northern resource consultants

Highway Reward

Surface Water Trends Analysis

June 2016

prepared for

Highway Reward

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Limitations of this Report

Client: Highway Reward

Prepared by Northern Resource Consultants (NRC)

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The results of work carried out by others may have been used in the preparation of this report. These results have been used in good faith, and we are not responsible for their accuracy.

This report has been formulated in the context of published guidelines, field observations, discussions with site personnel, and results of laboratory analyses.

NRC's opinions in this document are subject to modification if additional information is obtained through further investigation, observations or analysis. They relate solely and exclusively to environmental management matters, and are based on the technical and practical experience of environmental scientists.

They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts.

Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.

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Introduction

1. Transitional Environmental Program MAN17020

The Highway Reward Mine operates as a rehabilitation project under the Environmental Authority (EA) EPML00550413. In 2013, following non-compliance with the EA and an internal site evaluation and investigation, Thalanga Copper Mines Joint Venture (TCMJV) submitted a Program Notice to the Department of Environment and Heritage Protection (EHP). As a result of this Program Notice, EHP issued a notice requiring the preparation and submission of a Draft Transitional Environmental Program (TEP).

The condition of the EA subject to non-compliance and resulting in the submission of the original draft TEP in 2013 is:

Receiving Water Contaminant Limits

(C1-1) Receiving waters affected by the release of process water or storm water contaminated by the mining activities or both must be monitored at the locations and frequencies defined in Schedule C – Table 1 and Schedule J – Map 1 and comply with the **contaminant limits defined in Schedule C – Table 2.**

Table 1: Copy of Schedule C – Table 2 (Receiving water contaminant limits)

PARAMETER	UNITS	LIMIT TYPE	CONTAMINANT TRIGGER LEVELS
pH		Acceptable range	6 - 9
Total Dissolved Solids	Mg/L	Maximum	4000
Sulfate	Mg/L	Maximum	1000
Copper	Mg/L	Maximum	1
Molybdenum	Mg/L	Maximum	0.15
Arsenic	Mg/L	Maximum	0.5
Selenium	Mg/L	Maximum	0.02
Mercury	Mg/L	Maximum	0.002
Lead	Mg/L	Maximum	0.1
Zinc	Mg/L	Maximum	20
Cyanide (WAD)	Mg/L	Maximum	0.01

PARAMETER	UNITS	LIMIT TYPE	CONTAMINANT TRIGGER LEVELS
Cadmium	Mg/L	Maximum	0.01

NOTE: It is assumed that this table of the EA contains an error and the last column is in fact contaminant “limits”.

The non compliance with condition C1-1 of the EA, the surface water contaminant limits, were specifically in regards to ongoing exceedance of the EA limits at receiving surface water sites SW5 and SW6.

On 6 August 2013 the Draft TEP was finalised and submitted to EHP for review. Subsequently the TEP was approved and a notice accepting the TEP was issued on 27 August 2013. The TEP, with statutory reference number MAN17020 was to cover a three-year period until 30 September 2016 and included a number of reporting requirements. As a result of the TEP and as per Condition 1 of the Certificate of Approval, surface water sites SW5 and SW6 have been exempt from the EA contaminant limits and notification requirements during the program period.

This surface water report has been prepared and submitted to EHP as per the reporting requirements and commitments contained within the Draft TEP prepared by Thalanga Copper Mines Pty Ltd.

Table 2 of this document provides a status update on the TEP completion and tasks as per the approved program as of June 2016.

2. TEP Requirements

The TEP aims to address three issues, including:

1. Addressing surface flow towards SW6 on the north-west side of the site.
2. Addressing surface flow towards SW5 to the west of the site.
3. Surface water-groundwater interactions which impact on the amount of contaminated water which can be directed into the pit void.

This report addresses Point 1 and Point 2.

2.1 Surface water flows towards SW6

The TEP further states that objectives of investigation and analysis of flows towards SW6 will include:

- Longitudinal sampling along the flow path after rain events.
- Measuring major drainage flows from the Highway waste rock dump at a dedicated v-notch weir.
- Measuring rainfall on site.
- Measuring flows at each potentially contaminated seep emanating or potential emanating from the Highway waste rock dump.
- Sampling standing pools of water after rainfall.

- Analysing the results of the sampling programs and flow measurements to quantify pollutant sources and fluxes and differentiate sources of contamination.
- Carrying out a program of visually inspecting the Highway and Reward waste rock dumps to identify flaws in the capping which could cause contamination.
- Assessing bare patches on waste rock dumps for growth in size which might indicate scalding and the scale of remedial works needed.

2.2 Surface water flows towards SW5

The TEP further states that objectives of investigation and analysis of flows towards SW5 will include:

- Implementing a program of surface water sampling on the western side of the mining lease including flows directed into the pit.
- Developing a record of photographic monitoring to show and accompany surface water flow sampling for identification of surface water flow or pooling.
- Analysing the result to confirm presence or absence of contaminated water flows on site towards SW5.

3. Overview and Purpose

The purpose of this report is to address the requirements of the TEP as outlined.

Visual inspection of the waste rock dumps and assessing bare patches are undertaken separately to what is outlined in this report.

The purpose of analysis of water samples as outlined in the TEP is to determine if acidity is a result of rainfall or waste rock dump seepage.

During the six-month reporting period discussed in this report there were a number of flow events recorded at SF1 and SF2. All of these flows were below 0.126m3/sec with the average flow recorded at SF1 and SF2 being 24m3/day. These flows resulted in approximately 68,752m3 of flow being recorded past the SF1 gauge and 29,310m3 past the SF2 gauge over the six-month reporting period.

There were four monitoring events during the six monthly period these were:

1. 7 January 2016
2. 6 February 2016
3. 14 February 2016
4. 13 March 2016.

Monitoring events are undertaken when there has been sufficient rainfall for flow in Policeman's Creek (SW4), which is located offsite and is therefore representative of any potential offsite impacts of the mine. The monitoring event for 7 January 2016 only incorporated two TEP sites TEP3 and TEP4 as other sites held insufficient water, for this reason an analysis of the January TEP sampling is not included in the SW5 and SW6 flow analyses sections of this report. The data of these samples is provided in Appendix B.

Table 2: TEP completion status as of June 2016

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
1. Surface Flow Sampling					
1.1	SW6 flow path drain		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.2	SW6 flow path WRD		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.3	SW5 flow path		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.4	Pit V-notch		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.5	SW6 Flow path drain	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
1.6	SW6 flow path WRD	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**
1.7	SW5 flow path	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**
1.8	Pit V-notch	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**
2. Earthworks					
2.1	Remedial drainage and cap repairs	2.1.1 Remove exposed boulders containing sulphides from NW of Highway WRD to the pit 2.1.2 Cap remaining sulphidic material at Highway WRD. 2.1.3 Revegetation of bare patches on Highway and Reward WRD 2.1.4 Removal of sulphidic rocks from fence line at SW5 to pit.	17 September 2013 – 28 October 2013	Earthworks update report by 30 October 2013	**COMPLETE**

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
2.2	2014 earthworks program	-	15 May 2014 – 17 September 2014	Earthworks update report by 29 October 2014	**COMPLETE**
2.3	2015 earthworks program	-	18 May 2015 – 18 September 2015	Earthworks update report by 29 October 2015 including proposed surface water diversion assessment report	**COMPLETE**
2.4	2016 earthworks and surface diversion program	-	17 May 2016 – 5 September 2016	Earthworks update and Surface water diversion works report by 29 September 2016	**NOT YET COMPLETE** **DUE 29 SEPTEMBER 2016**
3. Groundwater / Pit Balance					
3.1	Measure surface flows at V notches	-	17 September 2013 – 20 June 2016	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
3.2	Survey pit water height	-	1 October 2013 – 14 October 2013	Runoff and pit water report by 30 December 2013	**COMPLETE**
3.3	Survey pit water height	-	1 January 2014 – 14 January 2014	Runoff and pit water report by 30 December 2014	**COMPLETE**
3.4	Survey pit water height	-	1 April 2014 – 14 April 2014		
3.5	Survey pit water height	-	1 July 2014 – 14 July 2014		
3.6	Survey pit water height	-	1 October 2014 – 14 October 2014		
3.7	Survey pit water height	-	1 January 2015 – 14 January 2015	Runoff and pit water report by 30 December 2015	**COMPLETE**
3.8	Survey pit water height	-	1 April 2015 – 14 April 2015		

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
3.9	Survey pit water height	-	1 July 2015 – 14 July 2015		
3.10	Survey pit water height	-	1 April 2015 – 14 April 2015		
3.11	Survey pit water height	-	1 July 2015 – 14 July 2015	Runoff and pit water report by 30 September 2016	**NOT YET COMPLETE** **DUE 30 SEPTEMBER 2016**
3.12	Survey pit water height	-	1 April 2016 – 14 April 2016		
3.13	Survey pit water height	-	24 June 2016 – 7 July 2016		
3.14	Groundwater model calibration	-	15 April 2015 – 7 July 2015	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
3.15	Surface water model calibration	-	15 April 2015 – 7 July 2015	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
3.16	Surface diversion assessment	-	8 July 2015 – 18 August 2015	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
4. Final TEP Report					
4.	Submission of Final TEP Report	-	30 September 2016	Submit final TEP report to DEHP by 30 September 2016	**NOT YET COMPLETE** **DUE 30 SEPTEMBER 2016**

Rainfall and Surface Flows

The Department of Transport and Main Roads (TMR) record rainfall on site at Highway Reward. SF2 also has the ability to record rainfall data; however, data was not available from SF2 for periods of the January – June reporting period. For this reason data from the onsite TMR gauge has been reviewed and is provided as a monthly total in Figure 1.

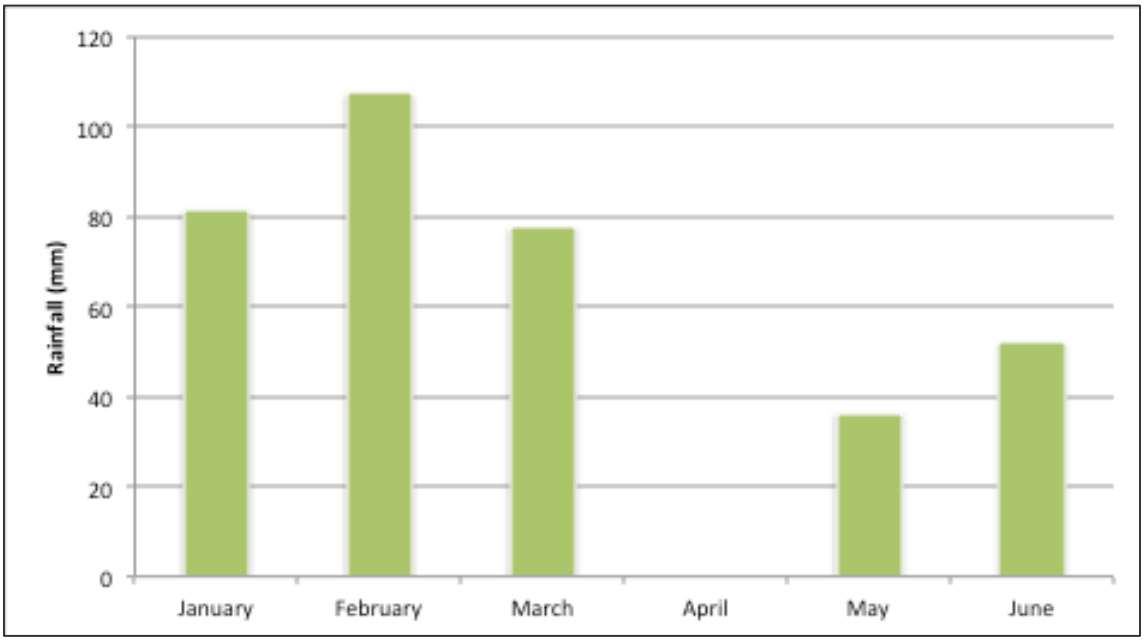


Figure 1: Monthly rainfall from Department of Transport and Main Roads onsite gauge.

There was 355.1mm of rainfall recorded at the TMR site from 1 January until 29 June 2016.

During the six-month reporting period discussed in this report there were a number of flow events recorded at SF1 and SF2. All of these flows were below 0.126m3/sec with the average flow recorded at SF1 and SF2 being 24m3/day (Figure 2). These flows resulted in approximately 68,752m3 of flow being recorded past the SF1 gauge and 29,310m3 past the SF2 gauge over the six-month reporting period (see Table 2).

Table 3: Monthly rainfall and flow volumes for SF1 and SF2

MONTH	SITE RAINFALL	SF1 FLOWS (SW5 CATCHMENT)	SF2 FLOWS (SW6 CATCHMENT)
	mm	m3	m3
January	81.6	0	4,923
February	107.5	26,327	22,050
March	77.7	39,067	614
April	0	0	0
May	36.4	3,357	756
June (to 29 Jun)	51.9	2	967
Total	355.1	68,752	29,310

There were more flow events from SF1 recorded than SF2 (Figure 2) even though SF2 has a larger catchment area. There are four flow events recorded from SF1 while there are only two major flow events recorded from SF2 (Figure 2).

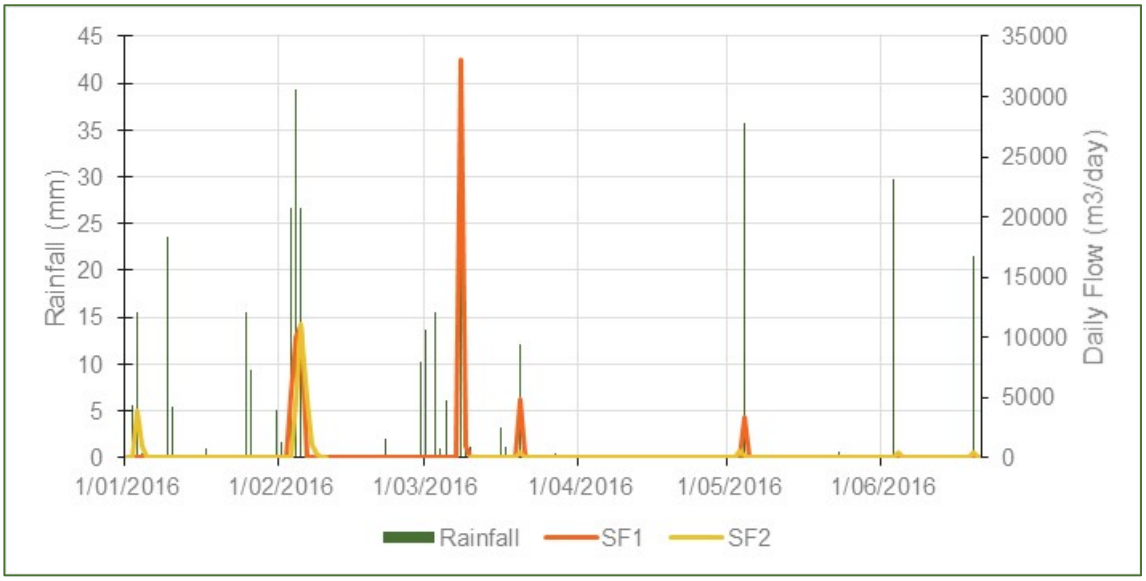


Figure 2: Daily flow values for SF1 and SF2 compared to rainfall

Rainfall values recorded for this monitoring period were multiplied by the catchment area of SF1 (approximately 17.067ha) and SF2 (approximately 31.239ha) and to determine the maximum potential volume of water that could have flowed through each V-notch weir. The cumulative total was then plotted against the cumulative total of flow that was recorded past each V-notch weir to describe the relationship between rainfall and runoff.

Values for SF1 show that there was more flow past the v-notch weir compared to what could have potentially occurred over the catchment area (Figure 3). There was a particularly large flow event contributing 30,000m^3 in the March flow event that is not picked up in the rainfall record represented by the green line in Figure 3. This discrepancy could be as a result of the DTMR gauge used for this period, malfunction of the flow gauge, or an incorrect catchment area used in calculations.

Values for SF2 show that approximately 26% of all rainfall that fell on the catchment area eventuated as runoff. However, as shown in Figure 4 the relationship between total rainfall and runoff is not linear and there are significant periods where rainfall (represented by the green line) did not result in flows past the gauge).

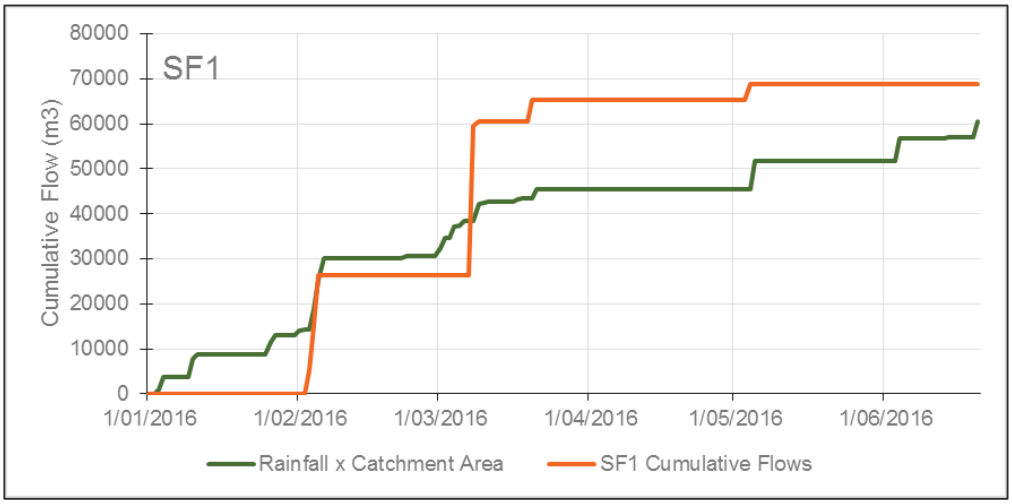


Figure 3: Cumulative flow and rainfall over the catchment of SF1

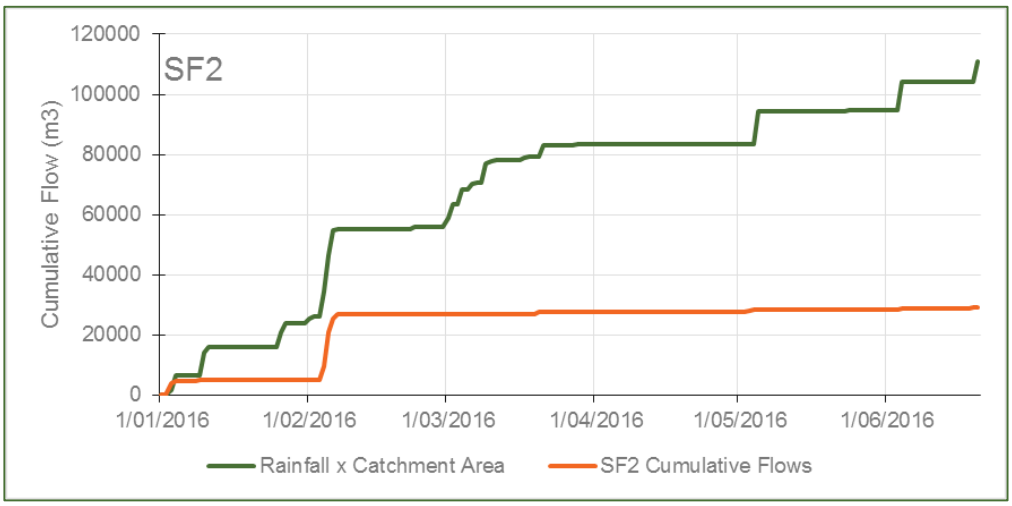


Figure 4: Cumulative flow and rainfall over the catchment of SF2

Water Quality Analyses

The number of samples available from each monitoring point is outlined below in Table 4 and represented in Figure 5 and Figure 6. As indicated above although the data from SF2 and SF1 may indicate a flow, some of these flows (most) were deemed to be insignificant and did not result in a flow in the receiving environment surface water sites.

The majority of samples are from locations draining the Highway waste rock dump (TEP 1-4, TEP6-10).

The locations of TEP and EA monitoring points are shown in Appendix A.

Table 4: Water quality samples available for the TEP reporting period

SAMPLE LOCATION	SAMPLING EVENT					
	7/01/2016	6/02/2016	14/02/2016	13/03/2016	4/05/2016	Total
Locations that flow towards SW6						
TEP 1		1				**1**
TEP 2		1				**1**
TEP 3	1	1		1		**3**
TEP 4	1	1		1		**3**
TEP 6		1	1	1		**3**
TEP 7		1	1	1		**3**
TEP 8		1	1			**2**
TEP 9		1				**1**
TEP 10		1	1	1		**3**
SW6		1			1	**2**
Locations that flow towards SW5						
TEP 5		1				**1**
TEP 11		1		1		**2**
SW5		1		1	1	**3**

Sampling times are correlated to flows in Figure 5 and Figure 6 below.

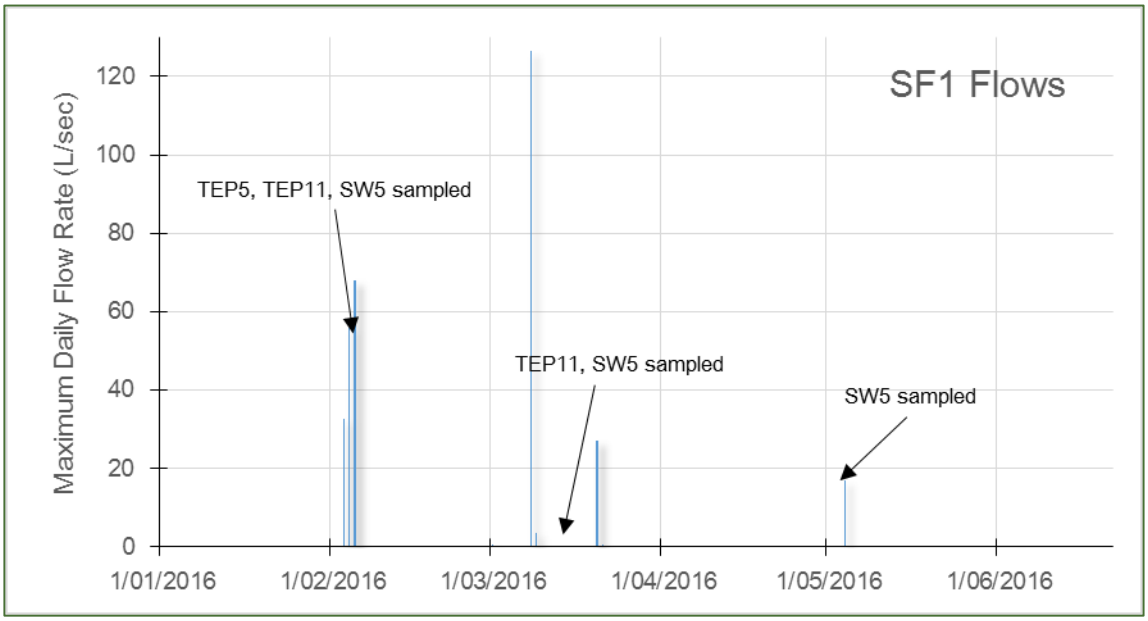


Figure 5: Flows and sampling times in SF1

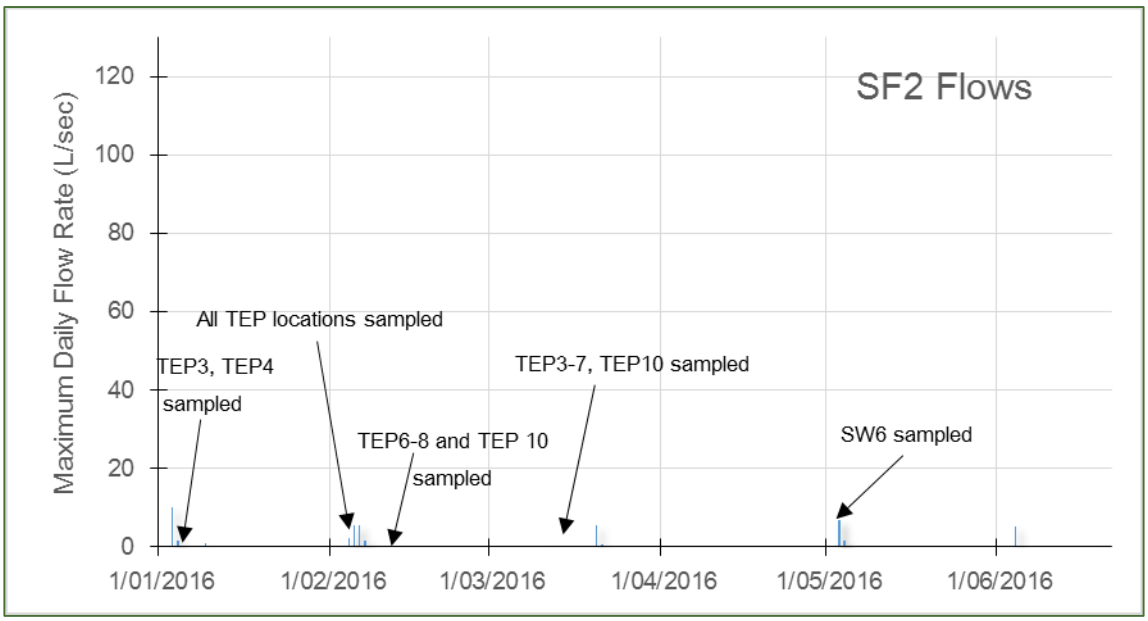


Figure 6: Flows and sampling times in SF2

Water Quality of Flows

1. Highway Waste Rock Dump Catchment

This section presents an analysis of water quality in TEP sampling points from the Highway Waste Rock Dump. Flows from Highway Waste rock Dump are towards SW6, therefore this section addressed SW6 flows as per the TEP.

These sample points are TEP01, TEP02, TEP03, TEP04, TEP06, TEP07, TEP08, TEP09 and TEP10.

During the six monthly period only 20 samples were collected from these TEP points. These samples were collected in relatively low flow conditions and therefore do not provide a true indication of any offsite release of contaminants.

Where relevant, water results from SW6 are included in each of these analyses.

The entire dataset for the TEP monitoring points is presented in Appendix B.

1.1 Sampling Event – 6 February 2016

There was much less flow in the catchment reporting to SF2 – compared to SF1.

There were several pools located throughout the catchment, particularly at TEP7, TEP8, TEP6, TEP2 and TEP1 (refer Appendix 3 for field sheets and photographs of these locations). These events were sampled on 6 February 2016.

Bar charts below show pH (Figure 7) and arsenic (Figure 8) values during this event.

The highest pH values are evident in TEP6 and TEP1, which approach neutral. Relatively acidic values (<4.5pH) are found at TEP10, TEP02, TEP03 and TEP04. Values at SW6 (the location furthest downstream) are 4.83, which is close to the median concentration (4.94) of all values along the SW6 catchment.

Arsenic values are highest at TEP02, TEP06, TEP07 and TEP09 while some of the lowest concentrations are recorded at SW6 (Figure 8). This may indicate arsenic is not a contaminant that will readily impact the receiving environment. The values are not correlated with pH.

Acidity values are shown in Figure 9 where it is evident the major sources of acidity are from TEP1 to TEP4 and TEP10. Since TEP1 is the most downstream point these values may influence the concentrations at TEP1. Acidity is not measured at SW6 so there has been no value reported.

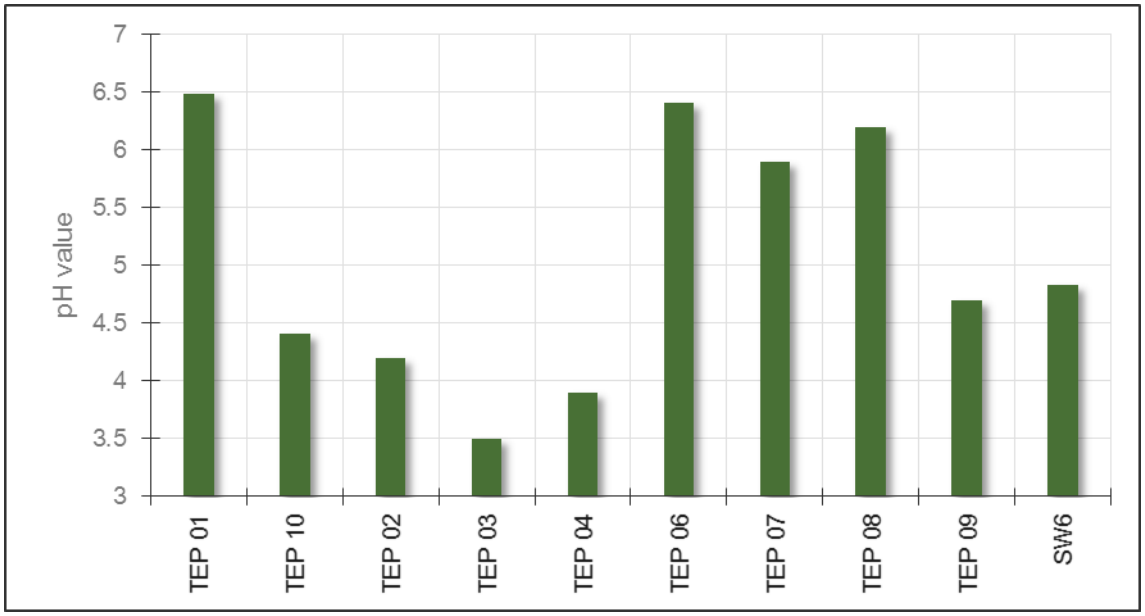


Figure 7: pH values from sample points on the Highway waste rock dump during the 6 February flow event

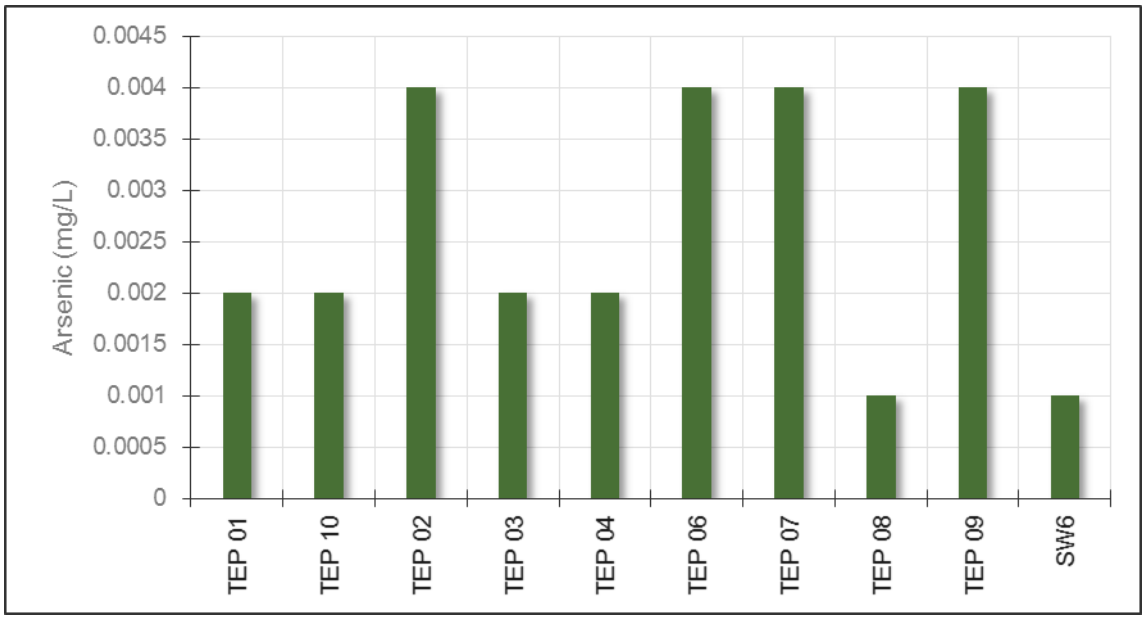


Figure 8: Arsenic values from sample points on the Highway waste rock dump during the 6 February flow event

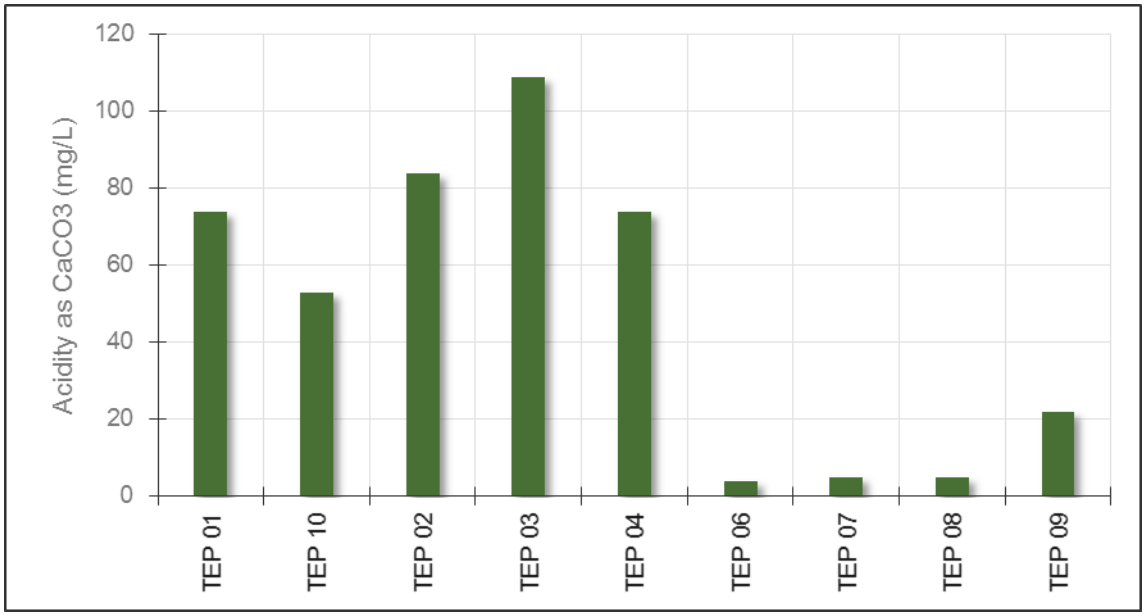


Figure 9: Acidity concentration from sample points on the Highway waste rock dump

1.2 Sampling Event - 14 February 2016

Arsenic is highest at TEP08 and TEP06 but is relatively low at TEP10 and TEP07 (Figure 10). Acidity appears to be negatively correlated with arsenic values, with TEP10 and TEP07 having the highest concentrations of acidity (Figure 11).

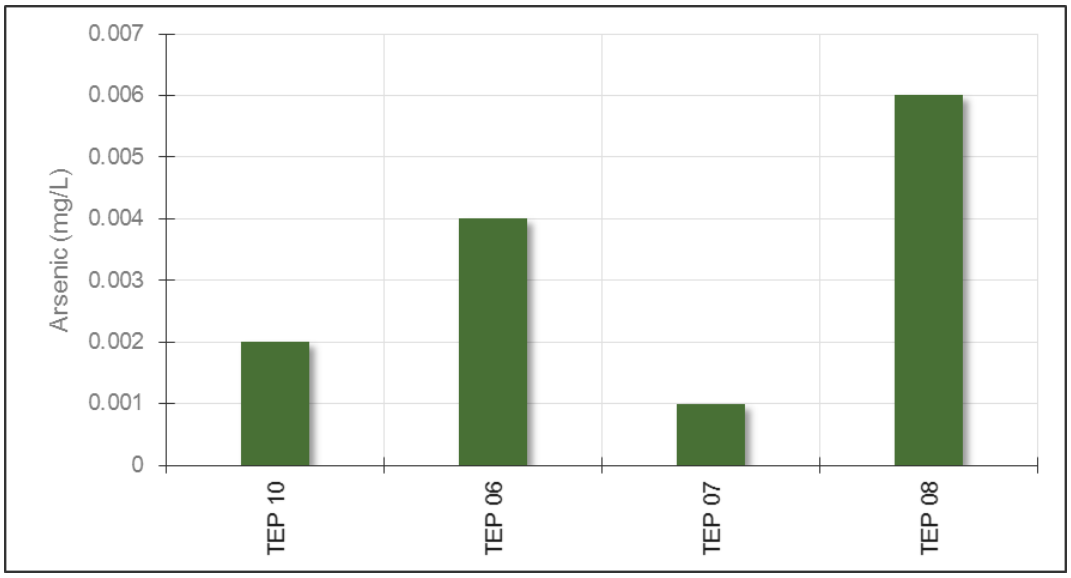


Figure 10: Arsenic from sample points on the Highway waste rock dump during the 12 February flow event

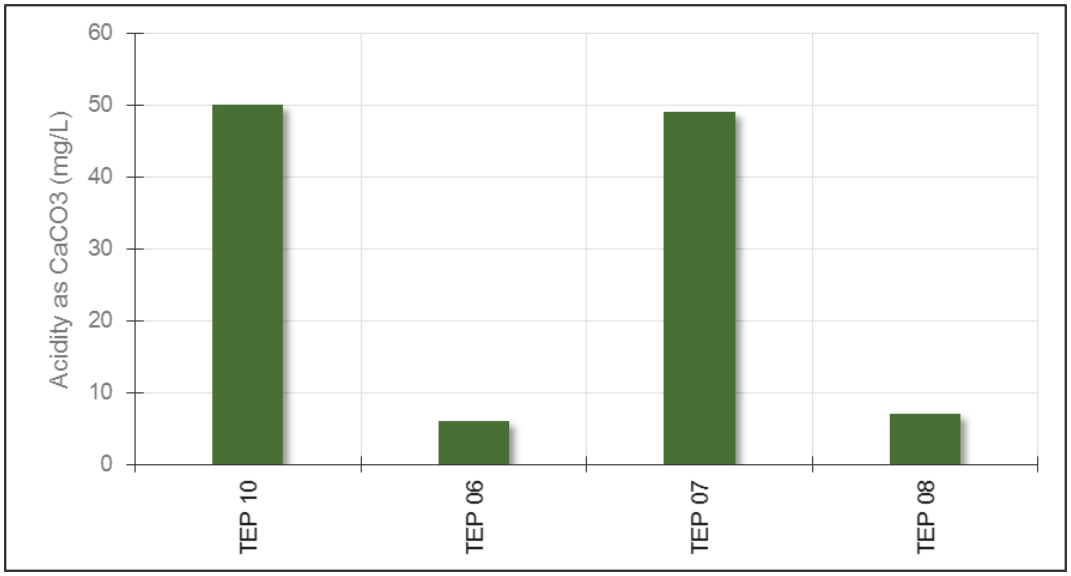


Figure 11: Acidity from sample points on the Highway waste rock dump during the 12 February flow event

1.3 Sampling Event – 13 March 2016

TEP03 and TEP04 (Figure 12) has the lowest pH values. TEP04 shows the highest arsenic concentrations (Figure 13). Acidity values were not analysed for this flow event.

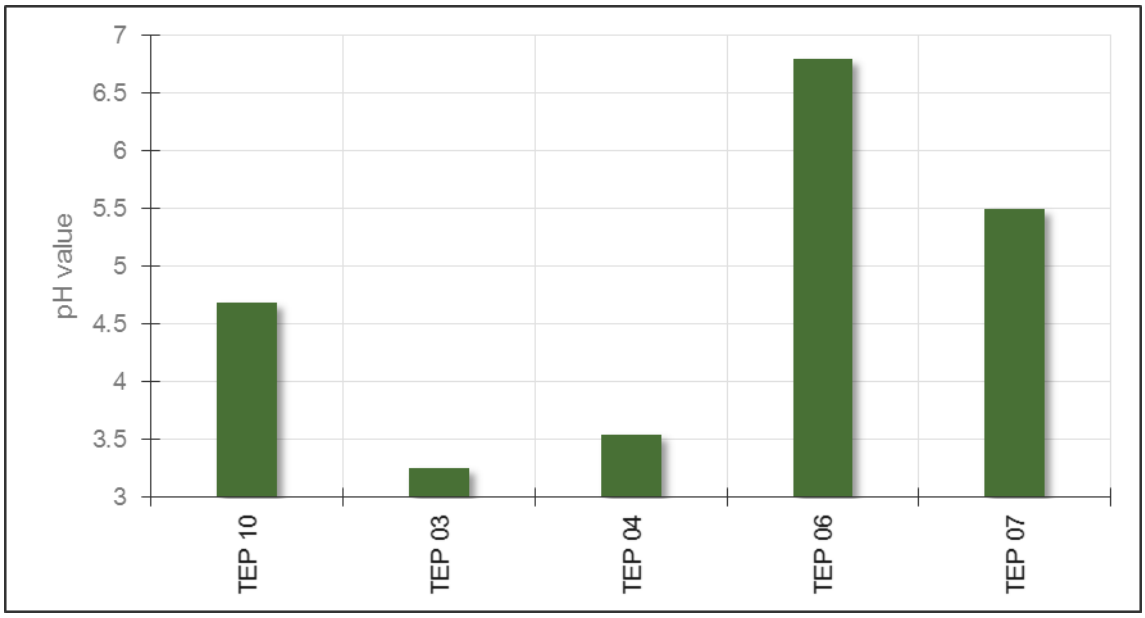


Figure 12: pH values along flow paths reporting to SW6 during the 13th March flow event

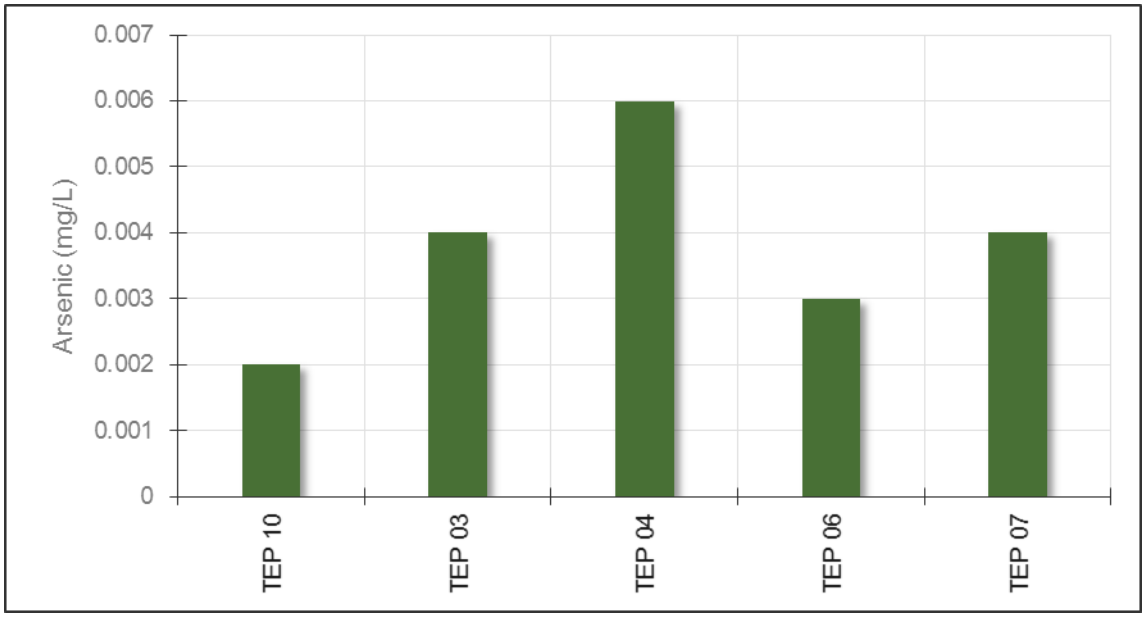


Figure 13: Arsenic concentrations from the Highway waste rock dump during the March flow event

2. Acidity flux

Acidity was measured at all TEP monitoring in the 06 February 2016 flow event and again at some TEP monitoring points in the 13 March 2016 monitoring event. It is apparent that rainfall occurring in early February resulted in the decrease in acidity at TEP03 and TEP04 (Figure 14). Following this rainfall event acidity rose at TEP06 and TEP08 at a similar rate, indicating that the same process may be affecting both points (Figure 14). Acidity also increased at TEP07 at a much greater rate than TEP06 and TEP08. Water samples collected at TEP07 were from a large, but very shallow pool approximately with approximately 0.1m depth in the 14 February monitoring event (Appendix 3). Therefore the large increase in acidity values could be the result of evaporative concentration or could reflect an ongoing source of acidity. It is likely to be a combination of both factors.

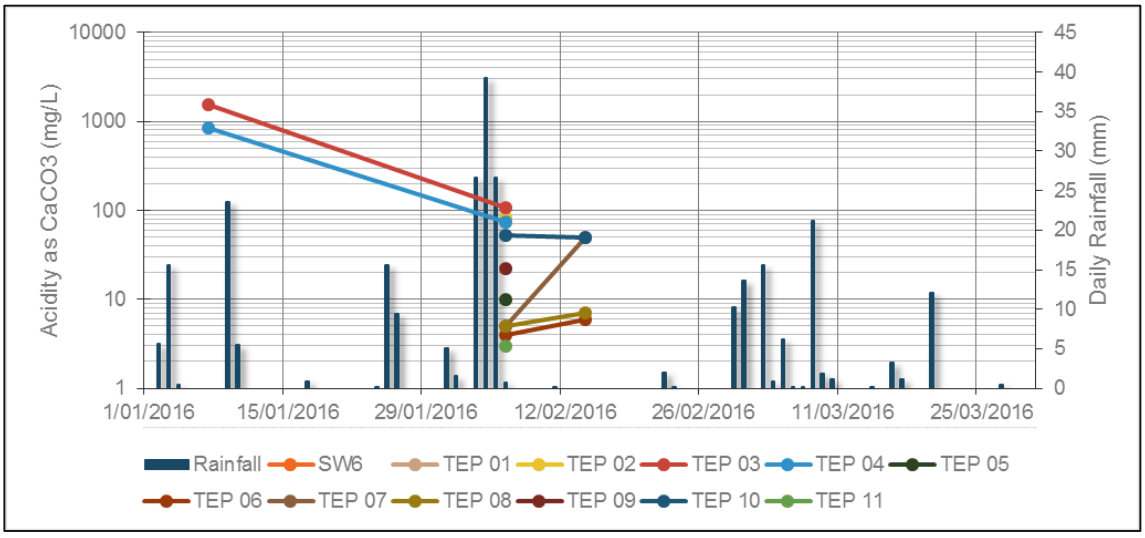


Figure 14: Changes in acidity concentrations associated with rainfall

3. Flows towards SW5

Earthworks blocked surface water flows from the mine site towards SW5 in June/July 2014 (Figure 15).

Figure 15: Diversion bund on western side of lease

Flows from mining infrastructure (Reward Dump) that did report to SW5 are now diverted into the Pit. Flows from Reward Dump diverted to the pit are discussed in the following section.

4. Flows from Reward Dump

The only sites that sample pools or water from the Reward waste rock dump are TEP11 and TEP05 with TEP05 being located the furthest downstream.

During the six month reporting period only three samples were collected from these TEP points. This sample number is deemed too insignificant to provide a true representation of potential contaminant movement. Successfully analysing the impacts flows, and any contaminant migration, further monitoring will be required over wet seasons with higher rainfall.

The entire dataset for the TEP monitoring points is presented in Appendix B.

4.1 Sampling Event – 6 February 2016

The pH values along TEP points that report to the pit are highly variable. For example, TEP11 shows a pH of 7.3 (neutral), TEP05 a field pH of 5.05 and SW5 a pH value of 7.39. Arsenic concentrations are lower at TEP11 and TEP05 compared to SW5. This possibly indicates an unknown source of arsenic within the catchment that is likely not attributed to the site as flow paths show significantly lower concentrations (Figure 17).

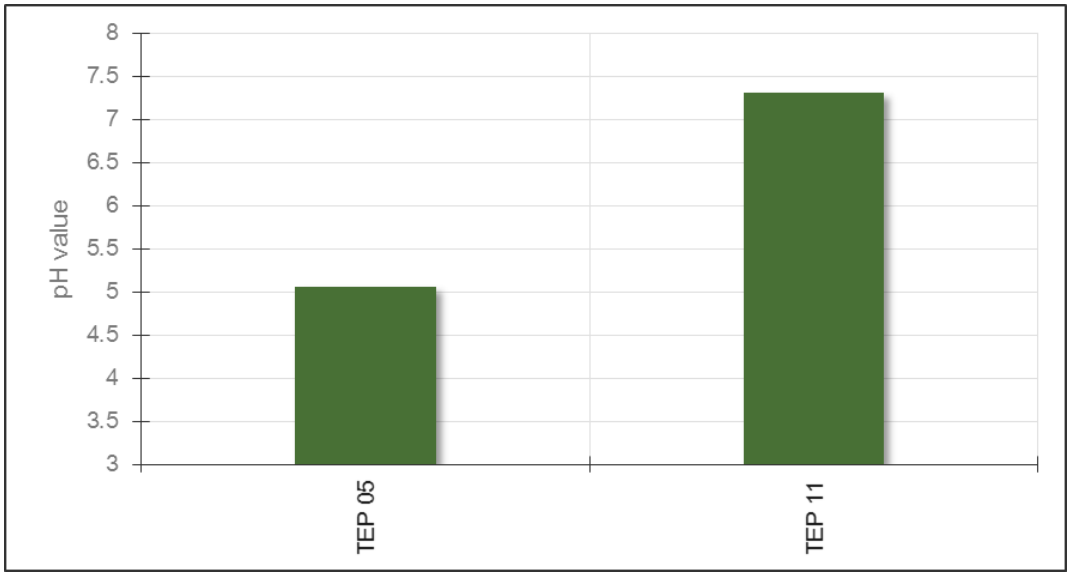


Figure 16: pH values from the TEP Points on the Reward waste rock dump during 6 February flow event

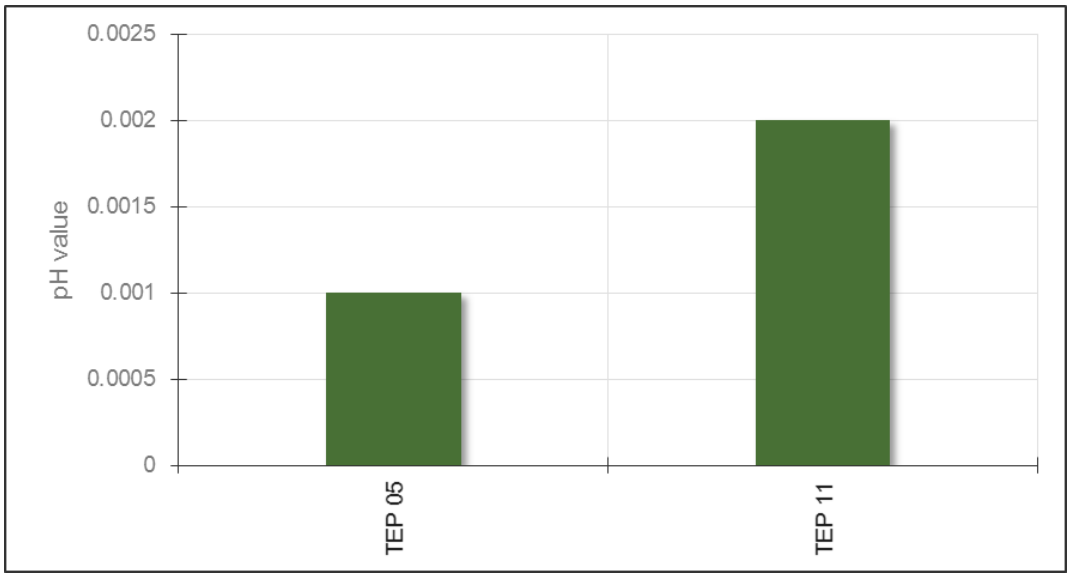


Figure 17: Arsenic from the TEP Points on the Reward waste rock dump during 6 February flow event

4.2 Sampling Event – 13 March 2016

Only one TEP site which flows to SW5 was sampled during the 13 March sample event this was TEP11. Analysis of this result was deemed to not provide any scientific basis of potential contaminant flows offsite therefore no statistical graphing or analyses was deemed beneficial. The results of this sample are provided in Appendix B.

Summary and Conclusions

The site received 355.1mm of rainfall in the reporting period between January 2016 and June 2016 (to 29 June 2016).

Approximately 68,752m3 of flow was recorded past the SF1 gauge and 29,310m3 past the SF2 gauge over the six-month reporting period. However, all of these flows had a low magnitude and were below 0.126m3/sec.

This low flow has resulted in a lack of appropriate monitoring events being triggered throughout the reporting period.

Data obtained within the reporting period does not provide a clear representation of contaminant migration offsite – as flows recorded were insufficient to result in surface water flows at offsite EA points. This is evident via the surface water monitoring undertaken as part of the EA, which included dry sample sites and no flow for certain monitoring months.

The pH values in the catchment flowing from the Highway waste rock dump show a similar trend over all sampling events during the reporting period. TEP03, TEP04, TEP10 showed consistent pH values below 4.5 while TEP01, TEP06, TEP07, TEP08 showed consistently neutral pH values above 5.

TEP11 shows a consistently neutral pH value above and below 8 while TEP5 appears to be relatively acidic with a pH value around 5 in the catchment that reports to the Pit from the Reward waste rock dump.

Data gathered over this six month period shows a slight linkage between rainfall and acidity values at some TEP points. However, the entire dataset from the beginning of the TEP should be assessed in order to characterise the correlation between rainfall and acidity generated.

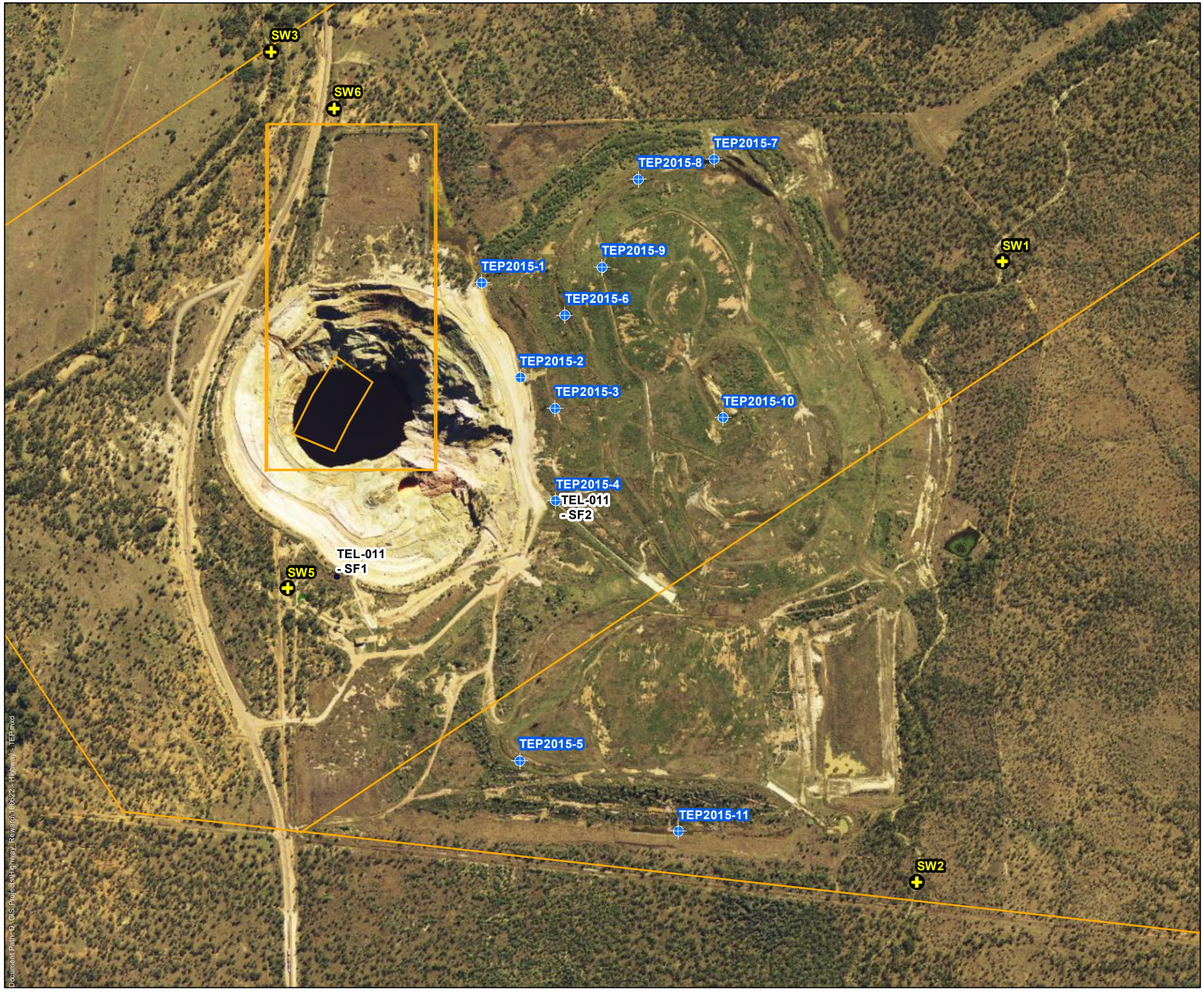
There are discrepancies between the volume of water flowing past the v-notch weirs and rainfall records. Additional information is required to properly determine the runoff coefficient. Because of the non-linear relationship between rainfall and runoff it is recommended more complex methods of determining the runoff coefficient (such as AWBM rainfall-runoff methods, or an Initial Loss and Continuing Loss model) are used and incorporated into the site's water balance.

A data set longer than six months is necessary to determine any linkage between surface water concentrations and rainfall. It is recommended the sampling program be extended over additional wet seasons to allow for the collection of representative data. Without adequate flows on the Highway Reward site there is no ability to capture true representative data. Sufficient representative data is required to accurately identify impact and risk of offsite contamination.

Appendix summary

Appendix A

Map of TEP Sites



HIGHWAY REWARD

TEP MONITORING POINTS

Legend

- TEP Surface Water Locations
- V-Notch Weirs
- EA Surface Water Sites
- Mining Lease

Mine Lease boundary extracted from ml.shp, from IRTM State of Queensland.

0 75 150 300
Metres

Scale: 1:8,000 at A3

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 29/06/2016

nrc
northern resource consultants

Appendix B

TEP Water Quality Data for Reporting Period

DATE	SAMPLE ID	TOTAL DISSOLVED SOLIDS	ACIDITY AS CACO3	TOTAL ARSENIC	TOTAL CADMIUM	TOTAL COPPER	TOTAL LEAD	TOTAL ZINC	WAD CYANIDE	FLUORIDE	FIELD PH	FIELD EC	TEMP
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH unit	µS/cm	*C
7/01/2016	**TEP 03**	4490	1530	0.012	1.77	199	0.0005	41.3					
7/01/2016	**TEP 04**	3570	853	0.031	0.501	84.5	0.213	56.2					
6/02/2016	**TEP 01**	1160	74	0.002	0.0975	16.6	0.013	13			6.48	1285	30
6/02/2016	**TEP 02**	1220	84	0.004	0.108	18.2	0.036	15			4.2	1281	29
6/02/2016	**TEP 03**	687	109	0.002	0.152	20.1	0.02	4.77			3.5	904	27.7
6/02/2016	**TEP 04**	1040	74	0.002	0.0903	10.8	0.124	13.6			3.9	1115	27.7
6/02/2016	**TEP 05**	299	10	0.001	0.0143	2.72	0.041	1.18			5.05	47	29.3
6/02/2016	**TEP 06**	178	4	0.004	0.0006	0.125	0.011	0.162			6.41	155	28.9
6/02/2016	**TEP 07**	346	5	0.004	0.0036	0.117	0.115	0.463			5.9	655	27.6
6/02/2016	**TEP 08**	376	5	0.001	0.0026	1.29	0.012	0.826			6.2	431	28
6/02/2016	**TEP 09**	1190	22	0.004	0.0383	2.09	0.637	9.84			4.7	1826	30
6/02/2016	**TEP 10**	597	53	0.002	0.0451	5.92	0.032	14.3			4.41	842	27
6/02/2016	**TEP 11**	69	3	0.002	0.00005	0.011	0.044	0.026			7.3	18.6	27
14/02/2016	**TEP 06**	185	6	0.004	0.0017	0.064	0.002	0.022					
14/02/2016	**TEP 07**	718	49	0.001	0.0939	6.24	0.0005	11.6					

DATE	SAMPLE ID	TOTAL DISSOLVED SOLIDS	ACIDITY AS CACO3	TOTAL ARSENIC	TOTAL CADMIUM	TOTAL COPPER	TOTAL LEAD	TOTAL ZINC	WAD CYANIDE	FLUORIDE	FIELD PH	FIELD EC	TEMP
14/02/2016	**TEP 08**	1000	7	0.006	0.0073	0.074	0.003	0.552					
14/02/2016	**TEP 10**	763	50	0.002	0.0464	2.16	0.002	14.4					
13/03/2016	**TEP 03**			0.004	0.562	78.8	0.004	13.3	0.002	0.3	3.25	1572	30.1
13/03/2016	**TEP 04**			0.006	0.17	40.8	0.042	21.3	0.002	0.8	3.54	986	28.5
13/03/2016	**TEP 06**			0.003	0.0001	0.068	0.002	0.019	0.002	0.1	6.8	107.2	28.8
13/03/2016	**TEP 07**			0.004	0.316	31.2	0.012	36.6	0.002	0.5	5.5	1335	27.5
13/03/2016	**TEP 10**			0.002	0.045	2.38	0.015	13.1	0.002	0.4	4.69	882	26
13/03/2016	**TEP 11**			0.002	0.00005	0.01	0.004	0.007	0.002	0.05	8	45.2	27.7

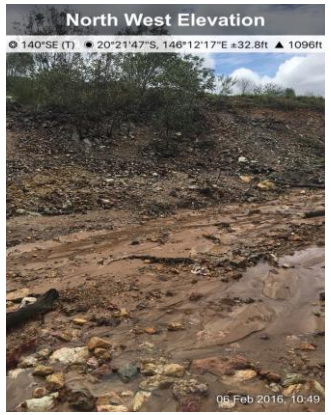
NOTE: Values less than the Limit of Reporting have been transformed to 50% of the Limit of Reporting.

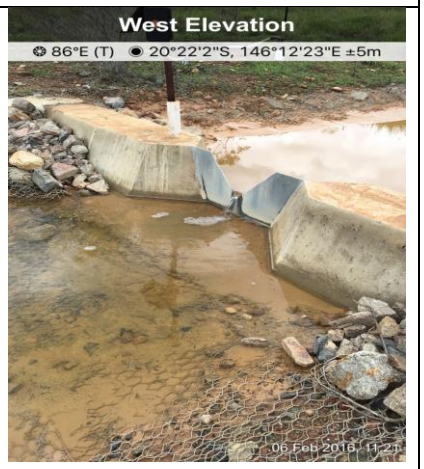
Appendix C

Field Sheets for TEP Reporting Period

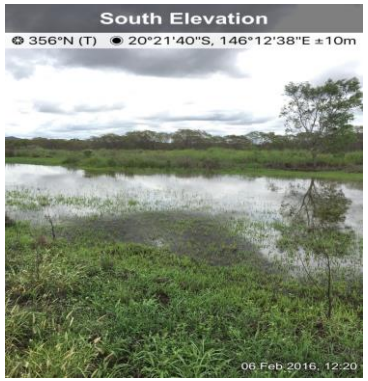
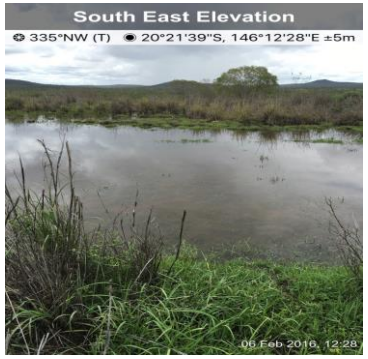
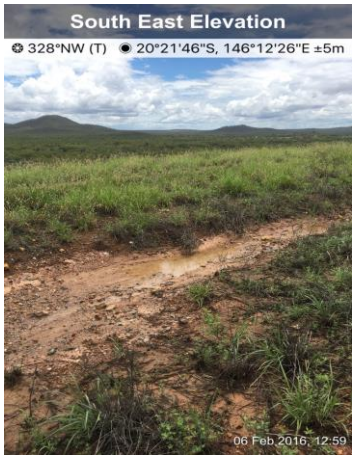
FIELD SHEET: TEP 2016 after heavy rainfall

Saturday 6 February 2016 Highway Reward Mine Site General Weather: Hot and overcast. Rain: 86mm previous week.

Area	GPS (as per photo)	Time	Flow	Turbidity	pH	EC	Temp	Field note	Picture
TEP 16 1		10.50am	Yes	Clear	6.48	1285uS	30	Clear Slow Flow Picture 2	
TEP 16 2		11.00am	Yes	Clear	4,2	1281uS	29	Clear Slow Flow Picture 3	

									2/….
TEP 163		**11.05am**	**No**	**Muddy**	**3.5**	**904uS**	**27.7**	**Picture 4 30m x 5m x .2m**	
TEP 164		**11.20am**	**Yes**	**Clear**	**3.9**	**1115.uS**	**27.7**	**Picture 5 35m x 6m x .2m**	

									3/…
Area	**GPS (as per photo)**	**Time**	**Flow**	**Turbidity**	**pH**	**EC**	**Temp**	**Field note**	**Picture**
TEP 16 5		**12.50pm**	**No**	**Muddy**	**5.05**	**47uS**	**29.3**	**Picture 9 35m x 6m x .2m**	
TEP 16 6		**12.40pm**	**No**	**Muddy**	**6.41**	**155uS**	**28.9**	**Picture 8 45m x 5m x .2m**	

									4/…
TEP 167		**12.20pm**	**No**	**Clear**	**5.9**	**655uS**	**27.6**	**Picture 6 100m x 15m x .2m**	
TEP 168		**12.30**	**No**	**Clear**	**6.2**	**431uS**	**28**	**Picture 7 30m x 7m x .2m**	
TEP 169		**1.00**	**No**	**Clear**	**4.7**	**1826uS**	**30**	**Picture 10 Small pond**	

									5/…
TEP 16 10		**1.10**	**No**	**Clear**	**4.41**	**842uS**	**27**	**Picture 11 60m x 5m .2m**	
TEP 16 11		**10.30**	**No**	**Muddy**	**7.3**	**18.6uS**	**27**	**Picture 1 15m x 5m x .1m**	
									Samples Given to Sherry Grinstead 0602016 at 18.30hrs **Don Grinstead and Noel Grinstead** **COC completed and samples refrigerated as courier does not leave till Monday 8am**

FIELD SHEET: TEP 2016 Don Grinstead and Noel Brown - Samplers

Sunday 13 March 2016 Highway Reward Mine Site General Weather: Sunny Rain: Nil Temp: 29C

Samples received in Office: 1.30pm

Are	Time	Flow	pH	EC	Temp	Field note	Field Pictures
TEP 16 1	**11.56 am**					**Dry – no seepage**	
TEP 16 2	**11.52 am**					**Dry – No seepage**	

TEP 16 3	**11.15 am**	**Nil**	**3.25**	**1572 uS**	**30.1**	**12mx 4m x .1 Muddy**	
TEP 16 4	**11.45 am**	**Nil**	**3.54**	**986 uS**	**28.5**	**5m x 3m x .1m Clear**	
TEP 16 5	**11.15 am**					**Dry**	

TEP 16 6	**11.00 am**	**Nil**	**6.80**	**107.2 uS**	**28.8**	**7m x 5m x .1 Clear**	
TEP 16 7	**10.45 am**	**Nil**	**5.5**	**1335 uS**	**27.5**	**75m x 15m x .1m Clear**	
TEP 16 8	**10.55 am**					**Dry**	

TEP 16 9	**11.30 am**					**Dry**	
TEP 16 10	**11.35 am**	**Nil**	**4.69**	**882 uS**	**26.0**	**50m x 5m x .2m** **Clear**	
TEP 16 11	**10.00 am**	**Nil**	**8.0**	**45.2 uS**	**27.7**	**15m x 5m x .1m** **Clear**