Centennial Coal

Longwalls 411 to 418 Environmental Monitoring Program

Springvale Colliery

June 2015

Centennial Coal
Environment Matters

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Abbreviations

ACEC	Animal Care & Ethics Committee
AEMR	Annual Environmental Management Report (now known as Annual Review)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DP&E	NSW Department of Planning and Environment
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy
EEC	Endangered Ecological Community
EMP	Environmental Monitoring Program
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FCNSW	Forestry Corporation of NSW
GDA	Geocentric Datum of Australia
GPS	Global Positioning System
HCPL	Helensburgh Coal Pty Ltd
ML	Mining Lease
NATA	National Association of Testing Authorities
NPSS	Newnes Plateau Shrub Swamps
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PUR	Polyurethane resins
SMP	Subsidence Management Plan
SMP EMP	*Springvale Subsidence Management Plan Longwalls 411 to 418 Environmental Management Plan*
SMSR	Subsidence Management Status Report
TARP	Trigger Action Response Plan
THPSS MMP	Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan
TSC Act	*Threatened Species Conservation Act 1995*

1. INTRODUCTION

1.1. Background

Springvale Colliery (Springvale) received planning approval in 1992 and has been extracting coal resources from beneath the Newnes Plateau and its surrounds using the longwall method of mining since 1995. Springvale received approval from the former Department of Primary Industries – Mineral Resources (now the Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (DTIRIS)) for the Longwalls 411 – 418 Subsidence Management Plan (SMP) on 7 March 2006. The management and monitoring of all subsidence related impacts resulting from the secondary extraction of Longwalls 411 – 418 is undertaken in accordance with the SMP.

Springvale has completed secondary extraction of Longwalls 411 – 416 from within Mining Lease (ML) 1326 and is currently focusing upon the monitoring and management of subsidence related impacts pre and post mining within Longwalls 417 – 418. The *Springvale Subsidence Management Plan Longwalls 411 to 418 Environmental Management Plan* (SMP EMP) and this *Longwalls 411 – 418 Environmental Monitoring Program* (Environmental Monitoring Program) have been revised to reflect the current measures being implemented by Springvale.

The monitoring program defined in this document will supersede version 1 of the *Subsidence Environmental Monitoring Program SV-MS-036*, dated August 2009 and will apply if approved, for the remainder of mining in Longwalls 417 and 418.

1.2. Purpose

This Environmental Monitoring Program has been revised to outline the monitoring and management measures that will be implemented by Springvale to identify and manage potential environmental consequences resulting from the secondary extraction of Springvale Longwalls 417 – 418. Required actions and responsibilities are defined to ensure detection and remediation of any potential environmental impacts from mining induced subsidence.

This Environmental Monitoring Program and the Longwalls 411 – 418 Land Management Plan are addendums to the SMP EMP. These documents have been collectively prepared to fulfil the requirements of Conditions 7, 8, 9, 15 and 18 of the SMP Approval.

2. SCOPE

This Environmental Monitoring Program applies to the Longwalls 411 – 418 SMP Area (herein referred to as the SMP Area). At the time of preparation, Longwall 411 to 416 had been completed and extraction in Longwall 417 was almost complete. The program applies to the remaining portion of Longwall 417 and Longwall 418 only.

For implementation and reporting purposes the EMP will be effective following the submission of the next SMSR. The End of Panel Report monitoring will reflect the monitoring program effective when the monitoring site was undermined.

In accordance with the requirements of the *Guidelines for Applications for Subsidence Management Approvals* (2003), published by the NSW Department of Mineral Resources (now DTIRIS), the SMP Area was calculated by combining the areas bound by the following limits:

- A 26.5° angle of draw line from the limit of proposed extraction; and

- The predicted limit of vertical subsidence, taken as the 20 mm subsidence contour resulting from the extraction of the Longwalls 411 – 418.

This Environmental Monitoring Program includes the monitoring of the following features relevant to the SMP Area:

- Newnes Plateau Shrub Swamps;
- Newnes Plateau Rush – Sedge Snow Gum Hollow Wooded Heath;
- Flora and fauna;
- Key surface features;
- Groundwater;
- Surface water flows and quality;
- Mine infrastructure including roads and fire trails, and
- Rainfall and temperature on the Newnes Plateau.

The document has been informed by the revised SMP Environmental Management Plan which modified and incorporated the Newnes Plateau Shrub Swamp Management Plan required under Condition 15 of the Longwalls 411 – 418 SMP Approval.

3. ENVIRONMENTAL MONITORING APPROACH

3.1. Objectives and Targets

The overall implementation of this Environmental Monitoring Program will aim to achieve:

- Compliance with relevant environmental legislation and standards;
- Effective monitoring programs in accordance with and to satisfy early response procedures and appropriate notification requirements;
- The early identification of potential harm to the environment to enable suitable management actions to be undertaken; and
- Minimal impact on the land resulting from Springvale operations.

The monitoring program will be revised following the completion of secondary extraction in the SMP Area to allow Centennial Coal to implement an adaptive management approach within active/inactive mining areas.

3.2. Monitoring Program Principles

The overall strategy for environmental management at Springvale is:

1. **Measure baseline information** – Establish background data for the surface above the mining area.
2. **Monitor the effects of mining** – Continue monitoring of identified parameters at key positions relating to the longwall position.
3. **Regularly assess and interpret monitoring** – Analyse monitoring data to identify any variations from predictions or unexpected anomalies. This will be carried out by specialist consultants.
4. **Reporting of monitoring results** – As described in **Section 8**.
5. **Re-assess any impacts** – Where variations are greater than predictions made in the SMP, additional assessment/investigation of impacts will be undertaken to determine any environmental consequences. This will be carried out by specialist consultants and Springvale personnel where required.

6. **Identify and implement remedial actions** – Additional assessments may indicate a requirement for remedial action. Specialist consultant and stakeholder consultation will be an integral part of determining and implementing appropriate remedial actions.
7. **Refine monitoring techniques** – Regularly review monitoring technology and design to take into account new developments in the science of environmental monitoring and reported research in the field.

A flowchart presenting the detail described above is presented in **Appendix 1**.

4. ENVIRONMENTAL MONITORING SCHEDULE

Monitoring outlined in this Environmental Monitoring Program is consistent with the SMP EMP and the *Temperate Highland Peat Swamps on Sandstone Monitoring and Management Plan* (THPSS MMP).

Subsidence monitoring within the SMP Area is undertaken in accordance with the *Longwalls 411 – 418 Subsidence Monitoring and Reporting Program*. Specific details regarding subsidence monitoring of potential subsidence induced environmental impacts are provided in Section 7.2 of the SMP EMP.

4.1. Flora

4.1.1. Layout of Monitoring Sites

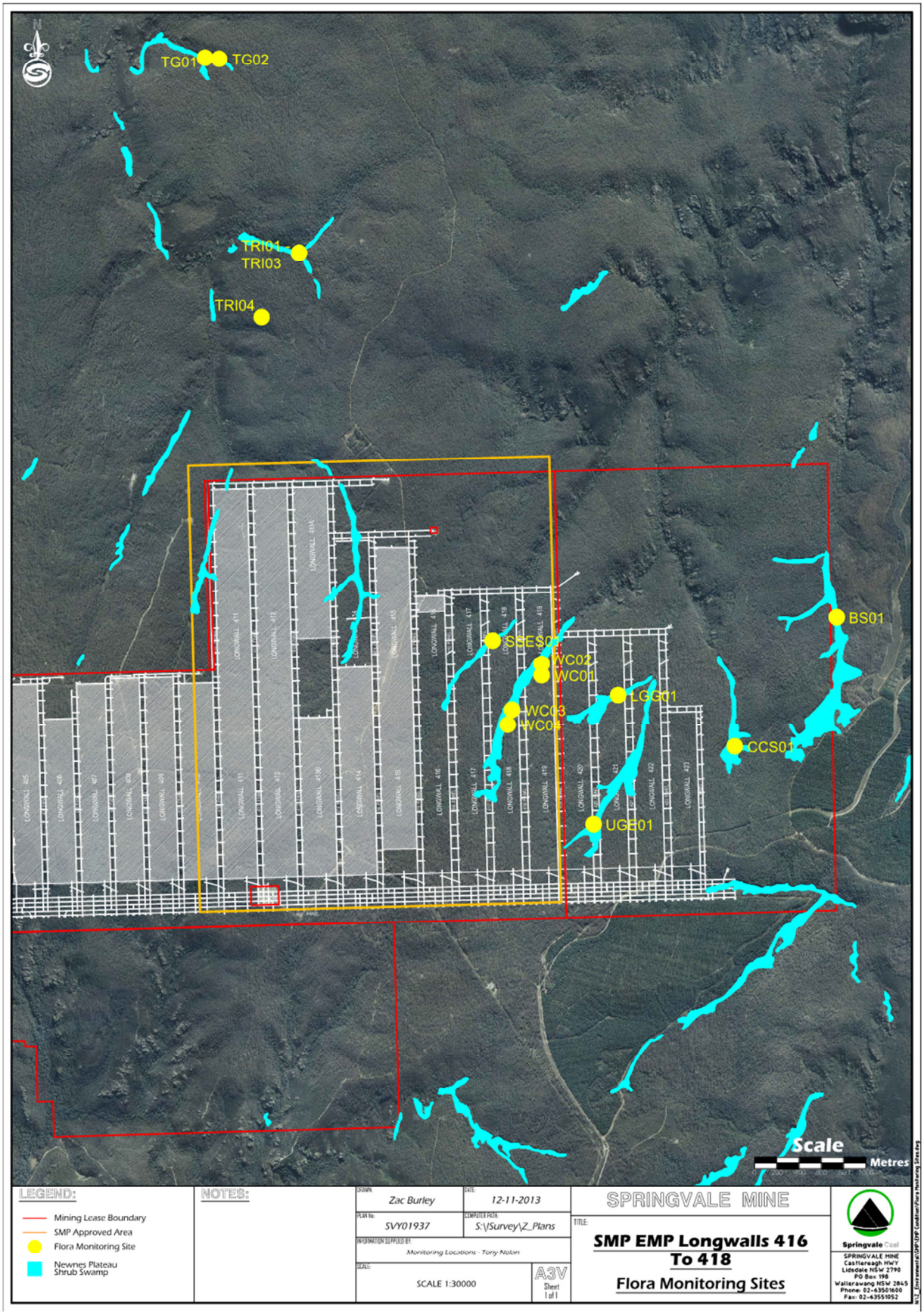
Flora monitoring is carried out on Newnes Plateau. Some of the flora quadrats are located directly above Springvale's SMP Area, whilst other quadrats (or control plots) are located outside of beyond the extent of the SMP Area. Details of the monitoring sites have been provided in **Table 1** and the locality of the sites has been presented on **Figure 1**.

Table 1. Flora Monitoring Locations

Monitoring site name	Swamp	Easting (GDA94)	Northing (GDA94)	Description
Impact Sites				
WC01	Carne West Swamp	239461	6303219	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
WC02	Carne West Swamp	239461	6303321	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
WC03	Carne West Swamp	239195	6302908	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
WC04	Carne West Swamp	239157	6302773	Permanently wet, groundwater fed swamp. Dominated by *Gymnoschoenus sphaerocephalus*, *Lepidosperma limicola*, *Leptospermum grandifolium*, *Gleichenia dicarpa*, *Xyris gracilis ssp. gracilis* and Baeckea linifolia.
SSE01	Sunnyside East	239022	6303531	Southern half is generally dry and channelized. Northern half likely permanently wet. Dominant species include *Gleichenia dicarpa, Leptospermum grandifolium*, *Baumea rubiginosa* and *Gahnia sieberiana*
Reference Sites				
TG01	Twin Gully	236565	6308755	Permanently wet, groundwater fed swamp. Dominant species include *Baeckea linifolia*, *Grevillea acanthifolia*, *Gleichenia dicarpa* and *Sphagnum cristatum.*

Monitoring site name	Swamp	Easting (GDA94)	Northing (GDA94)	Description
TG02	Twin Gully	236439	6308765	Permanently wet, groundwater fed swamp. Dominant species include *Baeckea linifolia*, *Grevillea acanthifolia*, *Gleichenia dicarpa* and *Sphagnum cristatum.*
TRI01	Tristar	236565	6308755	Permanently wet, groundwater fed swamp. Dominated by *Baeckea linifolia, Gleichenia dicarpa, Grevillea acanthifolia, Lepidosperma limicola, Leptospermum grandifolium*
TRI02	Tristar	236439	6308765	Permanently wet, groundwater fed swamp. Dominated by *Baeckea linifolia, Gleichenia dicarpa, Grevillea acanthifolia, Lepidosperma limicola, Leptospermum grandifolium*
LGG01	Lower Gang Gang Swamp	240148	6303040	Permanently wet, groundwater fed swamp, with channelised flows. Dominated by *Leptospermum grandifolium, Lepidosperma limicola, Boronia deanei and Gleichenia dicarpa.*
UGE01	Upper Gang Gang East Swamp	239928	6301878	Ephemeral, likely rainfall fed. Dominated by *Gleichenia dicarpa, Leptospermum grandifolium, Lepidosperma limicola, Gymnoschoenus sphaerocephalus and Xyris gracilis ssp. gracilis.*
BS01	Barrier Swamp	242111	6303738	Permanently wet, groundwater fed swamp. Dominated by *Gleichenia dicarpa, Leptospermum grandifolium, Lepidosperma limicola, Gymnoschoenus sphaerocephalus and Xyris gracilis ssp. gracilis.*
CCS01	Carne Central Swamp	241196	6302578	Ephemeral, likely rainfall fed. Dominated by *Lepidosperma limicola*, *Empodisma minus*, *Callistemon pityoides*, *Grevillea acanthifolia.*

Figure 1 Springvale Flora Monitoring Sites



4.1.2. Parameters, Monitoring Methods and Frequency

The following parameters are measured at each quadrat during each monitoring period:

- Change in diversity of native species;
- Recruitment of eucalypt species;
- Condition of key species;
- Non-live ground cover; and
- Non-native weeds.

Monitoring will be carried out by way of manual inspection of each quadrat. Transects will be assessed within each quadrat. Quantitative sampling will be conducted using the point intercept method. Additionally along each transect, 50cm x 50cm quadrats will be scored at 1 m intervals for the presence/absence of eucalypt species and weed species.

Monitoring will be carried out during Summer, Autumn and Spring for a period of three years post-mining.

4.1.3. Data Analysis and Reporting

Data will be analysed by a suitably qualified person and results compared to previous seasonal monitoring. If threatened species are located/reported within the quadrats, specific monitoring for each species will be conducted during subsequent surveys.

If data indicates a significant change in the following parameters, Springvale will investigate and report as appropriate.

The following are considered to be triggers for flora:

- A change in the number of species;
- An increase in eucalypts in an impact site compared to reference sites;
- A decline in condition score at an impact site;
- An increase of bare ground as detailed in the THPSS MMP; and
- An increase in non-native weeds.

Investigation and reporting of mining impact is outlined in the Trigger Action Response Plan (TARP) included in **Section 6**. A summary of results will be provided in the SMSR. An annual summary will be included in the AEMR.

4.2. Fauna

4.2.1. Layout of Monitoring Sites

Fauna monitoring will continue to be undertaken as part of general research efforts on the Newnes Plateau. The locations of sites are subject to change, however monitoring will be undertaken both within the SMP Area, and future areas for ongoing baseline collection.

Fauna monitoring within the SMP area is carried out within Sunnyside Swamp and Newnes Plateau Woodland. Fauna monitoring is also carried out in Carne Swamp, however the monitoring is outside of the SMP area, located east of longwall 418.

Table 2. Fauna Monitoring Sites

Swamp	Site
Newnes Plateau Woodland	F-SV2
Sunnyside Swamp	F-SV3
Carne West Swamp	F-SV4

4.2.2. Parameters, Monitoring Methods and Frequency

The faunal surveys will sample a range of faunal groups with a specific emphasis on threatened/endangered species (listed under the TSC Act and the EPBC Act).

Fauna Monitoring will be undertaken in Spring. Consideration to additional monitoring will be given if mining impact is observed to flora.

Data from the surveys is analysed to show:

- Species counts;
- Habitat characteristics;
- Species diversity; and
- Species richness.

Monitoring will be carried out by way of manually setting traps and/or inspections. Trapped animals will be released within 24 hours of being trapped. Species identified will be recorded and the data analysed. Inspections will be carried out by a qualified, experienced and recognised fauna consultant.

4.2.3. Data Analysis and Reporting

Data will be analysed by the specialist consultant and results compared to previous monitoring. If threatened species are located, specific monitoring for each species will be conducted during subsequent surveys.

Any loss of threatened or endangered species will be investigated and reported against the contingency plan.

A summary of results will be provided in the SMSR. An annual summary will be prepared for the AEMR.

4.3. Groundwater

The groundwater monitoring program has been implemented on the Newnes Plateau to detect mining related impacts on groundwater levels and groundwater chemistry.

The monitoring programs include the following main aspects:

- Groundwater levels are monitored in impacted and reference shrub swamps;
- Swamp surface flows are measured using a combination of a v-notch weir and pool depth monitors;

- The groundwater levels in the upper aquifer zone in the overburden are measured in piezometers that are installed on the ridges between the swamps; and
- A basic weather station provides climatic data on the plateau.

4.3.1. Layout of Monitoring Sites

Groundwater levels are monitored in impact and reference shrub swamp sites within the SMP Area. Details of these monitoring locations are provided in **Table 3** and the locality of the monitoring sites has been illustrated on **Figure 2**.

Groundwater chemistry is monitored only in piezometers located in permanently waterlogged swamp conditions as sampling in periodically waterlogged conditions is often not possible due to the lack of groundwater in the piezometer. Quality monitoring sites are shown in **Table 3**.

Details regarding piezometers installed in open boreholes along ridge tops to monitor deep and shallow aquifer are provided in **Table 4** and the locality of the monitoring sites is illustrated on **Figure 2**. The piezometers are designed to intersect the aquifer that feeds the swamps.

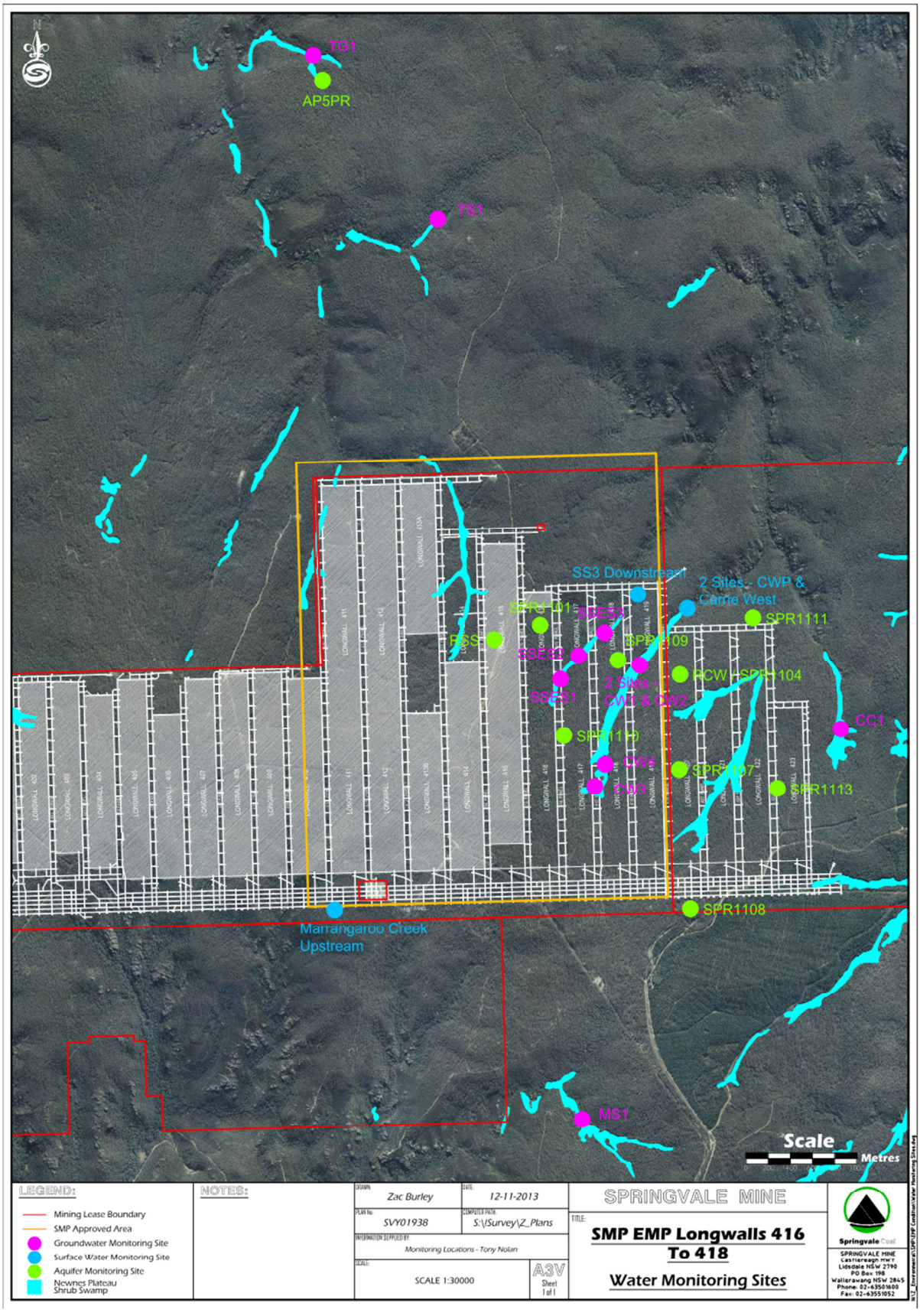
Table 3. Swamp – Groundwater Monitoring Locations

Site name		Easting (GDA94)	Northing (GDA94)	Location	Quality Monitoring
Impact sites	SSE1	238668	6303143	Longwall 416/417	No
	SSE2	238831	6303352	Longwall 417	No
	SSE3	239064	6303558	Longwall 418	Yes
	CW1	239352	6303196	Longwall 419	Yes
	CW2	239382	6303247	Longwall 419	Yes
	CW3	238977	6302179	Longwall 417	No
	CW4	239070	6302377	Longwall 417	No
Reference site	CC1	241193	6302693	East of Longwall 424	Yes
	MS1	238860	6299169	South of Longwall 417	Yes
	TS1	237559	6307289	Angus Place	No
	TG1	236438	6308766	Angus Place	No

Table 4. Aquifer Groundwater Monitoring Locations

Site name		Easting (GDA94)	Northing (GDA94)	Location
Impact sites	RSS	238072	6303500	Over Longwall 415
	SPR1101	238484	6303627	Over Longwall 416
	RCW/SPR1104	239746	6303184	Over Longwall 420
	SPR1107	239739	6302330	Over Longwall 420
	SPR1109	239186	6303314	Over Longwall 418
	SPR1110	238699	6302635	Over Longwall 416/417
Reference Site	SPR1108	239840	6301075	South of Longwall 420 over Longwall 427
	SPR1111	240404	6303692	Nth of Longwall 422
	SPR1113	240625	6302160	Over Longwall 423
	AP5PR	236523	6308535	NE of Angus Place Mine

Figure 2 Springvale Water Monitoring Sites



4.3.2. Parameters, Monitoring Methods and Frequency

Groundwater levels are measured by automatic water level logging instruments installed in the boreholes. The groundwater level data are downloaded at approximately two - monthly intervals. This involves visiting each piezometer to remove the instrument from the borehole and download the data with a laptop computer.

Chemical analysis is carried out for analytes that will indicate mining-induced changes in the swamp systems. The main possible impact on groundwater quality from mining is the potential for oxidation of fresh rock surfaces in subsidence-induced cracks that may form in the rock under the base of a swamp. The parameters that are monitored as indicators of any mining-related impacts and the justification for their use are pH, electrical conductivity (EC) and iron.

Aquifer piezometers are installed in open boreholes drilled from ridge tops and are designed to intersect the aquifer that feeds the swamps. Some piezometers have been installed in exploration bores that have been grouted up to the aquifer base. A length of 50 mm class 12 UPVC casing is inserted into the bore. The bottom six to nine metres of the casing is slotted and enclosed in filter sock to permit groundwater movement into the casing and to exclude other material that may cause blockages. The annulus around the casing is filled with sand and the collar enclosed in concrete or bentonite to prevent water ingress from surface runoff.

Automatic water level logging instruments are installed and groundwater levels are measured at three hourly intervals by automatic water level logging instruments. The groundwater level data are downloaded at two-monthly intervals using a lap top computer.

4.3.3. Data Analysis and Reporting

The methodology for developing groundwater level triggers to determine whether anomalous impacts have occurred is based on statistical analysis and the development of percentile based triggers.

Baseline data will be used to calculate and define triggers and will be collected to define the trigger value up to entering the 200m trigger zone. Triggers can only be exceeded when mining is within 200 m of the instrument. Data will be analysed in conjunction with climatic monitoring which is carried out on the Newnes Plateau.

For swamp piezometers, performance indicators for groundwater level will be considered to have been exceeded if statistically significant changes are indicated by the data using data calculated from a 2 years baseline (pre-mining) condition such as:

- For short-term change – if the groundwater depth is > 95th percentile pre-mining groundwater depth for more than 7 consecutive days; and
- For long-term change – if the post-mining 50th percentile groundwater depth for any piezometer is > 80th percentile pre-mining level after a minimum of 12 months.

Additionally for swamp piezometers, performance indicators for groundwater quality will be considered to have been exceeded if statistically significant changes are indicated by the data such as:

- For short-term change – if any measured parameter is > baseline 80th percentile by two standard deviations for more than two months and
- For long-term change – if the post-mining 50th percentile level for any analyte exceeds the 80th percentile pre-mining level after a minimum of 12 months.

For aquifer piezometers, performance indicators for groundwater level will be considered to have been exceeded if statistically significant changes are indicated by the data using data calculated from a 2 years baseline (pre-mining) condition such as:

- For short-term change – if the groundwater level is < 5th percentile or > 95th percentile pre-mining groundwater level for more than one month; and

- For long-term change – if the post-mining 50th percentile groundwater level for any piezometer is < 20th percentile or 80th percentile pre-mining level after a minimum of 12 months.

A summary of results will be provided in the SMSR. An annual summary will be prepared for the AEMR.

4.4. Surface Water

4.4.1. Layout of Monitoring Sites

Flow monitoring sites and surface water quality monitoring sites relevant to the SMP Area are shown in **Figure 2** and details presented in **Table 5**.

Table 5. Surface Water Monitoring Sites

Site		Easting (GDA94)	Northing (GDA94)	Description
Impact sites	Carne West	239808	6303782	Nth end of Carne West Swamp
	CWP	239816	6303814	Nth end of Carne West Swamp
	SS3 D/S	239363	6303908	Nth end of Sunnyside East Swamp
Reference site	Marangaroo Creek Upstream	236633	6301063	Marangaroo Creek upstream

4.4.2. Parameters, Monitoring Methods and Frequency

A pygmy flow meter will be used to determine flow rates at surface water monitoring sites with the exception of Carne West Pool (CWP). Water pool monitoring will be undertaken at CWP to assist in monitoring stream flow.

Stream flows are currently monitored monthly for flow, pH, electrical conductivity, manganese, iron and Total Suspended Solids. Water quality samples are taken manually and analysed in an appropriately registered laboratory.

4.4.3. Data Analysis

The methodology for developing surface water quality triggers to determine whether anomalous impacts have occurred is based on statistical analysis and the development of percentile based triggers using data calculated from a 2 years baseline (pre-mining) condition.

Performance indicators for surface water quality will be considered to have been exceeded if statistically significant changes are indicated by the data such as:

- For short-term change - if any measured parameter is > baseline 80th percentile by two standard deviations for more than two months; and
- For long-term change – if the post-mining 50th percentile level for any analyte exceeds the 80th percentile pre-mining level after a minimum of 12 months.

Stream flow monitoring results are reported to Springvale following each monitoring period. These results are analysed and compared to the climatic monitoring results and previous stream flow monitoring results.

A summary of results will be provided in the SMSR. An annual summary will be prepared for the AEMR. Any loss of surface water flows or abnormal changes in quality will be investigated and reported as appropriate.

4.5. Surface Features

Visual and photographic inspections of sensitive surface features may include rock formations, drainage lines, fire trails, waterholes, rock beds within the watercourses.

There are two aspects regarding the potential impacts on drainage lines. These include change of flow characteristics and the impact on rockbars, particularly within swamps.

The inspections will identify any impacts. This may include new water ponding, change in flows, changes to vegetation, changes in flow route and rock bar disturbance, cracking or upsidence. If this occurs, a field inspection will be carried out by a geotechnical expert and Springvale staff. The objective of this investigation will be to determine any adverse consequences to the flows within the drainage line and any adverse consequences to stream banks.

4.5.1. Layout of Monitoring Sites

Photographic inspections of sensitive features above the longwall shall be undertaken within 4 months (where practicable) prior to mining. The purpose of this inspection is to gain a baseline record of the surface before underground mining takes place and to record the condition of sensitive surface features. The sensitive surface features will be inspected post mining for any visible impacts.

4.5.2. Parameters, Monitoring Methods and Frequency

Where sensitive surface features are located, photographic monitoring sites will be established (with GPS location) and inspections will be carried out pre and post mining of the subject longwalls.

4.5.3. Data Analysis and Reporting

Climatic data, subsidence and groundwater monitoring data will be used to assist in the analysis of the results where necessary.

A report will be generated from the data with results summarised into the SMSR. An annual summary will be prepared for the AEMR.

Any irregular movements will be investigated and reported in accordance with the contingency plan.

4.6. Built Features

4.6.1. Forest Access Tracks

Visual inspections will be conducted of Forestry Access Tracks, prior to mining within 200m, when is approximately 200m past the track. An additional survey will be conducted when the extraction of the longwall is complete will conclude the monitoring program.

4.6.2. Mine Infrastructure

The mine infrastructure will be monitored through regular operational inspections.

All powerlines will be designed to allow for the predicted subsidence, tilts and strains.

The pipelines transporting water to the Wallerawang Power Station from dewatering boreholes have been installed such that any impacts from mine subsidence shall be negligible.

Controls which have been or are being installed include:

- The use of a fully welded, appropriately rated poly pipeline with the ability to withstand the predicted strains; and
- Burying of the pipeline to prevent damage by fire or machinery.

Where infrastructure is visible (i.e. not buried) within above the longwall being extracted, the condition will be captured in a photographic survey prior to undermining, and following the completion of extraction of the relevant longwall.

4.7. Aboriginal Heritage Sites

As outlined in the SMP EMP, there was no aboriginal heritage sites identified to be potentially impacted by mining in the SMP Area. Subsequently no monitoring program is proposed for aboriginal heritage sites.

5. ASSESSMENT OF IMPACTS

The focus of the Environmental Monitoring Program is on sensitive surface features, including the Newnes Plateau Shrub Swamps, rock features, drainage lines and infrastructure. Predicted impacts for relevant features have been outlined below.

Reference sites will be used to assess if triggers are related to mining induced subsidence.

There are no identified sensitive rock features associated with Longwalls 416 – 418.

5.1. Swamps

The primary risk associated with swamps is the loss of water. Water is delivered to swamps via the following mechanisms: rainfall; runoff; groundwater (spring or natural discharge) fed. Some swamps rely on all three (termed wet swamps or permanently waterlogged), whilst others associated with ephemeral drainage lines rely on rainfall and runoff (termed dry swamps or periodically waterlogged). Accordingly, there are four monitoring streams that would highlight any environmental consequences including:

1. Shallow groundwater monitoring;
2. Surface water flows;
3. Rainfall; and
4. Flora monitoring.

The TARP provides trigger levels and response in the event of detecting any anomalous results and/or impact. The detection of any anomalous results will trigger the following:

1. Field inspection;
2. Evaluation of the cause to determine if the results was caused by mining (or some other cause either natural or anthropogenic);
3. If mining induced, notify relevant Government Departments in accordance with SMP Approval conditions;
4. Determine impact – temporary or long term;
5. Investigate existing data;
6. Carryout additional monitoring (in consultation with relevant Government Departments / land owners or managers) as required; and
7. Undertake remediation if appropriate following consultation with the appropriate Government Departments.

The type and extent of additional monitoring required will depend solely on the nature and severity of the anomalous condition. Potential management and remedial measures are outlined in **Section 6** however their implementation will again depend solely on the severity of the situation, the outcome of Government Department Consultation and the outcome of consultation with expert consultants.

5.2. Drainage Lines

There are two aspects regarding the potential impacts on drainage lines. These include change of flow characteristics and the impact on rockbars, particularly within Swamps.

Visual inspections will identify any impacts on the drainage lines. This may include new water ponding, change in flows, changes to vegetation, changes in flow route and rock bar disturbance, cracking or upsidence. If this occurs, a field inspection or an analysis of photographs of the subject drainage line the Environmental and Community Coordinator with input from specialists if required. The objective of this investigation will be to determine any adverse consequences to the flows within the drainage line and any adverse consequences to stream banks.

Following this investigation an evaluation will be carried out to determine whether the observed changes represent a temporary or permanent disruption to the drainage line. A detailed evaluation of subsidence and climatic data will be carried out. Recommendations will then be made for additional monitoring (where appropriate) that may be necessary to determine the cause and/or impact of the anomalous condition. Such monitoring may include (but not limited to) detailed subsidence surveys, installation of additional groundwater observation bores or piezometers, flora surveys, fauna surveys, stream flow monitoring, stream water quality, waterhole depths and/or photographic monitoring and inspections.

Temporary management of impacts may also be required until the full extent of the subsidence impacts is realised. This may occur where drainage line flows have been impacted and may include erosion control techniques (sediment fencing, spoon drains, levelling, using existing fallen branches to control sedimentation) and/or soil stabilisation (revegetation using endemic seed, meshing).

The type and extent of additional monitoring and/or rehabilitation required will depend solely on the nature and severity of the anomalous condition.

5.3. Infrastructure

Springvale has installed warning signs along tracks in consultation with FCNSW regarding the potential for subsidence impacts from mining along the tracks. The objective of the signage is to ensure that public users of the roads are aware of potential hazards resulting from subsidence.

Visual inspections will most likely identify any impacts on infrastructure. This could potentially include cracking of FCNSW roads or damage to Springvale or Angus Place infrastructure. If cracking of FCNSW roads occurs, a field inspection of the subject area will be carried out by the Environment and Community Coordinator or delegate and an invitation to attend the inspection will be provided to a representative of FCNSW. The objective of the field inspection will be to determine any adverse consequences.

Following the field inspection an evaluation will be carried out to determine whether the observed changes represent a temporary or permanent disruption to the infrastructure. Cracking to the FCNSW roads can be rectified by regrading and positioning appropriate signage to ensure that the public are informed of any potential hazard. If road drainage is affected, additional spoon drains and/or roll overs can be installed in accordance with FCNSW requirements.

Springvale will have regular contact with Angus Place regarding the position of the longwall with respect to the location of surface infrastructure. Any impact from Springvale mining activities on Angus Place infrastructure will be rectified promptly.

6. CONTINGENCY PLAN AND REMEDIAL MEASURES

The TARP details the process how exceedances are investigated (refer to **Figures 3** and **4**). Monitoring investigation trigger levels are presented in the SMP EMP .

6.1. Contingency Plan

Note that subsidence trigger exceedances shall be reported in line with the contingency plan only when they are within 200 m of a shrub swamp. Other subsidence exceedances will be detailed in the SMSRs, end of panel reports and AEMRs.

In the event the trigger levels are considered to have been exceeded, Springvale will implement the contingency plan (**Figure 3**) to manage any unpredicted impacts and their consequences.

Figure 3 TARP Overview

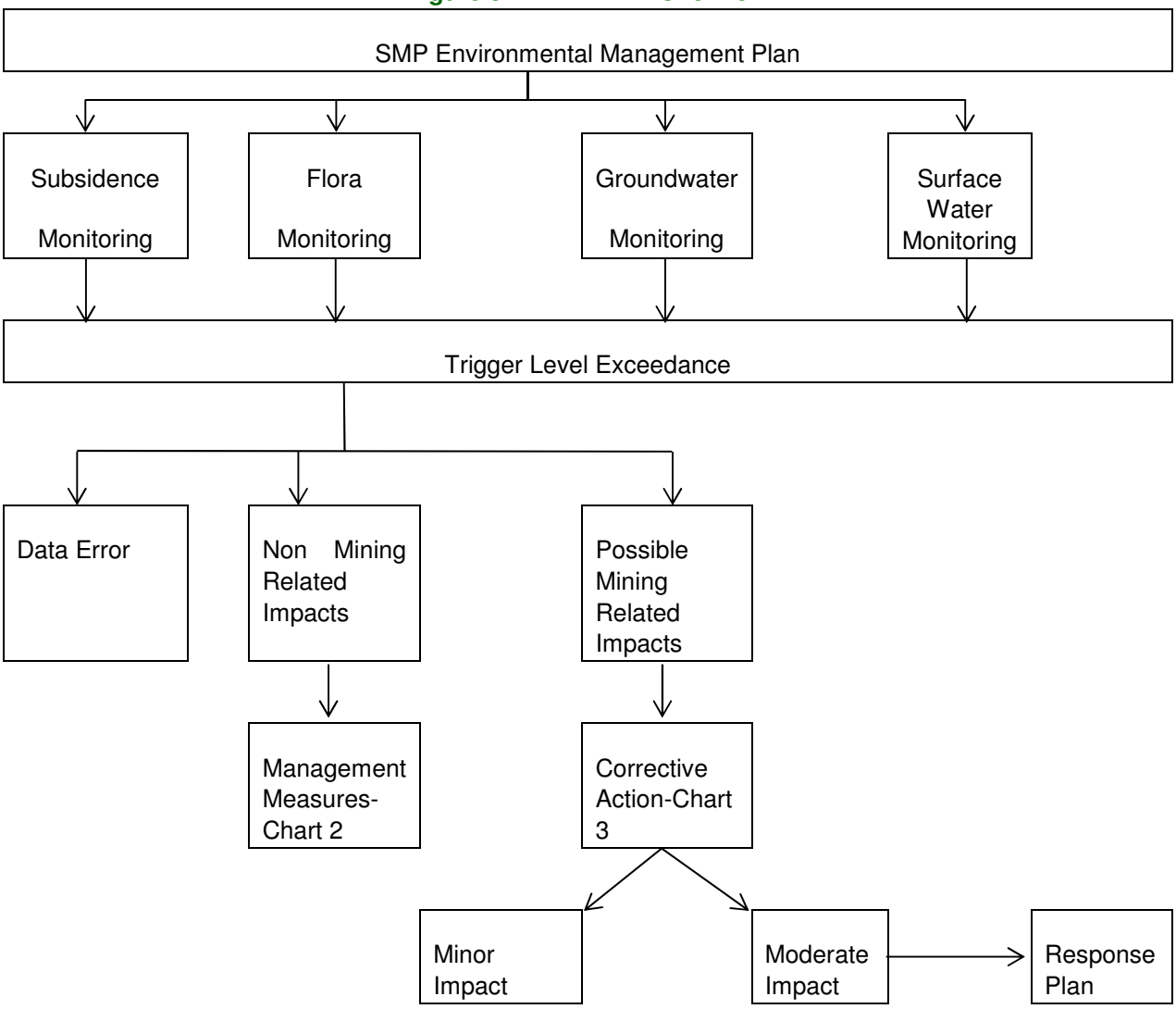


Figure 4 Chart 2 TARP/ Management Measures

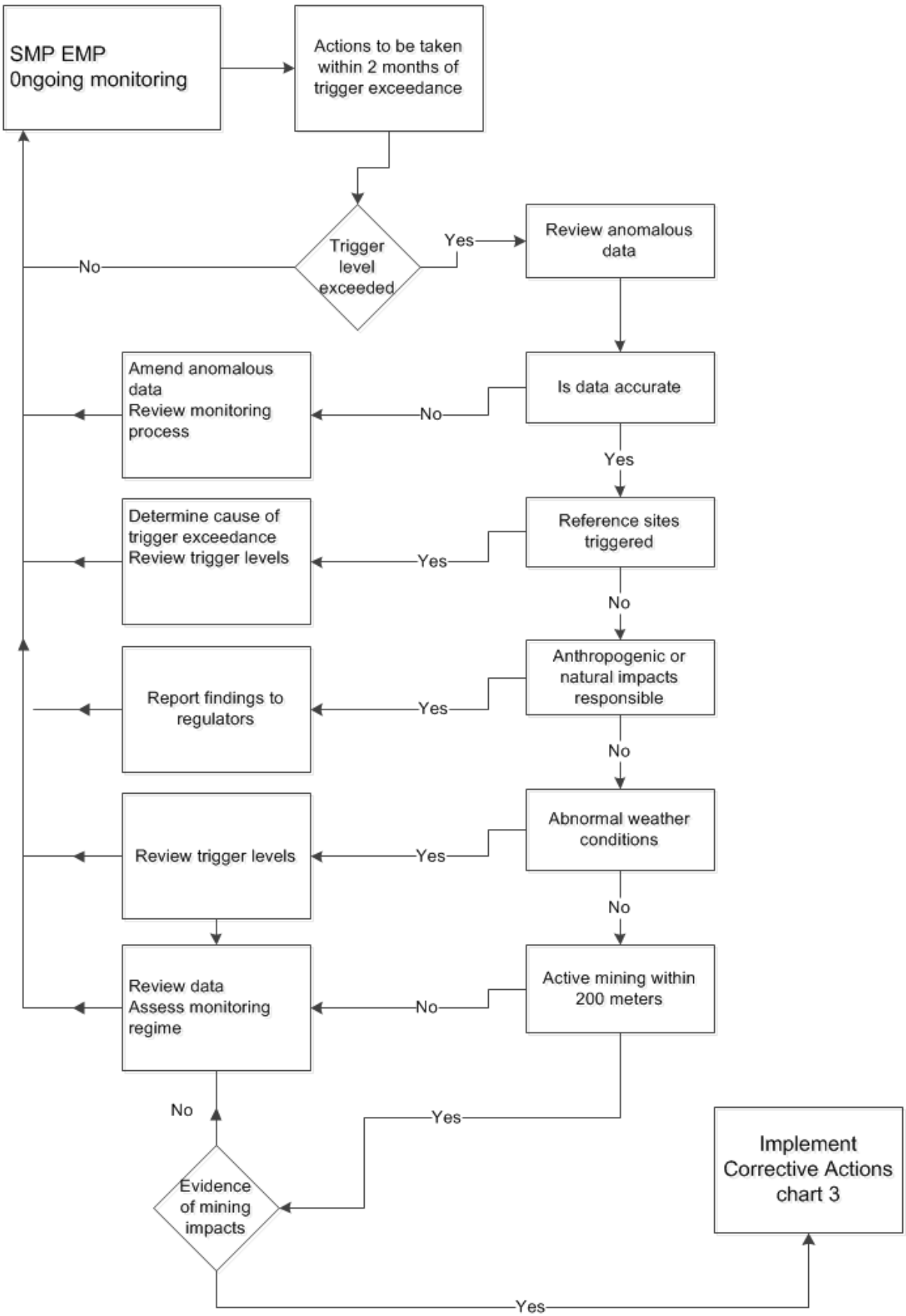
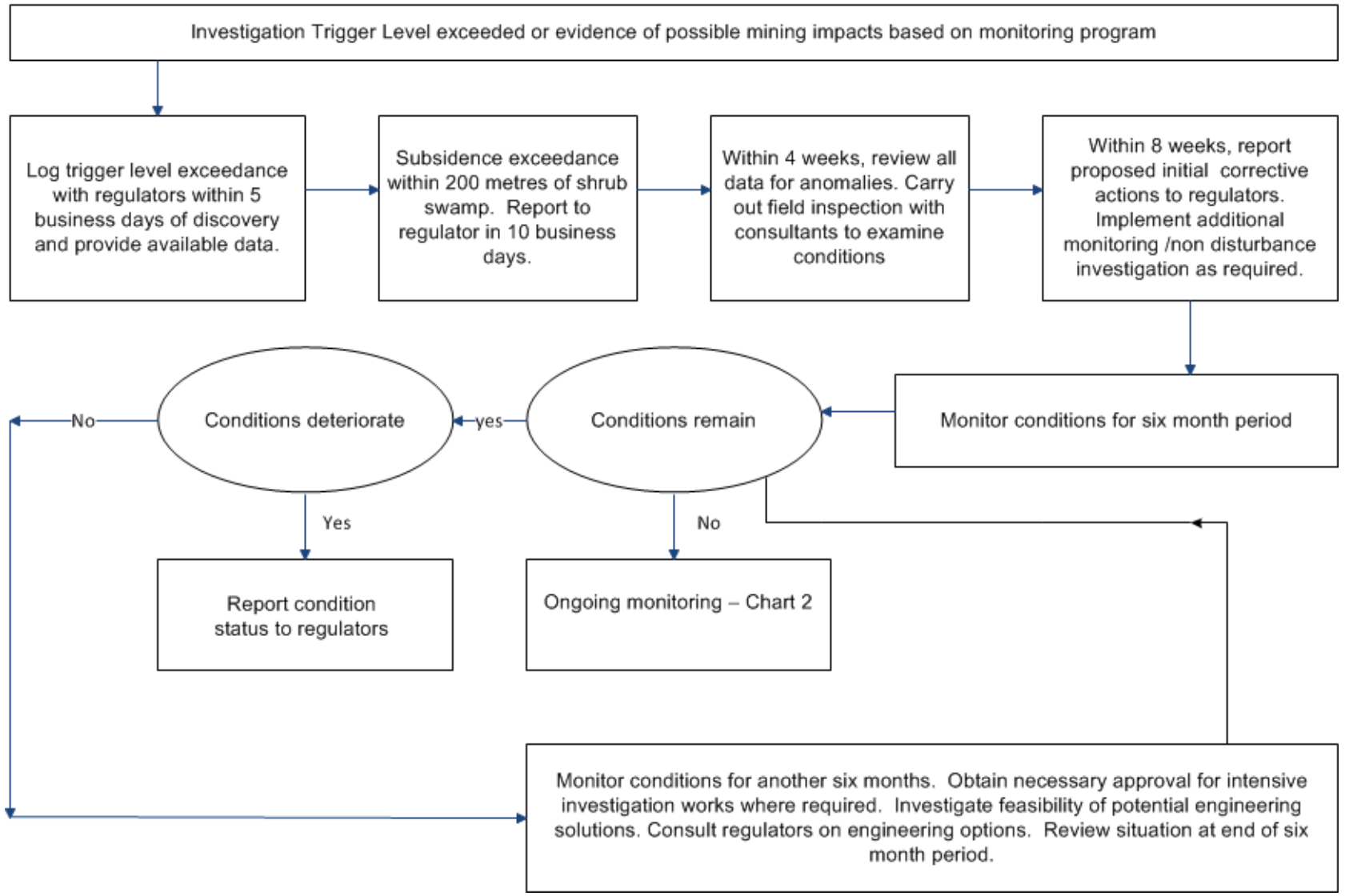


Figure 5 Chart 3 Contingency Plan



6.2. Remediation Strategies

Remedial measures may be required to address non-conformances with the predicted subsidence impacts identified by inspections, monitoring or complaints. All incidents shall be investigated to consider:

- The cause of the non-conformance;
- The extent of any damage caused by subsidence on infrastructure
- The extent of any damage caused or the potential for harm to the environment caused by subsidence from Springvale;
- Identification of the appropriate corrective or preventative action in consultation with the infrastructure owner or relevant government agency; and
- Prompt notification with the relevant infrastructure owner to develop the appropriate control and/or remediation strategies if required.

Remedial measures for the SMP Area are discussed in more detail in SMP EMP.

The design of identifying remedial measures can be summarised in the following steps:

1. Analyse monitoring data;
2. If monitoring results indicate abnormal conditions (or trigger points are approached as presented in the TARP), focus resources to determine why the results are abnormal;
3. If abnormal results continue, carry out a field inspection with relevant specialists;
4. Evaluation of the cause to determine if the results was caused by mining (or some other cause either natural or anthropogenic);
5. If mining induced, notify relevant government agencies in accordance with relevant approval conditions;
6. Determine impact – temporary or long term;
7. Investigate existing data;
8. Undertake additional monitoring as required;
9. Undertake remediation if appropriate following consultation with the appropriate government agencies; and
10. Investigate the need to instigate engineering solutions (as a last measure) with relevant specialist consultants and government agencies.

A flow chart of the abovementioned steps as implemented by Springvale Colliery has been provided as **Appendix 1**.

7. ROLES AND RESPONSIBILITIES

The responsibility for implementation, monitoring and review of the Environmental Monitoring Program lies with the Environment and Community Coordinator. The ultimate responsibility for the implementation of the Environmental Monitoring Program lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this Environmental Monitoring Program are outlined in **Table 6**.

Table 6. Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	• Ensuring that sufficient resources are available to implement and execute the requirements of this Environmental Monitoring Program; and • Reporting triggers/non-conformances to external stakeholders.
Environment and Community Coordinator	Implementation, monitoring and review of this plan, including: • The carrying out of inspections; • The installation and maintenance of signage; • Reporting triggers/non-conformances internally to the Mine Manager as appropriate; • Consulting with stakeholders on any issues arising from subsidence; • Consultation during the review process with relevant stakeholders and distributing this Environmental Monitoring Program; • Coordinating any remediation work as required; • Inspecting areas susceptible to tensile and compressive strains and potential cracking; • Co-ordinating the generation and submission of formal reporting requirements outlined in this plan (e.g. End of Panel Reports, SMSRs and the AEMR); and • Reviewing this Environmental Monitoring Program.

8. REPORTING

The AEMR/Annual Review will be made available on the Centennial Coal website and will include subsidence monitoring results, performance against subsidence predictions and identification of any subsidence related environmental impacts identified during the 12 month reporting period.

In accordance with Condition 12 of the Longwalls 411 - 418 SMP Approval, Springvale will provide notification to FCNSW, The Department of Planning and Environment (DP&E), NSW Office of Environment and Heritage (OEH), Sydney Catchment Authority (SCA), the Director Environmental Sustainability – DTIRIS, the Principal Subsidence Engineer – DTIRIS and any infrastructure owners within 24 hours of any occurrence where any observed mining induced subsidence impacts are: adverse to groundwater resources and/or the natural environment; adverse to the serviceability and/or safety of infrastructure and built features; significant unpredicted and or/higher than predicted subsidence and/or abnormalities; or any adverse subsidence impacts reported by any relevant stakeholder.

To satisfy Condition 14 of the Longwall 411 - 418 SMP Approval, Springvale will submit SMSRs to relevant stakeholders every four months until the completion of subsidence within the SMP Area.

Springvale will also prepare an End of Panel Report to encompass all environmental and subsidence monitoring, including a comparison of actual impacts with predicted subsidence impacts. This report will be submitted to DTIRIS within three months of secondary extraction being completed in each longwall panel.

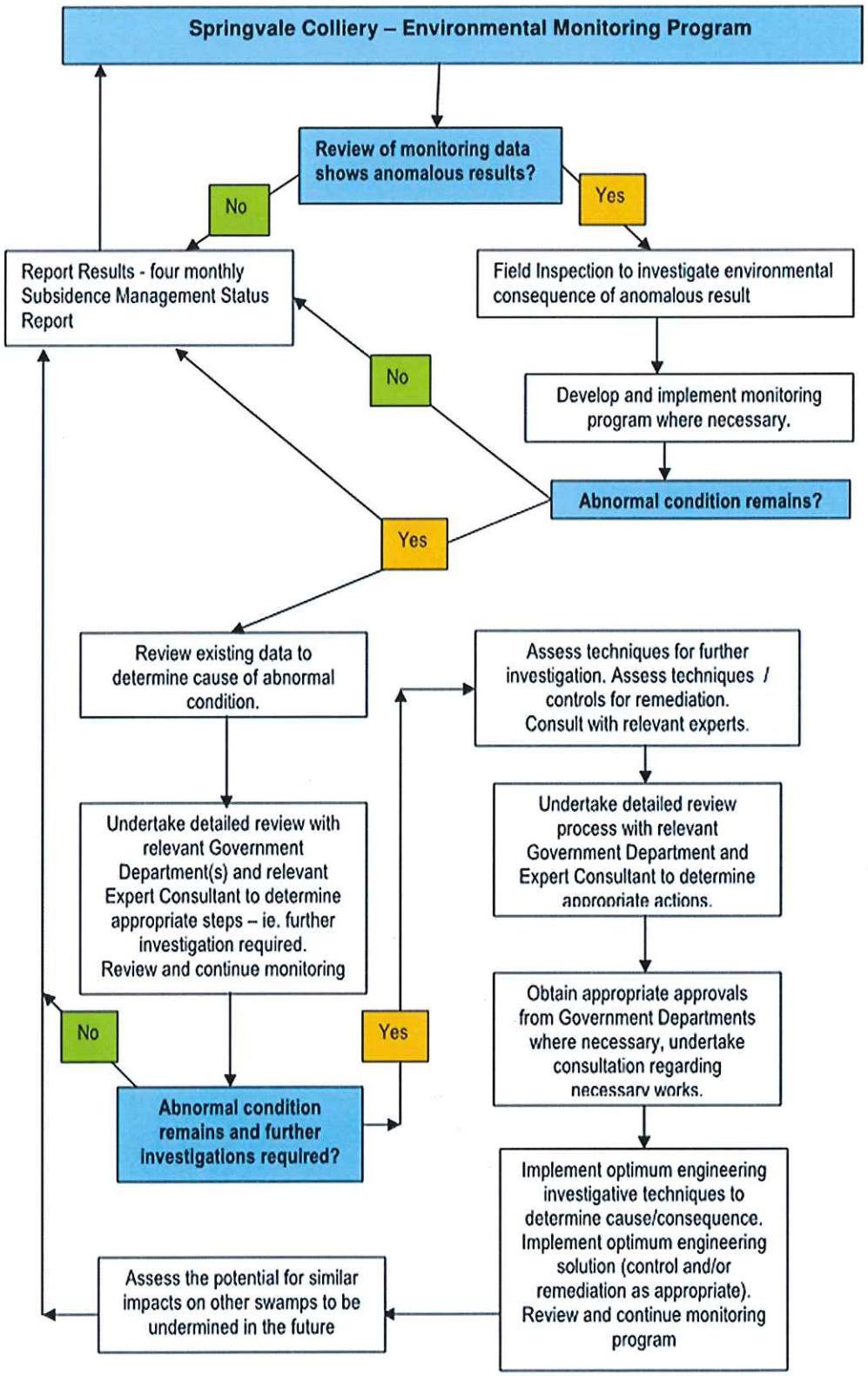
9. REVIEW

This Environmental Monitoring Program will be reviewed every three years, or in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are changes to the management requirements (e.g. a new monitoring site is established within the SMP Area, or if there are changes to related approvals);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan; or
- Monitoring, incident, or audit processes demonstrate that a review is warranted.

APPENDIX 1

Monitoring and Management Flow Chart



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