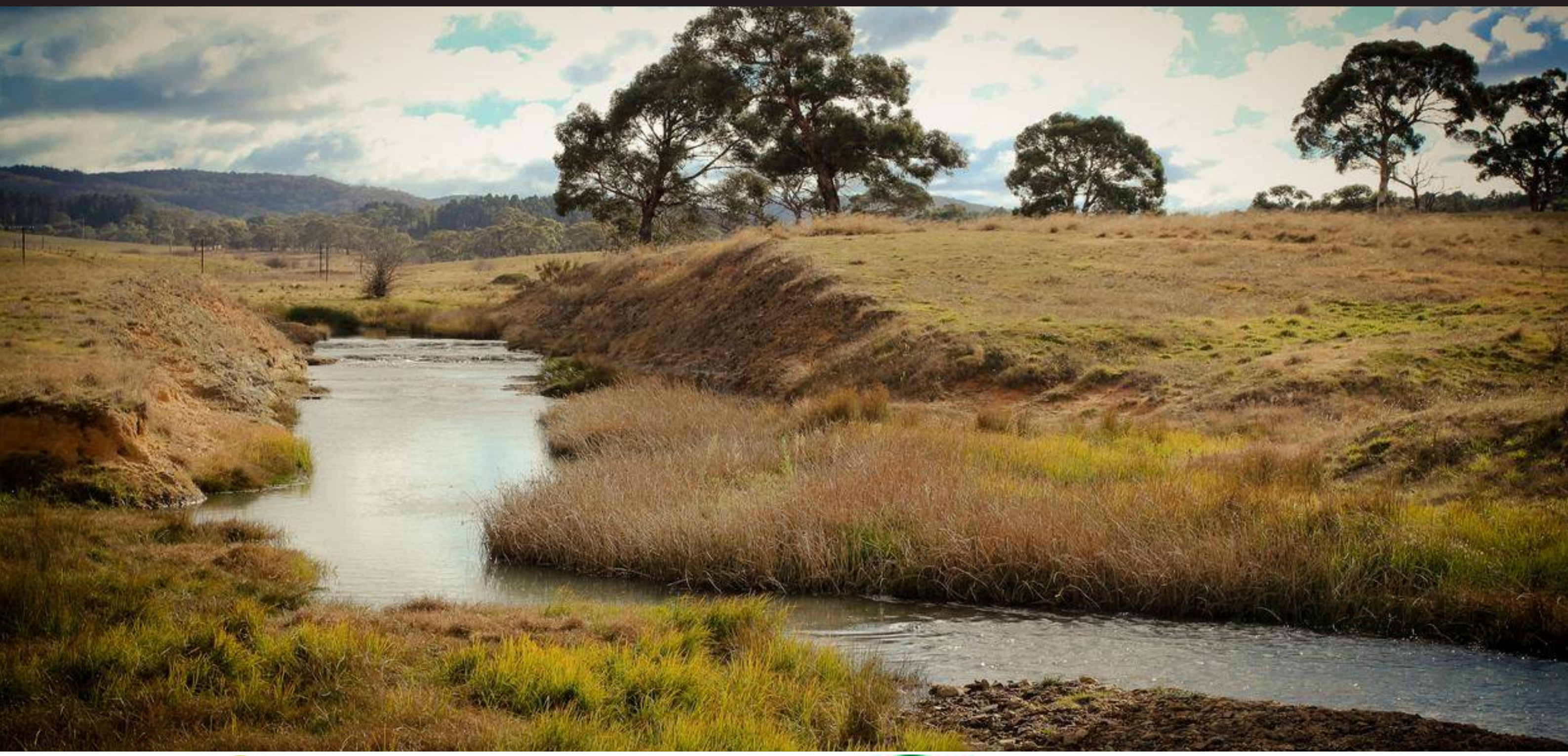
Springvale Water Treatment Project

State Significant Development 7592
Environmental Impact Statement
Volume 2 - Appendix B6

September 2016



EnergyAustralia

Centennial Coal

Appendices

Appendix A – Supporting assessment requirements

Table A-1 WaterNSW requirements

Element	Where addressed
Environmental Impact Statement	
How the project will achieve 'improved environmental incomes for the catchment and meet the water quality performance measures for salinity for mine water discharges required under the Springvale MEP SSD Consent (SSD 5594)'.	Section 6.2, Section 7
The expected water quality within the Coxs River downstream of Lake Lyell and in Lake Burragorang as a result of the project and in comparison with the expected quality at these locations if the permitted discharges under the Springvale MEP SSD Consent (SSD 5594) occurred.	Section 6.2,
Whether the construction of new salt ponds, Water Treatment Plant, installation of a crystalliser and any other infrastructure and disposal of additional brine at the MPPS site and increased impacts on groundwater will trigger a modification to the MPPS existing consent.	Section 6.9
If treated water discharges to Wangcol Creek will be directed to LDP006 or whether a new LDP will need to be approved.	Section 6.1
If a variation to the existing Springvale Mine Environmental Protection Licence (EPL 3607) would be required for the changes to discharges at LDP006 (or new discharge point along Wangcol Creek) and LDP009.	Section 8
Impacts of increased brine and sludge production and disposal at MPPS on groundwater and whether existing infrastructure has capacity to receive and store the additional brine and sludge produced and the proposed management measures.	Section 6.9
The location and description of all water monitoring points (surface and groundwater) including details of proposed monitoring of surface water flows, groundwater and surface water quality, along with information as to how the proposed monitoring will be used to monitor and, if necessary, mitigate impacts on surface water and groundwater resources beyond those predicted.	Section 9.2
Details of measures proposed to be adopted to offset impacts associated with construction activities e.g. earthworks, vegetation clearing, transfer pipeline construction etc.	Further discussed in EIS
Water balance assessment	
Predictions of the frequency, quantity and quality of mine water transfers to the proposed water treatment plant.	Section 6.2
Predictions of the frequency, quantity and quality of treated water being transferred for use by the MPPS and predictions of the frequency and quantity of any water extractions from local waterways to meet additional make-up water demand at the MPPS when the treated water volumes are not enough.	Section 6.2

Element	Where addressed
Predictions of the frequency, quantity and quality of treated water being discharged to Wangcol Creek when the MPPS is operating at reduced capacity and is unable to take some or all of the treated water from the water treatment plant.	Section 6.2
Predictions of the frequency, quantity and quality of mine water if and when it is not feasible to transfer to the water treatment plant including additional 6 ML proposed to be transferred than the existing discharges of 30 ML allowed in EPL for LDP009 and describe the scenarios and likelihood when this may occur.	Section 6.2
Details of the measures to manage site water associated with transferring and treating mine water, general stormwater runoff and any human activities likely to affect water quality at the site and how the neutral or beneficial effect on water quality test will be assessed and applied.	Section 7.1
Surface water assessment	
Comparison of the pre and post development volumes of water extracted from and mine water discharged to the Coxs River catchment (treated and untreated).	Section 6.2
Provide estimates of the volume, quality and pollutant loads of discharges into the Coxs River catchment annually and shall make clear statement as to whether the project would have a neutral or beneficial effect on water quality.	Section 6.5
Specific comparison of the quality and quantity of water currently being discharged from LDP006 with the total quality and quantity of discharges post development including from the water treatment plant.	Section 5.5 and Section 6.2
The potential impacts of any discharges on the water quality of receiving waters and whether there would be any consequences on geomorphology or ecology (flora and fauna) of the receiving watercourses.	Section 6.4 Ecology impact assessments
The potential impacts to receiving waters from LDP009 (or any other discharge location) when mine water is not feasible to transfer to the water treatment plant and whether water quality performance measures required by the Springvale Mine Extension Project will be achieved if this does occur.	The Project does not propose this to occur.
Clarification of the timeframes for the project with respect to meeting the timeframes for pollution reduction contained in the consent for the Springvale Mine Extension Project.	Further discussed in EIS
Concept plans, protocols and/or procedures	
Water management plan including surface water management plan, groundwater management plan and surface and groundwater monitoring programs.	Section 9.3.3

Element	Where addressed
Soil and water management plan which shall consider the principles outlined in the 'Managing Urban Stormwater – Soils and Construction – Installation of Services' manual prepared by the Department of Environment and Climate (2008).	Section 9.1.2
Details of the practices proposed to ensure mine water and waste materials transported to and from the sites do not spill or otherwise cause soil or water pollution.	Further discussed in EIS
Procedures for managing spills and emergency situations.	Further discussed in EIS
Rehabilitation plan.	Further discussed in EIS

Table A-2 DPI-Water requirements

Element	Where addressed
Annual volumes of surface water and groundwater proposed to be taken by the activity (including through inflow and seepage) from each surface and groundwater source as defined by the relevant water sharing plan.	Section 8
Assessment of any volumetric water licensing requirements (including those for ongoing water take following completion of the project).	Section 8
The identification of an adequate and secure water supply for the life of the project. Confirmation that water can be sourced from an appropriately authorised and reliable supply. This is to include an assessment of the current market depth where water entitlement is required to be purchased.	Section 8
A detailed and consolidated site water balance.	Section 6.2
A detailed assessment against the NSW Aquifer Interference Policy (2012) using DPI-Water's assessment framework.	Section 6.7
Assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land and groundwater dependent ecosystems and measures proposed to reduce and mitigate these impacts.	Section 6
Full technical details and data of all surface and groundwater modelling, and an independent peer review.	Not undertaken
Proposed surface and groundwater monitoring activities and methodologies.	Section 9.2
Proposed management and disposal of produced or incidental water.	Section 6.9
Assessment of any potential cumulative impacts on water resources and any proposed options to manage cumulative impacts.	Section 7
Consideration of relevant policies and guidelines.	Section 2

Table A-3 EPA requirements

Element	Where addressed
Development Consent Conditions – SSD_5594	
The EA needs to provide a timetable for works for Package 1 (Transfer System) and Package 2 (Water Treatment System) to ensure compliance with Development Consent Conditions 12 – Water Management Performance Measures.	Further discussed in EIS
Environment Protection Licence 3607 (EPL 3607)	
The abovementioned timetable for works for Package 1 (Transfer System) and Package 2 (Water Treatment System) is also required to ensure compliance with Condition U1 (1.1) – Pollution Studies and Reduction programs of EPL 3607.	Further discussed in EIS
Western Coal Services and Licensed Discharge Point (LDP006)	
The current quality of the discharge from LDP006 and the concentrations of water quality parameters.	Section 5.5
The characteristics of toxicity from the current discharge of LDP006.	Undertaken as part of Upper Coxs River Action and Monitoring Plan
The concentration of water quality parameters and quality of the treated water to be directed to LDP006.	Section 5.5
The toxic characteristics of the treated water.	To be undertaken as part of Commissioning Plan
The concentration of water quality parameters, quality and toxic characteristics of the blend of treated mine water with groundwater seepage and rainfall runoff that will be discharged through LDP006.	To be undertaken as part of Commissioning Plan
Potential impacts on the aquatic ecology of Wangcol Creek and the upper Coxs River of (a) the blend of the water sources and (b) when the discharge is only groundwater seepage and/or (c) with rainfall runoff.	Aquatic Ecology Impact Assessment
An assessment of the groundwater and groundwater seepage that may be occurring within the general area of the Western Coal Services site and the Mount Piper ash emplacement area, that is not captured and discharged through LDP006, and has the potential to disperse off-site within the upper Coxs River catchment and impact on the aquatic ecology of Wangcol Creek and the upper Coxs River.	Not part of Project
Address the need to implement a reliable groundwater monitoring program between the Western Coal Services site and Wangcol Creek.	Section 9.2

Element	Where addressed
For the water quality parameters list below, they should be assessed, and expressed in both total and acid extractable concentrations, for the following: • Total suspended solids, turbidity, pH, salinity (EC), total oil and grease. • Fluoride. • Elements and metals: aluminium, arsenic, barium, beryllium, boron, cadmium, calcium, chromium (III and VI), cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, sodium, sulfur, uranium, zinc. • Anions: chloride, sulfate. • Alkalinity (carbonate, bicarbonate and total). • Nitrogen and phosphorus: total nitrogen, TKN, nitrite, nitrate, total ammonium N, total phosphorus. • Phenolic compounds (total).	Section 5.5
Compare the various proposed combinations of discharges from LDP006 with the ecosystem protection levels of the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council 2000 – ANZECC 2000).	Section 5.5
Volume of mine water	
Provide the reasons why the volume of the pipeline needs to be increased to 36 ML/day and the source of the additional mine water directed to the SDWTS.	Section 6.1
Sludge disposal	
The quantities of sludge to be disposed per annum.	Section 6.2 and 6.9
The chemical composition of the sludge (e.g. metals, elements, salts, pH etc.)	Section 6.2 and 6.9
The classification of the sludge under the *Protection of the Environment Operations Act 1997* (Waste Act and Regulations 2014).	Further discussed as part of EIS
The suitability for co-disposal with tailings.	Section 6.2 and 6.9
Brine management and disposal	
The volume of brine concentration/crystals to be directed annually to the MPPS ash emplacement area.	Section 6.9
The potential for the leakage of saline water from the MPPS ash emplacement area to link with the groundwater below this facility and for dispersal via subsurface groundwater plumes towards the Coxs River.	Section 5.7
The need for a reliable groundwater monitoring program around the current ash dam (i.e. multiple piezometers with groundwater quality testing in between the ash dam wall and Coxs River).	Section 9.2

Element	Where addressed
The need to include proper monitoring/estimation of wet weather flows with the potential to transport salt and ash over the dam wall.	Section 9.1
An assessment of the potential for prolonged, heavy rainfall to cause the capacity of the MPPS ash emplacement area to be exceeded, with the potential for brine concentrate and ash to be flushed into the Coxs River.	Section 9.1
The impact of the disposal of this additional brine concentrate on the capacity, and life, of the MPPS ash emplacement area.	Section 6.9
The leakage of salt from the salt ponds into the local groundwater.	Section 6.9
Measures to achieve compaction to prevent leakage of salt to the local groundwater	Section 6.9
Construction of the pipelines	
Provide information on the sediment and erosion control measures that will be implemented during the construction of the pipelines.	Section 9.1
Routine maintenance and contingency operations	
Address the management strategies to be followed when there is either routine maintenance of the pipeline or water treatment system or a failure of either system.	Further discussed in EIS
Address the procedures being proposed to handle untreated mine water in the case of either routine maintenance or an emergency situation, to avoid the discharge of untreated mine water into the upper Coxs River or other local surface waters within the catchment.	Further discussed in EIS

Table A-4 OEH requirements

Element	Where addressed
The EIS must map the following features relevant to water and soils: b. Rivers, streams, wetlands, estuaries. c. Groundwater. d. Groundwater dependent ecosystems. e. Proposed intake and discharge locations.	This document
The EIS must describe background conditions for any water resource likely to be affected by the Springvale Water Treatment Pipeline, including: a. Existing surface and groundwater. b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations. c. Water Quality Objectives including groundwater as appropriate that represent the community's uses and values for the receiving waters. d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.	Section 5
The EIS must assess the impacts of the Springvale Water Treatment Pipeline on water quality, including: a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the Springvale Water Treatment Pipeline protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction. b. Identification of proposed monitoring of water quality.	Section 6.5
The EIS must assess the impact of the Springvale Water Treatment Pipeline on hydrology, including: a. Water balance including quantity, quality and source. b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas. c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems. d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flows, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches). e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water. f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options. g. Identification of proposed monitoring of hydrological attributes.	This document

Table A-5 Significant Impact Test

Element	Triggers an impact	Reasoning
Changes to Hydrology		
Flow regimes (volume, timing, duration, frequency)	No	Based on a 50% power generation scenario discharges would be limited to one-two years of the Project and be of a minimal consequence.
Recharge rates	No	No active groundwater interactions
Aquifer pressure or pressure relationships between aquifers	No	No active groundwater interactions
Groundwater table levels	No	No active groundwater interactions
Groundwater/surface water interactions	No	Connectivity exists between surface and groundwater environments however these are existing with no change proposed in relation to these interactions
River/floodplain connections	Yes	Minimal consequence
Inter-aquifer connectivity	No	No groundwater interactions
Changes to Water Quality		
Create risks to human or animal health or to the condition of the natural environment	No	
Substantially reduce the amount of water available for human consumptive uses or for other uses, including environmental, which are dependent on water of a particular quality	No	Improving water quality
Cause persistent organic chemicals, heavy metals, salts or other potentially harmful substances to accumulate in the environment	No	Improving water quality
ANZECC Water Quality Assessment undertaken	Yes	Applied to end of pipe as very little mixing available
Changes to Ecosystem Function and Integrity		
Areas of the water resource being destroyed or substantially modified in a way that has an adverse effect on a water-dependent ecosystem	No	Improving water quality

Element	Triggers an impact	Reasoning
An adverse change to the benefits or services provided by a water resource	No	Improving water quality
A change in the biological diversity or species composition of a water resource or its ecological connectivity to other water resources	No	Improving water quality
The habitat or lifecycle of native species which are ecologically associated with the water resource or which are important determinants of the water resource's character being seriously affected	No	Improving water quality
An invasive or pest species that is harmful to the ecosystem functioning or integrity of the water resource becoming established (or an existing invasive or pest species being spread) in the water resource.	No	Improving water quality
Cumulative Impacts		
An assessment of the cumulative impacts of all other known projects in the surface or groundwater source area	Yes	Standard cumulative assessment approach down to the boundary of Lake Burragorang
Timing, Scale and Value		
An assessment of the impacts in both the short and long term. The long term will at a minimum be 100 years, unless otherwise defined by a peer reviewed hydrogeological model	Yes	Assessment period determined from length of groundwater supply (2035). No hydrogeology component.
Timing of the activities that are likely to impact water resources	Yes	Up to 2035.
A robust water balance that identifies when in the project timing water impacts are likely to be *greater than* the existing situation	Yes	Regional water and salt balance that considers both local (operational level) and regional scales
A complete or revises existing local and regional water balance and hydrogeological model	Yes	Development of new modelling considering multiple scales (operations and regional) of modelling. No hydrogeology modelling.
A statement as to the value of the water resource must be included in the significant impact test. This statement must be in the context of the services provided by the resource as well as the connectivity of the resource to other water resources. Services include provisioning to other industries or potable	Yes	The value of Coxs River is high as it contributes to the drinking water supplies of Sydney. The value of Wangcol Creek is low as it only supports aquatic ecology

Element	Triggers an impact	Reasoning
water supplies, cultural services and supporting ecosystem services.		that is somewhat degraded.

Table A-6 Consolidated IESC Checklist

Element	Assessed within WRIA or AEIA
Background Data and Modelling Identification of the water related assets Identification of the geological formation/aquifer to which groundwater dependent ecosystems (GDEs) are connected Location of springs and other groundwater dependent ecosystems A site specific water balance complemented by a regional water balance A description of the water resources of the site A description of the geology and hydrogeology at a local and regional level, including definition of the geological sequence The depth to aquifers and standing water levels, hydro-chemical characteristics A description of the likely recharge sources for each aquifer, details of discharges from each aquifer, direction of groundwater flow and contours of groundwater elevations for all aquifers Surface water assessment and model, including hydrology and water quality parameters Relevant information to describe the existing state of water related ecosystems	Yes
Water and Salt Balance A site specific water balance and a site specific salt balance, complemented by a regional balance of both water and salt covering the larger area of potential impact. An assessment of the changes to any water storage or flow of water in the system as a result of the project, including changes to salt loads.	Yes
Assessment of the likely significant impacts on water resources and water related assets Consideration of the State based policies and guidelines Predicted change to both local and regional water balances Impacts associated with surface water diversions Estimates of the quantity and quality of operational discharges of water, including emergency discharges Indication of the vulnerability to contamination and the likely impacts on the identified water assets	Yes

Element	Assessed within WRIA or AEIA
Consideration of the impacts of water management infrastructure on the biodiversity assets Assessment of the cumulative impact of the project with past, present and known future projects Proposed mitigation measures for each identified impact	
Assessment of cumulative impacts The cumulative impact assessment needs to consider all past, present and known future projects, undertaking with regard to the regional water balance. Catchment and regional scale information Total existing and planning licensed and extracted water for consumptive, industrial and agricultural purposes in the surface catchment and groundwater system Existing water quality guidelines, targets, environmental flow objectives and requirements for the ecosystems of the surface and groundwater systems The proportional increase in water resource use and impacts as a consequence of the proposal The overall level of risk to water related assets that combine probability of occurrence with severity of impact of all past, present and known future projects	Yes
Ongoing management and monitoring Plan of management is to be included that focuses on the avoid, mitigate, manage and offset principles Clearly defined monitoring objectives Maps/figures demonstrating location of bores, their purpose and distribution such that impacts to groundwater gradients, flow directions, recharge processes, quality and water levels in each aquifer Variables such as water levels, EC, pH and other quality parameters to be measured and the interval for measurement An ANZECC water quality assessment and the development of guideline trigger values	Yes

Appendix B – Water and salt balance additional information

B.1 Operations timeline

A summary of the assumed operational phases for each site is provided in Figure B-1.

Operations Timeline

	Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Angus Place	**Status**	Active Mining			Active Mining															Rehab							SDWTS only
	Description	Current Approved Mining			Proposed Extension Project															Mine water to DWTS continues. Mine water to LDPs ceases. Taper runoff							
Lidsdale Siding	**Status**	Regular Operations	Construction	Regular Operations																							
	Description		Extra dewatering																								
Mount Piper	**Status**	Regular Operations																									
	Description																										
Neubeck	**Status**																										
	Description																										
Pinedale	**Status**	Active Mining	CM																								
	Description	Last yr of Stage 1																									
Springvale	**Status**	Active Mining			Active Mining										Rehab							SDWTS only					
	Description	Current Approved Operations			Proposed Extension Project										DWTS continues, Mine water to LDPs cease, LDPs taper down												
Wallerawang	**Status**	CM																									
	Description																										
Western Coal Services	**Status**	Regular Operations																									
	Description																										

Active Mining | Care & Maintenance | Rehabilitation | Other | No Discharges or Extractions

B.2 Water and salt balance model data

B.2.1 Catchment modelling data

The areas of each sub-catchment of the Coxs River catchment modelled are provided in Table B-1. The development footprints of each of the operations considered in the model are presented in Table B-2. Figure B-2 presents each of the sub-catchments and development footprints for the Coxs River catchment.

Table B-1 Sub-catchment areas

Sub-catchment	Area (ha)
Blackheath Creek	6,776
Breakfast Creek	7,193
Coxs River upstream	2,775
Coxs River upstream Blackheath Creek	7,036
Coxs River upstream Ganbenang Creek	9,504
Coxs River upstream Lake Burragorang	5,348
Coxs River upstream Lake Lyell	9,256
Coxs River upstream Lake Wallace	160
Coxs River upstream Pipers Flat Creek	383
Coxs River upstream Pulpithill Creek	7,528
Coxs River upstream Sawyers Swamp Creek	433
Coxs River upstream Springvale Creek	73
Coxs River upstream Wangcol Creek	1,015
Farmers Creek	7,240
Galong Creek	5,249
Ganbenang Creek	4,960
Jenolan River	12,340
Kanangra Creek	7,103
Kangaroo Creek	1,294
Lake Lyell	1,512
Lake Wallace	792
Little River	5,540
Long Swamp Creek	3,229
Megalong Creek	4,592
Mumbedah creek	4,060
Neubecks Creek	697
Pipers Flat Creek	7,162
Pulpithill Creek	1,987

Sub-catchment	Area (ha)
River Lett	10,226
Sawyers Swamp Creek	1,288
Springvale Creek	740
Thompsons Creek	718
Wangcol Creek	1,681
Whalania Creek	4,550

Table B-2 Development footprint areas

Development	Area (ha)
Angus Place Colliery	31
Lidsdale Siding	17
Mount Piper Power Station	596
Springvale Mine	110
Springvale Coal Services site	629

LEGEND

- Angus Place Colliery
- Coxs River upstream
- Coxs River upstream Blackheath Creek
- Coxs River upstream Ganbenang Creek
- Coxs River upstream Lake Lyell
- Coxs River upstream Lake Wallace
- Coxs River upstream Pipers Flat Creek
- Coxs River upstream Sawyers Swamp Creek
- Coxs River upstream Springvale Creek
- Coxs River upstream Wangcol Creek
- Farmers Creek
- Kangaroo Creek
- Lake Lyell
- Lake Wallace
- Lidsdale Siding
- Mount Piper Power Station
- Neubecks Creek
- Pipers Flat Creek
- River Lett
- Sawyers Swamp Creek
- Springvale Coal Services
- Springvale Creek
- Springvale Mine
- Thompsons Creek
- Wangcol Creek
- Waterbody

Paper Size A4

0 650 1,300 2,600 3,900 5,200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Centennial Coal
EA/CEY Water Treatment Project
Water Resources Impact Assessment

Job Number 21-25109
Revision A
Date 30 Jun 2016

Modelled Coxs River sub-catchments

Figure B-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au

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Data source: © NSW Office of Water: Groundwater Data, 2013; ESRI: Aerial Imagery, 2009. Centennial: Imagery, 2016. Created by: tmorton

B.2.2 Data sources

The sources of data for the water and salt balance are shown in Table B-3.

Table B-3 Data sources

Source	Data
Provided by EnergyAustralia	MPPS power generation capacity
	MPPS cooling water demand
	Pump rate from Lake Lyell to MPPS and Thompsons Creek Reservoir
Technical specifications of WTP (GHD, 2016f; 2016g)	Maximum capacity of WTP
	Rate of residual material transferred to SCSS
	Brine proportion
	Salinity of treated water and residual material
Provided by Centennial Coal	Water quality monitoring data
Provided by CSIRO (2015)	Groundwater inflows into underground workings of Angus Place Colliery and Springvale Mine
Queensland Department of Science, Information Technology and Innovation	Daily rainfall data
BOM	Average monthly evaporation data
Queensland Department of Natural Resources and Water (DNRW, 2007)	Salinity of rainfall

B.2.3 General operational data

Site-specific operational data that was used to develop the water and salt balance model is presented in Table B-4.

Table B-4 Operational data

Parameter	Value
Maximum MPPS power generation capacity	33,600 MWhr/day
MPPS cooling water demand	1.62 ML/MWhr
Maximum capacity of WTP	36 ML/day
Maximum rate of transfer of residual material to SCSS	0.43 ML/day
Brine proportion (for inflows less than 30 ML/day)	14.3%
Brine proportion (for inflows greater than 30 ML/day)	11%
Pump rate from Lake Lyell to MPPS and Thompsons Creek Reservoir	95 ML/day

B.2.4 Salinity data

The salinity data incorporated into the water and salt balance model is provided in Table B-5.

Table B-5 Salinity data

Parameter	Source	Statistic	Value (µS/cm)
Rainfall	Department of Natural Resources and Water, Queensland Government (DNRW, 2007)	Typical value	30
Catchment runoff (bushland/vegetation areas)	Calibrated by water and salt balance model		75
Catchment runoff (impervious areas)	Calibrated by water and salt balance model		373
Catchment runoff (disturbed areas)	Calibrated by water and salt balance model	Typical value	151
Dewatered mine water-make from Angus Place Colliery and Springvale Mine	Water quality monitoring of LDP009 discharges	50th percentile	1,170
RO treated water (for inflows less than 30 ML/day)	Technical specifications of WTP (GHD, 2016f; 2016g)	50th percentile	300
RO treated water (for inflows greater than 30 ML/day)	Technical specifications of WTP (GHD, 2016f; 2016g)	90th percentile	500
Residual material transferred to SCSS	Technical specifications of WTP (GHD, 2016f; 2016g)	Maximum	2,500

B.3 Model validation

Validation of the water and salt balance model was undertaken to ensure that the results of the model were not significantly affected by uncertainty in the adopted model parameters and the range of accuracy of the model was consistent with the application of the model. This accuracy was assessed by a comparison of the modelled and observed time series and cumulative distribution plots for daily total flow and daily average EC. Monitoring data was sourced from DPI-Water at the following two locations:

- Coxs River upstream of confluence with Springvale Creek.
- Coxs River upstream of Lake Burragorang.

Monitoring data was available for a maximum period of 11 years, from 1 January 1995 to 1 January 2016. The daily time step of the monitored data was consistent with the time step used in the water and salt balance model.

B.3.1 Coxs River upstream of Springvale Creek

Figure B-3 and Figure B-4 present the time series of modelled and observed daily total flow and daily average EC respectively for the monitoring point on the Coxs River upstream of the confluence with Springvale Creek. The observed flow and EC data was sourced from DPI-Water for gauge 212054 (referred to as 'Coxs @ Wallerawang'). This location corresponds with WaterNSW monitoring point E0321 shown in Figure 4-6.

The results presented in Figure B-3 and Figure B-4 show that the model replicated the general trends observed from year to year over the validation period. For daily total flow it showed a similar range to observed and matched some of the peak flow events. For daily average EC, the modelled time series had a greater range. Notably, the observed dataset had large gaps after 2009, indicated by horizontal lines in the time series. These periods were excluded from the cumulative probability distribution.

Figure B-5 and Figure B-6 show the cumulative probability distribution of daily total flow and daily average EC respectively for the monitoring point on the Coxs River upstream of the confluence with Springvale Creek. The daily total flow shows a very close match to observed, however overestimated low flows. This can be attributed to the difficulty in reconstructing the operational behaviour of the transfers between reservoirs on the Coxs River and Thompsons Creek Reservoir. The model predicts the median EC to within 11% of the median observed, however has a larger variability than the observed dataset. This again can be attributed to the difficulty in reconstructing the operational behaviour of the transfers between reservoirs on the Coxs River and Thompsons Creek Reservoir. The closeness of the median values and the overall match in the shape of the distribution indicate a reasonable match between the modelled and observed data.

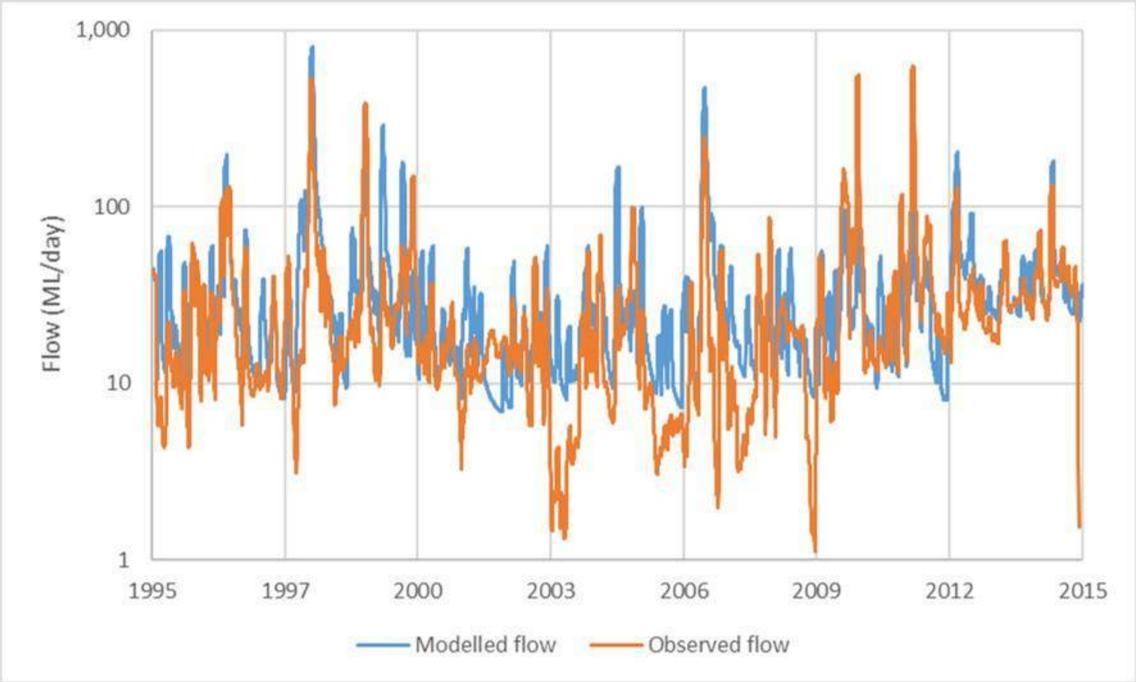


Figure B-3 Modelled and observed daily flow at Coxs River upstream of Springvale Creek

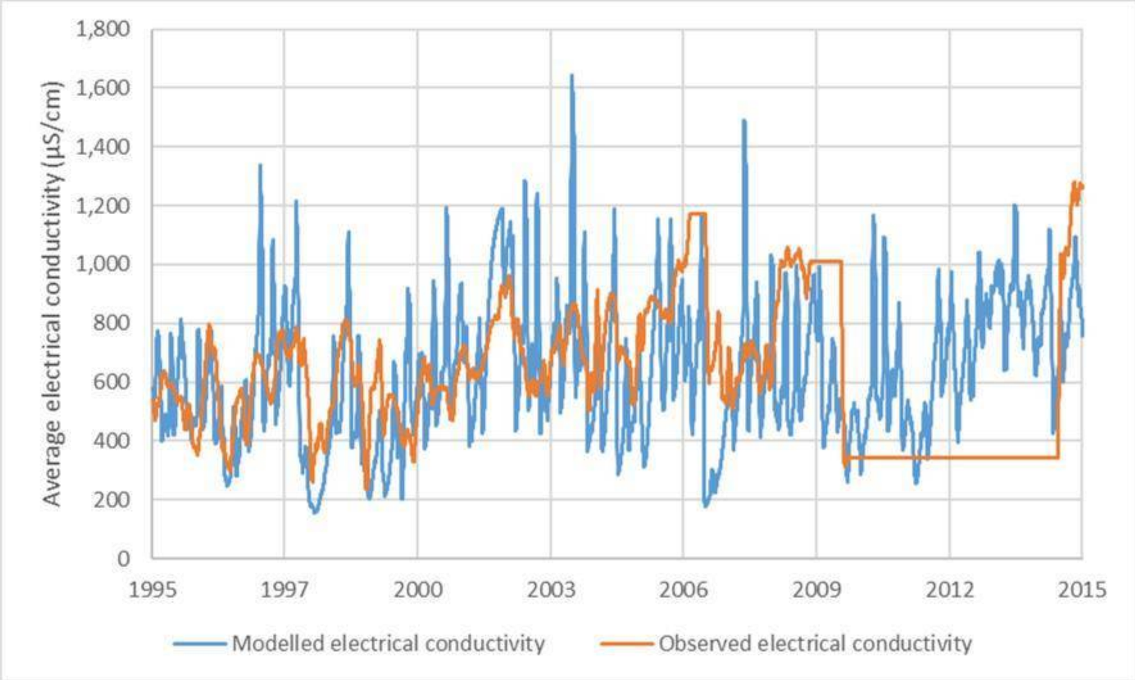


Figure B-4 Modelled and observed daily average EC at Coxs River upstream of Springvale Creek

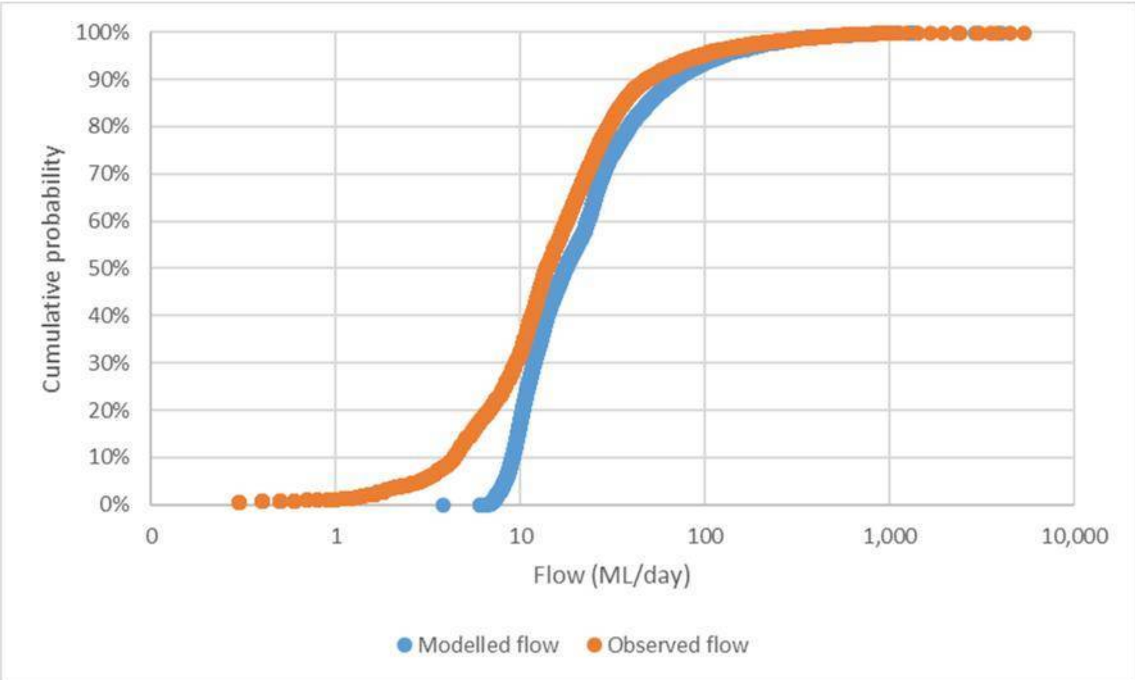


Figure B-5 Modelled and observed cumulative probability distribution of daily flow at Coxs River upstream of Springvale Creek

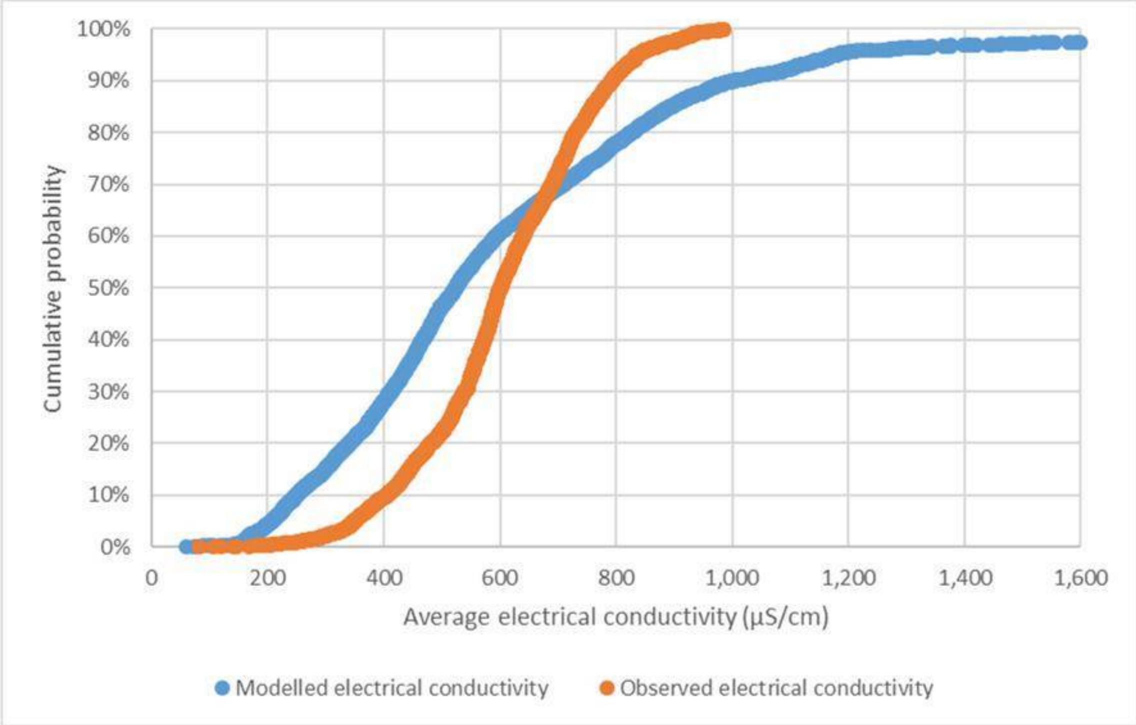


Figure B-6 Modelled and observed cumulative probability distribution of daily average EC at Coxs River upstream of Springvale Creek

B.3.1 Coxs River upstream of Lake Burragorang

Figure B-7 and Figure B-8 present the time series of modelled and observed daily total flow and daily average EC respectively for the monitoring point on the Coxs River upstream of Lake Burragorang. The observed flow and EC data was sourced from WaterNSW for point E083 (referred to as 'Cox's River at Kelpie Point'), as shown in Figure 4-6. This location corresponds with DPI-Water gauge 212250.

The observed EC data had irregular time intervals between observations. To compare the modelled data, the observed EC data was interpolated linearly between observations with the average taken each day. The period before 2005 was excluded from the cumulative probability distribution, which is presented in Figure B-9 and Figure B-10 for daily total flow and daily average EC respectively. The results indicate that the model underestimated median flows by up to 30%, however high and low flows showed minimal variability between modelled and observed results. The closeness of the median values and the overall match in the shape of the distribution indicate a reasonable match between the modelled and observed data.

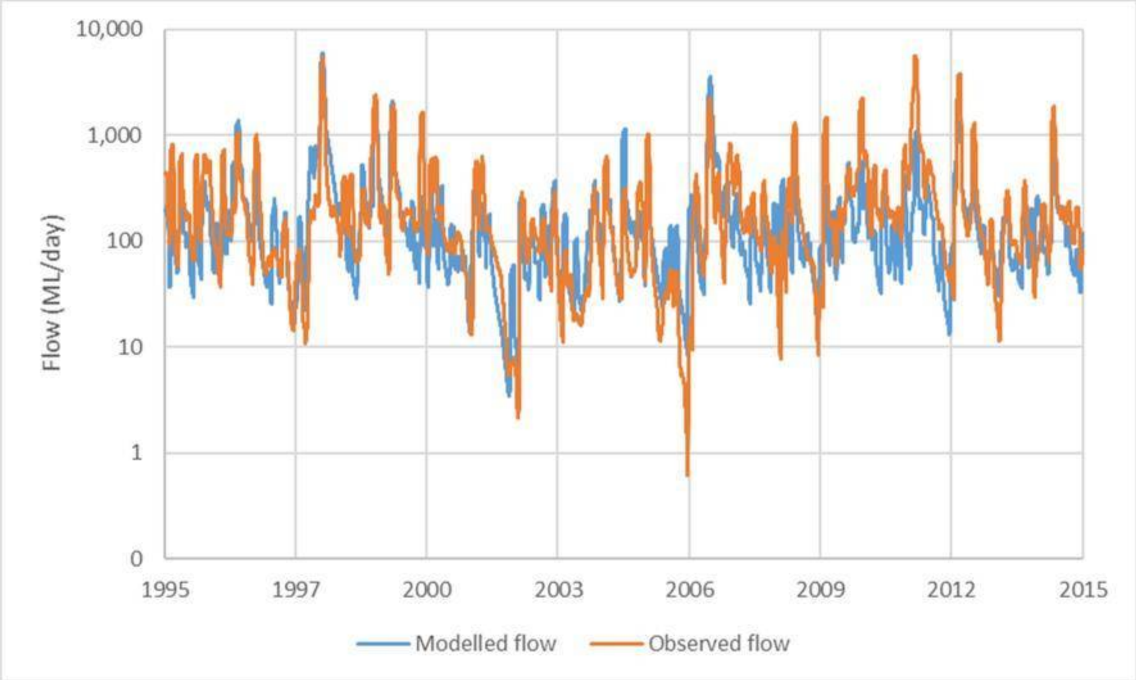


Figure B-7 Modelled and observed daily flow at Coxs River upstream of Lake Burragorang

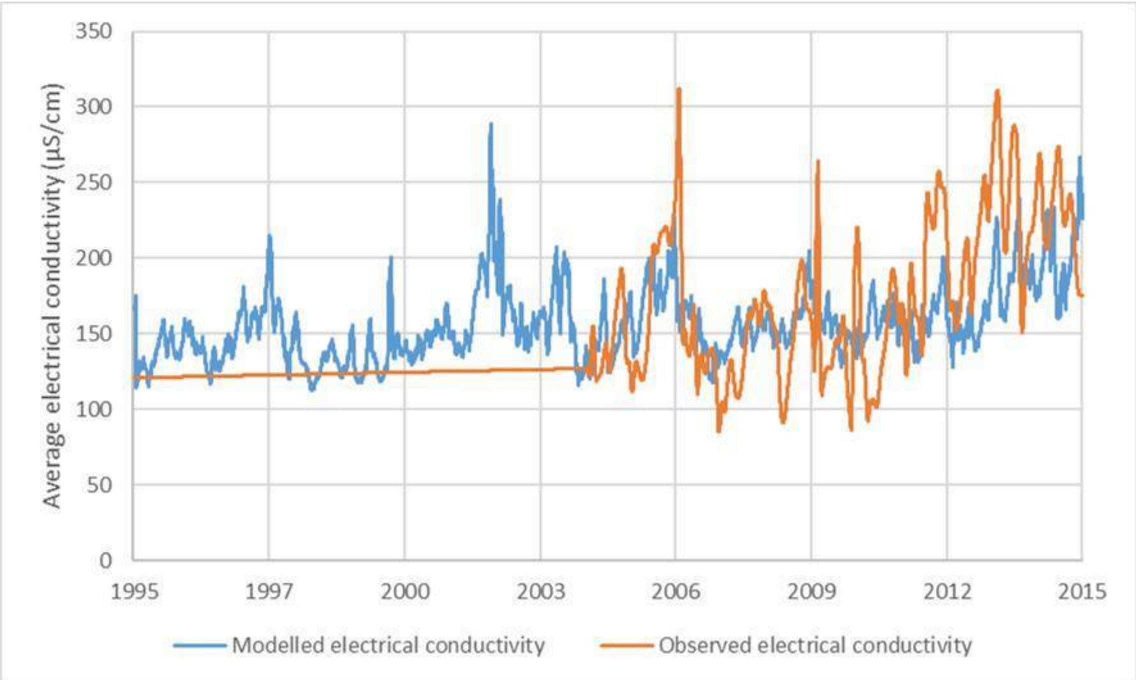


Figure B-8 Modelled and observed daily average EC at Coxs River upstream of Lake Burragorang

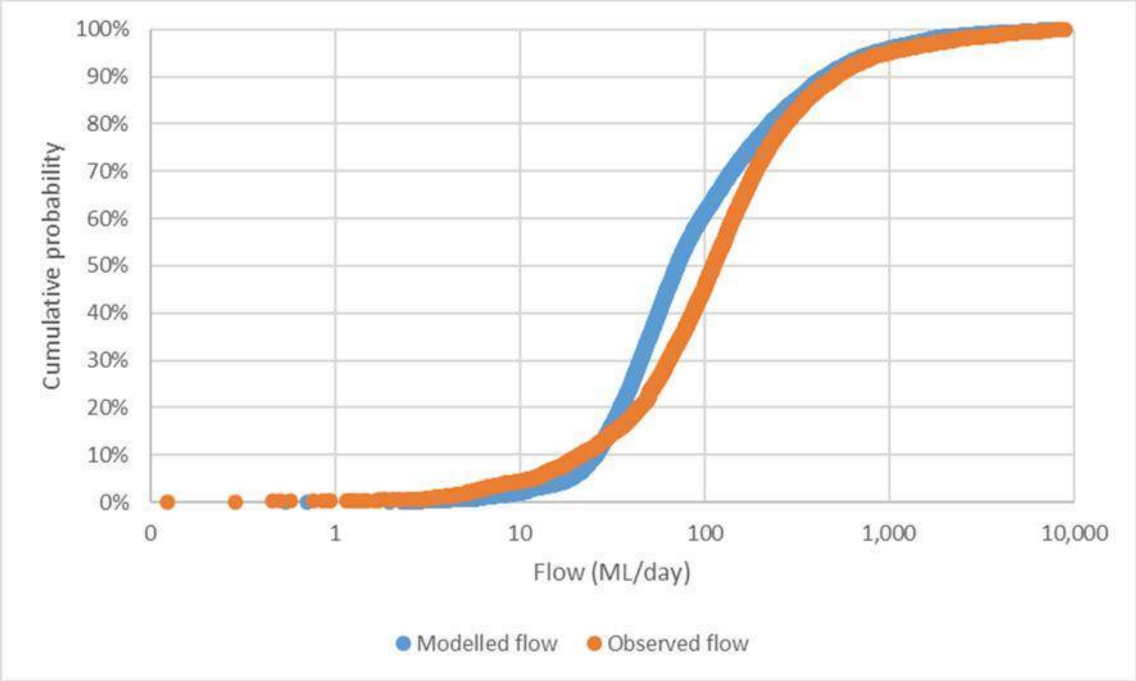


Figure B-9 Modelled and observed cumulative probability distribution of daily flow at Coxs River upstream of Lake Burragorang

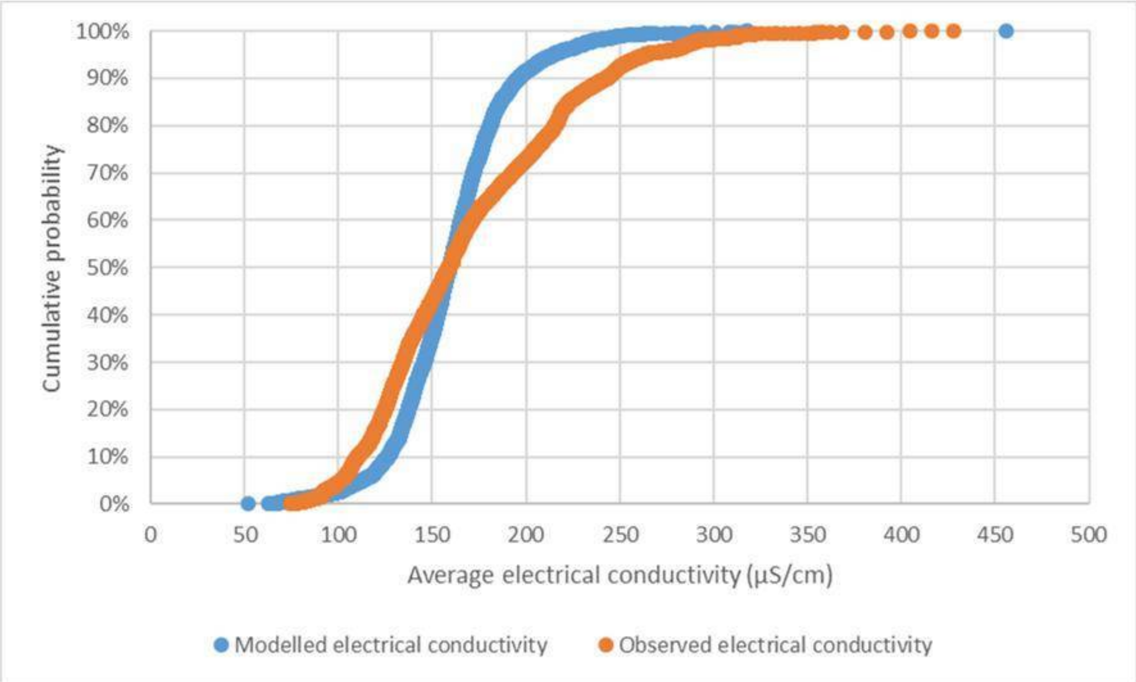


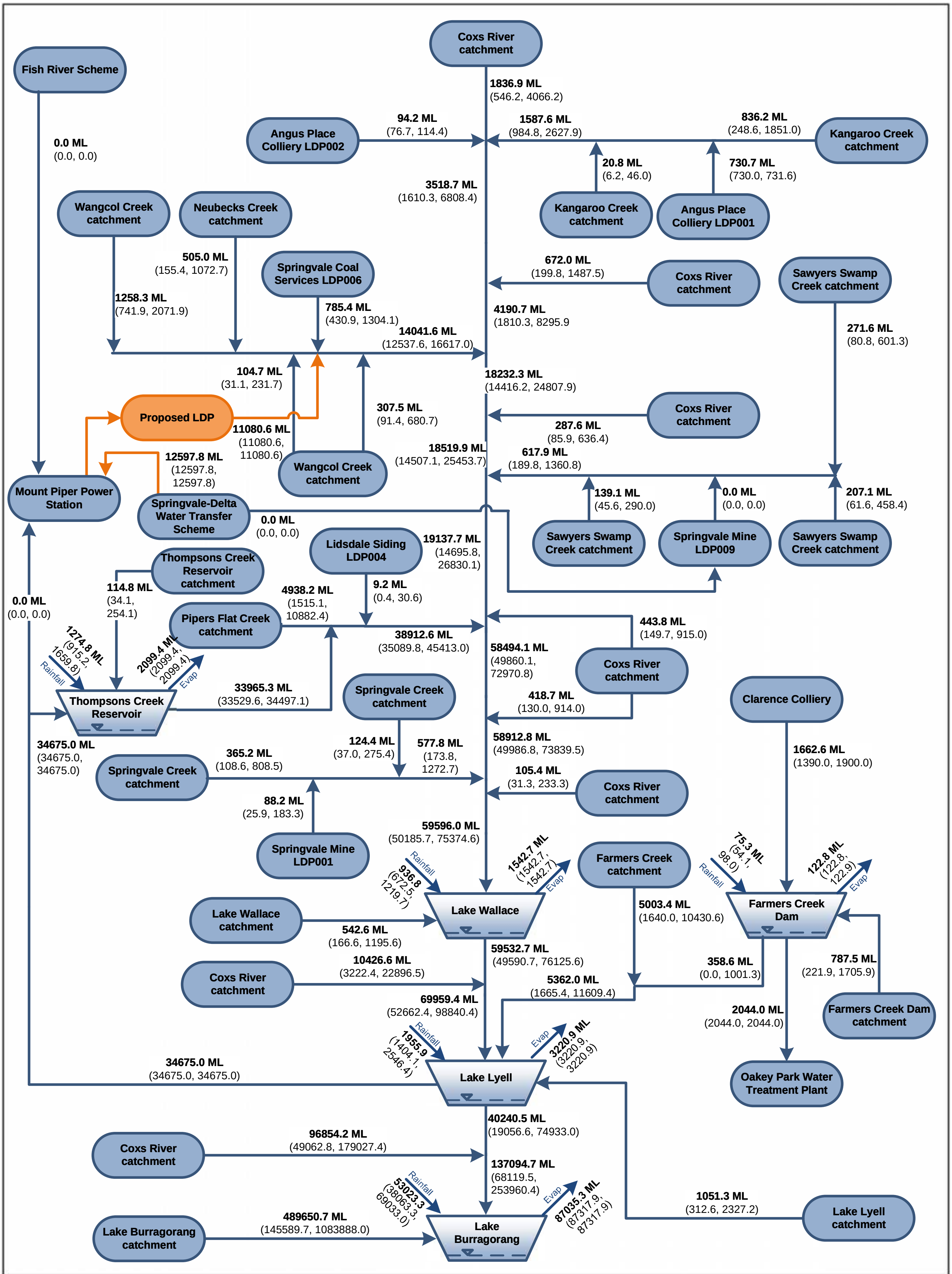
Figure B-10 Modelled and observed cumulative probability distribution of daily average EC at Coxs River upstream of Lake Burragorang

B.4 Additional water and salt balance results

B.4.1 Water balance results

Annual results

The predicted values for each of the water transfers within the Coxs River catchment for proposed conditions in 2030 are provided in Figure B-11, Figure B-12, Figure B-13 and Figure B-14 for scenarios 1, 2, 4 and 5 respectively.



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

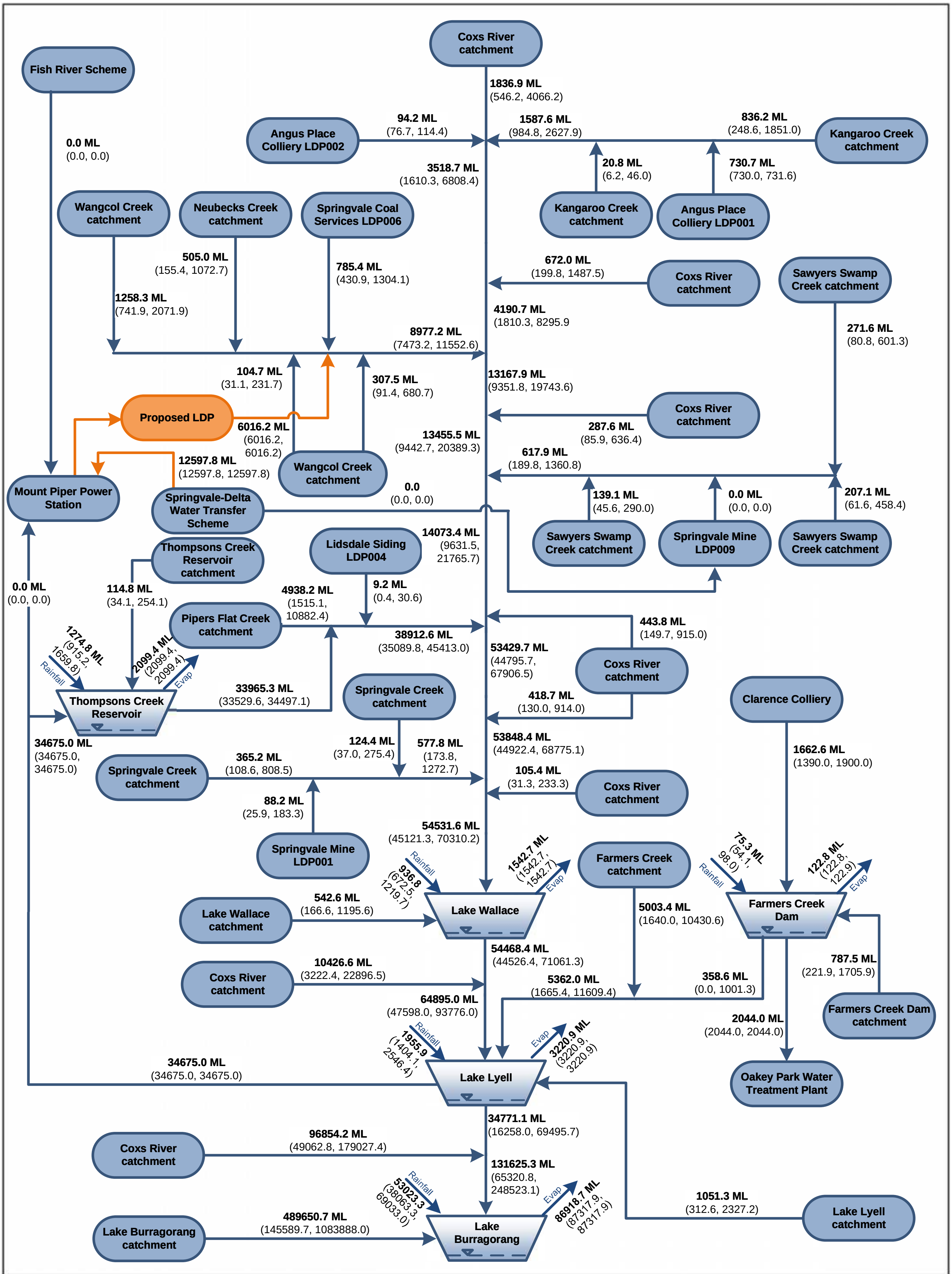
GHD

Springvale Water Treatment Project
Water Resources Impact Assessment

Annual water transfers
Proposed conditions (2030)
Scenario 1

Centennial Coal
EnergyAustralia

DATE	Jul 2016	Figure B-11



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

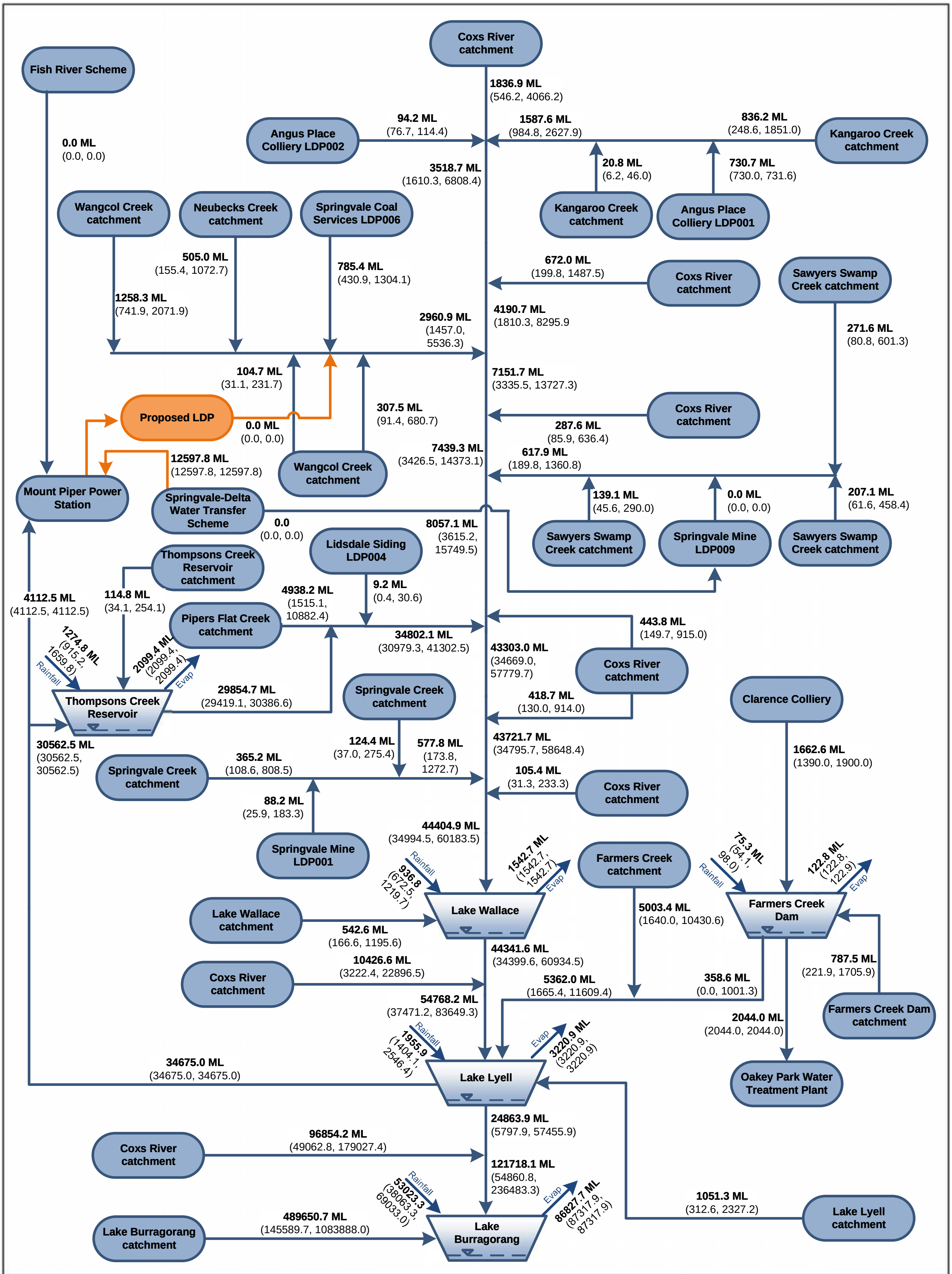
GHD

Springvale Water Treatment Project
Water Resources Impact Assessment

Annual water transfers
Proposed conditions (2030)
Scenario 2

Centennial Coal
EnergyAustralia

DATE Jul 2016 Figure B-12



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

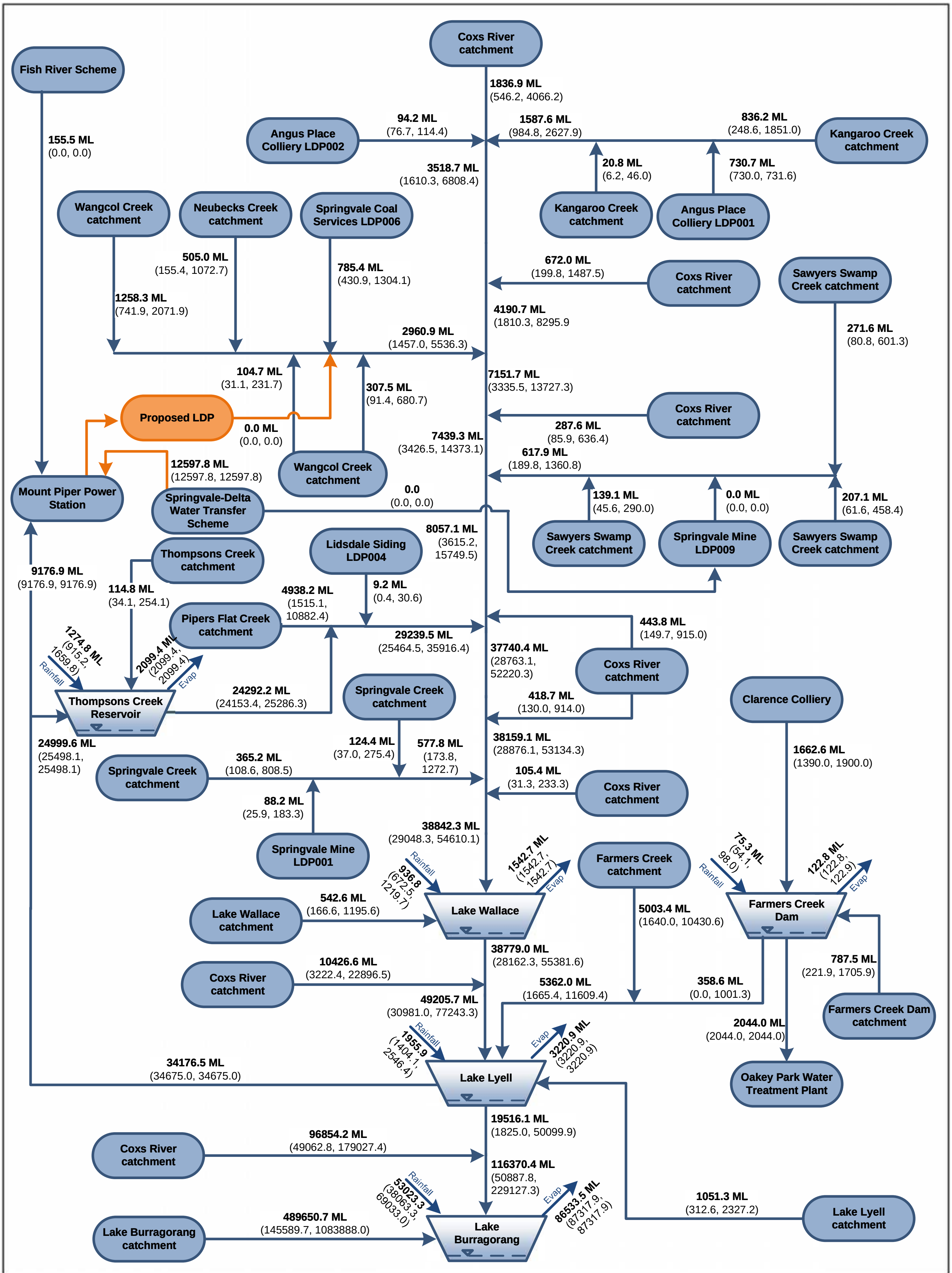
GHD

Springvale Water Treatment Project
Water Resources Impact Assessment

Annual water transfers
Proposed conditions (2030)
Scenario 4

Centennial Coal
EnergyAustralia

DATE Jul 2016 Figure B-13



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

GHD

Springvale Water Treatment Project
Water Resources Impact Assessment

Annual water transfers
Proposed conditions (2030)
Scenario 5

Centennial Coal
EnergyAustralia

DATE Jul 2016 | Figure B-14

Time series results

Monthly average time series results are presented for scenarios 1, 2, 4 and 5 are presented in Figure B-15 to B-46.

<u>Scenario 1</u>

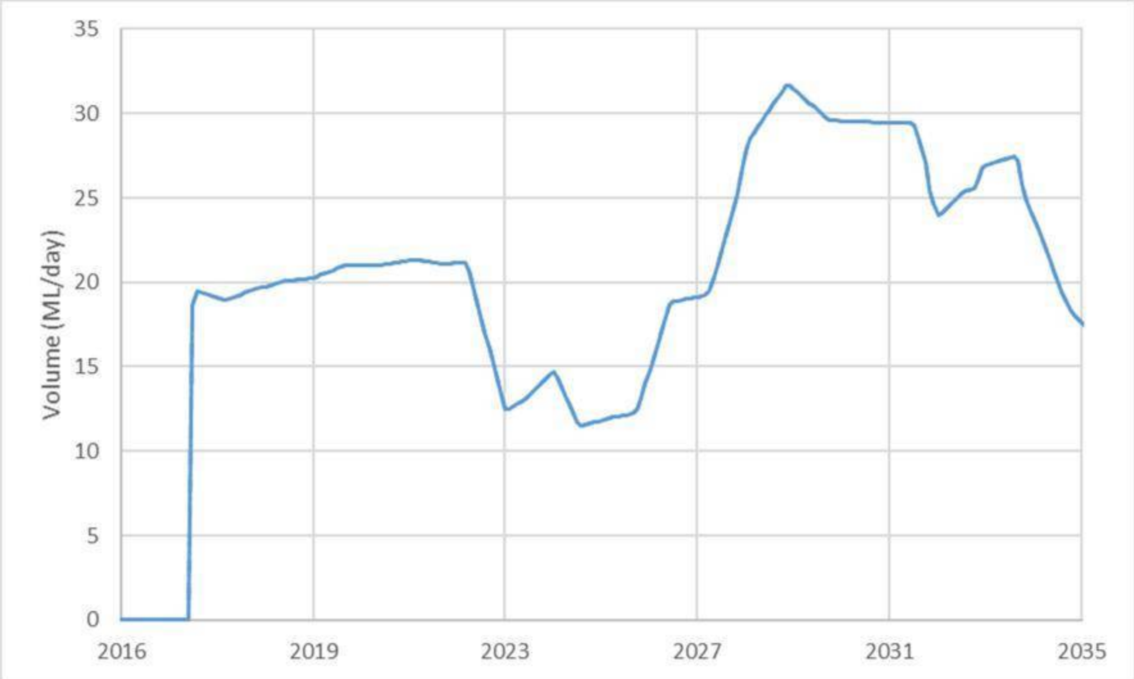


Figure B-15 Scenario 1 – Predicted proposed LDP discharge

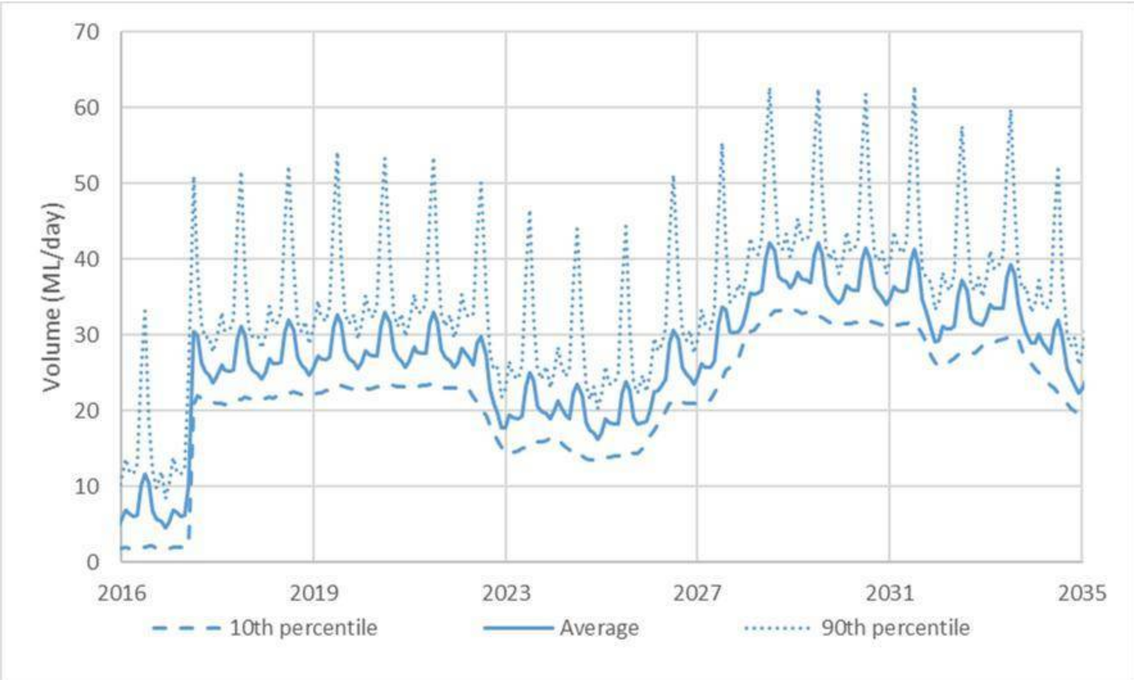


Figure B-16 Scenario 1 – Predicted flow of Wangcol Creek at LDPs

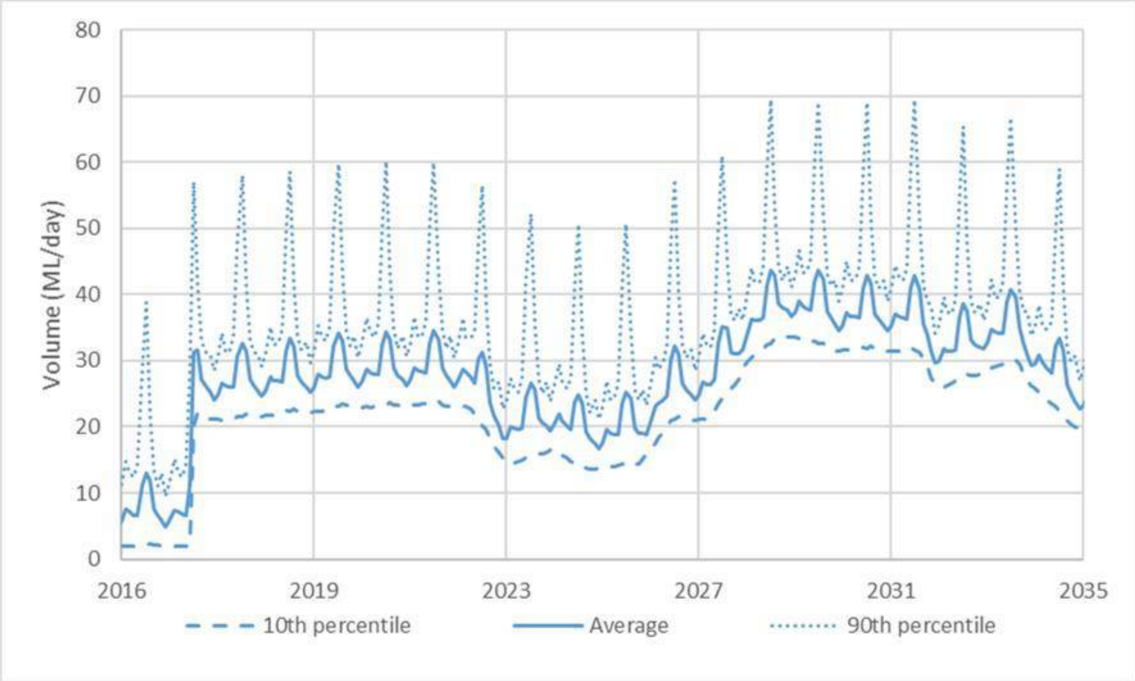


Figure B-17 Scenario 1 – Predicted flow of Wangcol Creek at the confluence with the Coxs River

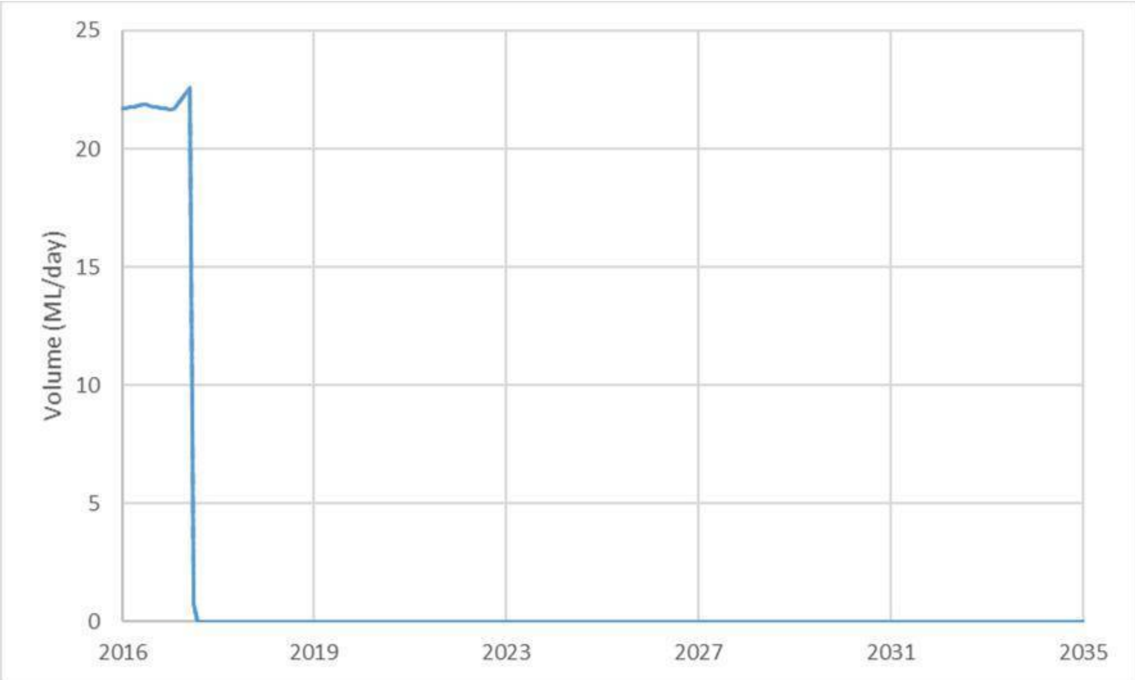


Figure B-18 Scenario 1 – Predicted LDP009 discharge to Sawyers Swamp Creek

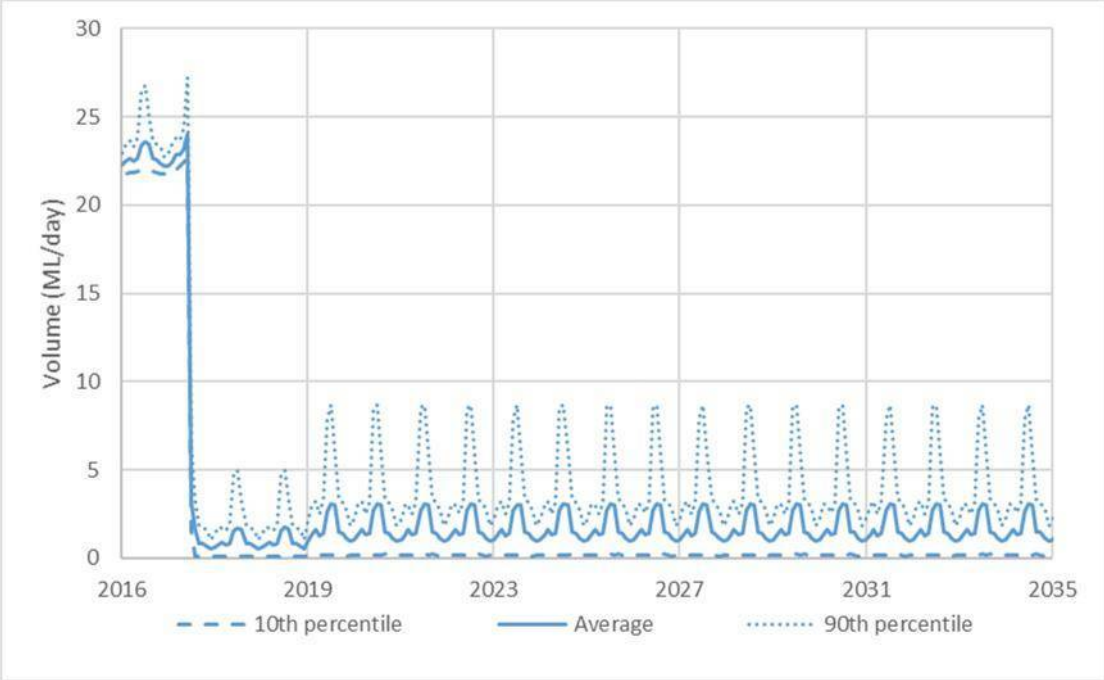


Figure B-19 Scenario 1 – Predicted flow of Sawyers Swamp Creek at the confluence with the Coxs River

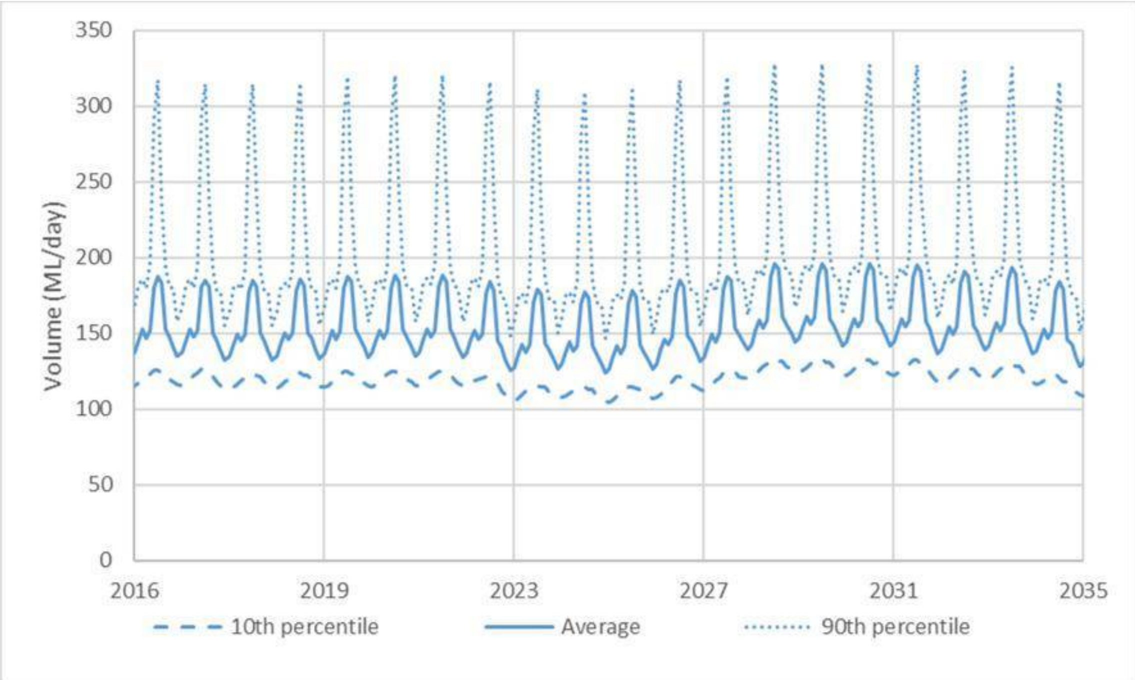


Figure B-20 Scenario 1 – Predicted flow from Coxs River to Lake Wallace

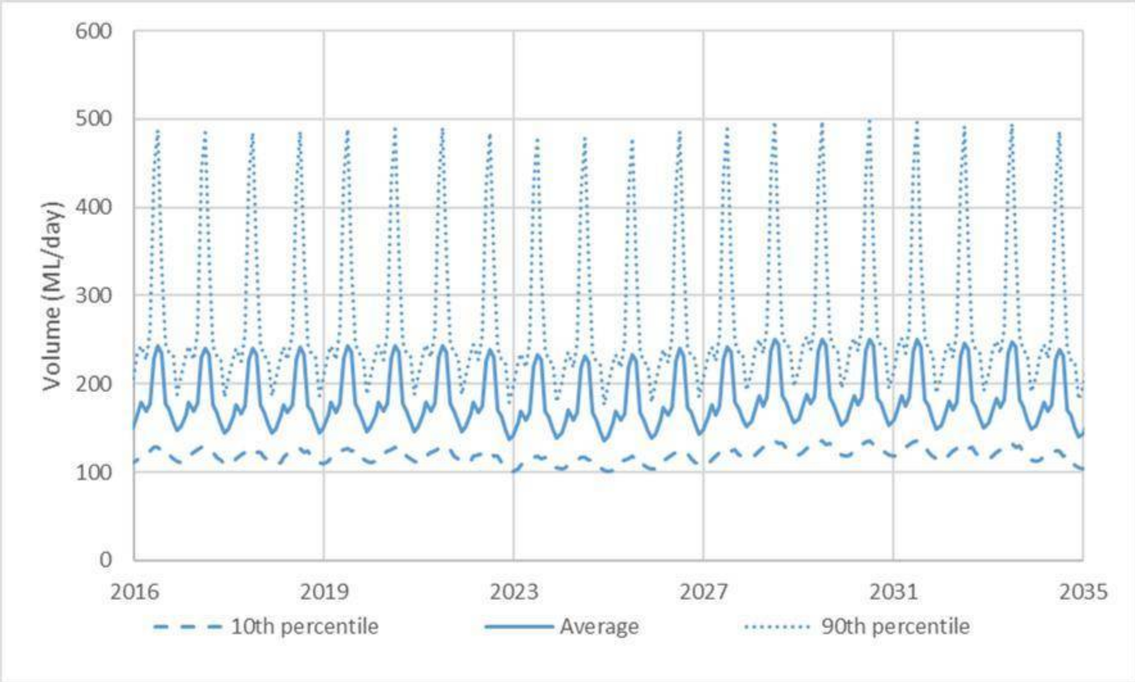


Figure B-21 Scenario 1 – Predicted flow from Coxs River to Lake Lyell

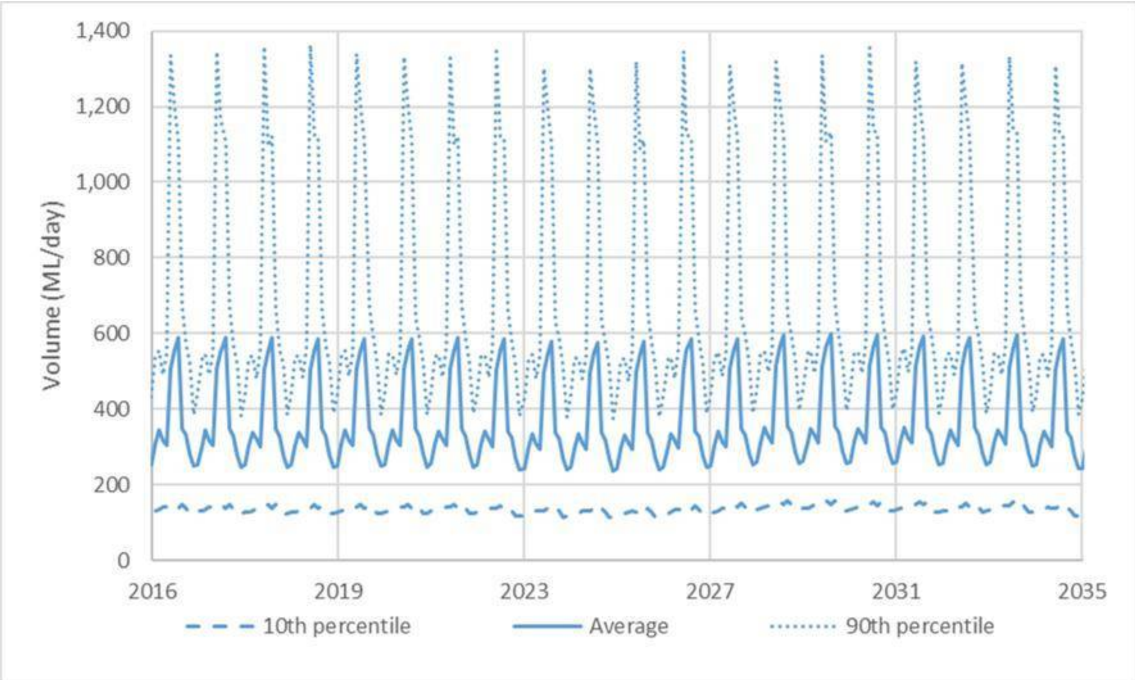


Figure B-22 Scenario 1 – Predicted discharge from Coxs River to Lake Burragorang

Scenario 2

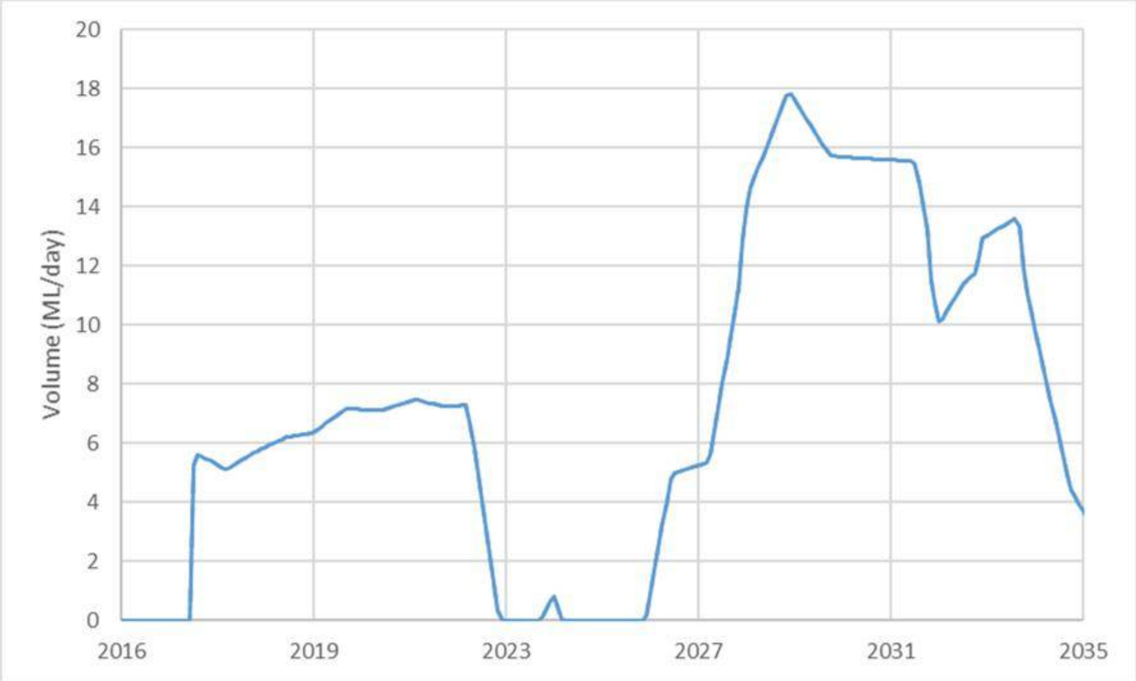


Figure B-23 Scenario 2 – Predicted proposed LDP discharge

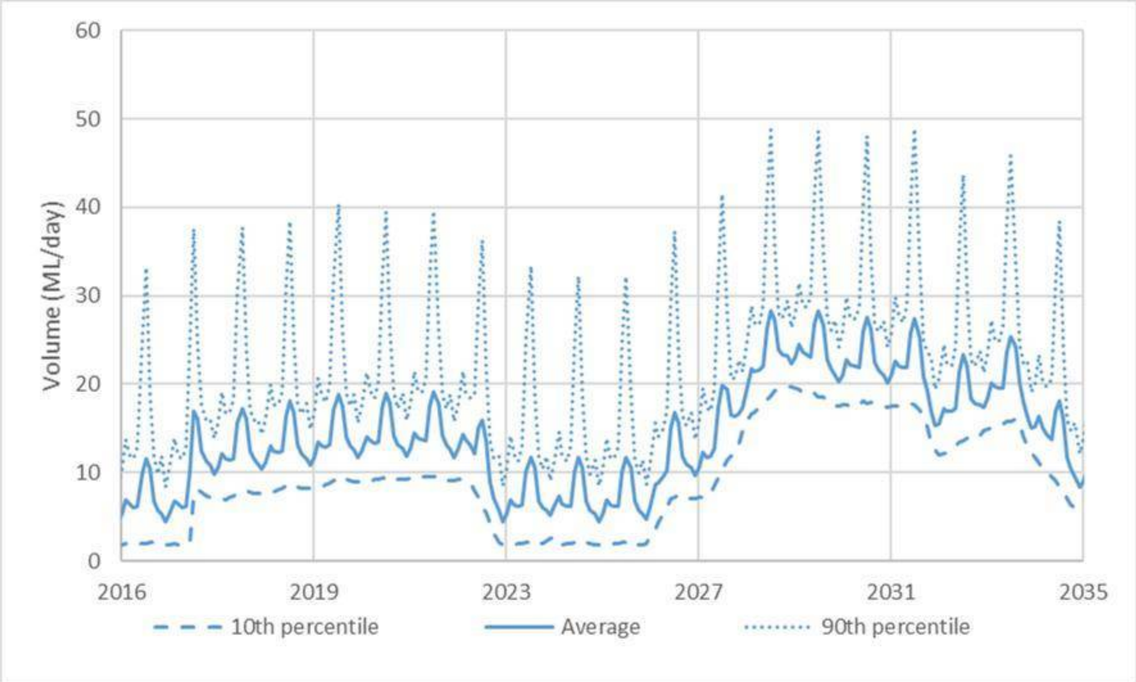


Figure B-24 Scenario 2 – Predicted flow of Wangcol Creek at LDPs

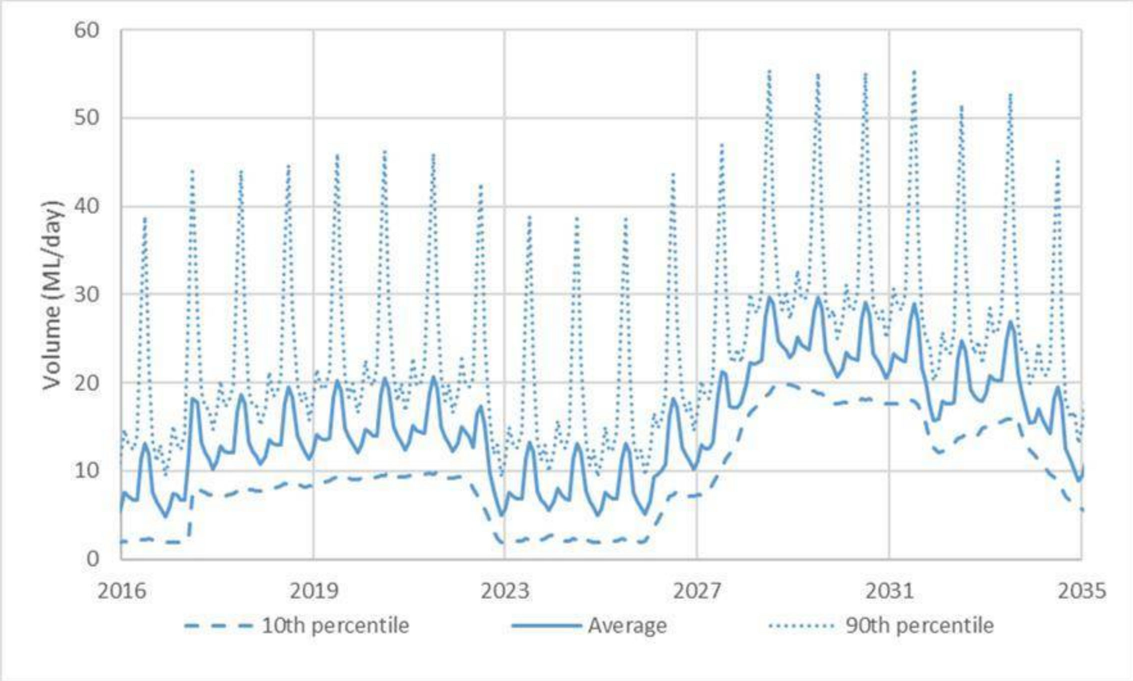


Figure B-25 Scenario 2 – Predicted flow of Wangcol Creek at the confluence with the Coxs River

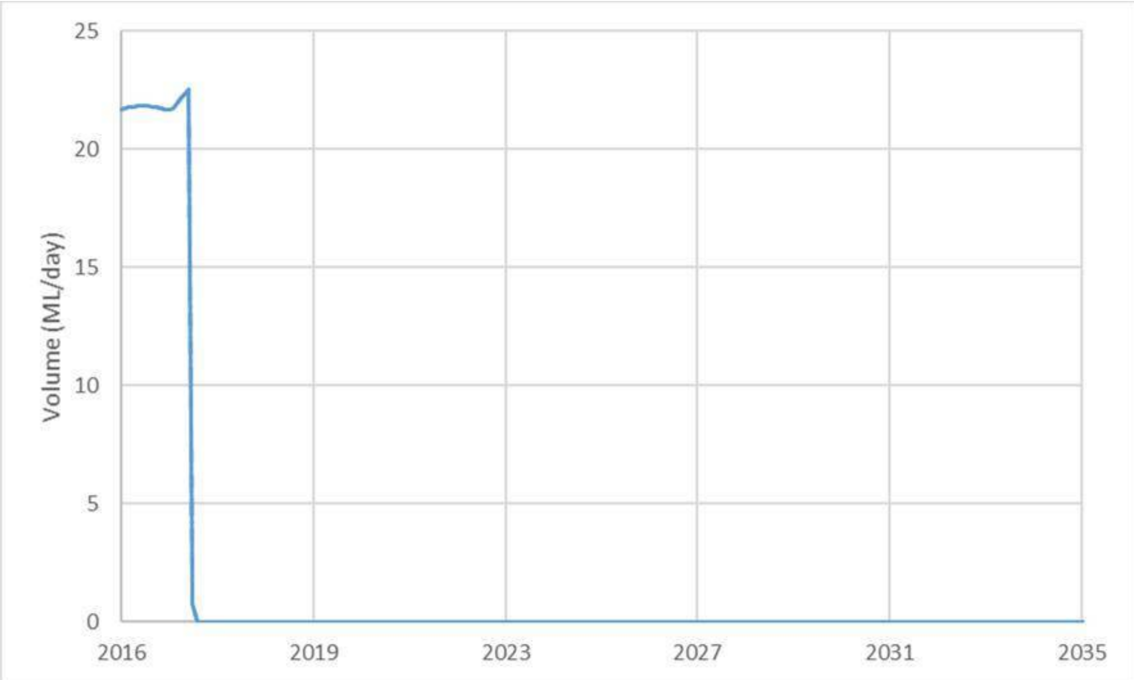


Figure B-26 Scenario 2 – Predicted LDP009 discharge to Sawyers Swamp Creek

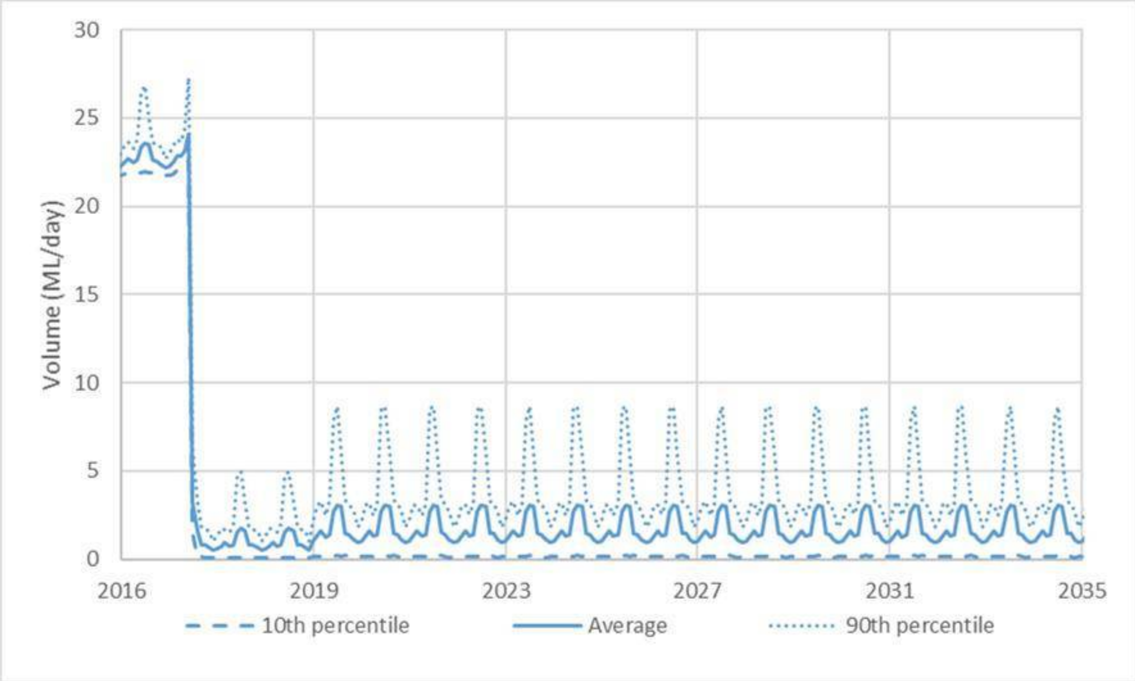


Figure B-27 Scenario 2 – Predicted flow of Sawyers Swamp Creek at the confluence with the Coxs River

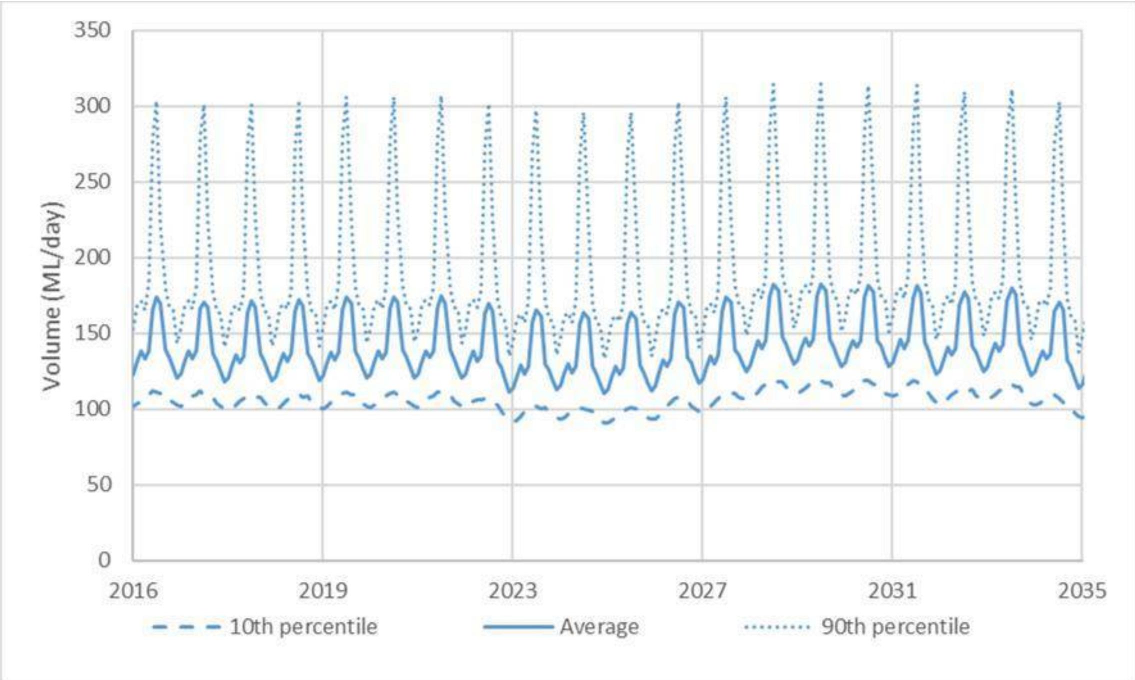


Figure B-28 Scenario 2 – Predicted flow from Coxs River to Lake Wallace

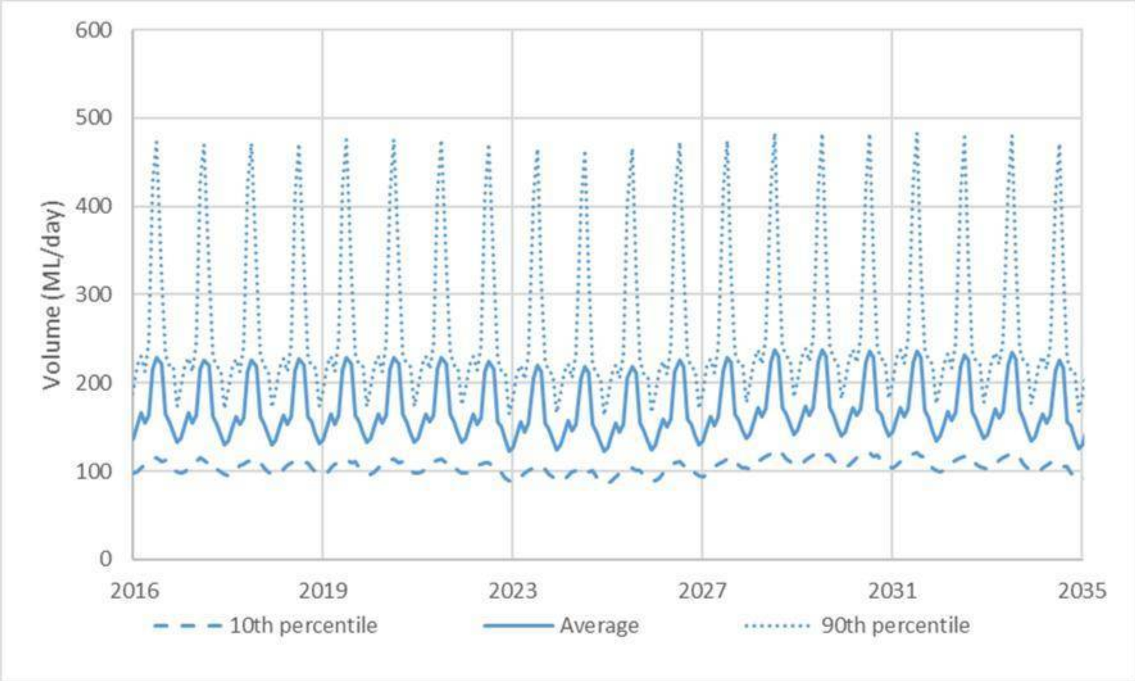


Figure B-29 Scenario 2 – Predicted flow from Coxs River to Lake Lyell

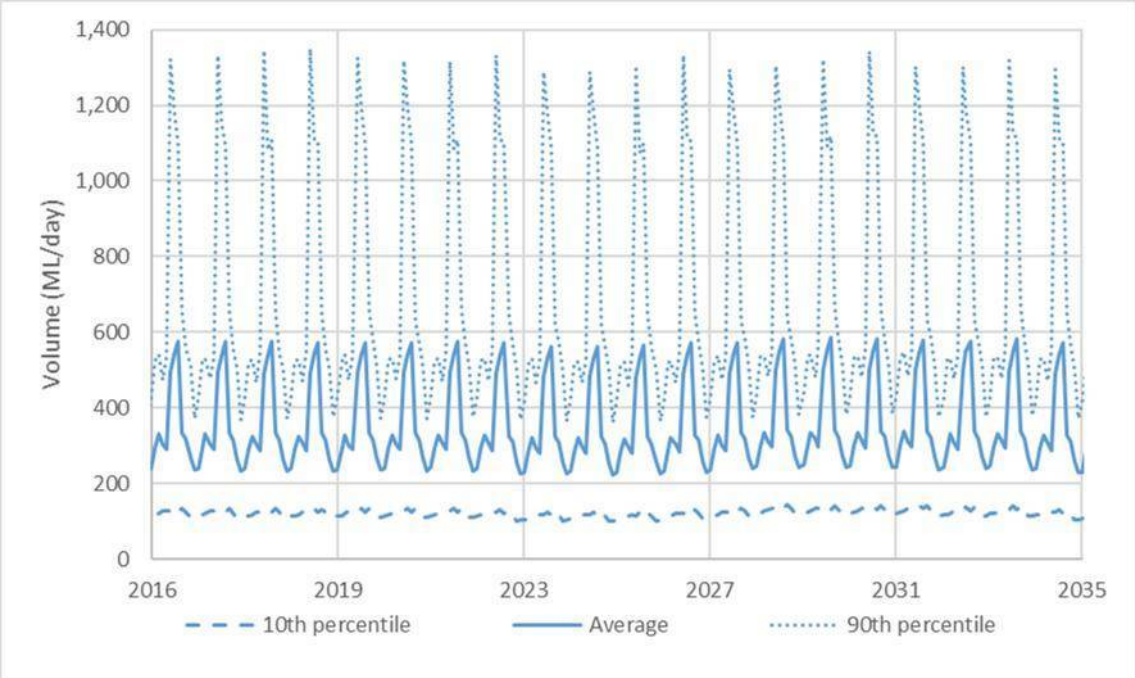


Figure B-30 Scenario 2 – Predicted discharge from Coxs River to Lake Burragorang

Scenario 4

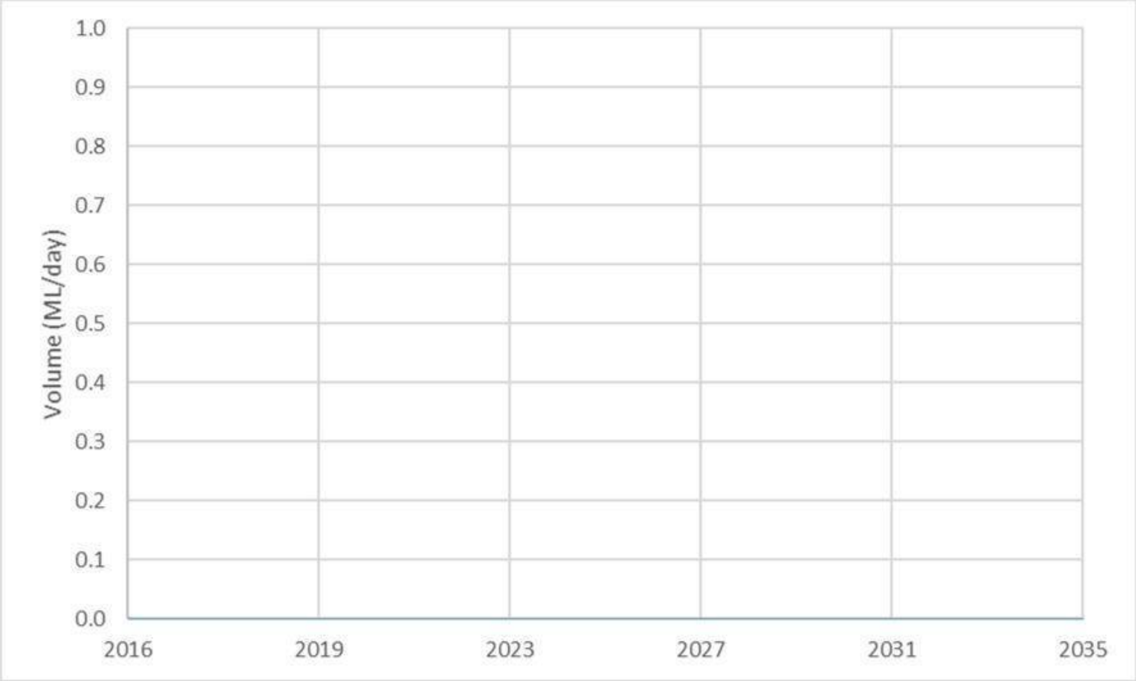


Figure B-31 Scenario 4 – Predicted proposed LDP discharge

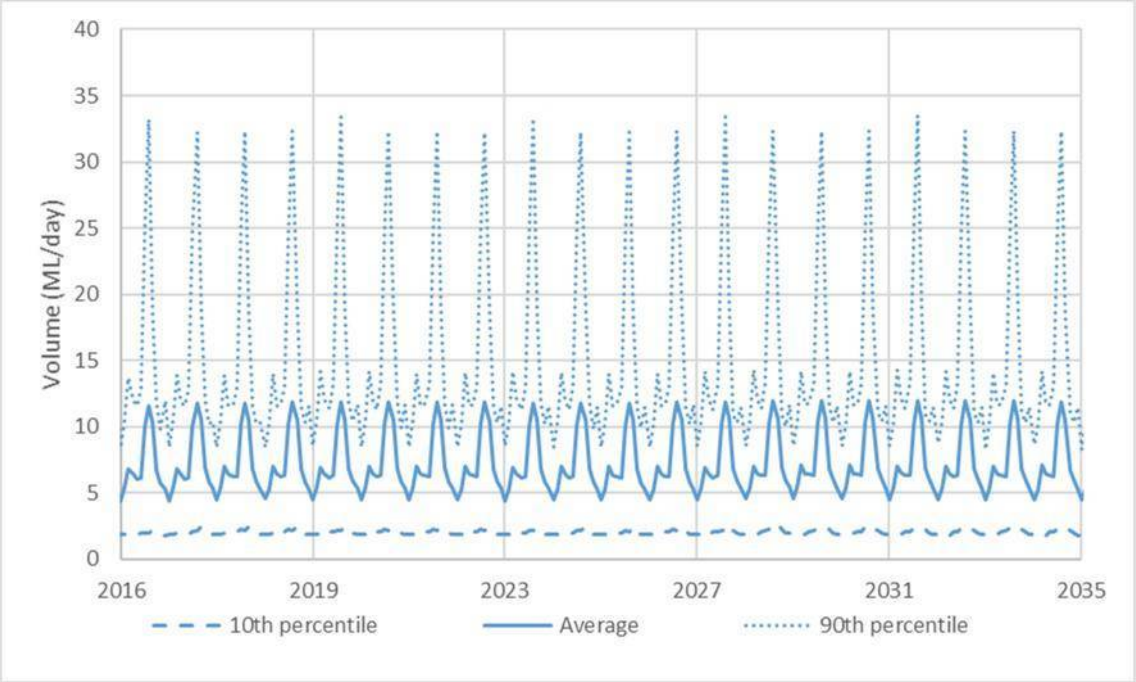


Figure B-32 Scenario 4 – Predicted flow of Wangcol Creek at LDPs

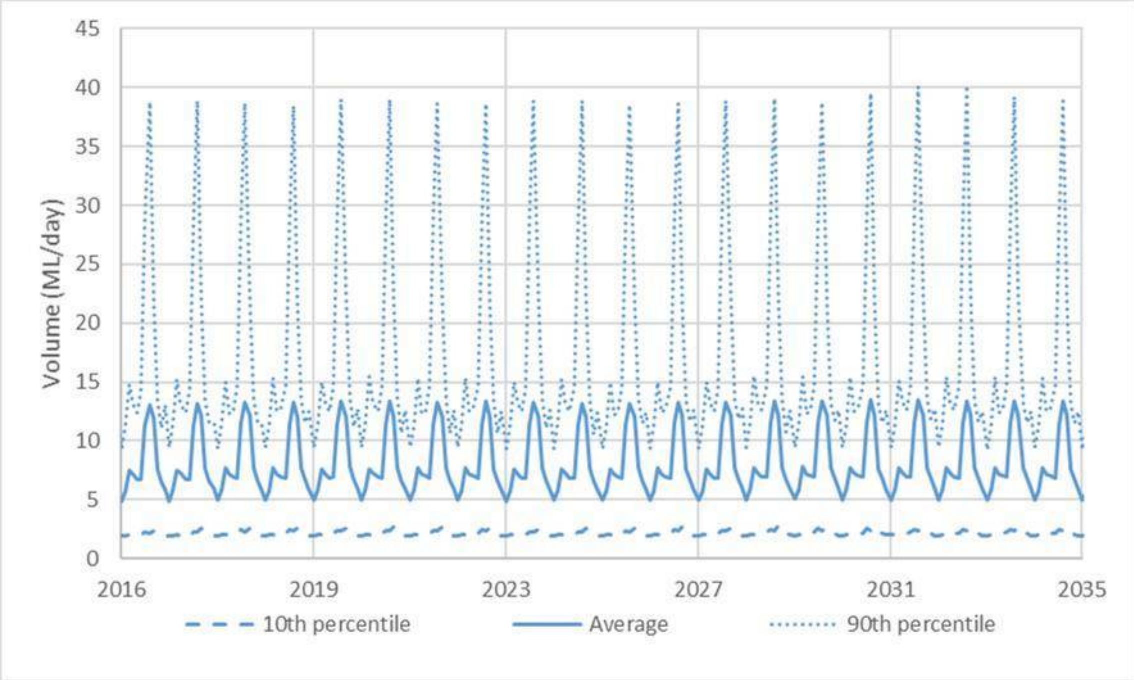


Figure B-33 Scenario 4 – Predicted flow of Wangcol Creek at the confluence with the Coxs River

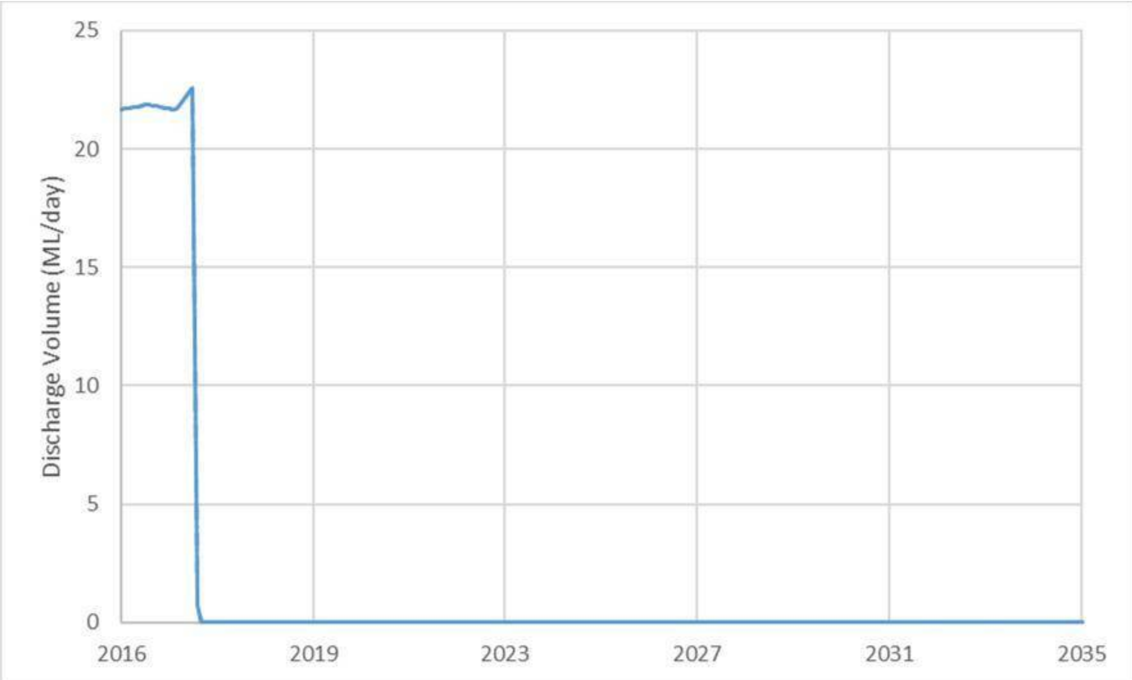


Figure B-34 Scenario 4 – Predicted LDP009 discharge to Sawyers Swamp Creek

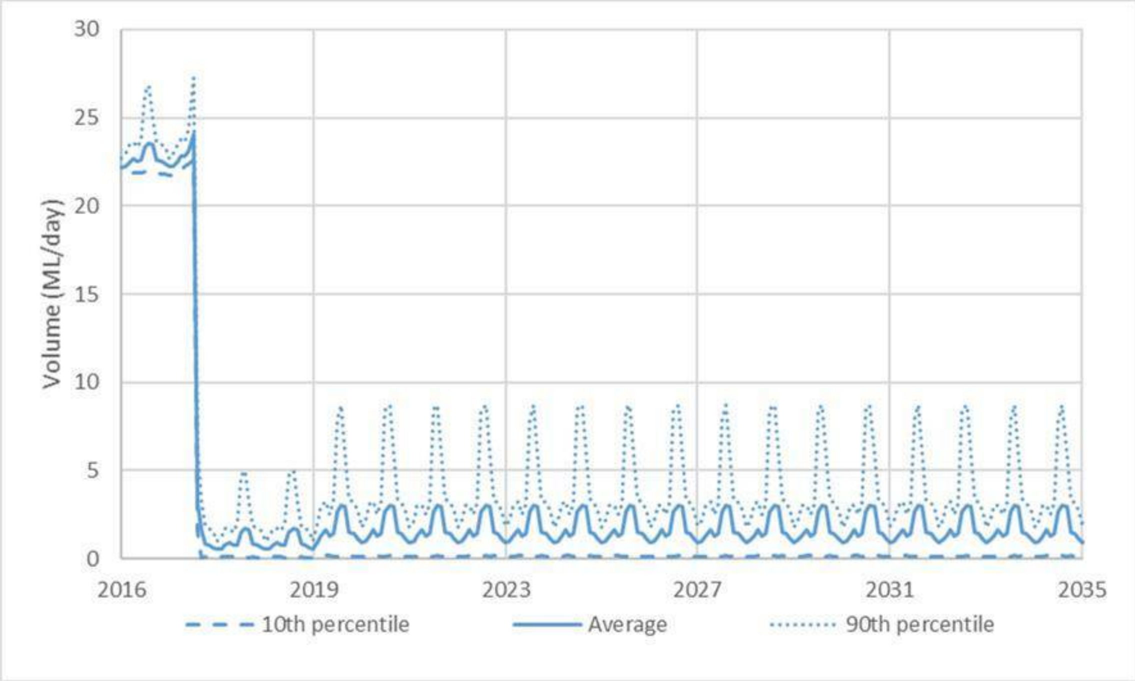


Figure B-35 Scenario 4 – Predicted flow of Sawyers Swamp Creek at the confluence with the Coxs River

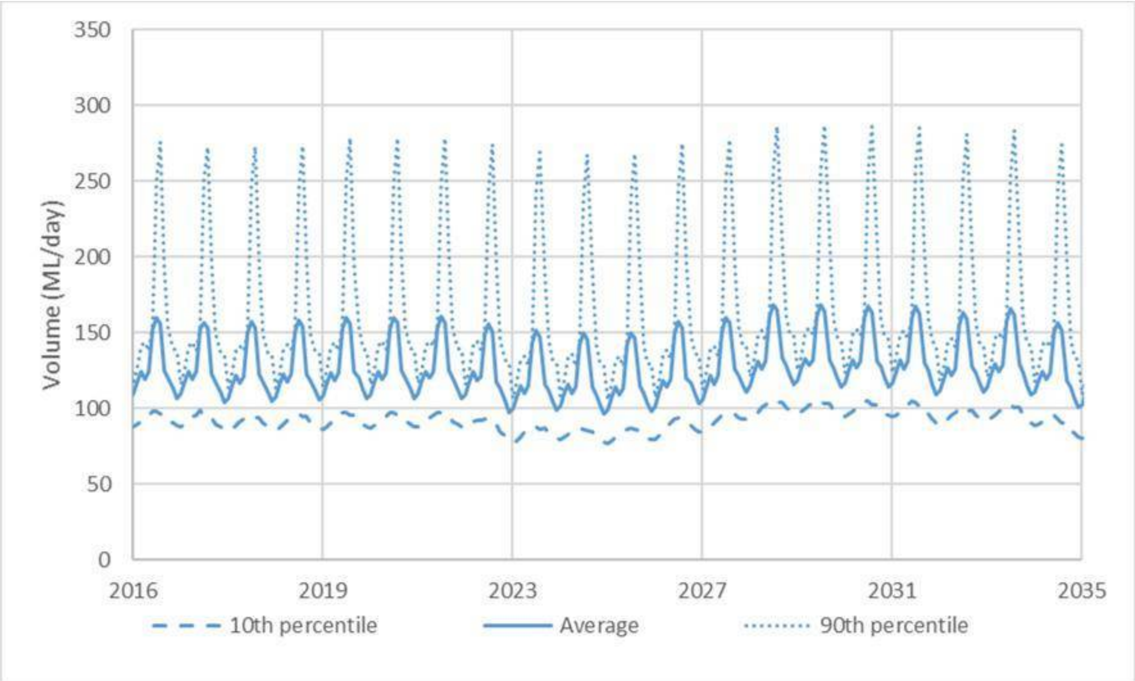


Figure B-36 Scenario 4 – Predicted flow from Coxs River to Lake Wallace

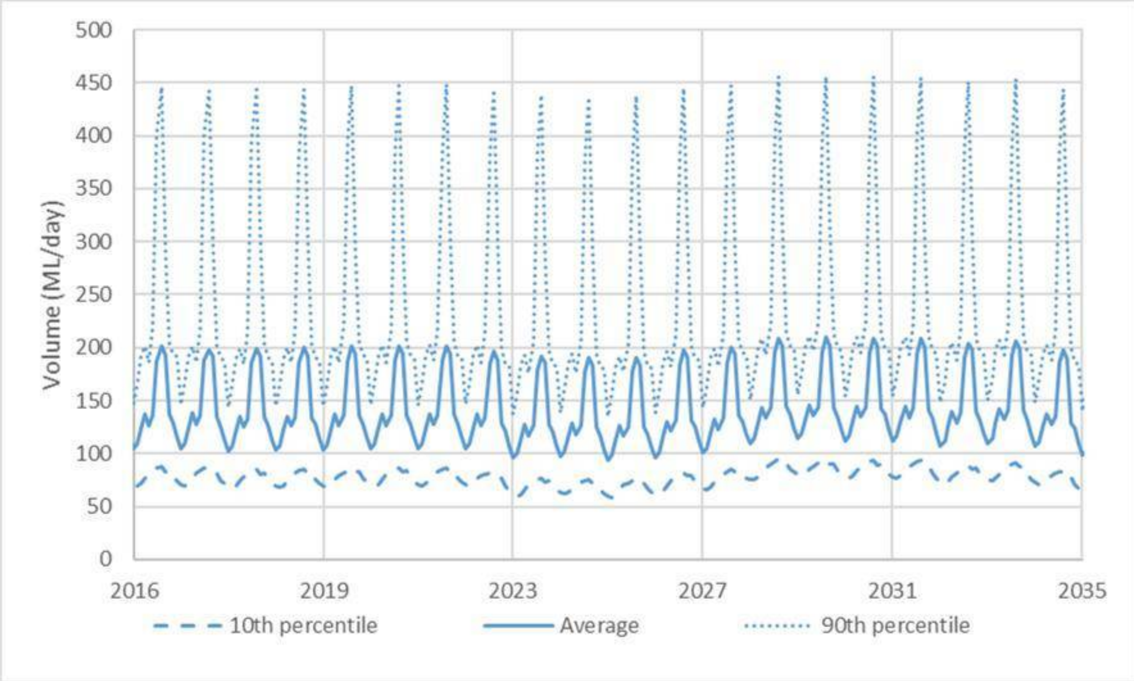


Figure B-37 Scenario 4 – Predicted flow from Coxs River to Lake Lyell

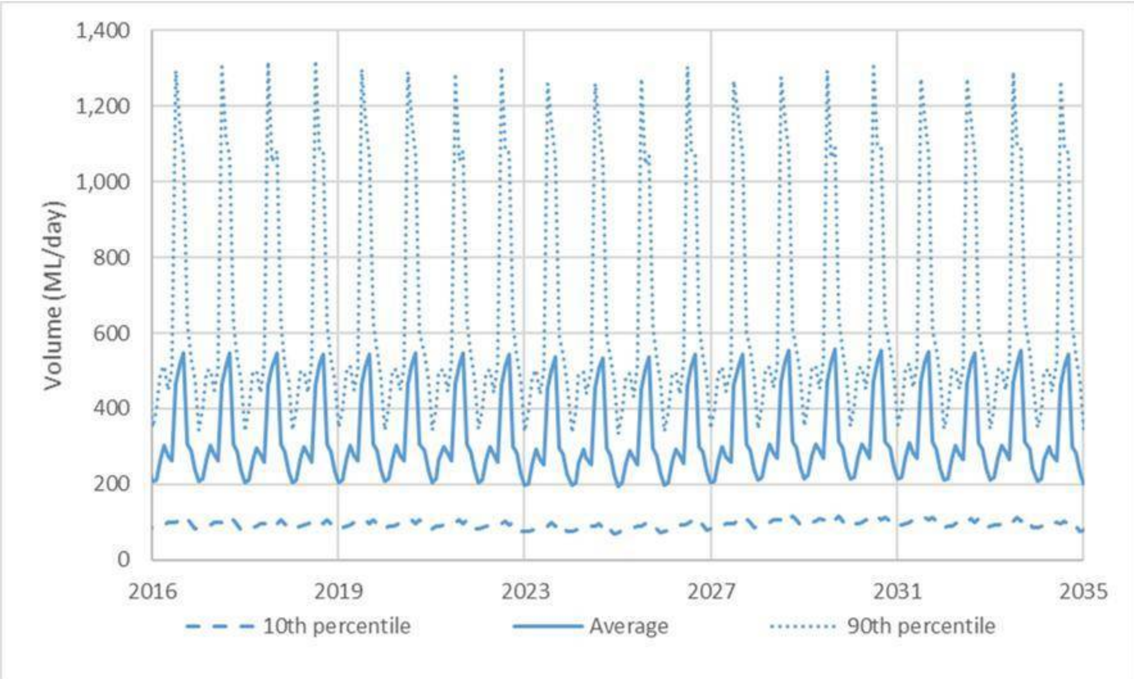


Figure B-38 Scenario 4 – Predicted discharge from Coxs River to Lake Burragorang

Scenario 5

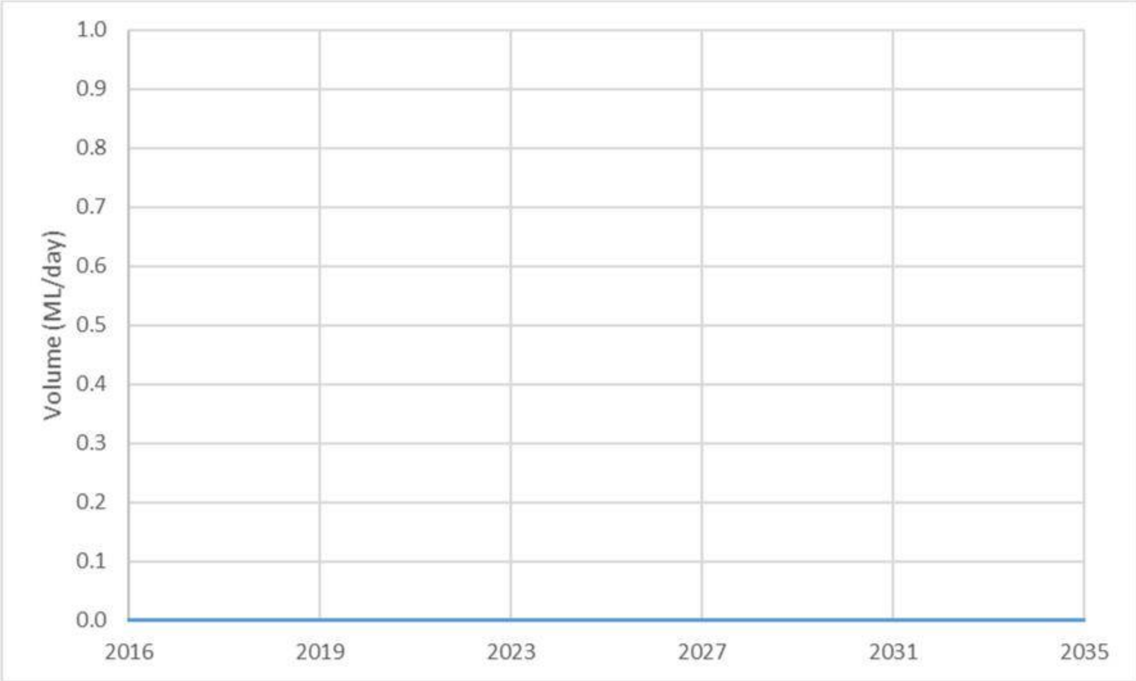


Figure B-39 Scenario 5 – Predicted proposed LDP discharge

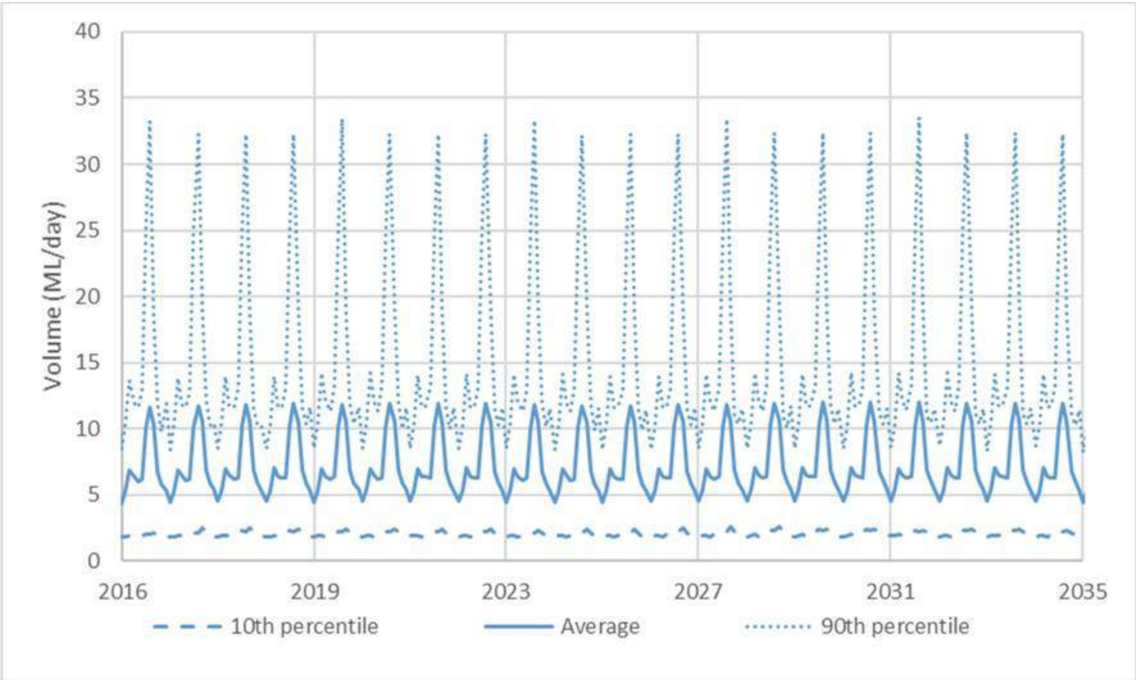


Figure B-40 Scenario 5 – Predicted flow of Wangcol Creek at LDPs

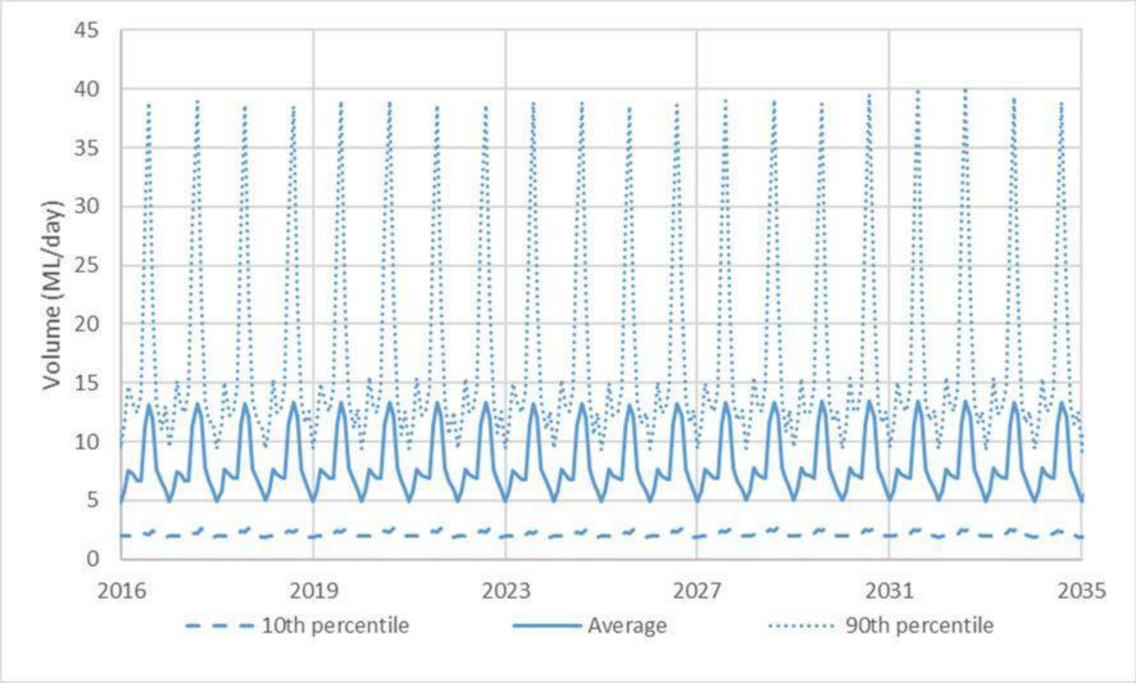


Figure B-41 Scenario 5 – Predicted flow of Wangcol Creek at the confluence with the Coxs River

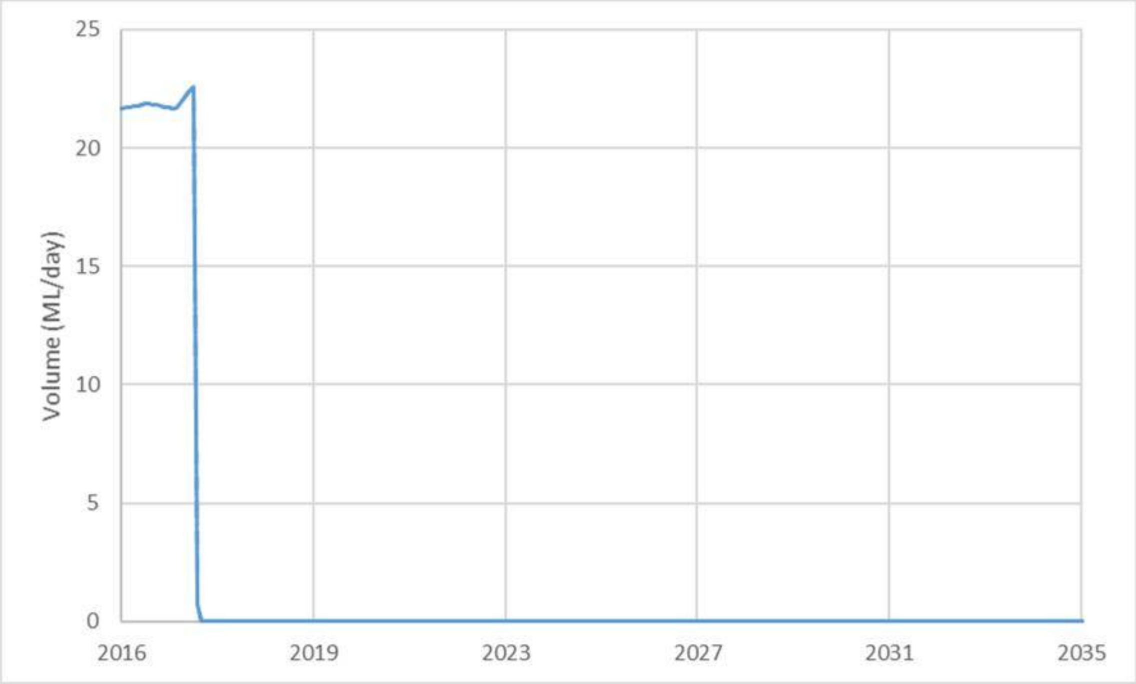


Figure B-42 Scenario 5 – Predicted LDP009 discharge to Sawyers Swamp Creek

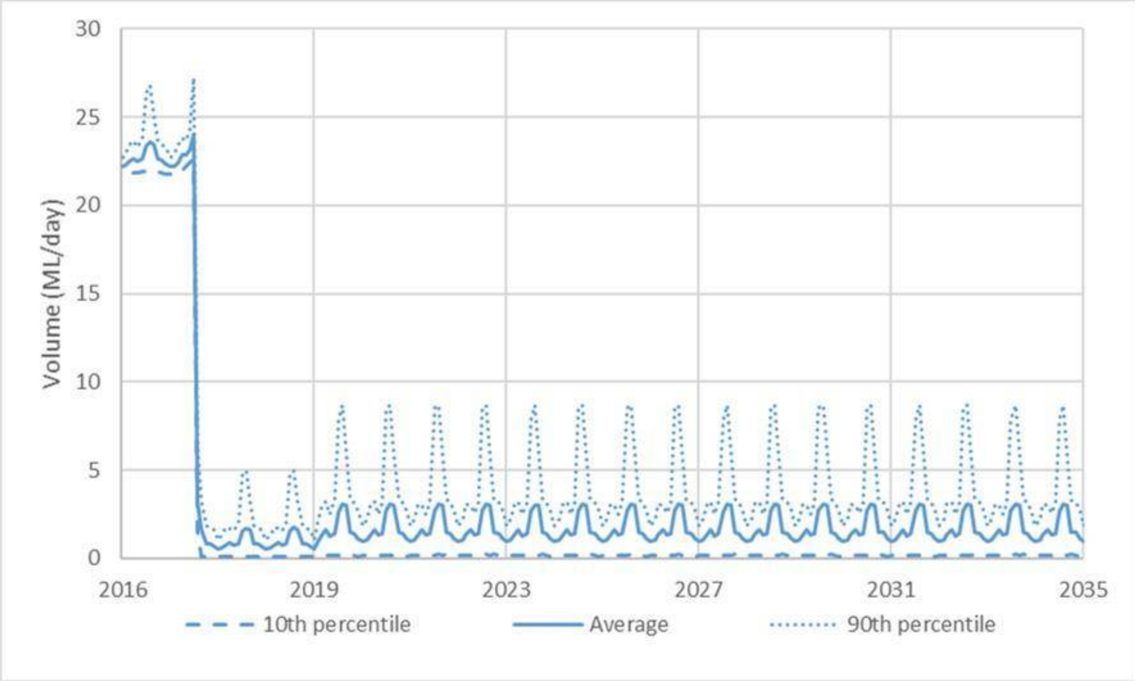


Figure B-43 Scenario 5 – Predicted flow of Sawyers Swamp Creek at the confluence with the Coxs River

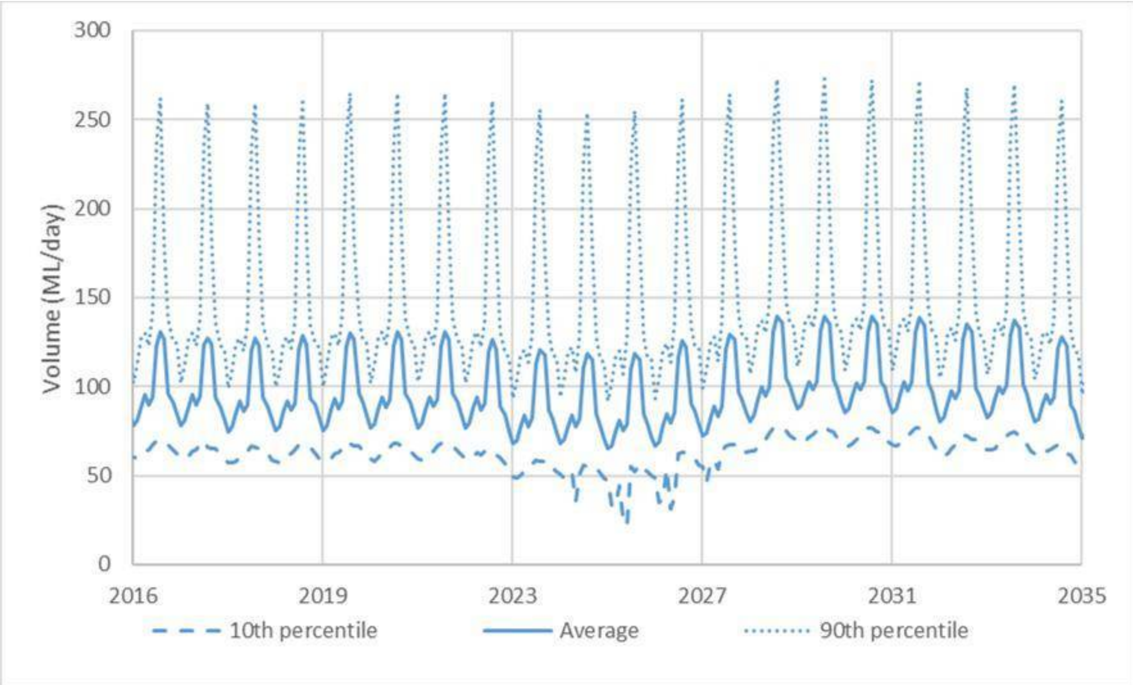


Figure B-44 Scenario 5 – Predicted flow from Coxs River to Lake Wallace

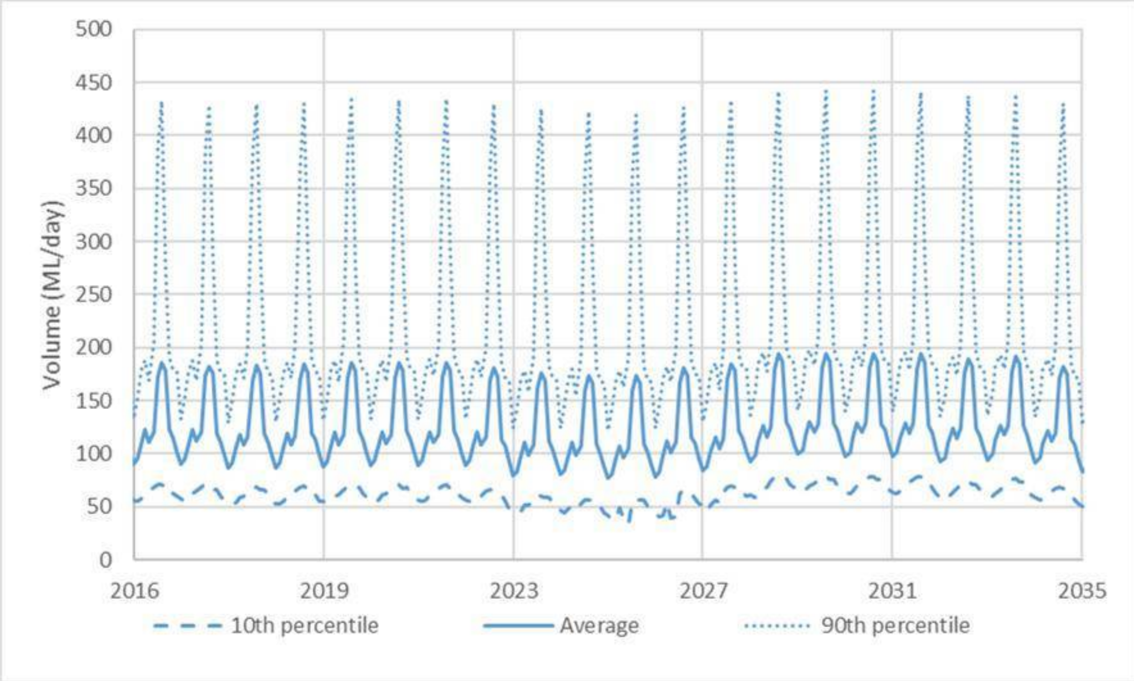


Figure B-45 Scenario 5 – Predicted flow from Coxs River to Lake Lyell

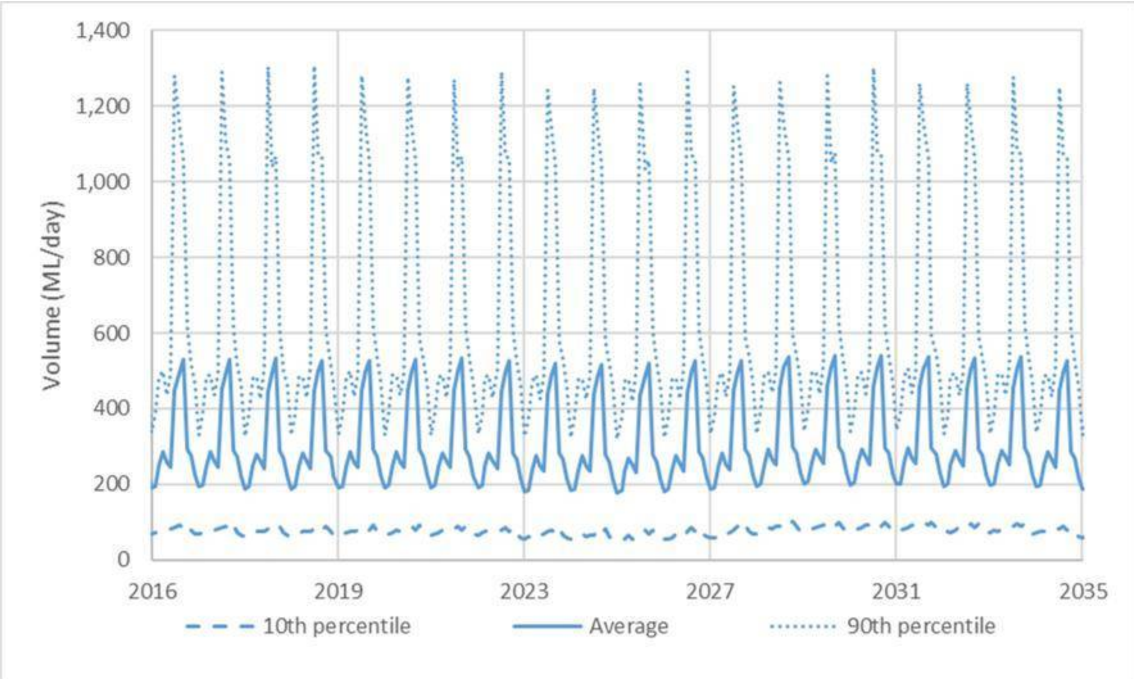
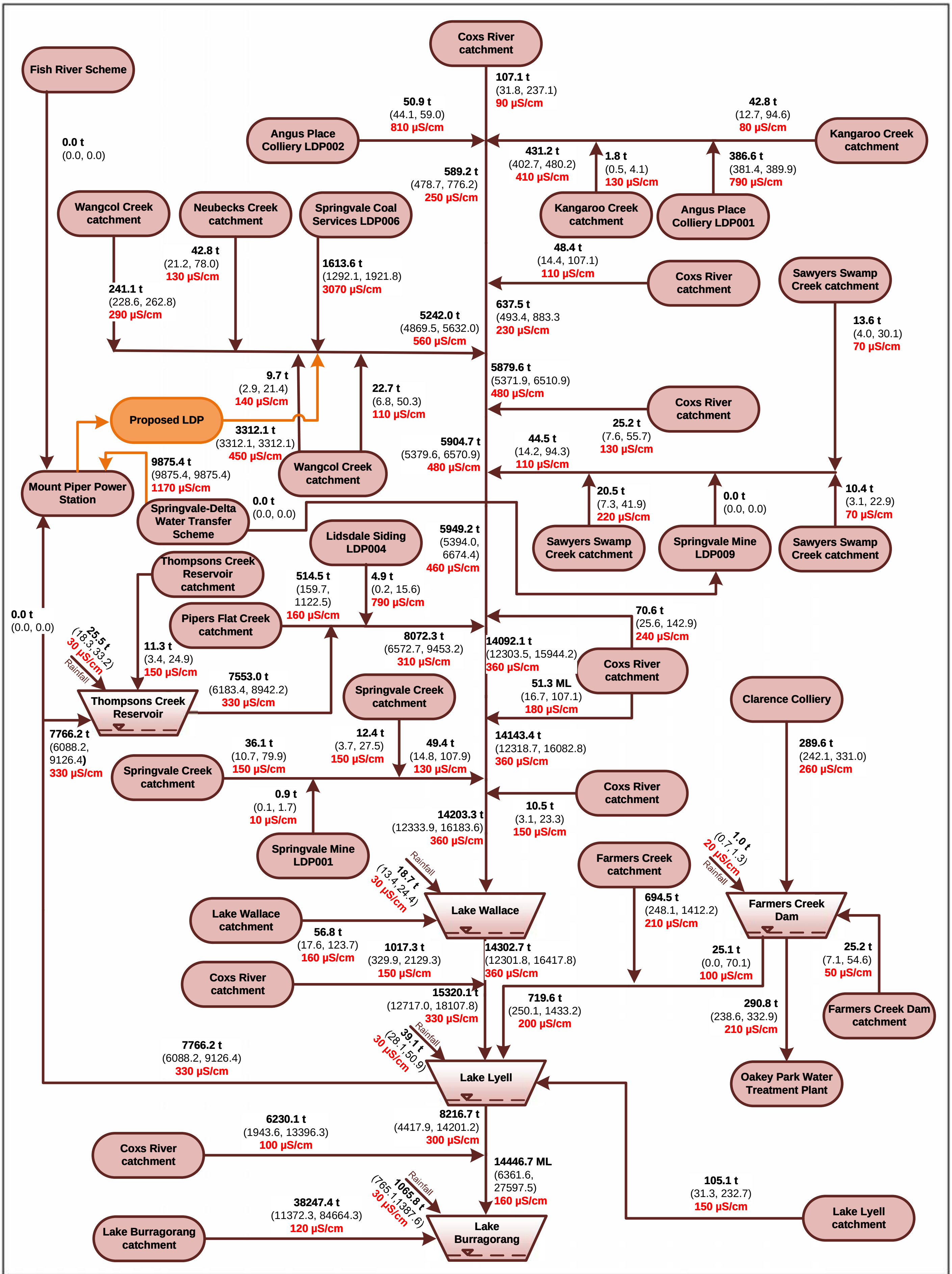


Figure B-46 Scenario 5 – Predicted discharge from Coxs River to Lake Burragorang

B.4.2 Salt balance results

Annual results

The predicted values for each of the salt transfers within the Coxs River catchment for proposed conditions in 2030 are provided in Figure B-47, Figure B-48, Figure B-49 and Figure B-50 for scenarios 1, 2, 4 and 5 respectively.



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

GHD

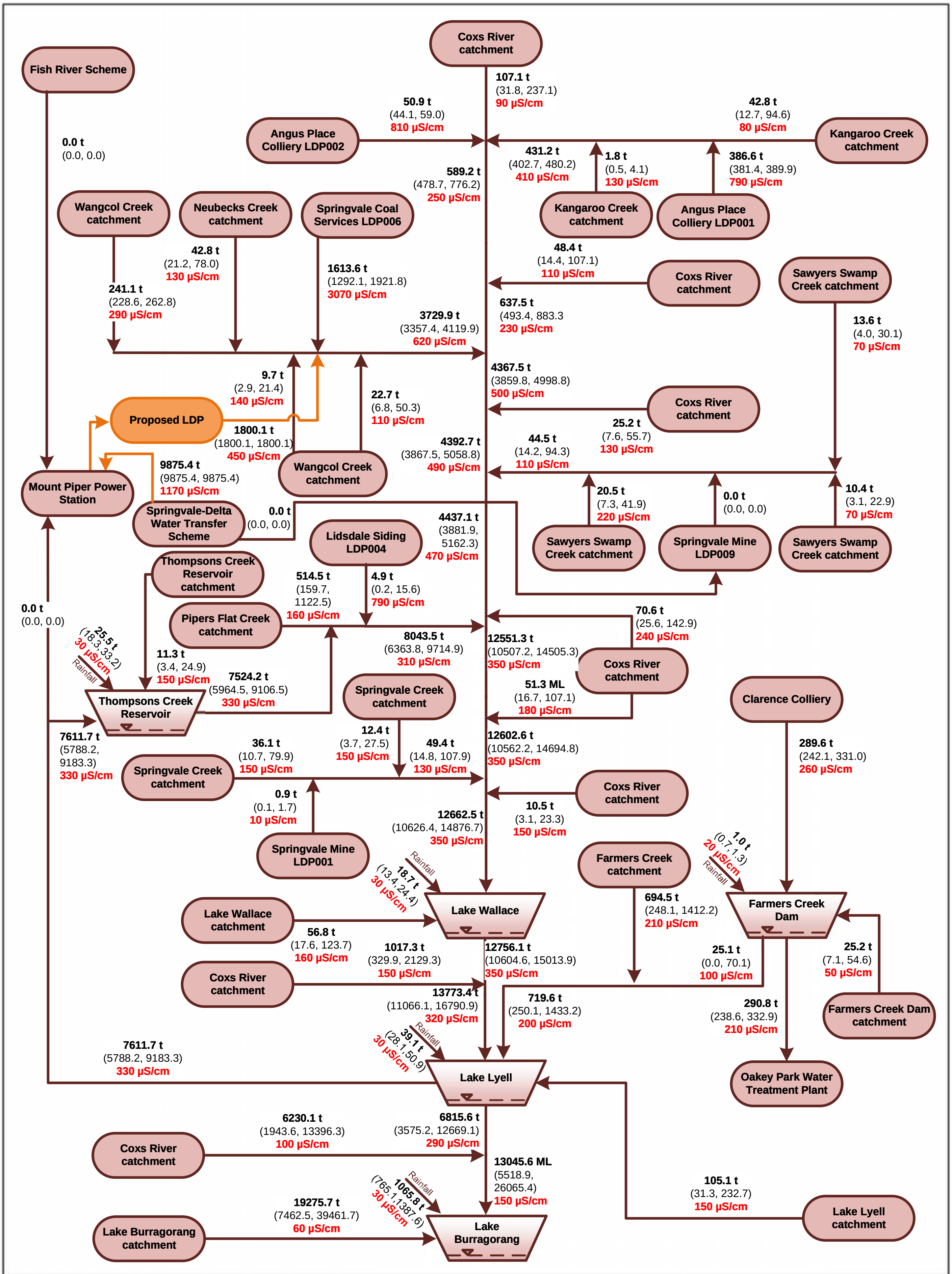
Springvale Water Treatment Project
Water Resources Impact Assessment

Annual salt transfers
Proposed conditions (2030)
Scenario 1

Centennial Coal
EnergyAustralia

DATE Jul 2016

Figure B-47



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

GHD

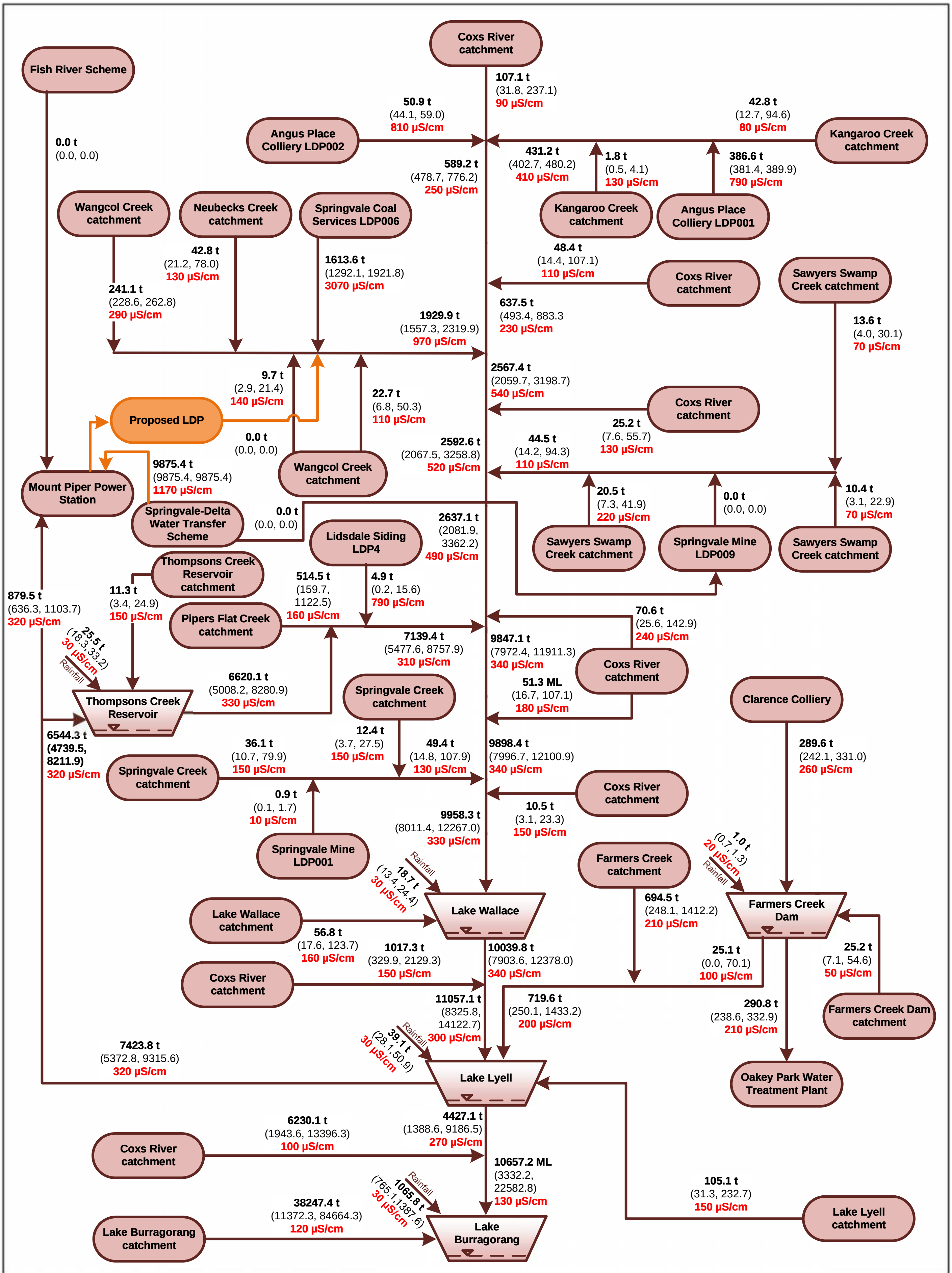
Springvale Water Treatment Project
Water Resources Impact Assessment

Annual salt transfers
Proposed conditions (2030)
Scenario 2

Centennial Coal
EnergyAustralia

DATE Jul 2016

Figure B-47



LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

GHD

Springvale Water Treatment Project
Water Resources Impact Assessment

Annual salt transfers
Proposed conditions (2030)
Scenario 4

Centennial Coal
EnergyAustralia

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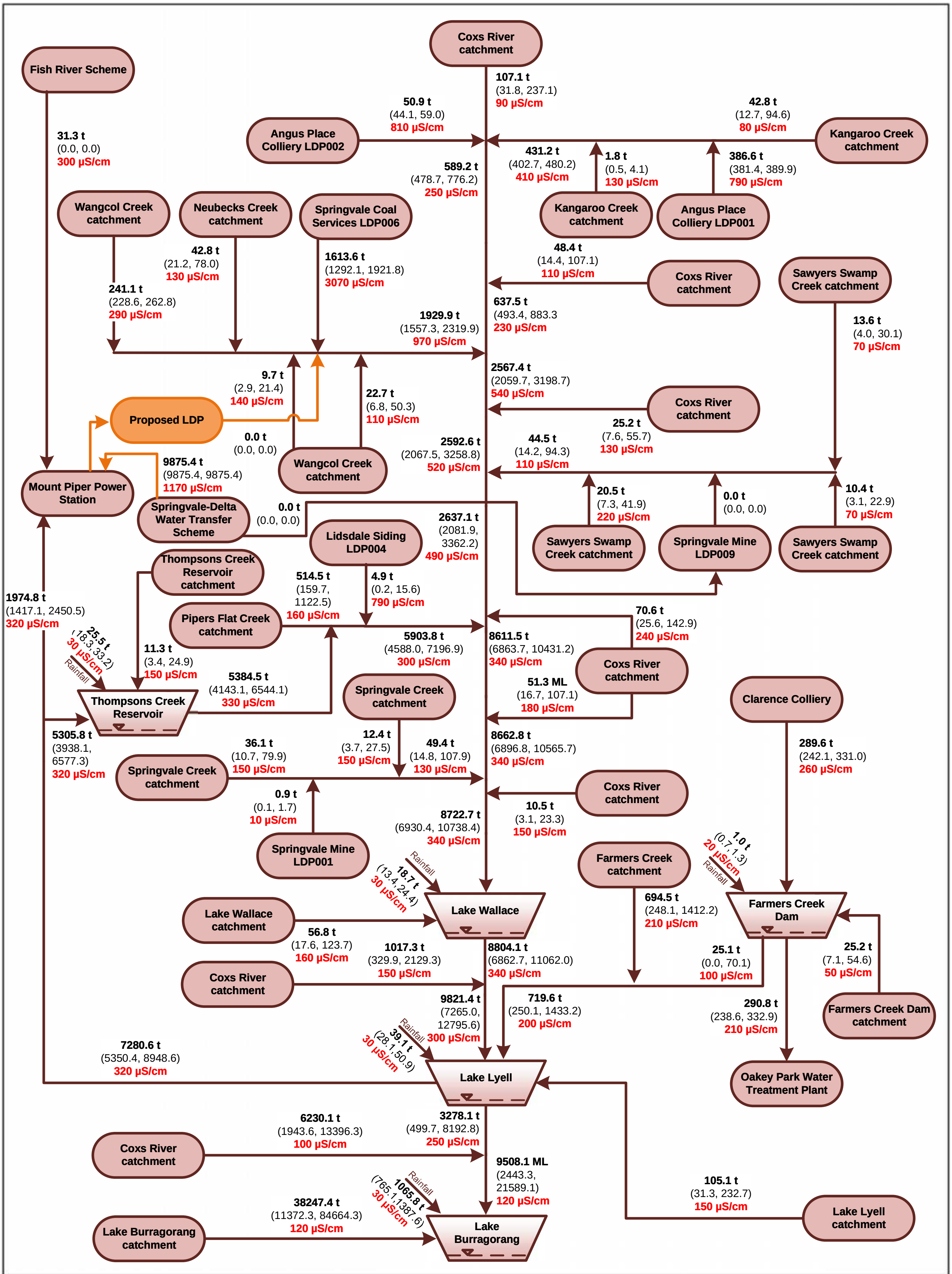

LOCATION	Coxs River
SEAM	NA
DRAWN	SM
CHECKED	TD
APPROVED	LH
SCALE	NTS

Springvale Water Treatment Project
Water Resources Impact Assessment

Annual salt transfers
Proposed conditions (2030)
Scenario 5

Centennial Coal
EnergyAustralia

DATE Jul 2016

Figure B-50

Time series results

Monthly average time series results are presented for scenarios 1, 2, 4 and 5 are presented in Figure B-51 to B-82.

Scenario 1

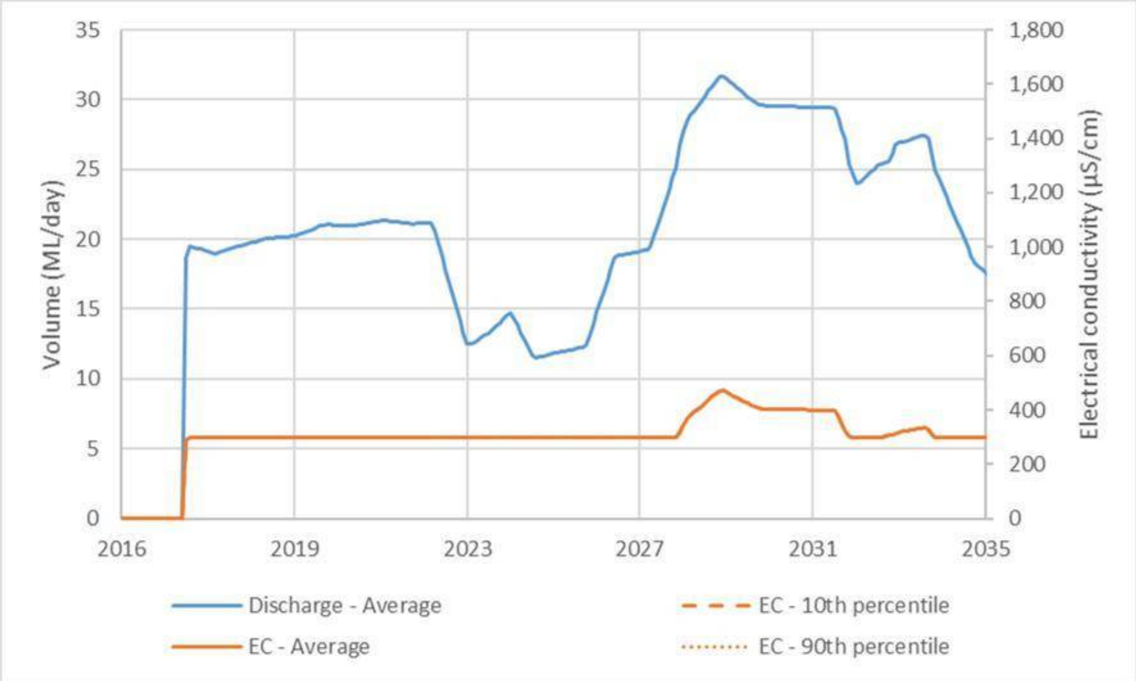

Figure B-51 Scenario 1 – Predicted EC of proposed LDP discharge

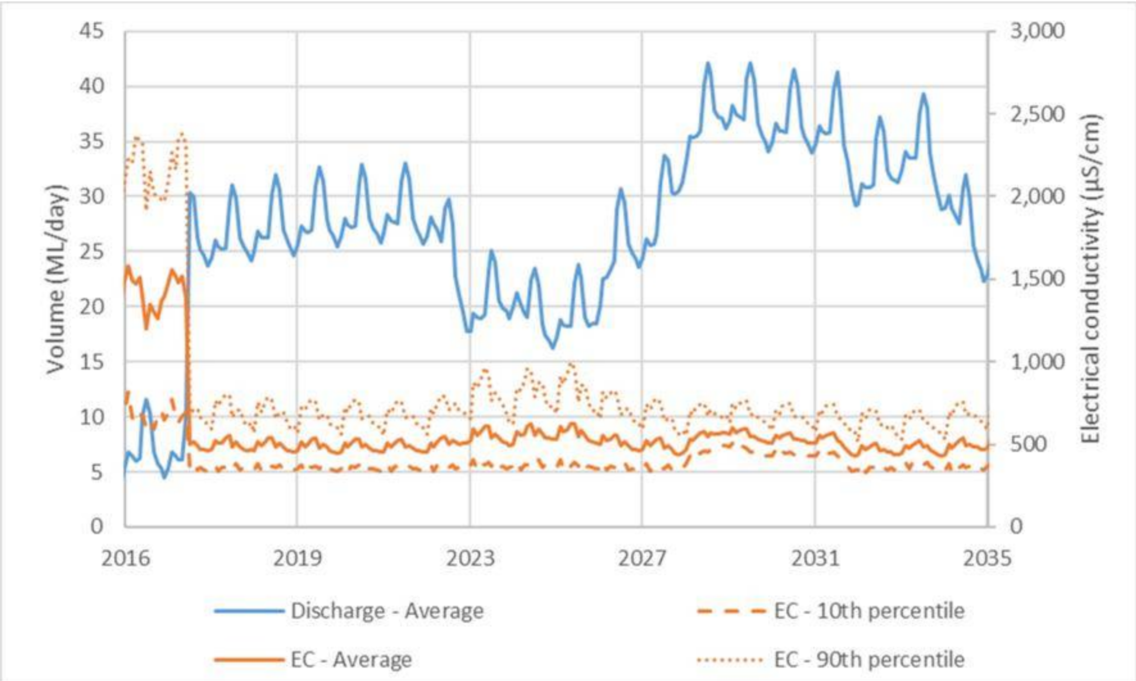

Figure B-52 Scenario 1 – Predicted EC of discharge of Wangcol Creek at LDPs

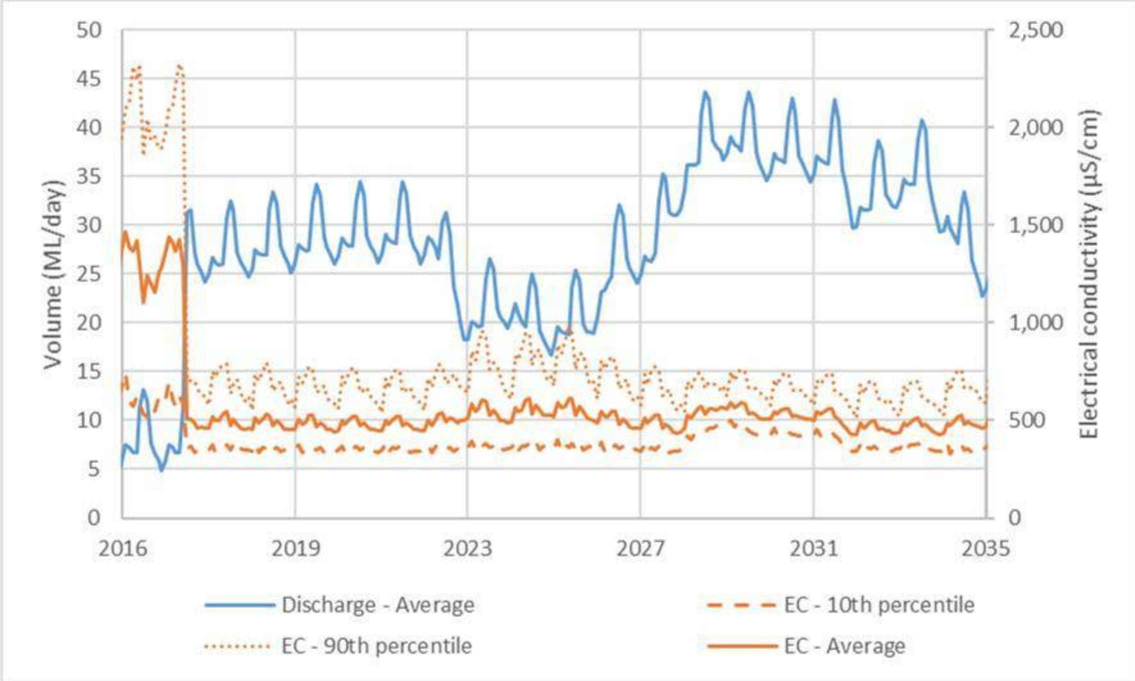

Figure B-53 Scenario 1 – Predicted EC of discharge from Wangcol Creek to Coxs River

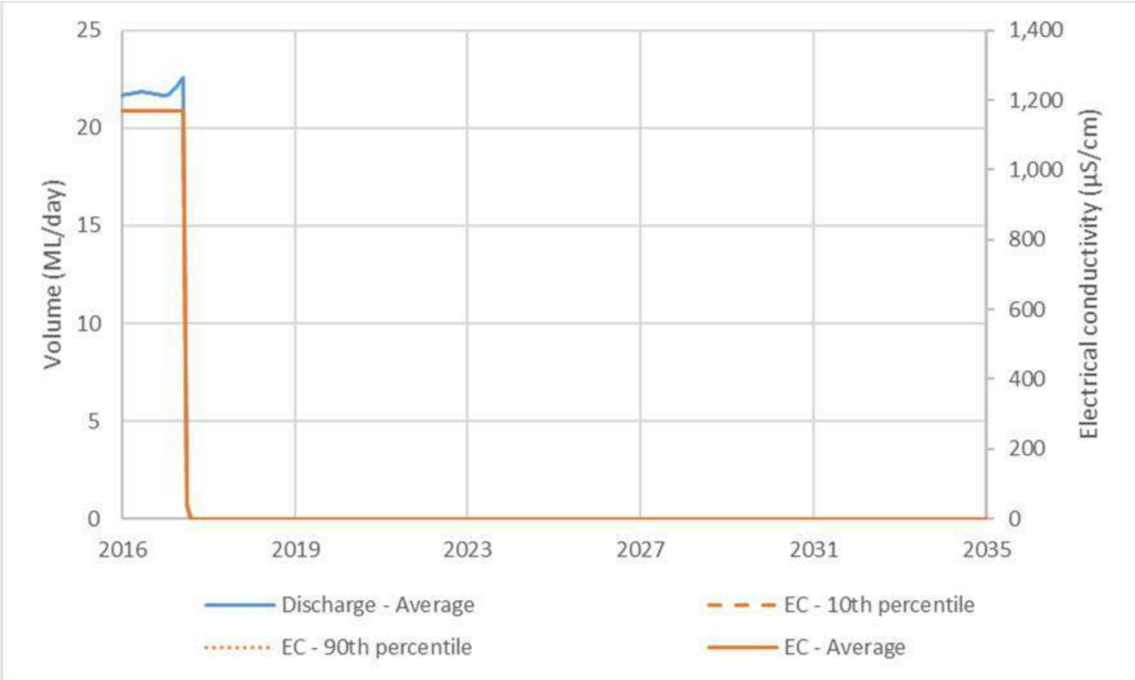

Figure B-54 Scenario 1 – Predicted EC of LDP009 discharge to Sawyers Swamp Creek

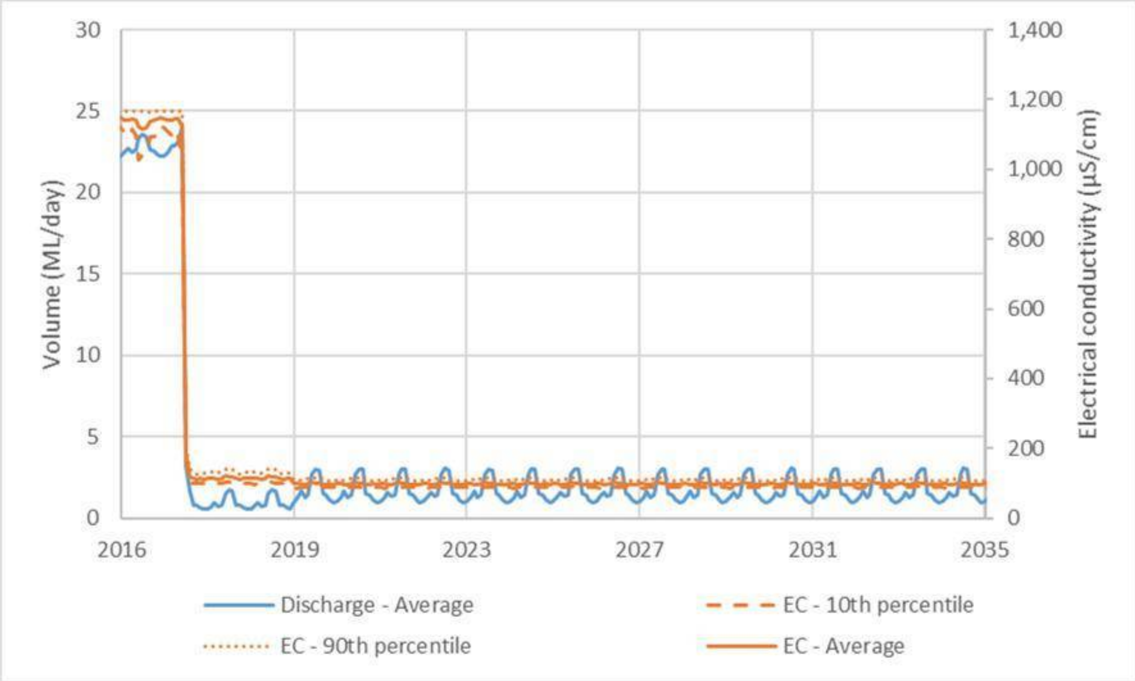

Figure B-55 Scenario 1 – Predicted EC of discharge from Sawyers Swamp Creek to Coxs River

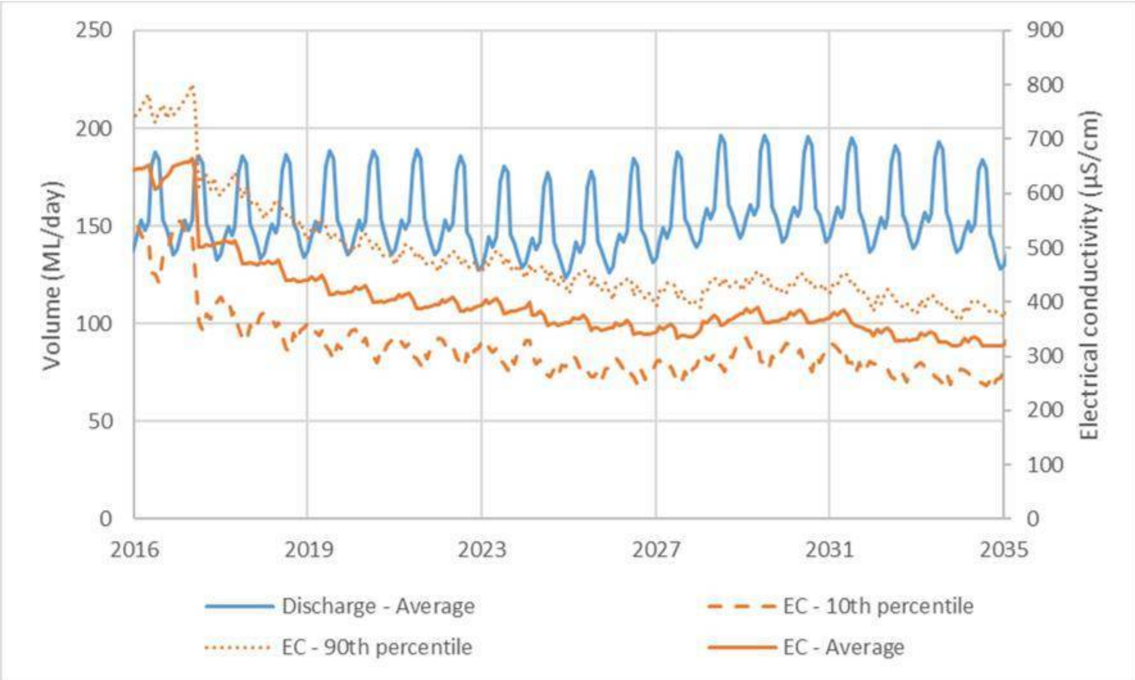

Figure B-56 Scenario 1 – Predicted EC of discharge from Coxs River to Lake Wallace

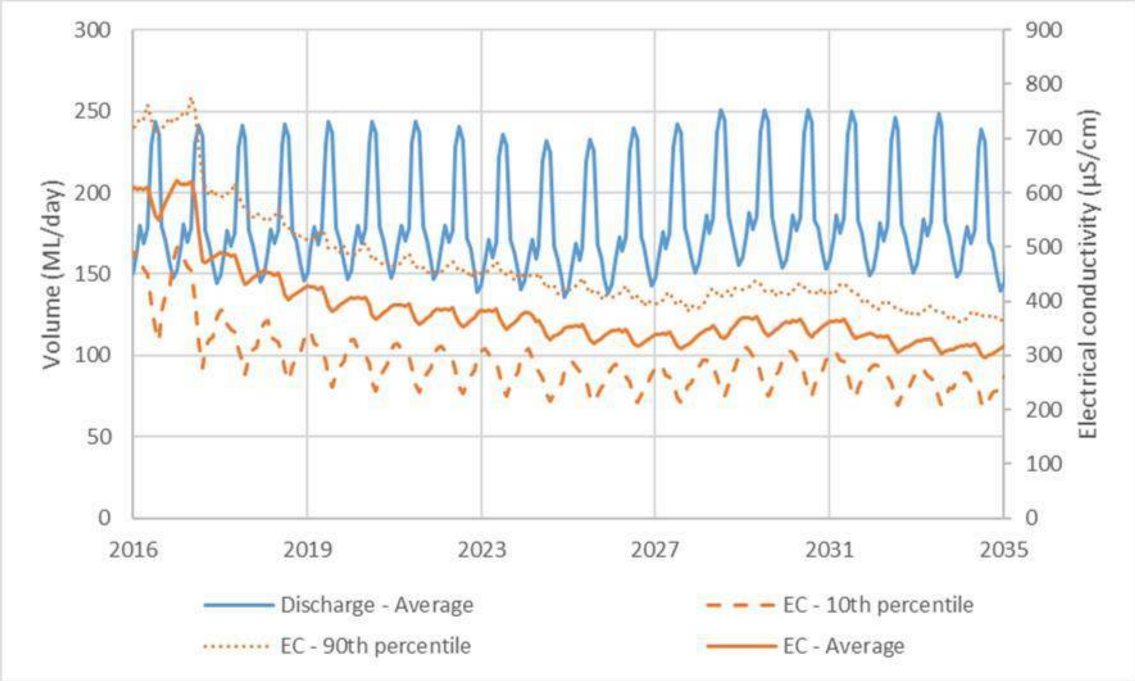

Figure B-57 Scenario 1 – Predicted EC of discharge from Coxs River to Lake Lyell

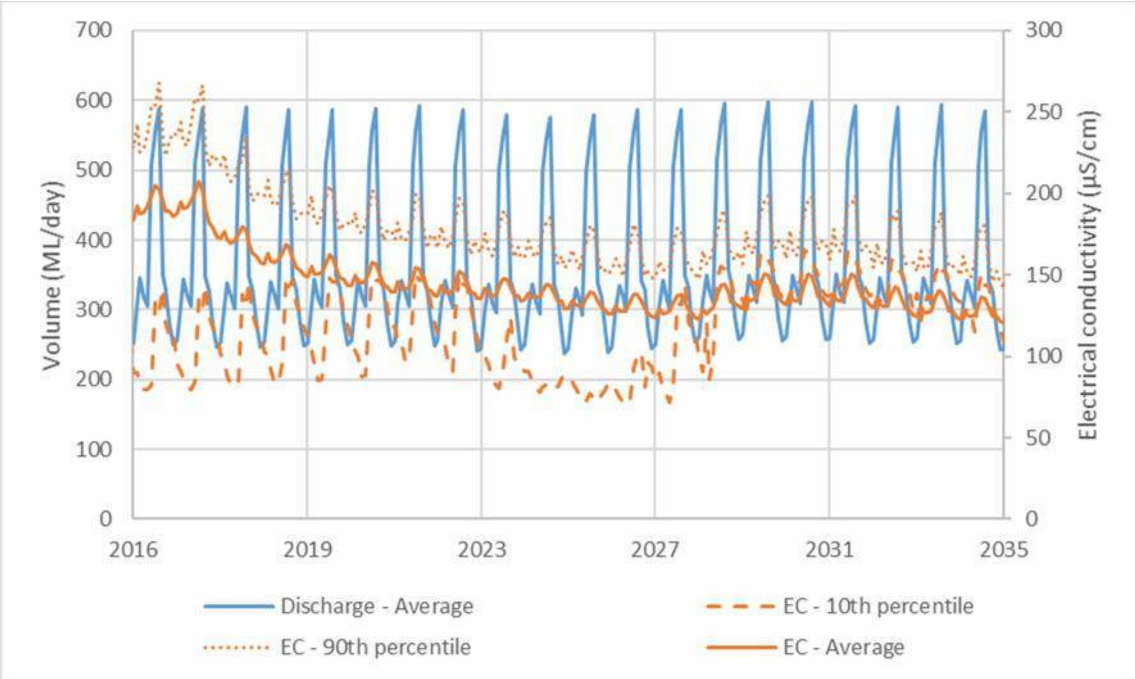

Figure B-58 Scenario 1 – Predicted EC of discharge from Coxs River to Lake Burragorang

Scenario 2

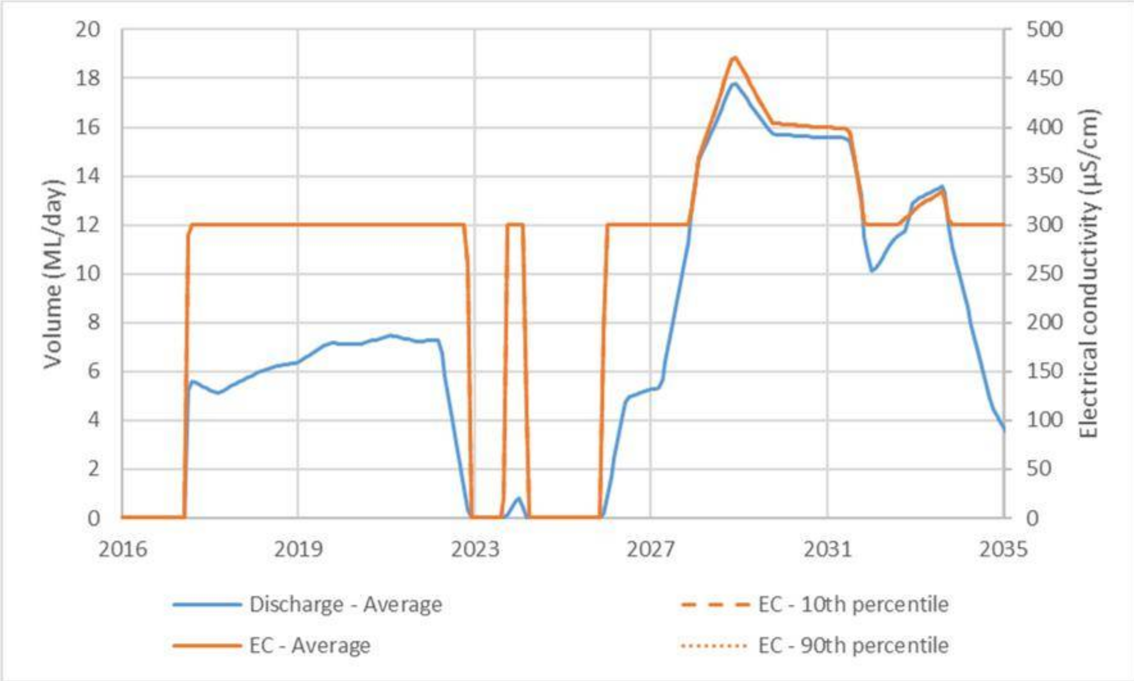

Figure B-59 Scenario 2 – Predicted EC of proposed LDP discharge

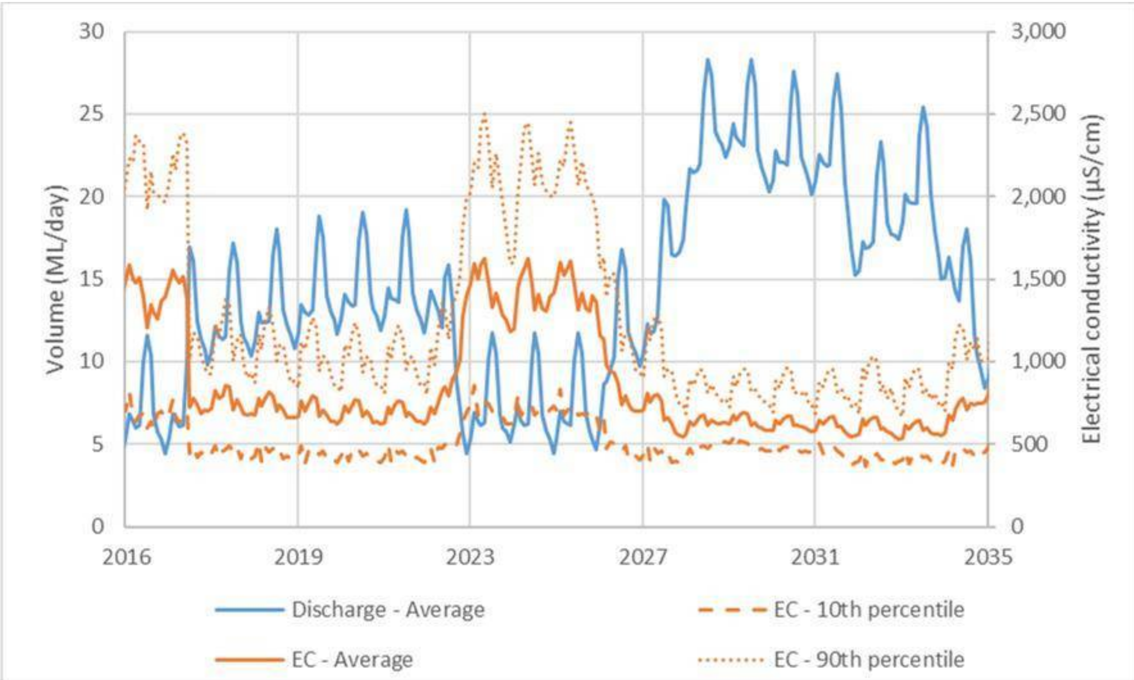

Figure B-60 Scenario 2 – Predicted EC of discharge of Wangcol Creek at LDPs

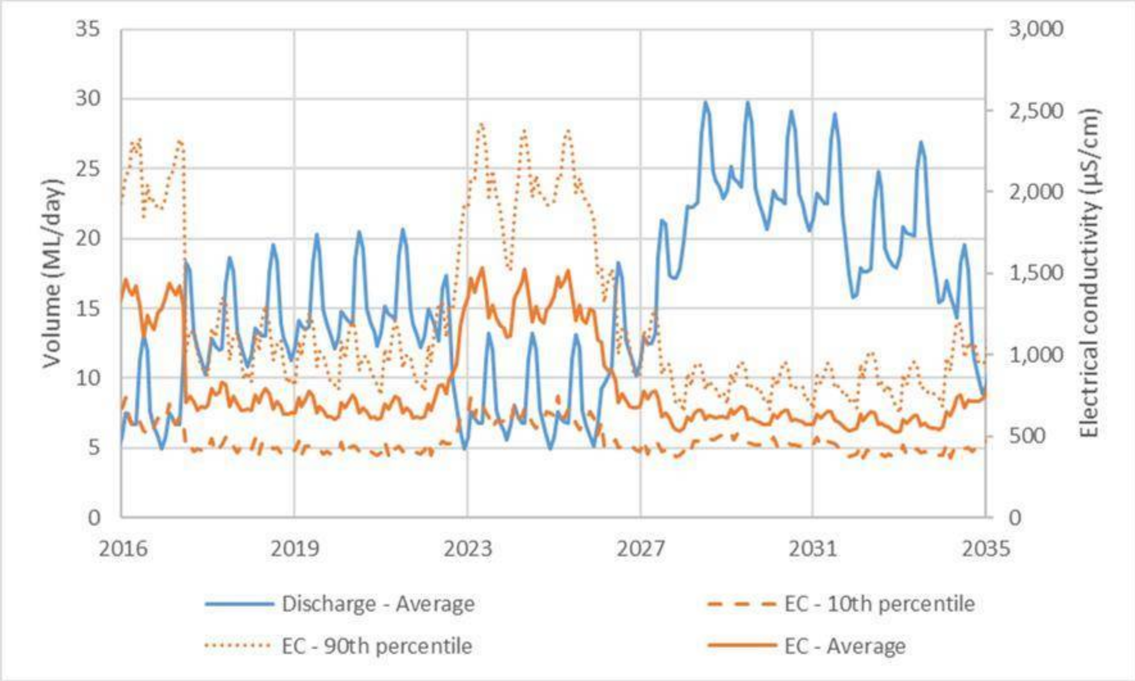

Figure B-61 Scenario 2 – Predicted EC of discharge from Wangcol Creek to Coxs River

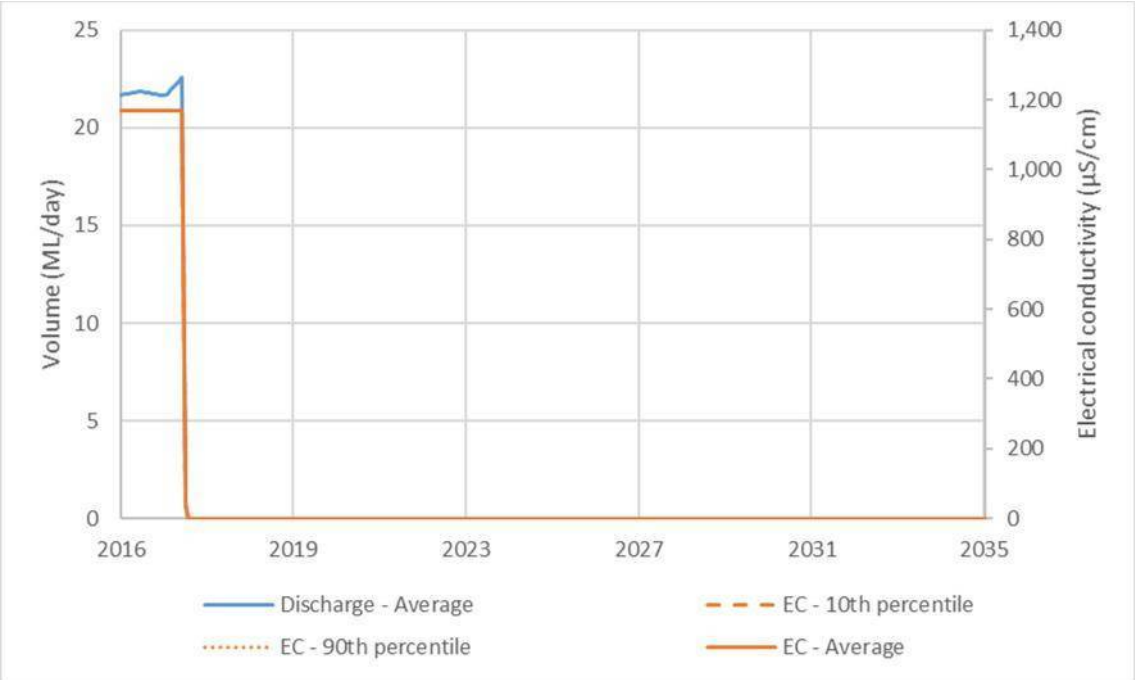

Figure B-62 Scenario 2 – Predicted EC of LDP009 discharge to Sawyers Swamp Creek

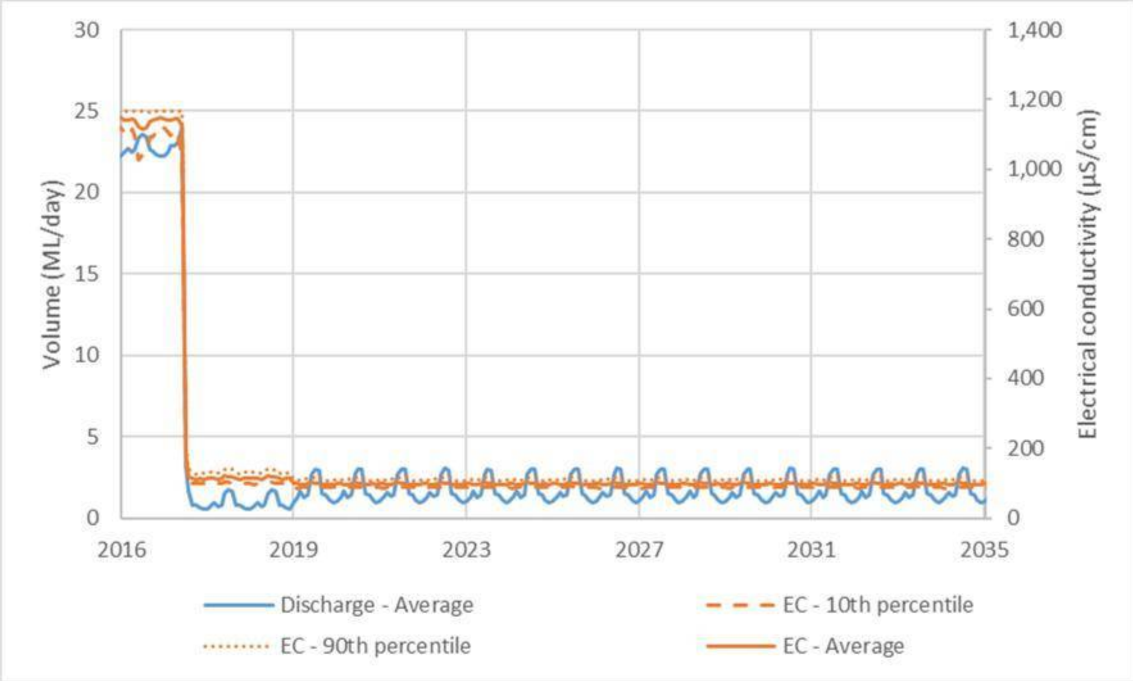

Figure B-63 Scenario 2 – Predicted EC of discharge from Sawyers Swamp Creek to Coxs River

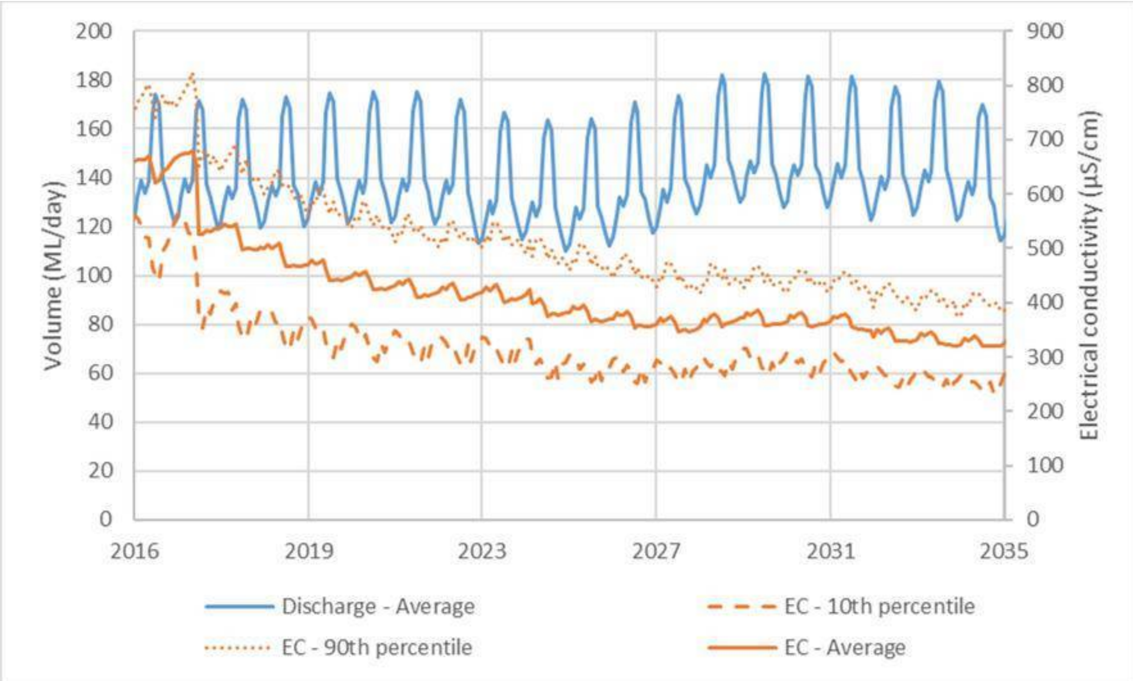

Figure B-64 Scenario 2 – Predicted EC of discharge from Coxs River to Lake Wallace

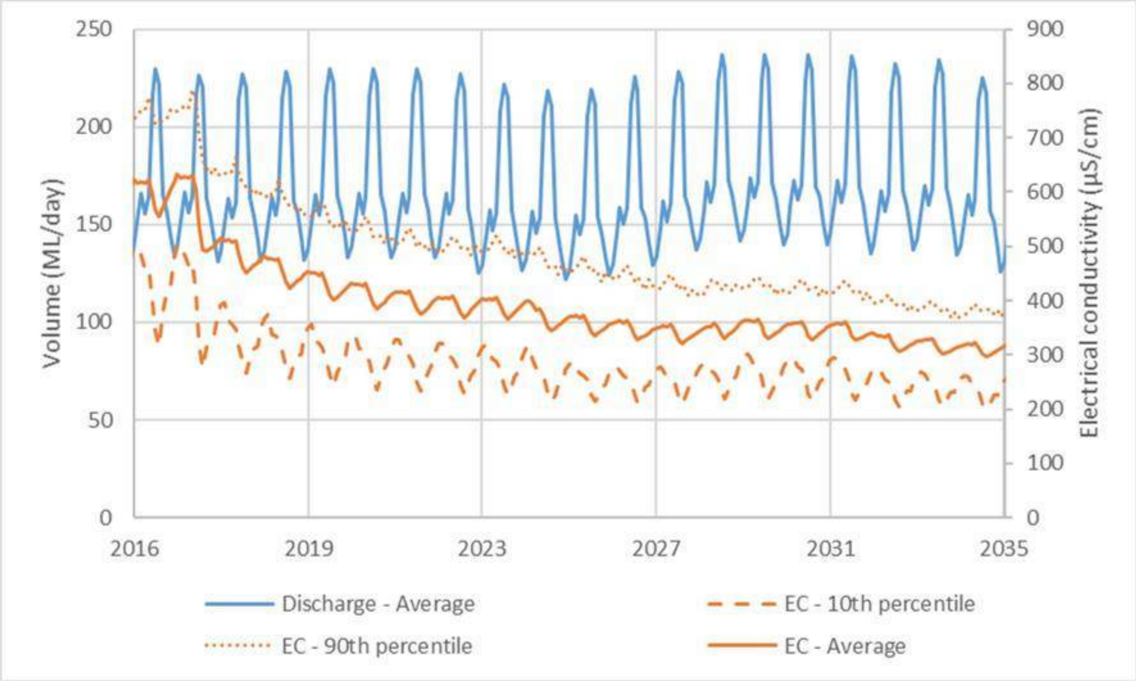

Figure B-65 Scenario 2 – Predicted EC of discharge from Coxs River to Lake Lyell

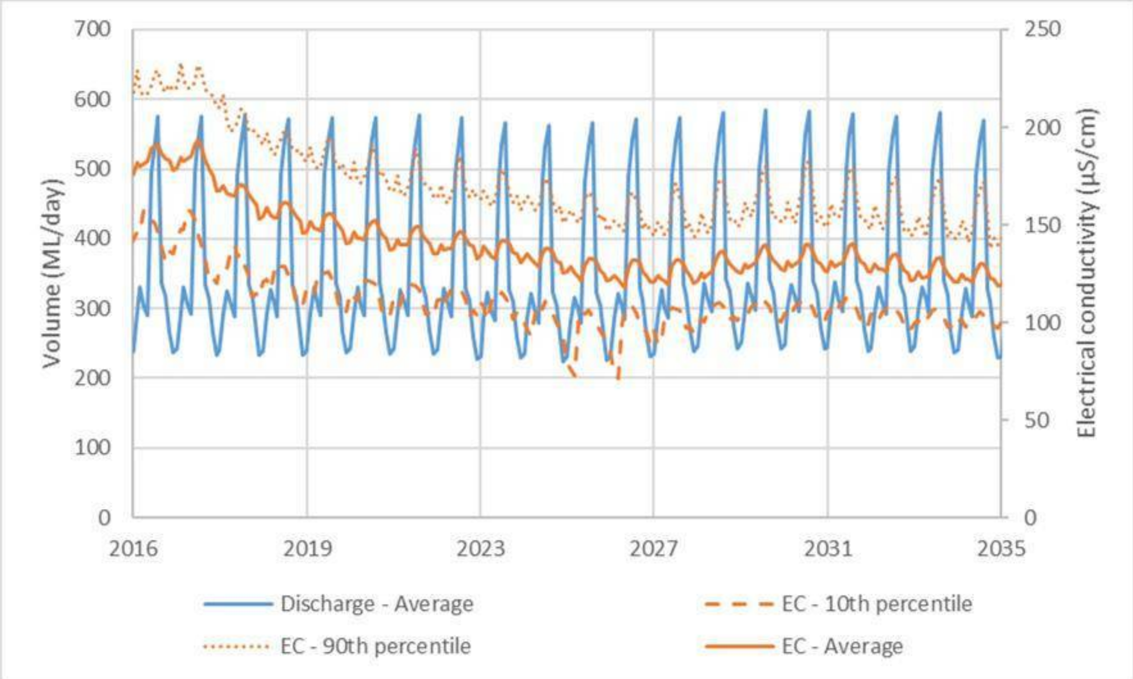

Figure B-66 Scenario 2 – Predicted EC of discharge from Coxs River to Lake Burragorang

Scenario 4

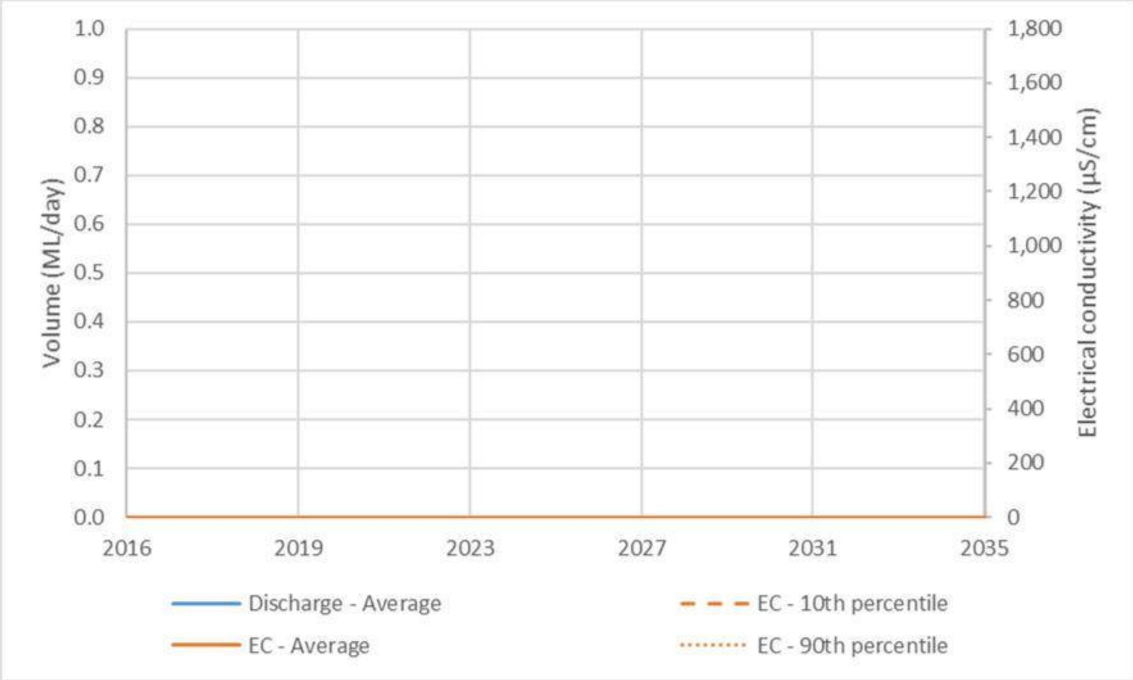

Figure B-67 Scenario 4 – Predicted EC of proposed LDP discharge

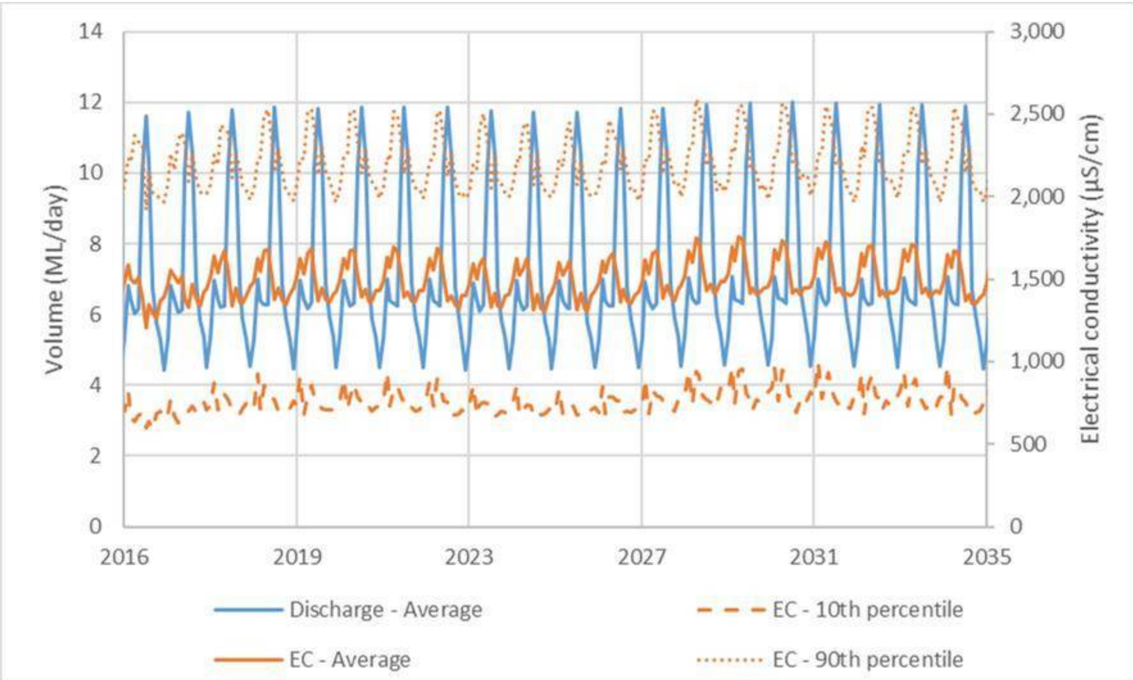

Figure B-68 Scenario 4 – Predicted EC of discharge of Wangcol Creek at LDPs

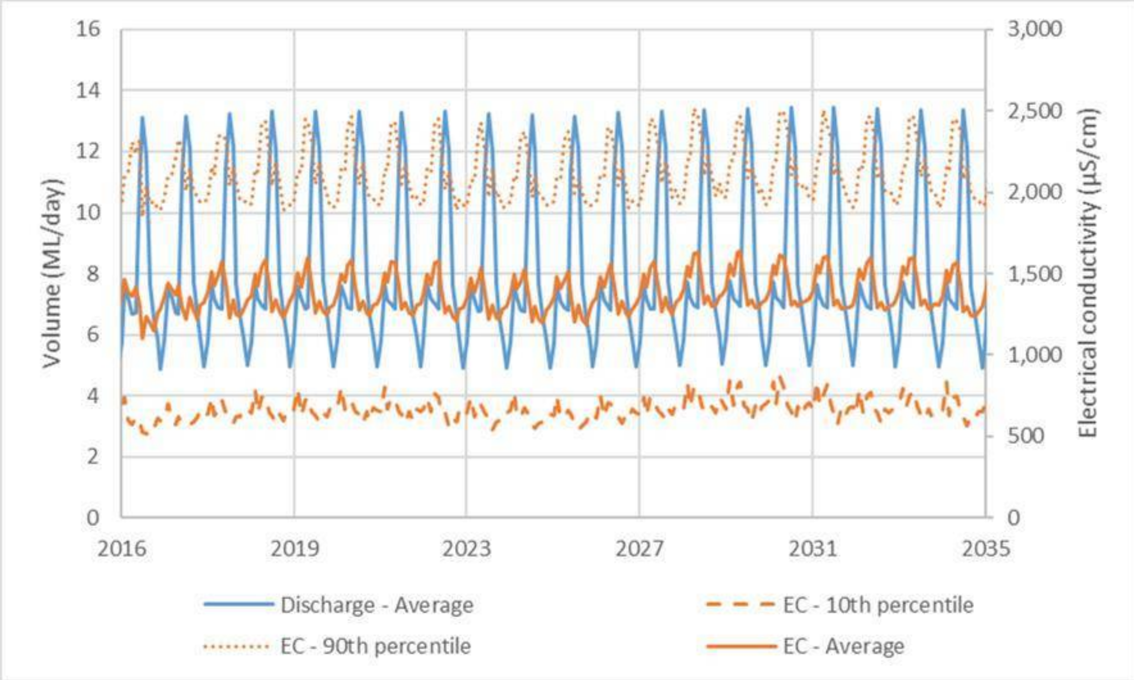

Figure B-69 Scenario 4 – Predicted EC of discharge from Wangcol Creek to Coxs River

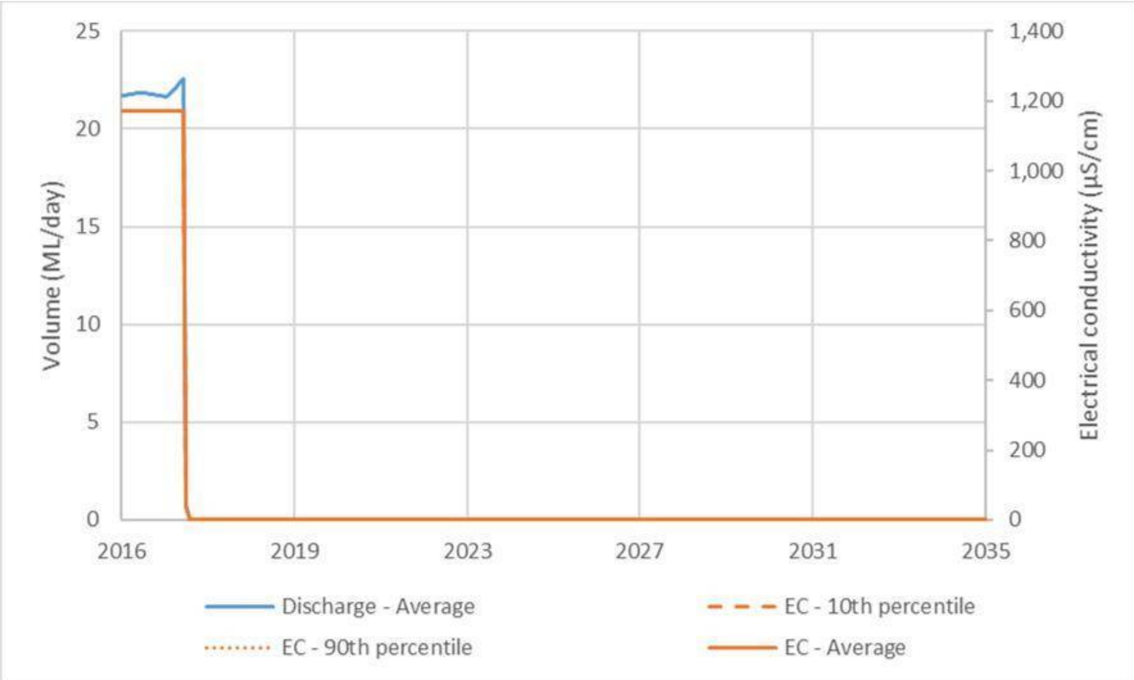

Figure B-70 Scenario 4 – Predicted EC of LDP009 discharge to Sawyers Swamp Creek

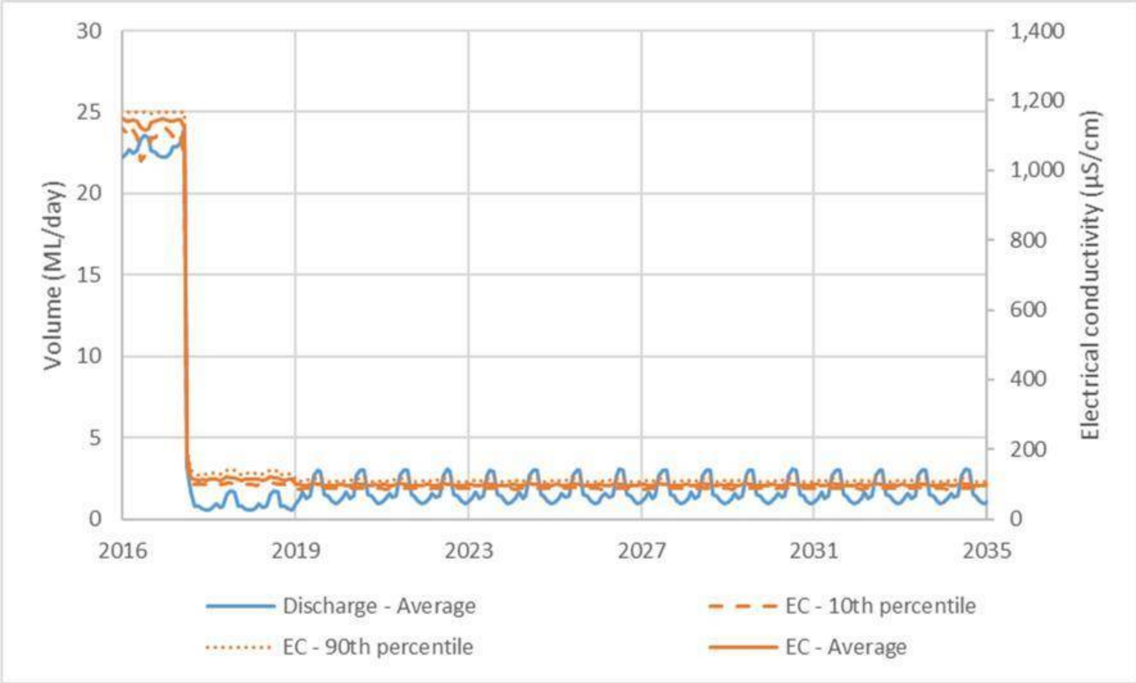

Figure B-71 Scenario 4 – Predicted EC of discharge from Sawyers Swamp Creek to Coxs River

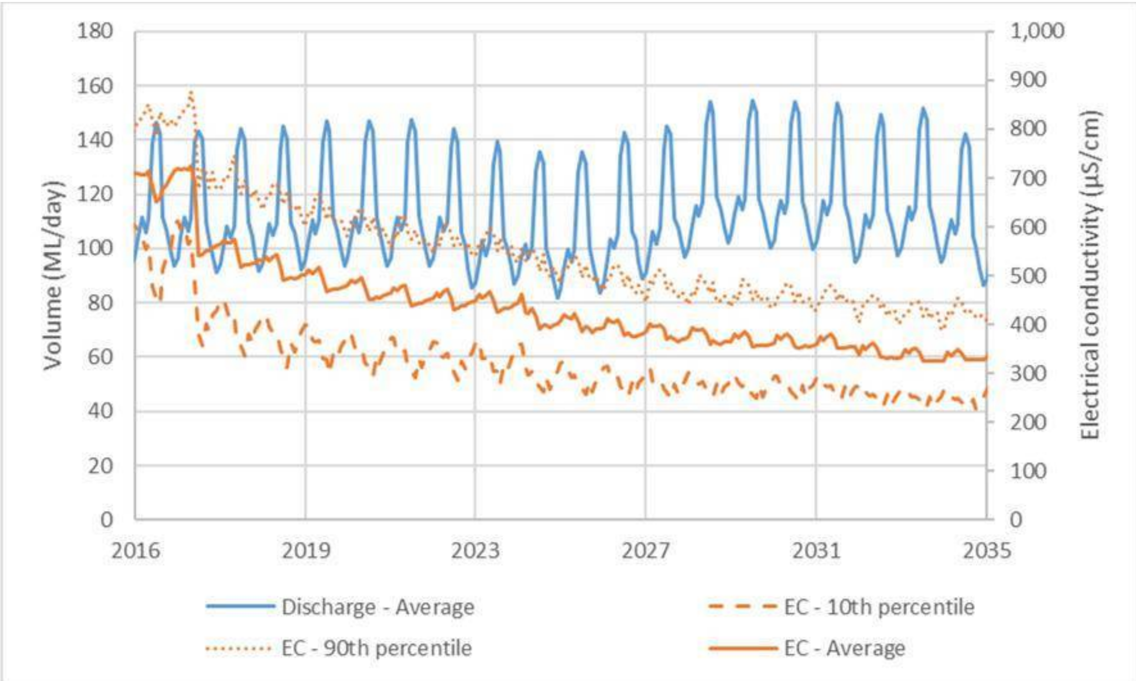

Figure B-72 Scenario 4 – Predicted EC of discharge from Coxs River to Lake Wallace

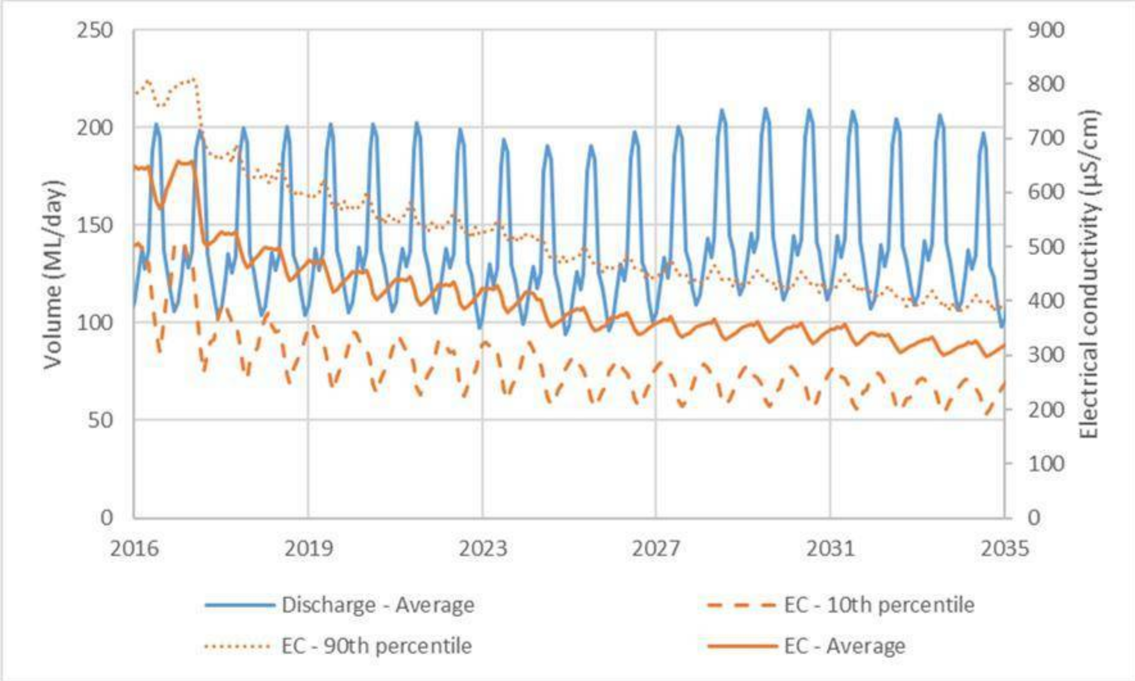

Figure B-73 Scenario 4 – Predicted EC of discharge from Coxs River to Lake Lyell

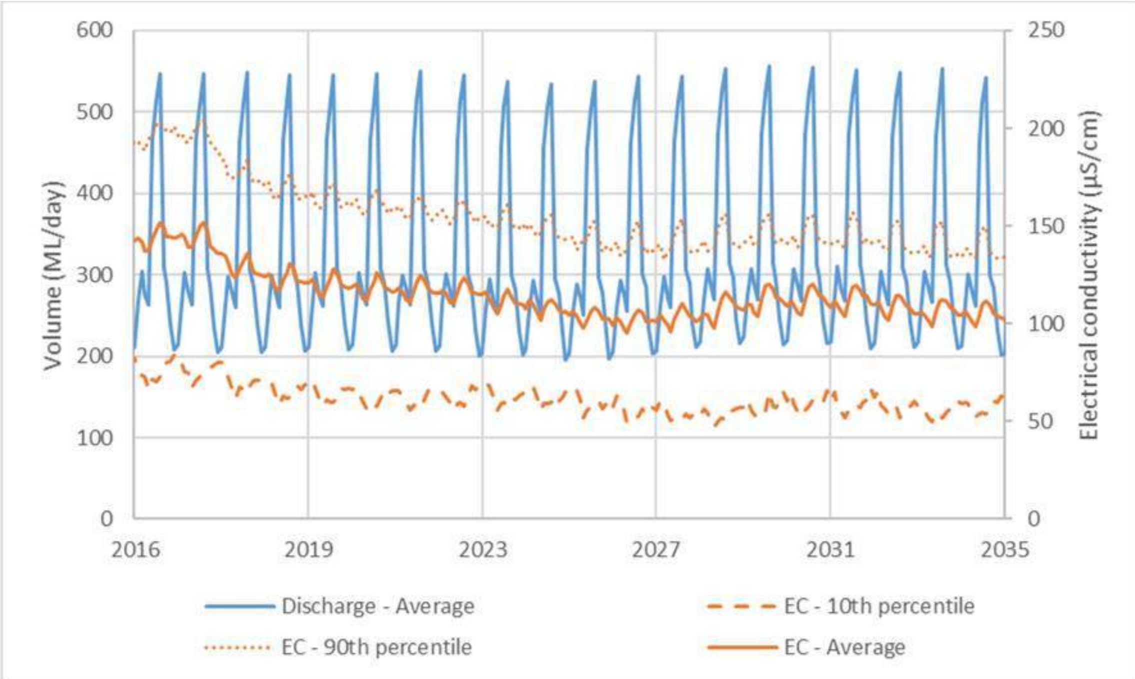

Figure B-74 Scenario 4 – Predicted EC of discharge from Coxs River to Lake Burragorang

Scenario 5

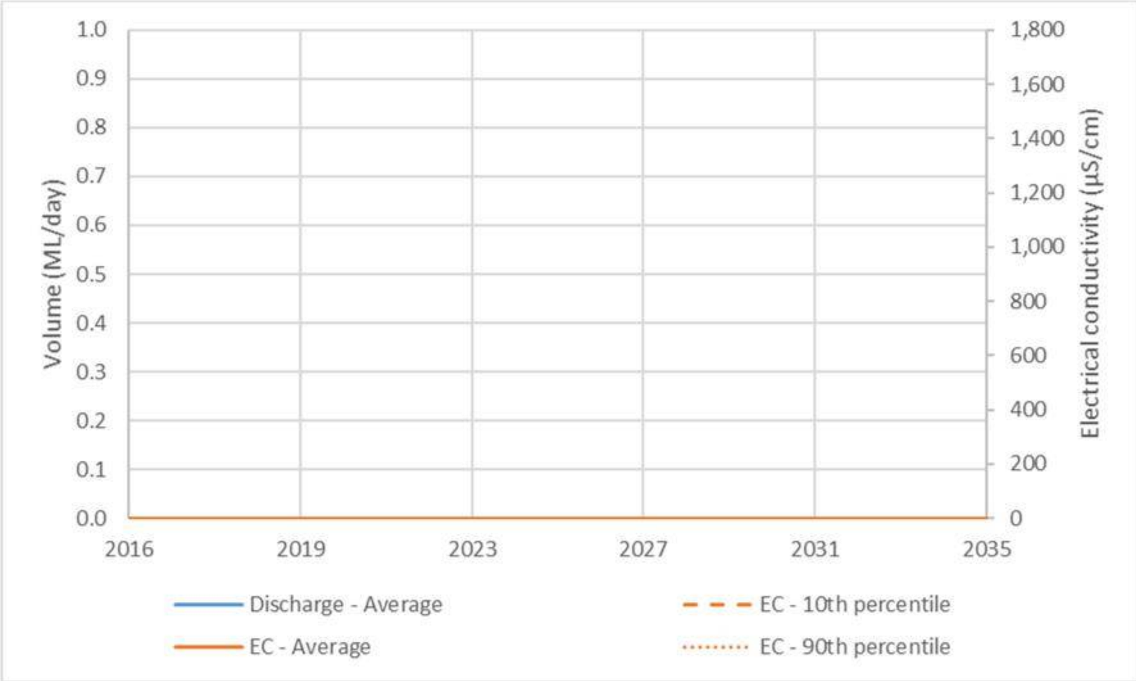

Figure B-75 Scenario 5 – Predicted EC of proposed LDP discharge

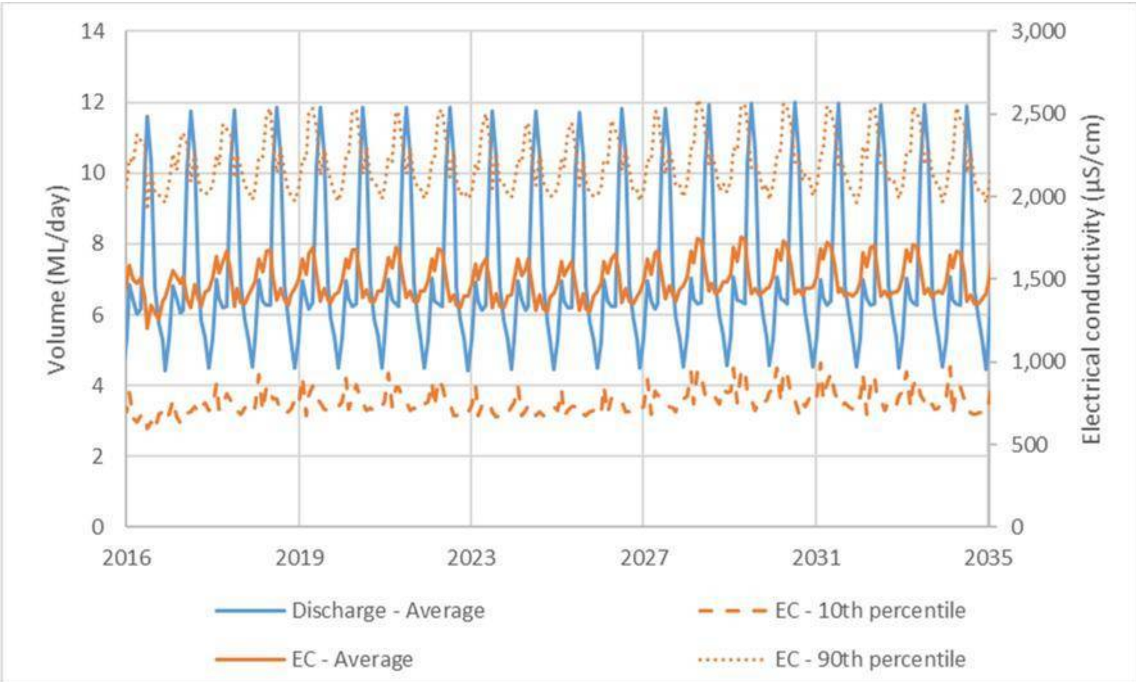

Figure B-76 Scenario 5 – Predicted EC of discharge of Wangcol Creek at LDPs

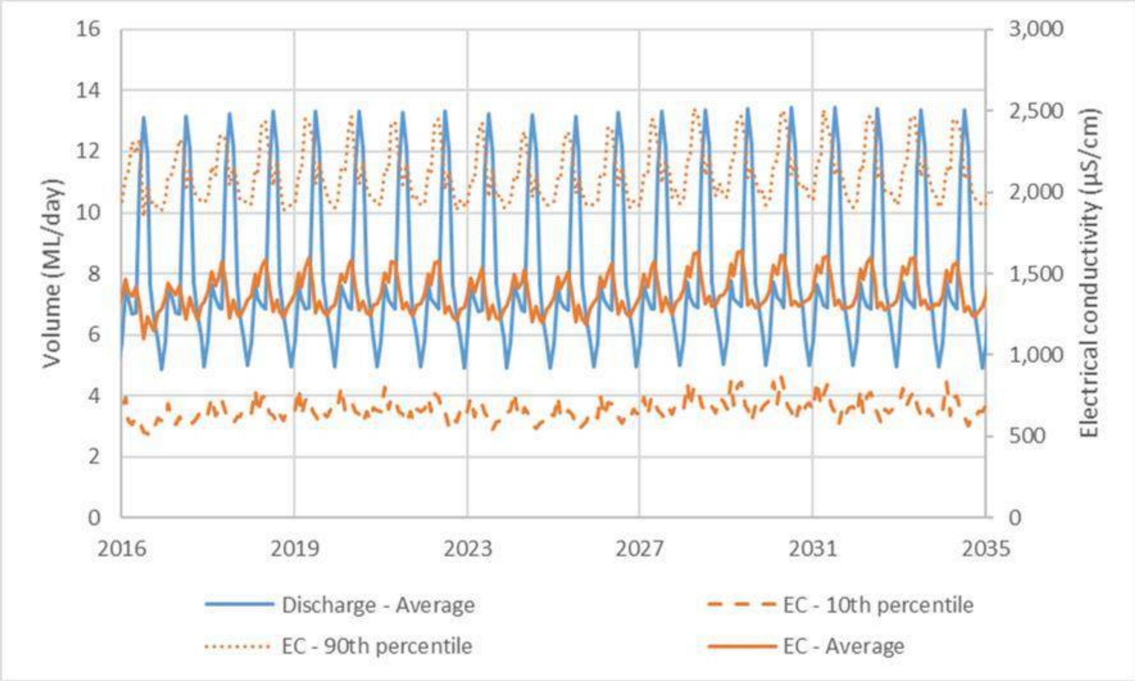

Figure B-77 Scenario 5 – Predicted EC of discharge from Wangcol Creek to Coxs River

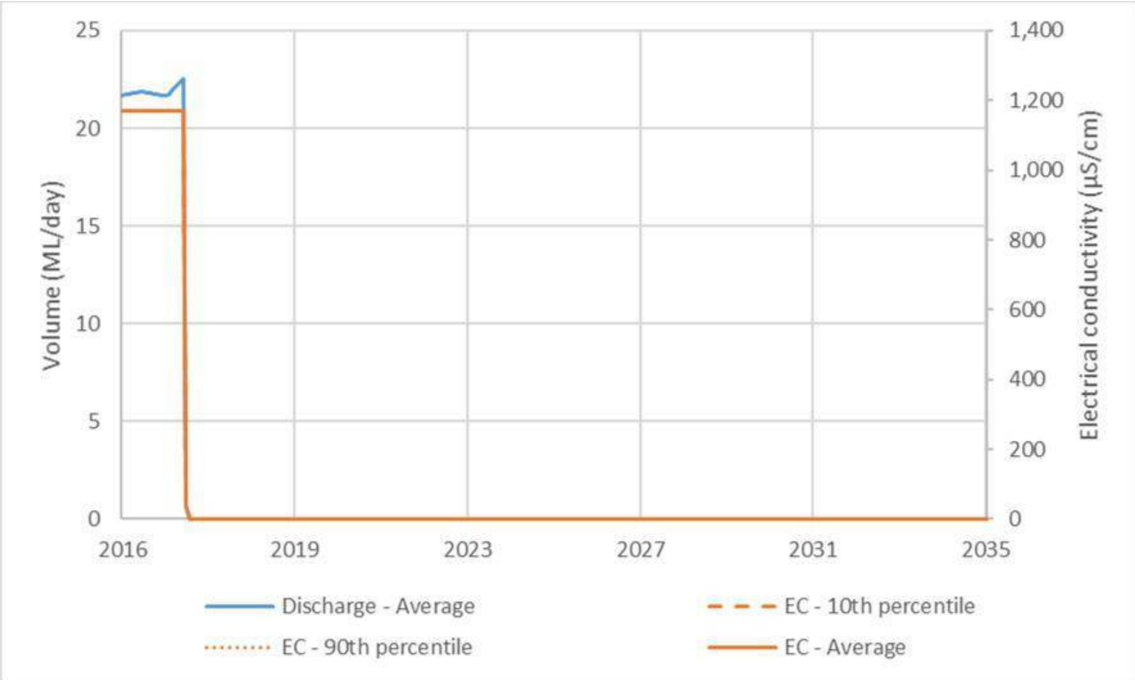

Figure B-78 Scenario 5 – Predicted EC of LDP009 discharge to Sawyers Swamp Creek

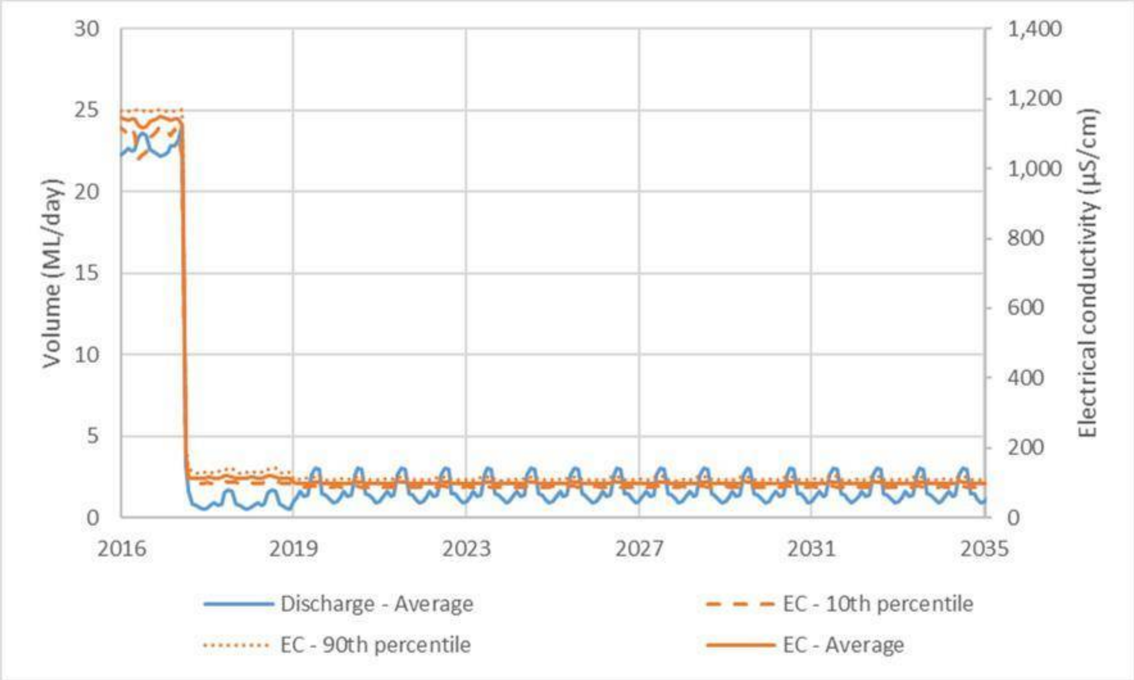

Figure B-79 Scenario 5 – Predicted EC of discharge from Sawyers Swamp Creek to Coxs River

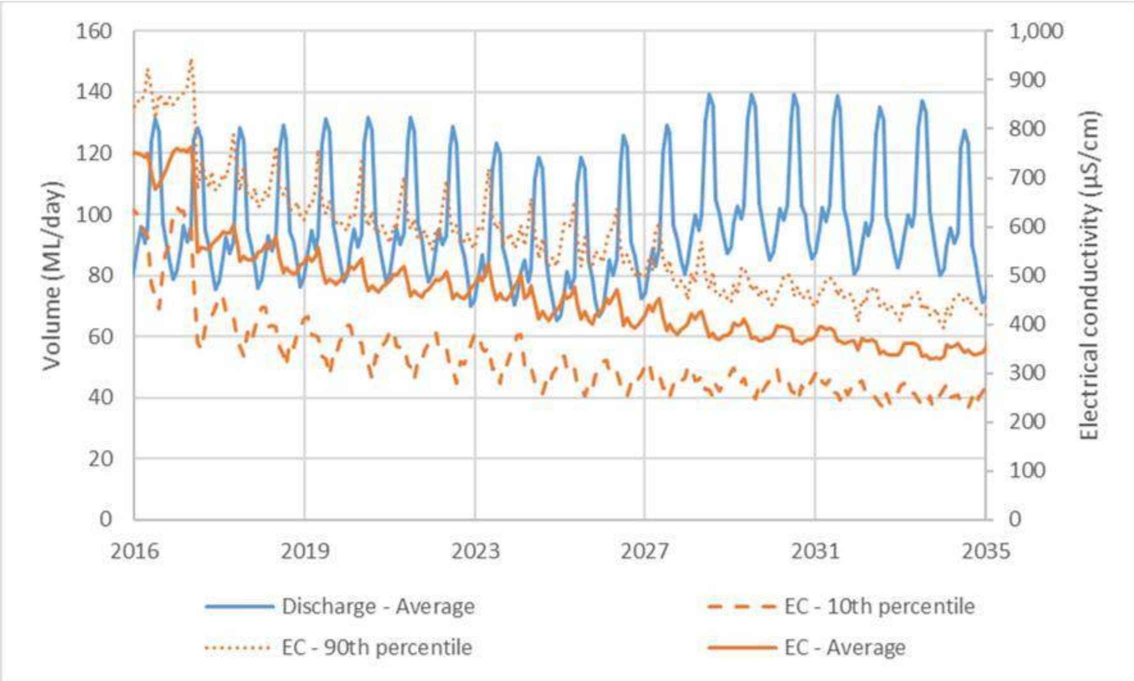

Figure B-80 Scenario 5 – Predicted EC of discharge from Coxs River to Lake Wallace

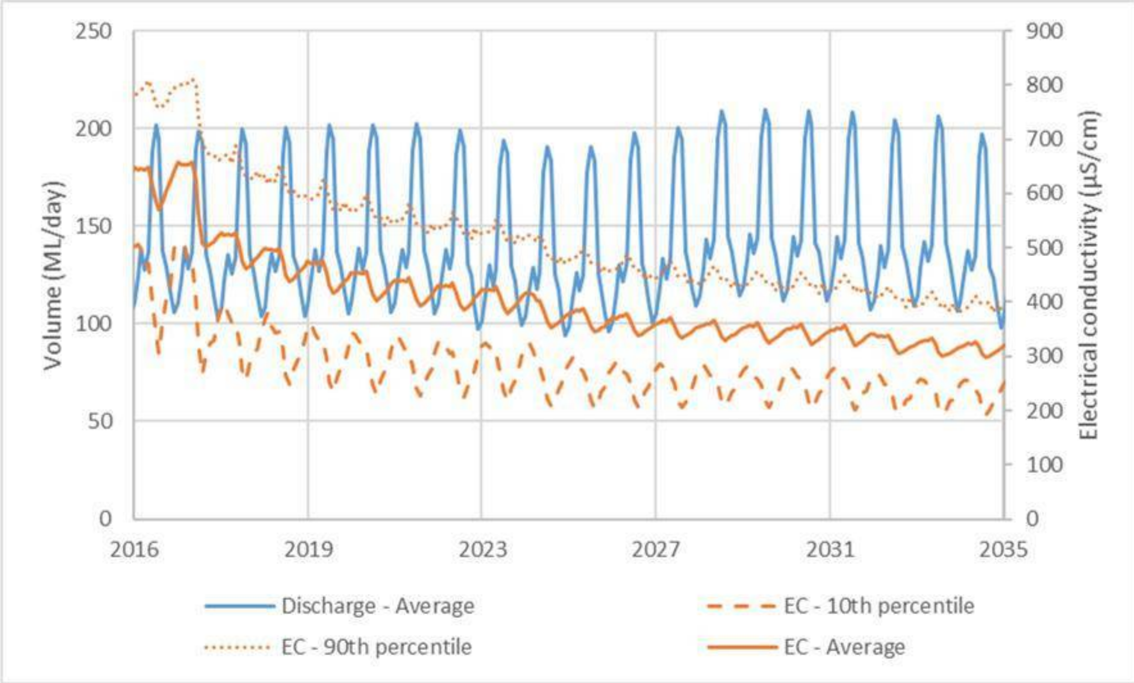

Figure B-71 Scenario 5 – Predicted EC of discharge from Coxs River to Lake Lyell

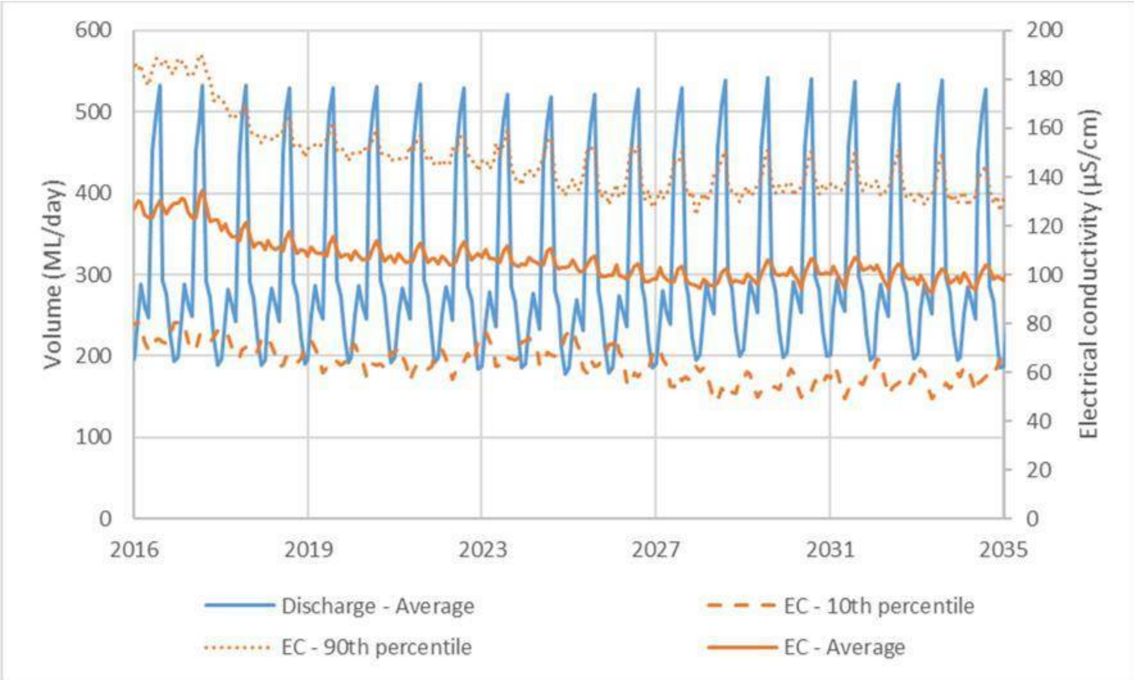

Figure B-72 Scenario 5 – Predicted EC of discharge from Coxs River to Lake Burragorang