Northern Resource
CONSULTANTS

DATE: 30 MAY 2017
OUR REF: 16_115_HIGHWAY_REWARD_SURFACE_WATER

JOHN RAINS
DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION
LEVEL 10, VERDE TOWER
445 FLINDERS STREET
TOWNSVILLE QLD 4810

RE: COMPLETION OF TEP SURFACE WATER FLOW MODELLING

Dear John,

I refer to the amended Transitional Environmental Program (TEP) MAN17020 approved by the Department of Environment and Heritage Protection (EHP) and issued to the Mt Windsor Joint Venture partners of Thalanga Copper Mines Pty Ltd (MWJV) on 19 October 2016.

The report accompanying this letter has been written to address the third task of the TEP, which is the completion of a technical report on surface water flow directions and estimated rates, to be completed by 30 May 2017.

The TEP committed to the following deliverable:

Using data collected to date and the ground truthing with a differential GPS, complete surface water flow modelling for the site to identify potential pathways and rates of flow. This will inform the diversion earthworks program. Major components of this action are included in Table 1 of this letter.

Table 1: Commitments for the earthworks program at Highway Reward

COMMITMENT	ACTIONS
Obtaining survey data of drainage network.	Recent drainage changes surveyed for hydrology modelling.
Re-calibration of the digital elevation model.	Confirmed with ground survey.
Installation of gauging stations at key drainage areas.	Monitoring sites SF1 and SF2, providing flow and weather data.
Measurement of a minimum of 5 flow events.	All suitable flow events were used in modelling. Drought conditions and some equipment malfunctions restricted the availability of flow data.
Development of the conceptual runoff model.	See Mining One consultant's report.
Calibration of the conceptual model with real time data from a minimum of 5 flow events.	See Mining One consultant's report.

The attached *Water Balance Review Preliminary Report* (Mining One, 2017) focuses on additional data collected since the last 2013 hydrologic assessment of the site. The modelling used the original topographic data, collected in 2010 using 0.5m contours, and updated this with on-ground survey data collected in 2017, which measured the diversion drains and bunds constructed in late 2016 as part of this TEP.

The report more accurately allows determination of the drainage area and runoff volume that can safely be diverted to the open cut for sustainable storage, without compromising groundwater. This will provide a solution to the containment of poor quality drainage identified earlier and subject to this TEP.

Please contact myself if you require further information or clarification.

Sincerely,

Marty Costello
Principal Environmental Scientist

Enc.: *Water Balance Review Preliminary Report,* Mining One, 2017

HIGHWAY REWARD MINE

WATER BALANCE REVIEW PRELIMINARY REPORT

For

MT WINDSOR JOINT VENTURE

Job No.	2332_G	
Doc No.	5006v1.docx	
Date:	May 2017	
Prepared by:	A. Valenza N. Cheema	

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Quality ISO 9001 SAI GLOBAL

FINAL REPORT

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EXECUTIVE SUMMARY

The Highway Reward open-cut and underground copper and gold mine was decommissioned and rehabilitated in 2005. An environmental monitoring program was developed in 2009 and a Transitional Environmental Program (TEP) was approved by the Department of Environment and Heritage Protection (EHP), to address sources of potential contamination from acid rock drainage observed across the site. An amended TEP (MAN17020) was issued to MWJV on 19 October 2016. NRC and MWJV are currently implementing works to bring the mine to a permanent closure state consistent with the requirements of EHP.

A groundwater model developed by Mining One in 2013 and updated in 2017 confirms that the pit is currently acting as a sink, with a steep inward hydraulic gradient. The model also shows that the height to which water in the pit can rise without adversely affecting local or regional groundwater is the base of the Campaspe Beds, overlying the oxidized zone at around 275 m AHD.

A surface water model was developed by Mining One in 2013. The primary objectives of the surface water model were to determine the catchment delineation and the yearly inflow rates of surface water to the pit. This study also focussed on identifying potential locations and sizes for bunds and drains to contain overland flows within the study area and identified locations for monitoring overland flow. Two flow monitoring stations were installed in 2013 to calibrate the yearly inflow rate produced by two groups of sub-catchments.

This 30 May 2017 deliverable under the Highway Reward TEP is a technical report on surface water flow directions and estimated rates. This report delivers that information in the context of a greater study on surface water flow, catchment areas, inflows to the pit and the pit's own capacity in a period up to 100 years.

This 2017 calibrated surface water model's objectives are to identify overland flow patterns and determine the yearly inflow rates of the surface water flow combined with the yearly recharge of the groundwater and estimate the rise of the pit water level over time.

Considering that a series of sub-catchments (3, 4, 5, 2, 27, 28, 29, 30, 31) are already contributing to flows into the pit, the analysis of catchment diversion options focused on the main sub-catchment covering part of the pit and the Highway waste dump (catchment 1), the largest of all potentially contributing catchments.

The main finding of the study is the assessment of the extent to which flows from sub-catchment 1 can be allowed to drain into the pit without the pit level rising to or above 275 m AHD. The results of the scenarios modelled are summarised below:

- Scenario 1, in which no flow from the sub-catchment is redirected to the pit, shows that the level remains at 257m AHD after 100 years;
- For Scenario 2, in which approximately 30% of sub-catchment 1 is drained into the pit, the pit level is expected to rise to 264 m AHD within the next 100 years;
- In Scenario 3, in which 60% of sub-catchment 1 is drained into the pit, the modelling indicates that the pit water level would rise to 272 m AHD within the next 100 years; and
- In Scenario 4, in which the entire sub-catchment 1 is drained to the pit, the pit water would exceed 275 mAHD, and would increase to 283 m AHD within the next 100 years.

A final pit water balance report addressing the comments of the Department of Environment and Heritage Protection (EHP), and integrating the geotechnical stability and final pit shape design, will be completed by Mining One in June 2017. The report will include the design of drains, bunds and related drainage elements (including erosion protection measures) required to provide long term diversions compliant with the final modelling results.

Mr. Alexis Valenza
Principal Hydrogeologist

Dr. Naimet Cheema
Principal Hydrologist

1 INTRODUCTION

1.1 Site History

Highway Reward has been the site of copper and gold mining since 1953. The Highway Reward project (also known as the Mt Windsor Joint Venture) started as an open-cut gold mine located approximately 35 km south west of Charters Towers in 1997. Large scale surface mining has been carried out until 2002 and formed a single residual void including two overlapping open pits (Highway and Reward). Open-cut mining ceased in February 2002 and was followed by underground mining accessed from two locations within the pit until June 2005. The mine site was decommissioned and rehabilitated according to a closure plan developed by Landline Consulting in 2005.

The Highway Reward project is managed by Mt Windsor Joint Venture partners of Thalanga Copper Mines Pty Ltd (TCM) and Grange Resources Ltd (MWJV).

An environmental monitoring program was developed in 2009 and a Transitional Environmental Program (TEP) approved by the Department of Environment and Heritage Protection (EHP), to address sources of potential contamination from acid rock drainage observed across the site. An amended TEP (MAN17020) was issued to MWJV on 19 October 2016, focusing on the installation of interim earthworks measures to treat or capture all water on site and prevent a release to Environmental Authority (EA) monitoring location SW6. The amended TEP and the remediation works are managed by Northern Resource Consultants (NRC).

NRC and MWJV are currently implementing works to bring the mine to a permanent closure state consistent with the requirements of EHP.

This 30 May 2017 deliverable under the Highway Reward TEP is a technical report on surface water flow directions and estimated rates. This report delivers that information in the context of a greater study on surface water flow, catchment areas, inflows to the pit and the pit's own capacity in a period up to 100 years.

1.2 Project Background

1.2.1 Hydrogeological Modelling

A groundwater model was developed by by Environmental Ground, Water & Air Consultants Pty Ltd (EGC) in April 2008. The model was updated in 2013 by Mining One[1] to confirm the hydrodynamics and water quality of the pit and surrounding aquifers. The primary objective of the groundwater model was to predict the likelihood of contaminants migrating off-site.

The findings of the 2013 modelling confirmed the pit is acting as sink, with a steep inward gradient. Based on the 2012 dataset, the modelled scenarios indicated that the pit would continue acting as a sink for the entire 100 years modelled, with a radius of influence ranging between 400 m and 1 km from the edge of the pit.

An analysis of groundwater contaminant concentrations indicates that all the wells where a breach of licence condition was detected are within influence of the drawdown generated by the

[1] Mt Windsor -Highway Reward mine Groundwater modelling report for Grange Resources (Ref 3269v2, March 2013)

pit dewatering. Consequently, the concentrations shown are likely to be attributable to the natural mineralization of the site.

1.2.2 Hydrological Modelling

A surface water model was developed by Mining One[2] in 2013. The primary objectives of the surface water model were to determine the catchment delineation and the yearly inflow rates of surface water to the pit. This study also focussed on identifying potential locations and size for bunds and drains to contain overland flow within the study area and identified locations for monitoring overland flow.

The 2013 hydrologic assessment includes delineation of the study catchments and estimation of the 1 in 1 and 1 in 10 year ARI (Average Recurrence Interval) events.

The 1 in 1 year ARI event represents frequent flow conditions in which pollutant concentrations are high. The overland flow patterns in the study area are quite important for the flows in this range. The 1 in 10 year event was selected as a typical high flow event for the study of the overland flow patterns. The flow pattern out of the study area will remain unchanged for higher flows like the 1 in 100 year ARI event which do not warrant an examination in the context of this investigation.

1.3 Scope of Work

Mining One's scope of work for 2017 is aligned with the recommendations of the 2013 studies and is based on the current site status (information provided by MWJV and Northern Resources Consultants).

1. **Stage 1: Annual report for 2016 (May 2017)**

   An annual monitoring report summarising the findings of the monitoring obtained for the site groundwater and surface water has already been completed for 2014 and 2015. Considering the below average rainfall recorded at the site in 2014, it was agreed that rainfall and flow data would be collected for another year (2016) before calibrating the hydrological model.

   This work includes the collation and analysis of groundwater and surface water data, production of one annual report in 2017 that incorporates all data up to and including 2016, and construction of the dataset input in preparation for Stage 2 tasks.

2. **Stage 2A: Calibration of the groundwater and surface flow model (May 2017)**

   This phase includes the collation and analysis of the surface flow monitoring records and groundwater levels, the integration of the current topography (survey files provided by MWJV), and the calibration of the groundwater and surface flow model based on the record of three full wet seasons (2014-15, 2015-16 and 2016-17).

[2] Mt Windsor - Highway Reward mine surface water modelling report for Mt Windsor Joint Venture (Ref 3616v5, August 2013)

3. **Stage 2B: Preliminary pit water balance (May 2017)**

Stage 2A results were used to develop the calibrated (current, or "preliminary") pit water balance model. The current pit water balance aims to confirm the volumes produced by each sub-catchment of the site under the current setup (existing drains, bunding, pit outline and slope settings).

Mining One initially proposed to obtain LIDAR data to update the DTM and review the changes in topography (man-made constructions and natural factors like erosion or slope failure) which may have impacted the overland flow since 2012. Considering the tight timeframe for completion of Stages 1A to 2B, and in the absence of an updated DTM, a series of site surveys and photographs identifying the main changes in topography were provided to Mining One to confirm the extent of the changes of conditions at the site since 2012.

The work includes the development of a series of scenarios describing the impact of the runoff capture on the pit level and the overall pit water balance.

4. **Stage 3: Final pit water balance (September 2017)**

Stage 3 pit water balance assessment (post earthworks, or "final") will be completed on the basis of the Stage 1 & 2 results combined with the long-term geotechnical assessment to be completed for the site.

The work will include the final series of scenarios describing the impact of the runoff capture on the pit level and the overall pit water balance, as well as the hydrological and geotechnical design of the internal bund and drains.

In summary, the work staging is as follows:

- Stage 1: Annual report for 2016 (May 2017) - Collate groundwater and surface water flow, level and quality data;
- Stage 2A: Calibration of the groundwater and surface flow model (May 2017) - Collate and analyse the surface flow monitoring records and groundwater levels for 2014 to 2016 period; and calibrate the groundwater and surface flow model based on the record of three full wet seasons.
- Stage 2B: Preliminary pit water balance (May 2017) – Run modelling water balance scenarios and draft a preliminary stage report for submission to MWJV and EHP for comments
- Stage 3: Final pit water balance (Date TBC) – Address comments of MWJV and EHP, develop final scenarios, integrating the geotechnical stability and final pit shape design; and design drains, bunds and related drainage elements including their erosion protection; and issue a final report.

This report covers Stages 2A & 2B. Stage 1 forms a separate report and Stage 3 will be completed once comments from MWJV and EHP are received.

2 MODELLING METHODOLOGY

2.1 Software Selection

The following standard software packages were used for this assessment:

- CatchmentSIM for sub-catchments delineation;
- HEC-HMS for hydrological assessment of flow from sub-catchments; and
- SVFlux for groundwater inflow to the pit.

Catchment Simulation program (CatchmentSIM) is a terrain analysis program that can set up hydrologic models using 3D contour data. CatchmentSIM was used to delineate sub-catchments and to calculate spatial and topographic characteristics needed for hydrologic modelling.

HEC-HMS is a world-wide used software package for rainfall runoff modelling. Among other items it outputs the flow volumes from sub-catchments for the modelled duration. The software's capability directly covers the objective of this assessment.

SVFlux is a 1D, 2D, axisymmetric and 3D finite-element program for calculating saturated and unsaturated groundwater flow. The package represents powerful and stable finite element groundwater modelling software including climatic coupling.

2.2 Presentation of Study Output

The preliminary study results are presented in a series of figures in this document and discussed in detail in Section 3. The topographic data used in the model was supplied by MWJV. The data collected in year 2010 consisted of 0.5 m contours. The output covers the following:

- Sub-catchment delineation;
- Flow hydrographs from hydrologic modelling were used in hydraulic modelling; and
- Rainfall data.

2.2.1 Sub-Catchment Delineation

The sub-catchments of the study area have been presented in Figure 2.1, The sub-catchment contributing to the pit with their areas and lengths of the main overland flow paths (Main Stream Lengths) are presented in Table 2.1.

Table 2.1 Highway Reward Sub-Catchment contributing to the pit

Sub-Catchment	Area (ha)	Mainstream Length (m)	Average Yearly Yield (ML)
1	47.4	1380	181.7
3	19.7	1200	97.9
4	18.5	1090	93.9
5	16.4	450	86.2

2,27,28,29,30,31(direct). All these modelled as one group	11.3	360	55

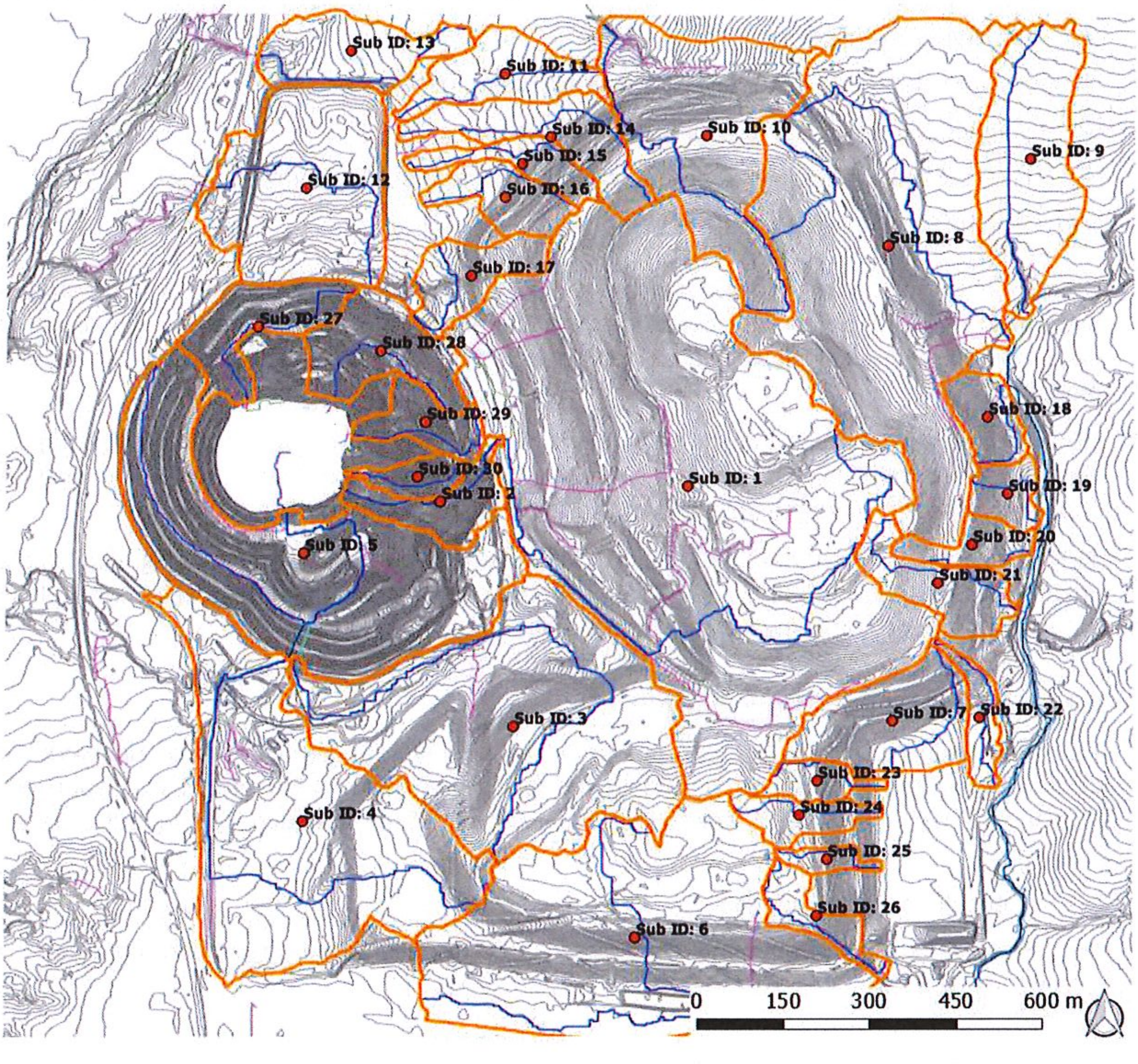

Figure 2.1 Sub-Catchments of the Study Area

The study area has been analysed with CatchmentSIM, which has delineated 31 sub-catchments, ranging from 0.93 to 47.44 ha (catchment 31 delineates the pit itself).

The topographic data (year 2010) used in sub-catchment delineation was updated to include the earthworks completed Since 2016 and presented in Figure 2.2.

Figure 2.2 Highway Reward TEP Repair Works (NRC 2016)

2.2.2 Hydraulic Modelling

The hydraulic modelling carried out using HEC-HMS mainly deals with the flow along the main flow paths. The modelling aims to:

- Identify sub-catchments draining into the pit;
- Identify the locations of possible bunds and drains needed to contain the overland flow within the site as well as directing it to desired locations;
- Identify locations of flow monitoring points in the study area; and
- Identify overland flow patterns of the entire site.

2.2.3 Pit Level / Surface Area

The pit level / surface area and level-volume information were derived from the DTM provided by MWJV, and are presented in Figure 2.3 and Figure 2.4.

The observed information shows that the average yearly inflow into the pit is about 200 ML.

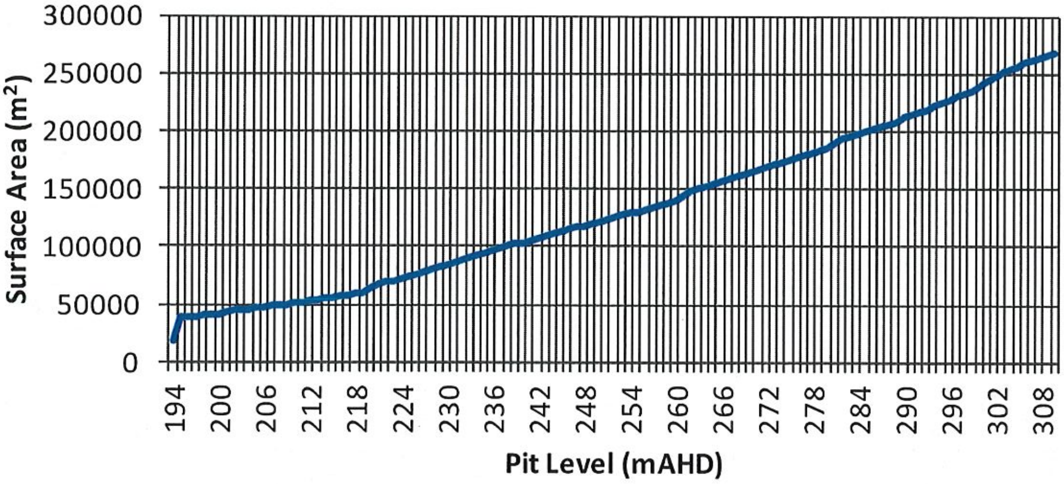

Figure 2.3 Pit Level-Surface Area Curve

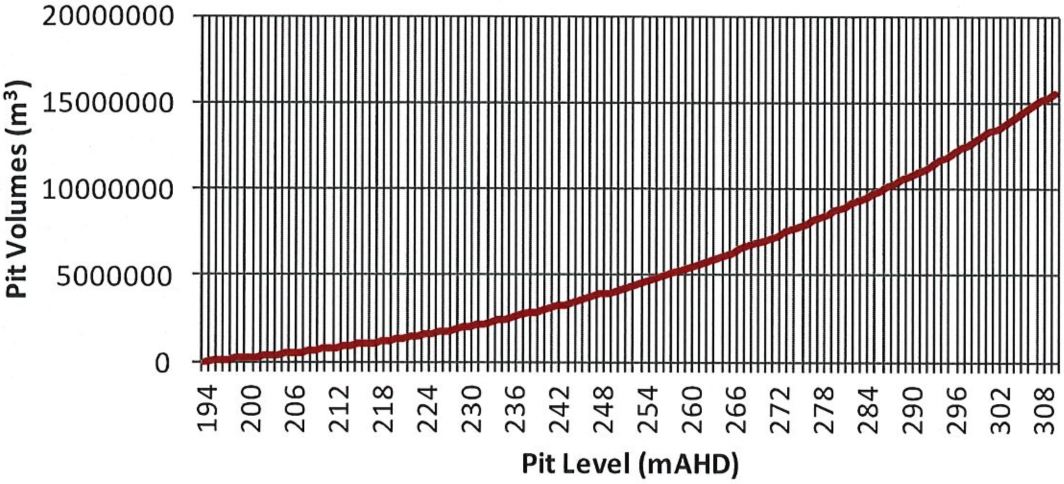

Figure 2.4 Pit Level-Volume Curve

2.2.4 Observed Pit level

Pit level rise photographs were provided to Mining One for assessment of the pit levels. Mining One inferred the level by analysing the 2010 DTM model. It is noted that in the absence of quarterly surveys, the inferred levels are approximate. A summary table is provided in Table 2.2, and the corresponding chart in Figure 2.5.

The observed pit levels combined with pit-level and surface relation, provide a reliable observation of average yearly inflow into the pit. This data was used as a broad check on the predicted inflow to the pit in an average year. The water level in the pit is approximately 222 m AHD at present.

The observed pit levels and the rainfall data were used to calibrate the surface flow model. The sub-catchment yields output by the calibrated value are relatively close to the ones determined in the 2013 study.

Table 2.2 Highway Reward Observed Pit Level Data (2017)

Recorded	RL (Mine Grid)	RL (Real Grid)	Pit Rise (in m)	Cumulative Pit Rise (in m)
02/11/2009	1194	194		
24/02/2010	1195	195	1	1
25/11/2010	1196	196	1	2
20/01/2011	1198	198	2	4
22/09/2011	1200	200	2	6
20/12/2011	1202	202	2	8
14/03/2012	1205	205	3	11
09/10/2012	1209	209	4	15
06/12/2012	1210	210	1	16
15/05/2013	1212	212	2	18
12/09/2013	1213	213	1	19
21/10/2014	1215	215	2	21
18/02/2016	1219	219	4	25
19/08/2016	1220	220	1	26
01/04/2017	1222	222	2	28

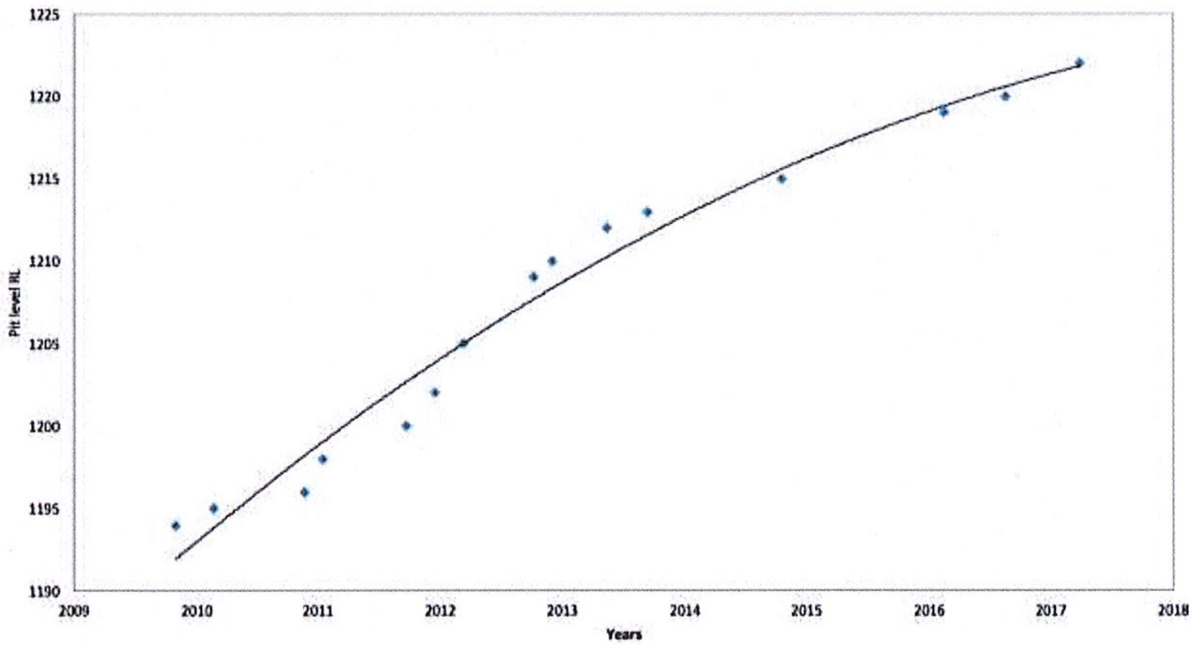

Figure 2.5 Highway Reward Observed Pit Level Chart (2017)

2.2.5 Rainfall Data

The rainfall data from the site rain gauge covers full years of 2014, 2015 and 2016. The data have sizeable missing observations. The total rainfall for 2014 and 2015 is less than the average annual rainfall reported for Bureau of Meteorology weather stations of Sellheim (BOM

034085), Doongara (BOM 034049) and Trafalgar (BOM 034010). Data from these two years was not considered for this assessment.

The rainfall data for year 2016 is close to the yearly average rainfall but with missing information. Hourly rainfall data was available from an adjoining site (a third party rainfall gauge situated near the entrance of the site), and was used in conjunction with the site rainfall data for a reliable prediction.

2.2.6 Weir Data

Two surface flow monitoring V-notch weirs mounted with ultrasonic distance sensors and connected to automated units fitted with telemetry were installed in the study area in March 2013. A weather station was installed on top of one of the units.

The surface monitoring units aim to facilitate monitoring of the quantity and quality of flow resulting from rainfall events recorded by the weather station and update/calibrate the hydrologic model.

The locations of the surface water monitoring points have been selected from the overland flow paths and are shown in Figure 2.6.

The analysis of the weir discharge data indicates that it presents missing observations over the 2013 to 2017 period, due to instrument malfunction. An analysis will be conducted as part of the final modelling and reporting to assess any discrepancies between the modelled total flow to the pit and the average inflow given by the pit level observation readings.

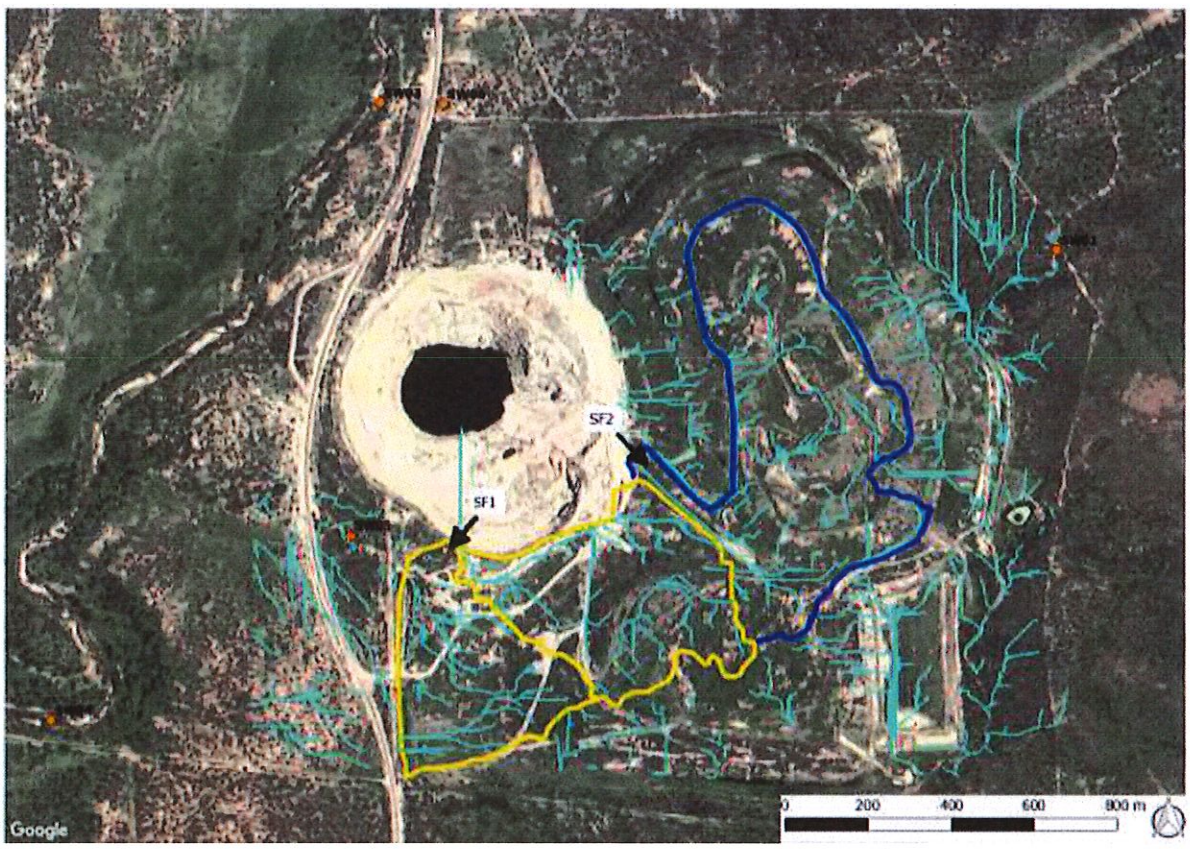

Figure 2.6 Sub-Catchments for Surface Water Flow Monitoring Gauges SF1 and SF2

The sub-catchments contributing flows to the pits with areas and corresponding average yields are presented in Table 2.3.

Table 2.3 Pit Sub-Catchment Area and Yield

Sub-Catchment	Area (ha)	Average Yearly Yield (ML)
1	47.4	181.7
3	19.7	97.9
4	18.5	93.9
5	16.4	86.2
2,27,28,29,30,31(direct). All these modelled as one group	11.3	55

2.2.7 Additional Discharge

In addition to the discharge of SF1, MWJV has indicated that with current diversions in place (since Nov 2016), all catchment 1 reports to the pit and catchments 11 to 17 inclusive report to the old tailings dam, with 3.6 ML of this was pumped into the pit during March & April 2017. This volume has been considered in the total inflow to the pit.

Note that

2.2.8 Groundwater Inflow

Groundwater inflow was obtained in SVFlux and calibrated from the existing model, with the groundwater levels observed at the site since 2013 and the observed pit level. Based on the 2017 results, the pit is still strongly acting as a sink with a radius of influence extending beyond the pit boundary in all directions. The pit captures flow at an estimated distance of around 1 km (Figure 2.7).

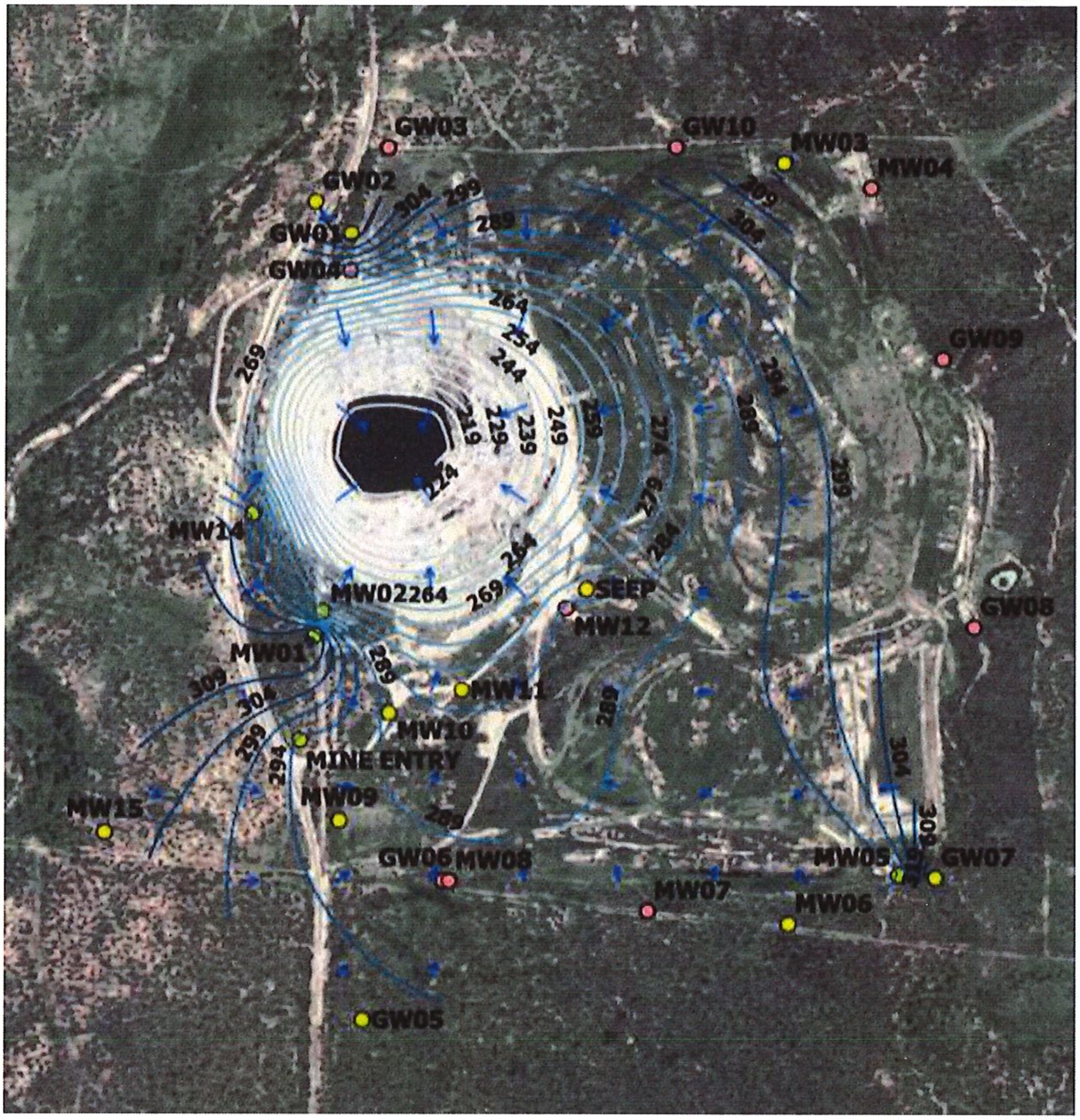

Figure 2.7 Fourth Quarter 2016 Groundwater Contour Map (Mining One 2017)

The groundwater model developed in 2013 was calibrated with the pit and groundwater levels collected between 2013 and 2017. It was noted that most of the wells were not showing a rise in levels over the period Figure 2.8), but rather reacting to rainfall recharge events.

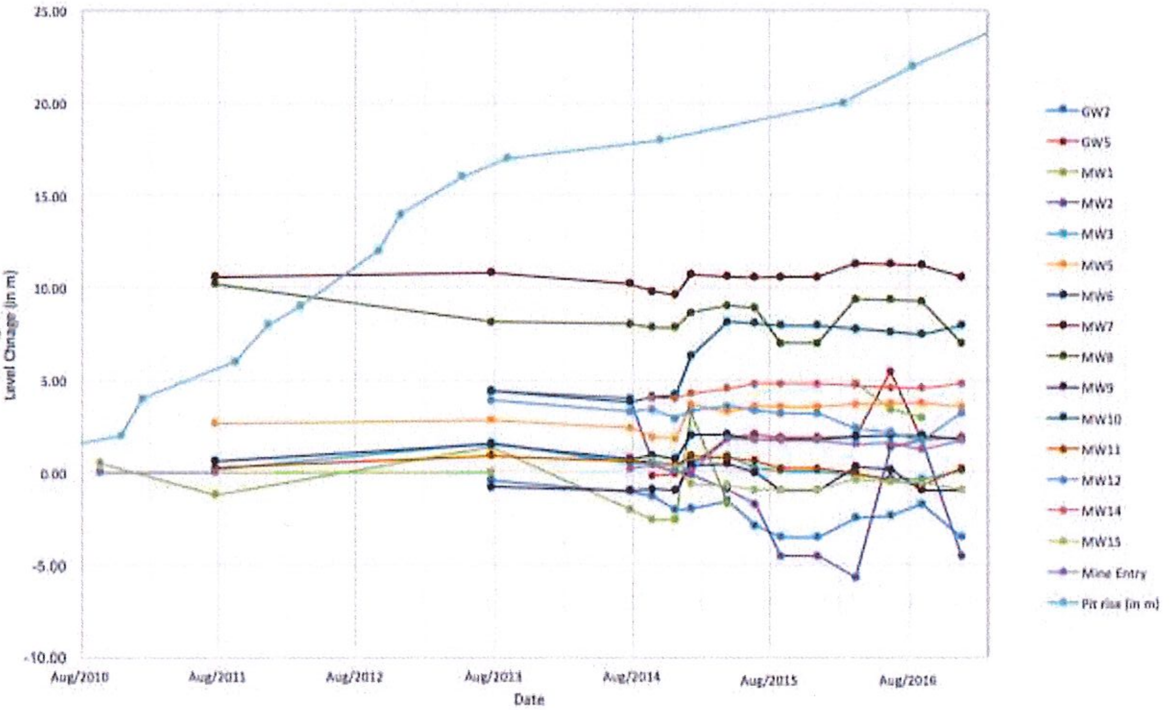

Figure 2.8 Groundwater Bore and Pit Level Change (2010/2017)

A screen capture of the axisymmetric model in SVflux is presented in Figure 2.9. It is based on the existing model developed in 2013, calibrated with the observed pit levels and groundwater levels observed from 2013 to 2017.

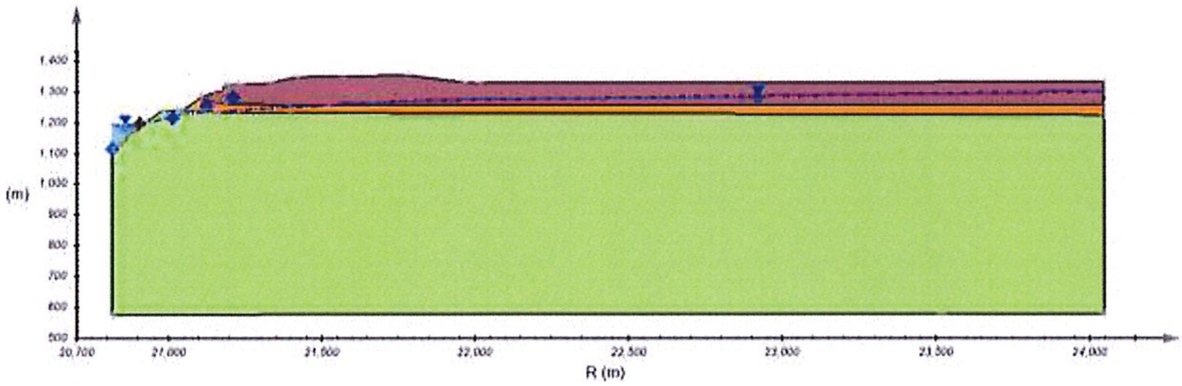

Figure 2.9 SVFlux Pit Axisymmetric Model

The relationship between groundwater inflow and pit level was obtained through the SVflux software, using the 2017 model (Figure 2.10).

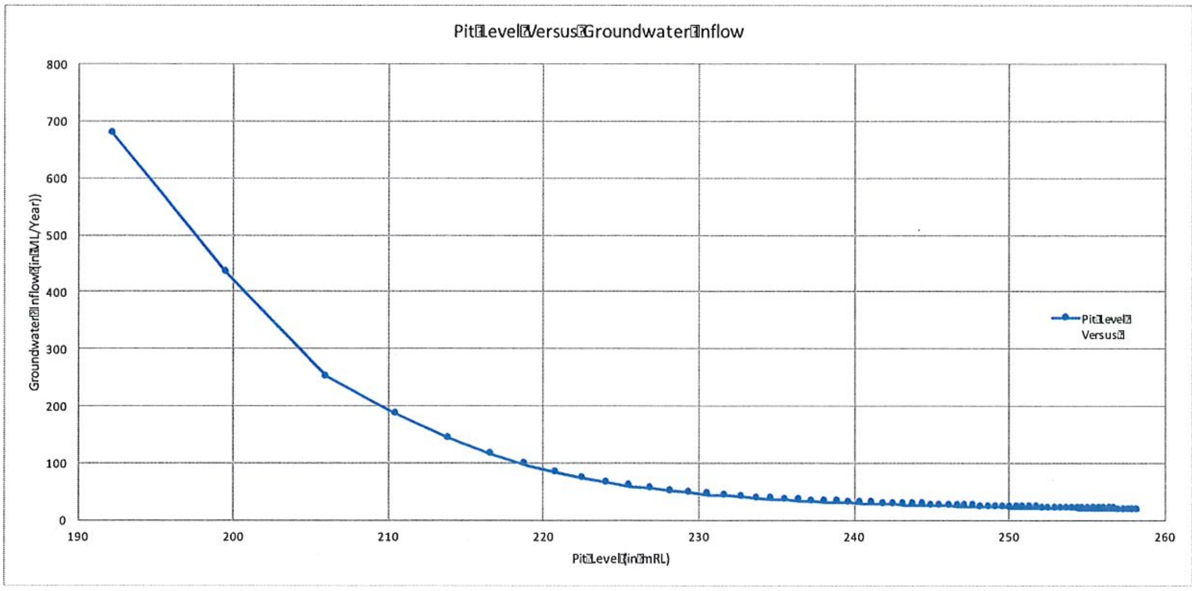

Figure 2.10 Groundwater Inflow / Pit Level (2017)

3 STUDY FINDINGS

The preliminary study findings described below cover the following:

- Identification of sub-catchments draining into the pit; and
- Overland flow paths to the pit.

3.1 Flow Discharge from Sub-Catchments

The sub-catchments of the study area have been presented in Figure 2.6. The catchments draining into the pit are sub-catchments 1 (partly), 2, 3, 4, 5, and 27 to 30. The area receiving direct rainfall for the pit has been denoted as sub-catchment 31.

The sub-catchments contributing to the pits with the corresponding average yield are presented in Figure 3.1 and Table 3.1.

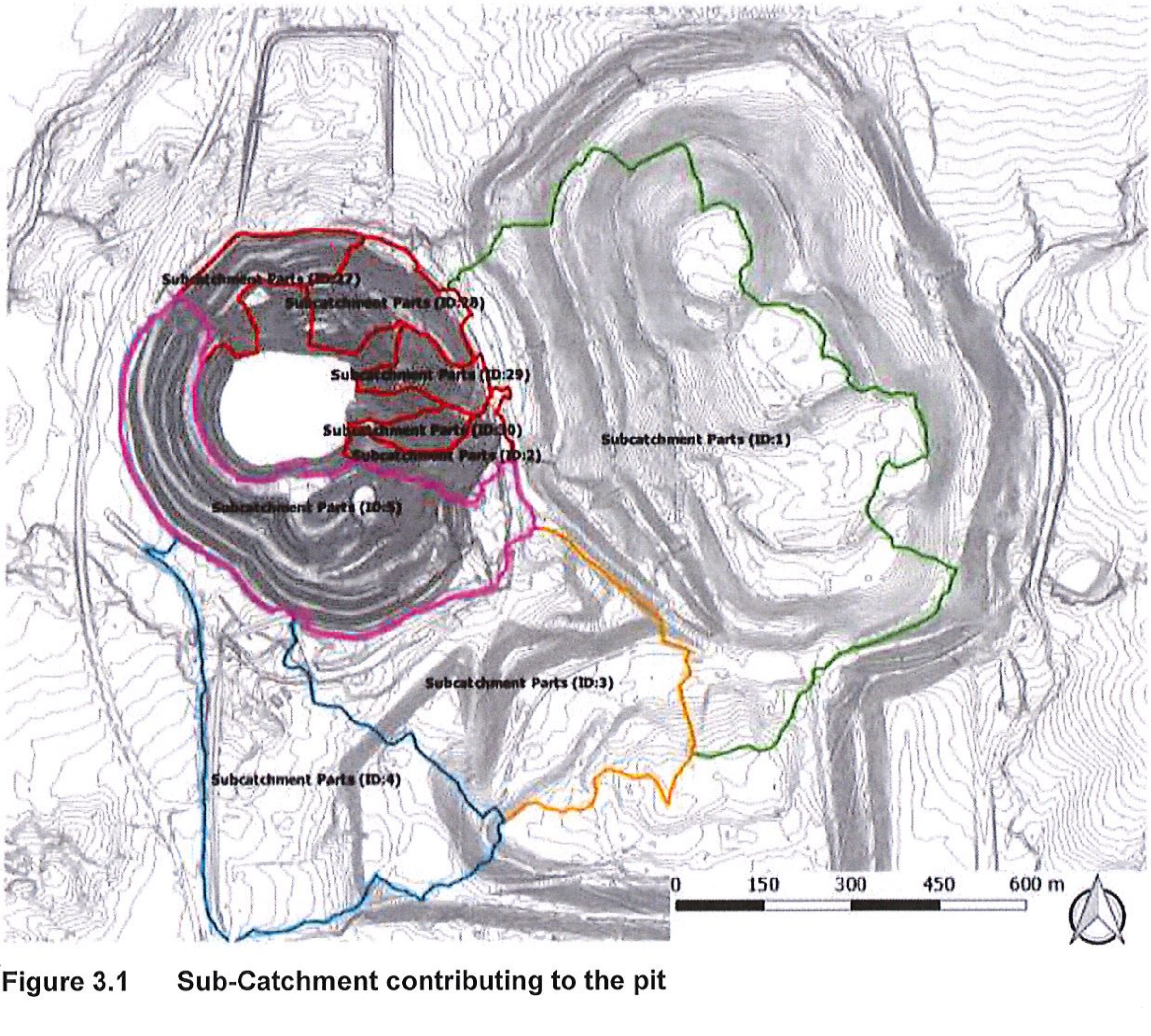

Figure 3.1 Sub-Catchment contributing to the pit

Table 3.1 Pit Sub-Catchment Yield

Sub-Catchment	Average Yearly Yield (ML)
1	181.7
3	97.9
4	93.9
5	86.2
2,27,28,29,30,31(direct). All these modelled as one group	55

The sub-catchment 1 is not linked to the pit in such a way that all of its yield gets to the pit. Future changes to the site topography may enable a substantial flow from sub-catchment 1 to drain into the pit (as per MWJV current and proposed water management sketch, presented in Figure 3.2).

With the background of this uncertainty, four scenarios have been considered in predicting rise of the pit water surface levels. The modelling output of these scenarios presents adequate information on planning to divert flow from part of sub-catchment 1 away from the pit.

These scenarios are:

- Scenario 1: 0% of the sub-catchment 1 draining into the pit;
- Scenario 2: 30% of the sub-catchment 1 draining into the pit;
- Scenario 3: 60% of the sub-catchment 1 draining into the pit; and
- Scenario 4: 100% of the sub-catchment 1 draining into the pit.

Scenario 2 has been added to three other scenarios that were modelled in 2013.

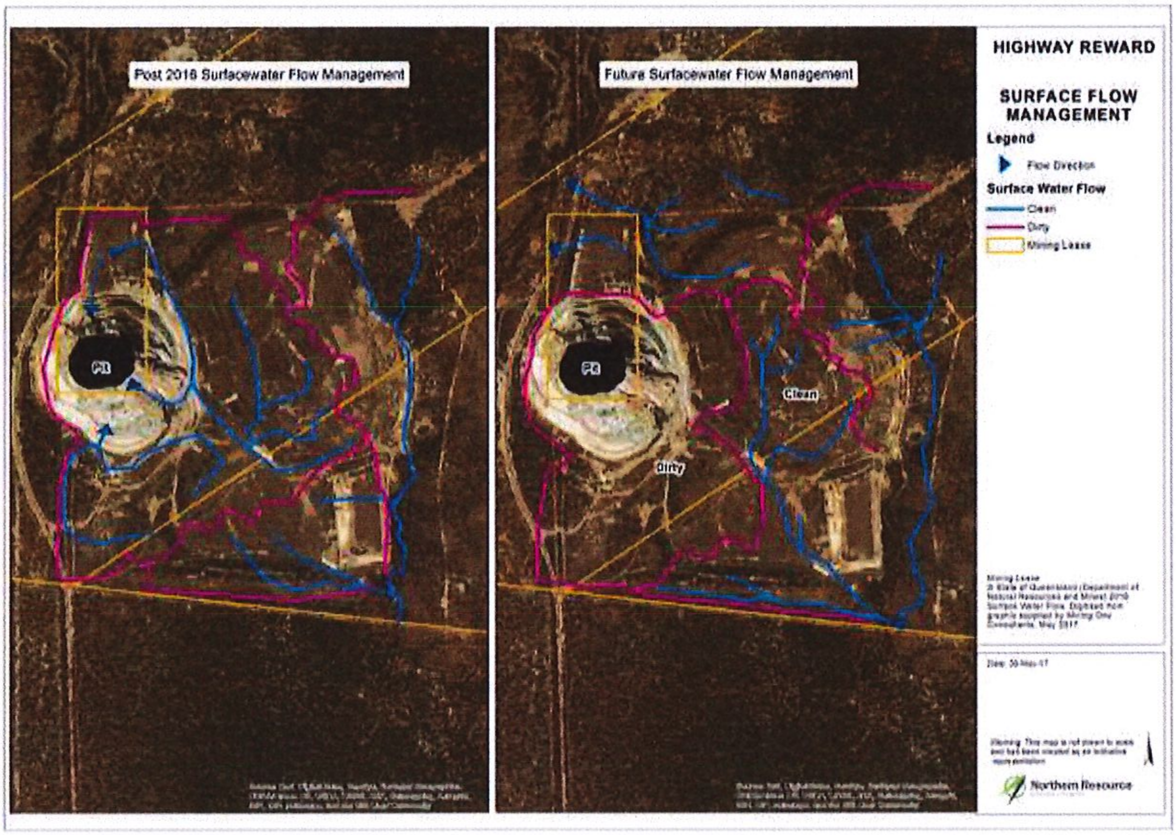

Figure 3.2 Post 2016 (Left) and Future (Right) Surface Flow Management (NRC 2017)

3.2 Assessment of Flow into the Pit

Assessments have been carried out for four scenarios noted above. The yearly average surface water flow (Table 3.2) was added to the ground water inflow and yearly evaporation was subtracted to compute the net inflow to the pit.

Table 3.2 Average Yearly Inflow of Surface Water to the Pit (ML)

Scenario	Average Yearly Inflow of Surface Water to the Pit (ML)
Scenario 1	333
Scenario 2	385
Scenario 3	437
Scenario 4	514

The volume of yearly evaporation increases with the rise of the pit level because of the increase in the water surface area. The modelling output has been summarised in Figure 3.3 to Figure 3.6. After a rapid rise initially, the rate of rise decreases as more area is subjected to evaporation.

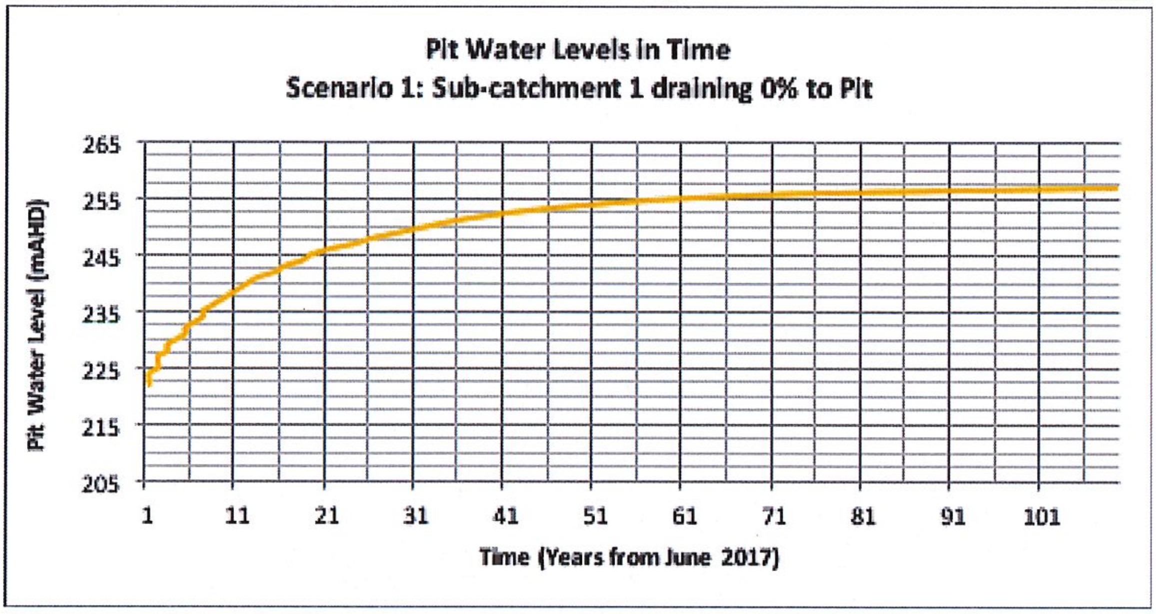

Figure 3.3 Scenario 1 Pit Water Level Rise

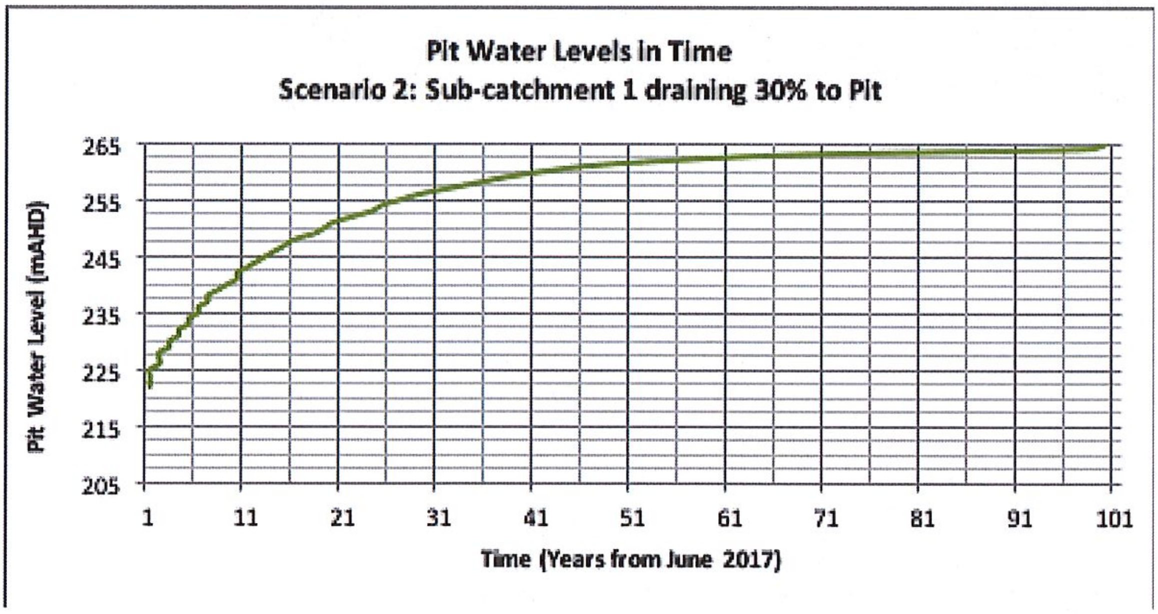

Figure 3.4 Scenario 2 Pit Water Level Rise

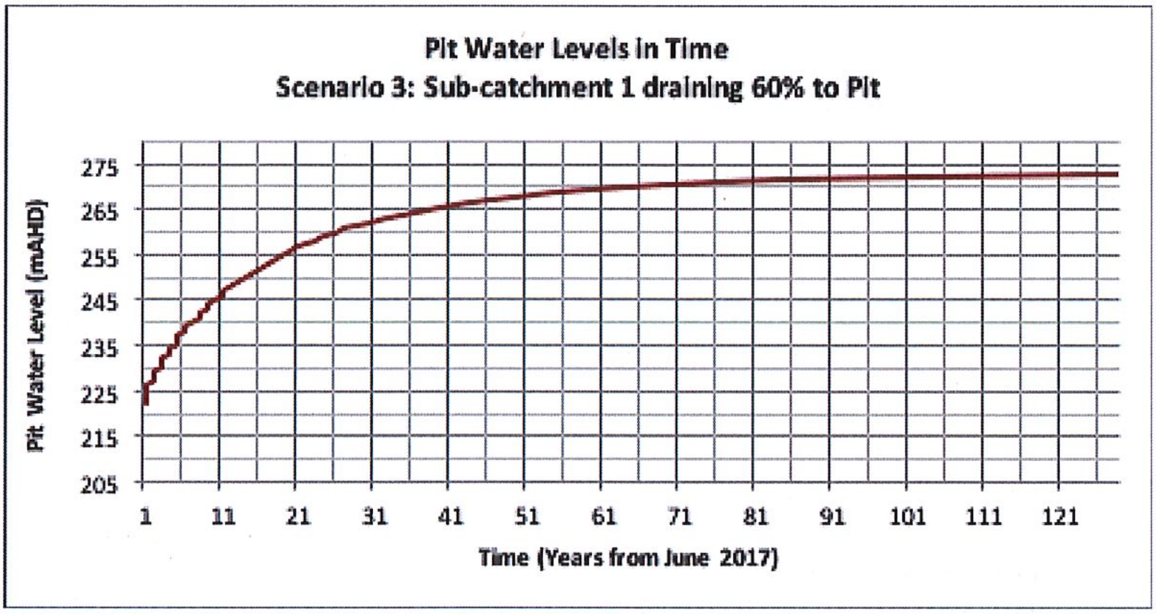

Figure 3.5 Scenario 3 Pit Water Level Rise

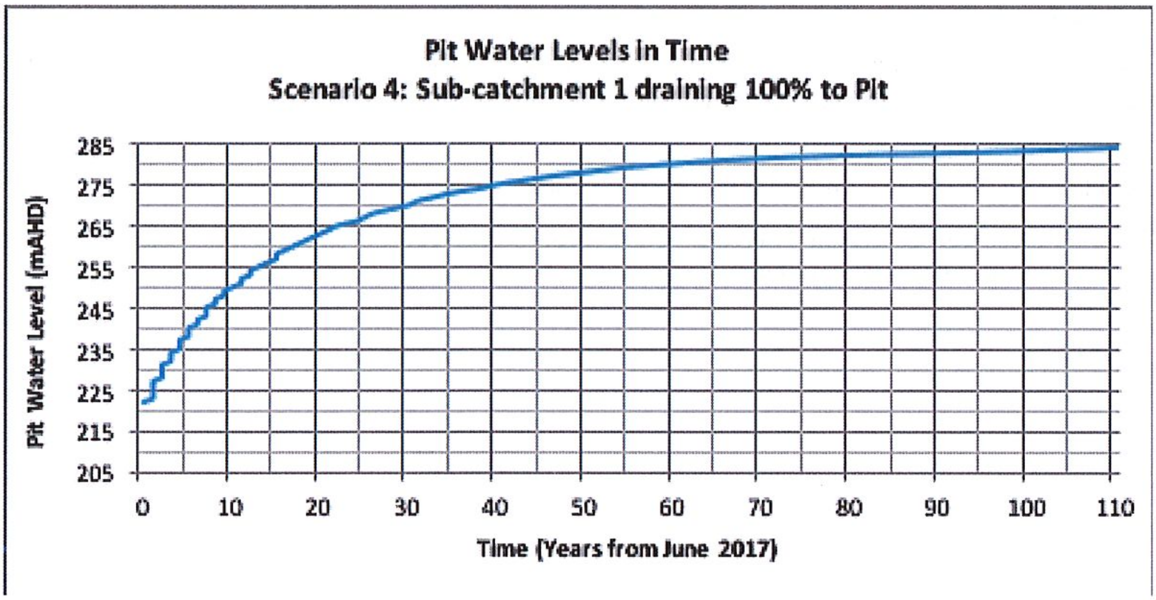

Figure 3.6 Scenario 4 Pit Water Level Rise

A summary of the projected Pit water level after 100 years for scenarios 1 to 4 is presented in Table 3.3.

Table 3.3 Projected Pit Water Levels After 100 Years

Scenario	Highest Pit Level AHD (HPL)	Number of Years to HPL	Year In Which HPL Achieved
Scenario 1	257	100	2117
Scenario 2	264	100	2117
Scenario 3	272	100	2117
Scenario 4	283	100	2117

3.3 Managing Surface Water Flow to the Pit

The preliminary calibrated computations made at this stage of the study provide an initial understanding of the surface water inflow to the pit. The main finding of the study is the assessment of the extent of sub-catchment 1 that can be allowed to drain into the pit without the pit level rising to or above 275 m AHD.

Scenario 1 shows that the level remains at 257m AHD with 0% of the sub-catchment redirected to the pit.

For Scenario 2, in which approximately 30% of sub-catchment 1 is drained into the pit, the pit level is expected to rise to 264 m AHD within the next 100 years.

In Scenario 3, in which 60% of the sub-catchment 1 is drained into the pit, the pit water level would rise to 272 m AHD within the next 100 years.

If the entire sub-catchment 1 is drained into the pit (Scenario 4), the pit water level would exceed 275 mAHD, and would increase to 283 m AHD within the next 100 years.

4 CONCLUSIONS AND RECOMMENDATIONS

The Highway Reward open-cut and underground copper and gold mine was decommissioned and rehabilitated in 2005. An environmental monitoring program was developed in 2009 and a Transitional Environmental Program (TEP) approved by the Department of Environment and Heritage Protection (EHP), to address sources of potential contamination from acid rock drainage observed across the site. An amended TEP (MAN17020) was issued to MWJV on 19 October 2016. NRC and MWJV are currently implementing works to bring the mine to a permanent closure state consistent with the requirements of EHP.

The 2013 groundwater model updated in 2017 confirms that the pit is currently acting as a sink, with a steep inward hydraulic gradient. The model also shows that the height to which water in the pit can rise without adversely affecting local or regional groundwater is the base of the Campaspe Beds, overlying the oxidized zone at around 275 m AHD.

This calibrated surface water model's objectives were to identify overland flow patterns and determine the yearly inflow rates of the surface water flow combined with the yearly recharge of the groundwater and estimate the rise of the pit water level over time.

Considering that catchments 3, 4, 5, 2, 27, 28, 29, 30, 31 (direct) as presented in Figure 2.6 and Table 2.3 are already contributing to flows into the pit, the analysis of catchment diversion focused on sub-catchment 1, the largest of all potentially contributing catchments.

The main finding of the study is the assessment of the extent to which flows from sub-catchment 1 can be allowed to drain into the pit without the pit level rising to or above 275 m AHD. The findings are summarised below:

- Scenario 1, in which no flow from the sub-catchment is redirected to the pit, shows that the level remains at 257m AHD after 100 years;
- For Scenario 2, in which approximately 30% of sub-catchment 1 is drained into the pit, the pit level is expected to rise to 264 m AHD within the next 100 years;
- In Scenario 3, in which 60% of sub-catchment 1 is drained into the pit, the modelling indicates that the pit water level would rise to 272 m AHD within the next 100 years; and
- In Scenario 4, in which the entire sub-catchment 1 is drained to the pit, the pit water would exceed 275 mAHD, and would increase to 283 m AHD within the next 100 years.

The modelling outputs of Scenarios 1 to 4 should be refined further in the next stage of this study, The final report will include the design of drains, bunds and related drainage elements (including erosion protection measures) required to provide long term diversions compliant with the final modelling results. The final phase of this water balance study (Stage 3) should incorporate the following inputs:

- Complete a review of the pit volume once the long term geotechnical stability assessment has been completed and final pit volume is defined;
- Complete a LIDAR survey to obtain accurate pit topography and accurately define the position of future bunds and drains that will allow for a diversion of the catchment to match the modelled diversion ratios; and
- Conduct ongoing yearly pit level surveys to confirm the validity of the model.

5 LIMITATIONS

Mining One has prepared this report for the use of MWJV in accordance with our proposal 4789v2. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use of any other third parties other than MWJV.

To the best of our knowledge, information contained in this report is accurate at the date of issue. However, the following limitations apply to the models developed and the associated report:

- The lack of aquifer parameters data and inconsistency in the surface water monitoring dataset may impact on the long term prognosis as the reliability of the calibration is considered low.

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