
Recorded Conc. down Line	ppm	160.8
Leak check acceptable (< 2%)	(Y/N)	Yes
Test Conditions	**Units**	**Run 1**
Run Ambient Temperature Range	C	13

Carbon Monoxide Results & Sampling details

Parameter	Units	Run 1
Concentration	$mg.m^{-3}$	1.60
Uncertainty	$mg.m^{-3}$	2.84
Mass Emission	kg.h	-

General Sampling Information	
Parameter	**Value**
Standard	EN15058
Technical Procedure	SOP2004
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Span Gas Reference Number	ASLTM15ING534
Span Gas Expiry Date	Dec-18
Span Gas Start Pressure (bar)	40
Gas Cylinder Concentration (ppm)	161
Span Gas Uncertainty (%)	<2
Zero Gas Type	Nitrogen
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	F1
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	3

Carbon Monoxide Trend



Carbon Monoxide Measurement Uncertainty

	Units	Run 1
Measured Quantities		
Certified Range of Analyser	ppm	1.36 to 1000
Operational Range of Analyser	ppm	200
Measured Reading	ppm	1.28
Measured Quantities	**Units**	**Run 1**
Nonlinearity	%	0.9
Temperature Dependent Zero drift	%	0.14
Temperature Dependent Span drift	%	-0.12
Cross-sensitivity	%	0.08
Leak	%	0
Calibration Gas Uncertainty	%	<2
Parameter	**Units**	**Run 1**
Combined uncertainty	$mg.m^{-3}$	0.97
Expanded uncertainty	$mg.m^{-3}$	1.95
Uncertainty corrected to std conds.	$mg.m^{-3}$	2.84
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	5.68
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	2.84
Expanded uncertainty expressed with a level of confidence of 95%	% of value	177.17
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Oxides of Nitrogen Quality Assurance

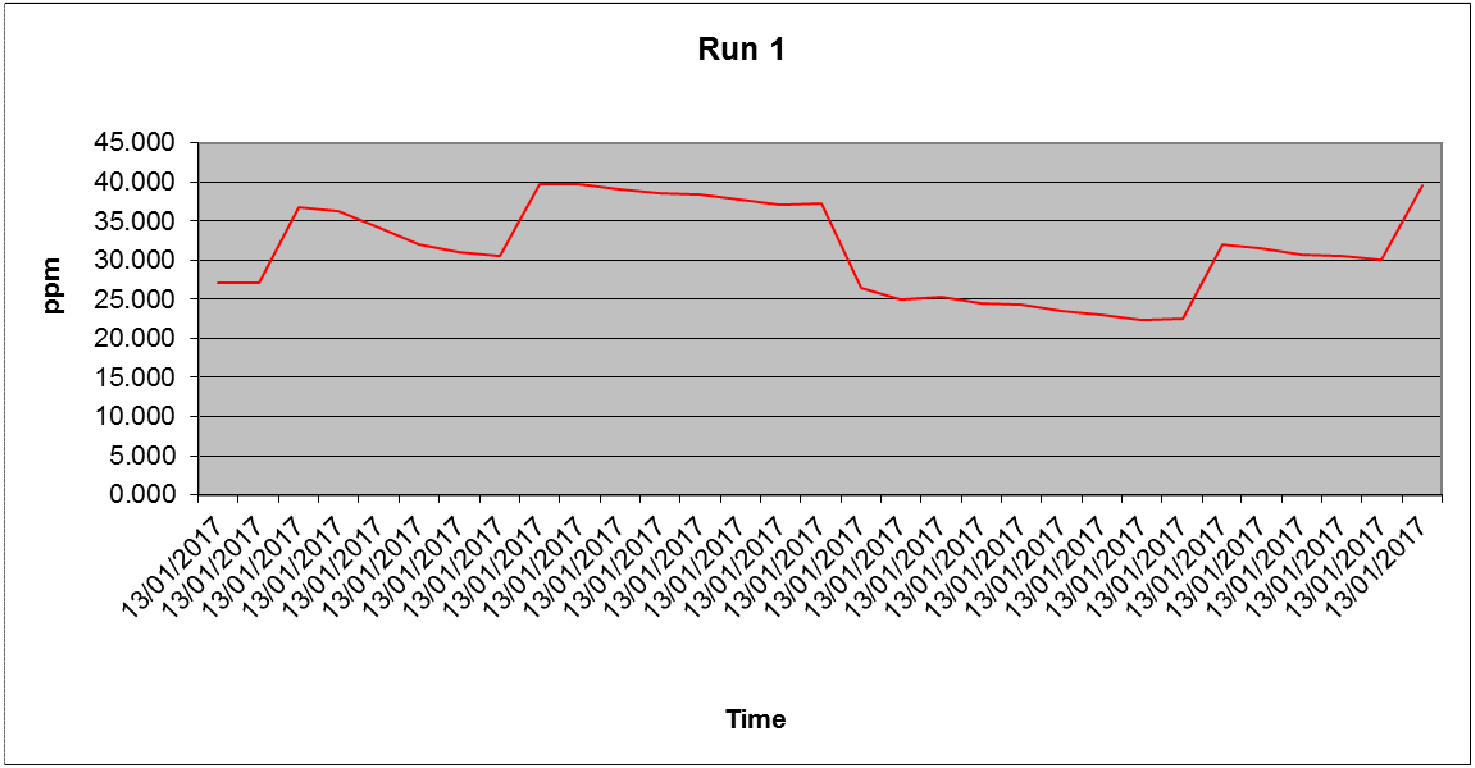
Sampling Details		
Stack ID	F1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	13:15
Sampling Dates	-	13/01/2017
Instrument Range	ppm	250
Span Gas Value	ppm	163
Acceptable Gas Range	-	Yes
Quality Assurance	**Units**	**Run 1**
Conditioning Unit Temperature	C	2
Average Temperature	< C	2
Allowable Temperature	-	4
Temperature Acceptable	-	Yes
Pump flow rate	l/min.	0.6
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	0.1
Zero Down Sampling Line (Post)	ppm	0.8
Zero drift	ppm	0.7
Allowable Zero Drift	ppm	3.2
Zero Drift Acceptable	-	Yes
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	163.1
Span Down Sampling Line (Post)	ppm	163.4
Span Drift	ppm	0.3
Allowable Span Drift	ppm	3.2
Span Drift Acceptable (Y/N)	-	Yes
Leak Check		
Span Gas Conc.	ppm	163
Recorded Conc. down Line	ppm	163.1
Leak check acceptable (< 2%)	(Y/N)	Yes
Test Conditions	**Units**	**Run 1**
Run Ambient Temperature Range	C	13
NOx Converter Efficiency	%	95.4

Oxides of Nitrogen Results & Sampling details

Parameter	Units	Run 1
Concentration	$mg.m^{-3}$	64.49
Uncertainty	$mg.m^{-3}$	7.91
Mass Emission	$kg.h^{-1}$	-

General Sampling Information	
Parameter	**Value**
Standard	EN14792
Technical Procedure	SOP2002
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Date & Result of last converter check	95.4 07/01/2017
Span Gas Reference Number	ASLTM16ING517
Span Gas Expiry Date	Jul-17
Span Gas Start Pressure (bar)	40
Gas Cylinder Concentration (ppm)	163
Span Gas Uncertainty (%)	<2
Zero Gas Type	Nitrogen
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	F1
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	3

Oxides of Nitrogen Trend



Oxides of Nitrogen Measurement Uncertainty

Measured Quantities	**Units**	**Run 1**
Nonlinearity	%	1.4
Temperature Dependent Zero drift	%	-0.04
Temperature Dependent Span drift	%	-0.25
Cross-sensitivity	%	0.5
Leak	%	0
Calibration Gas Uncertainty	%	<2
Mass Flow Controllers (Dilution) Uncertainty	%	<1
NOx Converter Efficiency	%	95.4
Parameter	**Units**	**Run 1**
Combined uncertainty	$mg.m^{-3}$	2.02
Expanded uncertainty	$mg.m^{-3}$	4.05
Uncertainty corrected to std conds.	$mg.m^{-3}$	7.91
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	5.28
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	7.91
Expanded uncertainty expressed with a level of confidence of 95%	% of value	12.27
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Total Volatile Organic Carbon Quality Assurance

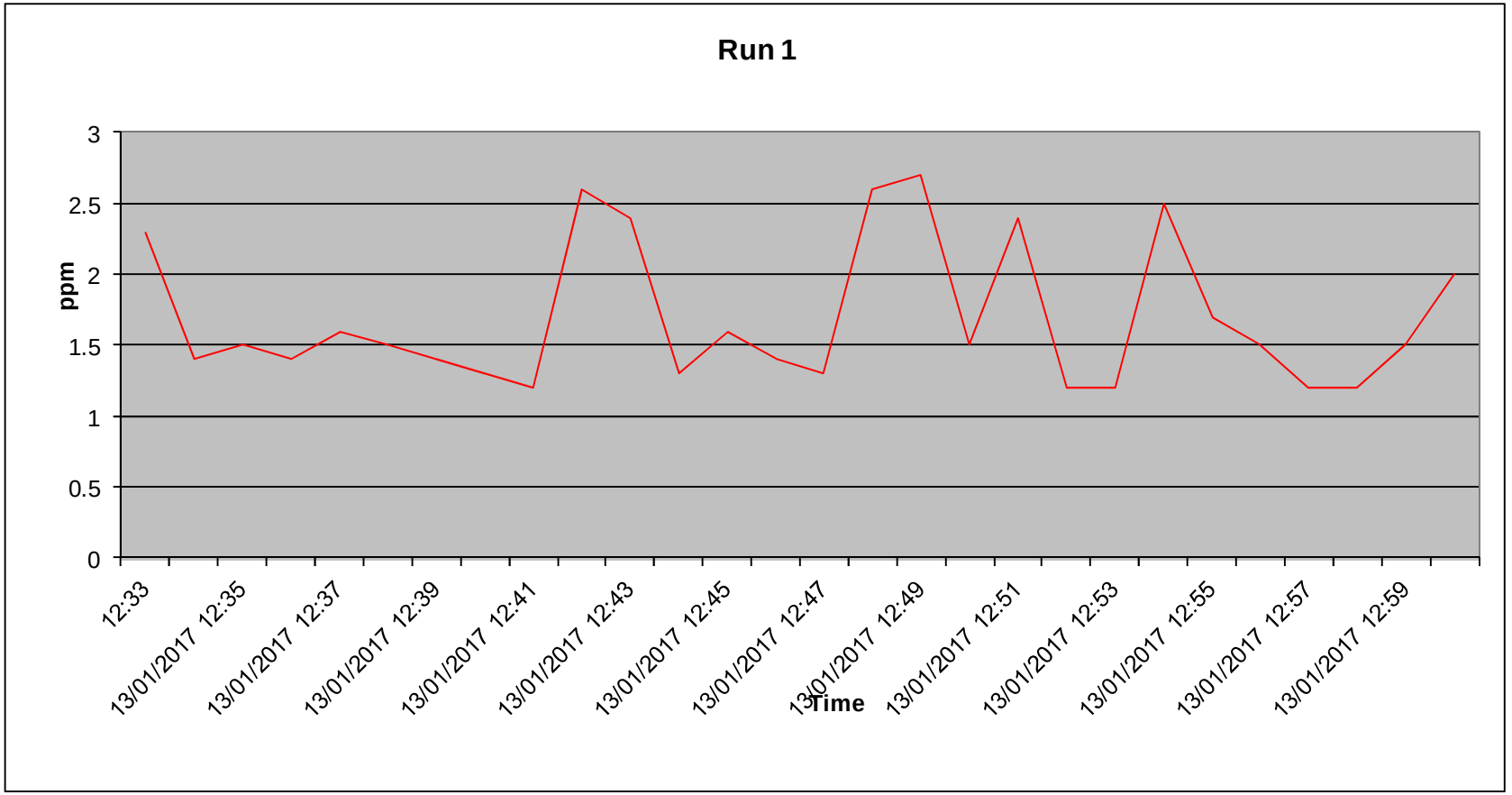
Sampling Details		
Stack ID	F1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	12:33
Sampling Dates	-	13/01/2017
Instrument Range	ppm	100
Span Gas Value	ppm	80.7
Acceptable Gas Range	-	Yes
Quality Assurance	**Units**	**Run 1**
Oven Temperature	C	192
Average Temperature	< C	192
Temperature Acceptable	-	Yes
Sample line temperature	C	190
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	0.1
Zero Down Sampling Line (Post)	ppm	0.3
Zero drift	ppm	0.2
Allowable Zero Drift	ppm	1.6
Zero Drift Acceptable	-	Yes
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	80.6
Span Down Sampling Line (Post)	ppm	80.8
Span Drift	ppm	0.2
Allowable Span Drift	ppm	1.6
Span Drift Acceptable (Y/N)	-	Yes
Leak Check		
Span Gas Conc.	ppm	80.7
Recorded Conc. down Line	ppm	80.6
Leak check acceptable (< 2%)	(Y/N)	Yes

Total Volatile Organic Carbon Results and Sampling Details

Parameter	Units	Run 1
Concentration	$mgC.m^{-3}$	2.99
Uncertainty	$mgC.m^{-3}$	0.60
Mass Emission	$kg.h^{-1}$	-

General Sampling Information	
Parameter	**Value**
Standard	EN12619
Technical Procedure	SOP2009
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Span Gas Reference Number	ASLTM16ING502
Span Gas Expiry Date	01/08/2021
Span Gas Start Pressure (bar)	20
Gas Cylinder Concentration (ppm)	80.7
Span Gas Uncertainty (%)	<2
Zero Gas Type	Ambient
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	F1
Reference Conditions	-
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	3

Total Volatile Organic Carbon Trend



Total Volatile Organic Carbon Measurement Uncertainty

	Units	**Run 1**
Measured Quantities		
Certified Range of Analyser	ppm	0.5 to 1000
Operational Range of Analyser	ppm	100
Measured Reading	ppm	1.69
Measured Quantities	Units	**Run 1**
Nonlinearity	%	0.068
Temperature Dependent Zero drift	%	0.3
Temperature Dependent Span drift	%	0.3
Cross-sensitivity	%	-
Leak	%	<2
Calibration Gas uncertainty	%	<2
Parameter	Units	**Run 1**
Combined uncertainty	$mg.m^{-3}$	0.30
Expanded uncertainty	$mg.m^{-3}$	0.60
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	5.96
Expanded uncertainty expressed with a level of confidence of 95%	% of value	19.95
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	0.60
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Hydrogen Chloride Sampling Details & Results

Stack ID	F1	**Run 1**
Sample ID	**F1 HCL**	**mls**
Impinger 1 ID	**F1 HCL 1+2**	320
Impinger 2 ID	**-**	0
Impinger 3 ID	F1 HCL 3	240
Time on	13:55	
Time off	**14:26**	
Leak Check Results		
Prior to test:	0	l/min
Post Test:	0	l/min
Sample Volume Flow Rate:	2	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	-	
Calibration Unit:	ASLTM15EQ504	
Calibration Rate Before Test:	2	litres per minute
Calibration Rate After Test:	2.000	litres per minute
Average sample Volume:	2	litres per minute
Sample Test Time:	31	minutes
Pump Gas Temperature:	0	^{O}C
Pump Sample Pressure:	101.3	kPa
Actual Sample Volume:	0.06200	m^3
Normalised Gas Volume:	0.06200	Nm^3

Hydrogen Chloride Quality Assurance

Stack ID	F1	-
Date	13/01/2017	-
Start time	-	13:55:00
Finish Time	-	14:26:00
	Units	**Run 1**
Leak test results		
Mean Sampling Rate	l/min	2
Pre-sampling leak rate	l/min	0
Post-sampling leak rate	l/min	0
Leak rate	l/min	0
Acceptable leak rate (<2%)	Y/N	Yes
Filtration		
Filter Material	-	N/A
Filter Size	mm	N/A
Max. Filter Temp	degrees	N/A
Absorbers Type	Glass/PTFE/ Other	PTFE
Absorption Solution	-	Di H2O
Absorption Efficiency		
Total Imp1 + Imp 2 + Imp 3	ug	56.8
Impinger 3	ug	12
Absorption efficiency	%	79
Acceptable Absorption Eff.	>95% (Y/N)	N
Blank sample		
Blank sample ID	-	E1HCLB
Blank result	mg/m^3	0.1
Acceptable Blank	<10% ELV (Y/N)	Y
Testing laboratory		
Laboratory Name	-	UKAS1549
Test certificate Number	-	627558

Hydrogen Chloride Results & Measurement Uncertainty

Stack ID	F1	**Run 1**
Date	-	
Start time	13:55	
Finish Time	14:26	
Results		
Laboratory Result	56.8	µg/ml
Impinger final Volume	560	ml
Factor	-	
Concentration	0.06	mg
Sample Volume	0.062	Nm^3
Emissions Concentration	0.92	$mg.m^{-3}$
Mass Emissions	-	$kg.h^{-1}$

	Units	**Run 1**
	Units	Run 1
Parameter		
Combined Uncertainty	$mg.m^{-3}$	0.001
Expanded uncertainty as percentage of measured value	% of measured value	4.62
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.003
Expanded uncertainty as percentage of limit value	% Of ELV	0.01

Hydrogen Fluoride Sampling Details & Results

Sampling Details		**Run 1**
Stack ID	F1	
Start time	13:58	
Finish Time	14:28	
Leak Check Results		
Prior to test:	0	l/min
Post Test:	0	l/min
Sample Volume Flow Rate:	2	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	-	
Calibration Unit:	ASLTM15EQ505	
Calibration Rate Before Test:	2	l/min
Calibration Rate After Test:	2	l/min
Average sample Volume:	2	l/min
Sample Test Time:	30	min
Pump Gas Temperature:	0	^{O}C
Pump Sample Pressure:	101.3	kPa
Actual Sample Volume:	0.06000	m^3
Normalised Gas Volume:	0.06000	Nm^3

Hydrogen fluoride Quality Assurance

Start time	-	13:58:00
Finish Time	-	14:28:00
	Units	**Run 1**
Leak test results		
Mean Sampling Rate	l/min	2
Pre-sampling leak rate	l/min	0
Post-sampling leak rate	l/min	0
Leak rate	l/min	0.00
Acceptable leak rate (<2%)	Y/N	Yes
Filtration		
Filter Material	-	N/A
Filter Size	mm	N/A
Max. Filter Temp	degrees	N/A
Absorbers Type	Glass/PTFE/ Other	Glass
Absorption Solution	-	0.1m NaOH
Absorption Efficiency		
Total Imp 1 + Imp2 + Imp3	ug	115.9
Impinger 3	ug	10.5
Absorption efficiency	%	91
Acceptable Absorption Eff.	>95% (Y/N)	N
Blank sample		
Blank sample ID	-	E1HFB
Blank result	mg/m^3	<0.1
Acceptable Blank	<10% ELV (Y/N)	Y

Hydrogen Fluoride Results & Measurement Uncertainty

Sampling Details		**Run 1**
Stack ID	F1	
Date	-	
Start time	13:58:00	
Finish Time	14:28:00	
Results		
Laboratory Result	115.9	µg/ml
Impinger final Volume	520	ml
Concentration	0.12	mg
Sample Volume	0.06	Nm^3
Emissions Concentration	1.93	$mg.m^{-3}$
Mass Emissions	-	$kg.h^{-1}$

	Units	**Run 1**
	Units	Run 1
Parameter		
Combined Uncertainty	$mg.m^{-3}$	0.045
Expanded uncertainty as percentage of measured value	% of measured value	4.697
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.091
Expanded uncertainty as percentage of limit value	% Of ELV	1.815

Sulphur Dioxide Quality Assurance

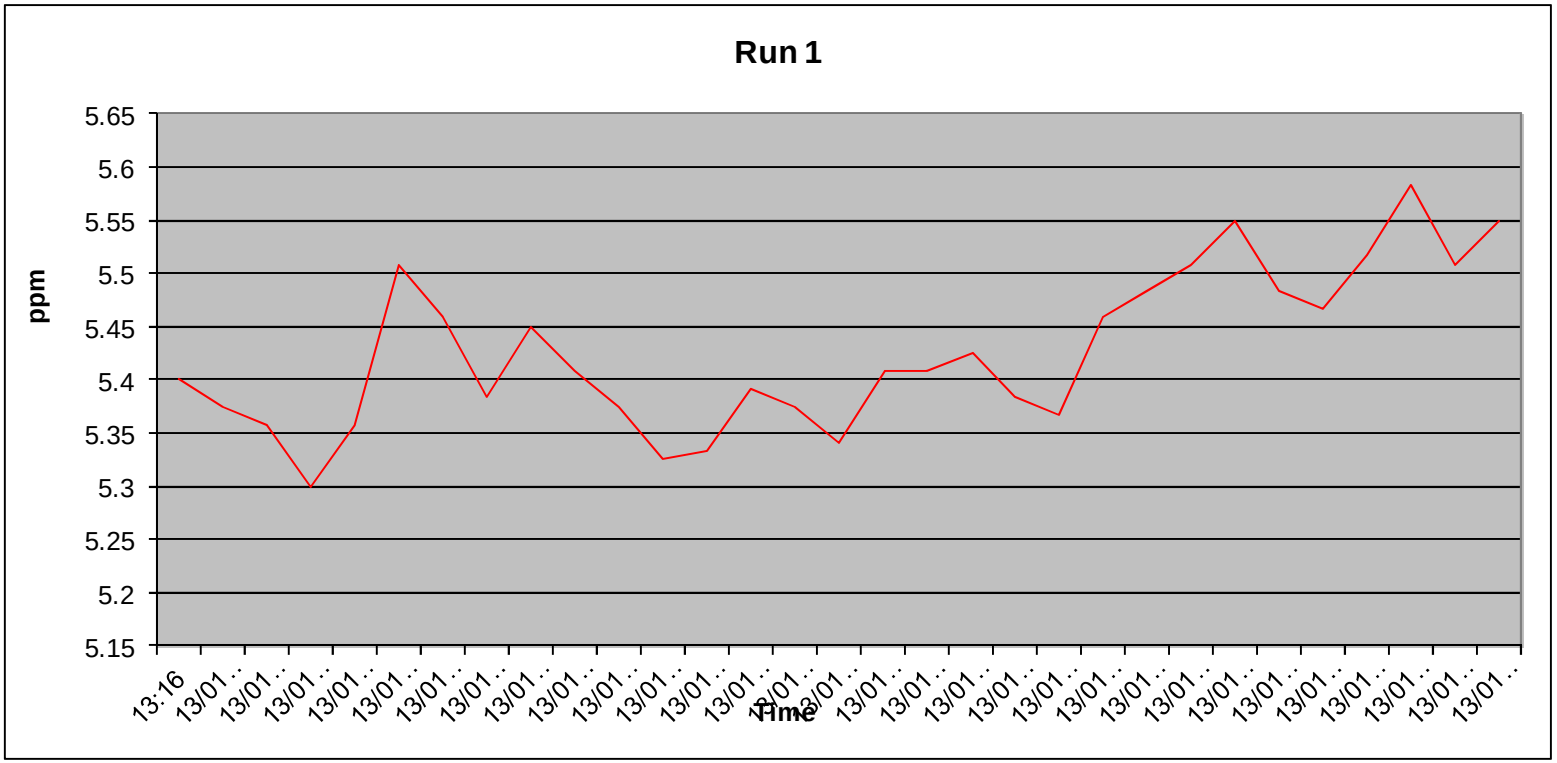
Sampling Details		
Stack ID	F1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	13:15
Sampling Dates	-	13/01/2017
Instrument Range	ppm	1000
Span Gas Value	ppm	548
Acceptable Gas Range	-	Yes
	-	-
Quality Assurance	**Units**	**Run 1**
Conditioning Unit Temperature	C	2
Average Temperature	< C	2
Allowable Temperature	-	4
Temperature Acceptable	-	Yes
Pump flow rate	l/min.	0.6
	-	-
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	1
Zero Down Sampling Line (Post)	ppm	6
Zero drift	ppm	5
Allowable Zero Drift	ppm	27
Zero Drift Acceptable	-	Yes
	-	-
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	551
Span Down Sampling Line (Post)	ppm	564
Span Drift	ppm	13
Allowable Span Drift	ppm	27
Span Drift Acceptable (Y/N)	-	Yes
	-	-
Leak Check		
Span Gas Conc.	ppm	548
Recorded Conc. down Line	ppm	551
Leak check acceptable (< 2%)	(Y/N)	Yes
	-	-
Test Conditions	**Units**	**Run 1**
Run Ambient Temperature Range	C	13

Sulphur Dioxide Results & Sampling details

Parameter	Units	Run 1
Concentration	$mg.m^{-3}$	15.52
Uncertainty	$mg.m^{-3}$	8.54
Mass Emission	kg.h	-

General Sampling Information	
Parameter	**Value**
Standard	TGN 21
Technical Procedure	2012
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Date & Result of last converter check	-
Span Gas Reference Number	ASLTM15ING535
Span Gas Expiry Date	Dec-17
Span Gas Start Pressure (bar)	20
Gas Cylinder Concentration (ppm)	548
Span Gas Uncertainty (%)	<2
Zero Gas Type	N
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	F1
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	3

Sulphur Dioxide Trend



Sulphur Dioxide Measurement Uncertainty

	Units	Run 1
Measured Quantities		
Certified Range of Analyser	ppm	2.14 to 1000
Operational Range of Analyser	ppm	1000
Measured Reading	ppm	5.43
Measured Quantities	**Units**	**Run 1**
Nonlinearity	%	0.8
Temperature Dependent Zero drift	%	0.8
Temperature Dependent Span drift	%	2
Cross-sensitivity	%	1.5
Leak	%	0
Calibration Gas Uncertainty	%	<2 %
Parameter	**Units**	**Run 1**
Combined uncertainty	$mg.m^{-3}$	2.89
Expanded uncertainty	$mg.m^{-3}$	5.79
Uncertainty corrected to std conds.	$mg.m^{-3}$	8.54
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	-
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	8.54
Expanded uncertainty expressed with a level of confidence of 95%	% of value	55.01
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Report Title	Air Emissions Compliance Monitoring Emissions Report
Company address	Air Scientific Ltd., 32 DeGranville Court, Dublin road, Trim, Co. Meath
Stack Emissions Testing Report Commissioned by	Cork City Council
Facility Name	Kinsale Road Facility
Contact Person	Mr Kevin Ryan
EPA Licence Number	WL012-03
Licence Holder	Cork City Council Kinsale E1
Stack Reference Number	E1
Dates of the Monitoring Campaign	28/02/2017
Job Reference Number	KIRDTL1280217 / 2017581
Report Written By	Dr. John Casey
Report Approved by	Dr. Brian Sheridan
Stack Testing Team	Dr. John Casey
Report Date	21/03/2017
Report Type	Test Report Compliance Monitoring
Version	1
Signature of Approver	Brian Sheridan Technical Manager

Contents

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1. Executive Summary

I. Monitoring Objectives

Overall Aim of the monitoring Campaign

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values as specified in the site licence.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter (TPM)
Carbon Monoxide (CO)
Oxides of Nitrogen (NOx) as NO_2
Hydrogen Chloride (HCL)
Hydrogen Fluoride (HF)
T A Luft Organics
Sulphur Dioxide (SO_2)
Stack Gas Temperature
Volume ($m^3.h^{-1}$)

Emission Limit Values

Emission Limit Values / Mass Emissions Limit Values	$mg.m^{-3}$	$kg.h^{-1}$
TPM	130	-
CO	1400	-
NOx as NO_2	500	-
HCL	50	-
HF	5	-
T A Luft Organics	20	-
SO_2	-	-
Stack Gas Temperature	-	-
Volume ($m^3.h^{-1}$)	3,000	-

Reference Conditions

Reference Conditions	Value
Oxygen Reference %	5
Temperature ºC	273.15
Total Pressure kPa	101.3
Moisture %	Yes

Executive Summary

Overall Results

	Concentration					Mass Emission	
Parameter	**Units**	**Result**	**MU +/-**	**Limit**	**Compliant**	**Units**	**Result**
Total Particulate Matter (TPM)	$mg.m^{-3}$	2.53	0.41	130	Yes	$kg.h^{-1}$	0.004
Carbon Monoxide (CO)	$mg.m^{-3}$	707.07	39.90	1400	Yes	$kg.h^{-1}$	1.166
Oxides of Nitrogen (NOx) as NO_2	$mg.m^{-3}$	491.66	36.61	500	Yes	$kg.h^{-1}$	0.811
Hydrogen Chloride (HCL)	$mg.m^{-3}$	<0.23	0.01	50	Yes	$kg.h^{-1}$	<0.0004
Hydrogen Fluoride (HF)	$mg.m^{-3}$	<0.25	0.01	5	Yes	$kg.h^{-1}$	<0.0004
T A Luft Organics	$mg.m^{-3}$	<0.70	0.13	20	Yes	$kg.h^{-1}$	<0.001
Sulphur Dioxide (SO_2)	$mg.m^{-3}$	421.48	24.57	-	N/A	$kg.h^{-1}$	0.695
Oxygen (%)	% v/v	5.46	0.13	-	N/A	-	-
Stack Gas Temperature	K	737.15	-	-	N/A	-	-
Stack Gas Velocity	$m.s^{-1}$	15.69	-	-	N/A	-	-
Volumetric Flow Rate	$m^3.h^{-1}$	1725	-	-	N/A	-	-
Volumetric Flow Rate (Ref.)	$m^3.h^{-1}$	1649	-	3,000	Yes	-	-

Accreditation details

Air Scientific Limited	INAB319T
External Analytical Laboratory	UKAS1549
Other	-

Executive Summary

Monitoring Dates & Times

Parameter	Run	Location ID	Sampling Dates	Sampling Time On	Sampling Time Off	Duration (mins.)
Total Particulate Matter (TPM)	Run 1	E1	28/02/2017	10:00:00	10:30:00	00:30:00
	Run 2					
	Run 3					
Carbon Monoxide (CO)	Run 1	E1	28/02/2017	10:47:00	11:27:00	00:40:00
	Run 2					
	Run 3					
Oxides of Nitrogen (NOx) as NO_2	Run 1	E1	28/02/2017	10:47:00	11:27:00	00:40:00
	Run 2					
	Run 3					
Hydrogen Chloride (HCL)	Run 1	E1	28/02/2017	09:30:00	10:02:00	00:32:00
	Run 2					
	Run 3					
Hydrogen Fluoride (HF)	Run 1	E1	28/02/2017	11:35:00	12:06:00	00:31:00
	Run 2					
	Run 3					
T A Luft Organics	Run 1	E1	28/02/2017	09:45:00	10:19:00	00:34:00
	Run 2					
	Run 3					
Sulphur Dioxide (SO_2)	Run 1	E1	28/02/2017	10:47:00	11:27:00	00:40:00
	Run 2					
	Run 3					
Oxygen (%)		E1	28/02/2017	10:47:00	11:27:00	00:40:00

Executive Summary

Process details

Parameter	
Process status	Normal
Capacity (per/hour) (if applicable)	85% Load
Continuous or Batch Process	Continuous
Feedstock	LFG
Abatement System	No
Abatement Systems Running Status	N/A
Fuel	LFG
Plume Appearance	Yes
Other information	None

Monitoring, Equipment & Analytical Methods

	Monitoring				Analysis	
Parameter	**Standard**	**Technical Procedure**	**Accredited Testing**	**Testing Lab**	**Analytical Technique**	**Analysis Lab**
Total Particulate Matter (TPM)	EN13284-1:2002	SOP 2000	Yes	AirSci	Gravimetric	SAL
Carbon Monoxide (CO)	EN15058:2006	SOP 2004	Yes	AirSci	NCIR By Horiba PG-250	AirSci
Oxides of Nitrogen (NOx)	EN14792:2006	SOP 2002	Yes	AirSci	Chemiluminescence	AirSci
Hydrogen Chloride (HCL)	EN1911:2010	SOP 2014	Yes	AirSci	Ion Chromatography	SAL
Hydrogen Fluoride (HF)	EN15713:2006	SOP 2024	No	AirSci	Ion Chromatography	SAL
T A Luft Organics	EN13649:2014	SOP 2019	No	AirSci	Thermal Desorption	SAL
Sulphur Dioxide (SO2)	TGN 21	SOP 2012	Yes	AirSci	NDIR Absorption	AirSci
Oxygen (%)	EN14789:2005	SOP 2008	Yes	AirSci	Paramagnetic	AirSci
Stack Gas Temperature	EN16911:2013	SOP 2005	Yes	AirSci	Thermocouple	AirSci
Stack Gas Velocity	EN16911:2013	SOP 2005	Yes	AirSci	Pitot tubes	AirSci

List of Equipment

ID	Item of Equipment	Manufacturer	Serial No.
ASLTM12EQ503	SKC Aircheck Sampler SKC 4	SKC	826925
ASLTM12EQ508	DryCal DC Lite Primary Flow Metre	BIOS	7298
ASLTM12EQ520	Buhler Sample Gas Cooler	Buhler Technologies	100063602044367-001
ASLTM13EQ504	Horiba PG2500 Portable Flue Gas Analzer	Horiba	41432840053
ASLTM13EQ506	S TYPE PITOT TUBE	Tecora	O710
ASLTM14EQ510	5 metre heated line, filters and temp controller box 1 & 2	Neptech	14B052
ASLTM14EQ512	GemRed Electronic Level 0 to 180 Degrees	GemRed	8088
ASLTM14EQ513	ISO Stack Sampling Machine and associated equipment	TCR Tecora	070205976 & 049039P
ASLTM15EQ504	Mass flow meter	Siargo	B3J04198

Sampling Deviations

Parameter	Deviation
Standard ID	EN1691 - in accordance with MID6911-1
Standard ID	-
Standard ID	-
Standard ID	-

Reference Documents

Risk Assessment (RA)	SOP1011
Site Review (SR)	SOP1015
Site Specific Protocol (SSP)	SOP1015

Executive Summary

Suitability of sampling location

General Information	Value
Permanent/Temporary	Temporary
Inside/ Outside	Outside

Platform Details		
Irish EPA Technical Guidance Note AG1 / BS EN 15259 Platform Requirements	**Value**	**Comment**
Sufficient Working area to manipulate probe and measuring instruments	Yes	-
Platform has 2 handrails (approx. 0.5m & 1.0 m high)	Yes	-
Platform has vertical base boards (approx. 0.25 m high)	Yes	-
Platform has chains / self closing gates at top of ladders	Yes	-
There are no obstructions present which hamper insertion of sampling equipment	No	-
Safe Access Available	Yes	-
Easy Access Available	Yes	-

Sampling Location / Platform Improvement Recommendations
None

BSEN 15259 Homogeneity Test Requirements
1: There is no requirement to perform a BSEN15259 Homogenity Test on this stack
E.g. Select Option **1: There is no requirement to perform a BSEN15259 Homogenity Test on this stack** **2: Test results were obtained from previous Homogeneity test carried out by ASL** **3: Test results were obtained from previous Homogeneity test carried out by Alternative contractor** **4: Other: Enter Description**

Stack diagram

APPENDICES

II. Appendix I Monitoring Personnel & Equipment

Stack Emissions Monitoring Personnel

Team Leader	**Name**	John Casey
	Qualifications	PhD. (Eng.), MSc. (Agr.), B. Agr. Sc.
	System approval	Air Scientific Limited Approved
		-

III. Appendix II Stack Details & flow characteristics

Preliminary stack survey calculations

General Stack Details		
Stack details	**Units**	**Value**
Date of survey		28/02/2017
Time of survey		09:15
Type		Circular
Stack Diameter / Depth, D	m	0.34
Stack Width, W	m	-
Average Stack Gas Temp., Ta	C	464
Average Static Pressure, P static	kPa	0.1
Average Barometric Pressure, Pb	kPa	100.8
Type of Pitot		S
Are Water Droplets Present ?		No
Average Pitot Tube Calibration Coeff, Cp		0.85
Negative flow		No
Highly homogeneous flow stream/gas velocity		Yes

Sample Port Size	mm	125
Initial Pitot Leak Check	Pa	750
Final Pitot Leak Check	Pa	738
Orientation of Duct		Vertical
Pitot Tube Cp		0.998
Number of Lines Available		1
Number of Lines Used		1

Sampling Line A						
Point	**Distance to duct (m)**	**Pa**	**Temp ºC**	**Velocity (m/s)**	**Oxygen (%)**	**Angle of Swirl**
1	0.02	-	-	-	-	-
2	0.05	81	464	15.6	-	<15
3	0.1	91	464	16.5	-	<15
4	0.24	80	464	15.5	-	<15
5	0.29	76	464	15.1	-	<15
6	0.33	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
Average	-	82.00	464	15.69	-	<15
Min	-	76	464	15.11	-	<15
Max	-	91	464	16.54	-	<15

Sampling Line B						
Point	**Distance to duct (m)**	**Pa**	**Temp °C**	**Velocity (m/s)**	**Oxygen (%)**	**Angle of Swirl**
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
Average	-	-	-	-	-	-
Min	-	-	-	-	-	-
Max	-	-	-	-	-	-

Component	Conc. ppm	Conc. Dry % v/v	Conc. Wet % v/v	Molar Mass
Carbon Dioxide CO_2	-	11.1	-	44.01
Oxygen O_2	-	5.7	-	32
Nitrogen N_2	-	83.2	-	28.1
Moisture (H_2O)	-	-	8.9	18.02
Reference Conditions	**Units**	**Numbers**		
Temperature	°C	273.15		
Total Pressure	kPa	101.3		
Moisture	%	-		
Oxygen (Dry)	%	5		

Stack Gas Composition & Molecular Weights								
Component	**Molar Mass M**	**Density Kg/m^3 p**	**Conc. Dry % v/v**	**Dry Volume Fraction r**	**Dry Conc. kg/m^3 pi**	**Conc. wet % v/v**	**Wet Volume Fraction r**	**Wet Conc.kg/m^3 pi**
Carbon Dioxide CO_2	44.01	1.96	11.1	0.111	0.22	10.11	0.10	0.20
Oxygen O_2	32	1.43	5.7	0.057	0.08	5.19	0.05	0.07
Nitrogen N_2	28.1	1.25	83.2	0.832	1.04	75.80	0.76	0.95
Moisture (H_2O)	18.02	0.80	-	-	-	8.9	0.09	0.07
	-	-	-	-	-	-	-	-
where p=M/22.41	-	-	-	-	-	-	-	-
pi = r x p	-	-	-	-	-	-	-	-

Calculation of Stack Gas Densities		
Determinand	**Units**	**Result**
Dry Density (STP), P STD	$kg.m^{-3}$	1.343
Wet Density (STP), P STW	$kg.m^{-3}$	1.299
Dry Density (Actual), P Actual	$kg.m^{-3}$	0.495
Average wet Density (Actual), P ActualW	$kg.m^{-3}$	0.479
Where		
P STD = sum of component concentrations, kg/m3 (excluding water vapour)	-	-
P STW = (P STD + pi of H2O) / (1 + (pi of H2O / 0.8036))	-	-
P actual = P STD x (T STP / (P STP)) x (Pa / Ta)	-	-
P actual W (at each sampling point) = P STW x (Ts / Ps) x (Pa / Ta)	-	-

Sampling Plane Validation Criteria	Value	Units	Requirement	Compliance	Method
Lowest Differential Pressure	76	Pa	>5 Pa	Yes	EN16911:2013
Lowest Gas Velocity	15.11	m/s	-	N/A	-
Highest Gas Velocity	16.54	m/s	-	N/A	-
Ratio of Above	1.09	:1	<3:1	Yes	EN16911:2013
Mean Velocity	15.69	m/s	-	N/A	-
Angle of flow with regard to duct axis	<15	degrees	< 15	Yes	EN16911:2013
No local negative flow	No	-	-	Yes	-
Homogeneous flow stream/gas velocity	Yes	-	-	Yes	-

Calculation of stack Gas Velocity, V	
Velocity at Traverse Point, V = Kcp * Sqroot ((2 * DP) / Density)	-
Where	
Kpt = Pitot tube calibration coefficient	0.85
Compressibility correction factor, assumed at a constant 0.998	0.998

Gas Volumetric Flowrate	Units	Result
Gas Volumetric Flow Rate (Actual)	$m^3.h^{-1}$	5129
Gas Volumetric Flow Rate (STP, Wet)	$m^3. h^{-1}$	1893
Gas Volumetric Flowrate (STP, Dry)	$m^3. h^{-1}$	1725
Gas Volumetric Flowrate REF to Oxygen	$m^3. h^{-1}$	1649

IV. Appendix III Individual parameter sampling details and results

Total Particulate Matter : Sampling details and results

Run 1			**Time On**	10:00:00	-
Stack ID	E1	-	**Time Off**	10:30:00	-
Filter ID	E1	-	**Uncertainty Data**	-	-
Start Dry Gas Meter	-	Nm3	**Temperature at Pump**	4	Deg C
Finish Dry Gas Meter	-	Nm3	**Pressure at Pump**	100.8	kPa
Average Stack Temperature	464	degrees	**Air Volume at Pump**	0.53	m^3
Moisture Content	8.90	%	**Humidity at Pumps**	0.1	%
Stack Flow Rate STP, Dry	1725	$m^3.h^{-1}$	**Filter Weight**	1.1	mg
Volume of Air Sampled	0.52	$m^{3\ (VgN)}$	**Front End Weight**	<0.3	mg
Balance Calibration	**Weight**				
300.0	-	g	-	-	-
500.0	-	g	-	-	-
1000.0	-	g	-	-	-
Inpinger Weights	**Initial**	**Final**	**Difference**		
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
Volume of Air Sampled	0.52	Nm3	0	-	-
Moisture Content (EN 14790)	-	%	-	-	-
Leak Check Results	**Result**	-	**% Leak**		
Before Blank	0.1	l/min	0.6	-	-
After Blank	0.1	l/min	0.6	-	-
Before Sample 1	0.1	l/min	0.6	-	-
After Sample 1	0.18	l/min	1.1	-	-
Average Flow Rate	17	l/min	1.1	-	-
Standard Maximum	0.34	l/min	2%	-	-
Back Pressure	-	bar	-	-	-
Leak check acceptable	Yes	-	Yes/No	-	-
Water droplets present	No	-	Yes/No	-	-
Standard Criteria to be Met	**Result**	**Standard Requirement**			
Angle of Flow	<15	<15 Degrees			
Negative Flow in the Stack	None	None			
Pitot Pressure Difference	>5Pa	>5Pa			
Ratio of Flow Measurement	<3:1	<3:1			
Pitot Tube Leak Check	**Result**				
Positive Pressure	Pass	-			
Negative Pressure	Pass	-			

Number of Ports	1	2			
Straight length before sample point	> 5	> 5 Hydraulic Diameters			
Straight length after sample point	> 5	> 5 Hydraulic Diameters			
Sample Calculations	-	-			
Blank (Filter and Front Wash Combined)	<0.35	mg			
Sample 1 (Filter and Front Combined)	1.4	mg			
Volume of Air Sampled	0.57	m^3			
Blank Result	<0.61	$mg.m^{-3}$			
Sample Result	2.45	$mg.m^{-3}$			
Emission Limit Value	130	$mg.m^{-3}$			
Blank as Percentage of ELV	0.5	%	**Standard Requirement**	**<10% ELV**	-
Isokinetic Criterion Compliance					
Isokinetic Variation	%	0	-	-	-
Allowable IsoKinetic Range	%	95-115	-	-	-
Iso Kineticity Acceptable	-	Yes	-	-	-

Total Particulates Quality Assurance

Stack ID	E1	-
Parameter	**Units**	**Run 1**
Sampling Times	-	10:00:00
Sampling dates	-	28/02/2017
Sampling Device	-	Basic
Volume Sampled (REF.)	m3	0.52
Filter ID Number	-	E1
Probe rinse ID	-	E1W
Total Filter Mass	mg	1
Probe Rinse Solids Mass	mg	<0.3
Total Mass Collected	mg	1.4
General information		
Standard	ISEN13284-1	**Run 1**
Technical Procedure	-	2000
Probe Material	-	SS
Filter Housing	-	SS
Positioning of Filter	-	In-stack
Filter Size and Material	-	47mm filter, 8mm nozzle
Number of Sampling lines used	-	1
Number of Sampling Points used	-	2

Carbon Monoxide Quality Assurance

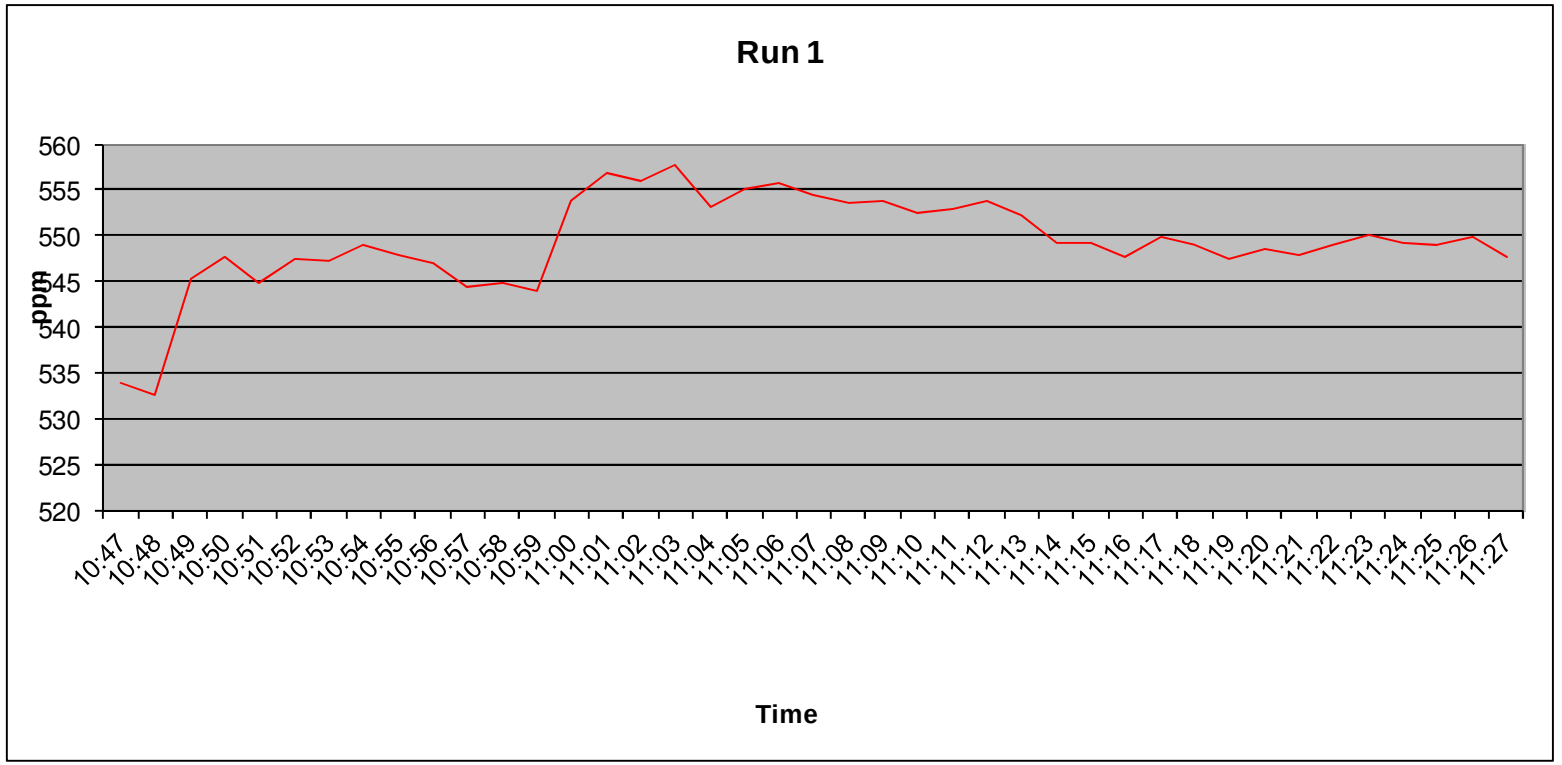
Sampling Details		
Stack ID	E1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	10:54
Sampling Dates	-	28/02/2017
Instrument Range	ppm	1000
Span Gas Value	ppm	598
Acceptable Gas Range	-	Yes
Quality Assurance	**Units**	**Run 1**
Conditioning Unit Temperature	C	2
Average Temperature	< C	2
Allowable Temperature	-	4
Temperature Acceptable	-	Yes
Pump flow rate	l/min.	0.5
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	1
Zero Down Sampling Line (Post)	ppm	3
Zero drift	ppm	2
Allowable Zero Drift	ppm	11.9
Zero Drift Acceptable	-	Yes
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	599
Span Down Sampling Line (Post)	ppm	596
Span Drift	ppm	3
Allowable Span Drift	ppm	11.9
Span Drift Acceptable (Y/N)	-	Yes
Leak Check		
Span Gas Conc.	ppm	598
Recorded Conc. down Line	ppm	599
Leak check acceptable (< 2%)	(Y/N)	Yes
Test Conditions	**Units**	**Run 1**
Run Ambient Temperature Range	C	3

Carbon Monoxide Results & Sampling details

Parameter	Units	Run 1
Concentration	$mg.m^{-3}$	686.60
Uncertainty	$mg.m^{-3}$	39.90
Mass Emission	kg.h	1.17

General Sampling Information	
Parameter	**Value**
Standard	EN15058
Technical Procedure	SOP2004
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Span Gas Reference Number	ASLTM15ING503
Span Gas Expiry Date	Nov-17
Span Gas Start Pressure (bar)	60
Gas Cylinder Concentration (ppm)	598
Span Gas Uncertainty (%)	<2
Zero Gas Type	Nitrogen
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	E1
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Carbon Monoxide Trend



Carbon Monoxide Measurement Uncertainty

	Units	Run 1
Measured Quantities		
Certified Range of Analyser	ppm	1.36 to 1000
Operational Range of Analyser	ppm	1000
Measured Reading	ppm	549.28
Measured Quantities	**Units**	**Run 1**
Nonlinearity	%	0.9
Temperature Dependent Zero drift	%	0.14
Temperature Dependent Span drift	%	-0.12
Cross-sensitivity	%	0.08
Leak	%	0
Calibration Gas Uncertainty	%	<2
Parameter	**Units**	**Run 1**
Combined uncertainty	$mg.m^{-3}$	9.19
Expanded uncertainty	$mg.m^{-3}$	18.39
Uncertainty corrected to std conds.	$mg.m^{-3}$	39.90
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	2.85
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	39.90
Expanded uncertainty expressed with a level of confidence of 95%	% of value	5.81
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Oxides of Nitrogen Quality Assurance

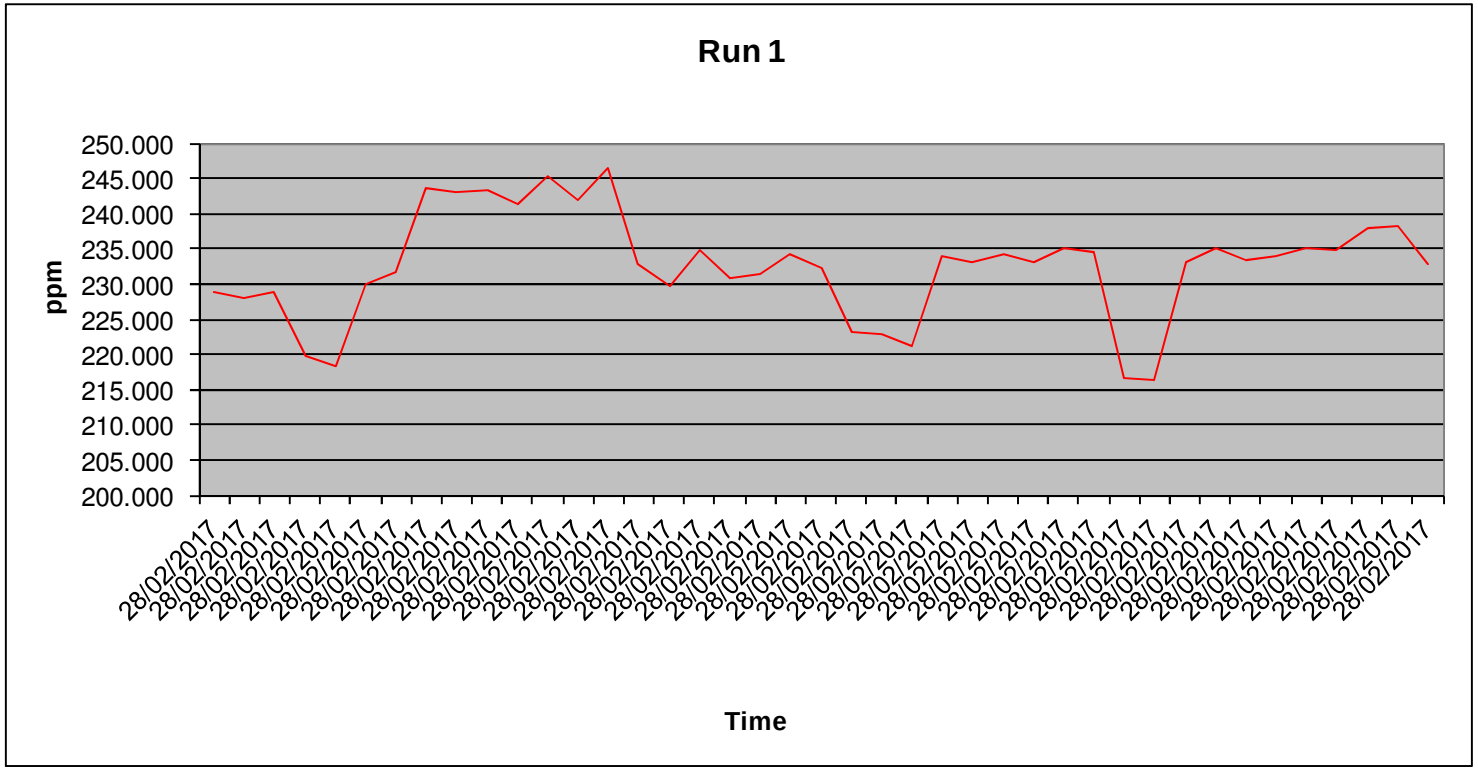
Sampling Details		
Stack ID	E1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	10:54
Sampling Dates	-	28/02/2017
Instrument Range	ppm	250
Span Gas Value	ppm	163
Acceptable Gas Range	-	Yes
Quality Assurance	**Units**	**Run 1**
Conditioning Unit Temperature	C	2
Average Temperature	< C	2
Allowable Temperature	-	4
Temperature Acceptable	-	Yes
Pump flow rate	l/min.	0.5
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	0.1
Zero Down Sampling Line (Post)	ppm	1.3
Zero drift	ppm	1.2
Allowable Zero Drift	ppm	3.2
Zero Drift Acceptable	-	Yes
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	163.1
Span Down Sampling Line (Post)	ppm	162.4
Span Drift	ppm	0.7
Allowable Span Drift	ppm	3.2
Span Drift Acceptable (Y/N)	-	Yes
Leak Check		
Span Gas Conc.	ppm	163
Recorded Conc. down Line	ppm	163.1
Leak check acceptable (< 2%)	(Y/N)	Yes
Test Conditions	**Units**	**Run 1**
Run Ambient Temperature Range	C	3
NOx Converter Efficiency	%	95.4

Oxides of Nitrogen Results & Sampling details

Parameter	Units	Run 1
Concentration	$mg.m^{-3}$	477.43
Uncertainty	$mg.m^{-3}$	36.61
Mass Emission	$kg.h^{-1}$	0.81

General Sampling Information	
Parameter	**Value**
Standard	EN14792
Technical Procedure	SOP2002
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Date & Result of last converter check	95.4 07/01/2017
Span Gas Reference Number	ASLTM16ING517
Span Gas Expiry Date	Jul-17
Span Gas Start Pressure (bar)	20
Gas Cylinder Concentration (ppm)	163
Span Gas Uncertainty (%)	<2
Zero Gas Type	Nitrogen
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	E1
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Oxides of Nitrogen Trend



Oxides of Nitrogen Measurement Uncertainty

Measured Quantities	**Units**	**Run 1**
Nonlinearity	%	1.4
Temperature Dependent Zero drift	%	-0.04
Temperature Dependent Span drift	%	-0.25
Cross-sensitivity	%	0.5
Leak	%	0
Calibration Gas Uncertainty	%	<2
Mass Flow Controllers (Dilution) Uncertainty	%	<1
NOx Converter Efficiency	%	95.4
Parameter	**Units**	**Run 1**
Combined uncertainty	$mg.m^{-3}$	13.95
Expanded uncertainty	$mg.m^{-3}$	27.90
Uncertainty corrected to std conds.	$mg.m^{-3}$	36.61
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	7.32
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	36.61
Expanded uncertainty expressed with a level of confidence of 95%	% of value	7.67
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Hydrogen Chloride Sampling Details & Results

Stack ID	E1	**Run 1**
Sample ID	E1 HCL	**mls**
Impinger 1 ID	E1 HCL 1+2	240
Impinger 2 ID	-	-
Impinger 3 ID	E1 HCL 3	160
Time on	09:30	
Time off	10:02	
Leak Check Results		
Prior to test:	0.01	l/min
Post Test:	0.02	l/min
Sample Volume Flow Rate:	2.8	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	-	
Calibration Unit:	ASLTM15EQ504	
Calibration Rate Before Test:	2.8	litres per minute
Calibration Rate After Test:	2.800	litres per minute
Average sample Volume:	2.8	litres per minute
Sample Test Time:	32	minutes
Pump Gas Temperature:	0	^{O}C
Pump Sample Pressure:	101.3	kPa
Actual Sample Volume:	0.08960	m^3
Normalised Gas Volume:	0.08960	Nm^3

Hydrogen Chloride Quality Assurance

Stack ID	E1	-
Date	28/02/2017	-
Start time	-	09:30:00
Finish Time	-	10:02:00
	Units	**Run 1**
Leak test results		
Mean Sampling Rate	l/min	2.8
Pre-sampling leak rate	l/min	0.01
Post-sampling leak rate	l/min	0.02
Leak rate	l/min	0
Acceptable leak rate (<2%)	Y/N	Yes
Filtration		
Filter Material	-	N/A
Filter Size	mm	N/A
Max. Filter Temp	degrees	N/A
Absorbers Type	Glass/PTFE/ Other	PTFE
Absorption Solution	-	Di H2O
Absorption Efficiency		
Total Imp1 + Imp 2 + Imp 3	ug	20
Impinger 3	ug	8
Absorption efficiency	%	60
Acceptable Absorption Eff.	>95% (Y/N)	N
Blank sample		
Blank sample ID	-	E1HCLB
Blank result	mg/m^3	<0.08
Acceptable Blank	<10% ELV (Y/N)	Y
Testing laboratory		
Laboratory Name	-	UKAS1549
Test certificate Number	-	638888

Hydrogen Chloride Results & Measurement Uncertainty

Stack ID	E1	**Run 1**
Date	-	
Start time	09:30	
Finish Time	10:02	
Results		
Laboratory Result	20	µg/ml
Impinger final Volume	400	ml
Concentration	0.02	mg
Sample Volume	0.090	Nm^3
Emissions Concentration	0.22	$mg.m^{-3}$
Mass Emissions	<0.0004	$kg.h^{-1}$

	Units	**Run 1**
	Units	Run 1
Parameter		
Combined Uncertainty	$mg.m^{-3}$	0.002
Expanded uncertainty as percentage of measured value	% of measured value	3.99
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.004
Expanded uncertainty as percentage of limit value	% Of ELV	0.01

Hydrogen Fluoride Sampling Details & Results

Sampling Details		**Run 1**
Stack ID	E1	
Start time	11:35	
Finish Time	12:06	
Leak Check Results		
Prior to test:	0.02	l/min
Post Test:	0.02	l/min
Sample Volume Flow Rate:	2.6	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	-	
Calibration Unit:	ASLTM15EQ504	
Calibration Rate Before Test:	2.6	l/min
Calibration Rate After Test:	2.6	l/min
Average sample Volume:	2.6	l/min
Sample Test Time:	31	min
Pump Gas Temperature:	0	^{O}C
Pump Sample Pressure:	101.3	kPa
Actual Sample Volume:	0.08060	m^3
Normalised Gas Volume:	0.08060	Nm^3

Hydrogen fluoride Quality Assurance

Start time	-	11:35:00
Finish Time	-	12:06:00
	Units	**Run 1**
Leak test results		
Mean Sampling Rate	l/min	2.6
Pre-sampling leak rate	l/min	0.02
Post-sampling leak rate	l/min	0.02
Leak rate	l/min	0.00
Acceptable leak rate (<2%)	Y/N	Yes
Filtration		
Filter Material	-	N/A
Filter Size	mm	N/A
Max. Filter Temp	degrees	N/A
Absorbers Type	Glass/PTFE/ Other	Glass
Absorption Solution	-	0.1m NaOH
Absorption Efficiency		
Total Imp 1 + Imp2 + Imp3	ug	19.5
Impinger 3	ug	8
Absorption efficiency	%	59
Acceptable Absorption Eff.	>95% (Y/N)	N
Blank sample		
Blank sample ID	-	E1HFB
Blank result	mg/m^3	<0.08
Acceptable Blank	<10% ELV (Y/N)	Y

Hydrogen Fluoride Results & Measurement Uncertainty

Sampling Details		**Run 1**
Stack ID	E1	
Date	-	
Start time	11:35:00	
Finish Time	12:06:00	
Results		
Laboratory Result	19.5	µg/ml
Impinger final Volume	390	ml
Concentration	0.02	mg
Sample Volume	0.08	Nm^3
Emissions Concentration	0.24	$mg.m^{-3}$
Mass Emissions	<0.0004	$kg.h^{-1}$

	Units	**Run 1**
	Units	Run 1
Parameter		
Combined Uncertainty	$mg.m^{-3}$	0.005
Expanded uncertainty as percentage of measured value	% of measured value	4.136
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.010
Expanded uncertainty as percentage of limit value	% Of ELV	0.200

Sulphur Dioxide Quality Assurance

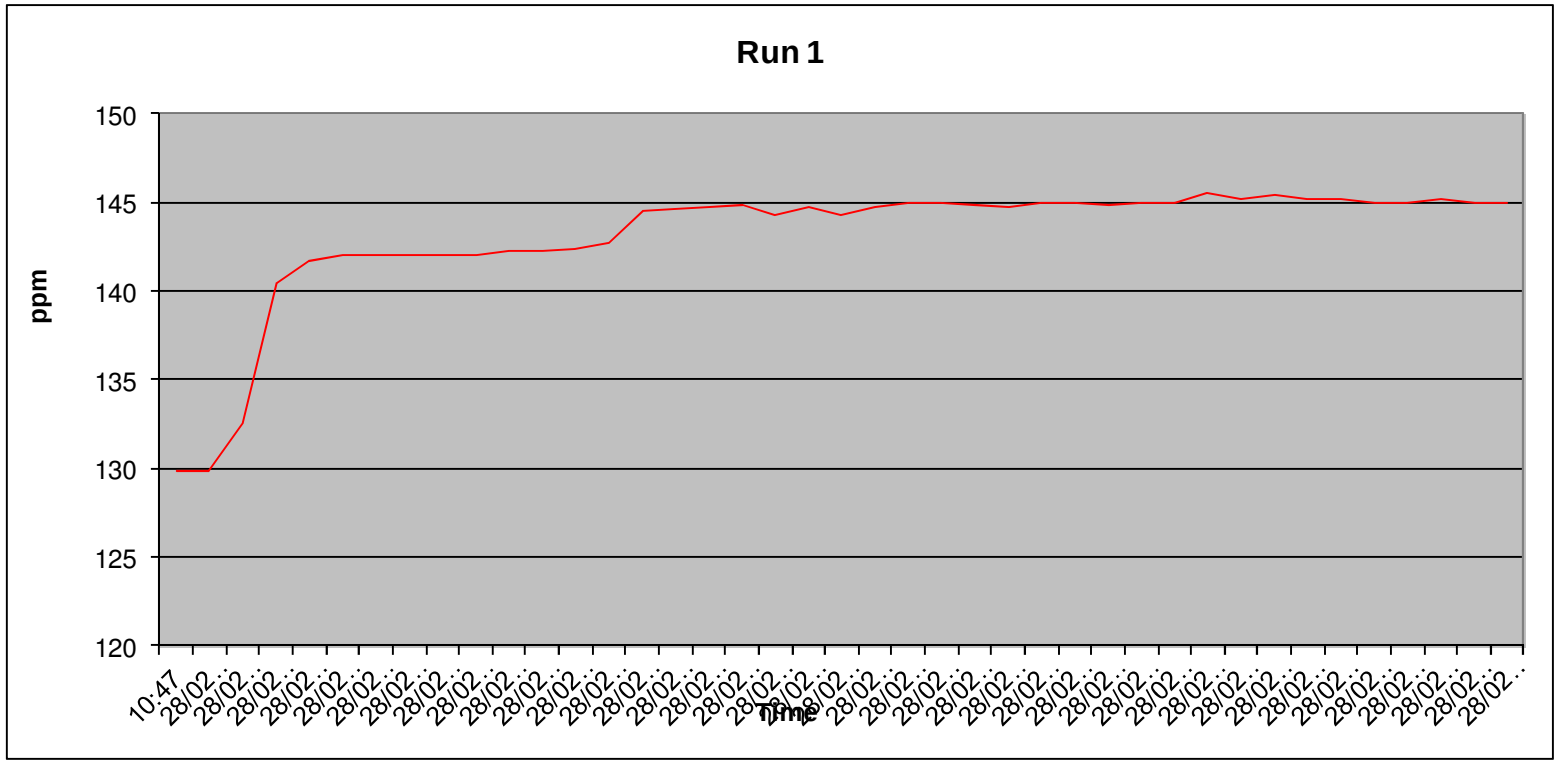
Sampling Details		
Stack ID	E1	-
	Units	**Run 1**
Parameter		
Sampling Times	-	10:54
Sampling Dates	-	28/02/2017
Instrument Range	ppm	1000
Span Gas Value	ppm	552
Acceptable Gas Range	-	Yes
	-	-
Quality Assurance	**Units**	**Run 1**
Conditioning Unit Temperature	C	2
Average Temperature	< C	2
Allowable Temperature	-	4
Temperature Acceptable	-	Yes
Pump flow rate	l/min.	0.5
	-	-
Zero Drift	Units	**Run 1**
Zero Down Sampling Line (Pre)	ppm	1
Zero Down Sampling Line (Post)	ppm	6
Zero drift	ppm	5
Allowable Zero Drift	ppm	27
Zero Drift Acceptable	-	Yes
	-	-
Span Drift	Units	**Run 1**
Span Down Sampling Line (Pre)	ppm	554
Span Down Sampling Line (Post)	ppm	577
Span Drift	ppm	25
Allowable Span Drift	ppm	27
Span Drift Acceptable (Y/N)	-	Yes
	-	-
Leak Check		
Span Gas Conc.	ppm	552
Recorded Conc. down Line	ppm	554
Leak check acceptable (< 2%)	(Y/N)	Yes
	-	-
Test Conditions	**Units**	**Run 1**
Run Ambient Temperature Range	C	3

Sulphur Dioxide Results & Sampling details

Parameter	Units	Run 1
Concentration	$mg.m^{-3}$	409.28
Uncertainty	$mg.m^{-3}$	24.57
Mass Emission	kg.h	0.69

General Sampling Information	
Parameter	**Value**
Standard	TGN 21
Technical Procedure	2012
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	190
Date & Result of last converter check	-
Span Gas Reference Number	ASLTM15ING528
Span Gas Expiry Date	Dec-17
Span Gas Start Pressure (bar)	60
Gas Cylinder Concentration (ppm)	552
Span Gas Uncertainty (%)	<2
Zero Gas Type	N
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	E1
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Sulphur Dioxide Trend



Sulphur Dioxide Measurement Uncertainty

	Units	Run 1
Measured Quantities		
Certified Range of Analyser	ppm	2.14 to 1000
Operational Range of Analyser	ppm	1000
Measured Reading	ppm	143.10
Measured Quantities	**Units**	**Run 1**
Nonlinearity	%	0.8
Temperature Dependent Zero drift	%	0.8
Temperature Dependent Span drift	%	2
Cross-sensitivity	%	1.5
Leak	%	0
Calibration Gas Uncertainty	%	<2 %
Parameter	**Units**	**Run 1**
Combined uncertainty	$mg.m^{-3}$	6.23
Expanded uncertainty	$mg.m^{-3}$	12.46
Uncertainty corrected to std conds.	$mg.m^{-3}$	24.57
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	0.00
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	24.57
Expanded uncertainty expressed with a level of confidence of 95%	% of value	6.00
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions		

Total Volatile Organic Carbon (Tube) Sampling details

Sampling Details	**Run 1**	
Stack ID	E1	
	Tube	
Leak Check Results		
Prior to test:	0	l/min
Post Test:	0	l/min
Sample Volume Flow Rate:	0.41	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	ASLTM12EQ503	
Calibration Unit:	ASLTM12EQ508	
Calibration Rate Before Test:	0.41	l/min
Calibration Rate After Test:	0.41	l/min
Average sample Volume:	0.41	l/min
Sample Test Time:	34	Min.
Pump Gas Temperature:	28	^{O}C
Pump Sample Pressure:	100.8	kPa
Actual Sample Volume:	0.01394	m^3
Normalised Gas Volume:	0.01258	m^3

Total Volatile Organic Carbon (Tube) Quality Assurance

Site Name	-	-
Stack ID	E1	-
Date	28/02/2017	**Run 1**
Start time	-	09:45:00
Finish Time	-	10:19:00
	Units	**Run 1**
Leak test results		
Mean Sampling Rate	l/min	0.41
Pre-sampling leak rate	l/min	0
Post-sampling leak rate	l/min	0
Leak rate	l/min	0
Acceptable leak rate (<2%)	Y/N	Y
Filtration		
Filter Material	-	N/A
Filter Size	mm	N/A
Max. Filter Temp	degrees	N/A
Absorbers Type	Glass/PTFE/ Other	226-09
Blank sample	-	
Blank sample ID	mg/m^3	6242014067
Blank result	<10% ELV (Y/N)	<0.79
Acceptable Blank	-	Y

Total Volatile Organic Carbon (Tube) Results and Measurement Uncertainty

Sampling Details		**Run 1**
Stack ID	E1	
Date	-	
Start time	09:45:00	
Finish Time	10:19:00	
Results		
Laboratory Result	<10	µg
Sample Volume	0.012581	m^3
Emissions Concentration	0.794859	$mg.m^{-3}$
Mass Emission	<0.001	$kg.h^{-1}$

Parameter	**Units**	**Run 1**
Combined Uncertainty	$mg.m^{-3}$	0.06
Expanded uncertainty as percentage of measured value	% of measured value	16.23
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.13
Expanded uncertainty as percentage of limit value	% Of ELV	0.64

Title:	**Determination of Speciated Organic Compounds**			
Method:	EN 13649			
Client:	Cork City Council			
Log Sheet Complete by:	John Casey			
Test Date:	28/02/2017			
Laboratory Used:	UKAS1549			
Certificate Numbers:	638888			
Stack Reference:	E1			
Leak Check Results				
Prior to test:	0	l/min		
Post Test:	0	l/min		
Sample Volume Flow Rate:	0.41	l/min		
Standard Requirement:	<2	%		
Test Result:	0	%		
Test Status	Pass			
Calibration Details				
Pump Number:	ASLTM12EQ503			
Calibration Unit:	ASLTM12EQ508			
Calibration Rate Before Test:	0.41	litres per minute		

Calibration Rate After Test:	0.41	litres per minute		
Average sample Volume:	0.41	litres per minute		
Sample Test Time:	34	minutes		
Pump Gas Temperature:	28	^{o}C		
Pump Sample Pressure:	100.8	kPa		
Actual Sample Volume:	0.01394	m^3		
Normalised Gas Volume:	0.01258	Nm^3		
Tube Details				
Tube Type:	226-09			
Tube Identification Number:	6700209157			
Blank Identification Number:	6242014067			
Test Details				
Adsorption Tube Temperature:	28	^{o}C		
Max Temperature Allowable:	40	^{o}C		
Stack Flow Rates				
Diameter:	0.34	m		
Average Velocity:	15.69	m/s		
Average Temperature:	464	^{o}C		
Average Pressure:	82	kPa		
Actual Flow Rate:	5129	m^3/Hr		
Normalised Flow Rate:	1725	Nm^3/Hr		
Speciated Organic Results				
Class I	***ug/tube***	***mg/Nm3***	***kg/hr***	
LLOD	<10	<0.79	<0.0014	
Class II				
LLOD	<10	<0.79	<0.0014	
Class III				
LLOD	<10	<0.79	<0.0014	
Total Class I	***<0.79***	***mg/Nm3***	***<0.001371***	***kg/Hr***
Total Class II	***<0.79***	***mg/Nm3***	***<0.001371***	***kg/Hr***
Total Class III	***<0.79***	***mg/Nm3***	***<0.001371***	***kg/Hr***

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john@odourireland.ie
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W0012-03-VOC/SURFACEEMISSIONS/2017/1 LANDFILL GAS SURFACE EMISSIONS SURVEY AT KINSALE ROAD LANDFILL FACILITY, BALLYPHEHANE, CURRAGHCONWAY, INCHISARSFIELD, SOUTH CITY LINK ROAD, CORK., CORK.

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF CORK CITY COUNCIL

PREPARED BY:	Dr. John Casey
ATTENTION:	Mr. Kevin Ryan
LICENCE NUMBER:	W0012-3
LICENCE HOLDER:	Cork City Council
FACILITY NAME:	Kinsale Landfill Facility
DATE OF MONITORING VISIT:	13/01/2017
NAME AND ADDRESS OF CLIENT ORGANISATION:	Kinsale Road landfill facility, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork., Cork
NAME AND ADDRESS OF MONITORING ORGANISATION:	Odour Monitoring Ireland, Unit 32 DeGranville Court, Dublin Road, Trim, Co. Meath
DATE OF REPORTING:	20/01/2017
NAME AND THE FUNCTION OF THE PERSON APPROVING THE REPORT:	Dr. Brian Sheridan, Managing Partner, Odour Monitoring Ireland
REPORT NUMBER:	2016529(1)
REVIEWERS:	

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Section **Page number**

DOCUMENT AMENDMENT RECORD

Client: ***Cork City Council***

Title: W0012-03-VOC/SurfaceEmissions/2017/1 Landfill Gas Surface emissions Survey at Kinsale Road landfill facility, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork., Cork.

Project Number: 2016529			**Document Reference:** W0012-03-VOC/SurfaceEmissions/2017/1		
2016529(1)	Document for review	JWC	BAS	JWC	20/01/2017
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**

Executive Summary

Cork City Council commissioned Odour Monitoring Ireland to perform a landfill gas surface emissions survey of Kinsale Road landfill facility (i.e. Waste licence number 12-03) in order to ascertain any likely sources of landfill gas surface emissions from the landfill site. Landfill gas surface emissions are the predominant source of odour emissions from landfills in Ireland. The survey was carried out on the 13th Jan. 2017.

The site including former landfill areas occupies approximately 72 Ha. The acceptance of waste ceased on the 15th July 2009.

During the surface emissions survey, the following tasks were performed on site:

1. Identification the key mechanisms that lead to the release of landfill gas surface emissions from the site.
2. Identify geographically on a site map, the locations of landfill gas surface emissions in order to perform remediation of the identified surface emissions areas.

The following conclusions were drawn from survey:

- No zones of surface emissions were identified within the landfill facility that exceeded recommended trigger levels.

1. Introduction

1.1. Background to work

Odour Monitoring Ireland was commissioned by Cork City Council to perform a specified independent Volatile organic compound surface emissions survey at Kinsale Road landfill facility. The assessment involved a Volatile organic compound (VOC) surface emissions survey of the landfill facility in order to ascertain the VOC emission points and mark them upon a map for remediation. This report presents a summary of the findings of a VOC surface emissions survey at Kinsale Road landfill facility, Ballyphehane, Curraghconway, Inchisarsfield, South City Link Road, Cork. The report is based on scientific measurements and observations made during a site visit conducted on the 13th Jan. 2017.

1.2. Scope of work

The main aims of the survey included:

- Surface emissions monitoring in accordance with AG6 requirements.
- Discussion meeting with landfill manager once survey was complete in order to communicate main surface emissions areas for immediate remediation, where necessary.
- Identification of short-term mitigation measured to be implemented within the landfill site to reduce surface emissions,

2. Techniques used

This section describes the techniques used throughout the study. The surface emissions surveying and reporting was performed by Dr. John Casey, Odour Monitoring Ireland. Dr. John Casey has preformed surface emissions monitoring survey's on behalf of Odour Monitoring Ireland for regulatory bodies in Ireland and Northern Ireland, local authorities in Ireland, private waste operators in Ireland and borough councils in Northern Ireland. A full documented list of previous survey's is available upon request.

2.1. "Odour hog" monitoring within the landfill

The "Odour hog" (i.e. Version 2, 4 years old with less than 3.5 second response time for the FID) VOC analyser is a portable, intrinsically safe, survey VOC dual monitor, which provides fast and accurate readings of organic and inorganic vapours. A Photo ionisation detector (PID) uses an Ultraviolet (UV) light source (*photo*) to ionise a gas sample and detect its concentration. Ionisation occurs when a molecule absorbs the high energy UV light, ejecting a negatively charged electron and forming of positively charged molecular ion. The gas becomes electrically charged. These charged particles produce a current that is easily measured at the sensor electrodes. Only a small fraction of the VOC molecules are ionised. A PID does not respond to methane. A FID is similar to a flame thermocouple detector, but measures the ions from the flame instead of the heat generated. The FID detects the methane fraction, which provides greater sensitivity in terms of methane surface emissions detection but not necessarily odour hence why the PID data is also interpreted. The FID/PID analyser was calibrated with certified reference material isobutylene and methane before commencement of the survey, see calibration certificates for gases used in Appendix II. The calibration readings were rechecked in accordance with AG6 requirements.

Using the continuous kinematic "Odour hog" with integrated GPS (i.e Magellan Professional with sub centimetre accuracy post processed), the capping of the landfill was surveyed for potential surface emissions areas. Those areas identified were geo-referenced and highlighted for remediation. This technique is useful for comparison in surface emissions area within the same landfill facility on different surveys. The surface emissions maps generated for the particular facility can be used to assess the effectiveness of implemented mitigation techniques and to qualitatively assess the nature of surface emissions from the facility. All surface emissions surveying was carried out in accordance with *"Surface VOC Emissions Monitoring on Landfill Facilities (AG6)".*

Efforts should be made to attain surface emissions <100 ppm from open surfaces and <500 ppm around features such as vertical wells, leachate collection sumps, leachate slope risers and other projections out of the waste body (Casey et al., 2008). These are minimum standards, which should lead to greater landfill collection efficiencies thus reducing the impact on the general environment.

2.2. Meteorological conditions

Table 2.1 illustrates the predominant wind direction during the monitoring exercise. The meteorological conditions were characterised for the day of monitoring and were as follows:

Table 2.1. Meteorological conditions during TVOC survey.

13th Jan. 2017	
Average wind speed 3 m s^{-1}	Wind direction northerly
Temperature 6^0C	1023 mbar
Dry weather	Capping moisture content high
Relative Humidity --%	Cloud cover -- Okta

During the TVOC and gas field survey, wind deviated from a southerly direction. Capping moisture content was low.

2.3 Current landfill gas collection infrastructure on the facility

There is a total of 4 vertical deep borehole wells (pumps to be installed in latter part 2012), 10 periphery pumping stations and 46 gravity condensate / leachate removal devices on the facility. There are 2 no. installed and operational landfill gas enclosed flares (1,250 m^3/hr (Duty), & 2,500 m^3/hr (Duty) capacity. In addition there is a landfill gas utilisation engine on the facility. At the time of the survey the engine was in operation. The central dome of the site (20 ha) is capped (*see Figure 6.1*).

3. Results

3.1. Volatile organic compound surface emissions locations identified within Kinsale Road landfill facility

Figure 6.2 and Table 3.1 illustrates the results obtained for the capping surface emissions survey. There were no surface emissions zones identified.

Table 3.1. Capping VOC surface emissions locations results with source identities correlating with *Figure 6.2 (see Appendix I)*.

Location ID	Easting (m)	Northing (m)	Max VOC conc. (ppm)	Identification and Mitigation	Recommended trigger levels
--	--	--	--	--	--

There were no sources of landfill gas surface emissions identified (*see Figures 6.2 and Table 3.1*) within the landfill.

3.2. Close out meeting with landfill manager

Following completion of the surface emissions survey, the surface emissions team and the landfill manager discussed all aspects and general conclusions of the survey. The landfill manager was informed of the potential areas of surface emissions.

4. Conclusions

The following conclusions were drawn from the survey of Kinsale Road Landfill facility:

- The surface emissions contour map generated from the kinematic Volatile organic compound (VOC) survey illustrated surface areas of landfill gas emissions.
- There were 0 surface emissions zones greater than or equal to 500 ppm around identified features. There was 0 surface emissions zone greater than or equal to 100 ppm instantaneous reading on open surfaces within the landfill footprint.

5. References

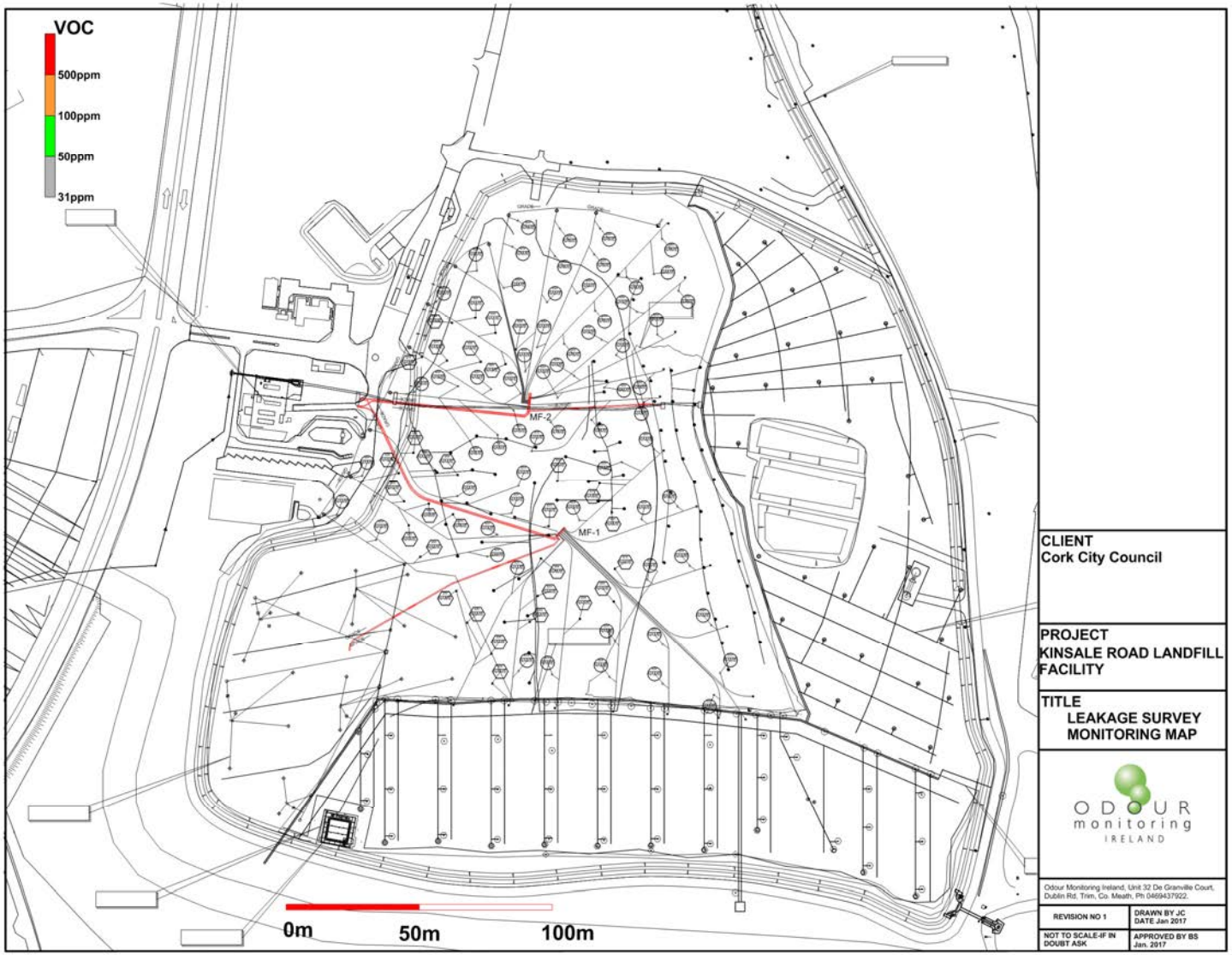
- Casey, J.W., Sheridan, B.A., Henry, M., Reynolds, K., (2008). Effective tools for managing odours from landfill facilities. International Conference on Environmental Odour Monitoring and Control**,** Rome, Italy**,** July 6-8, 2008**.**

6. *Appendix I*- Volatile organic compound surface emissions contour map & Cell capping outline & LFG infrastructure map

Figure 6.1. Cell capping outline & LFG infrastructure on the facility.


Permanent Cap
& Survey Area
MF-2
MF-1
0m
50m
100m
CLIENT
Cork City Council
PROJECT
KINSALE ROAD LANDFILL
FACILITY
TITLE
CAPPING OUTLINE
ODOUR
monitoring
IRELAND
Odour Monitoring Ireland, Unit 32 De Granville Court, Dublin Rd. Trim, Co. Meath. Ph 0469437922.
REVISION NO 1
DRAWN BY JC
DATE Oct 2013
NOT TO SCALE-IF IN DOUBT ASK
APPROVED BY BS
Oct. 2013

Figure 6.2. Landfill gas surface emissions monitoring within the landfill facility (colour scale area indicating TVOC gas colour scale).


VOC
500ppm
100ppm
50ppm
31ppm
MF-2
MF-1
0m
50m
100m
CLIENT
Cork City Council
PROJECT
KINSALE ROAD LANDFILL FACILITY
TITLE
LEAKAGE SURVEY MONITORING MAP
ODOUR monitoring IRELAND
Odour Monitoring Ireland, Unit 32 De Granville Court, Dublin Rd. Trim, Co. Meath, Ph 0469437922.
REVISION NO 1
DRAWN BY JC
DATE Jan 2017
NOT TO SCALE-IF IN DOUBT ASK
APPROVED BY BS
Jan. 2017

7. Appendix II-Calibration certificates and procedures.

7.1 Span & Calibration procedure

Necessary Calibration gases: Zero gas (0ppm), 98.8ppm and 988ppm methane (Calibration certificates below).

Calibration is carried out in accordance with manufacturers guidelines.

Location: Zero span instrument onsite.

Frequency: Before, midway through, and after the surface emissions survey, typically therefore at 3-4 hour intervals. If the survey only lasts 2 to 3 hours the instrument is checked before and after the event.

Instrument settling: The FID is switched on and left to settle for a period of 30 minutes minimum.

Span Procedure: The zero and span gases shall be introduced under the same flow and pressure conditions using the sample probe at the end of the sample line. The adjustment procedure shall be as follows:

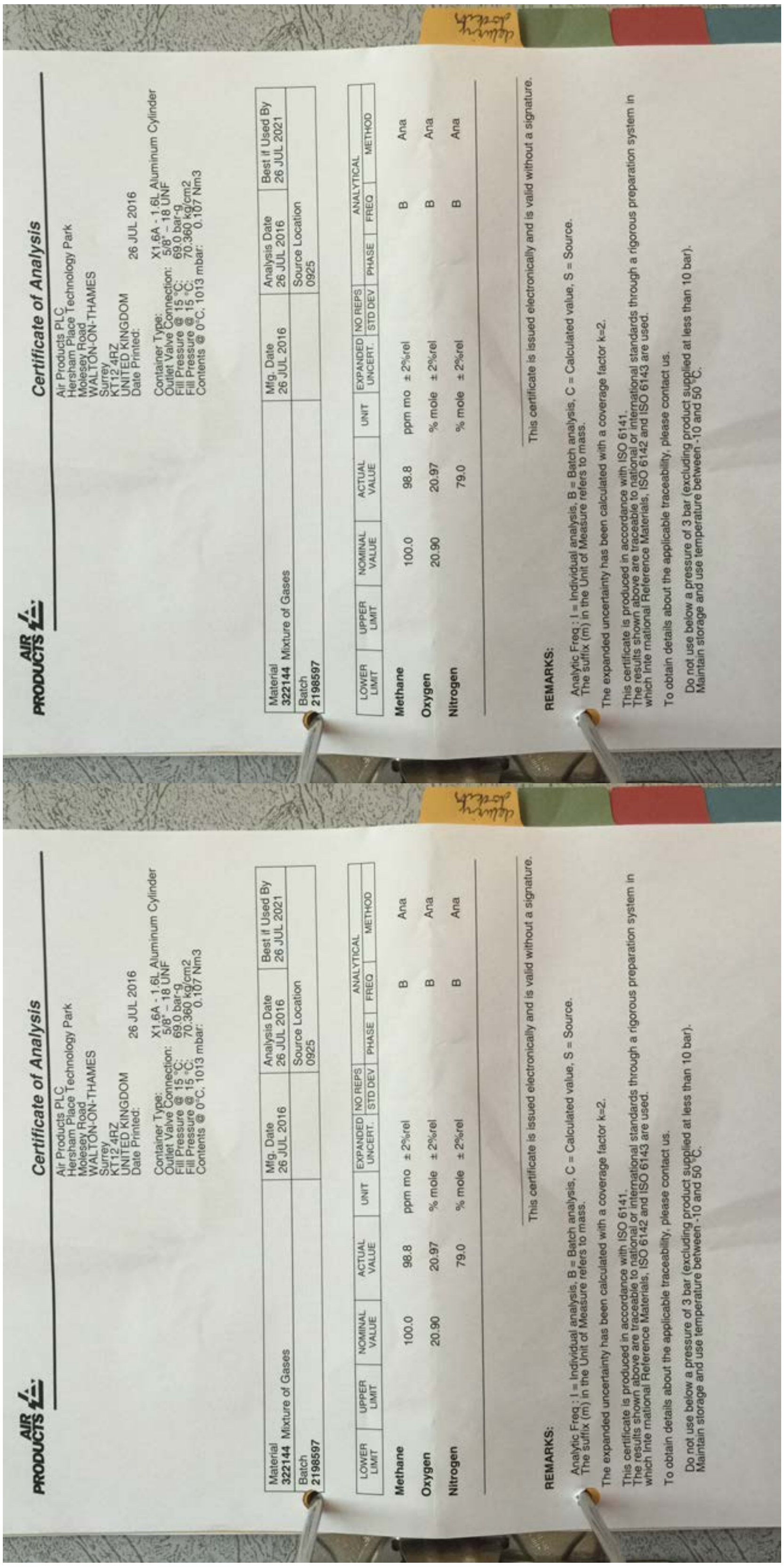
a) Feed the zero gas (0ppm) into the FID and set the zero;

b) Feed the span gas (98.8ppm) and adjust the instrument accordingly;

c) Feed the zero gas into the FID once more and check that the reading returns to zero; if not repeat steps a) to c).

d) repeat procedure A to C to verify

Equipment is maintained and operated as specified by the manufacturer.



AIR PRODUCTS

Certificate of Analysis

Air Products PLC
Hersham Place Technology Park
Molesey Road
WALTON-ON-THAMES
Surrey
KT12 4RZ
UNITED KINGDOM
Date Printed: 26 JUL 2016

Container Type: X1.6A - 1.6L Aluminum Cylinder
Outlet Valve Connection: 5/8" – 18 UNF
Fill Pressure @ 15 °C: 69.0 bar-g
Fill Pressure @ 15 °C: 70.360 kg/cm2
Contents @ 0°C, 1013 mbar: 0.107 Nm3

Material	Mfg. Date	Analysis Date	Best if Used By
322144 Mixture of Gases	26 JUL 2016	26 JUL 2016	26 JUL 2021
Batch 2198597		Source Location 0925	

	LOWER LIMIT	UPPER LIMIT	NOMINAL VALUE	ACTUAL VALUE	UNIT	EXPANDED UNCERT.	NO REPS STD DEV	ANALYTICAL PHASE	ANALYTICAL FREQ	ANALYTICAL METHOD
Methane			100.0	98.8	ppm mo	± 2%rel			B	Ana
Oxygen			20.90	20.97	% mole	± 2%rel			B	Ana
Nitrogen				79.0	% mole	± 2%rel			B	Ana

This certificate is issued electronically and is valid without a signature.

REMARKS:

Analytic Freq : I = Individual analysis, B = Batch analysis, C = Calculated value, S = Source.
The suffix (m) in the Unit of Measure refers to mass.

The expanded uncertainty has been calculated with a coverage factor k=2.

This certificate is produced in accordance with ISO 6141.
The results shown above are traceable to national or international standards through a rigorous preparation system in which Inte rnational Reference Materials, ISO 6142 and ISO 6143 are used.

To obtain details about the applicable traceability, please contact us.

Do not use below a pressure of 3 bar (excluding product supplied at less than 10 bar).
Maintain storage and use temperature between -10 and 50 °C.

AIR PRODUCTS

Certificate of Analysis

Air Products PLC
Hersham Place Technology Park
Molesey Road
WALTON-ON-THAMES
Surrey
KT12 4RZ
UNITED KINGDOM
Date Printed: 26 JUL 2016

Container Type: X1.6A - 1.6L Aluminum Cylinder
Outlet Valve Connection: 5/8" – 18 UNF
Fill Pressure @ 15 °C: 69.0 bar-g
Fill Pressure @ 15 °C: 70.360 kg/cm2
Contents @ 0°C, 1013 mbar: 0.107 Nm3

Material 322144 Mixture of Gases; Mfg. Date 26 JUL 2016; Analysis Date 26 JUL 2016; Best if Used By 26 JUL 2021; Batch 2198597; Source Location 0925

Methane 100.0 98.8 ppm mo ± 2%rel B Ana
Oxygen 20.90 20.97 % mole ± 2%rel B Ana
Nitrogen 79.0 % mole ± 2%rel B Ana

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PRTR Table 2015

	Carbon Monoxide (CO) (kg/yr)	Carbon dioxide (CO_2) (kg/yr)	Nitrogen Oxides (NO_x as NO_2) (kg/yr)	TNMVOC's (kg/yr)	Sulphur dioxide (SO_2) (kg/yr)	Total particulates (kg/yr)	Methane (kg/yr)
Flare	11	924,002	438	--	105	-	20
Engine	10,108	3,121,204	7,102	10	6,081	37	0

Meteorological Data for Kinsale Road Landfill Site - 2016

Station Name:	Cork Airport
Distance from Site:	4 KM
Station Height:	155 m
Latitude:	51.850
Longitude:	-8.480

Abbreviations

	Detail	Unit
maxtp:	Maximum Air Temperature	(*C)
mintp:	Minimum Air Temperature	(*C)
mnmax:	Mean Maximum Temperature	(*C)
mnmin:	Mean Minimum Temperature	(*C)
rain:	Precipitation Amount	(mm)
gmin:	Grass Minimum Temperature	(*C)
wdsp:	Mean Wind Speed	(knot)
mxgt:	Highest Gust	(knot)
sun:	Sunshine duration	(hours)

year	month	maxtp	mintp	mnmax	mnmin	rain	gmin	wdsp	maxgt	sun
2016	1	12.4	-0.8	8.6	3.6	251.7	-6.5	11.8	51	41.5
2016	2	12.4	-0.6	8.1	2	150.9	-5.9	10.8	55	85.4
2016	3	12.4	-1	9.1	3	84.4	-5.5	9.7	50	96.7
2016	4	13.5	-1.1	10.9	3.8	103.3	-4.7	10	49	174.8
2016	5	21.7	2.5	15.7	8.1	85.4	-1.5	8.1	36	204.4
2016	6	22.4	8.6	17.8	10.9	65.6	1.7	8.4	31	177.8
2016	7	23	7.7	18.4	11.9	56.7	2.6	8.4	38	131.6
2016	8	21.5	8.8	18.4	11.5	84.7	4.6	9.3	36	146.7
2016	9	20.3	6	16.5	10.3	136.3	-0.7	9.2	42	68.4
2016	10	15.5	4.4	13.3	8.4	48.7	-1.1	8.9	34	93.2
2016	11	15.4	-1.1	8.8	3	40.7	-5	9	36	116.1
2016	12	12.5	1.4	9.7	5	94.2	-5.7	8.7	50	35.8