

APPENDIX E: WATER QUALITY UNCERTAINTY ANALYSIS



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02 February 2017

Mr Paul Freeman
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NSW Department of Planning & Environment
320 Pitt Street
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Dear Mr Freeman

Springvale Mine Extension Project SSD 5594 Modification 1 – Additional Information

I refer to your email of 13 December 2016 to Peter Corbett requesting additional water quality uncertainty analyses based on the potential daily fluctuations identified in the COSFLOW hydrogeological modelling mine inflow data (¹CSIRO, 2015). These predicted mine inflow data have been utilised in the Surface Water and Groundwater Impact Assessments prepared by Jacobs Group (Australia) Pty Ltd (²Jacobs, 2016a; ³Jacobs, 2016b) to support the Springvale MOD 1 *Statement of Environmental Effects*.

As requested, an uncertainty analysis has been undertaken to quantify the predicted salinity impacts on the receiving environment, and is presented in the letter report attached (**Attachment 1**). The approach adopted in the uncertainty analyses is consistent with that reported in the Springvale Mine SSD 5594 Modification 1 Response to Submissions (⁴Jacobs, 2016c), and is based on the Regional Water Quality Impact Assessment Modelling (RWQIAM) developed during the assessment stage of the Springvale Mine Extension Project (⁵Jacobs, 2015a; ⁶Jacobs 2015b). The RWQIAM modelled locations in the Cocks River catchment (for salinity and flow/level) are shown in Figure A attached (**Attachment 2**).

It is noted further that, for the purpose of conservativeness, the uncertainty analysis was conducted assuming a constant and maximum increase in mine water discharge rate compared to that presented in Jacobs (2015a,b), rather than considering potential fluctuations on a daily basis. In the uncertainty analyses the mine water discharge flow rate from the time-series presented in Jacobs (2015a,b) was increased by +2 ML/day, +3 ML/day, +4 ML/day and +6 ML/day, respectively.

¹ CSIRO (2015), *Appendix G – Alternative Mine Schedule: Angus Place and Springvale Colliery Operations - Groundwater Assessment*, CSIRO, Report Reference. EP15346, January 2015.

² Jacobs (2016a) *Surface Water Assessment – SSD5594 Modification 1*, Jacobs Group (Australia) Pty Ltd, Report Reference IA097101/010c, July 2016.

³ Jacobs (2016b), *Groundwater Assessment – SSD5594 Modification 1*, Jacobs Group (Australia) Pty Ltd, Report Reference IA097101/009c, July 2016.

⁴ Jacobs (2016c), *SSD 5594 Modification 1 – Response to Submissions (Groundwater and Surface Water)*, Jacobs Group (Australia) Pty Ltd, Report Reference IA097101/033b, September 2016.

⁵ Jacobs (2015a), *Additional Simulations of the Regional Water Quality Impact Assessment Model*, Jacobs Group (Australia) Pty Ltd, Report Reference IA059800/002c, March 2015.

⁶ Jacobs (2015b), *Supplement to Additional Simulations of the Regional Water Quality Impact Assessment Model*, Jacobs Group (Australia) Pty Ltd, Report Reference IA059800/067b, August 2015.

The RWQIAM results are conservative, since they assume a constant and maximum increase in mine water discharge rate rather than potential daily fluctuations. Modelling predicts a minor change in median salinity in Lake Wallace, however remains within the range of historical observation. A negligible change is observed in modelled median salinity in Lake Burragorang.

Please contact me (6355 9814 / 0425 551 405) or Peter Corbett (0428 253 203) if further information is required.

Yours sincerely



Nagindar Singh
Approvals Coordinator

Encl. Attachment 1: *Additional Water Quality Uncertainty Analysis (Mine Water Discharge)*, Jacobs Group (Australia) Pty Limited, 20 January 2017.

Attachment 2: *Figure A Water Balance Modelling Locations in Coxs River Catchment*

Attachment 1



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2 February 2017

Attention: Peter Corbett
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Project Name: Springvale Mine Extension Project - Modification 1
Project Number: IA097101

Subject: Additional Water Quality Uncertainty Analysis (Mine Water Discharge)

Dear Peter

1. Introduction

This letter has been prepared in accordance with our proposal (IA097101/047a, dated 14 December 2016) to prepare additional uncertainty analysis simulations of the Regional Water Quality Impact Assessment Model (RWQIAM).

The letter has been prepared in response to Department of Planning and Environment's request (DP&E, 2016) for additional water quality uncertainty analysis, based on the potential daily fluctuations identified in the hydrogeological water modelling report (CSIRO, 2016) appended as Attachment A to Jacobs (2016b).

The simulations presented in this letter quantify the change in predicted salinity in Lake Wallace and Lake Burragorang. The current limit to discharge (quantity) at Springvale Licensed Discharge Point 009 (LDP009) is 30ML/d, as discussed in Section 2.2. For the purpose of conservativeness, the uncertainty analysis was conducted assuming a constant and maximum increase in mine water discharge rate.

2. Analysis and Assessment

2.1 Modelling

During the Response to Submissions to the Surface Water Assessment (Jacobs, 2106a) of proposed modification to Conditions of Consent at Springvale Mine (MOD1), a simulation was presented in Jacobs (2016b) quantifying the change to modelled salinity in Lake Wallace and Lake Burragorang due to an increase in mine water discharge of 10L/s (0.86ML/d). The increase of 10L/s was modelled as +1ML/d, rounding up.

The simulation was prepared in response to a query from WaterNSW requesting quantification of the modelled change in salinity due to the minor increase in inflows to underground operations noted in Jacobs (2016a).

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For the purpose of consistency, the approach adopted in Jacobs (2016b) was utilised in the preparation of the uncertainty analyses presented in this letter. The approach adopted in Jacobs (2016b) was to add a constant and maximum discharge to the time-series used in Jacobs (2015ab). With respect to this letter, the mine water discharge flow rate from the time-series presented in Jacobs (2015ab) was increased by +2ML/d, +3ML/d, +4ML/d and +6ML/d respectively.

This is a conservative approach since it was assumed the increase was constant and a maximum increase. The outcome from Jacobs (2016b), with respect to the +1ML/d simulation presented previously, is also represented below, to allow comparison.

The model control files pertaining to the simulations are as follows:

- 048a_UNC-WS2b-S_10_01a.gsp
- 048a_UNC-WS2b-S_2ML_01a.gsp
- 048a_UNC-WS2b-S_3ML_01a.gsp
- 048a_UNC-WS2b-S_4ML_01a.gsp
- 048a_UNC-WS2b-S_6ML_01a.gsp

It is noted that the version of GoldSIM, the modelling platform through which the AWBM is applied, was updated in the uncertainty analysis from Version 10.5 to Version 11.1. Accordingly the +1ML/d simulation was repeated to demonstrate that there was no change to model predictions due to the change in software version.

The change in water flow and water quality (salinity) is quantified at a number of modelling locations in the RWQIAM, as identified in RPS (2014) and Jacobs (2015ab). Results for Lake Wallace and Lake Burratorang only are presented in this letter, so as to be consistent with the approach adopted in Jacobs (2016b).

Lake Burratorang is presented because it is relevant with respect to the Neutral or Beneficial Effect test. Lake Wallace is relevant as it is the first water store in the Upper Cocks River catchment and has been adopted as the reporting location with respect to Condition 13, Schedule 4 of SSD 5994. As noted, the change in water flow and salinity is quantified at multiple locations in the RWQIAM.

Table 2.1 presents the outcome of the uncertainty analysis simulations at Lake Wallace (#074), which is equivalent to Table 2.1 in Jacobs (2016b) and Table 3.34 in Jacobs (2015a).

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Table 2.1 : Prediction Daily Statistics at #074 (Lake Wallace) (adapted from Table 2.1 of Jacobs (2016b) and Table 3.34 of Jacobs (2015a))

	OBSERVED	NUL ¹	WS1 ¹	WS1-S ¹	WS2b-S-10 ¹	WS2b-S-10_V11.1 ^{2,4}	WS2b-S-2ML ⁴	WS2b-S-3ML ⁴	WS2b-S-4ML ⁴	WS2b-S-6ML ⁴
Minimum	218	140	121	122	121	121, 0%	120,-1%	120,-1%	119,-2%	118,-3%
5%	398	197	279	268	271	271, 1%	273, 2%	275, 3%	277, 4%	282, 5%
10%	402	209	351	324	328	329, 1%	332, 3%	336, 4%	339, 5%	346, 7%
20%	436	239	427	411	415	415, 1%	420, 2%	425, 3%	429, 4%	437, 6%
50%	519	280	540	523	527	527, 1%	531, 2%	535, 2%	539, 3%	547, 5%
80%	603	327	622	611	615	615, 1%	618, 1%	622, 2%	626, 2%	632, 4%
90%	637	354	655	648	652	652, 1%	656, 1%	659, 2%	662, 2%	669, 3%
95%	754	374	688	670	674	674, 1%	678, 1%	681, 2%	685, 2%	691, 3%
Maximum	771	427	732	746	748	748, 0%	751, 1%	753, 1%	756, 1%	760, 2%

Note 1. NUL is Null Case, WS1 is Water Strategy 1 and comprised concurrent development of Angus Place Mine Extension Project (APMEP) and SVMPEP, WS1-S is the sequential development of APMEP and SVMPEP ('assessed and approved in SSD 5594'), WS2b-S-10 is simulation WS1-S plus 10L/s.

Note 2. WS2b-S-10_V11.1 is a re-run of WS2b-S-10 to demonstrate the change in software version did not lead to a change in model prediction.

Note 3. WS2b-S-2ML, WS2b-S-3ML, WS2b-S-4ML and WS2b-S-6ML are the uncertainty analysis simulations considering a constant and maximum +2ML/d, +3ML/d, +4ML/d and +6ML/d increase in mine water discharge compared to that presented in Jacobs (2015a).

Note 4. Change (expressed as %) compared to WS1-S.

From **Table 2.1**, the modelled median salinity in Lake Wallace increases from 523mg/L (781µS/cm) in the sequential implementation discharge conditions (simulation WS1-S) to 527mg/L (787µS/cm) in the +1ML/d simulation, 535mg/L (798µS/cm) in the +3ML/d simulation and 547mg/L (816µS/cm) in the +6ML/d simulation. This is equivalent to an increase, in %, of 1%, 2% and 5% respectively. The modelled 90th percentile salinity increases from 648mg/L (967µS/cm) in the WS1-S simulation and is 652mg/L (973µS/cm) in the +1ML/d run. The modelled 90th percentile salinity is 659mg/L (984µS/cm) in the +3ML/d simulation and is 669mg/L (999µS/cm) in the +6ML/d simulation. This is equivalent to an increase, in %, of 1%, 2% and 3% respectively.

The modelled increase in salinity in Lake Wallace due to increasing mine water discharge rate to Sawyers Swamp Creek is considered to be a minor change (being less than or equal to 5%) with respect to Lake Wallace. It is noted, in accordance with RPS (2014a) and Jacobs (2015a), that the proposed median salinity in Lake Wallace is consistent with historical observation, associated with the extended period of operation of Wallerawang Power Station (refer to

'Observed' column in **Table 2.1** for the statistical summary of the historical record). Review of modelled median salinity in the +6ML/d simulation, of 547mg/L, compared to the median salinity from the historical record, of 519mg/L, is an increase of 5.3% (calculated as $(547\text{mg/L} - 519\text{mg/L})/519\text{mg/L} = 5.3\%$).

Table 2.2 presents the outcome of uncertainty analysis at Lake Burragorang (#280), which is equivalent to Table 2.2 in Jacobs (2016b) and Table 3.40 in Jacobs (2015a).

Table 2.2 : Prediction Daily Statistics at #280 (Lake Burragorang) (adapted from Table 2.2 of Jacobs (2016b) and Table 3.40 of Jacobs (2015a))

	OBSERVED ⁴	NUL ¹	WS1 ¹	WS1-S ¹	WS2b-S-10 ¹	WS2b-S-10_V11.1 ^{2,5}	WS2b-S-2ML ⁵	WS2b-S-3ML ⁵	WS2b-S-4ML ⁵	WS2b-S-6ML ⁵
Minimum	n/a	87	89	89	89	89, 0%	89, 0%	89, 0%	89, 0%	90, 0%
5%	n/a	90	92	92	92	92, 0%	92, 0%	92, 0%	92, 0%	92, 0%
10%	n/a	91	93	93	93	93, 0%	93, 0%	93, 0%	93, 0%	93, 0%
20%	n/a	94	97	97	97	97, 0%	97, 0%	97, 0%	98, 0%	98, 1%
50%	n/a	98	104	103	103	103, 0%	103, 0%	103, 1%	103, 1%	104, 1%
80%	n/a	99	107	105	106	106, 0%	106, 0%	106, 1%	106, 1%	107, 1%
90%	n/a	101	107	107	107	107, 0%	107, 1%	108, 1%	108, 1%	108, 2%
95%	n/a	101	109	108	108	108, 0%	108, 1%	109, 1%	109, 1%	110, 2%
Maximum	n/a	102	112	109	110	110, 0%	110, 0%	110, 1%	111, 1%	111, 2%

Note 1. NUL is Null Case, WS1 is Water Strategy 1 and comprised concurrent development of Angus Place Mine Extension Project (APMEP) and SVMEP, WS1-S is the sequential development of APMEP and SVMEP ('assessed and approved in SSD 5594'), WS2b-S-10 is simulation WS1-S plus 10L/s.

Note 2. WS2b-S-10_V11.1 is a re-run of WS2b-S-10 to demonstrate the change in software version did not lead to a change in model prediction.

Note 3. WS2b-S-2ML, WS2b-S-3ML, WS2b-S-4ML and WS2b-S-6ML are the uncertainty analysis simulations considering a constant and maximum +2ML/d, +3ML/d, +4ML/d and +6ML/d increase in mine water discharge compared to that presented in Jacobs (2015a).

Note 4. Observed data was not available at the time of construction of the RWQIAM (RPS, 2014 and Jacobs, 2015ab).

Note 5. Change (expressed as %) compared to WS1-S.

From **Table 2.2**, the modelled median salinity in Lake Burragorang is 103mg/L (154µS/cm) in the original prediction (WS1-S) and is 103mg/L (154µS/cm) in each of the uncertainty analysis simulations, except for the +6ML/d simulation. In the +6ML/d simulation, the modelled median salinity is 104mg/L (155µS/cm). The increase in modelled median salinity from 103 to 104mg/L is an increase of 1% compared to that already assessed and approved.

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The modelled 90th percentile salinity is 107mg/L (160µS/cm) in the WS1-S simulation. The modelled 90th percentile salinity is 107mg/L (160µS/cm) in the +1ML/d and +2ML/d simulations and is 108mg/L (161µS/cm) in the +3ML/d, +4ML/d and +6ML/d simulations. The increase in modelled 90th percentile salinity from 107 to 108mg/L is an increase of <1% compared to that already assessed and approved.

It is concluded that the +2ML/d, +3ML/d, +4ML/d and +6ML/d simulations (conservative, as assume a constant and maximum increase) do not lead to a significant change in predicted water quality in Lake Burragorang compared to that already assessed and approved.

It is highlighted that simulations presented in this letter do not take into account the water quality criteria specified in the SSD 5594 Conditions of Consent (Condition 12 Schedule 4). Mine water discharge will continue at Springvale LDP009 at current water quality until the commencement of Condition 12 Schedule 4 on 30 June 2017.

2.2 Assessment

The Environmental Protection Licence (EPL) at Springvale Mine, EPL 3607, specifies the current limit to quantity and quality of discharge through Licenced Discharge Points (LDPs) at Springvale Mine. **Table 2.3** presents a summary of current LDPs.

Table 2.3 : Location of Licenced Discharge Points (LDPs) – Current (EPL 3607)

Discharge Point	Location and Function	Limit of discharge (kL/d)	Oil & Grease (mg/L)	pH	TSS (mg/L)	Conductivity (µS/cm)
LDP001	Main discharge point of Springvale pit top facilities, collecting the overflows from the Fire Dam, the Primary (or Stockpile) and the Secondary Ponds.	10,000	10	6.5 – 9.0	30	N/A
LDP002	Irrigation area on the north west extend of the site for the discharge of treated waste water effluent	N/A	N/A	N/A	N/A	N/A
LDP004	Emergency discharge point from dewatering bores to unnamed creek leading to Wolgan River.	15,000 ^a	N/A	N/A	N/A	N/A
LDP005	Emergency discharge point from dewatering bores to unnamed creek leading to Wolgan River	15,000 ^a	N/A	N/A	N/A	N/A
LDP006	Condition P1.3 of EPL 3607 is intended to be updated to remove LDP006 and be transferred to a new EPL for the Western Coal Services Project					
LDP007	Condition P1.3 of EPL 3607 will be updated to remove LDP007 and transfer to a new EPL for the Western Coal Services Project					
LDP009	Springvale Coal's Springvale Delta	30,000	10	6.5 – 9.0	50	1,200 ^c

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Discharge Point	Location and Function	Limit of discharge (kL/d)	Oil & Grease (mg/L)	pH	TSS (mg/L)	Conductivity (µS/cm)
	Water Transfer System (SDWTS) bypass point east of Kerosene Vale Ash Dam					
LDP010	Emergency/maintenance discharge from Springvale Coal's SDWTS upstream of the settling ponds. Formerly Delta Electricity's LDP020.	N/A	10	6.5 – 9.0	N/A	1,200 ^b

Notes: a) Combined daily limit must not exceed 30,000kL/d; b) Additional constituents include 100 percentile concentration limit: Al 0.45mg/L, As 0.024mg/L, B 0.37mg/L, Cu 0.007mg/L, F 1.8mg/L, Fe 0.4mg/L, Mn 1.7mg/L, Ni 0.047mg/L, Zn 0.05mg/L; c) as for b) as well as TSS 50mg/L and Turbidity 50NTU.

The modelled change in predicted water quality in Lake Wallace is minor compared to that assessed and approved in SSD 5594 and therefore is considered to have an insignificant effect on water quality.

Due to the insignificant change in predicted water quality in Lake Burragorang, it is considered that the increases in mine water discharge of +2ML/d, +3ML/d, +4ML/d and +6ML/d (modelled as a constant and maximum increase), compared to that presented in Jacobs (2015a), will have an insignificant impact on water quality.

DP&E (2015) define the 'base case', with respect to the Neutral or Beneficial Effect (NorBE) test (WaterNSW, 2015) for Springvale Mine, as the EPL limit of 1,200µS/cm at LDP009 existing at the time of the development application. On the basis of that definition, the above uncertainty analysis simulations, of increased volumetric discharge (modelled as a constant and maximum increase) but at the same water quality (1,200µS/cm), is regarded as a neutral impact with respect to the NorBE water quality effect test.

3. References

DP&E, 2015. *Addendum Report: State Significant Development – Springvale Mine Extension Project (SSD 5594)*. Report prepared by the Department of Planning and Environment to the Planning Assessment Commission. Reference No. N/A, dated August 2015.

DP&E, 2016. *Springvale Coal Mod 1 – Information Request*. Correspondence to Springvale Coal Pty Ltd from the Department of Planning and Environment. Reference No. N/A, dated 13 December 2016.

Jacobs, 2015a. *Additional Simulations of the Regional Water Quality Impact Assessment Model*. Consultant letter prepared by Jacobs Group (Australia) Pty Ltd to Springvale Coal Pty Ltd. Reference No. IA059800/002c, dated 26 March 2015.

Jacobs, 2015b. *Supplement to Additional Simulations of the Regional Water Quality Impact Assessment Model*. Consultant letter prepared by Jacobs Group (Australia) Pty Ltd to Springvale Coal Pty Ltd. Reference No. IA059800/067b, dated 3 August 2015.



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Jacobs, 2016a. *Surface Water Assessment – SSD5594 Modification 1*. Consultant report prepared by Jacobs Group (Australia) Pty Ltd for Springvale Coal Pty Ltd. Reference No. IA097101/010c, dated 6 July 2016.

Jacobs, 2016b. *SSD 5594 Modification 1 – Response to Submissions (Groundwater and Surface Water)*. Consultant letter prepared by Jacobs Group (Australia) Pty Ltd for Springvale Coal Pty Ltd. Reference No. IA097101/033b, dated 28 September 2016.

RPS, 2014. *Regional Water Quality Impact Assessment – Angus Place and Springvale Mine Extension Projects*. Consultant report prepared by RPS Aquaterra Pty Ltd for Centennial Angus Place Pty Ltd. Reference No. S187E/021b, dated 10 September 2014.

WaterNSW, 2015. *Neutral or Beneficial Effect on Water Quality Assessment Guideline*. Reference No. ISBN 987-0-9874680-3-1, dated February 2015.

4. Closing

Should you require additional information then please do not hesitate to contact our office.

Yours sincerely

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Attachment 2

