Appendix F

Preliminary responses to OEH and SEWPaC comments on the Preferred Project Report and Response to Submissions — biodiversity (26 March 2013)

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065
PO Box 21
St Leonards, NSW, 1590

T +61 2 9493 9500
F +61 2 9493 9599
E info@emgamm.com

www.emgamm.com

26 March 2013

Stephen O'Donoghue
Senior Planner
Department of Planning and Infrastructure

Via email

Re: Cobbora Coal Project – Preliminary Responses to OEH and SEWPaC Comments on the Preferred Project Report and Response to Submissions – Biodiversity

Dear Stephen,

The NSW Office of Environment and Heritage (OEH) and Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) have provided comments on the Cobbora Coal Project Preferred Project Report and Response to Submissions (PPR&RTS). This letter provides clarification on some of the issues raised and describes planned work to address outstanding ecological matters.

The matters identified by OEH include:

- assessment and mitigation of potential indirect impacts on habitat;
- calculations and justification of offset requirements;
- the adequacy of the proposed offset strategy; and
- the need to continue to consult with OEH on a range of biodiversity-related matters.

The matters identified by SEWPaC include:

- the quality of information and lack of analysis applied to determine the extent of impacts on matters of national environmental significance (MNES);
- the need for the provision of measures to mitigate and offset impacts for each MNES likely to be impacted; and
- biodiversity offsets, which do not yet adequately address the Environmental Offsets Policy under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1 Clarifications

1.1 Area to be impacted

Inconsistencies in the areas (hectares) of vegetation types to be impacted in Chapter 3 of the PPR&RTS have been identified. Table 1 provides the correct impact areas for the Project as described in the PPR&RTS. The table also includes the areas as presented in the exhibited Environmental Assessment (EA).

The main differences between the exhibited EA and PPR&RTS are a result of re-classification of grassland and to a far lesser extent from Project amendments.

Table 1 Areas of vegetation to be impacted by the Project

	Impact area (ha)	
Vegetation type	**Exhibited EA**	**PPR&RTS**
Box Gum Woodland EEC (woodland) (TSC Act and EPBC Act)	12	22*
Box Gum Woodland EEC (DNG) (TSC Act)	0	105
Fuzzy Box Woodland EEC (woodland) (TSC Act)	13	14
Fuzzy Box Woodland EEC (DNG) (TSC Act)	0	14
Grey Box Woodland EEC (woodland) (TSC Act and EPBC Act)	54	49*
Grey Box Woodland EEC (DNG) (TSC Act)	0	34
Total threatened ecological communities (TEC)	**79**	**238**
Non-TEC woodland vegetation	1,788	1,875
Native pasture in low condition	967	1,048
Total	**2,834**	**3,161**

Notes: DNG: derived native grassland

**correct area - inconsistency provided in the PPR&RTS*

1.2 Indirect impacts

OEH have recommended the following:

1. Clarify the location of the road over rail bridge and rail underpass in the vicinity of Goodiman SCA.

The rail and road alignments are shown in Figure 3.14, and described in Section 3.9.5 and Section 11.1.2 of the PPR&RTS. There will be an underpass (road-under-rail) on Brooklyn Road near the north-eastern corner of Goodiman SCA and a bridge (road-over-rail) approximately 1 km west of the north-western corner of Goodiman SCA. The underpass will have a clearance of 5.5 m. Section 12.1 of the PPR&RTS incorrectly states that both crossings will be underpasses.

2. Provide the additional noise assessments undertaken for the Goodiman SCA.

The additional assessments undertaken for the residences to the north of Goodiman SCA were provided as part of the PPR&RTS report (see Appendix I). These have been used as a surrogate for the potential noise levels from the rail spur in Goodiman SCA, when assessing potential indirect noise impacts in the PPR&RTS.

3. Provide information on the likely indirect impacts of the proposal on OEH Estate and proposed offsets (noise, light spill and dust) in particular the likely level of mitigation expected to be achieved and the types of measures that could be employed.

Section 9.1.4v(a and b) and Section 9.2.16 of the PPR&RTS discuss the potential indirect impacts of the Project on NPWS Estate, while Section 6.3.2 of the EA Terrestrial Ecology Assessment discusses the potential impacts of the Project in accordance with the *Guidelines for Developments Adjoining Land and Water Managed by the Department of Climate Change and Water* (DECCW 2010). This assessment includes the potential indirect impacts of erosion and sedimentation, stormwater runoff, pests, weeds and edge effects, visual, odour, noise, vibration, air quality and amenity.

Areas of NPWS Estate and proposed offsets close to the Project generally occur on the eastern side of the PAA. This area is unlikely to be subject to mining impacts, given the distance between these activities and progressive mining (the closest proposed offset is more than 0.5 km from any mining areas, but these are generally greater than 5 km). It will be subject to impacts from linear infrastructure construction and operation. Mitigation measures have been proposed for these areas, including fauna crossings, noise bunds (for residences but will also be effective in reducing noise levels in areas occupied by native fauna), screening plantings and regeneration. The exception to this is a small area containing a large population of *Zieria ingramii* (340 individuals) which is less than 1 km west of the CHPP and is adjacent to haul roads.

As the potential impacts to all species cannot be fully quantified, a monitoring and adaptive management approach will be adopted to identify any impacts on threatened fauna and additional mitigation measures (eg light shades) that will be applied in these areas.

4. Employ the methodology set out in the Biobanking Operation Manual to take into account any residual indirect impacts on biodiversity values after considering the likely efficacy of available mitigation measures.

There is a paucity of published literature on the indirect impacts of noise, light spill and dust from mining projects on threatened species and communities in surrounding areas. However, the literature suggests that some physiological changes in communication and behavioural modification can occur as a result of prolonged exposure to elevated noise levels, as discussed in the EA Terrestrial Ecology Assessment and the PPR&RTS.

It is not possible to accurately quantify the reduction in viability of habitat as a result of such impacts. Therefore, the application of the Biobanking Assessment Methodology would be subjective and non-quantitative.

Existing approved open-cut mine projects in the region including Wilpinjong, Maules Creek, Boggabri, Tarrawonga and Werris Creek, have only compensated for direct impacts on biodiversity using offsets.

1.3 Downstream environmental impacts

OEH have recommended that a mitigation and compensation strategy be developed that outlines the process that will be followed if adverse impacts on the in-stream habitat quality are detected or anticipated.

The PPR&RTS discusses the preparation and implementation of an aquatic monitoring strategy in consultation with OEH. This strategy will incorporate an adaptive management framework that will be reported back to a river monitoring committee that will include NSW Government agencies. This will provide the mitigation strategy (including compensatory measures if impacts are detected) requested by OEH.

2 Offset plan

The main outstanding matter identified by OEH and SEWPaC is the incomplete offset package. This is being finalised, with negotiations with landholders and ecological surveys underway to secure additional offset sites. In the interim, we would like to discuss and agree to the offset strategy approach with DP&I, OEH and SEWPaC based on the following steps:

1. EMM to provide an offset update document provided by 5 April;
2. offset strategy meeting with DP&I, SEWPaC and OEH; and
3. finalisation of the offset package based on the agreed strategy.

The following section details the proposed discussion points for the offset strategy meeting and the likely content of the offset update document.

2.1.1 Offset update

Additional offset identification work and survey has been undertaken since the PPR&RTS was prepared. More than 3,700 ha have been identified and surveyed for biodiversity offset values. These are in identified priority areas for addition to the NPWS Estate and contain some significant ecological values. An offset update will be provided to DP&I, OEH and SEWPaC to inform the offset strategy meeting. This will provide an indication of the outstanding offset requirements that can be discussed and agreed.

2.1.2 Offsets for fauna species with the potential to occur

Comment is made by SEWPaC relating to the inclusion of offsets for a number of fauna species which were not identified onsite but may occur in low numbers or move through the site on occasion. It is anticipated that these species will already be provided by the proposed offsets through the protection and enhancement of compensatory habitat, however this will be further discussed in the offset update.

2.1.3 Use of the Biobanking tool

The OEH Interim Offset Policy uses the Biobanking methodology to calculate the likely offset requirements of a project. OEH has recommended that this policy is used to ensure that adequate offsets have been provided for the project. OEH consider that the offset strategy has not appropriately used the Tier 3 variation criteria and further information is needed.

The OEH Interim Offset Policy is a guidance document and has been used to assist OEH in the assessment of the Project. However, the inherent issues with the Biobanking tool for a project of this scale as discussed with OEH throughout the Project assessment, have not allowed it to be applied for all vegetation clearing and habitat loss associated with the Project.

As described in the updated biodiversity offset strategy (Appendix H of the PPR&RTS), the Biobanking calculator indicates that unprecedented large offset areas would be required for the Project in comparison to a range of equivalent projects in NSW. The proposed offset ratios are based on recent similar approvals in the region and provide meaningful and ecologically suitable offset targets for the Project.

We would like to discuss OEH's comment, 'use of arbitrary impact to hectare ratios is not supported', at the offsets meeting. It is recommended that the use of the Biobanking tool also be discussed in the offset strategy meeting.

2.1.4 Use of the EPBC offset calculator

The EPBC offset calculator will be used to inform the offset update for each of the MNES identified as being impacted after implementation of mitigation measures and for those additional species identified by SEWPaC.

3 Closing

CHC and EMM are looking forward to the opportunity to discuss the matters discussed above at the offsets strategy meeting. Given that the offsets update will be provided by 5 April, we believe that the meeting could be held in the week commencing starting 8 April 2013. Please let me know if further information will assist prior to the meeting.

Yours sincerely

Cassandra Thompson
Senior Ecologist
cthompson@emgamm.com

Appendix G

Update on VPA (21 March 2013)

Cobbora Holding Company Pty Limited

Proposed Voluntary Planning Agreements

Cobbora Holding Company (CHC) has been negotiating Voluntary Planning Agreements (VPAs) with representatives of the four stakeholder Councils since November 2012.

VPAs are a common mechanism for proponents to contribute to upgraded or additional community infrastructure and services that are needed as a result of workers moving into a Council area. They are not intended to offset the impacts of the development itself.

The Cobbora Coal Project VPA negotiation process is unusual in that it is dealing with four Councils, whereas most major coal developments only negotiate with one council.

CHC has consulted with the DP&I in developing the proposed VPA. At the most recent meeting, 22 January 2013, CHC's approach was described by DP&I as a good model for other developments.

GENERAL

CHC'S financial contribution to the four Councils will be based on a payment of $1,000 per annum per employee over the Project's 23-year life (two years construction and 21 years operations). A minimum workforce of 400 will be used to calculate these contributions. Over the life of the Project, CHC will contribute at least $9.2 million to the Councils, although this will be higher based on the projected peak operations workforce of 590.

The proposed VPAs structure for construction and operations is described below.

MINE CONSTRUCTION PHASE

On an agreed date each year during construction, CHC will calculate the number of employees on its payroll. That number will be multiplied by $1,000 to determine the amount to be distributed evenly to the four Councils, with a minimum distribution of $400,000.

The majority of employees will live on-site in CHC's construction camp during this period. However, these payments will allow the Councils to plan for new or upgraded infrastructure to cater for the increase in population when the mine becomes operational.

MINE OPERATIONAL PHASE

On an agreed date each year during operations, CHC will calculate the number of employees on its payroll. That number will be multiplied by $1,000 to determine the amount to be distributed across the four Councils, with a minimum distribution of $400,000.

Sixty per cent of these funds will be distributed evenly to the four Councils. The remaining 40% of funds will be distributed to the Councils according to the actual number of employees residing within each Council area.

CHC is negotiating separate funding agreements with the individual Councils to cover infrastructure requirements specifically related to the impacts of the Project, such as roads and rail crossings.

<u>TRAINING</u>

As part of CHC's commitment to training a local workforce, CHC will contribute a total of $1,000 per person towards the cost of a 10-week entry level mining training course run by TAFE Western in each of the four stakeholder Council areas between 2013 and 2015. CHC will make these training payments through the four Councils.

Trainees will be free to work in either mining or other local industries upon completion of their course, which will assist Councils and businesses to fill local gaps in skills. Based on the number of course places available at each TAFE (735 in total), this is an estimated expenditure of $735,000. The allocation will be: Mid-Western - $180,000, Dubbo - $270,000, Wellington - $165,000 and Warrumbungle - $120,000.

<u>CURRENT STATUS OF VPA DISCUSSIONS</u>

CHC has recently held fruitful discussions with Mid-Western Regional Council (MWRC), particularly relating to road and rail crossing upgrades in the Council area. An infrastructure agreement has paved the way to finalise the VPA, which has been given in-principle support by Council's senior management. A draft VPA document was sent to Council for comment on 26 February 2013. CHC is meeting with Council on 22 March 2013, where CHC is seeking that Council's senior management sign-off on the VPA. The agreement will then require final approval from a meeting of MWRC Councillors.

CHC met with Wellington and Warrumbungle Shire Councils in December 2012 and February 2013. Based on these discussions, a draft VPA document was revised and sent to both Councils for comment on 26 February 2013. Further correspondence is currently being prepared answering Warrumbungle Council's request for additional information.

Negotiations with Dubbo City Council, which has requested a cents/tonne payment over the life of the mine, are ongoing. A draft VPA document was sent to Council on 26 February 2013 for comment. A further meeting is planned with Dubbo City Council on 28 March 2013.

Appendix H

Land use management strategy (20 March 2013)

Memorandum

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065
PO Box 21
St Leonards, NSW, 1590

T +61 2 9493 9500
F +61 2 9493 9599
E info@emgamm.com

www.emgamm.com

20 March 2013

To Stephen O'Donoghue, Department of Planning and Infrastructure
From Philip Towler

Subject CHC Land Use Management Strategy

Dear Stephen,

Local councils and the community have commented on the management of agricultural land owned by Cobbora Holding Company Pty Limited (CHC). This memorandum provides an update on this issue.

Context

Of the 32,538 ha of land owned by CHC, 30,468 ha continues to be farmed via lease or licence arrangements (ie 93%). The majority of existing arrangements were established through the previous Unincorporated Joint Venture of the NSW generators - Delta Electricity, Eraring Energy and Macquarie Generation. These leases were mostly on a short term basis of 1 to 2 years.

Land Use Management Strategy

CHC's Land Use Management Strategy (which is currently being finalised) will provide a framework for holistic long-term land management based on aggregation of land parcels and flexible licence tenure agreements. Its objective will be to maximise the commercial return to the licensees of CHC-owned agricultural land.

The strategy will aggregate land having similar characteristics and potential uses. Land not required for mine operations will be licenced for a term of 5 years with an option exercisable by the licensee to extend the term for a further 5 years. Lands that may experience disruption due to construction or operations will have a more flexible short term licence (generally two to three years).

Experienced farmers will be selected by open public tender and will need to agree to a commercially acceptable licence agreement that will require that the property continues to be operated as an agricultural enterprise.

The finalised Land Use Management Strategy will be provided to DP&I shortly.

Tender process

The tender process will be as follows:

- Tenders will be advertised in The Land newspaper and the local print media for a minimum of four weeks.
- Prospective tenderers will be provided with a general information package, including lease term, tendering timetable, evaluation methodology, map, invitation to tender form and example licence agreement.
- Property inspection days will be held for prospective tenderers.

- Tenders will be evaluated using the selection criteria, with weight given to tenderers who have a proven track record of adoption and implementation of the NSW Department of Agriculture PROfarm principles.

- Successful tenderers will be announced.

CHC are currently determining the land parcels that will be tendered and is developing the tender documentation, with a view to holding the first tender process in mid-2013.

Licence agreements

Licence agreements will include a range of good farm management practices including that:

- The property is run as an ongoing agricultural enterprise commensurate with equivalent properties in the region.

- All boundary fences are maintained in stock proof condition. On those properties where boundary fences need to be upgraded, a program will be agreed with the licensee. Generally, this will be on the basis that the materials will be supplied by CHC and the fence will be erected to the required standard at the licensee's expense.

- Internal fences are maintained by the licensee in a stock proof condition.

- A weed management plan is prepared and implemented. Guidance on effective weed management and the weed management plans principles will be included in the tender documentation.

Appendix I

Clarification of tailings information (19 March 2013)

Cobbora Holding
Company Pty Limited

DATE: 19/3/2013

MEMO TO: Department of Planning and Infrastructure – Stephen O'Donoghue

FROM: Gavin Heydon

SUBJECT: CLARIFICATION OF TAILINGS INFORMATION

REFERENCE:

Stephen

We write with reference to Department of Planning and Infrastructure's (DP&I) request (28 February 2013) for further information in relation to the calculation of tailings generated, tailings water usage and the methods used to rank the dewatering options for the Cobbora Coal Project (the Project).

Some background and specific responses are provided below.

Tailing production

The Project will process run-of-mine (ROM) coal to generate product coal. This will generate coarse and fine rejects. These fine rejects are also called tailings and are formed in the coal handling and preparation plant as a slurry. The tailings solids need to be stored while the water in the slurry will be removed or will remain bound with the stored tailings solids.

It is proposed that the tailings slurry will be pumped to a series of tailings emplacements and the associated water content reduced through drainage and evaporation to form a stable landform that can be capped and rehabilitated (ie conventional tailings management). A proportion of the water will be recovered from decant ponds and seepage drains and will be re-used in the process water circuit.

Tailings dewatering options

The available tailings solids storage methods (eg emplacements or co-disposal with coarse rejects) and the amount of water removed from the stored tailings depend on the treatment of the tailings prior to storage. Available methods were examined as part of Project design as described in the Dewatering Options Report – Comparisons of Options for Tailings Dewatering, Appendix C of the Preferred Project Report and Response to Submissions (PPR&RTS). The study and report are based on engineering studies undertaken early in the design of the Project.

Tailings emplacements and embankments have been sized based on tailings being 10% of ROM feed. This is based on industry advice that for Hunter Valley coals 70 to 75% of the total rejects are typically coarse, with the remainder (25 to 30%) being fines. This is mentioned in Section 3.6.5 of the EA. The mine plan used in the options review is based on an average yield of 60%, so 40% is rejects. Initially, it was assumed that 10% of ROM coal is fines (40% of ROM coal is rejects and 25% of rejects is fines). Further studies have found that there will be less tailings formed on average. However, this conservative assumption remains applicable as it results in conservatively large tailings emplacements and the higher costs associated with larger embankments and drainage works.

The mechanical and coal processing equipment designs are based on the need for the facilities to handle and process lower than the average grade coals, while maintaining coal production rates. Therefore, it is also applicable for the mechanical dewatering options require infrastructure to be sized to handle the maximum tailings volumes that may occur over the life of the mine (ie based on 10% fines).

First Floor, 133-135 King Street
Newcastle NSW 2300
Ph: 02 4924 3600 | Fax: 02 4924 3699
www.cobbora.com ABN 28 147 813 125

Tailings water balance

The Water Balance and Surface Water Management System report (Appendix E) of the Surface Water Assessment (Appendix F of the PPR&RTS) was undertaken based on the expectation that tailings will average 5.5% of ROM coal (on a dry weight basis) over the life of the mine.

This change in criteria is based on the results of further testing work that has shown the coal to be harder than typical Hunter Valley coal and would crush to a higher percentage of coarse coal rather than generating fines. The percentage has been calculated on a weighted average basis for the results of the sizing data obtained. The coal handling and preparation plant and tailings management infrastructure are designed to accommodate the full design envelope and there will, obviously, be times when the feed rate (ie % tailings of ROM coal) will be above or below this average. An updated yield of 65% has also been included in the water balance calculations.

Responses to specific questions

Our responses to specific DP&I questions provided below. DP&I questions are in italics and the responses in blue text.

Emailed questions 1

Key issues are - with reference to Figure 6.1 [of the Dewatering Options Report]:

- what was the discount rate used for this assessment?

A discount rate of 7% was used with no allowance for CPI.

- can you provide the cash flow for each option as both Steve and I have had trouble reconciling the npv values with the capex and opex figures identified in Tables 4.5 and 5.1. In particular the npv for the base case seems high and is indicating there may be additional costs (such as closure/ rehabilitation) not clearly identified in Tables 4.5 and/or 5.1.

The tailings options costs are provided in the attached spreadsheet <Tailings Options Costs_130319_CONFIDENTIAL>. All of the options were costed using a consistent set of assumptions.

- what assumptions were used for tailings dam capex costs - in particular the costs will vary significantly pending assumptions used for lining the dam - eg. if there is limited local clays of low permeability costs to meet EPA specifications then costs may be significantly higher, noting that there is no geo-technical available in the footprint of the out of pit tailings dams?

CHC will construct out-of-pit tailings emplacements to meet EPA criteria (to achieve a permeability of 1×10^{9} m/s or less over a thickness of at least 90 cm). Capex costs were taken from feasibility cost estimate (see <Tailings Options Costs_130319_CONFIDENTIAL>). Conservative allowances have been made in terms of material availability and placement. Recent advice is that if clay is not available in the full quantity required to line tailings emplacement, a synthetic liner can be installed for similar costs.

- the additional costs for risk mitigation of $15M for backup tailings dam for other de-watering options seems to be a high contingency / risk costs and possibly unreasonable inclusion compared to the base case. This implies that the alternative options are not operating for significant periods.

There is no clear justification provided for a backup tailings dam capacity of the size suggested in these additional capex costings.

Options 3-6 presented in the dewatering report will be prone to mechanical failure. If the process plant is in operation, the tailings underflow can be pumped to a storage facility and mine production maintained. The risk mitigation tailings emplacement would be the smaller of the two out-of-pit emplacements and an allowance has been made to lift the wall in three lifts over the life of the operation to account for the slower rate of filling. The total volume allowed as a risk mitigation measure is ~7 Mm^3 (@ 0.55 dry t/m^3) which equates to 3.85 Mt (dry) available. The total dry tonnes of tailings expected is 38.1 Mt (dry) for the life of the mine. The allowance on a risk mitigation basis is in the order of 10%.

- The analysis has not considered cost savings associated with reduced water pumping costs for replacement of makeup water from the Cudgegong River to the mine site by increased water recovery from dewatering options over the life of the mine.

This is correct. The electricity usage budgeted for the pump station is less than $100k pa and the balance of the operation and maintenance cost of the system is in the order of $250k pa. Therefore, a reduction in the cost associated with pumping would not affect the overall ranking of the base case (conventional tailings management). Minimal capital savings would be made as the costs incurred in building the pump station and pipeline would largely be the same.

Further, the site water balance indicates that even though the additional recovered water is of use in dry years, the modeling also shows that during wet years this additional recovered water inhibits mining operations as it would require storing large amounts of water in-pit. This negative impact has not been incorporated into the alternative options.

<u>Emailed questions 2</u>

As discussed yesterday*, as part of my effort to understand the water demands I have been struggling to define the amount of water that would be associated with the tailings for the 'base case' with tailings slurry pumped to a tailings dam or an in-pit emplacement. The Surface Water Assessment only talks about the make-up water required (after allowing for water recovery from the tailings), but does not state how much water is needed to convey the tailings from the CHPP. I have attempted to reconcile three sets of data:*

1. *If I attempt to back calculate from the information in Section 3.6.5 and Table 3.5 in the EA, I calculate that the water required to convey 2.4 million tonnes of tailings at 35% solids volume (say, Year 12) would be 2,040 ML. This analysis is dependent on the assumed specific gravity of the tailings particles. The note at the bottom of Table 3.5 implies a SG of 2.18 – which is higher than some data from the Hunter, but within the bounds of possibility.*

The EA (Section 3.6.5) incorrectly states that 'The tailings pumped from the CHPP will be about 35% solids (by volume)'. This should read 'by mass'.

The size of the tailings emplacements are based on the tailings being 10% of ROM coal (2.0 Mtpa dry). This was based on the information available at the time and provides a conservative estimate of the Project's footprint. As described above, over the life of the mine 5.5% of ROM coal (1.1 Mtpa) will be tailings.

The back calculation should therefore be:

- 1,100 ktpa (tailings, dry) / 0.35 (%w/w) = 3,142 ktpa
- 3,142 ktpa (tailings slurry) less 1,100 solids = 2,042 ktpa water (2,042 MLpa)

First Floor, 133-135 King Street
Newcastle NSW 2300
Ph: 02 4924 3600 | Fax: 02 4924 3699
www.cobbora.com ABN 28 147 813 125

2. *However, Table 6-1 of Appendix E of the Surface Water Assessment lists the make-up demand in Year 12 as 2,524 ML (ie about 500 ML more that the total water required to convey the tailings – see 1 above). Clearly an impossibility!*

The 2,524 ML demand is made up of:

- 2,345 ML (CPP demand from mine water)
- less 282 ML (return water from in-pit facility)
- plus 462 MLpa (from clean system).

3. *Table 3.6.1 of the Dewatering Options Report (Appendix C of the PPR), quotes the volume of water that could be recycled or saved over the life of the project. I have distributed the total volume quoted in the table in proportion to the proposed ROM tonnage in each year of the mine life. Examples of recycled/saved water for Year 12 are:*
   - *Base case (slurry disposal) 820 ML/year;*
   - *Option 5 (centrifuge) 3,530 ML/year.*

   Clearly, if 3,530 ML is saved by the centrifuge option, the water associated with the tailings before going through the centrifuge would have to be more that this! Again this value is not consistent with 2,040 ML/year calculated in 1 above.

   The basic question is – in the case of the proposed slurry disposal, how much water would be discharged from the CHPP as a tailings slurry in Year 12 assuming that 2.4 million tonnes of tailings were washed out of the ROM coal? The supplementary questions then relate to accounting for the evaporation and seepage losses from the out-of-pit tailings dams and the in-pit emplacements (which will be different).

A summary of Year 12 water volumes used in the Dewatering Options report and those used in the water balance provided in Attachment 1. Detailed tailings water recovery calculations are provided in the attached spreadsheet <Tailings Water Recovery_130319_CONFIDENTIAL>.

Summary

The technical and economic assessment of the dewatering options has been based on a consistent review of available options, within defined battery limits. The 10% ROM feed basis for tailings emplacements sizing and footprint is a conservative allowance and it is not intended to update the tailings emplacements designs for the EA, but the criteria will be reviewed as the project moves into the detailed design stage. It is appropriate that the 10% ROM feed basis for tailings has been used for sizing mechanical dewatering equipment which needs to be designed for the coal with the lowest quality and not on a yearly or life of mine average basis.

The water balance has been developed on a realistic long term average based on the results of recent coal testing and mine planning.

We look forward the opportunity next week to meet with DP&I to discuss these responses. Please contact Phil Towler on (02) 9493 9518 to seek further clarification or to arrange a time to meet.

Attachments

Tailings Options Costs_130319_CONFIDENTIAL

Tailings Water Recovery_130319_CONFIDENTIAL

Cobbora Holding
Company Pty Limited

Attachment 1

		Used in Dewatering Report	Used in Water Balance
	ALL QUANTITIES ARE PER ANNUM AT FULL PRODUCTION	**FY 2027**	
	ROM (Mt)	20	18.46
	Product (Mt)	12	12
	Yield	60%	65%
	Rejects Total (Mm3)	8.0	6.5
Option			
Input	25% Fines (dry kt)	2000	1015.4
	Solids (%w/w)	32.5%	35.0%
	Total slurry pumped to dewatering option (kt)	6154	2901.1
	Water to dewatering option (kt)	4154	1885.7
Base case	Emplacement location	In-pit	
	Solids in Process Outflow (% w/w)	32.5	35.0
	Water Recovered (% of water input to emplacement)	15	15
	Water Recovered and returned to CPP (kt)	623	283
	Emplaced Storage Density (dry t/m3)	0.55	0.55
	Emplacement volume required (m3)	3,636,364	1,846,154
Sec Floc	Emplacement location	In-pit	In-pit
	Solids in Process Outflow (% w/w)	52.5	52.5
	Water Recovered (% of water input to emplacement)	25	25
	Water Recovered and returned to CPP(kt)	1038	471
	Emplaced Storage Density (dry t/m3)	0.80	0.80
	Emplacement volume required (m3)	2,500,000	1,269,231
Paste Thickener	Emplacement location	Co-dispose with Coarse Reject	Co-dispose with Coarse Reject
	Solids in Process Outflow (% w/w)	52.5	52.5
	Total Cake to Conveyor (kt)	3810	1934
	Water Recovered (% of water input to emplacement)	56.4	51.3
	Water Recovered and returned to CPP(kt)	2344	967
	Emplaced Storage Density (dry t/m3)	0.80	0.80
	Emplacement volume required (m3)	2,500,000	1,269,231
Belt Press Filter	Emplacement location	Co-dispose with Coarse Reject	Co-dispose with Coarse Reject
	Solids in Process Outflow (% w/w)	60.0	60.0
	Total Cake to Conveyor (kt)	3333	1692
	Water Recovered (% of water input to emplacement)	67.9	64.1
	Water Recovered and returned to CPP(kt)	2821	1209
	Emplaced Storage Density (dry t/m3)	1.10	1.10
	Emplacement volume required (m3)	1,818,182	923,077
Pressure Filter	Emplacement location	Co-dispose with Coarse Reject	Co-dispose with Coarse Reject
	Solids in Process Outflow (% w/w)	67.5	67.5
	Total Cake to Conveyor (kt)	2963	1504
	Water Recovered (% of water input to emplacement)	76.8	74.1
	Water Recovered and returned to CPP(kt)	3191	1397
	Emplaced Storage Density (dry t/m3)	1.10	1.10
	Emplacement volume required (m3)	1,818,182	923,077
Solid Bowl Centrifuge	Emplacement location	Co-dispose with Coarse Reject	Co-dispose with Coarse Reject
	Solids in Process Outflow (% w/w)	67.5	67.5
	Total Cake to Conveyor (kt)	2963	1504
	Water Recovered (% of water input to emplacement)	76.8	74.1
	Water Recovered and returned to CPP(kt)	3191	1397
	Emplaced Storage Density (dry t/m3)	1.15	1.15
	Emplacement volume required (m3)	1,739,130	882,943

First Floor, 133-135 King Street
Newcastle NSW 2300
Ph: 02 4924 3600 | Fax: 02 4924 3699
www.cobbora.com ABN 28 147 813 125

Appendix J

Water balance and surface Water management system — addendum (18 March 2013)

Cobbora Coal Project – Water Balance and Surface Water Management System - Addendum

March 2013

Cobbora Holding Company Pty Limited

Parsons Brinckerhoff Australia Pty Limited
ABN 80 078 004 798

Level 27, Ernst & Young Centre
680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001
Australia
Telephone +61 2 9272 5100
Facsimile +61 2 9272 5101
Email sydney@pb.com.au

Certified to ISO 9001, ISO 14001, AS/NZS 4801
A+ GRI Rating: Sustainability Report 2010

Revision	Details	Date	Amended By
A	Draft for EMM/CHC review	14 March 2013	AJ, RL
B	2nd draft for EMM/CHC review	15 March 2013	RL
C	Final	18th March 2013	RL

Author: .... Aditya Jha

Signed: .... AJha ....

Reviewer: .... Rob Leslie .... Rob Leslie

Signed: ....

Approved by: .... Rob Leslie

Signed: .... Rob Leslie ....

Date: .... 18 March 2013

Distribution: .... EMM, Parsons Brinckerhoff

Please note that when viewed electronically this document may contain pages that have been intentionally left blank. These blank pages may occur because in consideration of the environment and for your convenience, this document has been set up so that it can be printed correctly in double-sided format.

Contents

List of tables

List of figures

Page number

1. Introduction

1.1 Background and purpose of addendum

As part of the Preferred Project Report and Response to Submissions for the Cobbora Coal Project, an updated Surface Water Assessment was submitted in early February 2013, which included an updated Appendix E – Water Balance and Surface Water Management System (document reference PR_9982D-2122570C_Appendix E, 31 January 2013).

The purpose of this addendum is to correct the results presented in Appendix E that were affected by a water balance model error, and to discuss the wider implications of the error for the Surface Water Assessment and Environmental Assessment. In addition, further information is provided in the addendum on additional model sensitivity analyses undertaken to address a concern of the DP&I's reviewer regarding the reliance of the mine on the surface water entitlement from the Cudgegong river source. Specifically, the reviewer raised the concern that the volume of groundwater inflow to the mine pits available for use in the mine water management system may have been overestimated.

It should be noted that the main implication of the error was that the assessment overestimated the reliance of the mining operation on water supply from the Cudgegong River source. The corrected results show that the Project's requirements for water from the Cudgegong are significantly reduced in all climate conditions. This is discussed further in Section 3 of this addendum.

1.2 Model error

The error in the water balance model relates to the values of groundwater inflow to the pits specified for mine stage years 12, 16 and 20. For these years, erroneously low values of groundwater inflow were used, as shown in Table 1.1.

Table 1-1 Groundwater inflow values with erroneous values noted in red

Mine stage year	Mining Area A		Mining Area B		Mining Area C		Total	
	Values used in model (ML)	Correct values (ML)	Values used in model (ML)	Correct values (ML)	Values used in model (ML)	Correct values (ML)	Values used in model (ML)	Correct values (ML)
1	24	24	107	107	0	0	131	131
4	368	368	600	600	101	101	1,069	1,069
12	452	452	**1**	1,444	550	550	**1,003**	2,446
16	637	637	**1**	1,237	529	529	**1,167**	2,403
20	**0**	195	**31**	631	**0**	337	**31**	1,163
21	0	0	31	31	0	0	31	31

Table 1-1 shows that the model error resulted in underestimation of total groundwater inflow by 1,443 ML (59%), 1,236 ML (51%) and 1,132 ML (97%) for Years 12, 16 and 20 respectively.

These model errors have been corrected and the mine water management system has been re-optimised to accommodate the increased groundwater inflows to the pits.

1.3 Addendum contents

This addendum contains the following:

- Corrected figures and tables from Appendix E of the Surface Water Assessment that were affected by the model error, and interpretation of the corrected results (Section 2).
- Implications of the changed results for the wider Surface Water and Environmental Assessments (Section 3).
- Results of additional analyses undertaken to respond to comments from the DP&I's reviewer (Section 4).
- Conclusions drawn from the above (Section 5).

2. Corrected results

2.1 Introduction

This section provides updated tables and figures from Appendix E of the Surface Water Assessment based on the outputs from the water balance model with corrected groundwater inflow values. In some cases, the incorrect results are included in brackets for comparison purposes. Section, table and figure headings from Appendix E have been noted to assist in cross referencing.

2.2 Dam sizes (Section 5.3.2 of Appendix E)

Section 5.3.2 of Appendix E gives dam sizes for the dams within the mine water management system. The groundwater inflow error underestimated the volume of groundwater that would be pumped from the pits to the mine water dams for reuse in the mine water management system. When the correct volumes were modelled, the contaminated water dams were found to spill to the local surface water environment under wet conditions, which is not permitted. In correcting the error it was therefore necessary to upsize these dams to prevent them from spilling.

This affected the mine water dams and sedimentation dams SD1, SD2 and SD3 which capture runoff from the Mine Infrastructure Area (MIA), and are therefore not allowed to release or spill water to the environment, but instead supply water to mine water dams for reuse. Tables 5-3 (part) and 5-4 are reproduced below with corrected dam capacities. The previous incorrect capacities are included in brackets in the tables. Note that MWD6 had been oversized in the previous version of the model and the opportunity was taken to optimise this dam and reduce its capacity when undertaking corrections to the model. These dams all remain within the disturbance footprint presented in the Preferred Project Report and Response to Submissions (February 2013).

Table 2-1 Sedimentation dam capacities (part of Table 5-3 in Appendix E)

Dam ID	Description	Maximum catchment area (ha)	Capacity (ML)		
			Settling zone	Sediment zone	Total
SD1	Sedimentation dam capturing runoff from infrastructure area west of run-of-mine stockpile pad	7.5	9.3	1.9	30.0 (11.2)
SD2	Sedimentation dam capturing runoff from mine infrastructure area	13.0	16.2	3.2	50.0 (19.4)
SD3	Sedimentation dam capturing runoff from mine infrastructure area	4.1	5.1	1.0	16.0 (6.1)

Table 2-2 Mine water dam capacities (Table 5-4 in Appendix E)

Dam ID	Description	Maximum catchment area (ha)	Volume (ML)		
			Adopted capacity (from water balance modelling)	100-year ARI 24-hour runoff volume	100-year ARI 72-hour runoff volume
MWD1	Water storage dams capturing infrastructure runoff from CHPP	64.7	349.7 (160.1)	86.4	110.1
MWD2	Water storage dams capturing infrastructure runoff from CHPP	11.7	65.3 (29.9)	15.6	19.9
MWD3	Mine water dam receiving water pumped from Mining Area A	0.0	500 (no change)	–	–
MWD4	Central mine water dam receiving surplus water pumped from other mine water dams	0.0	575 (375)	–	–
MWD5	Mine water dam receiving water pumped from Mining Area B	0.0	500 (no change)	–	–
MWD6	Staging dam for dewatering from Mining Area B (also captures runoff from stockpile pad near Mining Area B)	1.9	3.2 (30)	2.5	3.2
MWD7	Mine water dam receiving water pumped from Mining Area C	0.0	500 (no change)	–	–
MWD8	Infrastructure water storage dam capturing runoff from stockpile pad near Mining Area C	1.0	7.4 (2.6)	1.3	1.7
MWD9	Mine water dam receiving water pumped from Mining Area C (replaces MWD7)	0.0	500 (no change)	–	–
MWD10	Water storage dams capturing infrastructure runoff from CHPP	25.5	90 (65)	34.1	43.4
MWD11	Mine water dam supplying truck fill	2.3	6.0 (no change)	3.1	3.9
MWD12	Receives runoff from overburden and pumps to MWD9	54.9	150 (50)	73.3	93.4
MWD13	Staging dam for dewatering from Mining Area A	0.0	30 (no change)	–	–

Note: Excludes sediment storage.

2.3 Modelling results for proposed operating scenario (Section 6.1 of Appendix E)

The following key results tables are reproduced and updated from Appendix E. Additional rows have been added to the results tables to demonstrate volumes stored in the mine water management system dams at the start and end of each year. This information has been added to assist in interpreting the results of the site water balance.

Table 2-3 Annual site water balance — 10th percentile dry year (Table 6-1 in Appendix E)

	Units	Pre- mining	Year 1	Year 4	Year 12	Year 16	Year 20	Post-mining
Catchment breakdown								
Water management system (WMS)								
▪ Raw water dam	Ha	–	51	51	51	51	51	–
▪ Clean water/highwall dams	Ha	–	83	182	280	93	67	–
▪ Sedimentation dams	Ha	–	662	1,148	1,633	1,539	1,234	–
▪ Mine water dams and pits	Ha	–	156	689	1,194	1,479	1,395	384
▪ Refuse ponds	Ha	–	158	158	253	113	130	–
Existing west 'Woolandra' farm dams	Ha	1,034	0	0	0	0	0	–
Undisturbed	Ha	30,655	30,578	29,462	27,984	27,573	27,405	27,555
Established rehabilitation returned directly to creek	Ha	–	0	0	294	842	1,409	3,750
Total study catchment	Ha	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**
Proportion of study catchment in WMS	%	–	3.5%	7.0%	10.8%	10.3%	9.1%	1.2%
Inflows into WMS								
Runoff								
Water management system								
▪ Raw water dam	ML/a	–	1	1	1	1	1	–
▪ Sedimentation dams	ML/a	–	139	242	288	295	233	–
▪ Mine water dams and pits	ML/a	–	195	506	862	725	722	–
▪ Clean water/highwall dams	ML/a	–	2	3	5	2	1	–
Total WMS runoff	ML/a	**–**	**337**	**753**	**1,157**	**1,023**	**957**	**–**
Undisturbed and established rehabilitation returned directly to creek	ML/a	575	576	555	533	538	548	642
Existing west 'Woolandra' farm dams	ML/a	19	–	–	–	–	–	–
Groundwater seepage into pit	ML/a	–	131	1,068	2,444	2,401	1,162	–
Imported river water	ML/a	–	120	1,840	580	1,220	2,400	–
Sedimentation dam water reused on-site	ML/a	–	24	119	24	126	123	–
Outflows from WMS								
WMS dam evaporation (net of direct rain)	ML/a	–	334	498	601	543	496	–
CHPP make-up demand	ML/a	–	134	2,092	2,524	2,524	2,524	–
Haul road dust-suppression demand	ML/a	–	376	968	1,651	1,603	1,371	–
Mine infrastructure area demand	ML/a	–	9	140	150	150	150	–
Potable water demand	ML/a	–	5	10	15	15	10	–
Total supply to WMS demands	ML/a	**–**	**524**	**3,210**	**4,339**	**4,291**	**4,054**	**–**
Sedimentation dam overflows to creek	ML/a	–	0	0	0	0	0	–
Sedimentation dam controlled releases to creek	ML/a	–	41	0	118	34	0	–
Clean water/highwall dam (CWD9) overflows to creek	ML/a	–	0	0	0	0	0	–
Clean water/highwall dam controlled releases to creek	ML/a	–	1	3	5	1	0	–
Raw water dam overflows to creek	ML/a	–	0	0	0	0	0	–
Existing west 'Woolandra' farm dams overflows	ML/a	0	–	–	–	–	–	–
Total WMS controlled and overflow releases to creeks	ML/a	**–**	**42**	**3**	**124**	**35**	**0**	**–**
Water stored in WMS dams								
Start of the year	ML	–	1,155	594	1,662	787	586	–
End of the year	ML	–	842	545	780	563	555	–
Total flow at study catchment outlet	ML/a	**575**	**618**	**558**	**656**	**573**	**548**	**642**

Notes: Excludes runoff to refuse disposal ponds catchments

Table 2-4 Annual site water balance — 50th percentile median year (Table 6-2 in Appendix E)

	Units	Pre- mining	Year 1	Year 4	Year 12	Year 16	Year 20	Post-mining
Catchment breakdown								
Water management system (WMS)								
▪ Raw water dam	Ha	–	51	51	51	51	51	–
▪ Clean water/highwall dams	Ha	–	83	182	280	93	67	–
▪ Sedimentation dams	Ha	–	662	1,148	1,633	1,539	1,234	–
▪ Mine water dams and pits	Ha	–	156	689	1,194	1,479	1,395	384
▪ Refuse ponds	Ha	–	158	158	253	113	130	–
Existing west ‘Woolandra’ farm dams	Ha	1,034	0	0	0	0	0	–
Undisturbed	Ha	30,655	30,578	29,462	27,984	27,573	27,405	27,555
Established rehabilitation returned directly to creek	Ha	–	0	0	294	842	1,409	3,750
Total study catchment	Ha	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**
Proportion of study catchment in WMS	%	–	3.5%	7.0%	10.8%	10.3%	9.1%	1.2%
Inflows into WMS								
Runoff								
Water management system								
▪ Raw water dam	ML/a	–	3	3	3	3	3	–
▪ Sedimentation dams	ML/a	–	279	505	611	616	491	–
▪ Mine water dams and pits	ML/a	–	348	917	1,579	1,356	1,355	–
▪ Clean water/highwall dams	ML/a	–	6	11	17	6	4	–
Total WMS runoff	ML/a	**–**	**636**	**1,436**	**2,210**	**1,980**	**1,853**	**–**
Undisturbed and established rehabilitation returned directly to creek	ML/a	1,852	1,855	1,787	1,710	1,716	1,736	1,933
Existing west ‘Woolandra’ farm dams	ML/a	63	–	–	–	–	–	–
Groundwater seepage into pit	ML/a	–	131	1,068	2,444	2,401	1,162	–
Imported river water	ML/a	–	120	1,300	960	1,040	1,660	–
Sedimentation dam water reused on-site	ML/a	–	107	176	136	150	154	–
Outflows from WMS								
WMS dam evaporation (net of direct rain)	ML/a	–	81	217	272	257	236	–
CHPP make-up demand	ML/a	–	134	2,092	2,524	2,524	2,524	–
Haul road dust-suppression demand	ML/a	–	376	968	1,651	1,603	1,371	–
Mine infrastructure area demand	ML/a	–	9	140	150	150	150	–
Potable water demand	ML/a	–	5	10	15	15	10	–
Total supply to WMS demands	ML/a	**–**	**524**	**3,210**	**4,339**	**4,291**	**4,054**	**–**
Sedimentation dam overflows to creek	ML/a	–	0	0	0	0	0	–
Sedimentation dam controlled releases to creek	ML/a	–	92	193	318	325	218	–
Clean water/highwall dam (CWD9) overflows to creek	ML/a	–	1	0	0	0	0	
Clean water/highwall dam controlled releases to creek	ML/a	–	2	10	17	3	0	–
Raw water dam overflows to creek	ML/a	–	0	0	0	0	0	–
Existing west ‘Woolandra’ farm dams overflows	ML/a	0	–	–	–	–	–	–
Total WMS controlled and overflow releases to creeks	ML/a	**–**	**95**	**203**	**336**	**327**	**218**	**–**
Water stored in WMS dams								
Start of the year	ML	–	604	556	579	558	563	–
End of the year	ML	–	791	731	1,248	1,104	731	–
Total flow at study catchment outlet	ML/a	**1,852**	**1,949**	**1,990**	**2,046**	**2,043**	**1,954**	**1,933**

Notes: Excludes runoff to refuse disposal ponds catchments

Table 2-5 Annual site water balance — 90th percentile wet year (Table 6-3 in Appendix E)

	Units	Pre- mining	Year 1	Year 4	Year 12	Year 16	Year 20	Post-mining
Catchment breakdown								
Water management system (WMS)								
▪ Raw water dam	Ha	–	51	51	51	51	51	–
▪ Clean water/highwall dams	Ha	–	83	182	280	93	67	–
▪ Sedimentation dams	Ha	–	662	1,148	1,633	1,539	1,234	–
▪ Mine water dams and pits	Ha	–	156	689	1,194	1,479	1,395	384
▪ Refuse ponds	Ha	–	158	158	253	113	130	–
Existing west 'Woolandra' farm dams	Ha	1,034	0	0	0	0	0	–
Undisturbed	Ha	30,655	30,578	29,462	27,984	27,573	27,405	27,555
Established rehabilitation returned directly to creek	Ha	–	0	0	294	842	1,409	3,750
Total study catchment	Ha	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**	**31,689**
Proportion of study catchment in WMS	%	–	3.5%	7.0%	10.8%	10.3%	9.1%	1.2%
Inflows into WMS								
Runoff								
Water management system								
▪ Raw water dam	ML/a	–	44	44	44	44	44	–
▪ Sedimentation dams	ML/a	–	1,114	2,220	3,013	2,912	2,313	–
▪ Mine water dams and pits	ML/a	–	784	2,245	4,056	3,929	3,954	–
▪ Clean water/highwall dams	ML/a	–	71	152	234	78	57	–
Total WMS runoff	ML/a	**–**	**2,015**	**4,662**	**7,347**	**6,964**	**6,368**	**–**
Undisturbed and established rehabilitation returned directly to creek	ML/a	26,088	26,123	25,168	24,238	24,658	25,288	28,830
Existing west 'Woolandra' farm dams	ML/a	881	–	–	–	–	–	–
Groundwater seepage into pit	ML/a	–	131	1,068	2,444	2,401	1,162	–
Imported river water	ML/a	–	0	360	400	380	400	–
Sedimentation dam water reused on-site	ML/a	–	102	105	104	104	104	–
Outflows from WMS								
WMS dam evaporation (net of direct rain)	ML/a	–	238	130	1,178	984	440	–
CHPP make-up demand	ML/a	–	134	2,092	2,524	2,524	2,524	–
Haul road dust-suppression demand	ML/a	–	376	968	1,651	1,603	1,371	–
Mine infrastructure area demand	ML/a	–	9	140	150	150	150	–
Potable water demand	ML/a	–	5	10	15	15	10	–
Total supply to WMS demands	ML/a	**–**	**524**	**3,210**	**4,339**	**4,291**	**4,054**	**–**
Sedimentation dam overflows to creek	ML/a	–	117	371	489	565	369	–
Sedimentation dam controlled releases to creek	ML/a	–	870	1706	2377	2208	1806	–
Clean water/highwall dam (CWD9) overflows to creek	ML/a	–	7	6	6	6	6	–
Clean water/highwall dam controlled releases to creek	ML/a	–	16	104	191	24	0	–
Raw water dam overflows to creek	ML/a	–	0	0	0	0	0	–
Existing west 'Woolandra' farm dams overflows	ML/a	0	–	–	–	–	–	–
Total WMS controlled and overflow releases to creeks	ML/a	**–**	**1,010**	**2,187**	**3,064**	**2,804**	**2,182**	**–**
Water stored in WMS dams								
Start of the year	ML	–	1,882	1,298	4,423	3,792	2,056	–
End of the year	ML	–	2,255	1,862	6,034	5,459	3,311	–
Total flow at study catchment outlet	ML/a	**26,088**	**27,133**	**27,355**	**27,301**	**27,462**	**27,470**	**28,830**

Notes: Excludes runoff to refuse disposal ponds catchments

2.4 Adequacy of CHC's existing water entitlements (Section 6.1.1 of Appendix E)

The corrected water balance model predicts less reliance on water entitlements for mining operations, as demonstrated in the corrected table below (the previous incorrect values are included in brackets in the table).

Table 2-6 Summary of imported water requirement for dry, median and wet years (Table 6-4 in Appendix E)

Year	Total site demand (ML)	Groundwater seepage (ML)	Imported water for 10th percentile (dry) year 1967 (ML)	Imported water for 50th percentile (median) year 1906 (ML)	Imported water for 90th percentile (wet) year 1990 (ML)
1	524	131	120 (no change)	120 (160)	0 (no change)
4	3,210	1,069	1,840 (1,820)	1,300 (no change)	360 (no change)
12	4,340	2,446	580* (2,600)	960* (1,840)	400 (380)
16	4,292	2,403	1,220 (2,520)	1,040 (1,780)	380 (400)
20	4,055	1,163	2,400 (3,240)	1,660 (2,540)	400 (no change)

*Note: The climate of the year preceding the dry year of 1967 is wetter than the climate preceding the median year of 1906. This results in a larger volume of water stored in the mine water dams at the start of the dry year than the median year (see 'start of the year' storage volumes in Tables 2-3 and 2-4). This difference in starting storage is particularly pronounced for the mine water management system configuration of Year 12, and therefore results in a lower demand for imported water in the dry year than in the median year.

The corrected results show that the peak annual water requirement still occurs in Year 20 but the requirement is reduced to 2,400 ML, which is 911 ML below CHC's maximum water entitlement from the Cudgegong River of 3,311 ML/a.

The corrected Figure 6.1 from Appendix E (Figure 2.1) presents the sequence of the simulated annual requirement for imported water for Year 20. The corrected figure shows that the peak requirement for imported water is 2,920 ML for the driest year on record of 1919, which is 391 ML below the Cudgegong entitlement, and the minimum peak requirement is 300 ML for the climate of 1956.

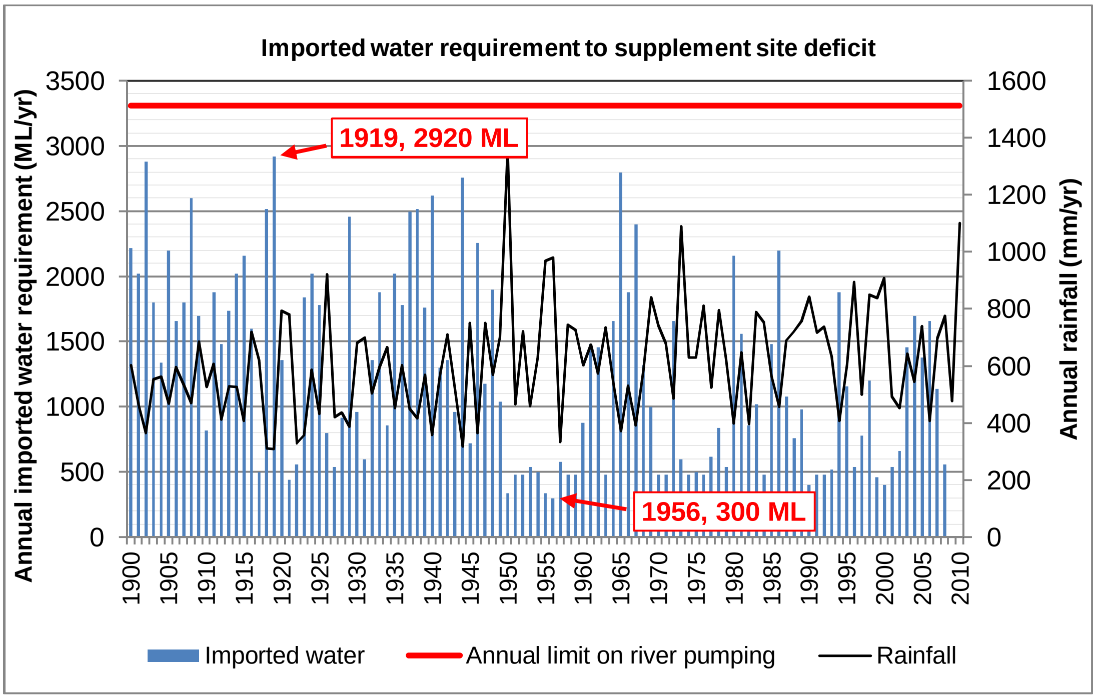

Figure 2.1 **Annual imported water requirement over the 111-year water balance simulation for Year 20 (Figure 6.1 in Appendix E)**

Appendix E included a sensitivity analysis of the impact of low flow in the Cudgegong on the water supply to the mine. This involved simulating the Year 20 mine stage under the worst case low flow conditions in the period of record, which occurred in 2009. The 2009 streamflow record was repeated to develop a 111 year 'worst case' synthetic streamflow sequence at Yamble Bridge. The water balance model was then simulated assuming that pumping from the Cudgegong River could only occur on days when streamflow at Yamble Bridge exceeded 25 ML/d. In accordance with the Framework for Extraction Strategy Agreement between State Water and CHC, a maximum pumping rate of 24 ML/d was used.

The sensitivity analysis involved running the synthetic streamflow sequence for Year 20 when imported water requirements are highest to determine the risk of a water deficit occurring at the peak water requirement year. The results of the sensitivity test are provided below in the corrected Figure 6.2 from Appendix E (Figure 2.2).

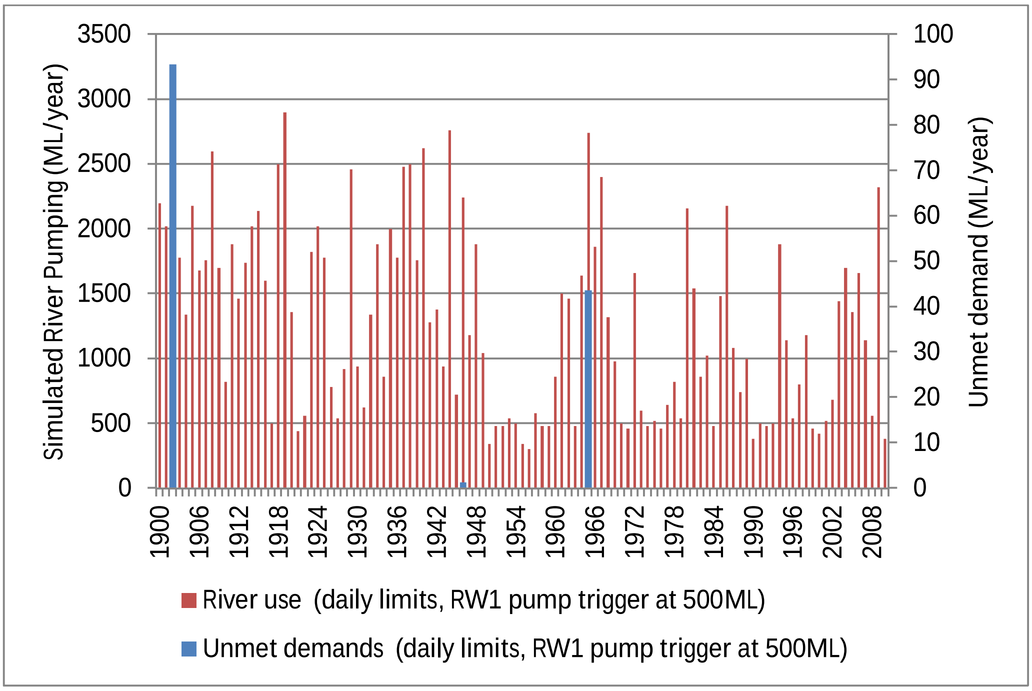

Figure 2.2 Results of sensitivity analysis of river water restrictions for peak imported water requirement year 20 (Figure 6.2 in Appendix E)

The corrected results show that there is a probability of a water deficit of 2% for the peak water requirement at Year 20, i.e. a deficit is predicted for a total of 2 years out of the 111 year sequence. The deficit ranges from 45 to 90 ML. The probability and peak magnitude of the deficit are considerably lower than the incorrect results of 21% and 334 ML as reported in Appendix E.

2.5 Dam performance (Section 6.1.2 of Appendix E)

Section 6.1.2 of Appendix E presented a sample of results from the water balance model to demonstrate the performance of the sedimentation dams. This involved presentation of sample outputs for sedimentation dams SD10 and SD31. The corrected outputs are provided below in the corrected Figures 6.3 to 6.6 from Appendix E (Figures 2.3 to 2.6).

Additional information has been added to Figures 6.4 and 6.6 (Figures 2.4 and 2.6) to demonstrate the full water balance of the dams, which now include evaporation and the breakdown of controlled and uncontrolled releases to the local creeks.

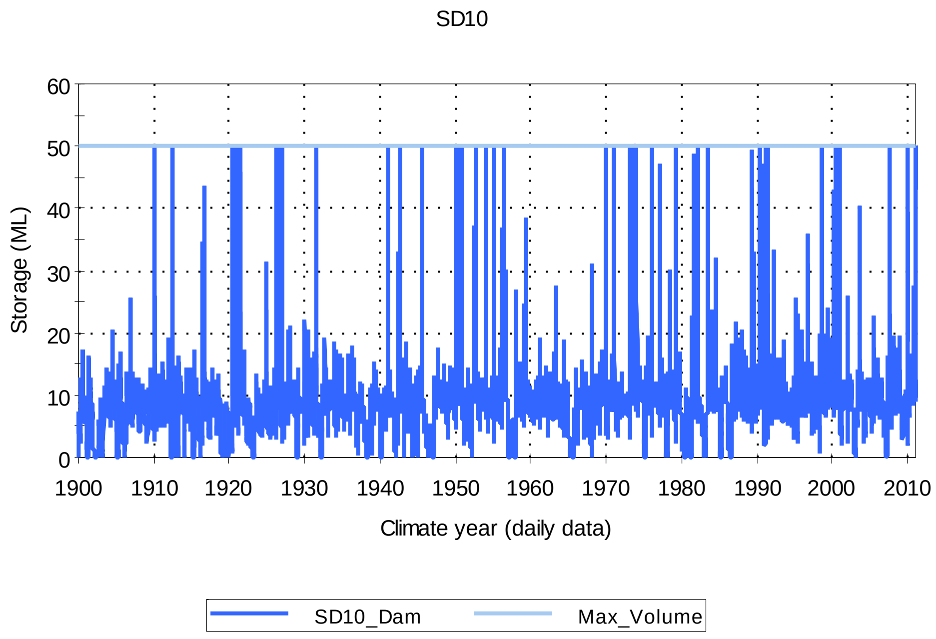

Figure 2.3 Simulated dam storage and overflows for SD10 for mining year 16 (Figure 6.3 in Appendix E)

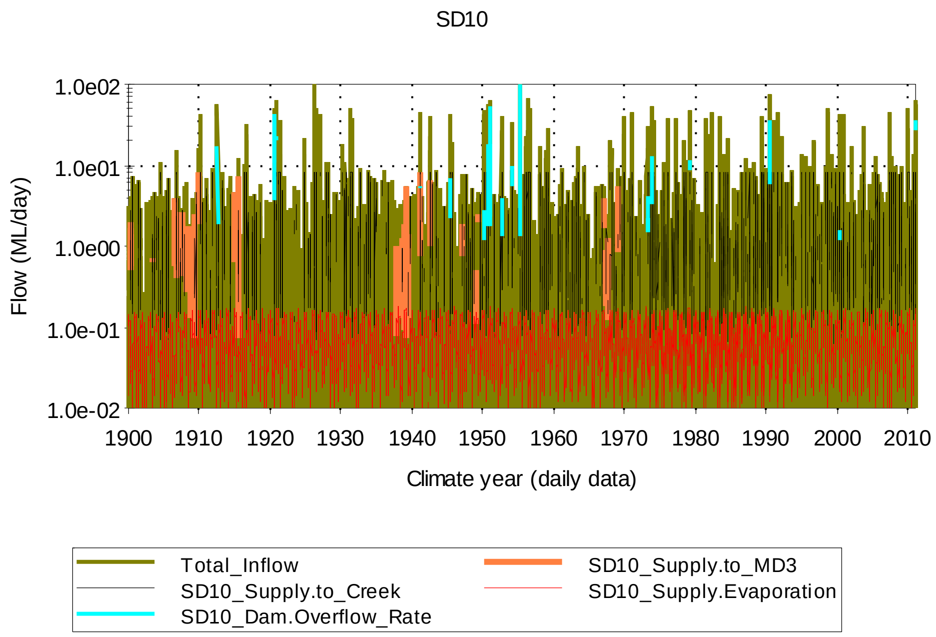

Figure 2.4 Simulated total inflow to and evaporation from SD10, pumping to MWD3 and overflows to the creek from SD10 for mining year 16 (Figure 6.4 in Appendix E)

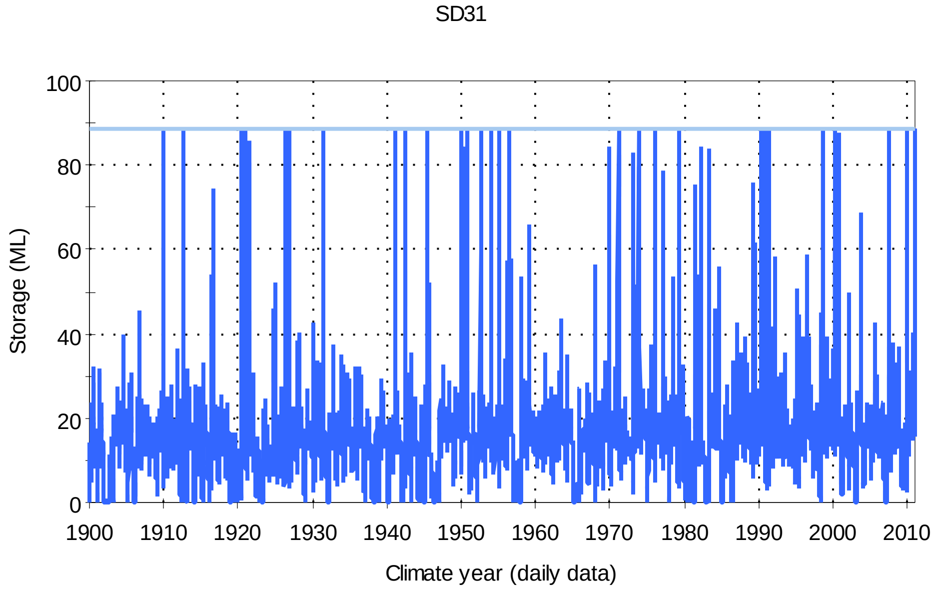

Figure 2.5 Simulated dam storage and overflows for SD31 for mining year 16 (Figure 6.5 in Appendix E)

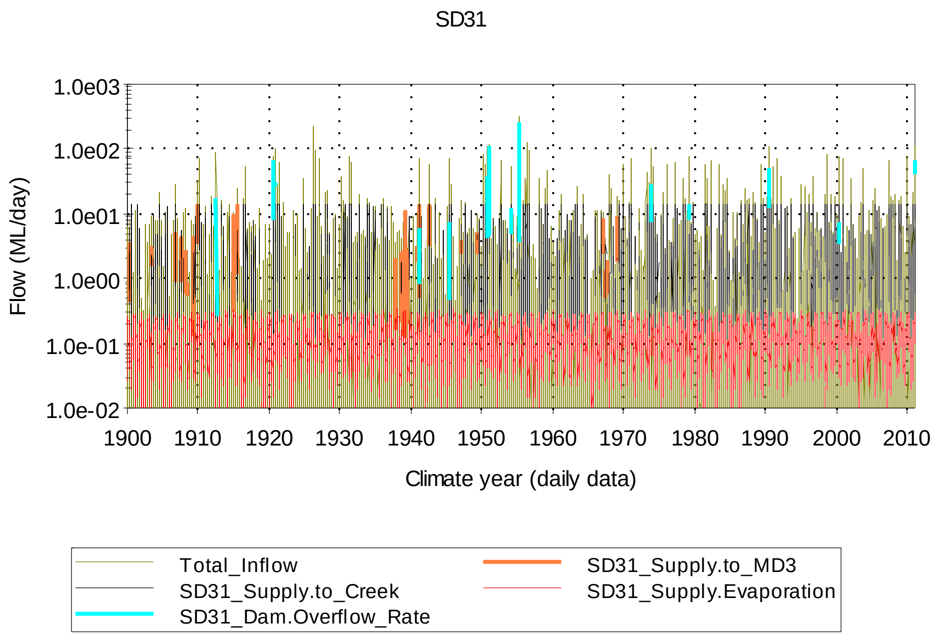

Figure 2.6 Simulated total inflow to SD31, pumping to MD3 and overflows to the creek from SD31 for mining year 16 (Figure 6.6 in Appendix E)

2.6 Frequency of in-pit flooding (Section 6.1.3 of Appendix E)

The corrected water balance model predicts significantly higher peak in-pit storage volumes due to the increased groundwater inflows, as demonstrated in the corrected table below (the previous incorrect values are included in brackets in the table).

Table 2-7 Maximum in pit storage volumes (Table 6-5 in Appendix E)

Year	Maximum stored volume (ML)		
	Mining area A	Mining area B	Mining area C
1	176 (no change)	175 (166)	0 (no change)
4	793 (805)	866 (894)	373 (401)
12	1,861 (1,023)	2,924 (1,671)	2911 (1,678)
16	1,624 (718)	3,344 (2,345)	3,134 (2,162)
20	1,556 (1,414)	2,344 (1,973)	1,067 (662)

Predicted stored volumes per mining area over the 111-year water balance simulation are provided in the corrected Figures 6.7 to 6.9 below (Figures 2.7 to 2.9) for Year 16, when the mining area catchment is greatest and the estimated maximum volume stored in the combined pits is greatest. Predicted frequencies of in-pit flooding per mining area over the 111-year water balance simulation for Year 16 are provide in the corrected Figures 6.10 to 6.12 below (Figures 2.10 to 2.12). It should be noted that the results are shown for the worst case mine stage Year 16 when the combined in-pit storage in all three mining areas is highest. This also coincides with the worst case year for mining areas B and C but not A, which experiences maximum storage at Year 12 (see Table 2-7).

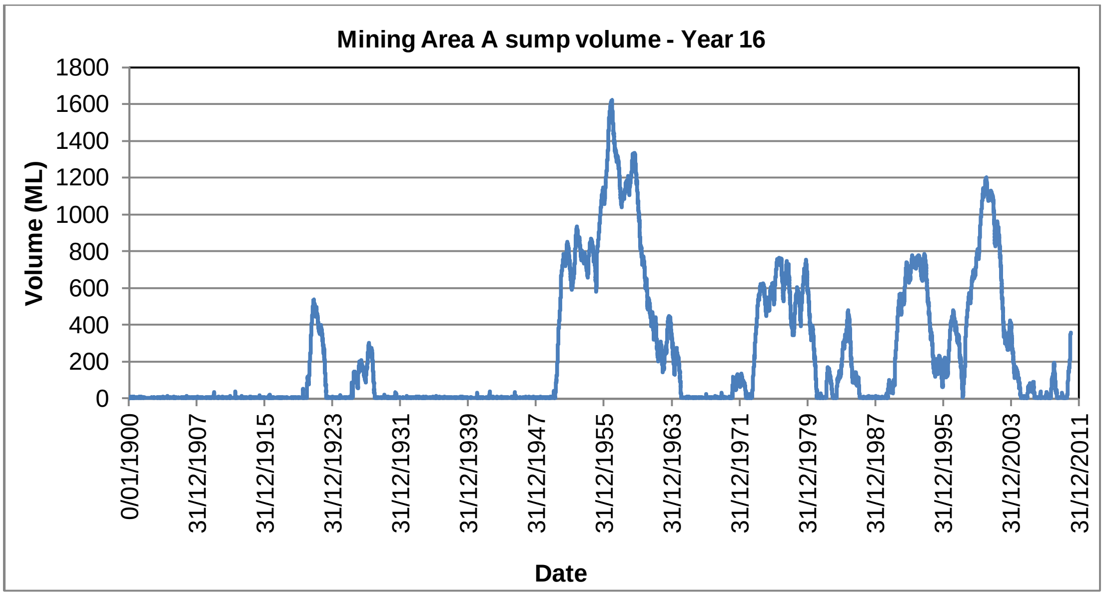

Figure 2.7 Stored volume in mining area A over the 111-year water balance simulation for Year 16 (Figure 6.7 in Appendix E)

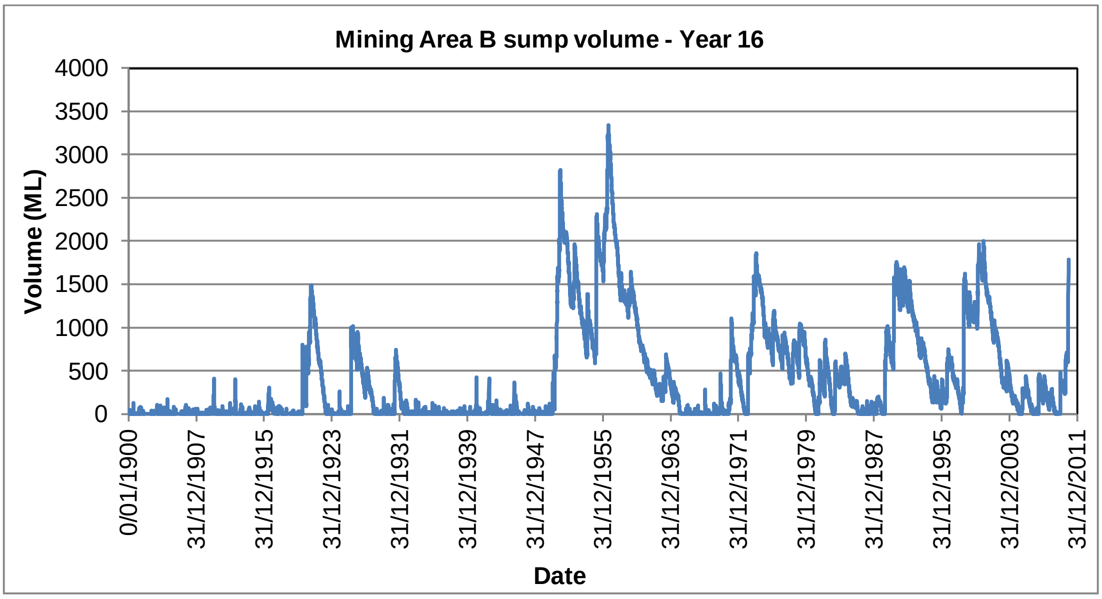

Figure 2.8 Stored volume in mining area B over the 111-year water balance simulation for Year 16 (Figure 6.8 in Appendix E)

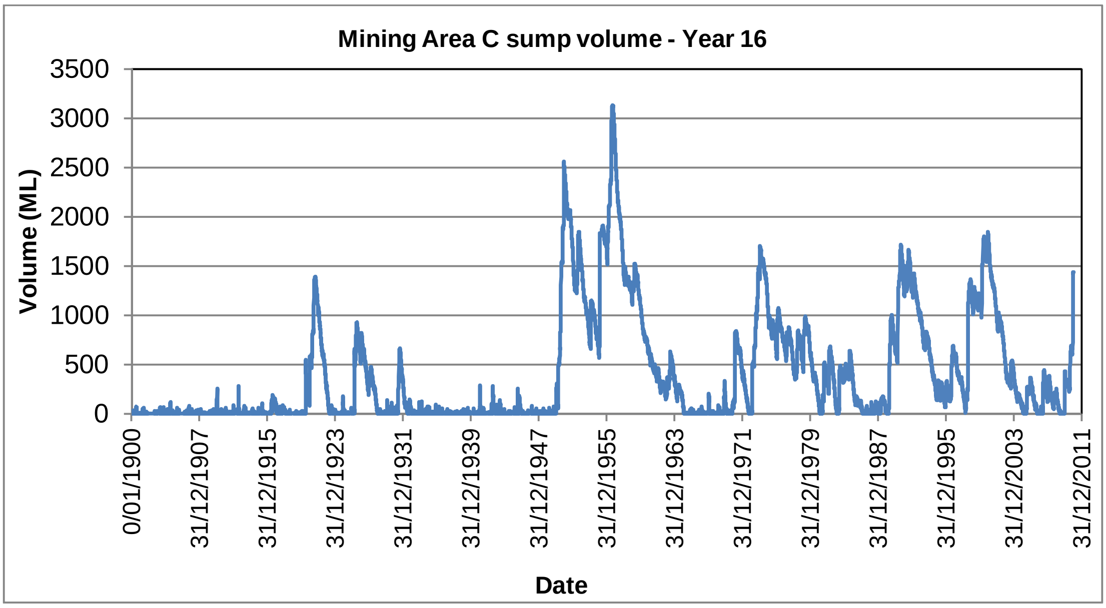

Figure 2.9 Stored volume in mining area C over the 111-year water balance simulation for Year 16 (Figure 6.9 in Appendix E)

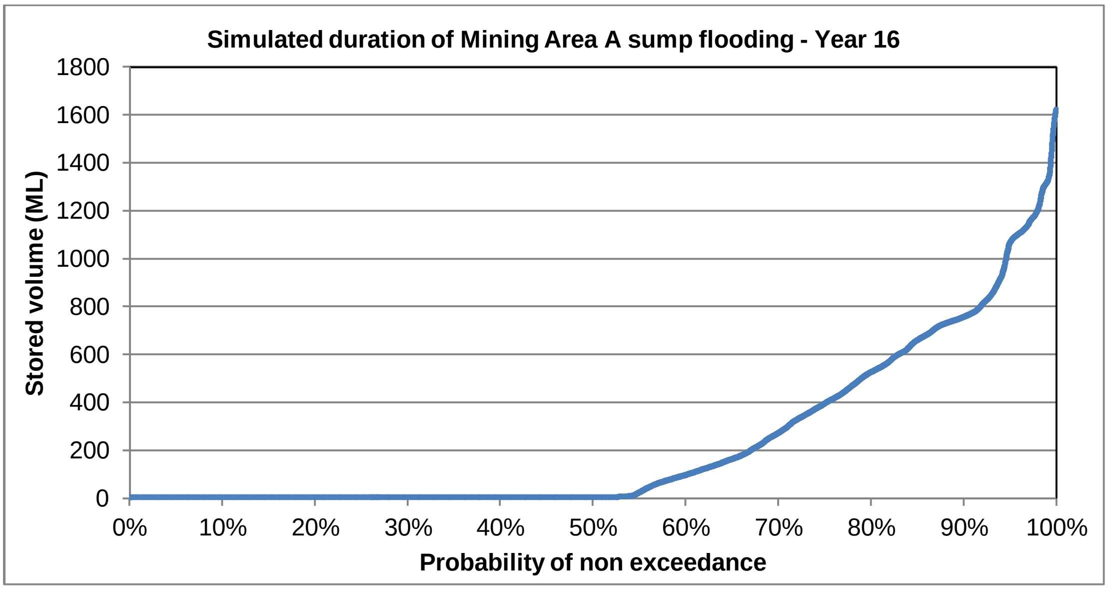

Figure 2.10 **Frequency of in-pit flooding for mining area A over the 111-year water balance simulation for Year 16 (Figure 6.10 in Appendix E)**

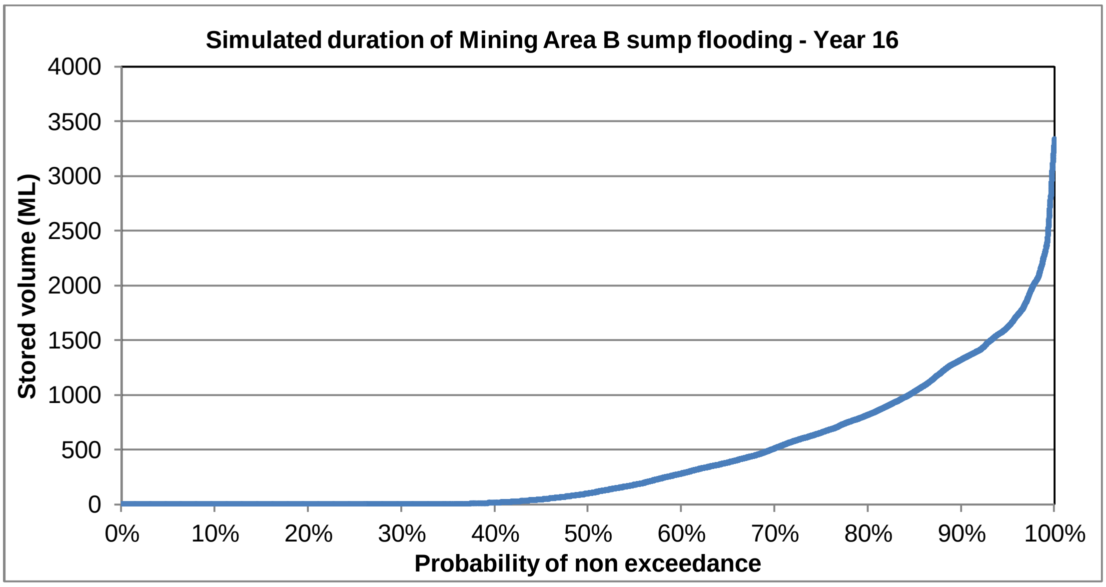

Figure 2.11 **Frequency of in-pit flooding for mining area B over the 111-year water balance simulation for Year 16 (Figure 6.11 in Appendix E)**

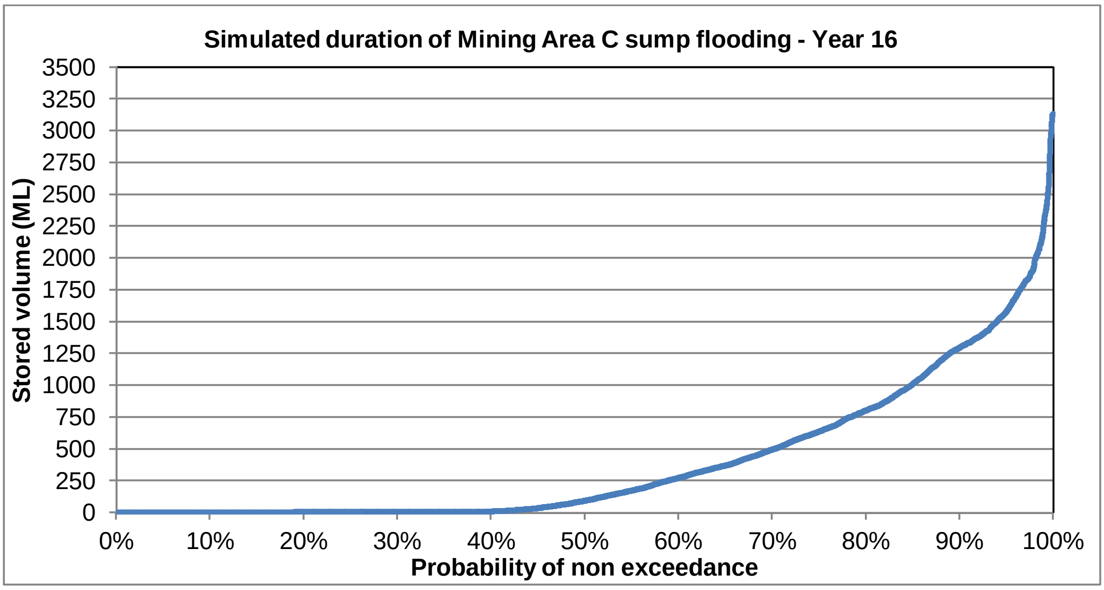

Figure 2.12 Frequency of in-pit flooding for mining area C over the 111-year water balance simulation for Year 16 (Figure 6.12 in Appendix E)

The worst case flood extents within each mining area are shown in the corrected Figures 6.13 and 6.14 below (Figures 2.13 and 2.14). The corrected figures show that under the worst case scenario mining operations can continue in pits B and C with multiple ramp access options. Peak flooding in pit A would inundate most of the pit, which would prevent operations in this area. The operation of concurrent mining areas will allow the continuation of mining in pits B and C under the worst case flooding scenario in pit A, with operations in pit A suspended until the pit could be dewatered.

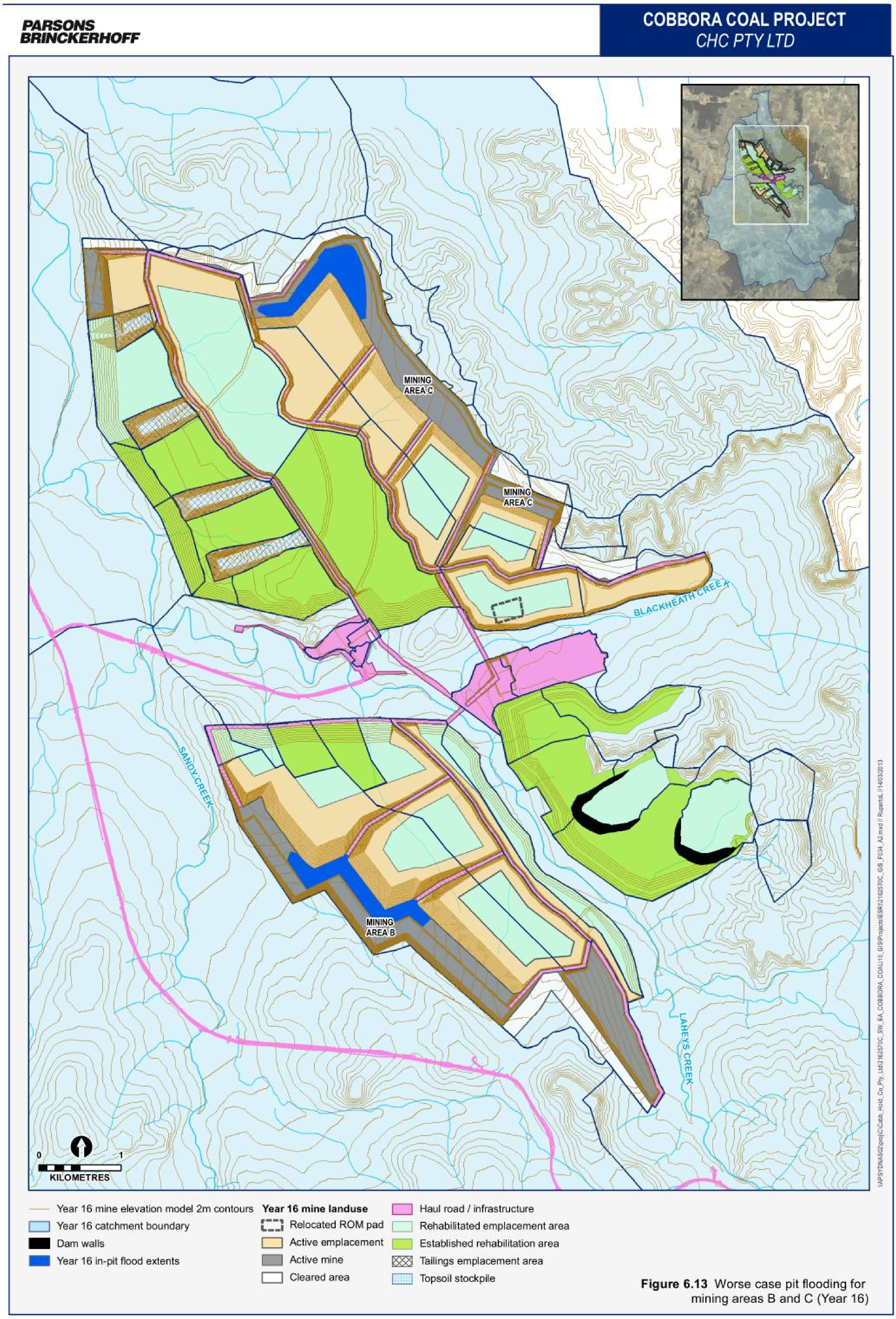

Figure 2.13 Worst case pit flooding for mining areas B and C (Year 16) (Figure 6.13 in Appendix E)

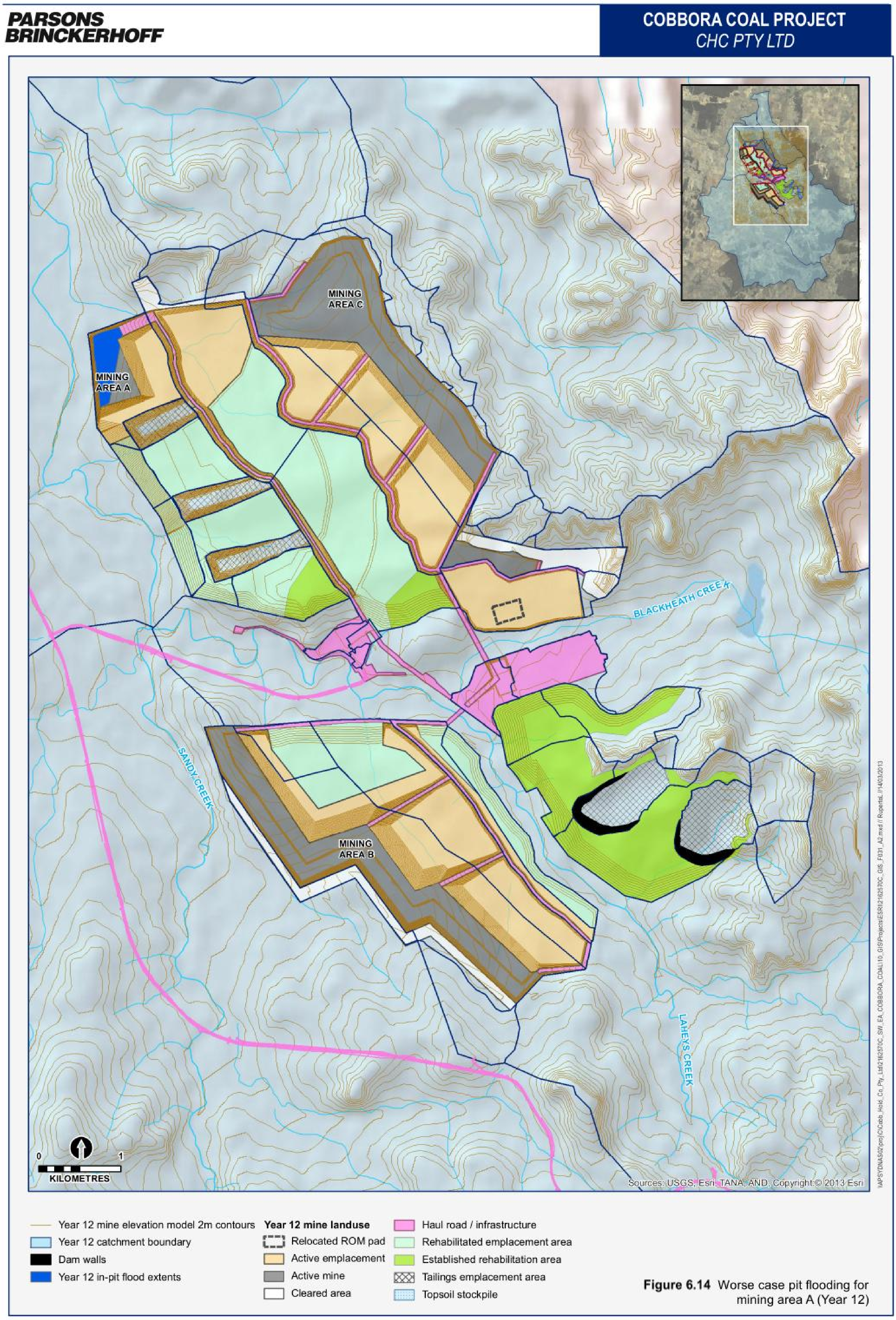

Figure 2.14 Worst case pit flooding for mining area A (Year 12) (Figure 6.14 in Appendix E)

2.7 Mining impacts on surface water flow regime (Section 6.1.4 of Appendix E)

The corrected Tables 6-6 and 6-7 (Tables 2-8 and 2-9) present the expected change in annual creek flows downstream of the site during mining compared to pre-mining conditions for dry, median and wet years (the previous incorrect values are included in brackets in the table).

The corrected results are similar to the reported results in Appendix E and indicate that there is an increase in downstream flows in the median and wet years. The results for the dry year show increases in downstream flows for Years 1 and 12 and slight decreases for Years 4 and 20. The corrected results do not change the reported conclusions of the assessment with respect to downstream flow and water quality impacts. This is discussed further in Section 3.

Table 2-8 Median annual flow in Sandy Creek, Flyblowers Creek, Isbester Gully and Unnamed Tributary 1 (Table 6-6 in Appendix E)

	Units	Pre-mining	Year 1	Year 4	Year 12	Year 16	Year 20	Post-mining
Natural catchment								
Undisturbed catchment runoff and established rehabilitation runoff returned directly to creek	ML/a	1,852	1,855	1,787	1,710	1,716	1,736	1,933
Existing west 'Woolandra' farm dams catchment runoff	ML/a	63	-	-	-	-	-	-
Existing west 'Woolandra' farm dams overflows	ML/a	0	-	-	-	-	-	-
Release from water management system to creek								
Sedimentation dam overflows	ML/a	-	0	0	0	0	0	-
Sedimentation dam controlled release	ML/a	-	92 (103)	193 (217)	318 (no change)	325 (no change)	218 (194)	-
Clean water/highwall dam controlled release	ML/a	-	2	10	17	3	0	-
Raw water dam overflows	ML/a	-	0	0	0	0	0	-
Total flow at study catchment outlet	ML/a	1,852 (no change)	1,949 (1,960)	1,990 (2,014)	2,046 (no change)	2,043 (no change)	1,954 (1,930)	1,933 (no change)
Percentage change from pre-mining		-	5% (6%)	7% (9%)	10% (no change)	10% (no change)	6% (4%)	4% (no change)

Table 2-9 Summary of expected changes to pre-mining creek flows during mining (Table 6-7 in Appendix E)

Year	Net change from pre-mining flow (%)		
	10th percentile (dry year)	50th percentile (median year)	90th percentile (wet year)
1	+7% (no change)	+5% (+6%)	+4% (no change)
4	-3% (no change)	+7% (+9%)	+5% (no change)
12	+14% (-6%)	+10% (no change)	+5% (no change)
16	0% (-6%)	+10% (no change)	+5% (no change)
20	-5% (no change)	+6% (+4%)	+5% (no change)

2.8 Impact of imported water supply on mining (Section 7.1 of Appendix E)

The corrected Figure 7.1 below (Figure 2.15) shows the imported water requirements over the 111 year simulation of the water balance model. The corrected figure shows that the peak requirement for imported water is 2,920 ML for the driest year on record of 1919, which is 391 ML below the Cudgegong entitlement, and the minimum peak requirement is 300 ML for the climate of 1956.

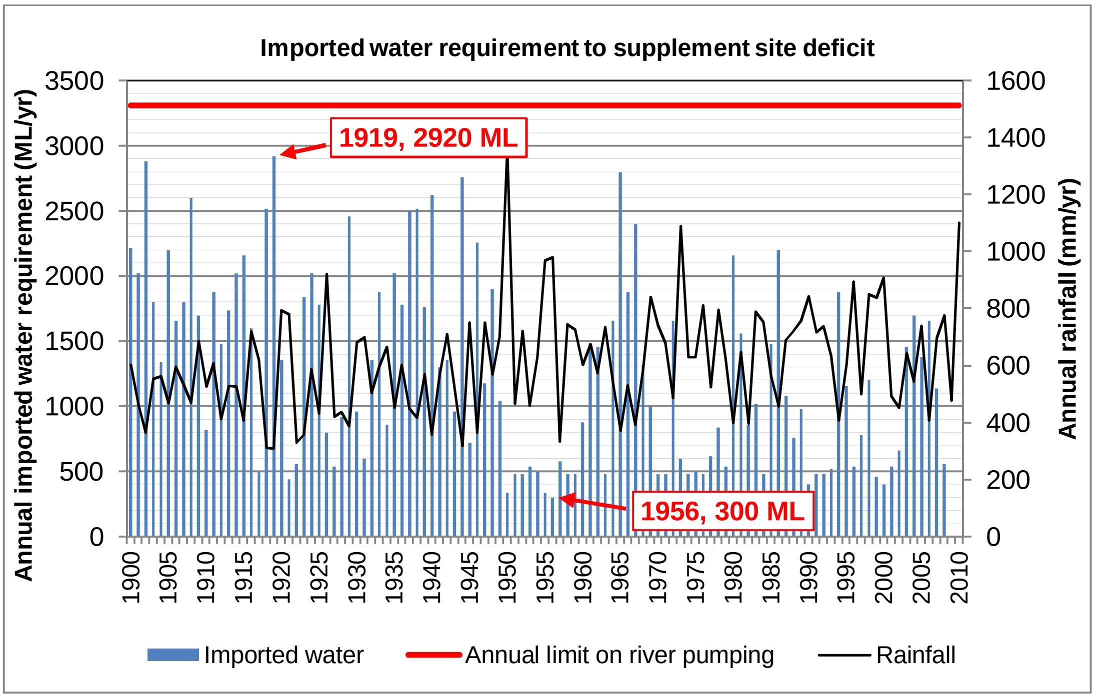

Figure 2.15 Comparison of annual imported water requirements over the 111-year water balance simulation for Year 20 (Figure 7.1 in Appendix E)

The corrected Table 7-1 below (Table 2-10) presents the imported water requirement for the 10th percentile dry year and the sedimentation dam water use and releases (the previous incorrect values are included in brackets in the table).

The table shows significant reductions in imported water volumes and increases in sedimentation dam water reuse volumes in Years 12 and 16 due to increased water availability in the upsized sedimentation dams SD1, 2 and 3 (see Section 2.2).

Table 2-10 Imported water requirement for a 10th percentile dry year (Table 7-1 in Appendix E)

Year	Total site demand (ML/a)	Imported water (ML/a)	Groundwater seepage (ML/a)	Total WMS runoff (ML/a)	Sedimentation dam water reused on-site (ML/a)	System releases (overflows and releases) (ML/a)
1	524	120 (no change)	131	337	24 (26)	42 (no change)
4	3,210	1,840 (1,820)	1,068	753	119 (no change)	3 (4)
12	4,339	580 (2,600)	2,444	1,157	24 (144)	124 (5)
16	4,291	1,220 (2,520)	2,401	1,023	126 (161)	35 (2)
20	4,054	2,400 (3,240)	1,162	957	123 (125)	0 (no change)

3. Implications for the Project Assessments

3.1 Implications for the Surface Water Assessment

The error in the water balance model resulted in total groundwater inflow for Years 12, 16 and 20 to be underestimated by between 1.1 and 1.4 GL/a. The error occurred during import of groundwater modelling results and does not affect the groundwater assessment. Correction of the error has resulted in the following key changes to the modelling results:

- Imported water requirements from the Cudgegong River have reduced by between 26 and 78% for Years 12, 16 and 20 for the 10th percentile dry year.
- Peak in-pit storage volumes have increased by between 32 and 45%.

In terms of the key impact on water extraction from the Cudgegong River source, the errors have resulted in a conservative assessment to date, i.e. the reliance of the Project on water entitlement from the Cudgegong River was previously overestimated.

The volumes of in-pit water that will need to be managed have increased significantly. However, the corrected assessment demonstrates that mining operations can continue in pits B and C, with temporary suspension of operations in pit A until dewatering of this pit occurs.

The water balance model provides simulated outflows from the mine water system which are used in the downstream flow and water quality impact assessments (Appendices B and C of the Surface Water Assessment). Rectification of the error in the water balance model has changed the sedimentation dam release/overflow regime which has also changed the outflows from the mine water system. These changes are provided in Table 2-8 and are minor – in the order of a 10% reduction in sedimentation dam controlled releases for the median year. In addition, Table 2-9 shows only minor changes in the results for downstream flow impacts, i.e.:

- No change to creek flow impacts for the 90th percentile wet year.
- A maximum of 2% change in creek flow impacts for Years 1, 4 and 20 for the 50th percentile median year.
- No change in flow impacts for Years 1, 4 and 20; a 14% increase in flow in Year 12 (compared to a 6% decrease previously reported) and no impact in Year 16 (compared to a 6% decrease previously reported) for the 10th percentile dry year.

Sedimentation dam water is considered to be relatively clean. Sensitivity analysis undertaken by PB found that the water quality impact assessment was insensitive to any large changes in contaminant loading from sedimentation dams (which are not predicted to occur) as the governing factor on water quality impacts is the much larger volumes of runoff from the undisturbed and established rehabilitated areas within the mining area.

There will be negligible changes to the results in the downstream flow and water quality impact assessments as a result of these corrections.

3.2 Implications for the Environmental Assessment

Results of the downstream flow and water quality impact assessments are used to inform the ecological assessment. Information on the changed hydrologic regimes in the creeks receiving sedimentation dam releases from the mine are used to identify potential impacts on aquatic habitats, including refuge pools. As explained above, the changes to the results of the downstream flow and water quality impacts are insignificant.

4. Additional analyses

4.1 Sensitivity analysis on groundwater inflow volumes

The DP&I's reviewer provided the following initial comment on evaporative loss of groundwater inflow:

> The Groundwater Assessment (page 95) states:
>
> *It should be noted that these dewatering estimates are the theoretical pit inflow rates derived from the applied drain cells in MODFLOW. It is anticipated that active pumping from the pit may be significantly less than the predicted dewatering volume due to the effects of evaporation. Evaporative losses have been taken into account in the mine water balance presented in the surface water report (Parsons Brinckerhoff 2012b)*
>
> The water balance summaries in Tables 6.1 – 6.3 of Appendix E quote essentially the same values for pit inflow as set out in Table 6.3 of the Groundwater Assessment. Tables 6.1 – 6.3 of Appendix E include a line item 'WMS dam evaporation (net of rain)' but do not appear to provide for evaporative losses from the seepage into the pit. Have I missed something?

PB provided the following initial response:

Inflow from groundwater seepage reports to the mine pit sump from which it is pumped to the mine water dams. Evaporation from the mine pit sump as well as mine water dams are accounted for. As noted, the pit inflow values are quoted from the groundwater assessment report. Evaporation loss is then applied as part of the water balance in the mine pit sumps and mine water dams.

The reviewer provided the following response:

Groundwater inflow to the pit will occur as dispersed seepage along the pit walls where they meet the floor as well as through the pit floor itself – rather than as a defined inflow. At year 12 (for example) the mine plans show a total pit area of about 450 ha with a perimeter of about 19 km. On a hot dry day, the pit has the potential to evaporate about 45 ML which is far more than the estimated groundwater inflow (2,446 ML/year in year 12 = 6.7 ML/day). My concern is that in the hot dry climate at Cobbora, much of the groundwater seepage into the pit will be lost before it even reaches the sumps (from which evaporation has been taken into account according to PB). The bottom line is that I suspect that the groundwater contribution to the overall water balance has been significantly over-estimated. If we assume that the groundwater contribution that can actually be used is only 50% of the groundwater model value (an over estimate in my opinion) then this would infer that in Year 12 about an additional 1,200 ML would need to be found from somewhere!

It is reasonable to question whether the groundwater inflow contribution to the mine water balance has been overestimated. However, CHC can implement management measures to greatly reduce evaporative loss of groundwater inflow to maximise the use of this water source. A range of dewatering methods can be implemented if groundwater is relied on for water supply during dry conditions, particularly in later years when groundwater inflow and water demand are high. Examples of dewatering methods that eliminate or reduce evaporative losses include in-pit or out-of-pit dewatering bores, horizontal and inclined seepage holes drilled into the pit face or dewatering galleries.

The maximum Cudgegong River water entitlement of 3,311 ML/a is sufficient to meet demand under scenarios of reduced groundwater availability. This has been demonstrated by a sensitivity test of the water balance model assuming a 60% reduction in the groundwater inflow available to the mine water system. The results of this sensitivity test are provided below in Table 4-1. The results show that the imported water requirements for the 10th percentile dry year remain below the maximum entitlement for all mine stage years. The peak water requirement at Year 20 of 3,040 ML is 271 ML below the maximum entitlement of 3,311 ML.

Table 4-1 Imported water requirement for a 10th percentile dry year with 60% reduction in groundwater inflows

Year	Total site demand (ML/a)	Groundwater seepage reduced by 60% (ML/a)	Imported water requirement for 10th percentile dry year (ML/a)	Imported water requirement for 50th percentile median year (ML/a)	Imported water requirement for 90th percentile wet year (ML/a)
1	524	52	200	200	0
4	3,210	427	2,420	1,780	460
12	4,339	978	2,700	1,880	400
16	4,291	961	2,800	1,940	400
20	4,054	465	3,040	2,200	400

5. Conclusions

The following conclusions are drawn from the results of the water balance modelling undertaken for this addendum:

- For the base case, CHC's maximum water entitlement of 3,311 ML/a from the Cudgegong River Source is adequate to meet the Project water demands. The modelled peak imported water requirement is 2,920 ML for the driest year on record, which is 391 ML less than the maximum entitlement. The 10^{th} percentile dry year peak imported water requirement is 2,400 ML, which is 911 ML less than the maximum entitlement.

- The adequacy of the water entitlement has been tested under the scenario of restricted water availability in the Cudgegong River. The results of this test show that there is a low probability of a water deficit of 2% for the peak water requirement Year 20, i.e. a deficit is predicted for a total of 2 years out of the 111 year sequence, under this scenario. The deficit ranges from 45 to 90 ML, which is a very low proportion of the overall site demand and well within the range of manageable deficit.

- The adequacy of the water entitlement has also been tested under the scenario of a 60% reduction in groundwater inflow (e.g. as a result of evaporation within the pit), which reduces the volume of water available for reuse in the mine water management system. The entitlement was also found to be adequate under this scenario, with the 10^{th} percentile dry year peak imported water requirement increasing to 3,040 ML, which is 271 ML less than the maximum entitlement.

- The corrected water balance model predicts a significantly higher volume of water stored in-pit during wet conditions. However, the corrected assessment demonstrates that mining operations can continue in pits B and C, with temporary suspension of operations in pit A until dewatering of this pit occurs.

- Rectification of the error in the water balance model has changed the sedimentation dam release/overflow regime which has also changed the outflows from the mine water system. These changes are insignificant with respect to downstream flow and water quality impacts in the receiving creeks, and therefore the previously reported findings of these assessments remain valid.

- Correction of the water balance model error has no implications for other elements of the Environmental Assessment, e.g. the ecological assessment, as the findings of the Surface Water Assessment with respect to downstream flow and water quality impacts are unchanged.

Appendix K

Surface water assessment — responses to initial comments from DP&I (7 March 2013)

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

Level 27 Ernst & Young Centre
680 George Street, Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001
Australia
Tel: +61 2 9272 5100
Fax: +61 2 9272 5101
Email: sydney@pb.com.au

www.pbworld.com

Certified to ISO 9001, ISO 14001, AS/NZS 4801
A GRI Rating: Sustainability Report 2011

Memo

Date	7 March 2013
To	Trish McDonald, Andrew Krause, CHC Phil Towler, EMM
From	Rob Leslie
Ref	2162570C-DMS-WAT-006 RevF
Subject	Cobbora Coal Project - Surface Water Assessment - Responses to initial comments from DP&I reviewer Steve Perrens

1. Introduction

Steve Perrens, the DP&I's reviewer for the Surface Water Assessment, has raised four queries in a letter to the DP&I dated 21 February 2013 and in a follow up email response to initial responses by PB on 25 February. The queries related to the following issues:

1. Evaporative loss of groundwater inflows to mine pit sumps;
2. Seasonality of dust suppression requirements for the haul road;
3. Clarity on volumetric balance presented in Tables 6.1-6.3 of Appendix E
4. Elements of volumetric balance of sedimentation dams

This detailed memo response presents, in the following order:

- Further information to address Point 4, with charts to illustrate all elements of the water balance for sedimentation dams – Section 2.
- Further information to address Point 3, with charts to illustrate mine site storage at the beginning and end of the simulated years – Section 3.
- Discussion of the impact of evaporative loss of groundwater inflows on the water balance and imported water requirement – Section 4.
- Discussion of the haul road dust suppression assumptions and the impact of seasonal variation on this water demand and the water balance and imported water requirement – Section 5.
- Discussion of the implications of an error found in the water balance model during preparation of this response.

The error in the water balance model is described in Section 3.2. The error resulted in an underestimation of the potential groundwater inflow volumes available for reuse within the mine water management system. This had the impact of increasing the imported water requirement from the Cudgegong River source, and therefore resulted in a conservative assessment with respect to reliance on this source of water.

2. Sedimentation dam water balance

The reviewer's query in relation to the water balance of the sedimentation dams (SD) was as follows:

> On a related issue, I have difficulty understanding how the water balance works for the sediment basins. For example, for a median year in mine Year 12:
>
> - Runoff to the sediment dams is 616 ML;
> - Water reuse from sediment dams is 137 ML;
> - Overflow and controlled release from sediment dams is 318 ML.
>
> Is the difference (161 ML) accounted for by evaporation? Is this included in the net evaporation from all WMS dams (230 ML)?

This section and the information presented in Appendix A address this query.

There are 39 SDs modelled in the GoldSim water balance model. However, the number of active dams varies for each mine stage simulated. For example, there are 13 active SDs at the mine stage year 1 and 16 active SDs at the mine stage year 4. Each of the active SDs receives direct rainfall and runoffs from each of its catchment land use types. The SD water balance adds these inflows to the initial water storage and computes end of the day storage before releasing water for: water surface evaporation, mine water dams (MWDs) and creeks. If the capacities of any of the SDs are exceeded, the overflows on any day are sent to the river flow balance elements in the model: Lahey and Sandy Creeks. The releases to the creeks are made at a maximum rate that would empty the SD within 5 days to the sediment store level. The model calculates the final store value after accounting for all possible releases constrained by available water. Most of the SDs empty frequently depending on the rainfall-runoff situation; however some of the SDs are sized to be used as water storage, i.e. SD1, SD2 and SD3 in the Mine Infrastructure Area (MIA).

Three examples to illustrate that the water balance of the SDs (SD1, SD9 and SD15) accounts for evaporation, releases to creek and pumping to MWDs are presented in the form of the tabulated water balance summary in Table 1 and in the form of graphs for mine stage year 4 and the 90th percentile rainfall (wet) year (1990) in Figures A1.1 to A3.3 in Appendix A. The water balance for SD9 is also provided for 1967, the 10th percentile rainfall (dry) year, in Figures A4.1 to A4.3. In the figures in Appendix A the simulated storages are separately compared with plots of rain and evaporation, inflows and overflows, and supply to creek and supply to MWDs.

The results for SD1, SD9 and SD15 were selected for the following reasons:

- SD1 captures runoff from the MIA and is therefore not allowed to release or spill water to the environment, and instead supplies water to MWDs for reuse.
- SD9 was selected to demonstrate the operational rule that stops SDs pumping water to MWDs when the MWDs are over 25% full.
- SD15 was selected to demonstrate a typical example of an SD that discharges water to the creek system through both controlled releases and overflows under wet conditions.

The year 4 mine stage was selected to demonstrate initial and final storages in the dams for a typical operational year and to present results that are not affected by the error in the groundwater inflows that is discussed further in Section 3.2. The wet year of 1990 was selected to demonstrate controlled releases and overflows to the creeks for SD9 and SD15, and to demonstrate transfer of captured storage to the mine water system for SD1. The dry year of 1967 was selected to demonstrate drying out of SD9 under dry conditions.

Table 1 Summary of water balance for mine stage year 4 for SD1, SD9 and SD15

Sedimentation Dam	Water holding capacity [ML]	Initial Store [ML]	Direct Rainfall [ML]	Total Inflow [ML]	Supply for Local Demands [ML]	Supply to MWD3 [ML]	Supply to Creek [ML]	Supply for Evaporation [ML]	Final Store [ML]	Dam Overflow Rate [ML]	Net Balance [ML]
1990 climate representing the 90th percentile rainfall (wet) year											
SD1	10.25	0.70	3.80	34.40	0.00	31.70	0.00	3.30	0.10	0.00	0.00
SD9	83.80	6.85	34.10	204.60	0.00	0.00	161.20	48.00	2.10	0.00	0.00
SD15	49.30	7.76	15.70	374.40	0.00	0.00	245.70	27.00	2.10	107.40	0.00
1967 climate representing the 10th percentile rainfall (dry) year											
SD9	83.80	7.11	15.90	34.50	0.00	0.00	0.00	41.60	0.00	0.00	0.00

All of the dams listed in Table 1 had some water stored in the dams on the 1st of January of the simulated year because of rainfall-runoff events prior to January. The final stores at the end of the simulated years reduced in all of the tabulated dams. SD9 became dry in the 1967 simulation.

All of these SDs release water for evaporation and, in accordance with the operating rule, have the potential to pump water to MWD3. SD9 and SD15 release water to the creeks but SD1 does not as it is designed to retain contaminated runoff from the MIA.

Figures A1.1 to A1.3 show the daily simulation for SD1 for 1990 (wet) conditions. The figures illustrate that whenever the rainfall-runoff raises water volumes greater than half of the SD1 sedimentation volume, water is pumped to MWD3. Below this storage level only evaporation occurs and no other supplies are made from this dam. No overflows from SD1 occurred as the final volume never exceeded the maximum water holding capacity of SD1 (see Table 1).

Figures A2.1 to A2.3 show the daily simulation for SD9 for 1990 (wet) conditions. During the simulation, numerous outflows to the creek occur but no pumping to MWD3 occurs as the MWD3 storage volume was more than 25% full (i.e. above the operating rule for SD pumping to MWDs). The storage in this dam did not exceed the maximum water holding capacity hence no overflow occurred. Evaporation gradually made the dam dry towards the end of 1990.

Figures A3.1 to A3.3 show the daily simulation for SD15 for 1990 (wet) conditions. The figures illustrate that overflows from an SD can occur at the same time when it is releasing water to the creek through its controlled outlets. No pumping from this dam to MWD3 was allowed as the MWD3 dam was more than 25% full.

Figures A4.1 to A4.3 show the daily simulation for SD9 for 1967 (dry) conditions. These figures illustrate that the dam storage reduced to near zero multiple times. Supply from this dam did not occur to the creek or to MWD3 during 1967 as the water stored in the dam did not exceed the pipe outlet level, and because MWD3 was more than 25% full.

These examples illustrate that the water balance of the SDs accounts for evaporation, releases to creek and pumping to mine water dams. The same principles apply to all 64 dams including clean water dams (CWDs), SDs, mine-pit sumps, MWDs, the raw water dam (RWD1) and tailings dams (TDs). Water transfer from one to another is governed by pumping rules and constraints in terms of maximum flow rates. Mine demands are ultimately supplied from MWD3, MWD4, MWD5 and RWD1.

3. Annual water balance

The reviewer's query in relation to the annual water balance was as follows:

The tables below provide my assessment of the overall annual water balance based on the data in Tables 6.1 – 6.3 of Appendix E. As can be seen, there is considerable discrepancy between the available water and the water that is accounted for by on-site uses. What is the explanation for these differences? Is it related to the difference in storage volumes between the beginning and end of the representative years used for the water balance summary?

10th Percentile Year

	Year 1	Year 4	Year 12	Year 16	Year 20
Runoff/Inflow	588	3,641	6,202	5,946	5,360
Discharge	42	4	5	2	0
Evaporation	313	480	492	474	317
Available	233	3,157	5,705	5,470	5,043
Water use	524	3,210	4,340	4,292	4,055
Discrepancy	***-291***	***-53***	***1,365***	***1,178***	***988***

Median Year

	Year 1	Year 4	Year 12	Year 16	Year 20
Runoff/Inflow	927	3,805	6,496	6,164	5,556
Discharge	105	227	335	328	194
Evaporation	85	221	230	215	110
Available water	737	3,357	5,931	5,621	5,252
Water use	524	3,210	4,340	4,292	4,055
Discrepancy	***213***	***147***	***1,591***	***1,329***	***1,197***

90th Percentile Year

	Year 1	Year 4	Year 12	Year 16	Year 20
Runoff/Inflow	2,144	6,090	10,173	9,766	7,931
Discharge	1,111	2,181	3,057	2,797	2,144
Evaporation	259	184	475	459	219
Available	774	3,725	6,641	6,510	5,568
Water use	524	3,210	4,340	4,292	4,055
Discrepancy	***250***	***515***	***2,301***	***2,218***	***1,513***

This section and the information presented in Appendix B address this query.

3.1 Response to query

The annual balance presented in Tables 6.1 to 6.3 of Appendix E provided a summary of volumes of water that entered and left the project site. The intent of the tables was to show whether the project demands could be met from available water sources: groundwater inflows into the pits during mining, licenced water entitlement from the Cudgegong River source and local site rainfall and runoff. The water storage at the beginning and end of the simulated years were not shown in the tables.

The information summarised in Appendix E is snapshot information from 101 years (1900 to 2010) of simulation for:

- The 10th percentile rainfall year (1967 climate) in Table 6.1 of Appendix E.

- The 50th percentile rainfall year (1906 climate) in Table 6.2 of Appendix E.
- The 90th percentile rainfall year (1990 climate) in Table 6.3 of Appendix E.

Years 1, 4, 12, 16 and 20 mine plan land-use and the proposed water management system consisting of RWD1, CWDs, SDs, Mine Pit Sumps (PitA, PitB, PitC), MWDs and TDs were tested against 101 years of historical climate to assess water availability for mining. The simulations of these dams were undertaken on a daily time step for 101 years based on similar water balance logic as explained for SD in Section 2. Water transfers from CWDs to Pits, SDs to MWDs and Pits and TDs and other MWDs to MWD4 (main dam) were undertaken as per the operating rules explained in Appendix E. RWD1 supplied potable and top up water for unmet demands in the model.

The reviewer's tables above highlighting the discrepancies have been reproduced and expanded below in Table 2 for the 10th percentile rainfall year, Table 3 for the 50th percentile rainfall year and Table 4 for the 90th percentile rainfall year. These expanded tables provide initial and final storage for the simulated years 1967, 1906 and 1990 from 101 years of continuous simulation, the final discrepancy in the water balance and the percentage error in terms of total inflows handled by the model. The tables demonstrate that the water balance is now closed to within 0.1% for Year 1 and 0.0% for all other years with the initial and final storages in the dams. It should be noted that the discrepancy seen in the final balance is due to numerical round-off errors in accumulating values from daily to annual and vice-versa. Note that the discussion regarding groundwater inflow input errors presented in Tables 2 to 4 is provided in Section 3.2.

Table 2 Summary of Project water management system balance for 10th percentile rainfall (dry) year (based on Table 6.1 of Appendix E)

Volume (ML)	Year 1	Year 4	Year 12*	Year 16*	Year 20	Year 20 (revised)
	Correct flows as presented in Table 6.1		Incorrect flows as presented in Table 6.1 (see Section 3.2)			Corrected flows (revised results)
Runoff	337	753	1,157	1,023	957	957
Groundwater	131	1,069	**1,003**	**1,167**	**31**	**1,163**
River	120	1,840	2,620	2,520	3,240	2,380
TOTAL INFLOW	**588**	**3,662**	**4,780**	**4,711**	**4,228**	**4,500**
Evaporation – Rain	314	482	494	477	319	480
Project Demand	524	3,210	4,339	4,291	4,054	4,054
Overflows and releases	42	4	5	1	0	0
TOTAL OUTFLOW	**880**	**3,696**	**4,838**	**4,769**	**4,373**	**4,534**
Intermediate Balance	-292	-34	-58	-58	-144	-34
Initial Store	1,026	599	606	598	413	589
Final Store	733	564	547	540	268	554
Final Balance	1	1	1	1	0	1
Discrepancy with respect to total inflows (%)	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
*Note: Corrected model results not yet available for Years 12 and 16						

Table 3 Summary of Project water management system balance for 50th percentile rainfall (median) year (based on Table 6.2 of Appendix E)

Volume (ML)	Year 1	Year 4	Year 12*	Year 16*	Year 20	Year 20 (revised)
	Correct flows as presented in Table 6.2		Incorrect flows as presented in Table 6.2 (see Section 3.2)			Corrected flows (revised results)
Runoff	636	1,436	2,210	1,980	1,853	1,853
Groundwater	131	1,069	**1,003**	**1,167**	**31**	**1,163**
River	160	1,300	1,840	1,780	2,540	1,680
TOTAL INFLOW	**927**	**3,805**	**5,054**	**4,928**	**4,424**	**4,696**
Evaporation – Rain	86	223	232	216	111	241
Project Demand	524	3,210	4,339	4,291	4,054	4,054
Overflows and releases	106	227	336	327	194	248
TOTAL OUTFLOW	**716**	**3,660**	**4,907**	**4,834**	**4,359**	**4,543**
Intermediate Balance	211	146	147	94	65	153
Initial Store	554	552	548	554	509	557
Final Store	764	697	695	647	574	709
Final Balance	0	1	1	1	0	1
Discrepancy with respect to total inflows (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
*Note: Corrected model results not yet available for Years 12 and 16						

Table 4 Summary of Project water management system balance for 90th percentile rainfall (wet) year (based on Table 6.3 of Appendix E)

Volume (ML)	Year 1	Year 4	Year 12*	Year 16*	Year 20	Year 20 (revised)
	Correct flows as presented in Table 6.3		Incorrect flows as presented in Table 6.3 (see Section 3.2)			Corrected flows (revised results)
Runoff	2,015	4,662	7,347	6,964	6,368	6,368
Groundwater	131	1,069	**1,003**	**1,167**	**31**	**1,163**
River	0	360	400	400	400	400
TOTAL INFLOW	**2,146**	**6,091**	**8,751**	**8,532**	**6,799**	**7,931**
Evaporation – Rain	249	168	458	444	203	479
Project Demand	524	3,210	4,339	4,291	4,054	4,054
Overflows and releases	1,053	2,187	3,064	2,804	2,150	2,186
TOTAL OUTFLOW	1,826	5,565	7,861	7,539	6,407	6,719
Intermediate Balance	318	527	890	994	392	1,212
Initial Store	1,829	1,257	1,762	1,834	1,177	1,990
Final Store	2,148	1,783	2,651	2,826	1,568	3,200
Final Balance	0	1	1	1	0	1
Discrepancy with respect to total inflows (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
*Note: Corrected model results not yet available for Years 12 and 16						

Additional figures are presented in Appendix B to demonstrate the water balance for the different types of dams in the GoldSim model. The figures are based on Year 1 of operation and demonstrate that the project dams build up storage in the system within a year of operation. Figure B.1 provides an overview of the water balance in all dam types for the entire simulation. Figures B.2 to B.6 provide water balance results for the mine water dams, sedimentation dams, pits, the raw water dam and tailings dams for mine stage year 1 and the 10th percentile rainfall (dry) year of 1967. While not all time series results are easily visible on the charts, the main purpose of the figures is to demonstrate the variation in storage within the different dam types throughout the 10th percentile (dry) year, and the initial and final storages at the start and end of the year. More detailed results can be provided if required.

3.2 Water balance model error

In undertaking further work to respond to the reviewer's queries, input data errors were discovered for the Year 12, 16 and 20 results in Tables 6.1 to 6.3 in Appendix E of the Surface Water Assessment. During detailed interrogation of the model results, it was discovered that the initial and final storage for Years 12 and 16 were not closing the water balances, as pointed out by the reviewer. Further examination of the input data revealed that the groundwater flows for the Pit B sump were read into GoldSim incorrectly for Years 12 and 16. For Year 20, it was discovered that a previous feature of the model that involved reading groundwater inflow for Year 21 for the last year of mining was not reset to Year 20 to reflect the shortened operational life. The effect of these errors was to reduce the groundwater inflow considerably below the intended input values, as shown in Table 5.

Table 5 Groundwater inflows for mine stage years 1, 4, 12, 16, 20 and 21 with erroneous values highlighted in red

Mine Stage Year	Mining area A (ML)	Mining area B (ML)	Mining area C (ML)	Total groundwater inflow (ML)	Incorrect groundwater inflow values input to GoldSim (ML)
1	24	107	0	131	131
4	368	600	101	1,069	1,069
12	452	1,444	550	2,446	**1,003**
16	637	1,237	529	2,403	**1,167**
20	195	631	337	1,163	**31**
21	0	31	0	31	31

Table 5 shows that the total groundwater inflows entered into GoldSim for Years 12, 16 and 20 were 59%, 51% and 97% less than the intended values respectively. An addendum to Appendix E of the Surface Water Assessment is currently being prepared to correct all tables and figures that reflect the above errors. Tables 2 to 4 contain corrected results for Year 20 only which demonstrate that the corrected model also balances. The models for Years 12 and 16 are currently being re-run for the addendum.

The water balance for the mine stage years 12, 16 and 20 in Table 2 for the 10th percentile rainfall year, Table 3 for the 50th percentile rainfall year and Table 4 for the 90th percentile rainfall year, while erroneous due to the incorrect groundwater inflows used, nevertheless demonstrate that the Project can meet its water demand with the available surface water entitlement even if groundwater inflows to the pits are reduced by between 50 and 100% in the later years of mining.

4. Evaporative loss of groundwater inflows

The reviewer provided the following initial comment on evaporative loss of groundwater inflow:

The Groundwater Assessment (page 95) states:

> *It should be noted that these dewatering estimates are the theoretical pit inflow rates derived from the applied drain cells in MODFLOW. It is anticipated that active pumping from the pit may be significantly less than the predicted dewatering volume due to the effects of evaporation. Evaporative losses have been taken into account in the mine water balance presented in the surface water report (Parsons Brinckerhoff 2012b)*

The water balance summaries in Tables 6.1 – 6.3 of Appendix E quote essentially the same values for pit inflow as set out in Table 6.3 of the Groundwater Assessment. Tables 6.1 – 6.3 of Appendix E include a line item 'WMS dam evaporation (net of rain)' but do not appear to provide for evaporative losses from the seepage into the pit. Have I missed something?

PB provided the following initial response:

Inflow from groundwater seepage reports to the mine pit sump from which it is pumped to the mine water dams. Evaporation from the mine pit sump as well as mine water dams are accounted for. As noted, the pit inflow values are quoted from the groundwater assessment report. Evaporation loss is then applied as part of the water balance in the mine pit sumps and mine water dams.

The reviewer provided the following response:

Groundwater inflow to the pit will occur as dispersed seepage along the pit walls where they meet the floor as well as through the pit floor itself – rather than as a defined inflow. At year 12 (for example) the mine plans show a total pit area of about 450 ha with a perimeter of about 19 km. On a hot dry day, the pit has the potential to evaporate about 45 ML which is far more than the estimated groundwater inflow (2,446 ML/year in year 12 = 6.7 ML/day). My concern is that in the hot dry climate at Cobbora, much of the groundwater seepage into the pit will be lost before it even reaches the sumps (from which evaporation has been taken into account according to PB). The bottom line is that I suspect that the groundwater contribution to the overall water balance has been significantly over-estimated. If we assume that the groundwater contribution that can actually be used is only 50% of the groundwater model value (an over estimate in my opinion) then this would infer that in Year 12 about an additional 1,200 ML would need to be found from somewhere!

The reviewer has raised the valid concern that the groundwater inflow contribution to the mine water balance may be significantly overestimated. However, CHC can implement management measures to greatly reduce evaporative loss of groundwater inflow to maximise the use of this water source. A range of dewatering methods can be investigated if groundwater is heavily relied upon for water supply during dry conditions, particularly in later years when groundwater inflow and water demand are high. Examples of dewatering methods include in-pit or out-of-pit dewatering bores, horizontal and inclined seepage holes drilled into the pit face or dewatering galleries.

The maximum Cudgegong River water entitlement of 3.3GL/a held by CHC (i.e. the entitlement from the Cudgegong River source which provides the 'imported river water' supply to the project) is sufficient to meet demand under scenarios of reduced groundwater availability. PB proposes to demonstrate this by running a sensitivity test of the water balance model assuming a 60% reduction in the groundwater inflow available to the mine water system. The results of this sensitivity test will be provided in the addendum to Appendix E to correct the groundwater inflow errors. It is possible that this sensitivity test could show potential water deficits in dry years in the later stages of mining. However, such shortfalls could be managed through forward planning of dewatering measures as necessary. As discussed in Section 3.2, the results in the current revision of the report, which are based on erroneous groundwater inflow values, demonstrate that the mine can operate under significantly reduced groundwater inflows of between 50 and 100% in the latter years of mining.

5. Implications of seasonal variation on dust suppression demand

The reviewer provided the following comment on the estimate of dust suppression demand:

The haul road dust suppression in Tables 6.1 – 6.3 of Appendix E is a constant for any mine year regardless of the climate. Intuitively, I would expect water requirements for dust suppression to vary significantly between wet and dry years.

PB provided the following initial response:

Haul road demand may vary from season to season and day to day. We have represented it as an average daily demand. Accounting for the daily variation may change the levels and storages in the water management system dams.

The reviewer provided the following response:

My analysis indicates that in a similar climate, water demand for dust suppression can vary by ±20% from the average between wet and dry years. This equates to differences of ±330 ML for Year 12 water balance analysis. I accept that some of the day to day variation from the average could be accommodated by the operation of the storages, but I do not consider the storages would adequately cater for year to year variation. My estimated deficit of 330 ML in a dry year would compound the shortfall due to evaporation of *the groundwater (see above). I would also like to know the area that has been used for the dust suppression analysis – so that I can benchmark the adopted water demand.*

The haul road lengths requiring dust suppression in each year are given in Table 6 below:

Table 6 Haul road lengths and areas for each stage of mining

Year	Road Length (m)	Road Width (m)	Road surface area (m^2)
1	6,158	30	184,729
4	15,417	30	462,509
12	21,906	30	657,173
16	19,638	30	589,134
20	18,201	30	546,024

The water balance modelling is based on the assumption that dust suppression will constitute a major component of the site water demand. Management measures are available to CHC to greatly reduce this demand, e.g. through the use of dust suppressants. Typical water demand reductions achieved by dust suppressants are in the range of 40 to 70%. The list below provides water demand reductions for four typical products:

- RST Dust Management: 40%
- DusTreat by GE: 50%
- Water$ave by Polymer Innovations: 50%
- Range of products by 3M: up to 70%

The achievable reduction in water demand for dust suppression through use of such products significantly exceeds the ±20% potential variation in demand from the average between wet and dry years. CHC can therefore employ dust suppressants to reduce this water demand during dry periods, and reduce reliance on imported river water.

6. Rectification of water balance model error

As discussed in Section 3.2, the error in groundwater inflows will require an addendum to Appendix E of the Surface Water Assessment to present corrected results of the water balance model. The following contents of Appendix E will require updating in the addendum:

- Tables 6-1 to 6-3 – Annual site water balance for 10^{th}, 50^{th} and 90^{th} percentile years
- Table 6-4 – Summary of imported water requirement for dry, median and wet years
- Table 6-5 – Maximum in pit storage volumes
- Table 6-6 – Median annual flow in Sandy Creek, Flyblowers Creek, Isbester Gully and Unnamed Tributary 1
- Table 6-7 – Summary of expected changes to pre-mining creek flows during mining
- Table 7-1 – Imported water requirement for 10^{th} percentile dry year
- Figure 6-1 – Annual imported water requirement over the 111-year water balance simulation for Year 20
- Figure 6-2 – Results of sensitivity analysis of river water restrictions for peak demand year 20

- Figure 6-3 – Simulated dam storage and overflows for SD10 for mining year 16
- Figure 6.4 – Simulated total inflow to SD10, pumping to MD3 and overflows to the creek from SD10 for mining year 16
- Figure 6-5 – Simulated dam storage and overflows for SD 31 for mining year 16
- Figure 6-6 – Simulated total inflow to SD31, pumping to MD3 and overflows to the creek from SD31 for mining year 16
- Figure 6-7 – Stored volume in mining area A over the 111-year water balance simulation for Year 16
- Figure 6-8 – Stored volume in mining area B over the 111-year water balance simulation for Year 16
- Figure 6-9 – Stored volume in mining area C over the 111-year water balance simulation for Year 16
- Figure 6-10 – Frequency of in-pit flooding for mining area A over the 111-year water balance simulation for Year 16
- Figure 6-11 – Frequency of in-pit flooding for mining area B over the 111-year water balance simulation for Year 16
- Figure 6-12 – Frequency of in-pit flooding for mining area C over the 111-year water balance simulation for Year 16
- Figure 7-1 – Comparison of annual imported water requirements over the 111-year water balance simulation for Year 20

The errors resulted in total groundwater inflow for years 12, 16 and 20 to be underestimated by between 1.1 and 1.4 GL. Based on the correction of the error for Year 20, the results for Years 12, 16 and 20 are expected to change as follows:

- Imported water requirements from the Cudgegong River are expected to be reduced by about 25%.
- In-pit storage volumes are expected to increase by about 10 to 60%.
- Initial and final storages in the SDs and MWDs are expected to increase by about 70 to 100%.

In terms of the key impact on water extraction from the Cudgegong River source, the errors have resulted in a conservative assessment to date, i.e. the reliance of the Project on water entitlement from the Cudgegong River has been overestimated. This will be further explained in the addendum.

The addendum will also contain an additional section reporting on the results of the sensitivity analysis on groundwater inflows, as discussed in Section 4.

The water balance model provides simulated outflows from the mine water system which are used in the downstream flow and water quality impact assessments (Appendices B and C of the Surface Water Assessment report). Rectification of the error in the water balance model will change the sedimentation dam release/overflow regime which will also change the outflows from the mine water system. However, this will not measurably change the downstream flow and water quality impacts for the following reasons:

- There is no change to the release/overflow regime for the 10th percentile rainfall (dry) year as demonstrated by the Year 20 and Year 20 (revised) columns in Table 2.
- For the 50th percentile rainfall (median) year, the change in the release/overflow regime at Year 20 of 54ML only constitutes a 3% change in the total flow at the study catchment outlet of 1,930ML, as reported in Table 6-2 of Appendix E.

- For the 90th percentile rainfall (wet) year, the change in the release/overflow regime at Year 20 of 36ML only constitutes a 0.1% change in the total flow at the study catchment outlet of 27,439ML, as reported in Table 6-3 of Appendix E.
- Sedimentation dam water is considered to be relatively clean water. Sensitivity analysis undertaken by PB found that the water quality impact assessment was insensitive to any large changes in contaminant loading from sedimentation dams (not predicted to occur) as the governing factor on water quality impacts is the much larger volumes of runoff from the undisturbed and established rehabilitated areas within the mining area.

Changes to results in the downstream flow and water quality impact assessments will therefore be insignificant / negligible and these will not be updated in the addendum.

We trust the above responses clarify the initial comments from Steve Perrens and enable him to proceed with his in-depth review. We would be happy to discuss any of the points made above with the reviewer in more detail.

Yours sincerely

Rob Leslie

Rob Leslie
Team Manager, Water Resources NSW
Parsons Brinckerhoff

APPENDIX A – SEDIMENTATION DAM WATER BLANCE TIME SERIES PLOTS

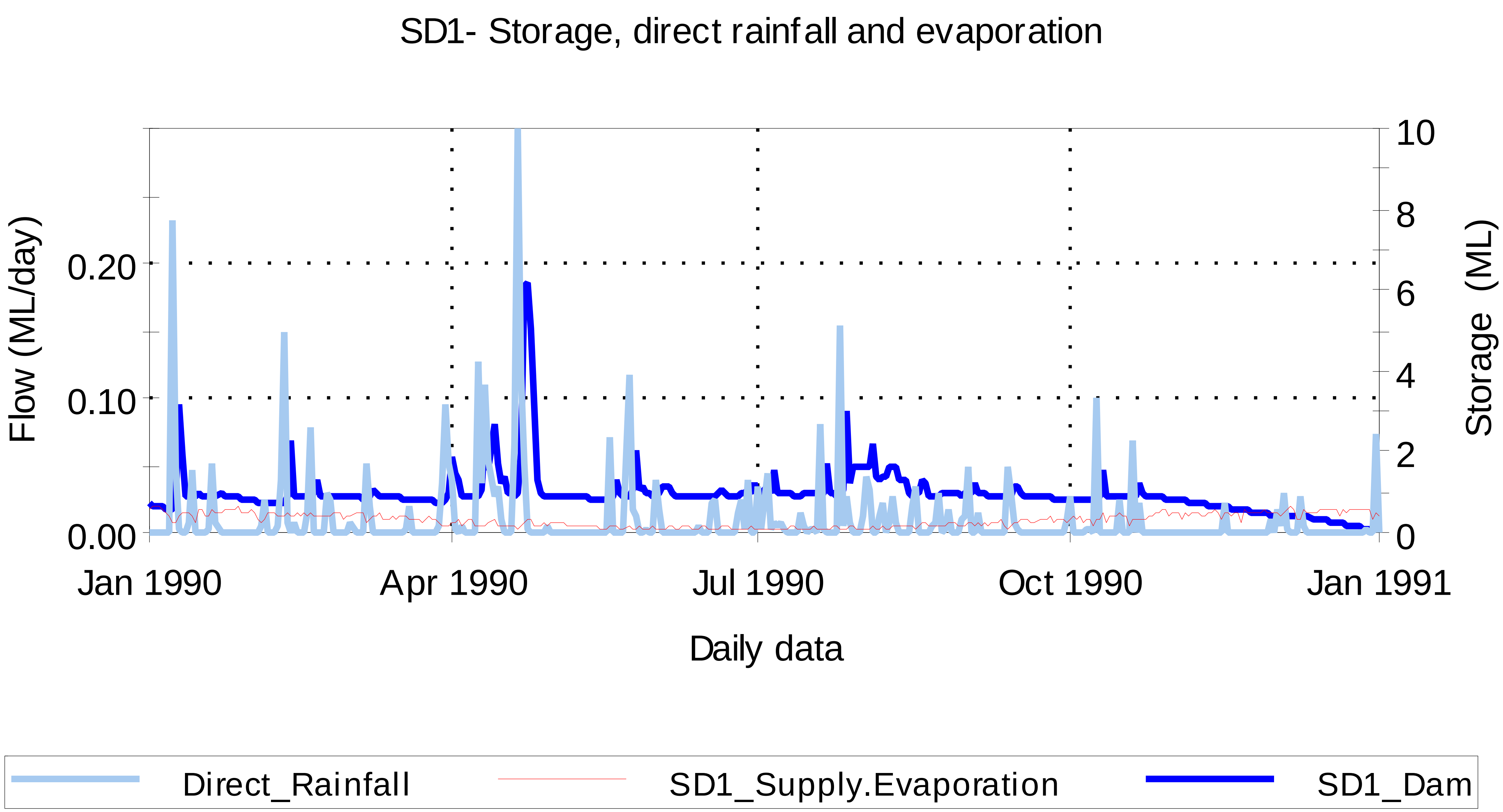

Figure A1.1 – Water balance for SD1 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 1 of 3)

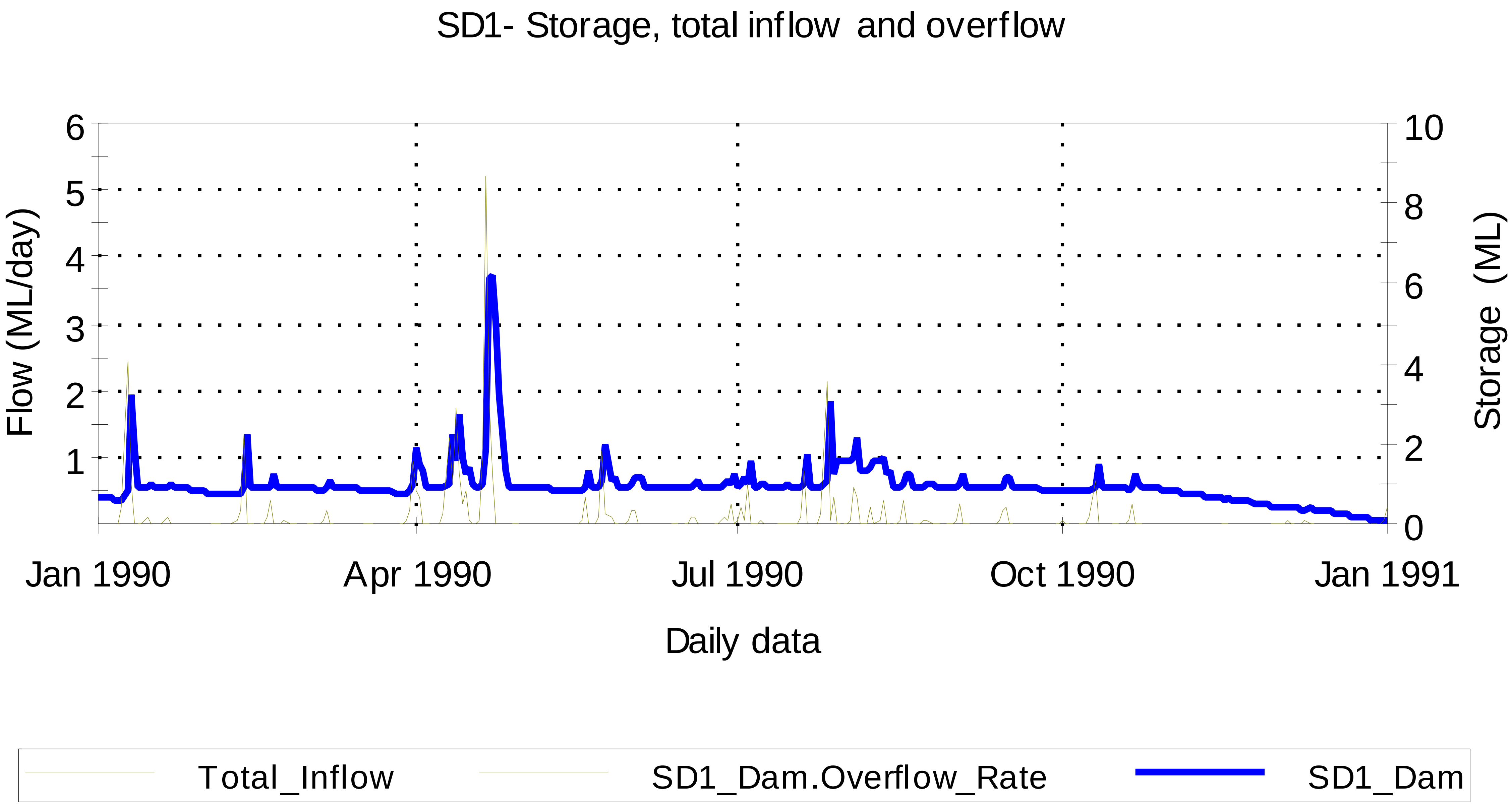

Figure A1.2 – Water balance for SD1 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 2 of 3)

PARSONS BRINCKERHOFF

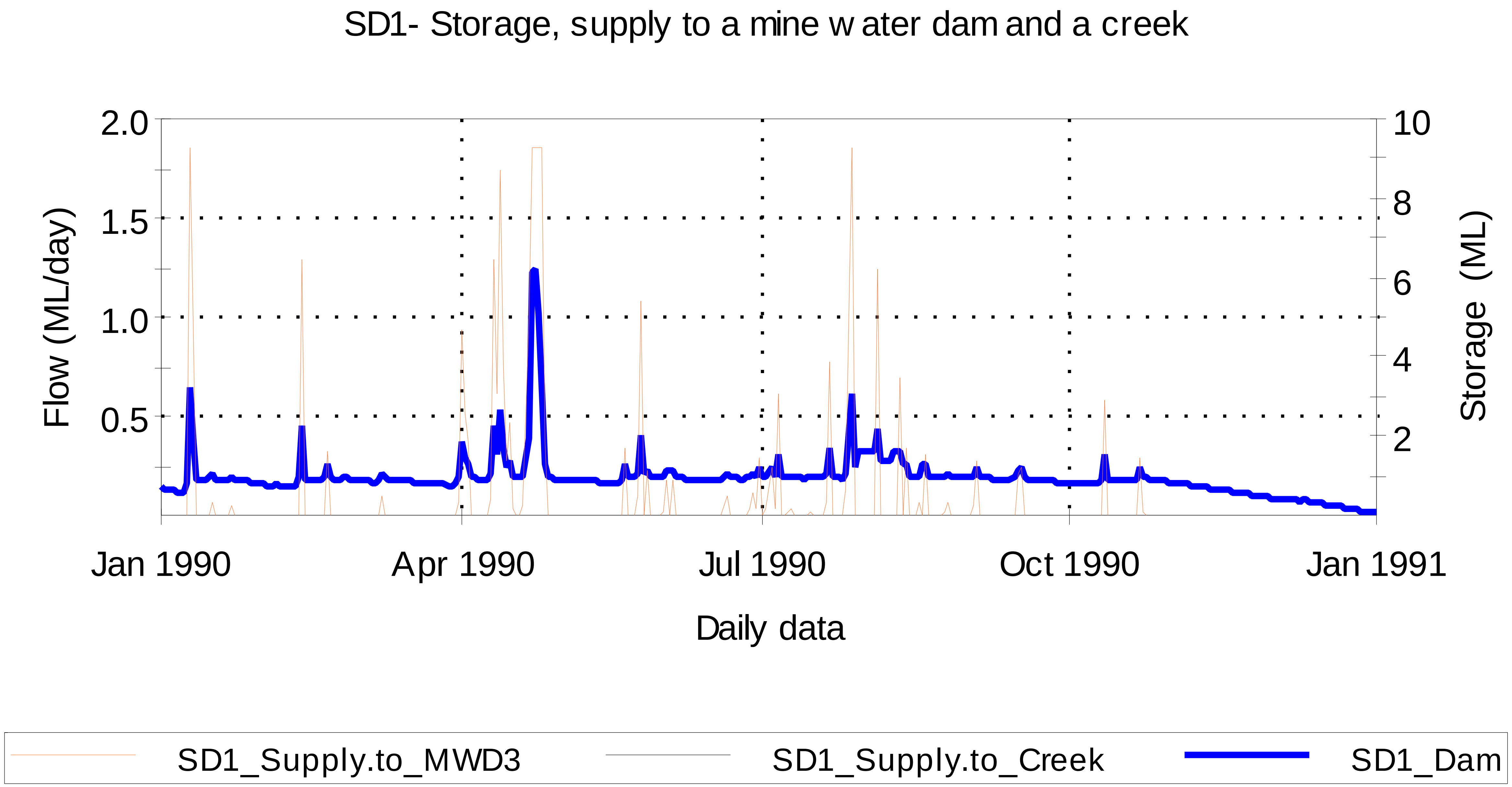

Figure A1.3 – Water balance for SD1 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 3 of 3)

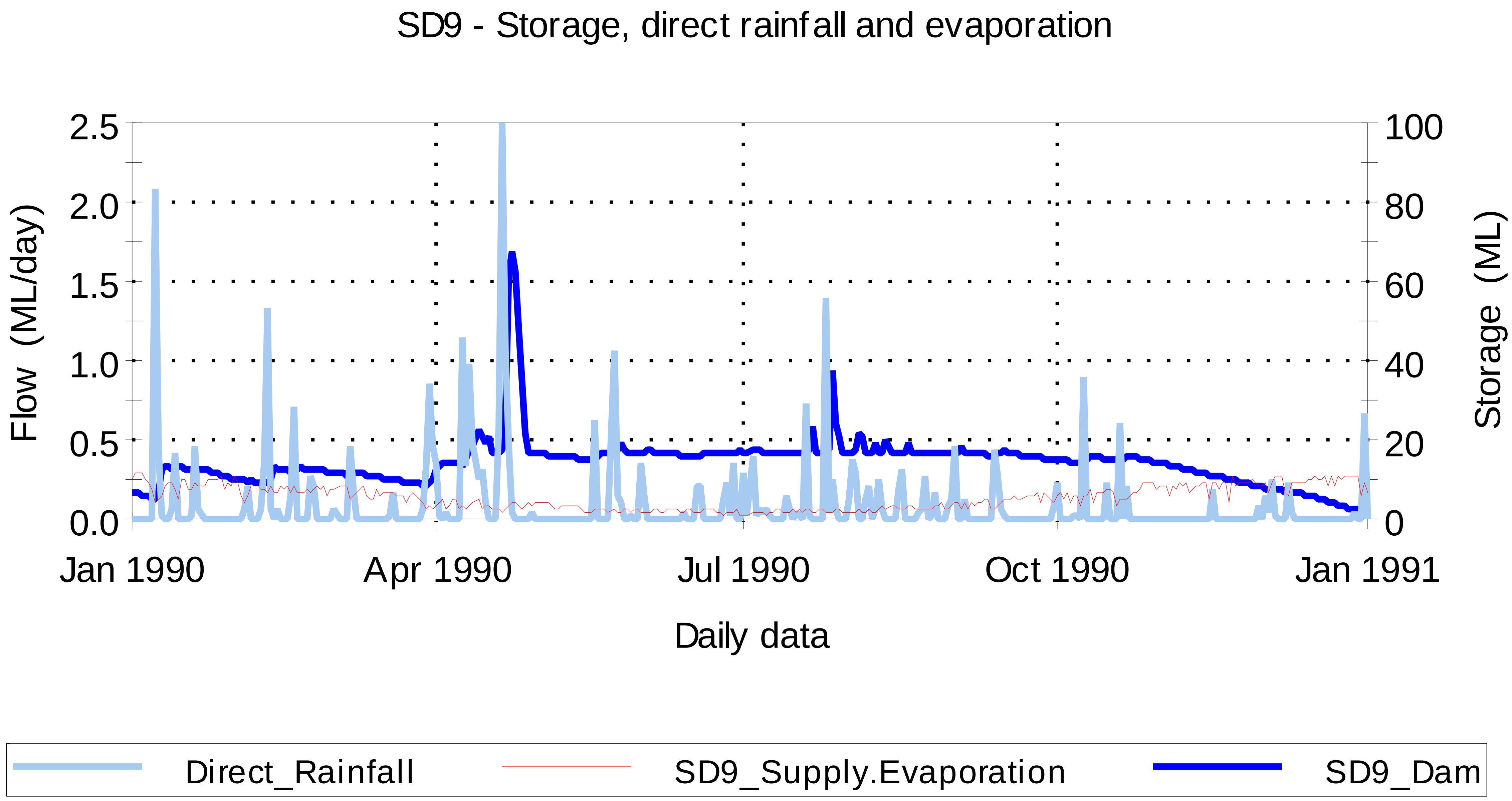

Figure A2.1 – Water balance for SD9 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 1 of 3)

PARSONS BRINCKERHOFF

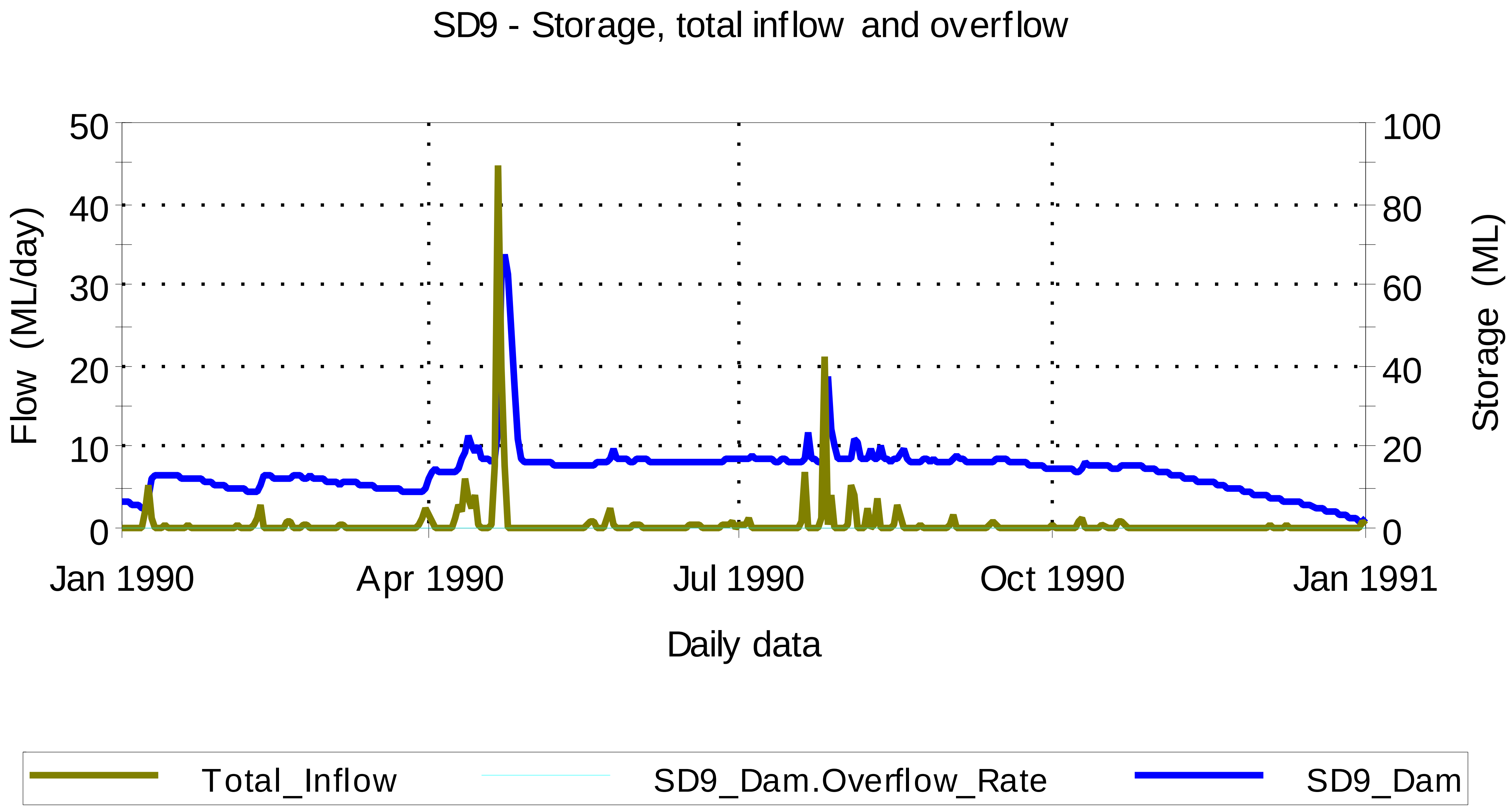

Figure A2.2 – Water balance for SD9 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 2 of 3)

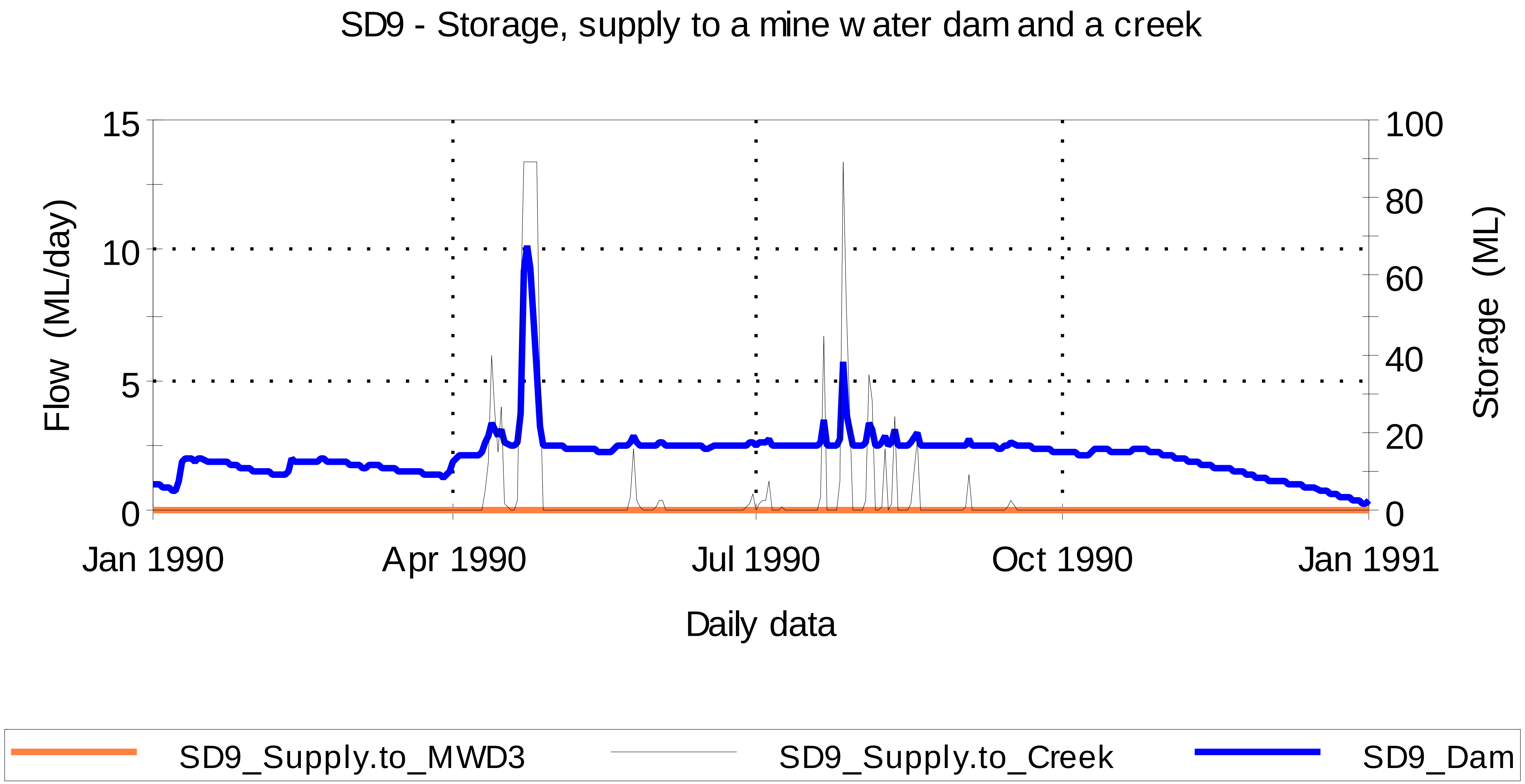

Figure A2.3 – Water balance for SD9 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 3 of 3)

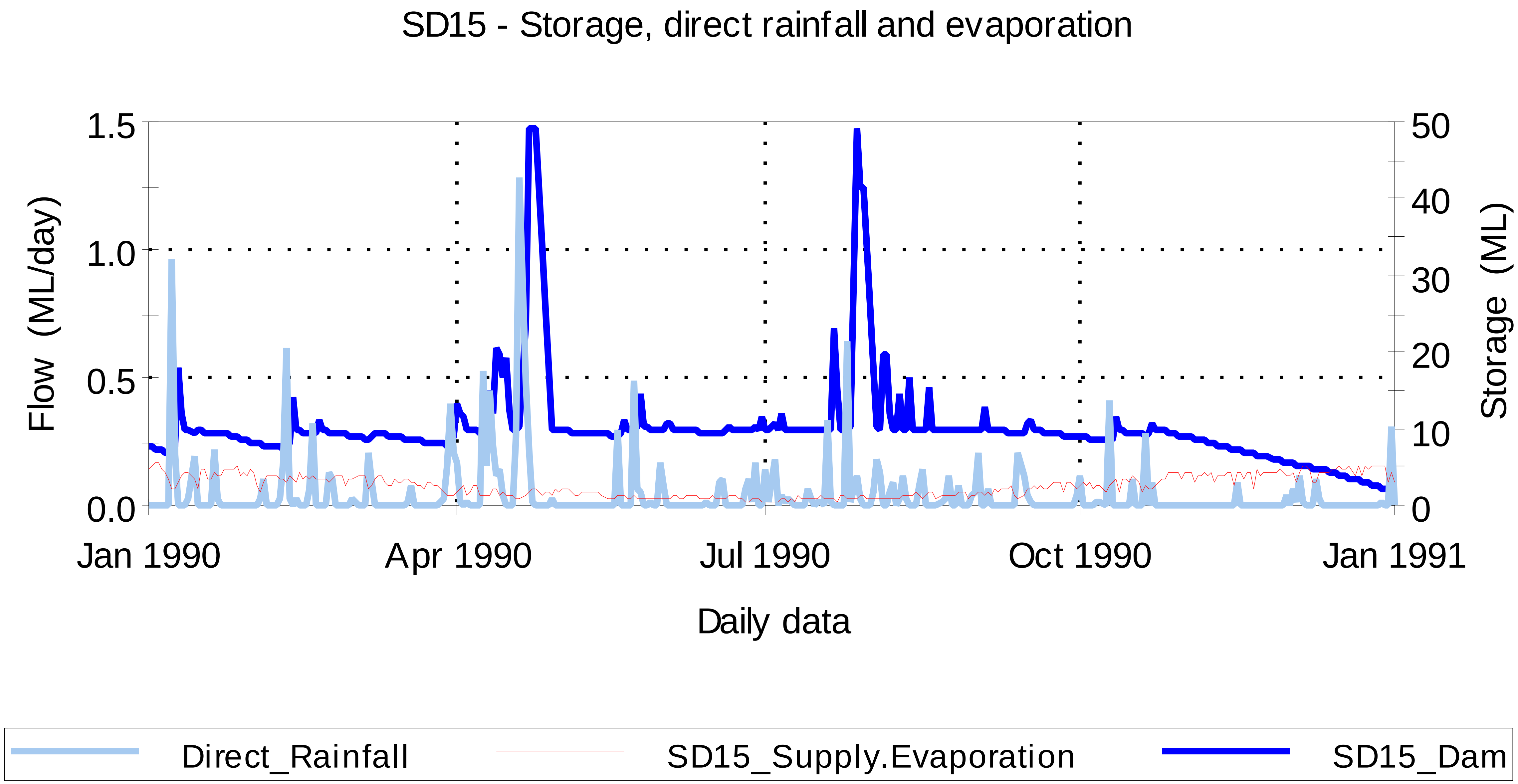

Figure A3.1 – Water balance for SD15 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 1 of 3)

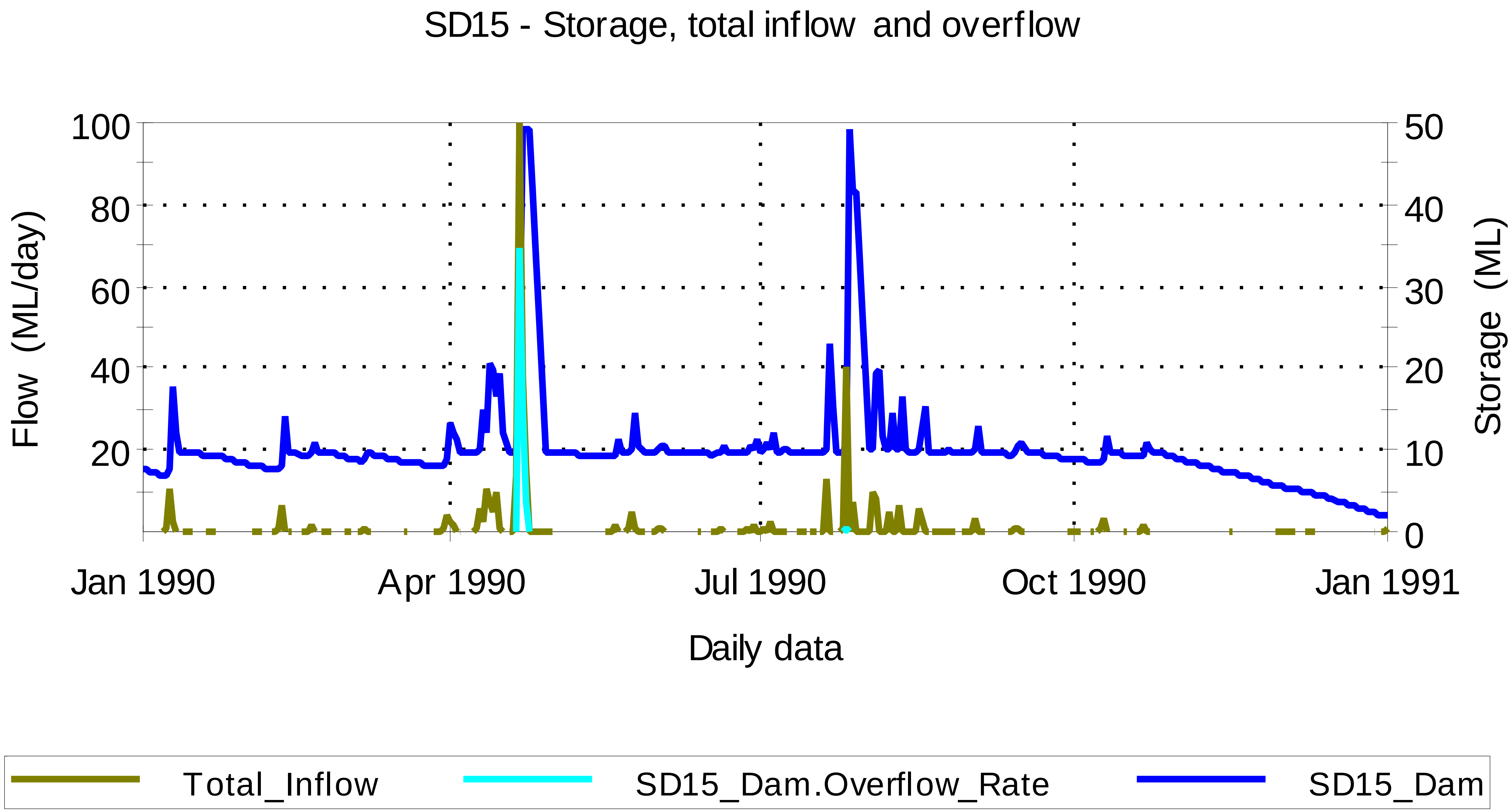

Figure A3.2 – Water balance for SD15 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 2 of 3)

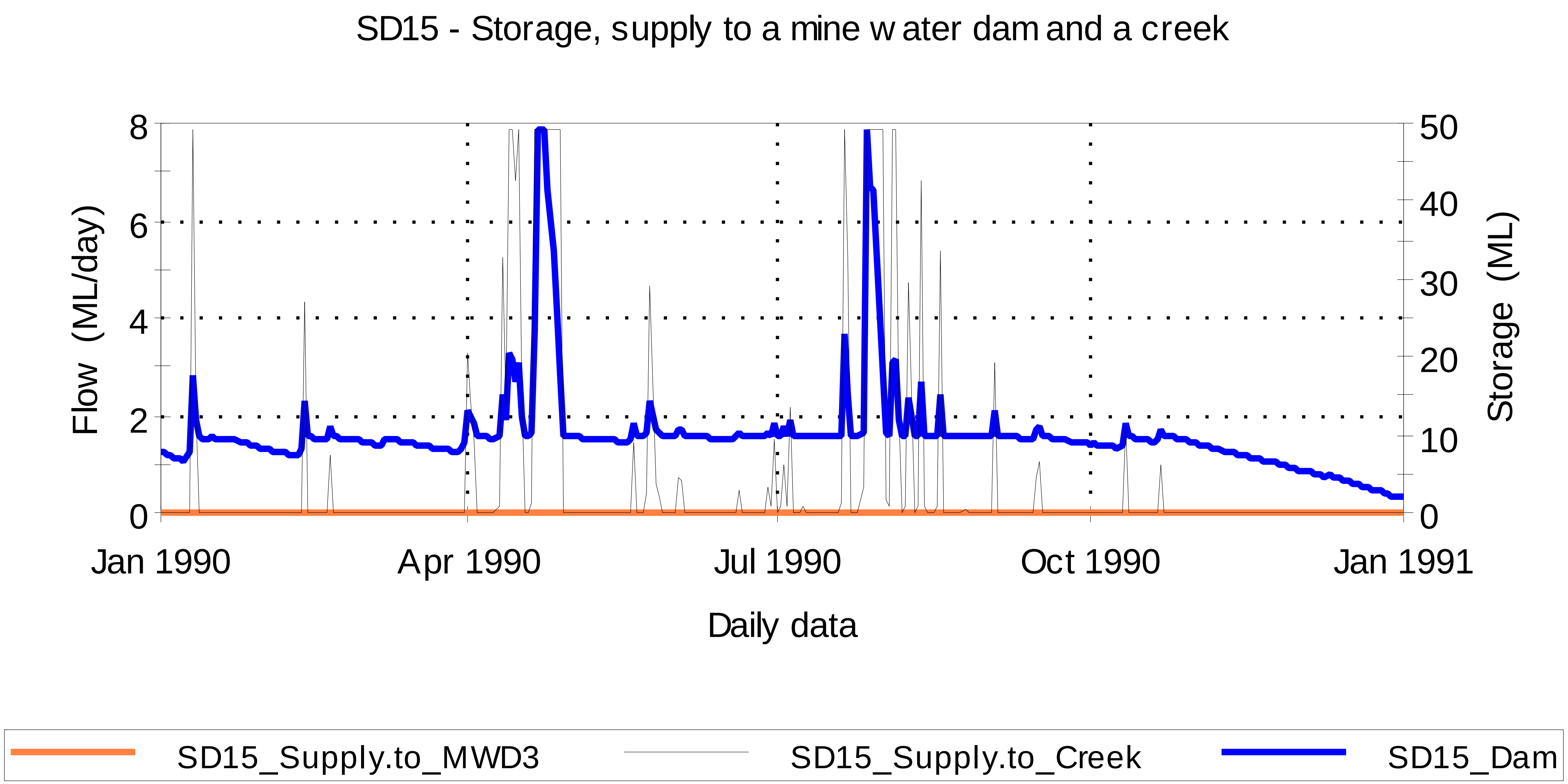

Figure A3.3 – Water balance for SD15 for mine stage year 4 and 90th percentile rainfall (wet) year of 1990 (plot 3 of 3)

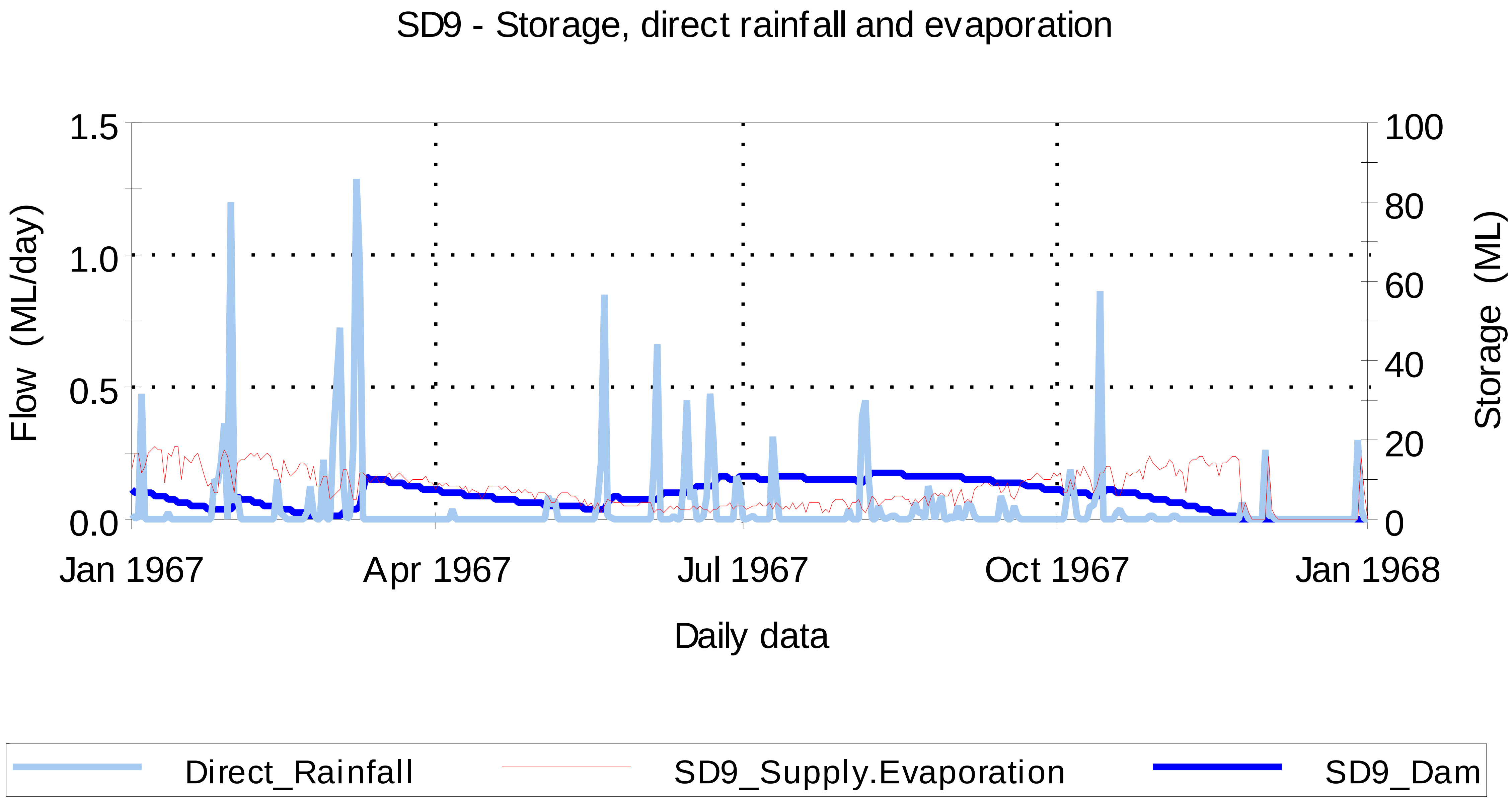

Figure A4.1 – Water balance for SD9 for mine stage year 4 and 10th percentile rainfall (dry) year of 1967 (plot 1 of 3)

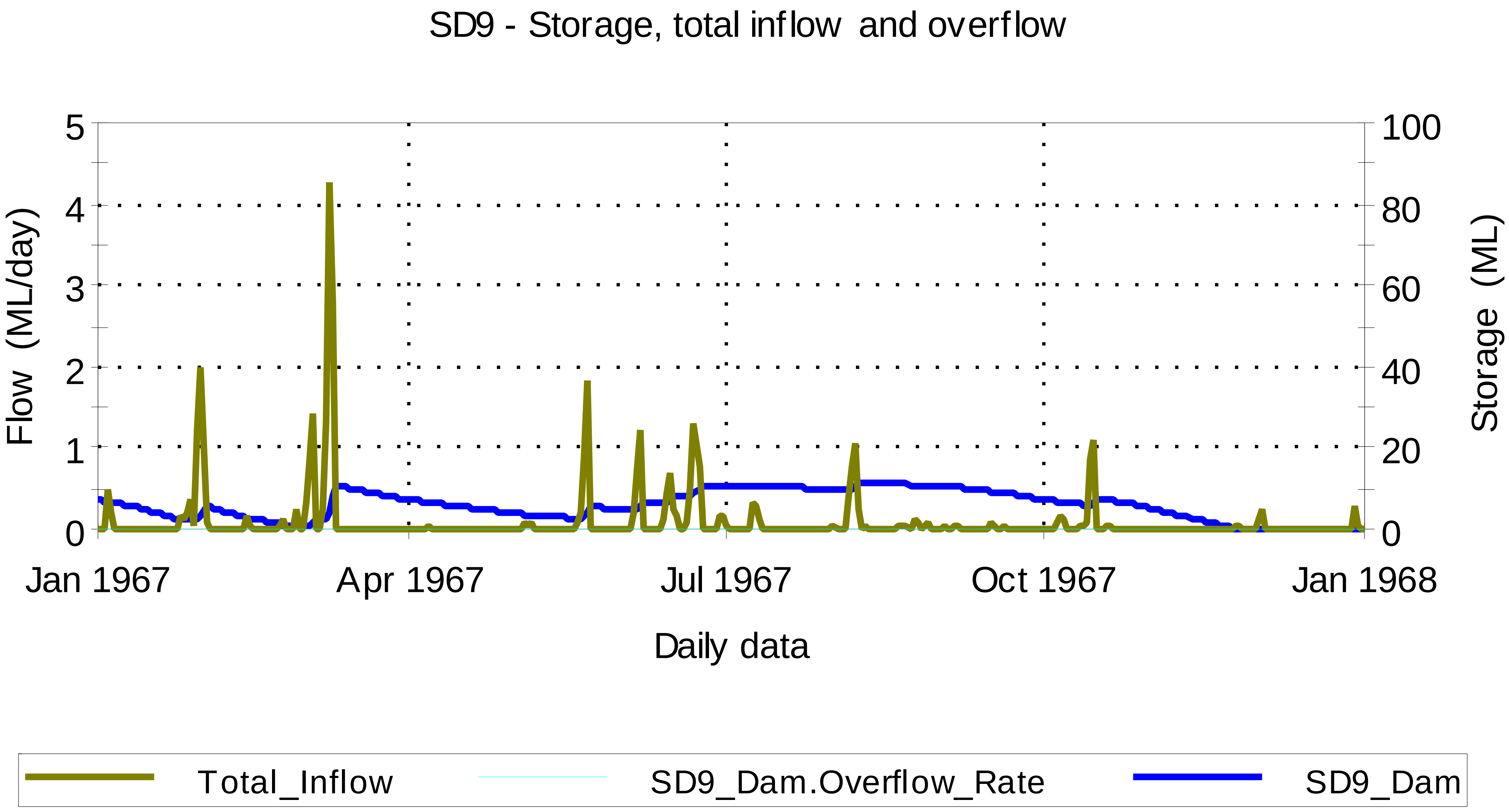

Figure A4.2 – Water balance for SD9 for mine stage year 4 and 10th percentile rainfall (dry) year of 1967 (plot 2 of 3)

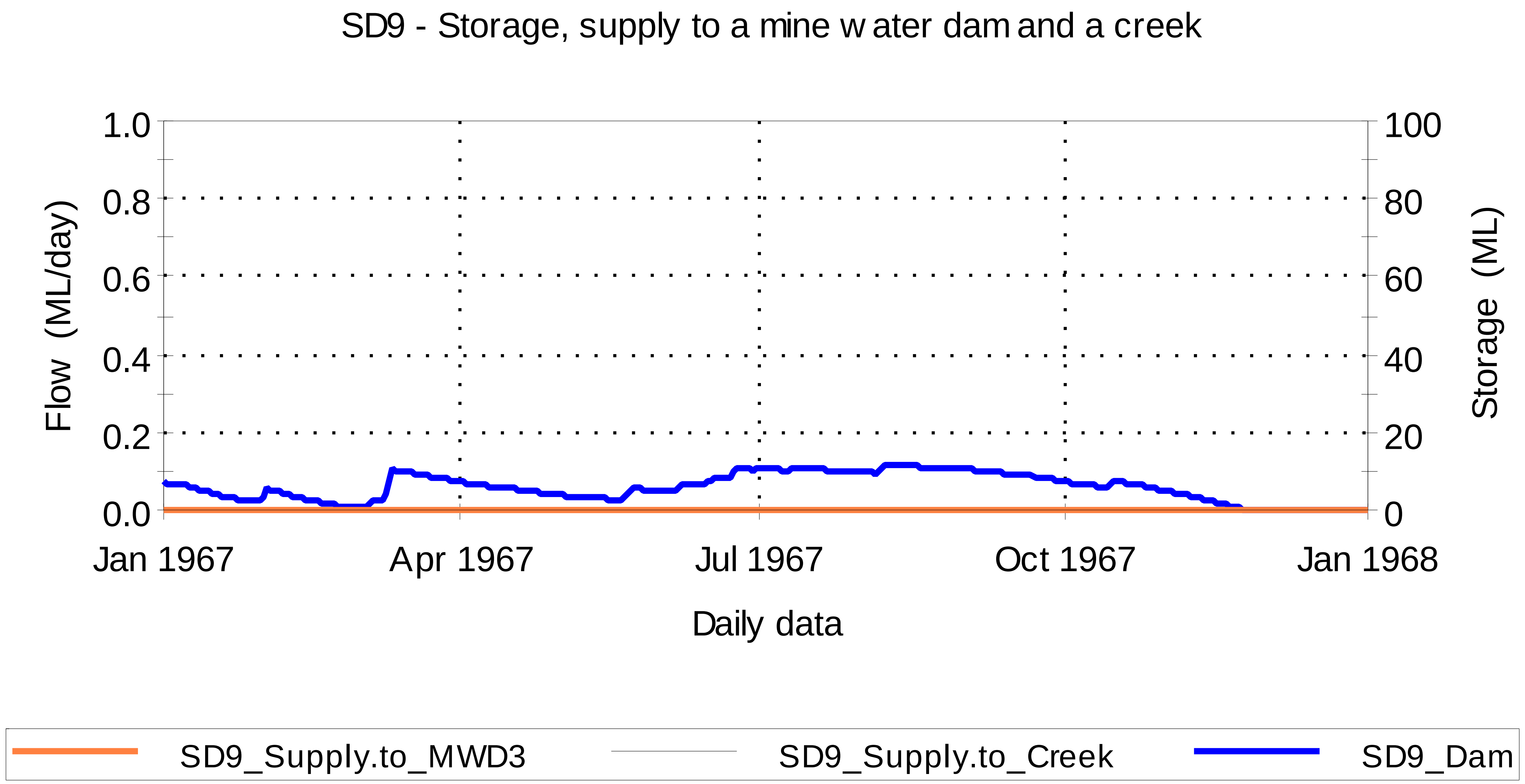

Figure A4.3 – Water balance for SD9 for mine stage year 4 and 10th percentile rainfall (dry) year of 1967 (plot 3 of 3)

APPENDIX B – TIME SERIES PLOTS DEMONSTRATING ANNUAL WATER BALANCE IN STORAGES

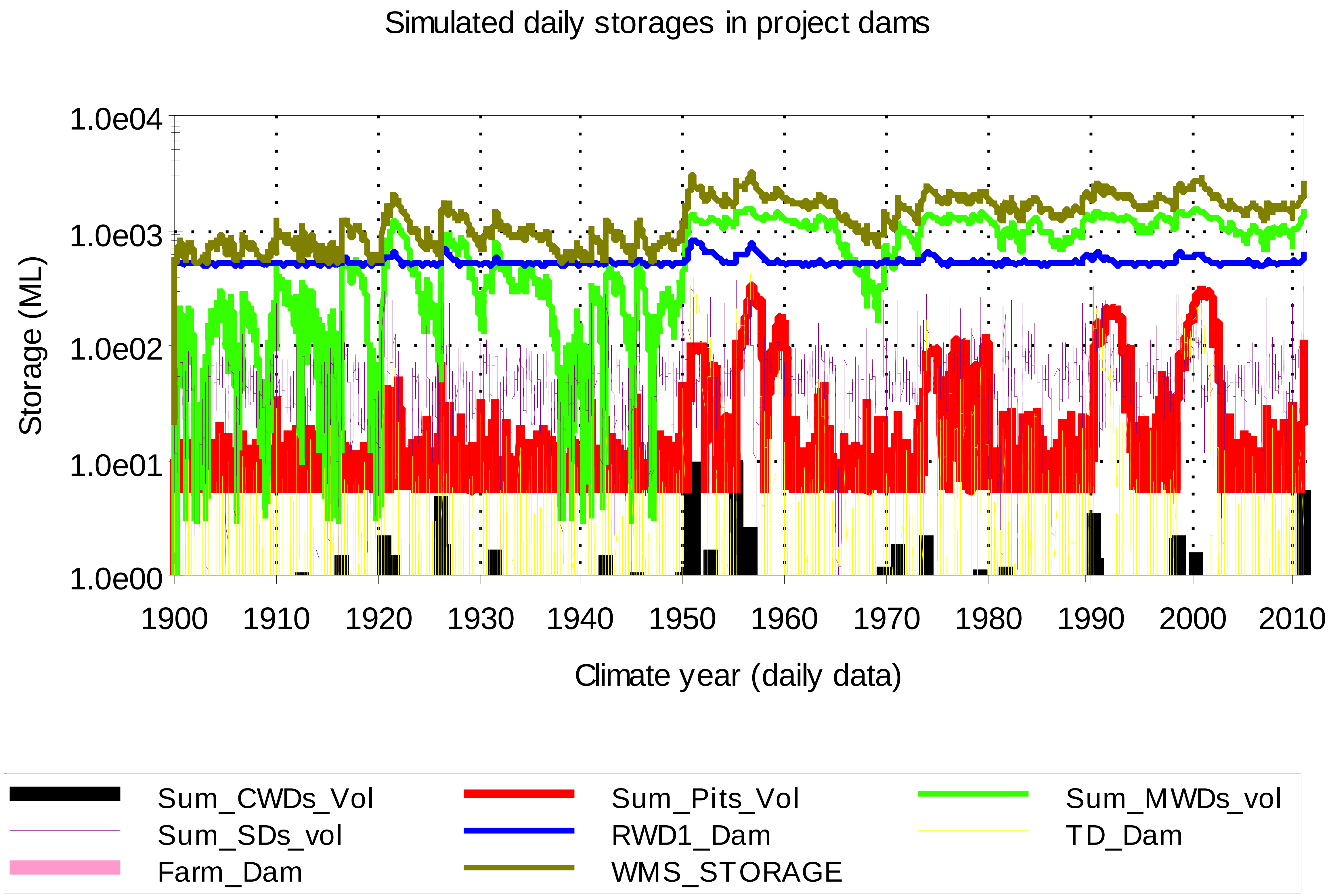

Figure B.1 – Simulated daily storages for all dam types for mine stage year 1

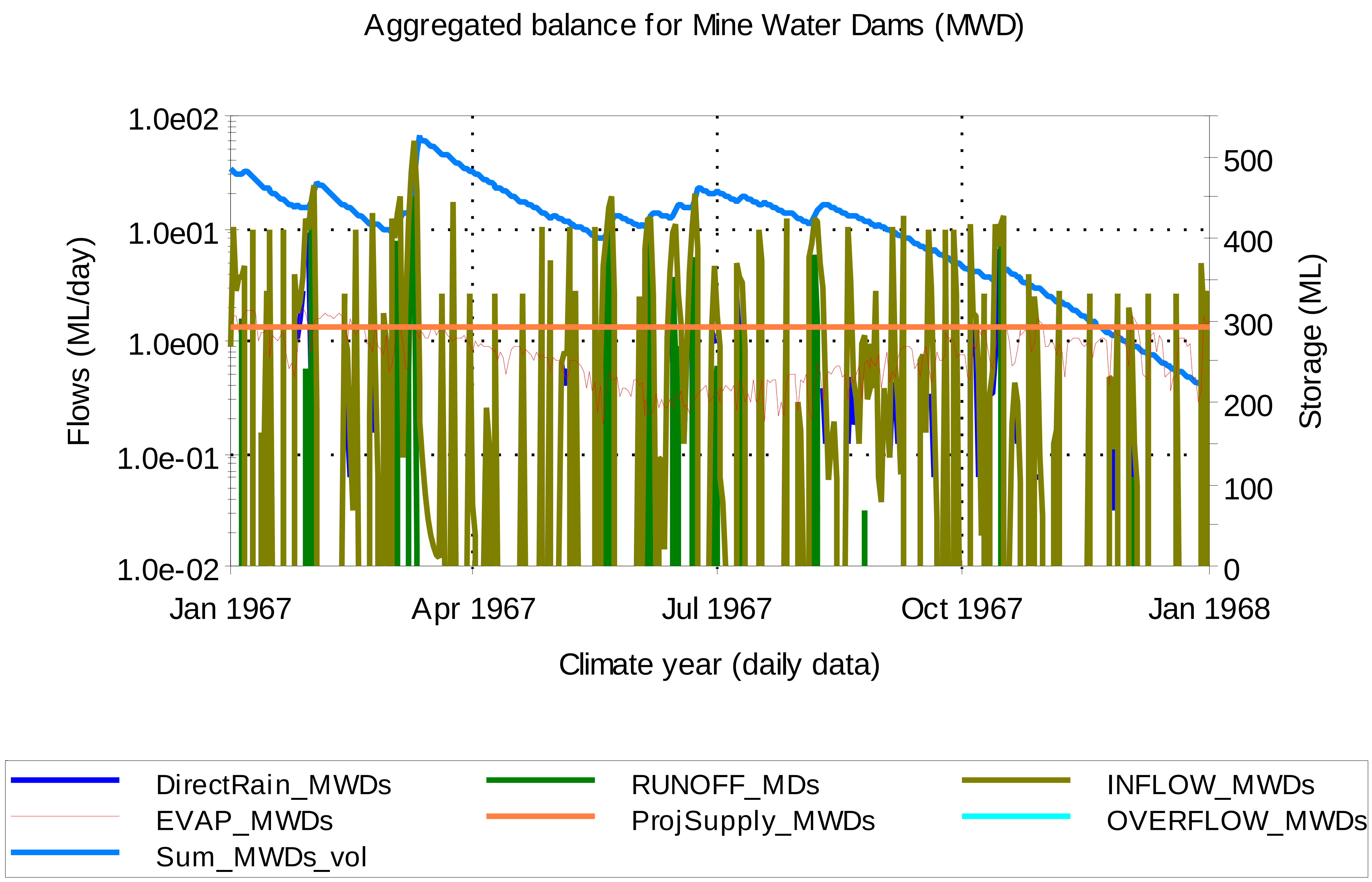

Figure B.2 – Sum of simulated daily storages in all mine water dams for mine stage year 1 and 10th percentile rainfall (dry) year of 1967

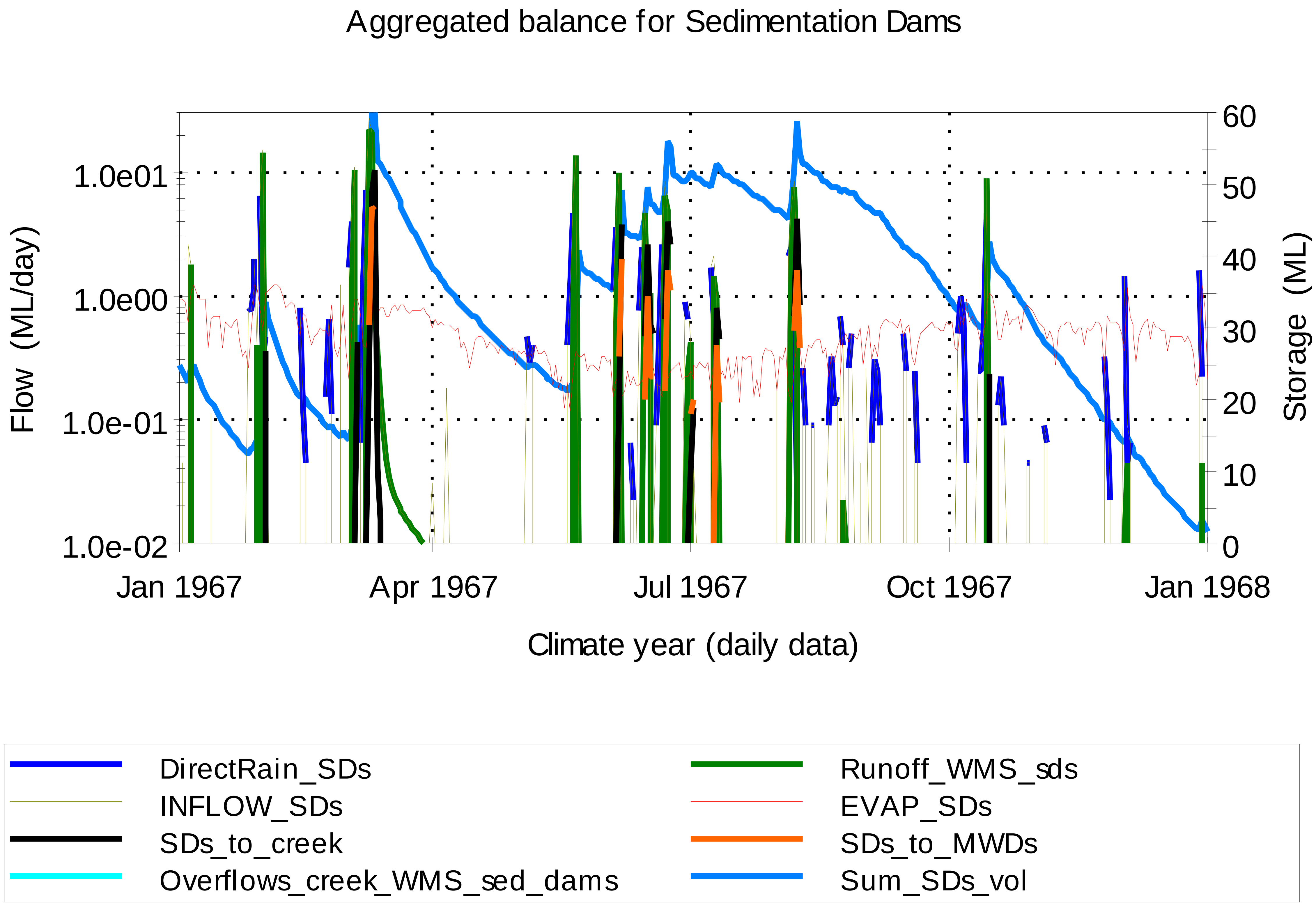

Figure B.3 – Sum of simulated daily storages in all sedimentation dams for mine stage year 1 and 10th percentile rainfall (dry) year of 1967

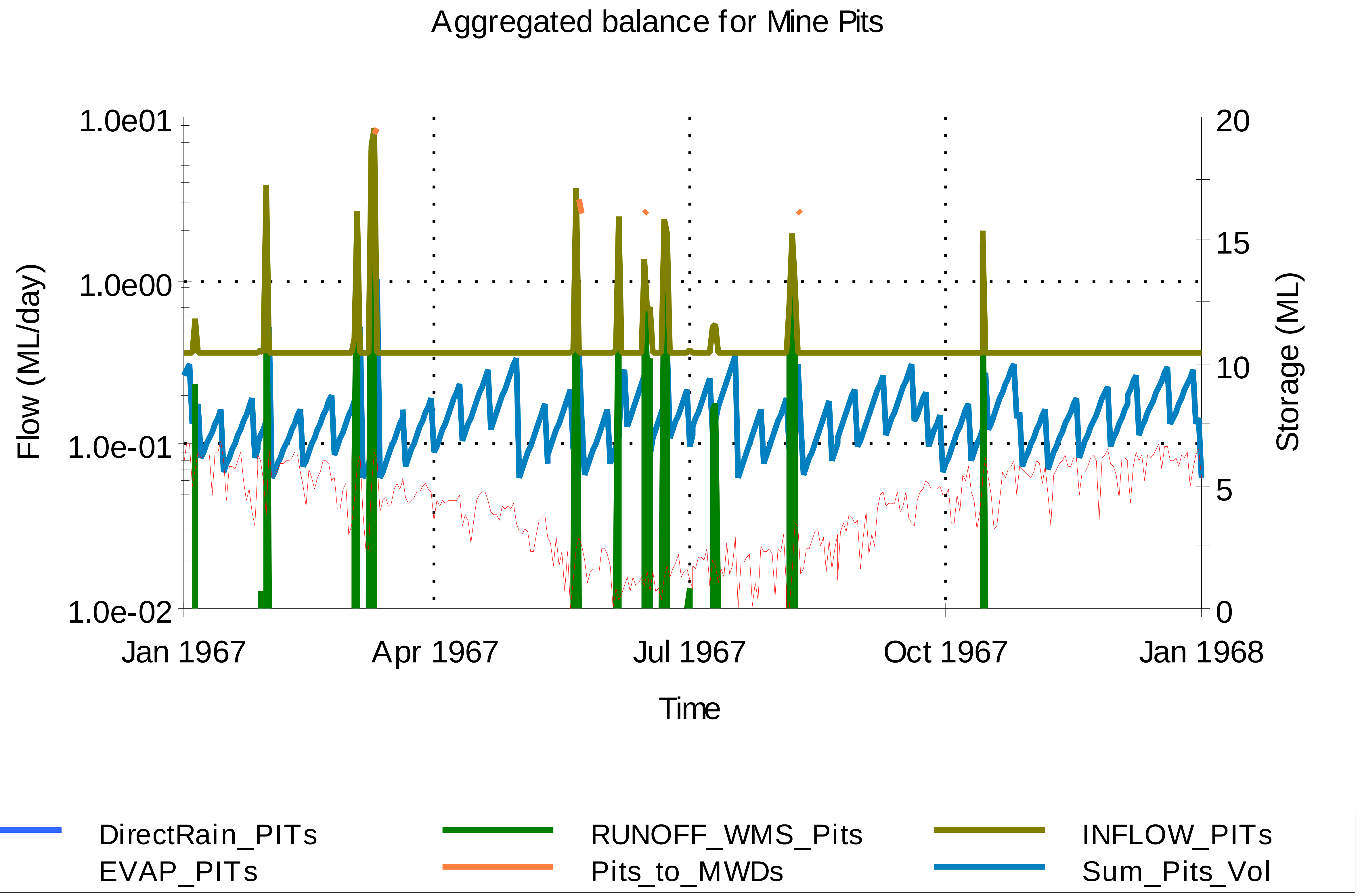

Figure B.4 – Sum of simulated daily storages in all mine pits for mine stage year 1 and 10th percentile rainfall (dry) year of 1967

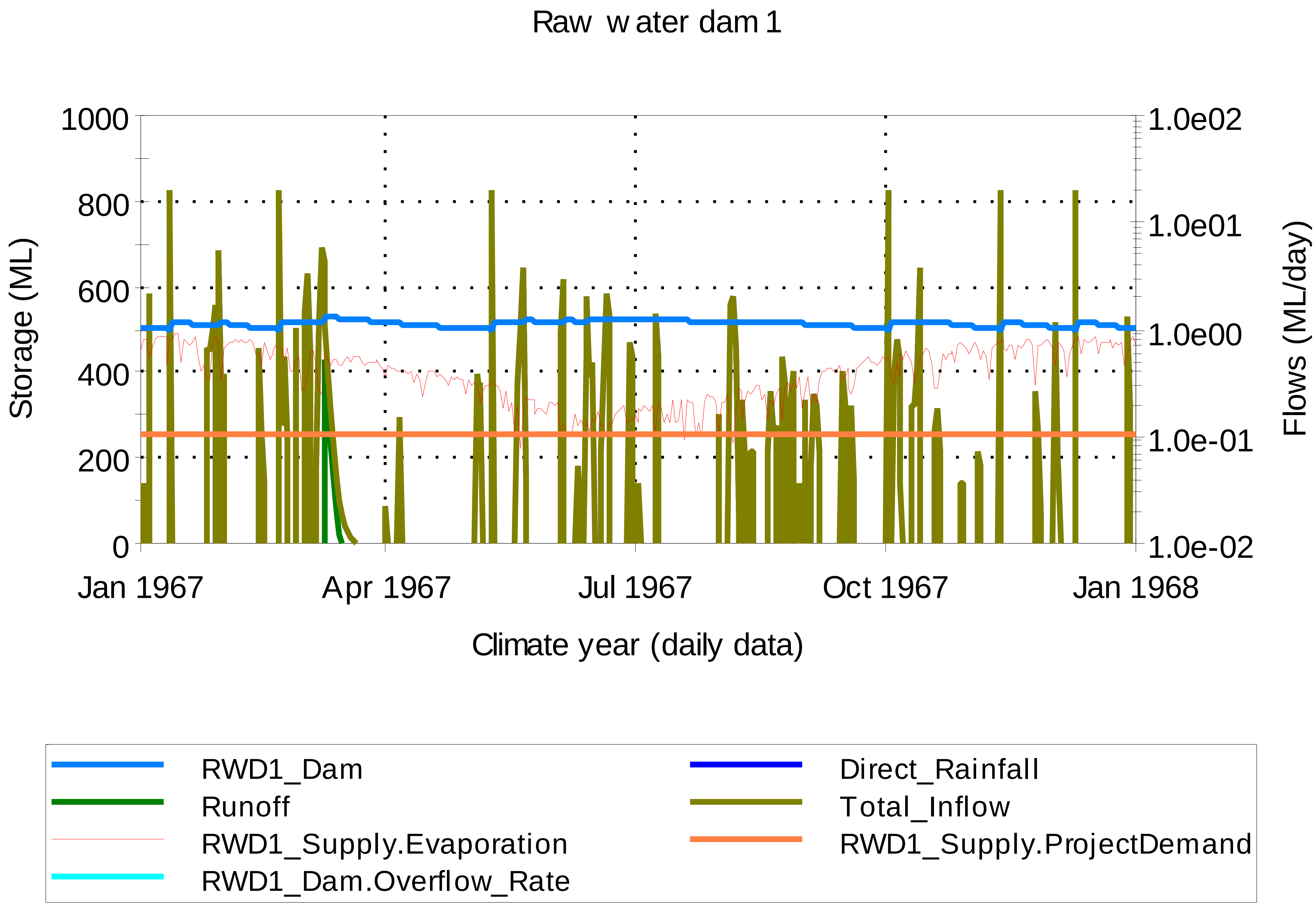

Figure B.5 – Sum of simulated daily storages in the raw water dam RWD1 for mine stage year 1 and 10th percentile rainfall (dry) year of 1967

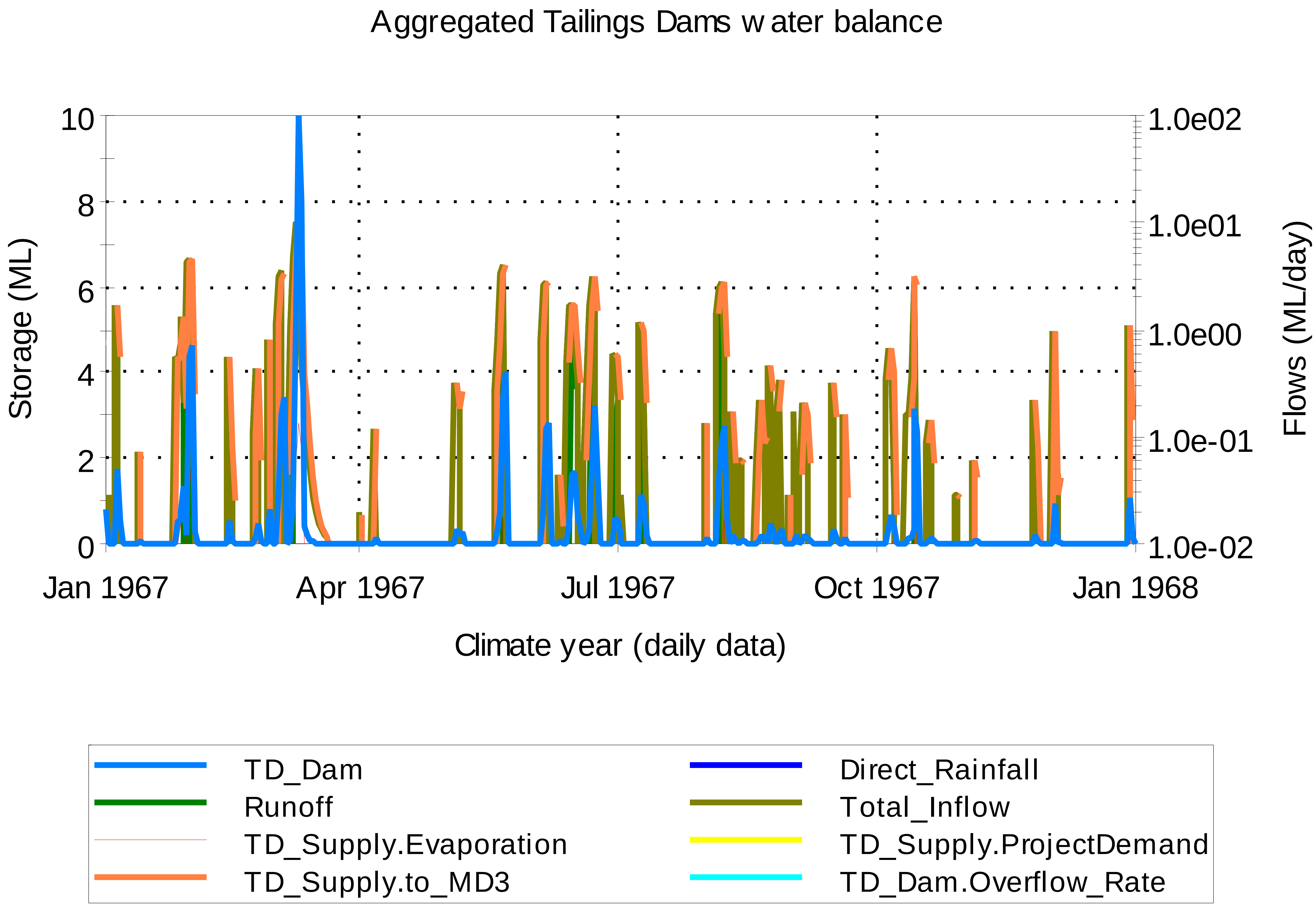

Figure B.6 – Sum of simulated daily storages in all tailings dams for mine stage year 1 and 10th percentile rainfall (dry) year of 1967