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Our Ref: S188H/004e
Date: 1 October 2014

Nagindar Singh
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Lidsdale House
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LIDSDALE NSW 2790

Dear Nagindar,

RE: Springvale Colliery LDP009 SSTV Assessment

1. Introduction

This document forms a technical Appendix to the Response to Submissions regarding the Springvale Colliery Extension Project *Environmental Impact Statement*, and specifically addresses concerns raised regarding the quality of the discharge water with respect to ANZECC and ARMCANZ (2000) guideline (the Guidelines) values.

LDP009, on Springvale Mine's EPL 3607, is the Springvale Delta Water Transfer Scheme (SDWTS) bypass point and discharges water into Sawyers Creek. The water is mine water make abstracted by dewatering bores Bore 6 and Bore 8 at Springvale Mine.

Sawyers Swamp Creek Ash Dam is a major artificial surface waterbody on the boundary between Springvale Mine and Angus Place Colliery. The dam is used for ash disposal from Wallerawang Power Station (when in operation). There is also an emergency / maintenance discharge point at this dam, associated with the SDWTS (LDP010). The bypass from the SDWTS is located immediately downstream of this dam (LDP009) as shown on Figure 1.

The purpose of this document is to assess the appropriateness of the ANZECC and ARMCANZ (2000) default guideline trigger values for application to the receiving waters of the LDP009 discharge. Site Specific Trigger Values (SSTV) may then be derived for the water quality downstream of LDP009 in accordance with the ANZECC and ARMCANZ (2000) methodology.

Trigger values focus on environmental protection and are effective tools in the early detection of potential impacts and provide guideline water quality criteria to be met downstream of a mixing zone.

A location map showing the relevant water bodies and monitoring locations is provided in Figure 1.

1.1 ANZECC and ARMCANZ 2000 Guidelines

The ANZECC and ARMCANZ (2000) Guidelines provide a framework for assessing water quality, based on whether the physical, chemical and biological characteristics of a waterway support community environmental values and help to define the water quality needed to protect these values.

Trigger values are conservative assessment levels for the early identification of potential risk to environmental values. Local conditions vary naturally between waterways and it is usually necessary to tailor trigger values to local conditions or "local guideline levels". ANZECC and ARMCANZ (2000) provide a process for the establishment of suitable SSTV.

The application of trigger values is not appropriate at the point of discharge or within the mixing zone of the receiving waters. Mixing zones are often defined as explicit areas around effluent discharges where the management goals of the ambient waters do not need to be achieved and hence the designated environmental values may not be protected. Trigger values should be applied downstream of the mixing zone.

2. Methodology

ANZECC and ARMCANZ (2000) have provided an assessment methodology (Figure 2) that summarises the documented methodology for the determination of appropriate guideline trigger values.

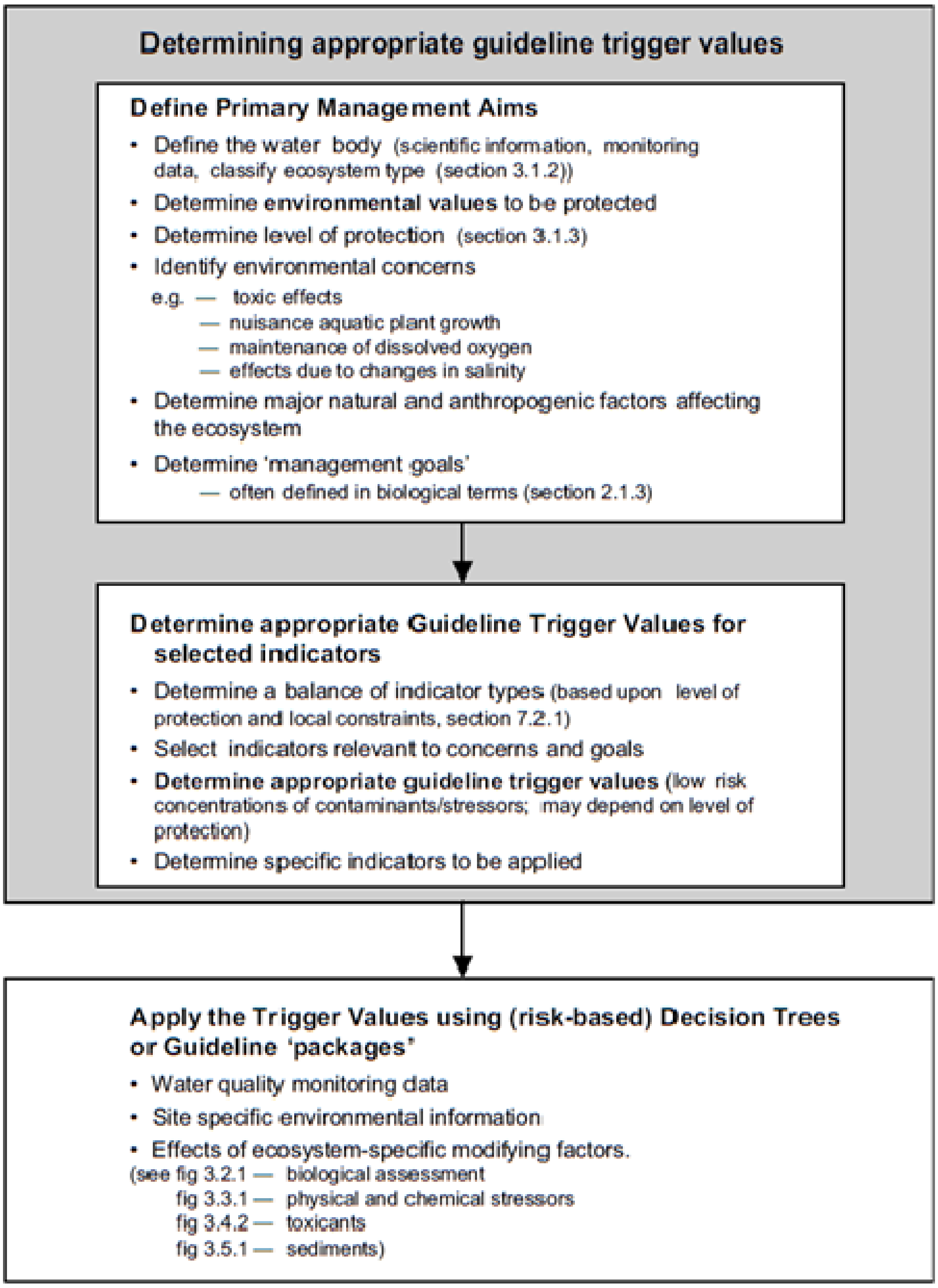


Figure 2: Flow Chart for the Determination of Appropriate Guideline Trigger Values

2.1 Waterbody Definition

The assessment methodology first requires the definition of the waterbody in question so the correct set of values can be considered. This process requires assessment against the six ecosystem types that are outlined in the Guidelines. These are as follows:

- upland rivers and streams (>150 mAHD)
- lowland rivers (<150 mAHD)
- freshwater lakes and reservoirs
- wetlands
- estuaries
- coastal and marine.

The altitude of LDP009 is approximately 950 mAHD, therefore the upland river and streams values are to be used for consideration in this assessment.

2.2 Environmental Values

The environmental values that are to be protected must then be determined. The Guidelines define environmental values as the "particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and that require protection from the effects of pollution, waste discharges and deposits. Several environmental values may be designated for a specific waterbody".

The Guidelines recognises the following environmental values:

- aquatic ecosystems
- primary industries (irrigation and general water uses, stock drinking water, aquaculture and human consumption of aquatic foods)
- recreation and aesthetics
- drinking water
- industrial water (no water quality guidelines are provided for this environmental value)
- cultural and spiritual values (no water quality guidelines are provided for this environmental value).

Given the industrial and agricultural activity within the Coxs River Catchment, along with the downstream situation of water supply reservoirs, there are a number of the stated environmental values that may apply to the catchment. Where this is the case the Guidelines advise a conservative approach by adopting the guideline values of the most sensitive of the applicable environmental values.

On that basis the guideline values for Aquatic Ecosystems are considered the most appropriate for use within the catchment containing LDP009.

2.3 Level of Protection

Determination of the "level of protection" addresses the current condition of the ecosystem and what level of change would be regarded as acceptable. The Guidelines propose the following three levels of ecosystem condition as a basis for application:

- **High conservation/ecological value systems –** Effectively unmodified or other highly-valued ecosystems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations. While there are no aquatic ecosystems in Australia and New Zealand that are entirely without some human influence, the ecological integrity of high conservation/ecological value systems is regarded as intact.
- **Slightly to moderately disturbed systems –** Ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity. The biological communities remain in a healthy condition and ecosystem integrity is largely retained. Typically, freshwater systems would have slightly to moderately cleared catchments and/or reasonably intact riparian vegetation. Slightly–moderately disturbed systems could include rural streams receiving run-off from land disturbed to varying degrees by grazing or pastoralism.

- **Highly disturbed systems –** These are measurably degraded ecosystems of lower ecological value. Examples of highly disturbed systems would be some shipping ports and sections of harbours serving coastal cities, urban streams receiving road and stormwater run-off, or rural streams receiving run-off from intensive horticulture.

Considering the environmental values within the local vicinity and downstream catchment of LDP009, the designation of "slightly to moderately disturbed ecosystem" has been applied to this assessment. One of the submissions commented on some reaches of the system being highly degraded, however, in trying to raise the overall condition of the system the slightly to moderate level is considered more appropriate

The trigger values provided in the Guidelines have been derived using a statistical distribution approach to estimate the concentrations of a variety of physical and chemical stressors that would protect a predetermined percentage of species.

The 95% protection level is most commonly applied to ecosystems that could be classified as slightly to moderately disturbed. A complete table of guideline trigger values is provided in Appendix A.

2.4 Assessing the Requirement for SSTV

The documented methodology for the application of the Guideline trigger values incorporates a degree of tailoring to the nature of the catchment where the discharge is taking place. However the Guidelines recognise that there can be significant variation in physical, chemical and biological characteristics between and within catchments which may require the derivation of SSTVs.

Following establishment of the appropriate Guideline trigger values for the waterbody in question, these values must be compared against water quality data collected upstream of the discharge point to understand background concentrations.

Where background values exceed Guideline trigger values, the 80th percentile concentration of the background data may be adopted as the SSTV.

2.5 Hardness Modified Trigger Values

Water hardness is known to influence the bioavailability of certain metals to aquatic organisms. The reduction in bioavailability of Cd, Cr(III), Cu, Ni, Pb and Zn as a function of hardness is described mathematically and presented in the Guidelines. The requirement for Hardness Modified Trigger Values (HMTV) has been assessed, where applicable, in this investigation.

2.6 Dilution Analysis

In the circumstance where downstream median data does not always comply with the adopted trigger values due to the influence of a discharge then a dilution analysis can be carried out.

The dilution analysis considers flow and water quality data of the upstream and discharged water to assess the likelihood that the discharge would be sufficiently diluted by the upstream water such that trigger values are met downstream. This analysis can also be extrapolated to approximate discharge volumes that would maintain the downstream water quality within the adopted trigger values.

2.7 Application to LDP009

There are two options for undertaking an SSTV analysis regarding discharge at Springvale Mine's LDP009:

- Consider LDP009 discharging into Sawyers Creek and set SSTVs for median concentrations at the confluence of Sawyers Creek and Coxs River.
- Consider Sawyers Creek as the discharge and Coxs River as the receiving waters with SSTVs set for the median concentrations at a downstream Cox's River monitoring location.
- Consider the diversion of the majority of Angus Place Colliery's mine water make to Springvale Mine's LDP009.

These options have been considered separately and the analysis and derived trigger values are presented in the following sections.

3. LDP009 Discharging into Sawyers Creek:

This scenario considers the discharge from LDP009 directly into Sawyers Creek. This approach is limited in that there is no upstream monitoring in Sawyers Creek so the assumption has been made that the upstream water quality is the same as Kangaroo Creek as they drain neighbouring catchments in similar environments. Furthermore, the downstream site, where the trigger values will be applied is LDP003 D/S, which is not only downstream of LDP009 but also downstream of Angus Place LDP003 (discharge site from Kerosene Vale) and Springvale LDP010 (Figure 1).

Angus Place LDP003 (EPL 467) discharges run-off from the Ash Placement and LDP010 is an emergency discharge point for Sawyers Creek Ash Dam. Whilst discharge volumes from these points are minimal compared to LDP009; the additional variables in the downstream water quality will cause difficulties in relating downstream water quality directly to LDP009 discharge.

The following monitoring locations have been used in this assessment:

- Upstream Site: Kangaroo Creek U/S
- Discharge Site: LDP009
- Downstream Site: LDP003 D/S.

3.1 Analyte Selection

The concentrations of a range of physical and chemical analytes are measured routinely at all monitoring locations shown on Figure 1. The median and 80th percentile concentrations are shown in Table 1 for the LDP009 discharge and the upstream and downstream monitoring locations. The numbers shown in bold represent concentrations exceeding the ANZECC 95% species protection trigger values. For reference, the raw water supply agreements from Warragamba Dam to Prospect Water Filtration Plant (WFP) and the Australian Drinking Water Guideline values have been included.

Analytes that show elevated concentrations in the upstream dataset require SSTV analysis. EC has also been considered as this water quality parameter has been raised as a key concern within the catchment.

Based on Table 1, the following parameter/analytes have been considered further:

- Electrical conductivity (EC)
- Aluminium (Al)
- Iron (Fe)
- Zinc (Zn)
- Copper (Cu).

Exemptions

The Guideline value for silver (0.05 µg/L) is below the detection limit (0.001 mg/L) of the current laboratory analysis. There have only been two samples analysed in the downstream dataset and one in the upstream dataset, all of which have been below the detection limit, therefore this data has not been considered.

LDP009 has shown two isolated occurrences of elevated cyanide concentration, however this data is only from two samples and such concentrations are not evident in the downstream dataset. There is not enough data to verify the cyanide concentrations and as such, cyanide has not been considered further.

However, it is noted that cyanide will continue to be screened for to allow future assessment of positive results.

Table 1: Summary Statistics for Relevant Water Quality Monitoring Locations

Analyte	Kangaroo Creek (U/S)				LDP009				LDP003 (D/S)				Guideline Values				
	Median	20th Percentile	80th percentile	Count	Median	20th percentile	80th percentile	Count	Median	20th percentile	80th percentile	Sample Count	ANZECC (95%)	Prospect WFP		ADWG (mg/L)	
														Min	Max	Min	Max
pH (pH Unit)	6.4	5.9	6.8	65	7.8	7.6	7.9	95	7.2	7.0	7.4	48		6.3	7.9	6.5	8.5
TSS	5	1.7	10	62	6	4	12	95	1	1	5	48					
TDS	60.5	35	82.6	54	684	684	684	1	181	154	246	46					600
Ec (µS/cm)	69	53	89	65	**1060**	**1020**	**1090**	95	262	202	289	48	350				
Oil & Grease	5	5	5	62	5	5	5	92	5	5	5	47					
Manganese Filt	0.1165	0.0352	0.4526	60	0.012	0.008	0.017	95	0.04	0.022	0.0822	44	1.9		1.4		0.5
Iron Filt	**0.975**	**0.464**	**4.002**	60	0.05	0.05	0.05	95	0.085	0.05	0.138	44	0.3*		3.5		
Turbidity (NTU)	7	2	19.2	55	8	4	19.4	95	3	1	15	47			40		5
Aluminium	**0.12**	**0.07**	**0.204**	54	0.01	0.01	**0.06**	95	0.01	0.01	0.014	44	0.055		2.6		
Arsenic	0.001	0.001	0.001	54	**0.02**	**0.0142**	**0.026**	47	0.001	0.001	0.001	44	0.013				0.01
Barium	0.025	0.0176	0.0368	54				0	0.015	0.0126	0.0184	44					2
Boron Filtered	0.05	0.05	0.05	49	0.07	0.06	0.08	47	0.13	0.112	0.15	37	0.37				4
Cadmium Filtered	0.0001	0.0001	0.0001	54				0	0.0001	0.0001	0.0001	44	0.0002				0.002
Calcium	1	1	2	53				0	14	11	16	44					
Total Chromium Filtered	0.001	0.001	0.001	3				0	0.001	0.001	0.001	2	0.001				0.05
Chloride	9	7	10.4	54				0	10	8.6	12	44					
Cobalt	0.0035	0.002	0.005	2	0.001	0.001	0.001	1	0.001	0.001	0.001	1					
Copper	**0.002**	0.001	**0.004**	50	0.001	0.001	**0.002**	56	**0.002**	0.001	**0.004**	40	0.0014				2
Cyanide Total	0.004	0.004	0.004	50	**1.3**	**1.3**	**1.3**	2	0.004	0.004	0.004	35	0.007				0.08
Lead	0.001	0.001	0.001	54				0	0.001	0.001	0.001	44	0.0034				0.01
Magnesium	1	1	2	54				0	9.5	8	11	44					
Nickel Filtered	0.001	0.001	0.002	54	0.004	0.003	0.004	47	0.004	0.002	0.005	44	0.011				0.02
Potassium	2	1	2	54				0	12	10	13	44					

Analyte	Kangaroo Creek (U/S)				LDP009				LDP003 (D/S)				Guideline Values				
	Median	20th Percentile	80th percentile	Count	Median	20th percentile	80th percentile	Count	Median	20th percentile	80th percentile	Sample Count	ANZECC (95%)	Prospect WFP		ADWG (mg/L)	
														Min	Max	Min	Max
Selenium	0.01	0.01	0.01	2	0.01	0.01	0.01	1	0.01	0.01	0.01	1	0.011				0.01
Silver	**0.001**	**0.001**	**0.001**	2	0.01	0.01	0.01	1	**0.001**	**0.001**	**0.001**	1	0.00005				0.1
Sodium	7.5	6	8.4	54				0	15	14	22.2	44					
Total Sulphur (Sulphate)	2	1	6	57				0	66	53.6	76	44					500
Uranium	0.001	0.001	0.001	54	0.001	0.001	0.001	1	0.001	0.001	0.001	44					0.017
Zinc Filtered	**0.01**	0.006	**0.019**	56	**0.013**	**0.0088**	**0.0204**	70	**0.013**	0.0066	**0.02**	44	0.008				
Nitrogen (Ammonia)	0.02	0.01	0.03	52				0	0.01	0.01	0.03	43					
Nitrite as N	0.01	0.01	0.01	52				0	0.01	0.01	0.01	43					
Nitrate as N	0.01	0.01	0.03	52				0	0.02	0.01	0.076	43	0.7				50
Nitrate + Nitrite	0.01	0.01	0.03	52				0	0.02	0.01	0.076	43					3
Total Nitrogen as N	0.4	0.2	0.6	52				0	0.2	0.1	0.46	43					
Total Phosphorous	0.02	0.01	0.06	52				0	0.01	0.01	0.066	43					
Carbonate Alkalinity	1	1	1	54				0	1	1	1	44					
Bicarbonate Alkalinity	11.5	5.6	20.8	54				0	40	31	61	44					
Hydroxide	1	1	1	54				0	1	1	1	44		15	60		
Total Alkalinity	11.5	5.6	20.8	54				0	40.5	31	64.4	44					
Total Hardness	7	1	13	54				0	76	62.6	85	44		25	70		
Total Fluoride	0.1	0.1	0.1	51	1.3	1.3	1.4	74	0.1	0.1	0.2	42					1.5

All units are in mg/L unless otherwise stated

* Low reliability trigger value due to insufficient data (ANZECC and ARMCANZ, 2000. Section 8.3.7)

3.2 Analysis

Table 2 shows median concentrations of the selected analytes at the discharge and downstream monitoring locations and the 80th percentile background concentrations from the upstream data set. The numbers shown in bold represent concentrations exceeding the ANZECC 95% species protection trigger values.

The 80th percentile background concentrations have been compared to the Guideline values (95% species protection) and the maximum value taken as the trigger value for the downstream median concentrations. The numbers shown in bold represent concentrations exceeding the ANZECC 95% species protection trigger values.

Where appropriate, trigger values for Zinc and Copper are modified for hardness according to the following algorithms:

Zinc: $HMTV = TV\,(H/30)^{0.89}$

Copper: $HMTV = TV\,(H/30)^{0.85}$

Where:

HMTV = Hardness Modified Trigger Value

TV = Trigger Value

H = Hardness of water at downstream site

The results of the analysis are presented in Table 2.

Table 2: SSTV Analysis Results: Sawyers Creek LDP003 D/S

Analyte	Median		80th Percentile	ANZECC 95%	TV	HMTV	Adopted TV
	LDP003 D/S	LDP009	Kangaroo Creek U/S				
EC (µS/cm)	262	**1060**	89	350	350	n/a	350
Al (mg/L)	0.01	0.01	**0.2**	0.055	0.2	n/a	0.2
Fe (mg/L)	0.09	0.05	**4.0**	0.3	4.0	n/a	4.0
Zn (mg/L)	**0.01**	**0.01**	**0.019**	0.008	0.019	n/a	0.019
Cu (mg/L)	**0.0015**	0.001	**0.004**	0.0014	0.004	n/a	0.004

NB: Values in bold exceed ANZECC guideline value for 95% species protection.

Table 2 shows that concentrations of Aluminium, Iron, Zinc and Copper are elevated in the background data so the upstream 80th percentile concentrations have been adopted as SSTVs in place of the Guideline trigger values. No hardness modification is required.

The downstream concentrations of Aluminium, Zinc and Copper exceed the Guideline value but fall below the adopted trigger value.

The EC at the downstream monitoring location falls below the Guideline value; however it is not clear if this data incorporates LDP009 discharge. The full data set contains data from before the cessation of SDWTS, however following the cessation, the EC at the downstream site increased to approximately 600 to 700 µS/cm, which is low considering the discharge at LDP009 is two orders of magnitude greater than the background flows and has a median EC of 1060 µS/cm.

The LDP009 discharge EC exceeds the ANZECC 95% species protection trigger values. Whilst in the upstream dataset, EC falls below the ANZECC trigger value. A component of dilution is therefore required to enable the trigger value for EC to be met for the median conditions downstream.

Dilution Requirements

The 80th percentile upstream EC value (Kangaroo Creek U/S data) is less than the Guideline value (350 µS/cm); therefore the Guideline value has been adopted as the most appropriate trigger value.

As shown in Table 2, the discharge median EC at LDP009 is greater than 350 µS/cm. It is therefore necessary to calculate the potential for discharged water to be diluted by Kangaroo Creek upstream water such that the water quality criteria are met and the downstream EC is maintained within the adopted trigger value.

A dilution factor analysis uses flow data to calculate the ratio of discharged water to background flows and, to ensure the methodology is conservative, considers the 80th percentile discharge concentrations being diluted by median upstream water concentrations.

Table 3 shows the discharge and upstream concentrations, the water quality criteria (Adopted TV) and the dilution factor required such that the downstream water quality meets the water quality criteria. Where the 80th percentile discharge concentration is less than the adopted trigger value, and hence within the downstream water quality criteria, there is no requirement for dilution.

Table 3: Sawyers Creek/LDP009 Dilution Factor Analysis

Analyte	80 Percentile LDP009	Median Kangaroo Creek U/S	Adopted TV	Required Dilution Factor
EC (µS/cm)	1090	69	350	2.6
Al (mg/L)	0.06	0.12	0.2	n/a
Fe (mg/L)	0.05	0.975	4.0	n/a
Zn (mg/L)	0.020	0.011	0.019	0.13
Cu (mg/L)	0.002	0.002	0.004	n/a

Table 3 shows that to meet the water quality criteria for EC, the discharged water requires dilution by upstream water at the ratio of 2.6:1 (units upstream water to units discharge water). For zinc, while the median concentration at LDP009 falls below the adopted trigger values, the 80th percentile is slightly elevated, requiring a dilution ratio of 0.13:1.

The likelihood of meeting this criteria based on flow data can be considered. The following analysis considers the likelihood of achieving a dilution factor of 2.6 for EC, i.e. the likelihood that the discharge quantity at LDP009 will make up approximately 28% and the background flow will make up approximately 72% of the total flow at the downstream site.

There is no flow monitoring on Sawyers Creek, however modelled flows from the Regional Water Quality Impact Assessment (RPS 2014a) indicate that flows are typically two orders of magnitude less than LDP009 discharge:

- Median flow in Sawyers: 0.2 ML/d (modelled data December 2012 to July 2013)
- Median discharge from LDP009: 19.95 ML/d (actual data December 2012 to July 2013).

Based on modelled and actual flow data; the degree to which discharge at LDP009 is diluted by Sawyers Creek is shown in Figure 3.

Figure 3 shows that a dilution factor of 2.6 is achieved approximately 5% of the time therefore the water quality criteria for EC will not be met 95% of the time.

In the case of zinc, the required dilution factor is met 95% of the time.

Where dilution is insufficient, the mixing zone criteria are not met in that the mixing zone extends from bank to bank. In this circumstance ANZECC recommends performing a “biological effects assessment” (e.g. Direct Toxicity Assessment). Research undertaken by Hart et al. (1991) shows that the TDS needs to be above 1000 mg/L before it can lead to toxic effects, this equates to an EC of approximately 1500 µS/cm.

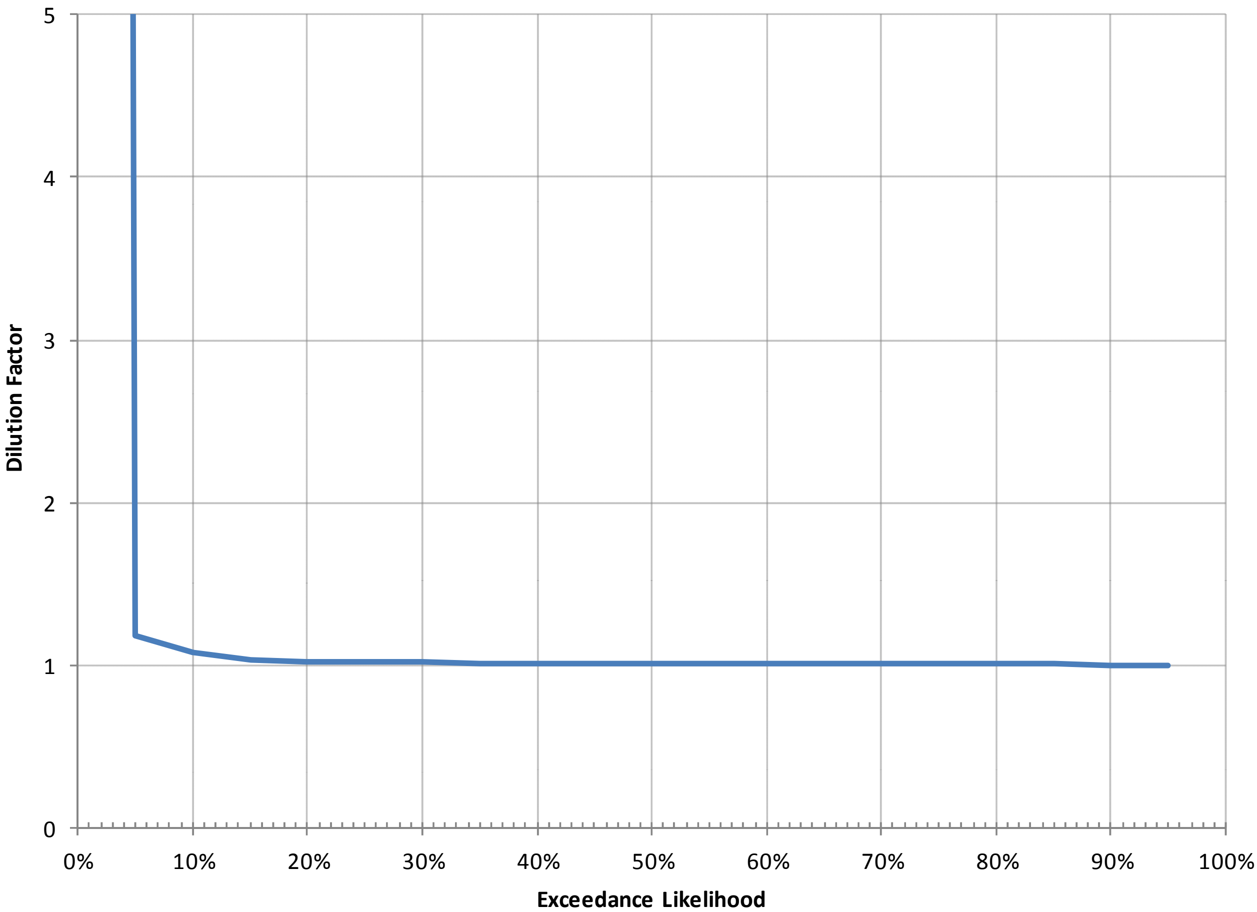


Figure 3: Sawyers Creek/LDP009 Dilution Factor Exceedance Statistics

4. Sawyers Creek Discharge into Coxs River

This scenario considers Sawyers Creek as a discharge into Coxs River. The upstream monitoring location on Coxs River (AP Coxs River D/S), as shown on Figure 1, is upstream of the confluence of Wangcol Creek and Coxs River. Therefore the upstream monitoring location used for this method is Node 60 (Figure 1), which is a node used in the Regional Water Quality Impact Assessment (RPS 2014a).

The modelled flow data at Node 60 has been used in conjunction with actual flow data from Wangcol Creek (SV LDP006 + Wangcol Creek Far Upstream) to derive flow data for AP Coxs River D/S (SV LDP006 is the licensed discharge point located within the Springvale Coal Services Site and discharges to Wangcol Creek). On this basis, the flow from Wangcol Creek contributes 85% of the flow at Node 60.

The relative flow contributions and respective water quality data from the two upstream monitoring locations have been used to derive water quality data for Node 60.

As shown in Section 3, the discharge at LDP009 is typically two orders of magnitude greater than background flow in Sawyers Creek. Furthermore, there is uncertainty around the LDP003 D/S data and the representation of LDP009 discharge. On that basis, the discharge of Sawyers Creek into Coxs River is assumed to be entirely comprised of LDP009 water.

The following monitoring locations have been used in this assessment:

- Upstream Site: Node 60
- Discharge Site: LDP009
- Downstream Site: SV Coxs River U/S.

Table 4 shows median concentrations of the selected analytes at the discharge and downstream monitoring locations and the 80th percentile background concentrations from the upstream data set. The numbers shown in bold represent concentrations exceeding the ANZECC 95% species protection trigger values.

The 80th percentile background concentrations have been compared to the Guideline values (95% species protection) and the maximum value taken as the trigger value for the downstream median concentrations.

Where appropriate, trigger values for Zinc and Copper are modified for hardness according to the following algorithms:

Zinc: $HMTV = TV\ (H/30)^{0.89}$

Copper: $HMTV = TV\ (H/30)^{0.85}$

Where:

HMTV = Hardness Modified Trigger Value

TV = Trigger Value

H = Hardness of water at downstream site

The results of the analysis are presented in Table 4.

Table 4: SSTV Analysis Results: SV Coxs River U/S

Analyte	Median		80 Percentile			ANZECC 95%	TV	HMTV	Adopted TV
	SV Coxs River U/S	LDP009	AP Coxs River D/S	Wangcol Creek Far D/S	Node 60*				
EC (µS/cm)	**690**	**1060**	**855**	**1660**	**1539**	350	1539	n/a	1539
Al (mg/L)	0.040	0.010	**0.264**	**0.080**	**0.11**	0.055	0.11	n/a	0.11
Fe (mg/L)	0.09	0.05	0.3	0.3	0.3	0.3	0.3	n/a	0.3
Zn (mg/L)	**0.014**	**0.013**	**0.016**	**0.083**	**0.07**	0.008	0.07	n/a	0.07
Cu (mg/L)	**0.0020**	0.0010	**0.0040**	N/A	**0.0040**	0.0014	0.0040	n/a	0.004

NB: Values in bold exceed ANZECC guideline value for 95% species protection.
* Node 60 assumes 85/15 blend of Wangcol Creek and Coxs River water

Table 4 shows that concentrations of all analytes are elevated in the background data so the upstream 80th percentile concentrations have been adopted as SSTVs in place of the ANZECC guideline trigger values. No hardness modification is required.

The median downstream data for EC, Aluminium, Zinc and Copper exceed the Guideline trigger value but fall below the adopted trigger value.

Dilution Requirements

Dilution analysis assumes 80th percentile discharge concentrations are being diluted by median upstream concentrations.

Table 5 shows the discharge and upstream concentrations and the adopted water quality criteria. As all 80th percentile discharge concentrations are less than the adopted trigger value, no dilution is required to achieve the downstream water quality criteria.

Table 5: Coxs River/Sawyers Creek Dilution Factor Analysis

Analyte	80 Percentile LDP009	Median Node 60	Adopted TV	Required Dilution Factor
EC (µS/cm)	1090	990	1539	n/a
Al (mg/L)	0.06	0.045	0.11	n/a
Fe (mg/L)	0.05	0.22	0.3	n/a
Zn (mg/L)	0.02	0.033	0.07	n/a
Cu (mg/L)	0.002	0.002	0.004	n/a

Table 5 shows that there is no required dilution of the LDP009 discharge as the Coxs River at the confluence with Sawyers Creek as the upstream data shows elevated concentrations of the selected analytes.

5. Diversion of Angus Place Colliery's Mine Water to Springvale Mine's LDP009 via SDWTS

This scenario considers the additional discharge from Angus Place Colliery at LDP009 with respect to the scenario detailed in Section 4, whereby Sawyers Creek discharges to the Coxs River.

Table 6 shows the 80th percentile concentrations of LDP009 and LDP001. Based on median discharge rates of 20ML/d and 3.3ML/d respectively, the 80th percentile concentrations of the combined discharge have been derived.

From Table 6 it is apparent that the 80th percentile concentrations of the selected analytes in the blended discharge are below the adopted trigger values and therefore no dilution is required (i.e. negative dilution factor).

This analysis shows that the diversion of Angus Place mine water to Springvale LDP009 will maintain the downstream median concentrations to within the SSTV for the selected analytes.

Under the current plans; limited discharge will continue at Angus Place LDP001 at volumes approximately three orders of magnitude less than that transferred to Springvale LDP009 (RPS 2014b).

Table 6: Coxs River/Sawyers Creek Dilution Factor Analysis – Including Angus Place LDP001

Analyte	80 Percentile LDP009	80 Percentile LDP001	80 Percentile Combined Discharge	Median Node 60	Adopted TV	Required Dilution Factor
EC (µS/cm)	1090	1130	1096	990	1539	n/a
Al (mg/L)	0.06	0.05	0.059	0.045	0.11	n/a
Fe (mg/L)	0.05	0.08	0.054	0.22	0.3	n/a
Zn (mg/L)	0.02	0.056	0.025	0.033	0.07	n/a
Cu (mg/L)	0.002	0.0038	0.002	0.002	0.004	n/a

6. References

ANZECC/ARMCANZ, 2000, *National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality*.

Hart et al. 1991. *A review of the salt sensitivity of the Australian freshwater biota*. Hydrobiologia, March 1991, Volume 210, Issue 1-2, pp 105-144.

RPS, 2014a. Regional Water Quality Impact Assessment. Consultant Report Prepared for Centennial Coal Company Ltd, Reference No. S187E/021a.

RPS, 2014b. Angus Place Mine Extension Project – Surface Water Impact Assessment. Consultant Report Prepared for Centennial Angus Place Pty Ltd, Reference No. S187D/021c, dated 9 February 2014.

Yours sincerely
RPS Water Management

Sean

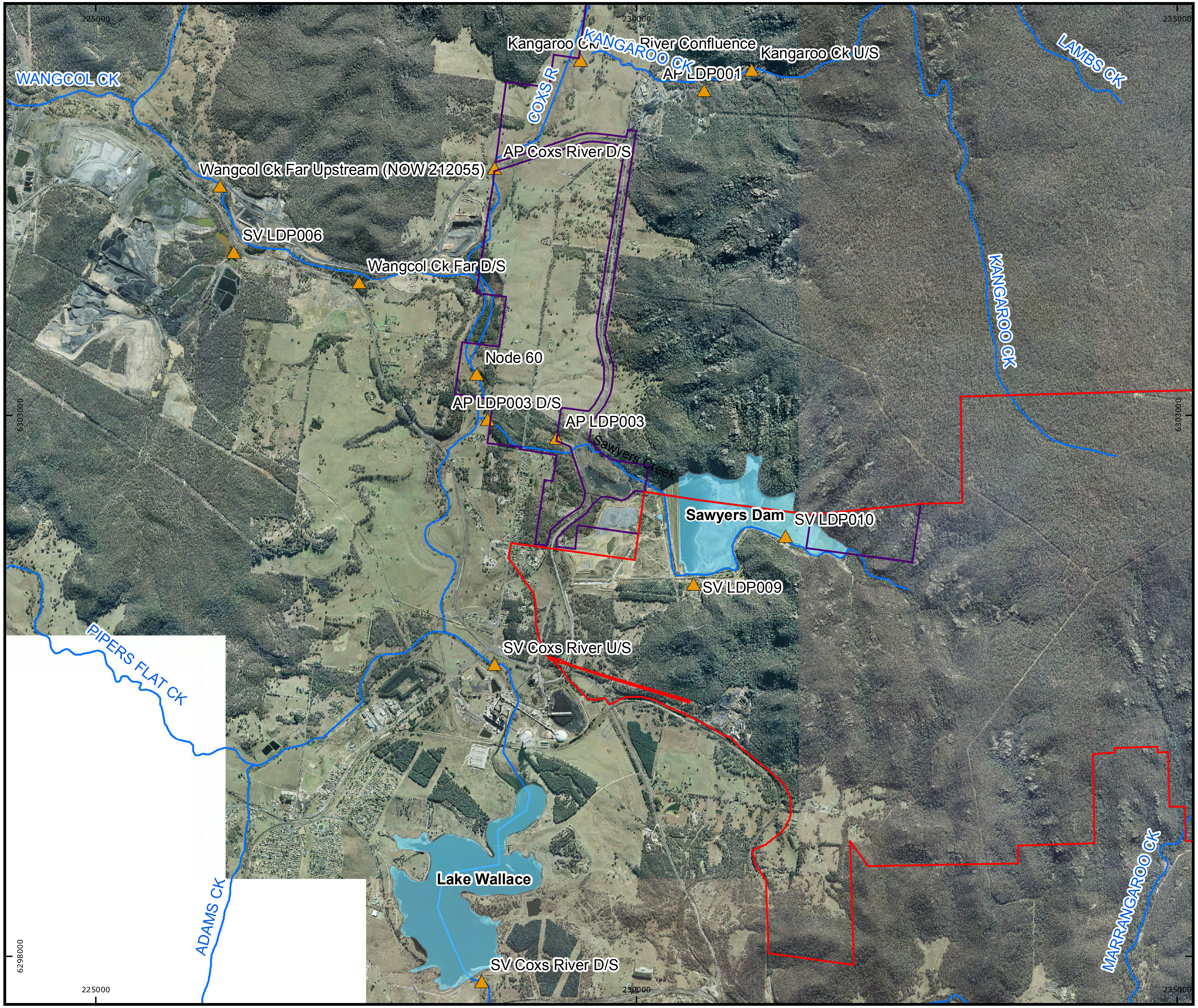
Sean Daykin
Senior Hydrogeologist

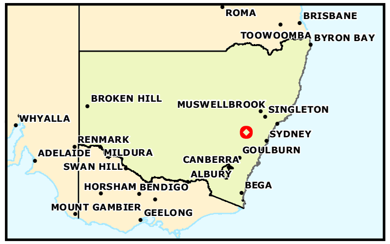
Greg

Greg Sheppard
Principal Hydrogeologist

enc:
Figure 1: SSTV Analysis Surface Water Monitoring Locations
Appendix A: ANZECC and ARMCANZ, 2000. Guideline Trigger Values

FIGURES





LEGEND

- Springvale Project Application Area
- Angus Place Project Application Area
- Centennial Surface Water Monitoring Location
- River/Creek
- Lake/Dam

500 0 500 1,000

Metres

APPROX SCALE 1:50,000 @ A4

GDA 1994 MGA Zone 56

DATA SOURCES:
Centennial Coal
Australia/MapConnect
Land and Property Management Authority

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

Note: The information shown on this map is a copyright of RPS Aquaterra Australia 2012

RPS

Figure 1

Surface Water Monitoring Locations

S188H_004d_D001_All_SW_Monitoring_Locations.mxd Produced: JB Reviewed: JB Date: 28/08/2014

APPENDIX A:
TRIGGER VALUES

Table 3.4.1 Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical *slightly–moderately disturbed systems*; see table 3.4.2 and Section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Chemical		**Trigger values for freshwater (μgL^{-1})**				**Trigger values for marine water (μgL^{-1})**			
		Level of protection (% species)				**Level of protection (% species)**			
		99%	**95%**	**90%**	**80%**	**99%**	**95%**	**90%**	**80%**
METALS & METALLOIDS									
Aluminium	pH >6.5	27	55	80	150	ID	ID	ID	ID
Aluminium	pH <6.5	ID	ID	ID	ID	ID	ID	ID	ID
Antimony		ID	ID	ID	ID	ID	ID	ID	ID
Arsenic (As III)		1	24	94 [C]	360 [C]	ID	ID	ID	ID
Arsenic (AsV)		0.8	13	42	140 [C]	ID	ID	ID	ID
Beryllium		ID	ID	ID	ID	ID	ID	ID	ID
Bismuth		ID	ID	ID	ID	ID	ID	ID	ID
Boron		90	370 [C]	680 [C]	1300 [C]	ID	ID	ID	ID
Cadmium	H	0.06	0.2	0.4	0.8 [C]	0.7 [B]	5.5 [B, C]	14 [B, C]	36 [B, A]
Chromium (Cr III)	H	ID	ID	ID	ID	7.7	27.4	48.6	90.6
Chromium (CrVI)		0.01	1.0 [C]	6 [A]	40 [A]	0.14	4.4	20 [C]	85 [C]
Cobalt		ID	ID	ID	ID	0.005	1	14	150 [C]
Copper	H	1.0	1.4	1.8 [C]	2.5 [C]	0.3	1.3	3 [C]	8 [A]
Gallium		ID	ID	ID	ID	ID	ID	ID	ID
Iron		ID	ID	ID	ID	ID	ID	ID	ID
Lanthanum		ID	ID	ID	ID	ID	ID	ID	ID
Lead	H	1.0	3.4	5.6	9.4 [C]	2.2	4.4	6.6 [C]	12 [C]
Manganese		1200	1900 [C]	2500 [C]	3600 [C]	ID	ID	ID	ID
Mercury (inorganic)	B	0.06	0.6	1.9 [C]	5.4 [A]	0.1	0.4 [C]	0.7 [C]	1.4 [C]
Mercury (methyl)		ID	ID	ID	ID	ID	ID	ID	ID
Molybdenum		ID	ID	ID	ID	ID	ID	ID	ID
Nickel	H	8	11	13	17 [C]	7	70 [C]	200 [A]	560 [A]
Selenium (Total)	B	5	11	18	34	ID	ID	ID	ID
Selenium (SeIV)	B	ID	ID	ID	ID	ID	ID	ID	ID
Silver		0.02	0.05	0.1	0.2 [C]	0.8	1.4	1.8	2.6 [C]
Thallium		ID	ID	ID	ID	ID	ID	ID	ID
Tin (inorganic, SnIV)		ID	ID	ID	ID	ID	ID	ID	ID
Tributyltin (as µg/L Sn)		ID	ID	ID	ID	0.0004	0.006 [C]	0.02 [C]	0.05 [C]
Uranium		ID	ID	ID	ID	ID	ID	ID	ID
Vanadium		ID	ID	ID	ID	50	100	160	280
Zinc	H	2.4	8.0 [C]	15 [C]	31 [C]	7	15 [C]	23 [C]	43 [C]
NON-METALLIC INORGANICS									
Ammonia	D	320	900 [C]	1430 [C]	2300 [A]	500	910	1200	1700
Chlorine	E	0.4	3	6 [A]	13 [A]	ID	ID	ID	ID
Cyanide	F	4	7	11	18	2	4	7	14
Nitrate	J	17	700	3400 [C]	17000 [A]	ID	ID	ID	ID
Hydrogen sulfide	G	0.5	1.0	1.5	2.6	ID	ID	ID	ID
ORGANIC ALCOHOLS									
Ethanol		400	1400	2400 [C]	4000 [C]	ID	ID	ID	ID
Ethylene glycol		ID	ID	ID	ID	ID	ID	ID	ID
Isopropyl alcohol		ID	ID	ID	ID	ID	ID	ID	ID
CHLORINATED ALKANES									
Chloromethanes									
Dichloromethane		ID	ID	ID	ID	ID	ID	ID	ID
Chloroform		ID	ID	ID	ID	ID	ID	ID	ID
Carbon tetrachloride		ID	ID	ID	ID	ID	ID	ID	ID
Chloroethanes									
1,2-dichloroethane		ID	ID	ID	ID	ID	ID	ID	ID
1,1,1-trichloroethane		ID	ID	ID	ID	ID	ID	ID	ID

Chemical	Trigger values for freshwater (μgL^{-1})				Trigger values for marine water (μgL^{-1})			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
1,1,2-trichloroethane	5400	6500	7300	8400	140	1900	5800 C	18000 C
1,1,2,2-tetrachloroethane	ID	ID	ID	ID	ID	ID	ID	ID
Pentachloroethane	ID	ID	ID	ID	ID	ID	ID	ID
Hexachloroethane B	290	360	420	500	ID	ID	ID	ID
Chloropropanes								
1,1-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
CHLORINATED ALKENES								
Chloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1-dichloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2-trichloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2,2-tetrachloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
3-chloropropene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloropropene	ID	ID	ID	ID	ID	ID	ID	ID
ANILINES								
Aniline	8	250 A	1100 A	4800 A	ID	ID	ID	ID
2,4-dichloroaniline	0.6	7	20	60 C	ID	ID	ID	ID
2,5-dichloroaniline	ID	ID	ID	ID	ID	ID	ID	ID
3,4-dichloroaniline	1.3	3	6 C	13 C	85	150	190	260
3,5-dichloroaniline	ID	ID	ID	ID	ID	ID	ID	ID
Benzidine	ID	ID	ID	ID	ID	ID	ID	ID
Dichlorobenzidine	ID	ID	ID	ID	ID	ID	ID	ID
AROMATIC HYDROCARBONS								
Benzene	600	950	1300	2000	500 C	700 C	900 C	1300 C
Toluene	ID	ID	ID	ID	ID	ID	ID	ID
Ethylbenzene	ID	ID	ID	ID	ID	ID	ID	ID
o-xylene	200	350	470	640	ID	ID	ID	ID
m-xylene	ID	ID	ID	ID	ID	ID	ID	ID
p-xylene	140	200	250	340	ID	ID	ID	ID
m+*p*-xylene	ID	ID	ID	ID	ID	ID	ID	ID
Cumene	ID	ID	ID	ID	ID	ID	ID	ID
Polycyclic Aromatic Hydrocarbons								
Naphthalene	2.5	16	37	85	50 C	70 C	90 C	120 C
Anthracene B	ID	ID	ID	ID	ID	ID	ID	ID
Phenanthrene B	ID	ID	ID	ID	ID	ID	ID	ID
Fluoranthene B	ID	ID	ID	ID	ID	ID	ID	ID
Benzo(a)pyrene B	ID	ID	ID	ID	ID	ID	ID	ID
Nitrobenzenes								
Nitrobenzene	230	550	820	1300	ID	ID	ID	ID
1,2-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3,5-trinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-methoxy-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-methoxy-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloro-5-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,4-dichloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dichloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID

Chemical		Trigger values for freshwater (μgL^{-1})				Trigger values for marine water (μgL^{-1})			
		Level of protection (% species)				Level of protection (% species)			
		99%	**95%**	**90%**	**80%**	**99%**	**95%**	**90%**	**80%**
1,2,4,5-tetrachloro-3-nitrobenzene		ID	ID	ID	ID	ID	ID	ID	ID
1,5-dichloro-2,4-dinitrobenzene		ID	ID	ID	ID	ID	ID	ID	ID
1,3,5-trichloro-2,4-dinitrobenzene		ID	ID	ID	ID	ID	ID	ID	ID
1-fluoro-4-nitrobenzene		ID	ID	ID	ID	ID	ID	ID	ID
Nitrotoluenes									
2-nitrotoluene		ID	ID	ID	ID	ID	ID	ID	ID
3-nitrotoluene		ID	ID	ID	ID	ID	ID	ID	ID
4-nitrotoluene		ID	ID	ID	ID	ID	ID	ID	ID
2,3-dinitrotoluene		ID	ID	ID	ID	ID	ID	ID	ID
2,4-dinitrotoluene		16	65 [C]	130 [C]	250 [C]	ID	ID	ID	ID
2,4,6-trinitrotoluene		100	140	160	210	ID	ID	ID	ID
1,2-dimethyl-3-nitrobenzene		ID	ID	ID	ID	ID	ID	ID	ID
1,2-dimethyl-4-nitrobenzene		ID	ID	ID	ID	ID	ID	ID	ID
4-chloro-3-nitrotoluene		ID	ID	ID	ID	ID	ID	ID	ID
Chlorobenzenes and Chloronaphthalenes									
Monochlorobenzene		ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichlorobenzene		120	160	200	270	ID	ID	ID	ID
1,3-dichlorobenzene		160	260	350	520 [C]	ID	ID	ID	ID
1,4-dichlorobenzene		40	60	75	100	ID	ID	ID	ID
1,2,3-trichlorobenzene	B	3	10	16	30 [C]	ID	ID	ID	ID
1,2,4-trichlorobenzene	B	85	170[C]	220[C]	300[C]	20	80	140	240
1,3,5-trichlorobenzene	B	ID	ID	ID	ID	ID	ID	ID	ID
1,2,3,4-tetrachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID	ID
1,2,3,5-tetrachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID	ID
1,2,4,5-tetrachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID	ID
Pentachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID	ID
1-chloronaphthalene		ID	ID	ID	ID	ID	ID	ID	ID
Polychlorinated Biphenyls (PCBs) & Dioxins									
Capacitor 21	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1016	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1221	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1232	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1242	B	0.3	0.6	1.0	1.7	ID	ID	ID	ID
Aroclor 1248	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1254	B	0.01	0.03	0.07	0.2	ID	ID	ID	ID
Aroclor 1260	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1262	B	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1268	B	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4'-trichlorobiphenyl	B	ID	ID	ID	ID	ID	ID	ID	ID
4,4'-dichlorobiphenyl	B	ID	ID	ID	ID	ID	ID	ID	ID
2,2',4,5,5'-pentachloro-1,1'-biphenyl	B	ID	ID	ID	ID	ID	ID	ID	ID
2,4,6,2',4',6'-hexachlorobiphenyl	B	ID	ID	ID	ID	ID	ID	ID	ID
Total PCBs	B	ID	ID	ID	ID	ID	ID	ID	ID
2,3,7,8-TCDD	B	ID	ID	ID	ID	ID	ID	ID	ID
PHENOLS and XYLENOLS									
Phenol		85	320	600	1200 [C]	270	400	520	720
2,4-dimethylphenol		ID	ID	ID	ID	ID	ID	ID	ID
Nonylphenol		ID	ID	ID	ID	ID	ID	ID	ID
2-chlorophenol	T	340 [C]	490 [C]	630 [C]	870 [C]	ID	ID	ID	ID
3-chlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
4-chlorophenol	T	160	220	280 [C]	360 [C]	ID	ID	ID	ID
2,3-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dichlorophenol	T	120	160 [C]	200 [C]	270 [C]	ID	ID	ID	ID

Chemical		Trigger values for freshwater (μgL^{-1})				Trigger values for marine water (μgL^{-1})			
		Level of protection (% species)				Level of protection (% species)			
		99%	**95%**	**90%**	**80%**	**99%**	**95%**	**90%**	**80%**
2,5-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,6-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
3,4-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
3,5-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4-trichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,3,5-trichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,3,6-trichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,4,5-trichlorophenol	T,B	ID	ID	ID	ID	ID	ID	ID	ID
2,4,6-trichlorophenol	T,B	3	20	40	95	ID	ID	ID	ID
2,3,4,5-tetrachlorophenol	T,B	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4,6- tetrachlorophenol	T,B	10	20	25	30	ID	ID	ID	ID
2,3,5,6- tetrachlorophenol	T,B	ID	ID	ID	ID	ID	ID	ID	ID
Pentachlorophenol	T,B	3.6	10	17	27 [A]	11	22	33	55 [A]
Nitrophenols									
2-nitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
3-nitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
4-nitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
2,4-dinitrophenol		13	45	80	140	ID	ID	ID	ID
2,4,6-trinitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
ORGANIC SULFUR COMPOUNDS									
Carbon disulfide		ID	ID	ID	ID	ID	ID	ID	ID
Isopropyl disulfide		ID	ID	ID	ID	ID	ID	ID	ID
n-propyl sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Propyl disulfide		ID	ID	ID	ID	ID	ID	ID	ID
Tert-butyl sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Phenyl disulfide		ID	ID	ID	ID	ID	ID	ID	ID
Bis(dimethylthiocarbamyl)sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Bis(diethylthiocarbamyl)disulfide		ID	ID	ID	ID	ID	ID	ID	ID
2-methoxy-4H-1,3,2-benzodioxaphosphorium-2-sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Xanthates									
Potassium amyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Potassium ethyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Potassium hexyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Potassium isopropyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium ethyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium isobutyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium isopropyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium sec-butyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
PHTHALATES									
Dimethylphthalate		3000	3700	4300	5100	ID	ID	ID	ID
Diethylphthalate		900	1000	1100	1300	ID	ID	ID	ID
Dibutylphthalate	B	9.9	26	40.2	64.6	ID	ID	ID	ID
Di(2-ethylhexyl)phthalate	B	ID	ID	ID	ID	ID	ID	ID	ID
MISCELLANEOUS INDUSTRIAL CHEMICALS									
Acetonitrile		ID	ID	ID	ID	ID	ID	ID	ID
Acrylonitrile		ID	ID	ID	ID	ID	ID	ID	ID
Poly(acrylonitrile-co-butadiene-co-styrene)		200	530	800 [C]	1200 [C]	200	250	280	340
Dimethylformamide		ID	ID	ID	ID	ID	ID	ID	ID
1,2-diphenylhydrazine		ID	ID	ID	ID	ID	ID	ID	ID
Diphenylnitrosamine		ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorobutadiene		ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorocyclopentadiene		ID	ID	ID	ID	ID	ID	ID	ID

Chemical		Trigger values for freshwater (μgL^{-1})				Trigger values for marine water (μgL^{-1})			
		Level of protection (% species)				Level of protection (% species)			
		99%	**95%**	**90%**	**80%**	**99%**	**95%**	**90%**	**80%**
Isophorone		ID	ID	ID	ID	ID	ID	ID	ID
ORGANOCHLORINE PESTICIDES									
Aldrin	B	ID	ID	ID	ID	ID	ID	ID	ID
Chlordane	B	0.03	0.08	0.14	0.27 C	ID	ID	ID	ID
DDE	B	ID	ID	ID	ID	ID	ID	ID	ID
DDT	B	0.006	0.01	0.02	0.04	ID	ID	ID	ID
Dicofol	B	ID	ID	ID	ID	ID	ID	ID	ID
Dieldrin	B	ID	ID	ID	ID	ID	ID	ID	ID
Endosulfan	B	0.03	0.2 A	0.6 A	1.8 A	0.005	0.01	0.02	0.05 A
Endosulfan alpha	B	ID	ID	ID	ID	ID	ID	ID	ID
Endosulfan beta	B	ID	ID	ID	ID	ID	ID	ID	ID
Endrin	B	0.01	0.02	0.04 C	0.06 A	0.004	0.008	0.01	0.02
Heptachlor	B	0.01	0.09	0.25	0.7 A	ID	ID	ID	ID
Lindane		0.07	0.2	0.4	1.0 A	ID	ID	ID	ID
Methoxychlor	B	ID	ID	ID	ID	ID	ID	ID	ID
Mirex	B	ID	ID	ID	ID	ID	ID	ID	ID
Toxaphene	B	0.1	0.2	0.3	0.5	ID	ID	ID	ID
ORGANOPHOSPHORUS PESTICIDES									
Azinphos methyl		0.01	0.02	0.05	0.11 A	ID	ID	ID	ID
Chlorpyrifos	B	0.00004	0.01	0.11 A	1.2 A	0.0005	0.009	0.04A	0.3 A
Demeton		ID	ID	ID	ID	ID	ID	ID	ID
Demeton-S-methyl		ID	ID	ID	ID	ID	ID	ID	ID
Diazinon		0.00003	0.01	0.2 A	2 A	ID	ID	ID	ID
Dimethoate		0.1	0.15	0.2	0.3	ID	ID	ID	ID
Fenitrothion		0.1	0.2	0.3	0.4	ID	ID	ID	ID
Malathion		0.002	0.05	0.2	1.1 A	ID	ID	ID	ID
Parathion		0.0007	0.004 C	0.01 C	0.04 A	ID	ID	ID	ID
Profenofos	B	ID	ID	ID	ID	ID	ID	ID	ID
Temephos	B	ID	ID	ID	ID	0.0004	0.05	0.4	3.6 A
CARBAMATE & OTHER PESTICIDES									
Carbofuran		0.06	1.2 A	4 A	15 A	ID	ID	ID	ID
Methomyl		0.5	3.5	9.5	23	ID	ID	ID	ID
S-methoprene		ID	ID	ID	ID	ID	ID	ID	ID
PYRETHROIDS									
Deltamethrin		ID	ID	ID	ID	ID	ID	ID	ID
Esfenvalerate		ID	0.001*	ID	ID	ID	ID	ID	ID
HERBICIDES & FUNGICIDES									
Bypyridilium herbicides									
Diquat		0.01	1.4	10	80 A	ID	ID	ID	ID
Paraquat		ID	ID	ID	ID	ID	ID	ID	ID
Phenoxyacetic acid herbicides									
MCPA		ID	ID	ID	ID	ID	ID	ID	ID
2,4-D		140	280	450	830	ID	ID	ID	ID
2,4,5-T		3	36	100	290 A	ID	ID	ID	ID
Sulfonylurea herbicides									
Bensulfuron		ID	ID	ID	ID	ID	ID	ID	ID
Metsulfuron		ID	ID	ID	ID	ID	ID	ID	ID
Thiocarbamate herbicides									
Molinate		0.1	3.4	14	57	ID	ID	ID	ID
Thiobencarb		1	2.8	4.6	8 C	ID	ID	ID	ID
Thiram		0.01	0.2	0.8 C	3 A	ID	ID	ID	ID
Triazine herbicides									
Amitrole		ID	ID	ID	ID	ID	ID	ID	ID
Atrazine		0.7	13	45 C	150 C	ID	ID	ID	ID

Chemical	Trigger values for freshwater (μgL^{-1})				Trigger values for marine water (μgL^{-1})			
	Level of protection (% species)				Level of protection (% species)			
	99%	**95%**	**90%**	**80%**	**99%**	**95%**	**90%**	**80%**
Hexazinone	ID	ID	ID	ID	ID	ID	ID	ID
Simazine	0.2	3.2	11	35	ID	ID	ID	ID
Urea herbicides								
Diuron	ID	ID	ID	ID	ID	ID	ID	ID
Tebuthiuron	0.02	2.2	20	160 C	ID	ID	ID	ID
Miscellaneous herbicides								
Acrolein	ID	ID	ID	ID	ID	ID	ID	ID
Bromacil	ID	ID	ID	ID	ID	ID	ID	ID
Glyphosate	370	1200	2000	3600 A	ID	ID	ID	ID
Imazethapyr	ID	ID	ID	ID	ID	ID	ID	ID
Ioxynil	ID	ID	ID	ID	ID	ID	ID	ID
Metolachlor	ID	ID	ID	ID	ID	ID	ID	ID
Sethoxydim	ID	ID	ID	ID	ID	ID	ID	ID
Trifluralin B	2.6	4.4	6	9 A	ID	ID	ID	ID
GENERIC GROUPS OF CHEMICALS								
Surfactants								
Linear alkylbenzene sulfonates (LAS)	65	280	520 C	1000 C	ID	ID	ID	ID
Alcohol ethoxyolated sulfate (AES)	340	650	850 C	1100 C	ID	ID	ID	ID
Alcohol ethoxylated surfactants (AE)	50	140	220	360 C	ID	ID	ID	ID
Oils & Petroleum Hydrocarbons	ID	ID	ID	ID	ID	ID	ID	ID
Oil Spill Dispersants								
BP 1100X	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 7664	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 8667		ID	ID	ID	ID	ID	ID	ID
Corexit 9527	ID	ID	ID	ID	230	1100	2200	4400 A
Corexit 9550	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Most trigger values listed here for metals and metalloids are *High reliability* figures, derived from field or chronic NOEC data (see 3.4.2.3 for reference to Volume 2). The exceptions are *Moderate reliability* for freshwater aluminium (pH >6.5), manganese and marine chromium (III).

Most trigger values listed here for non-metallic inorganics and organic chemicals are *Moderate reliability* figures, derived from acute LC_{50} data (see 3.4.2.3 for reference to Volume 2). The exceptions are *High reliability* for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

* = *High reliability* figure for esfenvalerate derived from mesocosm NOEC data (no alternative protection levels available).

A = Figure may not protect key test species from acute toxicity (and chronic) — check Section 8.3.7 for spread of data and its significance. 'A' indicates that trigger value > acute toxicity figure; note that trigger value should be <1/3 of acute figure (Section 8.3.4.4).

B = Chemicals for which possible bioaccumulation and secondary poisoning effects should be considered (see Sections 8.3.3.4 and 8.3.5.7).

C = Figure may not protect key test species from chronic toxicity (this refers to experimental chronic figures or geometric mean for species) — check Section 8.3.7 for spread of data and its significance. Where grey shading and 'C' coincide, refer to text in Section 8.3.7.

D = Ammonia as TOTAL ammonia as [NH_3-N] at pH 8. For changes in trigger value with pH refer to Section 8.3.7.2.

E = Chlorine as total chlorine, as [Cl]; see Section 8.3.7.2.

F = Cyanide as un-ionised HCN, measured as [CN]; see Section 8.3.7.2.

G = Sulfide as un-ionised H_2S, measured as [S]; see Section 8.3.7.2.

H = Chemicals for which algorithms have been provided in table 3.4.3 to account for the effects of hardness. The values have been calculated using a hardness of 30 mg/L $CaCO_3$. These should be adjusted to the site-specific hardness (see Section 3.4.3).

J = Figures protect against toxicity and do not relate to eutrophication issues. Refer to Section 3.3 if eutrophication is the issue of concern.

ID = Insufficient data to derive a reliable trigger value. Users advised to check if a low reliability value or an ECL is given in Section 8.3.7.

T = Tainting or flavour impairment of fish flesh may possibly occur at concentrations below the trigger value. See Sections 4.4.5.3/3 and 8.3.7.