PEABODY

WILPINJONG COAL
SITE WATER BALANCE

(WI-ENV-MNP-0038)

AUGUST 2017

Document Owner		Document Approver
Environmental Representative		Environment and Community Manager
Version	**Approval Date**	**Approver Name**
1	XX	Kieren Bennetts

General Description of Changes from Previous Version

Document No.	Version	Date	Prepared/Reviewed By	Distribution	Description of Change
SWB-R01	G	February 2006	WCPL, Resource Strategies, Mr Lindsay Gilbert (Gilbert and Associates), Mr Ian Callow (AGE)	DNR, DP&E	Original plan - developed for initial development phase of the project
SWB-R01	H	6 March 2006	WCPL, Resource Strategies, Mr Lindsay Gilbert (Gilbert and Associates), Mr Ian Callow (AGE)	DP&E	Amended to address DP&E comments. This version was approved by DP&E.
SWB-R02	B	August 2006	WCPL, Resource Strategies	DNR, DP&E	This version was approved by DP&E in July 2006.
SWB-R02	A	March 2009	WCPL, Resource Strategies	DP&E	Revision for mining from 2009 to 2012
SWB-R02	C	December 2010	WCPL, Ms Sarah Gosling & Mr Brian Rusk (SKM), Mr Andrew Durick (AGE), Dr Steve Perrens (Evans and Peck)	DP&E	Amendments to address DP&E comments following Independent Environmental Audit
SWB-R03	A	November 2010	WCPL, Ms Sarah Gosling & Mr Brian Rusk (SKM), Mr Andrew Durick (AGE), Dr Steve Perrens (Evans and Peck)	OEH, NOW and DP&E	Revision following the August 2010 Modification and to address NOW comments
WI-ENV-MNP-0006	1	20 June 2014	WCPL, Palaris, Mr Anthony Marszalek (Gilbert & Associates Pty Ltd), Resource Strategies	OEH and NOW	Revised following approval of Mod 5 (PA 05-0021). New format. Forms appendix (Appendix 3) to Water Management Plan (WMP). Submitted to OEH and NOW for consultation
WI-ENV-MNP-0006	1.1	30 June 2014	WCPL, Palaris	DP&E, OEH and NOW	Minor amendments to address comments by Resource Strategies prior to submission to DP&E.
WI-ENV-MNP-0006	2	November 2014	WCPL, Palaris	DP&E, OEH and NOW	Minor amendments to address comments by DP&E.
WI-ENV-MNP-0038	1	June 2016	WCPL	DP&E	Change of Document number match SAWOL MS number
WI-ENV-MNP-0038	2	October 2016	WCPL	DP&E	MOD 7
WI-ENV-MNP-0038	3	August 2017	WCPL, Hatch	DP&E, DPI Water and EPA	Updated to reflect Development Consent (SSD-6764)

CONTENTS

TABLES

FIGURES

ATTACHMENTS

1 Introduction

The Wilpinjong Coal Mine is owned and operated by Wilpinjong Coal Pty Ltd (WCPL), a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (Peabody).

The Wilpinjong Coal Mine is an existing open cut coal mining operation situated approximately 40 kilometres (km) north-east of Mudgee, near the Village of Wollar, within the Mid-Western Regional Local Government Area, in central New South Wales (NSW). The Wilpinjong Coal Mine produces thermal coal products which are transported by rail to domestic customers for use in electricity generation and to port for export. Open cut mining operations are undertaken 24 hours per day, seven days per week.

The Wilpinjong Coal Mine originally operated under Project Approval 05-0021 that was granted by the NSW Minister for Planning under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 1 February 2006. Modification of the Project Approval subsequently occurred six times[1] with the most recent modification (Modification 7) approved in August 2016. The existing Site Water Management Plan (including an Erosion and Sediment Control Plan, Surface Water Management and Monitoring Plan, Groundwater Monitoring Plan and Surface and Ground Water Response Plan) was developed in accordance with NSW Project Approval 05-0021 and the last revision was approved on 20 March 2017.

On 24 April 2017, WCPL was granted Development Consent (SSD-6764) for the Wilpinjong Extension Project that provides for the continued operation of the Wilpinjong Coal Mine at rates of up to 16 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal out to 2033, and access to approximately 800 hectares (ha) of open cut extensions. Development Consent (SSD-6764) has superseded the Project Approval (Project Approval 05-0021). This Site Water Balance (SWB) has been prepared to satisfy the relevant conditions in Development Consent SSD-6764.

The Secretary of the NSW Department of Planning and Environment (DP&E) approved Jim Heaslop as a suitably qualified and experienced person for the preparation/review of the SWB on 24 May 2017. This SWB was prepared in consultation with Jim Heaslop.

---

[1] Mod 2 was withdrawn

2 Statutory and Project Approval Requirements

2.1 Specific Development Consent Requirements

This SWB has been prepared in accordance with Condition 30(d)(ii), Schedule 3 of Development Consent (SSD-6764). Table 1 presents these requirements and indicates where they are addressed within this SWB.

Table 1
Specific SWB Requirements

Development Consent (SSD-6764) Condition	SWB Section
Water Management Plan	
30. Prior to carrying out any development under this consent, unless the Secretary agrees otherwise, the Applicant must prepare a Water Management Plan for the development to the satisfaction of the Secretary…	
…	
(d) ... this plan must include a:	
(ii) <u>Site Water Balance</u> that:	
• Includes details of:	
o sources and security of water supply, including contingency planning for future reporting periods;	Section 5
o water use and management on site, including details of water sharing between neighbouring mining operations (if applicable);	Sections 3 to 6
o any off-site water transfers and discharges;	Section 6
o reporting procedures, including the preparation of a site water balance for each calendar year; and	Water Management Plan (WMP)
• investigates and implements all reasonable and feasible measures to minimise water use on site;	Section 3.5

2.2 General Management Plan Requirements

Condition 3, Schedule 5 of Development Consent (SSD-6764) outlines general management plan requirements that are applicable to the preparation of the SWB. Table 2 presents these requirements and indicates where they are addressed within this SWB.

2.3 Environmental Protection Licence

The *Protection of the Environment Operations Act, 1997* (POEO Act) enables the government to set policies that provide environmental standards, goals, protocols and guidelines. The POEO Act also establishes a licensing regime for pollution generating activities in NSW. Under section 48 of the POEO Act, an environment protection licence (EPL) is required for “scheduled activities”, which includes coal mining.

The EPA issued EPL 12425 on 8 February 2006 under the POEO Act.

EPL 12425 currently regulates the discharge of water from the Wilpinjong Coal Mine via a Water Treatment Facility (WT Facility). EPL 12425 was most recently varied on 16 January 2017 to increase the volume of water permitted to be discharged from the WT Facility.

Table 2
General Management Plan Requirements

Development Consent (SSD-6764) Condition	SWB Section
Management Plan Requirements	
3. The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	
(a) detailed baseline data;	Surface Water Management Plan
(b) a description of:	
• the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 2
• any relevant limits or performance measures/criteria;	WMP
• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	WMP
(c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	WMP
(d) a program to monitor and report on the:	WMP
• impacts and environmental performance of the development;	
• effectiveness of any management measures (see c above);	
(e) a contingency plan to manage any unpredicted impacts and their consequences;	WMP
(f) a program to investigate and implement ways to improve the environmental performance of the development over time;	WMP
(g) a protocol for managing and reporting any:	WMP
• incidents	
• complaints	
• non-compliances with statutory requirements; and	
• exceedances of the criteria and/or performance criteria; and	
(h) a protocol for periodic review of the plan.	WMP

As requested by the EPA, WCPL will apply as required to vary EPL 12425 to also incorporate any sediment dams that will discharge off-site (under specific water quality and/or rainfall conditions).

2.4 Specific Guidance from Regulatory Agencies

The approved Site Water Management Plan (including the relevant sub-plans) was prepared in consultation with EPA and DPI Water, as required by Condition 28, Schedule 3 of the Wilpinjong Coal Mine Project Approval 05-0021.

Consultation was also undertaken with a variety of regulators throughout the assessment and approval of the Wilpinjong Extension Project. As requested by the EPA during consultation for the assessment of Wilpinjong Extension Project, WCPL will adopt a design rainfall depth of 44 millimetres for all future sediment dams, which is based on a 95th percentile 5 day rainfall event for the Central Tablelands area (Section 3.4).

3 Water Management System

3.1 Objectives

The objectives of the mine water management system are:

- to protect the integrity of local and regional water sources;
- to operate such that there is no contained water storage overflow;
- to maintain separation between runoff from areas undisturbed by mining and water generated within active mining areas; and
- to provide a reliable source of water to meet mine requirements (e.g. operational water demand and dust suppression).

3.2 Water Management System Components

The location and system schematics of the Wilpinjong Coal Mine Water Management System are presented in Appendix A.

The key components of the current/future Water Management System are listed below:

- Water Storage Dams:
  - Run-of-Mine (ROM) Dam 1 – 8.
  - Ed's Lake.
  - Clean Water Dam (CWD).
  - Recycled Water Dam (RWD).
  - Pit 1S Dam.
  - Pit 2 West Void.
  - Pit 8 Mine Water Dam (MWD).
  - Mine Infrastructure Area (MIA) Dam.
- Tailings Dams:
  - TD3.
  - TD4.
  - TD5.
  - TD6.
- Sediment Dams:
  - SD1A and SD1B.
  - SD2A, SD2C, SD2D and SD2E.
  - SD3A, SD3B, SD3C, SD3D and SD3E.
  - SD4A, SD4B, SD4C, SD4D, SD4E and SD4F.
  - SD5A, SD5B, SD5C, SD5D and SD5E.
  - SD6A, SD6B, SD6C and SD6D.
  - SD7A, SD7B, SD7C, SD7D and SD7E.
  - SD8A, SD8B, SD8C, SD8D, SD8E and SD8F.

- Open cut pits.
- Other Infrastructure:
  - Coal Handling and Processing Plant (CHPP)/Industrial Area.
  - Water Treatment (WT) Facility.
  - Belt Press Filter (BPF).
  - Various upstream diversion structures.

The main components of the system include:

- Pit 2 West is a remnant void in the north-west corner of Pit 2 and is the main mine water storage on-site. Pit 2 West receives pumped inflow from open cut pits and other water storages. Pit 2 West is a supplementary supply source for the CHPP and provides water to other storages and for treatment prior to licensed discharge. Pit 2 West has an estimated capacity of 2,694 ML.
- The Recycle Water Dam (RWD) provides water for haul road dust suppression via a “fastfill” point, as well as supplementary supply to the CHPP. The RWD is principally supplied by pumped transfer from Pit 2 West. The RWD has an estimated capacity of 394 ML.
- The Clean Water Dam (CWD) is an above-ground water storage constructed within the rail loop. It is the principal source of supply for the CHPP. The CWD is supplied by pumped transfer from Pit 2 West and Ed’s Lake. The CWD has an estimated capacity of 40 ML.
- Ed’s Lake is a small storage dam within the mined out northern end of Pit 1 that receives runoff from partially rehabilitated overburden emplacement and other active mining areas. It has an estimated capacity of 52 ML.
- A pit dewatering system allows removal of water from open cut pit sumps to Pit 2 West. This will be expanded as additional open cut pits are developed. Active pumping from open cut pits on the southern side of the mine area (e.g. Pit 5 South) does not normally occur – likely because of limited groundwater inflow and seepage of any accumulated rainfall runoff through in-pit overburden to the northern end of the mine (e.g. Pit 5 North). However, in the event of prolonged or intense rainfall, dewatering from these open cut pits may also need to occur.
- A WT Facility is located adjacent to Pit 2 West. Feed water is supplied to this facility from Pit 2 West and from open cut pits depending on water quality. Operation of the WT Facility is discussed further in Section 6.1.

3.3 Water Storages

Characteristics of the Water Management System key water storages and existing open cuts are summarised in Table 3.

Table 3
Water Management System Characteristics

Storage/Open Cut	Full Supply Volume (ML)
Dams/Voids	
Ed's Lake	52
Clean Water Dam	40
Recycled Water Dam	394
Pit 1S Dam	1,500
Pit 2 West	2,694
ROM Dam 1 – ROM Dam 8	20
Pit 8 MWD	20
MIA Dam	20
Open Cuts	
Pit 1	408
Pit 2E	897
Pit 3	574
Pit 4	816
Pit 5 North	5,026
Pit 5 South	864
Pit 7	266

Note: ML = megalitres.

Note: The full supply volume of the open cuts will change over time as mining progresses.

Source: WRM Water and Environment (2017).

ROM dams are storages that collect runoff and seepage from ROM stockpiles.

3.4 Sediment Dams

Sediment dam sizing was undertaken in accordance with the following guidelines:

- *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004); and
- *Managing Urban Stormwater, Soils and Construction – Volume 2E Mines and Quarries* (Department of Environment and Climate Change, 2008).

Sediment dam volumes were based on the following design standards and methodology:

- 'Type F' sediment basins consistent with SD 6-4 (page 6-19, Landcom 2004).
- Total sediment basin volume = settling zone volume + sediment storage volume. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.

- Sediment basin settling zone volume based on 95th percentile 5-day duration rainfall (44 mm for Central Tablelands) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.64.
- Solids storage volume = 50% of settling zone volume.

The adopted design standard does not provide 100% containment for runoff from disturbed areas. Hence, it is possible that overflows will occur from sediment dams if rainfall exceeds the design standard. When overflow occurs, the sediment dams have been designed to flow into either an allocated active open cut, or into Wilpinjong or Cumbo Creek. As requested by the EPA, WCPL will apply as required to vary EPL 12425 to incorporate any sediment dams that will potentially discharge off-site.

WCPL are currently managing sediment dams on-site to avoid discharges to the environment by directing all water back to the mine water management system.

Table 4 provides the adopted sediment dam sizes and the associated pump requirements to restore the settling capacity within 5 days.

Table 4
Sediment Dam Sizing

Sediment Dam	Maximum Catchment Area (ha)	Total Volume Required (ML)	5-Day Pump Requirement (L/s)
SD1A	136.6	57.7	134
SD1B	45.1	19.1	44
SD2A	15.1	6.4	15
SD2C	198.0	83.6	194
SD2D	44.9	19.0	44
SD2E	34.4	14.5	34
SD3A	44.1	18.6	43
SD3B	29.2	12.3	29
SD3C	41.0	17.3	40
SD3D	68.7	29.0	67
SD3E	29.0	12.2	28
SD4A	15.6	6.6	15
SD4B	34.5	14.6	34
SD4C	26.0	11.0	25
SD4D	24.9	10.5	24
SD4E	51.6	21.8	50
SD4F	31.0	13.1	30
SD5A	55.8	23.6	55

Table 4 (Continued)
Sediment Dam Sizing

Sediment Dam	Maximum Catchment Area (ha)	Total Volume Required (ML)	5-Day Pump Requirement (L/s)
SD5B	73.1	30.9	71
SD5C	81.0	34.2	79
SD5D	103.2	43.6	101
SD5E	234.2	98.9	229
SD6A/B	17.4	7.3	17
SD6A	135.9	57.4	133
SD6B	100.4	42.4	98
SD6C	88.7	37.5	87
SD6D	117.7	49.7	115
SD7A	14.5	6.1	14
SD7B	26.5	11.2	26
SD7C	21.1	8.9	21
SD7D	114.5	48.4	112
SD7E	24.5	10.3	24
SD8A	37.4	15.8	37
SD8B	37.1	15.7	36
SD8C	13.3	5.6	13
SD8D	148.3	62.6	145
SD8E	83.7	35.4	82
SD8F	67.1	28.3	66

Note: ha = hectares, L/s = litres per second.
Source: WRM Water and Environment (2017)

The model operating rules for the sediment dam collection system are based on the recommendations in *Managing Urban Stormwater Soils and Construction Guideline: Mines and Quarries* (DECC 2008). The operating rules are as follows:

- runoff from disturbed areas will be captured in sediment dams and, if capacity is available, pumped to mine water storages;
- pump capacities will be sized to empty sediment dams in 5 days;
- runoff from rehabilitated areas established for more than two years will be directed to a sediment dam and released off-site; and
- sediment dams will overflow when rainfall exceeds the design criteria (95th percentile, 5 day rainfall).

3.5 Measures for Minimisation of Water Use

The Wilpinjong Coal Mine Water Management System includes preferential use of on-site derived mine water, thereby reducing the need to import raw water from external sources for operational purposes. As described in Section 5, the primary water sources for the mine include recycled runoff and groundwater inflow, which have been prioritised over imported water wherever practicable.

WCPL has been operating a BPF since April 2015. The BPF changes the management of waste from disposal of a wet tailings slurry in tailings dams, to a dry disposal system. The tailings filter cake produced by the BPF is mixed with the coarse rejects in the CHPP and transported to mine voids for co-disposal with mine waste rock. The BPF reduces the makeup water demand associated with operation of the CHPP.

If, in the future, the site water inventory drops significantly, WCPL would suspend operation of the WT Facility and would investigate further water demand reduction measures such as the use of synthetic dust suppressants and further improvements in CHPP water recovery.

4 Water Demands

The primary water demands for the Wilpinjong Coal Mine include:

- the CHPP (including vehicle washdown and industrial use water demands); and
- haul road dust suppression.

These water demands are summarised in the sections below.

4.1 Coal Handling and Preparation Plant

The following average material moisture contents have been assumed and applied to the CHPP inputs and outputs:

- ROM coal feed – 7.5% weight for weight (w/w).
- Product coal – 10.32% w/w.
- Coarse reject – 14.65% w/w.
- Tailings Filter Cake – 35% w/w.

The projected process CHPP water requirements have been calculated for each year of mining, based on the proposed CHPP feed, plant yield and associated moisture contents for each waste stream. The CHPP water requirements include all coal handing and processing water uses, as well as all minor industrial water usage, including vehicle washdown.

The water demand of the CHPP is predicted to decline over the life of the Wilpinjong Coal Mine, as the predicted CHPP Feed rate also declines (Table 5).

4.2 Haul Road Dust Suppression

Haul road dust suppression watering rates will vary over the life of the Wilpinjong Coal Mine, as the haul road areas vary with each stage of mine development. Haul road footprints have been calculated from the mine plans for each mine stage. The following assumptions were applied to determine the dust suppression rate on any given day of the historical rainfall record:

- Daily evaporation rates were sourced from the Queensland Department of Science, Information Technology, Innovation and the Art's Data Drill service (Jeffrey et al., 2001) SILO evaporation dataset (Morton's estimate of wet environment areal evapotranspiration over land was used).
- For a dry day (zero rainfall), the haul road watering rate was assumed to be equal to the daily evaporation rate.
- For a rain day when rainfall was less than the daily evaporation rate, watering rate was reduced and only required to make up the remaining demand to the daily evaporation rate.
- For a rain day when rainfall exceeded the daily evaporation rate, no haul road watering was assumed to be required.
- It was assumed that 22 metres of the haul road width will be watered.
- Only a percentage of haul road length will be active at any time. This was estimated to be 80% (on average) based on previous experience at the Wilpinjong Coal Mine.

The predicted haul road dust suppression is expected to rise over the mine life, peaking during 2019-2021, before declining over the remainder of the mine life (Table 5).

4.3 Overall Water Demand

The overall predicted water demand, incorporating the predicted demands for both the CHPP and haul road dust suppression, is presented in Table 5.

Table 5
Overall Water Demand

Year	CHPP Net Demand (ML/Year)	Dust Suppression (ML/Year)	Total Demand (ML/Year)
2015	582	522	1,104
2016	615	522	1,137
2017	611	695	1,306
2018	614	695	1,309
2019	578	785	1,363
2020	595	785	1,380
2021	454	785	1,239
2022	499	762	1,261
2023	440	762	1,202
2024	492	762	1,254
2025	451	762	1,213
2026	435	536	971
2027	407	536	943
2028	360	536	896
2029	306	536	842
2030	266	536	802
2031	228	497	725
2032	229	497	726
2033	127	497	624

Source: WRM Water and Environment (2017).

5 Water Sources

The primary water sources for the Wilpinjong Coal Mine include groundwater inflows and surface runoff.

These water sources have been modelled using historical rainfall and evaporation data sourced from nearby Bureau of Meteorology weather stations, as well as synthetic climate data from the Queensland Department of Science, Information Technology, Innovation and the Art's Data Drill service (Jeffrey *et al*., 2001). Assumptions used for the water sources are summarised in the sections below.

5.1 Groundwater Inflows

Groundwater inflows to the open cut mining areas over the life of the Wilpinjong Coal Mine were adopted based on modelled inflows provided by HydroSimulations (2015). The estimates for the open cuts have been corrected for evaporation from pit walls. Evaporative losses from pit walls have been estimated using the area of proposed active mining face (length multiplied by seam thickness), multiplied by the average annual evaporation (using Morton's estimate of wet environment areal evapotranspiration over land). Additional evaporative losses are accounted for separately within the model. They are calculated daily based on the surface area of water ponded at the bottom of the pit. These additional evaporative losses are not included in the predicted groundwater inflows below. The adopted groundwater inflow rates for water balance modelling are the average for each representative phase, as shown in Table 6 below.

Table 6
Groundwater Inflows

Year	Total Groundwater Inflows (ML/Year)	Evaporative Losses (ML/Year)	Net Groundwater Inflows (ML/Year)
2015	1,235	159	1,076
2016	1,078	159	921
2017	1,109	305	804
2018	1,187	305	883
2019	1,137	254	883
2020	858	254	604
2021	706	254	452
2022	638	193	445
2023	662	193	469
2024	680	193	487
2025	521	193	328
2026	482	94	388
2027	616	94	522
2028	726	94	632
2029	626	94	533
2030	429	94	335
2031	380	62	318
2032	332	62	270
2033	137	62	75

Source: WRM Water and Environment (2017).

5.2 Surface Runoff

The water balance model described in Section 7 uses the Australian Water Balance Model (AWBM) (Boughton, 1993) to estimate runoff from rainfall. The AWBM is a saturated overland flow model which allows for variable source areas of surface runoff.

The AWBM uses a group of connected conceptual storages (three surface water storages and one groundwater storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evaporation. Simulated surface runoff occurs when the storages fill and overflow. The model uses daily rainfalls and estimates of catchment evapotranspiration to calculate daily values of runoff using a daily water balance of soil moisture.

Catchments across the site have been characterised into the following land use types:

- natural/undisturbed;
- roads/hardstand;
- overburden;
- open cut;
- rehabilitated overburden; and
- tailings.

The adopted AWBM model parameters are shown in Table 7.

Table 7
Adopted AWBM Parameters

Parameters	Natural/ Undisturbed	Roads/ Hardstand	Overburden	Open Cut	Rehabilitated Overburden	Tailings
A1	0.01	1.0	0.05	0.1	0.012	1.0
A2	0.65	-	0.95	0.9	0.63	-
A3	0.34	-	-	-	0.358	-
C1	6	3	5	5	6	2
C2	120	-	65	15	120	-
C3	160	-	-	-	160	-
BFI	0.3	-	0.7	0.2	0.3	-
k_b	0.975	-	0.99	0.95	0.97	-
k_s	0.5	-	0.15	0.1	0.5	-
Long term c_v	2.2%	51.7%	8.6%	30.6%	2.2%	54.9%

5.3 Other Sources

The mine water supply system also includes a water supply borefield comprising up to 19 bores located to the north of the mine area. Five existing production bores have been developed to date of which two are currently licensed to each provide up to 110 ML annually (equivalent to 3.5 L/s if pumped continuously). Licence renewal applications for the other three bores have been lodged with DPI Water at production rates of 50 ML, 50 ml and 23 ML annually. Additional production bores may be established as required over the life of the mine.

WCPL also has an in principle agreement with the nearby Ulan Coal Mines Ltd (UCML) to source excess water from the Ulan Coal Mine (by pipeline) if required in the future (subject to approval).

Potable water is trucked to the site to supply drinking water and ablution facilities in the office and crib areas. Sewage treatment occurs at a domestic sewage treatment facility located near the mine administration area and at the CHPP (septic system). Treated effluent is used for irrigation in accordance with EPL 12425. The existing sewage treatment facilities and treated/grey water spray areas will continue to be operated in accordance with the *Environmental Guidelines: Use of Effluent by Irrigation* (NSW DEC, 2004).

Treated/grey water from the offices and bath house will continue to be re-used as irrigation water for vegetated areas within the rail loop and/or the CHPP area. Additional wastewater treatment plants, sized for approximately three shifts of 30 people each day, will be constructed at the new mine infrastructure areas. Effluent from additional future wastewater treatment plants will be managed as above for the existing sewage treatment facilities, and will be re-used for irrigation on rehabilitated areas in the vicinity of future infrastructure areas. In the event there are limited rehabilitation areas available proximal to mine infrastructure areas, irrigation would be directed to unmined grassed/vegetated areas within the approved open cut footprint and within the operational water management area (i.e. that drain to an operational storage).

6 Off-site Water Transfers and Discharges

6.1 Water Treatment Facility

A WT Facility treats water from the water storages before it is discharged to Wilpinjong Creek. Construction of the WT Facility was completed in June 2012, and approved water releases commenced on 16 June 2012.

WCPL is in the process of upgrading the capacity of the WT Facility to reflect the increased EPL discharge limit. In the interim, temporary mobile plants are being used to increase the volume of water discharged from site whilst maintaining compliance with the water quality concentration limits in the EPL.

Excess mine water accumulating on site is released after treatment in the WT Facility located adjacent to Pit 2 West. The plant is supplied with feed water from Pit 2 West, and if quality allows, directly from nearby pits. Treated WT Facility water is discharged to Wilpinjong Creek in accordance with the requirements of EPL 12425, which prescribes water quality (maximum electrical conductivity of 500 microsiemens/centimetre) and daily discharge (maximum of 15 ML/day until 31 December 2019, when it reverts to a maximum of 5 ML/day) limits. Permeate is mixed with a proportion of feed water prior to discharge to produce treated water which meets the discharge criteria (i.e. once mine water is combined with permeate it is considered treated). Backwash from the WT Facility and water that doesn't meet the discharge requirements outlined in EPL 12425 is discharged to Pit 2 West. WT Facility concentrate is pumped to Pit 1 South for use in dust suppression and process water circuits.

Releases from the Wilpinjong Coal Mine (via the WT Facility) into Wilpinjong Creek have been modelled as an outflow in the water balance model. The outflows have been modelled as follows:

- Year 2015 – 0.85 ML/day; and
- Year 2017 onwards – 3.5 ML/day[2].

For the purposes of the site water balance modelling, RO Plant is operated as follows:

- RO Plant active when the inventory in Pit 2 West exceeds 1,300 ML; and
- RO Plant inactive when the inventory in Pit 2 West reduces below 500 ML.

6.2 Off-site Transfers

As discussed in Section 5.3, WCPL has an agreement with UCML to source excess water from the Ulan Coal Mine (by pipeline) if required in the future (subject to approval). Additionally, potable water is trucked to the site to supply drinking water and ablution facilities in the office and crib areas. A minor portion of treated effluent from remote crib areas may also be trucked off-site by a waste contractor.

[2] The long-term discharge rate of 3.5 ML/day is based on the design capacity of the WT Facility at the time of modelling. Since that time, WCPL has sought and obtained a variation to EPL 12425 to permit discharge of up to 15 ML/day until 31 December 2019.

6.3 Sediment Dams

As described in Section 3.4, the adopted design standard for sediment dams does not provide 100% containment for runoff from disturbed areas. Hence, it is possible that overflows will occur to Wilpinjong or Cumbo Creeks should rainfall exceed the design standard. As requested by the EPA, WCPL will apply as required to vary EPL 12425 to incorporate any sediment dams that will discharge off-site.

7 Water Balance Model Configuration and Assumptions

The water balance model was run using a computer-based operational simulation model (OPSIM), which assessed the dynamics of the Water Management System under conditions of varying rainfall and catchment conditions throughout the Wilpinjong Coal Mine life. The OPSIM model dynamically simulated the operation of the Water Management System and produced outputs of all site water volumes and representative water qualities on a daily time step. The model was configured to simulate the operations of all major components of the Water Management System.

The simulated inflows and outflows included in the model are provided in Table 8. The primary inflows and outflows for the Wilpinjong Coal Mine are described in Sections 4, 5 and 6, along with the assumptions used for the inflows and outflows in the water balance model.

Table 8
Simulated Inflows and Outflows

Inflows	Outflows
Direct rainfall on storages	Evaporation from storages
Catchment runoff	CHPP demand
Groundwater inflows to open cuts	Dust suppression demand
External Water Supply	Mine Infrastructure Area demands
-	WT Facility discharge
-	Spills/Discharges from Sediment Dams

7.1 Simulation Methodology

The water balance model was run using two types of simulation methodologies:

- static; and
- forecast.

The static water balance results were based on a long-term simulation (126 years) with the model configuration fixed to a particular phase of mine development. This provided an indication of the relative magnitude of inflows and outflows for each particular phase of mining development. The forecast water balance results were generated by running multiple climate sequences through the model and taking a statistical representation of the results for the different climate cases modelled. These results more accurately reflected the actual performance of the system as they accounted for the dynamic nature of the mine phases, groundwater inflows and CHPP throughputs.

The forecast water balance model was run on a daily time step for a 19 year period, corresponding to the period of proposed mining operation for the Wilpinjong Coal Mine. The model was run for a total of 108 climate sequences, each referred to as a 'realisation'. Each realisation was based on a 19 year sequence extracted from the historical rainfall data (Section 5) (i.e. the first realisation was based on rainfall data from 1889 to 1907, the second was based on data from 1890 to 1908 etc.). This approach provided the widest possible range of climate scenarios covering the full range of climatic conditions represented in the historical rainfall record.

The model configuration changes over the life of the Wilpinjong Coal Mine, reflecting changes in the water management system over time. The different stages of the mine life are linked in the model to reflect variations over time such as catchments, ROM coal production and groundwater inflows. Six different representative stages of mine life were modelled (Years 2016, 2018, 2020, 2024, 2028 and 2031). Although the catchment areas will continuously change as the Wilpinjong Coal Mine progresses, the adopted approach of modelling discrete stages provides a reasonable representation of conditions over the life of the mine.

7.2 Production Schedule

The projected annual coal production schedule at the Wilpinjong Coal Mine is shown in Table 9.

Table 9
Coal Production Schedule

Year	CHPP Feed (Mt)	CHPP Product (Mt)	Coarse Reject (Mt)	Tailings (Mt)
2015	9.2	6.2	2.6	0.4
2016	9	5.9	2.6	0.52
2017	8.9	6	2.37	0.53
2018	8.8	5.8	2.47	0.53
2019	8.35	5.57	2.28	0.5
2020	8.25	5.02	2.74	0.49
2021	6.5	4.26	1.85	0.39
2022	6.95	4.31	2.22	0.42
2023	6.4	4.3	1.72	0.38
2024	7	4.52	2.06	0.42
2025	6.51	4.34	1.78	0.39
2026	6	3.62	2.02	0.36
2027	5.75	3.63	1.78	0.35
2028	5	3.07	1.63	0.3
2029	4.25	2.57	1.43	0.25
2030	3.55	1.96	1.38	0.21
2031	3	1.61	1.21	0.18
2032	3	1.6	1.22	0.18
2033	1.64	0.85	0.69	0.1

Mt = million tonnes.

For ease of comparison, the tonnages presented in Table 9 represents equivalent tonnages at the CHPP feed moisture content (7.5%), and not the actual wet tonnages (which varies between feed coal, product coal and the various waste streams).

7.3 Model Calibration

Calibration of the Wilpinjong Coal Mine OPSIM water balance model was undertaken against observations of the gross system behaviour made over the period January 2013 to December 2014.

The model was calibrated against the total site inventory, which includes recordings of storage volume in Pit 2 West, RWD, CWD and Ed's Lake. Calibration against individual storages was not possible given significant and highly variable rates of pumping between storages within the system and variable rates of leakage between water storages and open cuts through backfilled waste rock.

The calibration used predicted groundwater inflows from the Modification 5 Surface Water Assessment (Gilbert and Associates, 2013), which were amended to achieve a satisfactory calibration. The total groundwater inflow rates used were:

- January to June 2013 – 1.0 ML/day.
- July to December 2013 – 3.5 ML/day.
- January to June 2014 – 3.25ML/day.
- July to December 2014 – 2.5 ML/day.

The assumed groundwater inflow rates listed above are generally consistent with inflow rates prepared by HydroSimulations (2015), and are therefore considered reasonable.

The calibration results indicated the following (Figure 1):

- The modelled total site inventory is generally consistent with the observed inventory for the site over the calibration period.
- The model generally reflects the increase in total site inventory following significant rainfall events, and decreases in total site inventory during dry periods.

This suggests the site water balance model is suitable for modelling the total site inventory.

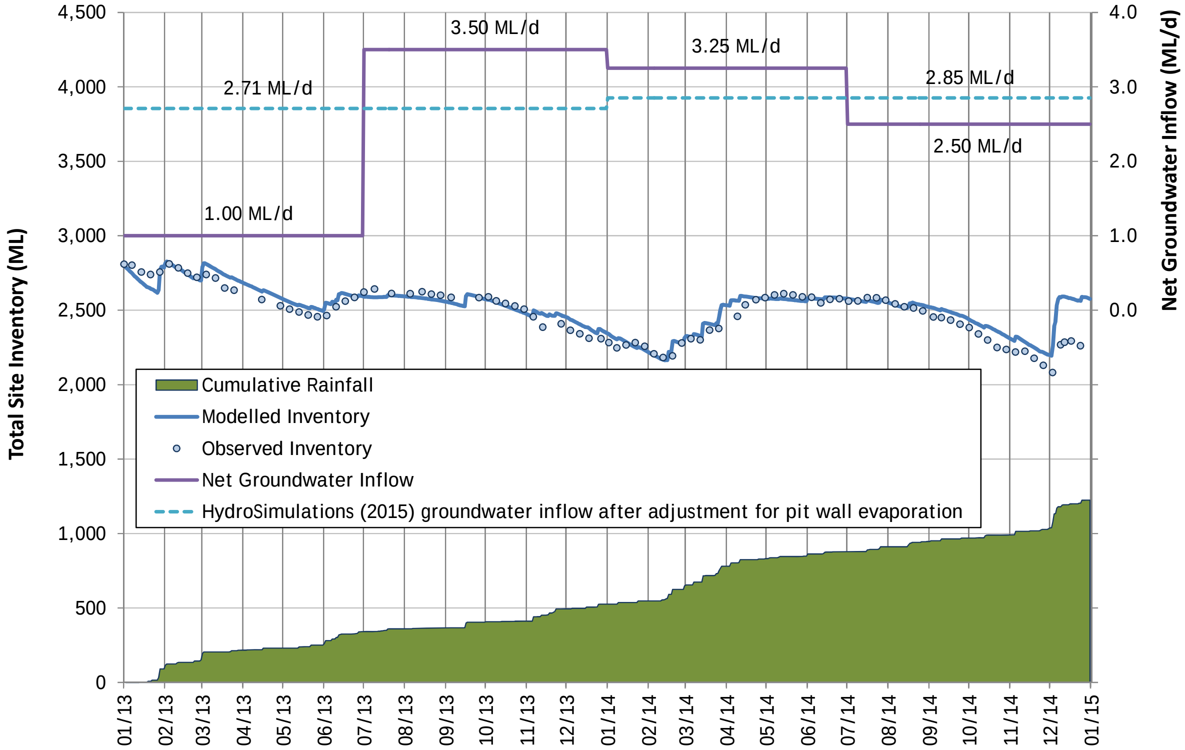


Figure 1 – Water Balance Model Calibration Results

8 Water Balance Model Results

8.1 Overall Water Balance

Water balance results for all of the 108 modelled realisations are presented in Table 10, averaged over each model phase.

Table 10
Average Annual Water Balance

Water Inflows (ML/year)						
Water Source	**2016**	**2018**	**2020**	**2024**	**2028**	**2031**
Catchment runoff	1,676	1,953	2,073	2,062	1,846	1,898
Direct Rainfall	419	449	409	328	304	204
Groundwater inflows	973	924	646	432	482	190
External water supply	0	0	0	2	1	2
Net Water Inflows	**3,068**	**3,326**	**3,128**	**2,824**	**2,633**	**2,294**
Water Outflows (ML/year)						
Evaporation	670	793	750	606	599	418
CHPP demand	609	613	542	471	355	195
Dust suppression demand	525	698	791	770	543	503
WT Facility discharge	276	950	668	459	522	747
Overflows – mine water dams	0	0	0	0	0	0
Overflows – sediment dams	114	161	151	52	25	26
Outflows – rehabilitated catchments	0	47	219	383	445	567
Outflows – diverted catchments	115	204	221	158	89	40
Net Water Outflows	**2,309**	**3,466**	**3,342**	**2,899**	**2,578**	**2,496**
Net Water Balance (ML/year)						
Change in Storage Volumes	**759**	**-140**	**-214**	**-75**	**55**	**-202**

The results show that on average over the life of the Wilpinjong Coal Mine:

- overflows do not occur from the mine water dams;
- average external water supply is minimal, with an annual average demand in the final three phases of 1 to 2 ML;
- the largest demand from the Water Management System is initially from the CHPP (for the first phase), and dust suppression usage for the five remaining phases;
- the average annual WT Facility discharge ranges between approximately 276 ML/year and 950 ML/year, with the highest discharge in Year 2018; and
- the average annual overflow volume from the sediment dams ranges between 25 ML/year and 161 ML/year, and is highest in Year 2018.

Note that the results presented in Table 10 are for the average of all realisations and will include wet and dry periods distributed throughout the Wilpinjong Coal Mine life. Rainfall yield for each stage is affected by the variation in climatic conditions within the adopted climate sequence.

8.2 Climate Sensitivity

Table 11 shows the variability of the water inputs and outputs of the Wilpinjong Coal Mine given varying climatic scenarios. The model has produced revised input and output values averaged over the 19 year period for a low (90th percentile), median (50th percentile) and high (10th percentile) rainfall scenario.

Table 11
Water Balance Climate Sensitivity

Water Inflows (ML/year)			
Water Source	**Low Rainfall**	**Median Rainfall**	**High Rainfall**
Catchment runoff	1,894	1,990	2,216
Direct Rainfall	295	350	403
Groundwater inflows	549	549	549
External water supply	0	0	0
Net Water Inflows	**2,738**	**2,889**	**3,168**
Water Outflows (ML/year)			
Evaporation	595	617	684
CHPP demand	438	438	438
Dust suppression demand	649	631	631
WT Facility discharge	514	677	798
Overflows – mine water dams	0	0	0
Overflows – sediment dams	27	43	138
Outflows – rehabilitated catchments	343	352	309
Outflows – diverted catchments	177	129	198
Net Water Outflows	**2,743**	**2,887**	**3,196**

The results show that:

- overflows do not occur from the mine water dams under any climate scenario;
- the external water supply required will average 0 ML/year.
- WT Facility discharge and sediment dam overflows remain largely the same over each climate scenario.

8.3 Mine Water Dam Storages

The Wilpinjong Coal Mine is operated to achieve the objective of no contained water storage overflow. As a result, the Wilpinjong Coal Mine is operated with an operational risk of disruption to mining which could occur as a result of exceedance of the design capacity of the water management system and the need to store water in active open pits if required.

Figure 2 shows the combined forecast inventory for the key mine water storages (Pit 2 West and Pit 1S Dam). This inventory show results for a wet (10th percentile) and dry (90th percentile) climate scenario, run over the full 19 year period.

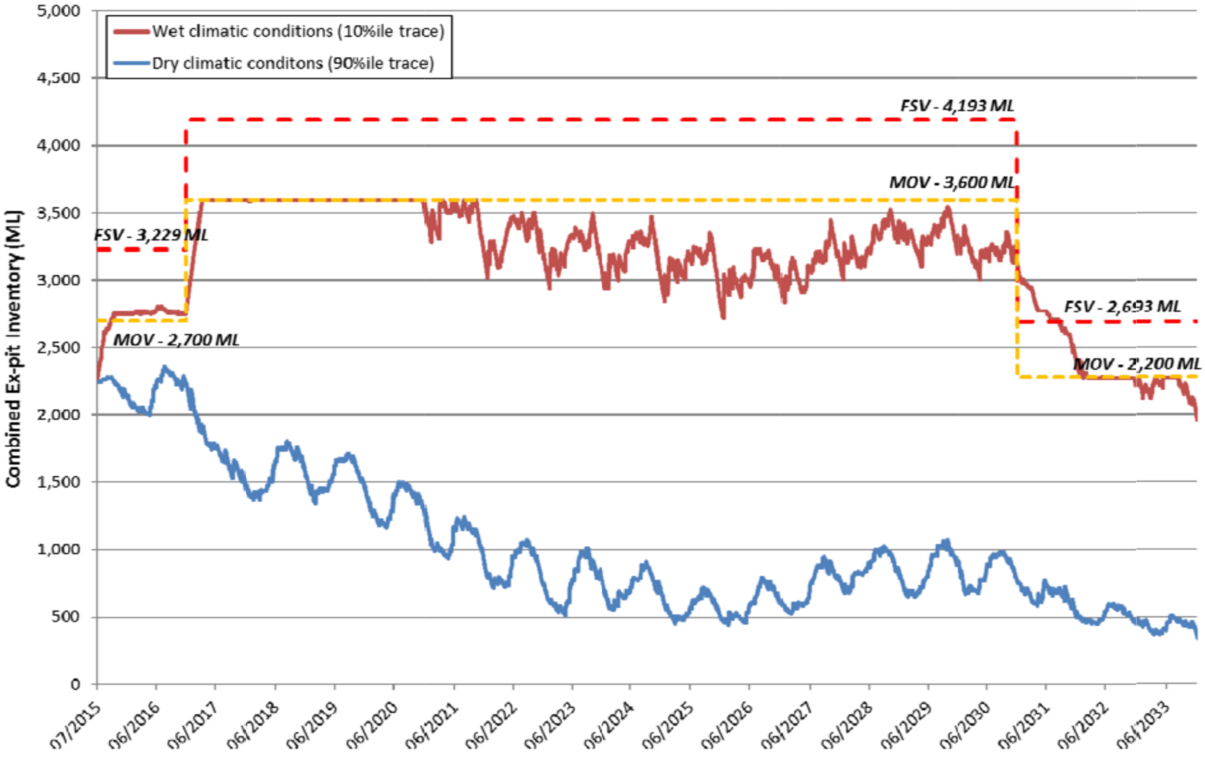


Figure 2 – Forecast Combined Mine Water Storage

To prevent uncontrolled discharges from the mine water storages, maximum operating volumes (MOV) have been set for the mine water storages. The MOV is the volume at which pumping from the open cuts and sediment dams into the Water Management System ceases. This was included as an operating rule in the OPSIM model. Also shown is the combined Full Supply Volume (FSV), which is the combined capacity of these dams.

The initial MOV volumes for Pit 2 West and Pit 1S Dam are 2,280 ML and 420 ML respectively. From Year 2016 onwards, the MOV for Pit 1S Dam increases to 1,320 ML until its decommissioning in Year 2031.

The nominal decommissioning date for Pit 1S Dam would be adjusted based on the capacities at the time so that the water held in storage remains below the FSV.

The forecast modelling results for the combined mine water dams show the 10th percentile mine water inventory will be around the MOV (i.e. the effective capacity of the mine water system) over the first 4 to 5 years of the simulation. The results indicate that the site is very sensitive to climatic conditions, which is to be expected given the relatively large catchments reporting to the site storages and open cuts. This response to climatic conditions decreases over time, as additional catchments are rehabilitated and diverted around the Water Management System.

8.4 Open Cut Storages

Figure 3 shows the forecast inventory for the combined mining open cuts over the 19 year period, under a wet (10th percentile) and very wet (1st percentile) climatic scenario. A build-up of water in the open cut generally occurs when the mine water storages are too full to accept additional pit water.

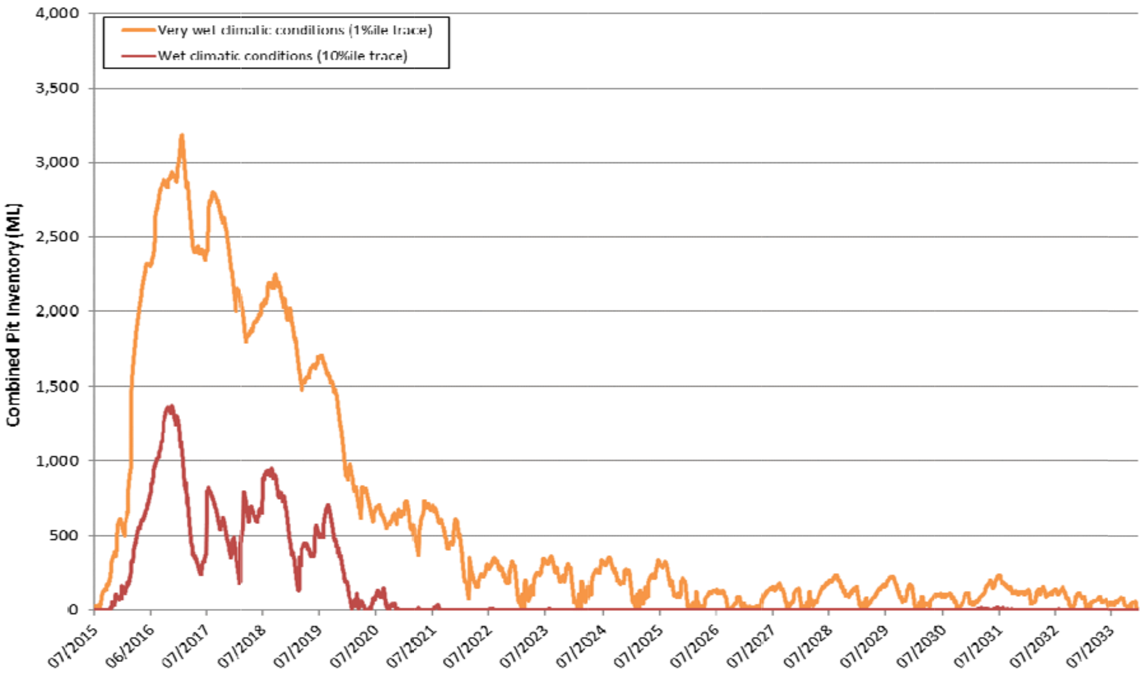


Figure 3 – Forecast Combined Open Cut Storage

The results show the following:

- The 1st percentile combined open cut inventory reaches approximately 3,200 ML by the start of Year 2017.
- The 10th percentile combined open cut inventory reaches approximately 1,360 ML by the start of Year 2017.

The results show that there is a chance that significant quantities of water will need to be stored in-pit in order to supplement the site storages, particularly in the first 5 years of the simulation.

8.5 External Makeup

The Wilpinjong Coal Mine Water Management System has been designed to maximise the reuse of on-site water runoff and groundwater flows. Nevertheless, in particularly dry years, water from the existing borefield (Section 5.3) may be required.

Figure 4 shows the predicted external makeup water required from the existing borefield over the 19 year period, under a median (50th percentile), dry (10th percentile) and very dry (1st percentile) climate scenario.

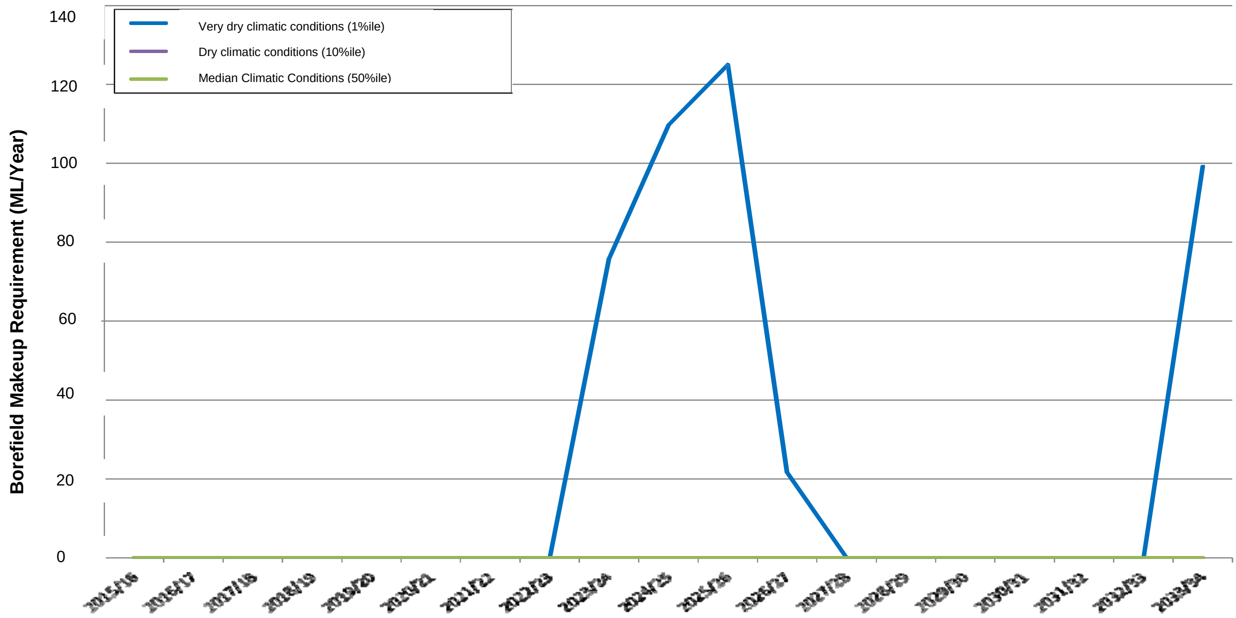


Figure 4 – Forecast External Makeup Demand

The results show that during median and dry conditions, no external makeup water will be required to supplement water storage at the Wilpinjong Coal Mine. Nevertheless, under very dry climatic conditions, from Year 2020 onwards up to 35 ML/month may be required until the end of Year 2026. Modelling indicates that the maximum water supply demand, which would only occur under very dry climatic conditions, would be up to approximately 130 ML/year. This small amount of make-up water could be readily secured via WCPL's existing hard rock groundwater licences given WCPL holds approximately 1,000 ML/year of available entitlement not required to account for modelled groundwater inflows.

8.6 Water Treatment Facility Discharges

Figure 5 shows the forecast WT Facility discharges over the 19 year period under very wet (1st percentile), wet (10th percentile), median (50th percentile), dry (90th percentile) and very dry (99th percentile) climate conditions.

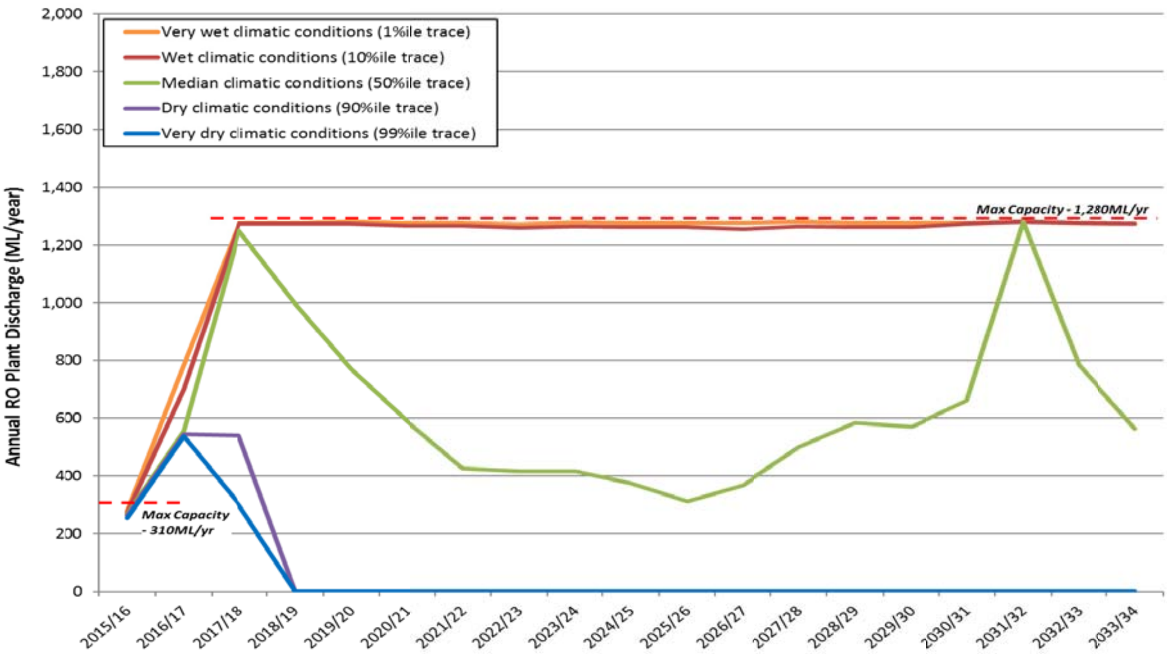


Figure 5 – Forecast Water Treatment Facility Discharge

The results show that:

- During both very wet and wet climatic conditions, modelled controlled releases are between 270 ML/year and 1,280 ML/year. Under these climatic conditions, the WT Facility operates almost 100% of the time.
- During median climatic conditions, modelled controlled releases are between 270 ML/year and 1,280 ML/year, with the peak in Year 2031.
- During both dry and very dry climatic conditions, modelled controlled releases only occur in the first three years of the simulation, with a peak annual discharge of around 545 ML/year.

The Wilpinjong Coal Mine experienced a period of significantly above average rainfall following the completion of the site water balance modelling. As a result, WCPL has sought and obtained a variation to EPL 12425 to permit discharge of up to 15 ML/day until 31 December 2019. Therefore, discharges from site may be greater than forecast on Figure 5 for the period up until 31 December 2019.

8.7 Sediment Dam Overflows

The potential for overflows from the proposed sediment dams has been assessed using a forecast assessment simulation. The predicted annual combined sediment dam overflows are provided in Figure 6.

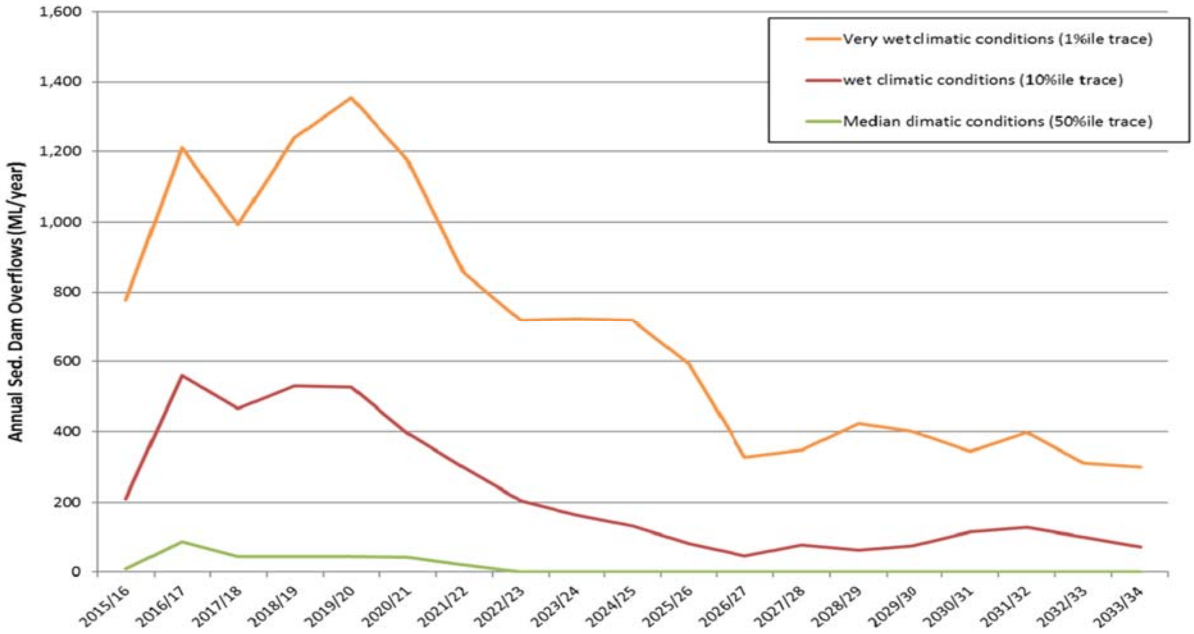


Figure 6 – Forecast Sediment Dam Overflows

The results show that:

- During very wet climatic conditions where rainfall events often exceed the required design standard, modelled sediment dam overflows are between 300 ML/year and 1,354 ML/year. The majority of the overflows occur in the first 5 to 6 years of the simulation.
- During wet climatic conditions where rainfall events sometimes exceed the required design standard, modelled sediment dam overflows are between 45 ML/year and 560 ML/year. The majority of the overflows occur in the first 5 to 6 years of the simulation.
- During median climatic conditions where very few rainfall events exceed the design standard, modelled sediment dam overflows are between 0 ML/year and 90 ML/year.
- During both dry climatic conditions and very dry climatic conditions where few or no rainfall events exceed the design standard, modelled sediment dam overflows are negligible.

As requested by the EPA, WCPL will apply as required to vary EPL 12425 to incorporate any sediment dams that will discharge off-site.

8.8 Mine Water Dam Overflows

The Water Management System has been configured to ensure no uncontrolled discharge of water from mine water storages to the receiving environment. As such, the modelled results show no spills from the Water Management System under any climatic scenarios, including during very wet climatic scenarios (1st percentile).

9 Annual Review and Improvement of Environmental Performance

The results of SWB monitoring are reported in the Annual Review. Further reporting details are provided in the WMP.

Monitoring parameters and locations will be reviewed and may be altered or discontinued as a result of changes to operations. Any revisions to the SWB monitoring program will also be described in the Annual Review and in future revisions of this SWB.

Annual Reviews will include a site water balance modelling review. The modelling review will include validation/calibration of the site water balance model against data obtained from water management system monitoring. Examples of data that may be used to calibrate the model includes:

- Comparison of modelled water inventory against measured total site inventory.
- Comparison of modelled storage inventory against recordings of individual storage volumes (in cases where rates of pumping/seepage between storages are not significant or are well understood).
- Update of model predictions to incorporate contemporary groundwater modelling or rainfall runoff data.

The outcomes of contemporary site water balance modelling will also be considered at periodic life of mine risk assessments. Operational site water management practices and contingency measures will also be reviewed and, if required, updated to reflect the outcomes of contemporary water balance modelling.

WCPL is preparing an updated site water balance model of the Wilpinjong Coal Mine. The outcomes of the updated model will be reported in the next annual review (March 2018) and this Site Water Balance will be updated accordingly.

10 Responsibilities

Specific responsibilities for personnel in relation to this SWB are provided in Table 12. General responsibilities for water management are contained within the WMP.

Table 12
Responsibilities

Responsibility	Task	Timing
General Manager	Ensure that adequate resources are available to effectively implement requirements of this SWMP.	Ongoing and during budget planning
	Authorise water supply augmentation if advised by the Environmental and Community Manager that there is insufficient water for the Wilpinjong Coal Mine.	As required
Environmental and Community Manager	Oversee development of water management system.	Continuous
	Ensure disturbance areas are minimised and progressive rehabilitation is undertaken in accordance with the MOP.	Continuous
	Ensure clean water diversions are designed and constructed upslope of mining areas.	As required
	Monitor site water usage and advise General Manager as soon as possible if it appears there may be insufficient water for the mine water supply.	As required
	Seek approvals for additional production bores and associated licences.	If/when water balance model indicates required
	Progress water sharing agreement with UCML and seek approvals process for pipeline.	If/when water balance model indicates required
Environmental Representative	Organise and record potable water deliveries to site.	As required
	Coordinate the validation of the water balance model using available monitoring data.	Annually
Open Cut Examiner	Monitor water storage levels and pumping.	Check readings each shift, ensure records stored electronically at end of shift

11 References

Boughton, W.C. (1993) *Direct evaluation of parameters in a rainfall runoff model*. In: McAleer, M.J., Jakeman, A. (Eds.), Proceedings of the International Congress on Modelling and Simulation, Vol. 1, Modelling and Simulation Society of Australia, pp. 13 – 18.

Department of Environment and Climate Change (2008) *Managing Urban Stormwater Soils and Construction – Volume 2E Mines and Quarries.*

Department of Environment and Conservation (2004) *Environmental Guidelines: Use of Effluent by Irrigation*.

Gilbert and Associates (2013) *Wilpinjong Coal Mine Modification – Surface Water Assessment.*

HydroSimulations (2015) *Wilpinjong Extension Project Groundwater Assessment.*

Jeffrey SJ, Carter JO, Moodie KM & Beswick AR, (2001) *Using Spatial Interpolation to Construct a Comprehensive Archive of Australian Climate Data*, Environmental Modelling & Software, Vole 16/4. Pp 309-330, 2001.

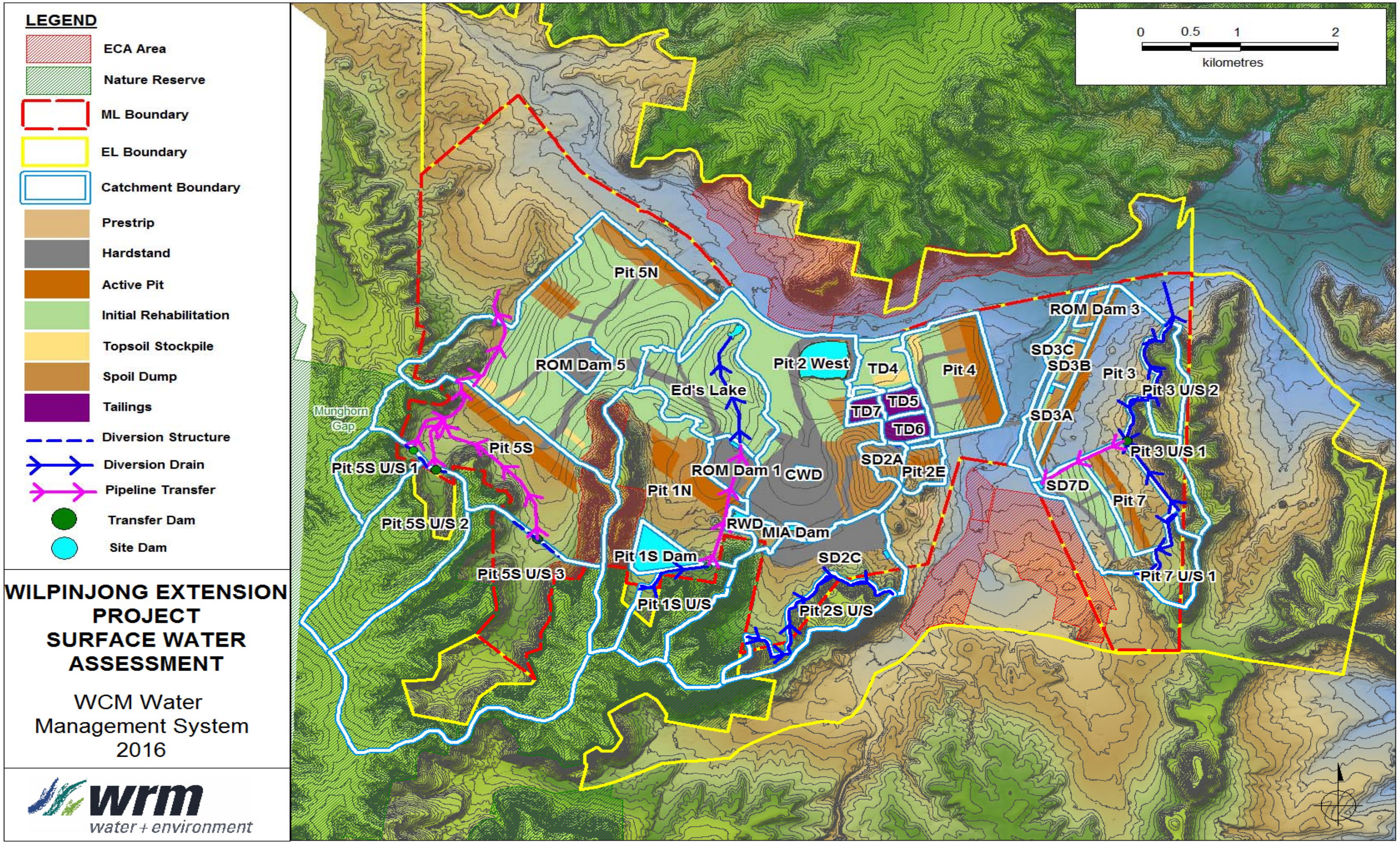
Landcom (2004) *Managing Urban Stormwater: Soils and Construction manual*.

WRM Water and Environment (2015) *Wilpinjong Extension Project – Surface Water Assessment.*

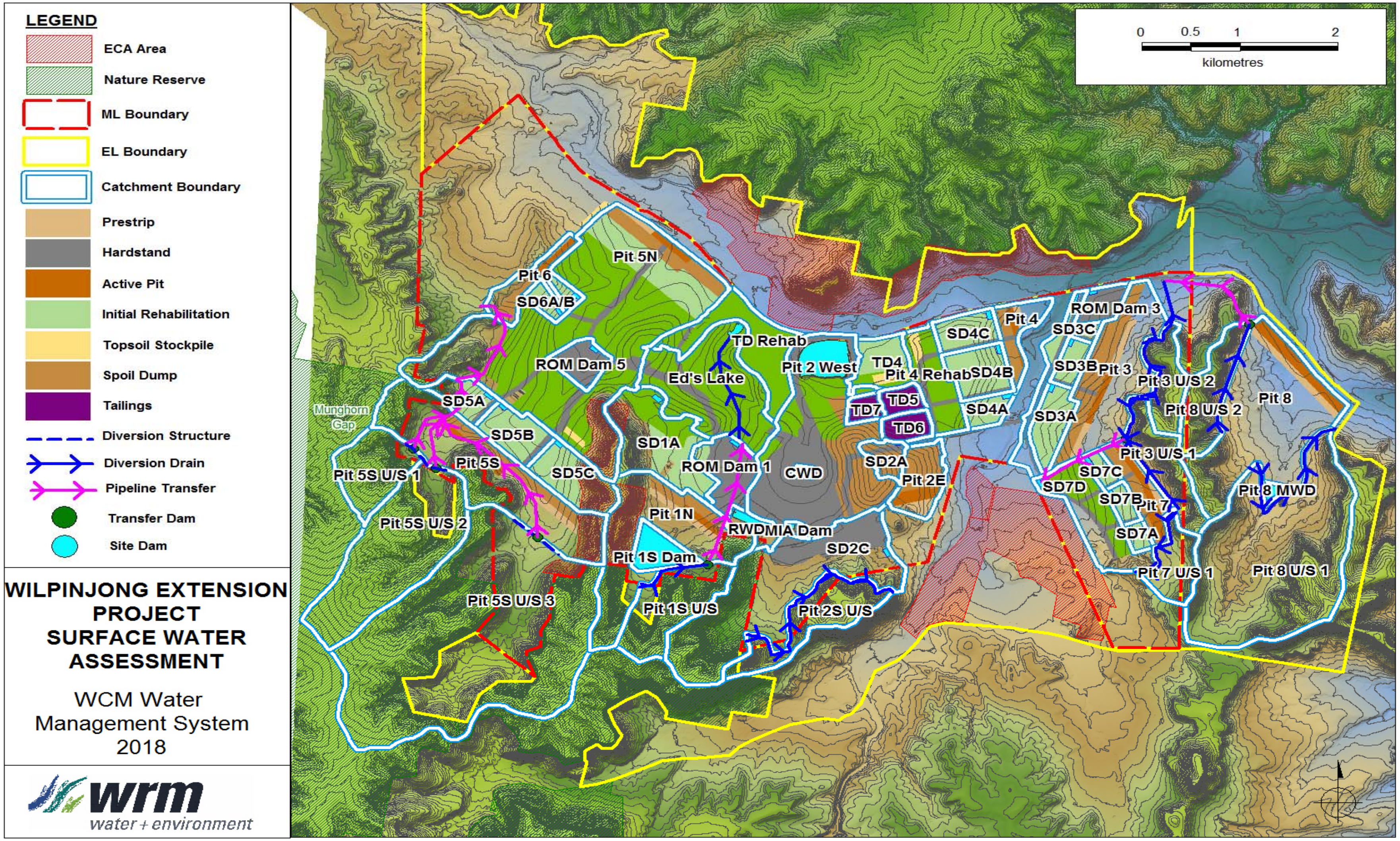
WRM Water and Environment (20170 *Wilpinjong Extension Project – Sediment Dam Sizing Sensitivity Analysis*. Published in Peabody Energy Australia (2017) *Wilpinjong Extension Project Response to Planning Assessment Commission Review.*

ATTACHMENT A

WATER MANAGEMENT SYSTEM
(WRM, WATER AND ENVIRONMENT 2015)

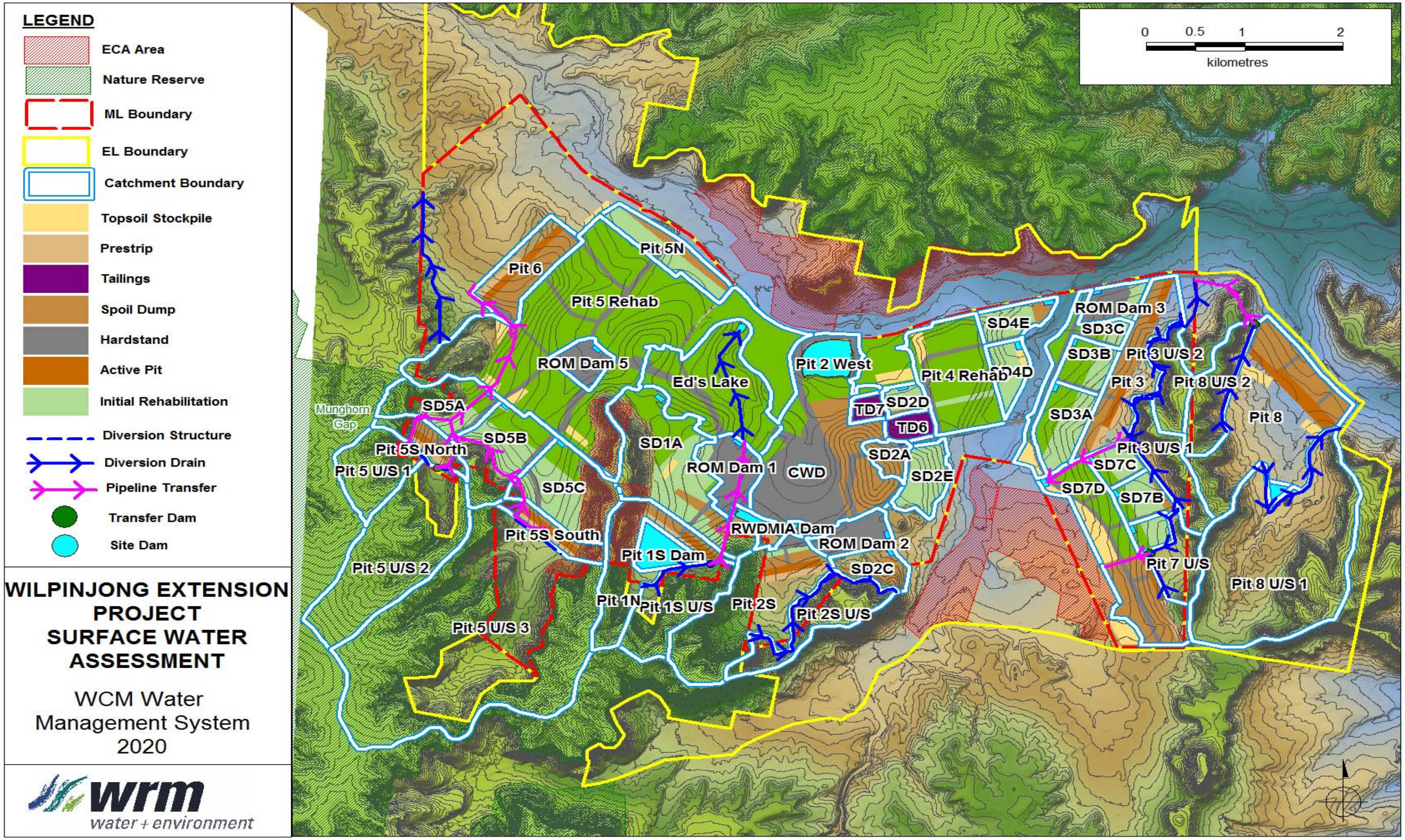


Water Management System – 2016



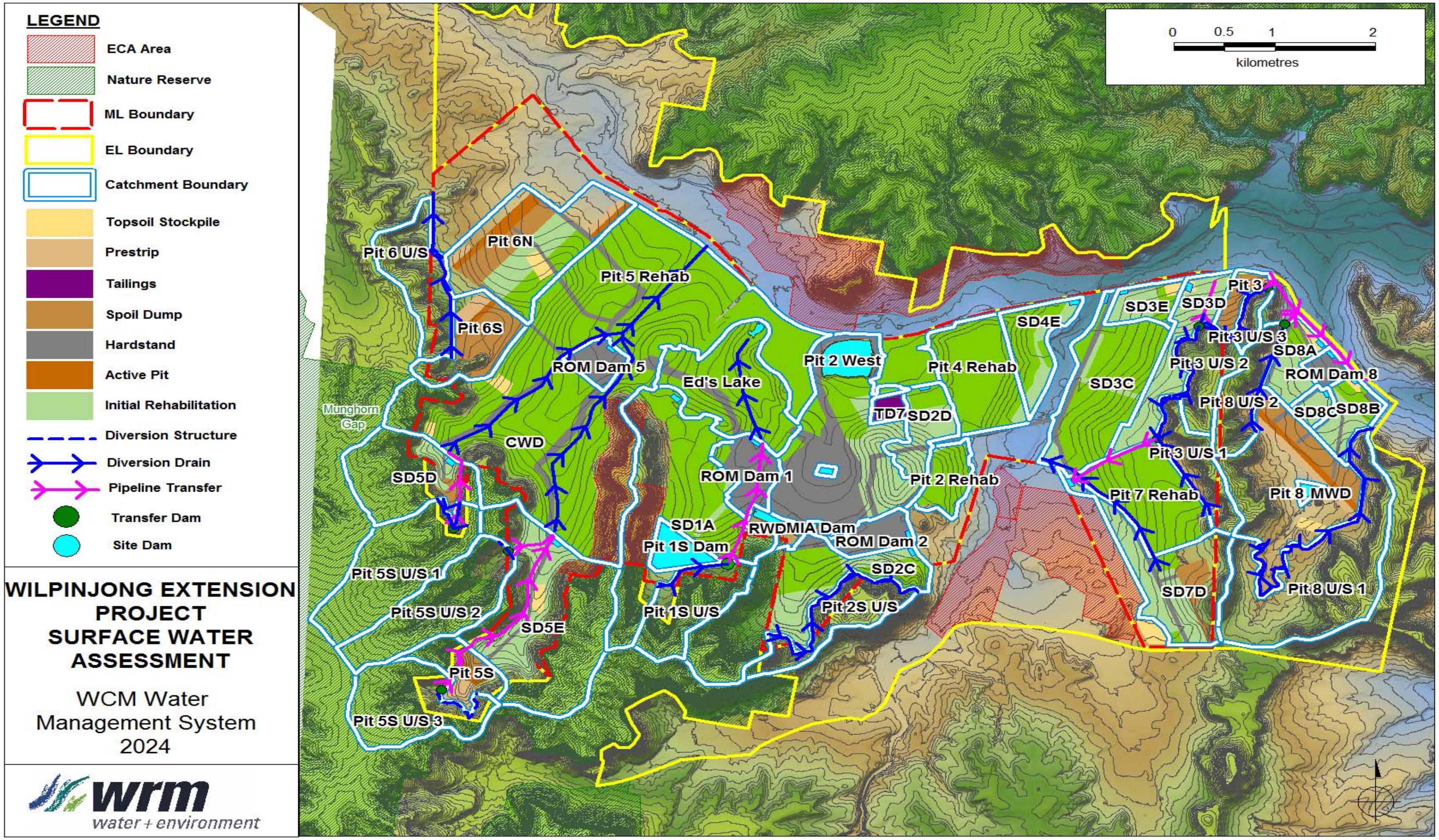
Water Management System – 2018

Peabody

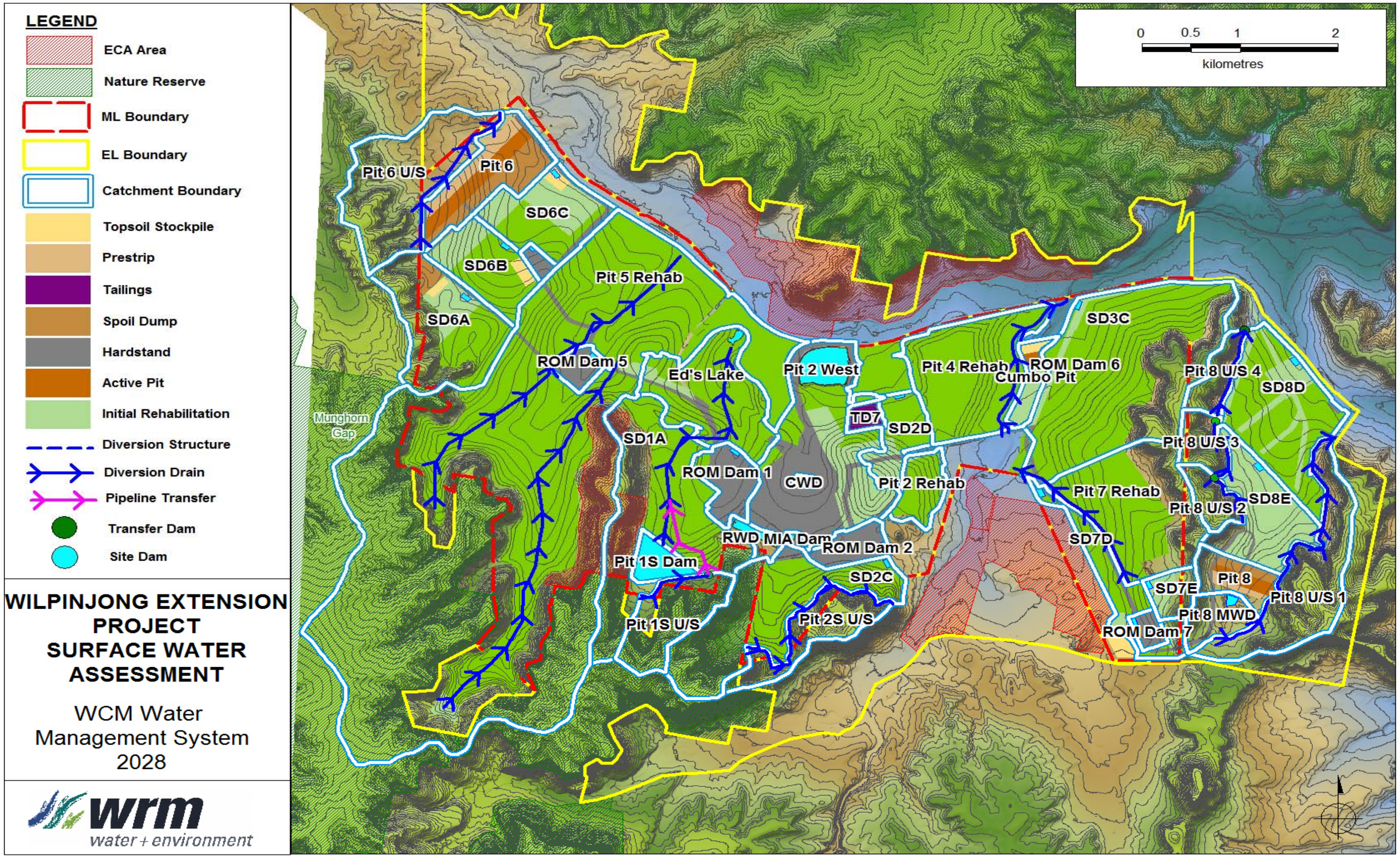


Water Management System – 2020

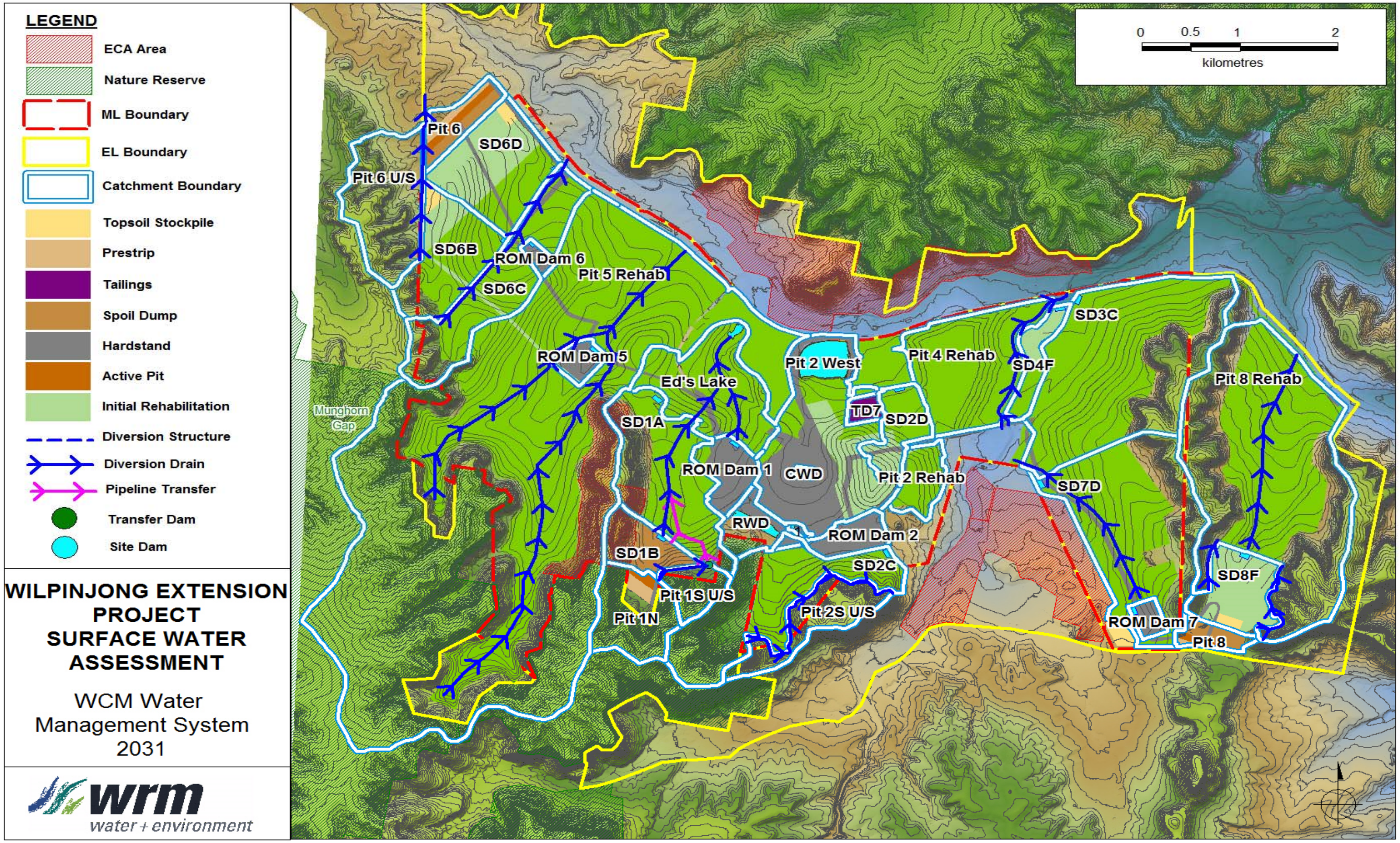
Peabody



Water Management System – 2024

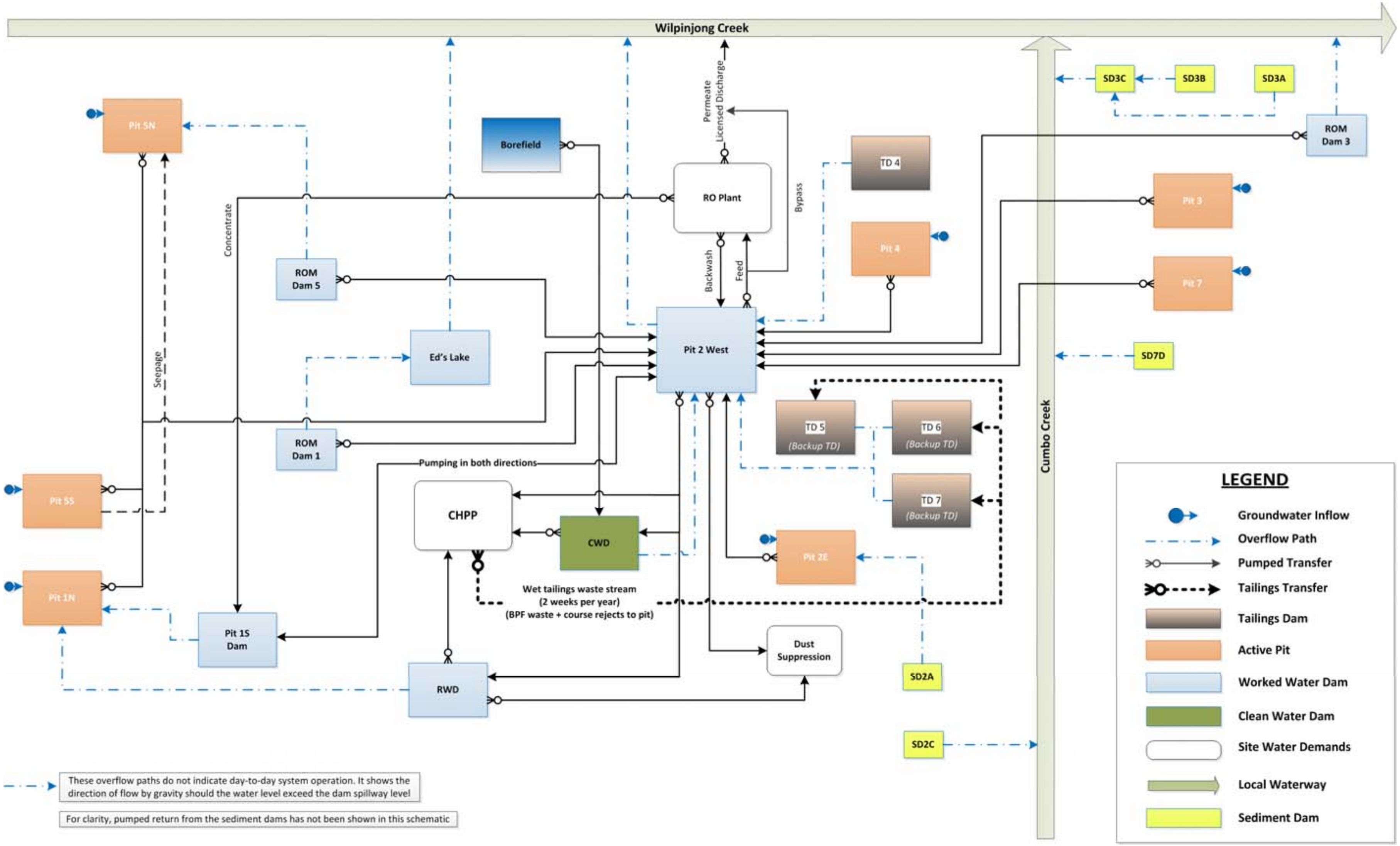


Water Management System – 2028

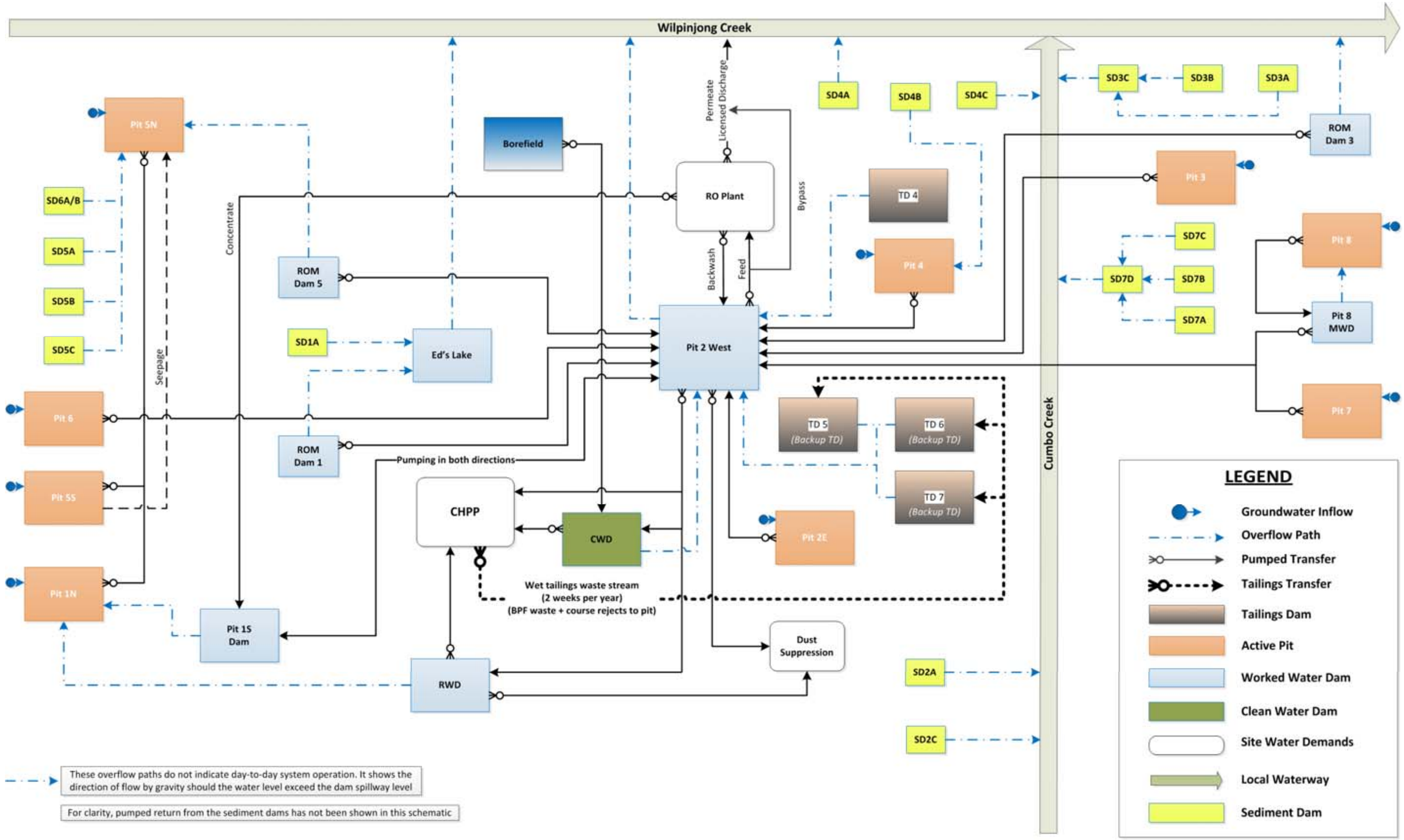


Water Management System – 2031

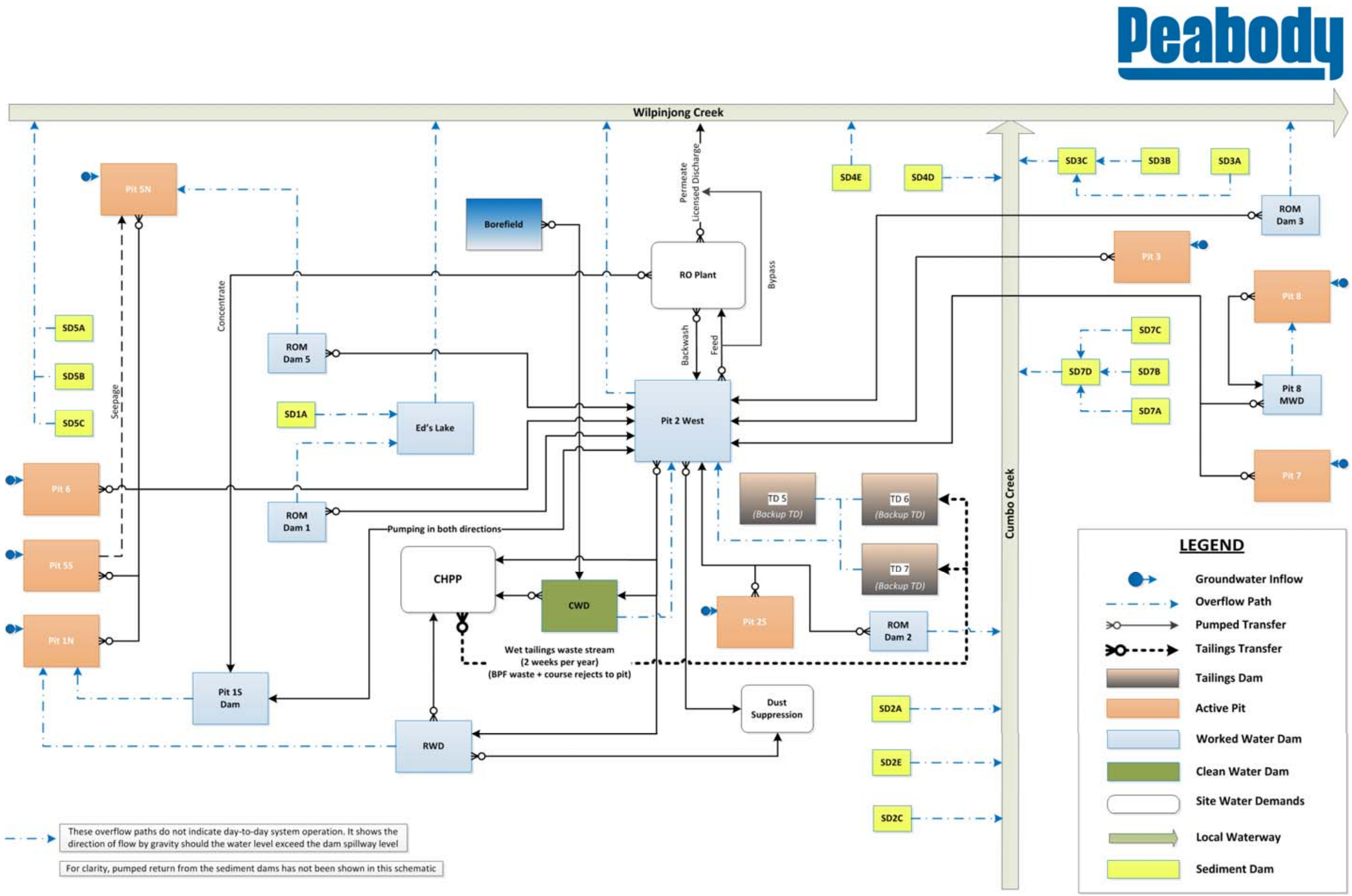
Peabody



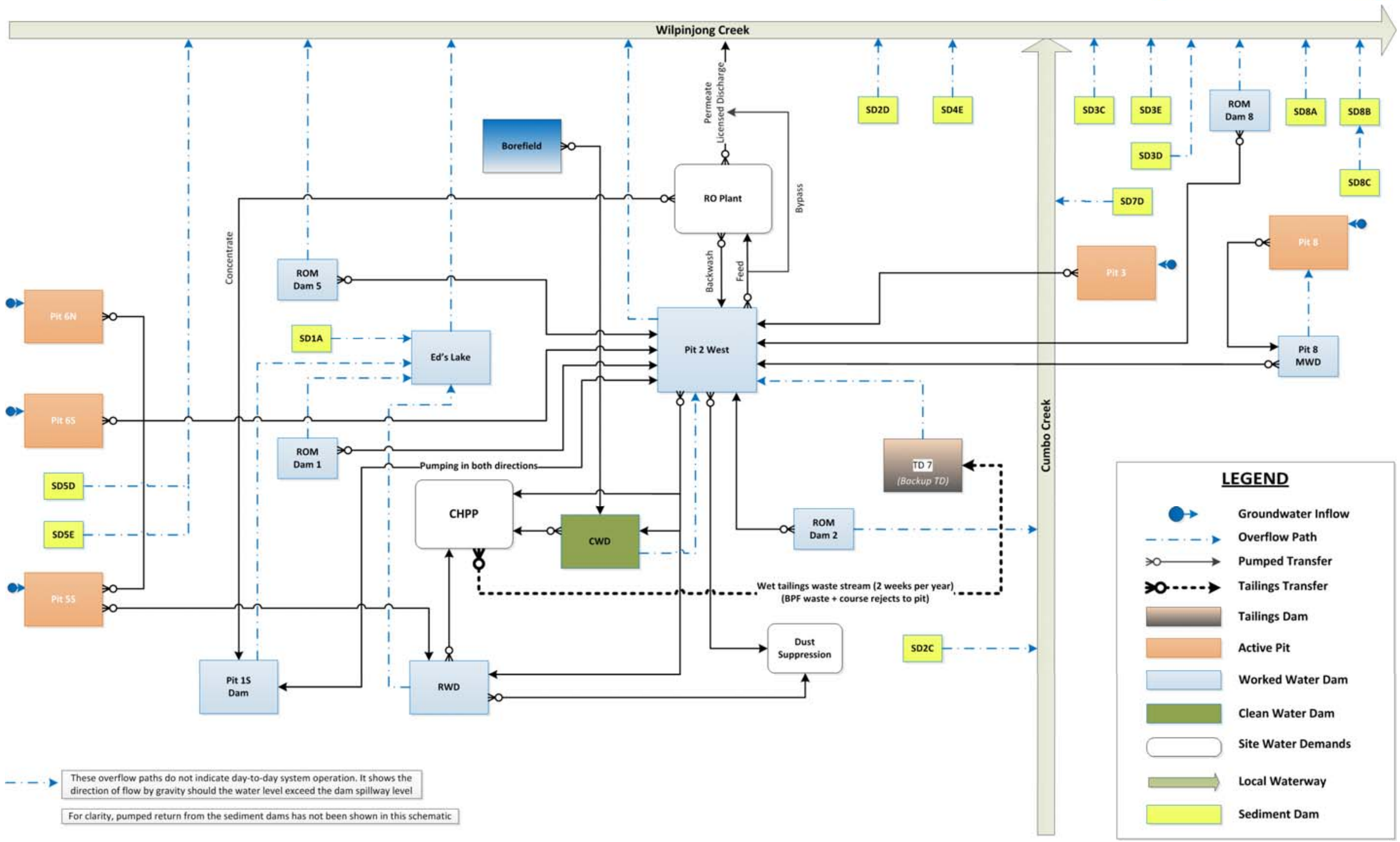
Water Management System Schematic – Year 2016



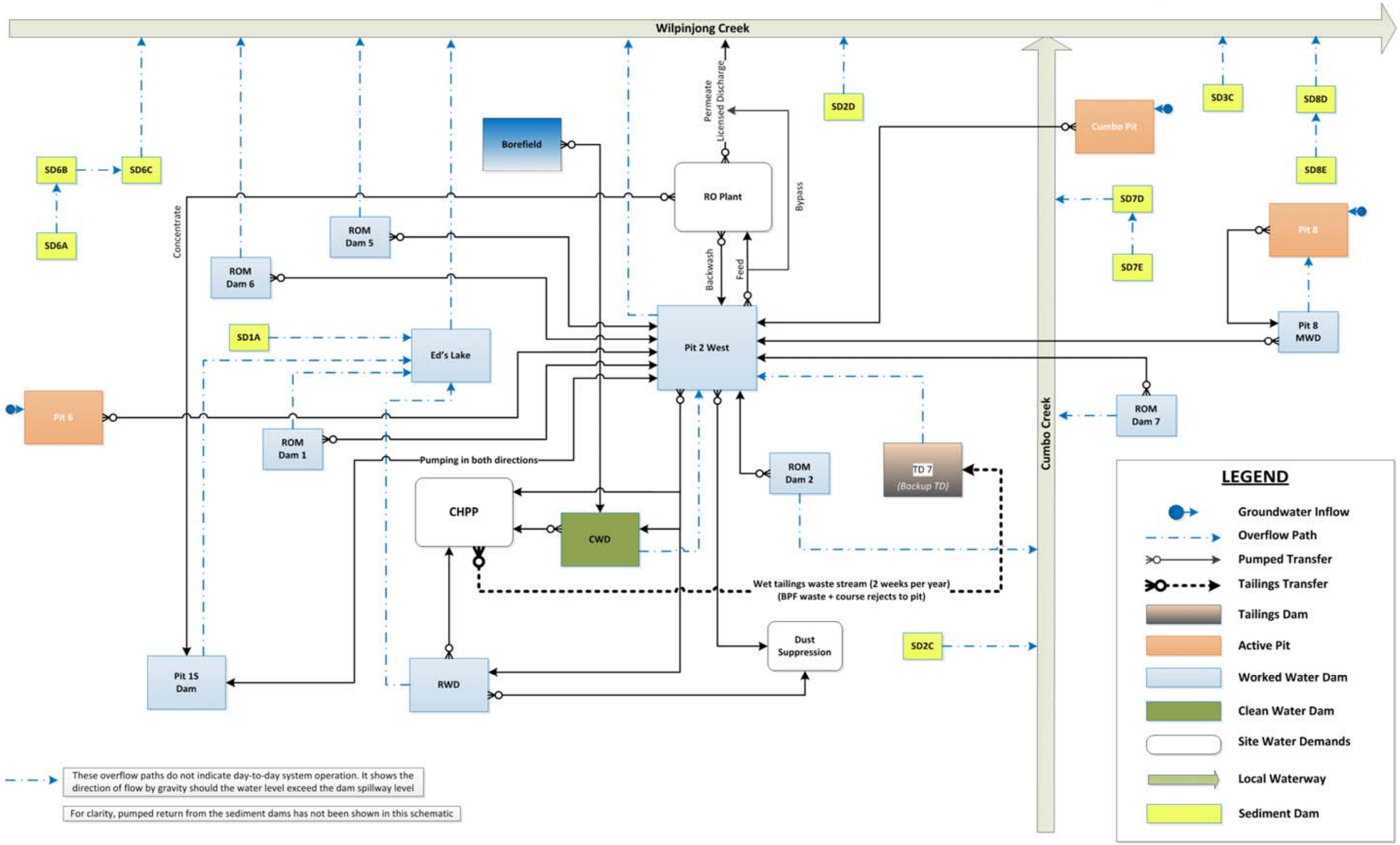
Water Management System Schematic - 2018



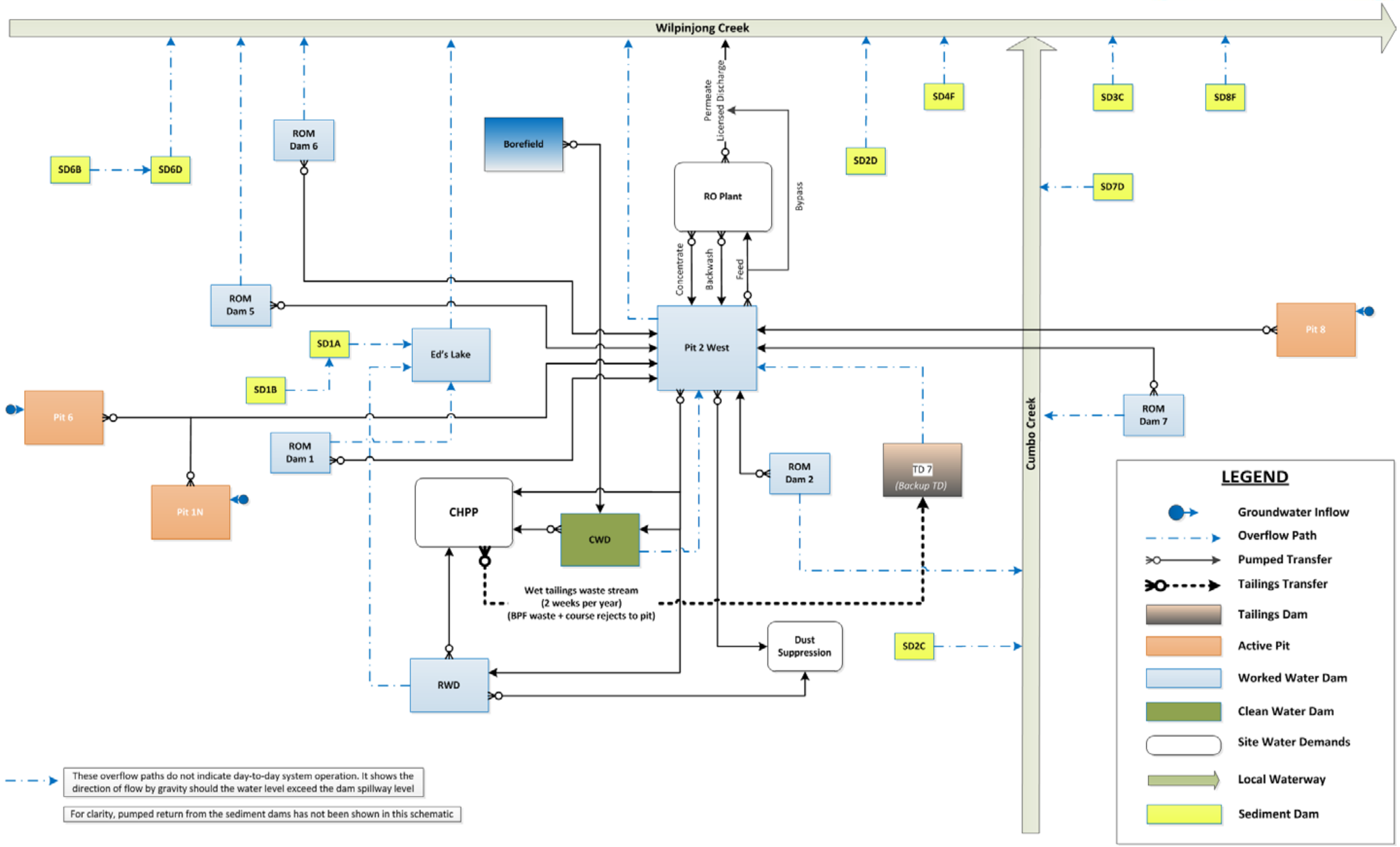
Water Management System Schematic - 2020



Water Management System Schematic - 2024



Water Management System Schematic - 2028



Water Management System Schematic - 2031