

RESOLUTION COPPER WATER BALANCE TAILINGS ALTERNATIVES 2, 3, 4, 5, AND 6

Prepared for: Resolution Copper

Prepared by: WestLand Resources, Inc.

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I. INTRODUCTION

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper (Resolution) to conduct water balance analyses for five tailings storage alternatives to inform Forest Service evaluation of the Resolution Copper Project (the Project) under the National Environmental Policy Act. The U.S. Forest Service has investigated and developed five tailings storage alternatives to the proposed action which is described in the May 2016 General Plan of Operations (GPO; Resolution 2016).

The purpose of this memo is to present results of water balance analysis for each of the five tailings storage alternatives (Alternatives 2 through 6). Project water sources and use are described in detail in section 3.6 of the GPO (Resolution 2016). A large part of the consumptive water use of the Project is associated with the tailings storage facility (TSF) and can vary considerably depending on the tailings facility design, location, and storage methods.

2. METHODS

The water balances compile the various mine water consumptive uses and losses as well as passive water sources such as precipitation, runoff, and dewatering. Water demands will vary throughout the years of mine operation as well as seasonally, due primarily to the water required for the construction of the tailings facility and the increased tailings evaporation rate as the TSF surface area increases. Water demand will also vary during the year, with peak demand occurring during the pre-monsoon summer months, when dust suppression needs and evaporation are greatest. The water balances develop an estimate of the makeup water needed for the life of the mine, split between the start-up, peak production, and ramp-down periods of the mine life; Years 1 through 7, Years 8 through 31 and Years 32 through 41, respectively. Note that there are no changes to assumptions regarding consumptive water use for the Project outside of the tailings facility. As such, for each tailings alternative, Project water use outside of the tailings facility is unchanged from that described for the proposed action (Resolution 2016).

Data Sources

Data sources for the analyses included the following:

- General Plan of Operations (Resolution 2016);
- Resolution Copper Project DEIS Design for Alternative 3A – Near West Modified Proposed Action (Modified Centerline Embankment - “wet”) (Klohn 2018a);
- Resolution Copper Project DEIS Design for Alternative 3B – Near West Modified Proposed Action (High-density thickened NPAG Scavenger and Segregated PAG Pyrite Cell) (Klohn 2018b);
- Resolution Copper Project DEIS Design for Alternative 4 – Silver King Filtered (Klohn 2018c);

- Draft EIS Design Peg Leg Site Alternative 5 (Golder 2018);
- Resolution Copper Project DEIS Design for Alternative 6 – Skunk Camp (Klohn 2018d);
- Resolution Copper estimates of concentrator evaporation, refrigerant evaporation, and shaft vent loss; and
- WSP Global, Inc. mine groundwater inflow estimates.

Model Structure

Each of the alternatives differ in water balance values. WestLand prepared a model based on the laws of conservation of mass where the flow into the system equals the flow out plus the change in storage volume over time:

$$Q_{in} = Q_{out} + \frac{\partial V}{\partial t}$$

The time step used for this analysis is annual. See the Figure for each respective alternative described in **Sections 3.1. through 3.5** for the layout of the model (**Figures 1 through 15**). The overall model has system gains. (e.g., Inflows and Groundwater) and system losses (e.g., Lost Water), which are shown on the figure as blue arrows and red arrows, respectively. This represents water entering the system from outside or leaving the system entirely. The orange, purple, and green arrows indicate water circulating within the system between nodes.

The system was modeled as seven nodes, with each facility being separately balanced with its inflows and outflows:

- TSF Ponds/Collection Ponds
- TSF, Ponds, and Cyclones/TSF, Filter Plant, and Ponds
- West Plant Site
- East Plant Site
- 3 MG Storage
- Filter Plant
- Recovery Wells and CAP Canal

The components of each node vary slightly between alternatives due to differences in TSF design. For all nodes except the TSF Ponds/Collection Ponds, inflows and outflows were balanced such that there were no changes in storage at those nodes. The TSF Ponds/Collection Ponds is the only node within this model where water accumulates or diminishes over the course of a year. Each alternative treats entrainment at the TSF as a loss rather than storage.

Five TSF site location alternatives are being proposed for the Project:

- Alternative 2 – Modified Proposed Action “Wet”
- Alternative 3 – Modified Proposed Action “Dry”
- Alternative 4 – Silver King Filtered
- Alternative 5 – Peg Leg
- Alternative 6 – Skunk Camp

Alternative 1 is the *No Action Alternative* described in detail in the GPO (Resolution 2016) and will not be discussed further in this report; the remaining five alternatives are discussed in the following Section 3.

3. RESULTS

3.1. ALTERNATIVE 2 – MODIFIED PROPOSED ACTION “WET”

Alternative 2 would be at the Near West site which is located within the Superior Basin within Forest system lands, approximately 3 miles west of Superior and 3 miles east of Queen Valley, Pinal County, Arizona. The site would occupy the area of land bounded by Potts Canyon to the east, Roblas Canyon to the west, and Queen Creek to the south. The East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain the same as described in the GPO (Resolution 2016). **Figures 1 through 3** show the process water supply and balance for Alternative 2 for years 1 through 7, 8 through 31, and 32 through 41, respectively. Consumptive water use for years 1 through 7 averages to 8,932 acre-feet/year; for years 8 through 31 averages to 19,926 acre-feet/year; and for years 32 through 41 averages to 4,576 acre-feet/year. Total water use over the life of the mine for this alternative is 587,000 acre-feet (**Table 1**).

Table 1. Alternative 2 Summary

Description (years 1-41)	Volume (ac-ft)
Total amount makeup water need over mine life	587,000
Total amount dewatering over mine life	160,000
Max. annual dewatering amount	7,400

3.2. ALTERNATIVE 3 – MODIFIED PROPOSED ACTION “DRY”

Alternative 3 would be located at the Near West site, identical to Alternative 2. The East Plant Site infrastructure, panel cave mining, West Plant Site ore processing, slurry copper concentrate delivery to the filter plant, and other utility corridors would remain the same as described in the GPO (Resolution 2016). **Figures 4 through 6** show the process water supply and balance for Alternative 3

for years 1 through 7, 8 through 31, and 32 through 41, respectively. Consumptive water use for years 1 through 7 averages to 7,178 acre-feet/year; for years 8 through 31 averages to 16,245 acre-feet/year; and for years 32 through 41 averages to 5,416 acre-feet/year. Total water use over the life of the mine for this alternative is 494,000 acre-feet (**Table 2**).

Table 2. Alternative 3 Summary

Description (years 1-41)	Volume (ac-ft)
Total amount makeup water need over mine life	494,000
Total amount dewatering over mine life	160,000
Max. annual dewatering amount	7,000

3.3. ALTERNATIVE 4 – SILVER KING FILTERED

Alternative 4 would be located at the Silver King site which is located within the Superior Basin within Forest system lands, approximately 1.5 miles north of Superior, Pinal County, Arizona. The site would occupy the upper end of Silver King Canyon in the Silver King and Happy Camp Washes, and the middle portion of Whitford and Potts Canyons. **Figures 7 through 9** show the process water supply and balance for Alternative 4 for years 1 through 7, 8 through 31, and 32 through 41, respectively. Consumptive water use for years 1 through 7 averages to 2,184 acre-feet/year; for years 8 through 31 averages to 5,918 acre-feet/year; and for years 32 through 41 averages to 1,848 acre-feet/year. Total water use over the life of the mine for this alternative is 176,000 acre-feet (**Table 3**).

Table 3. Alternative 4 Summary

Description (years 1-41)	Volume (ac-ft)
Total amount makeup water need over mine life	176,000
Total amount dewatering over mine life	160,000
Max. annual dewatering amount	7,000

3.4. ALTERNATIVE 5 – PEG LEG

Alternative 5 would be located at the Peg Leg site which is located within the Gila River watershed on a combination of Bureau of Land Management and Arizona State Land Department lands, approximately 18 miles south of Superior and 15 miles east of Florence, Pinal County, Arizona. **Figures 10 through 12** show the process water supply and balance for Alternative 5 for years 1 through 7, 8 through 31, and 32 through 41, respectively. Consumptive water use for years 1 through 7 averages to 7,416 acre-feet/year; for years 8 through 31 averages to 17,244 acre-feet/year; and for years 32 through 41 averages to 7,901 acre-feet/year. Total water use over the life of the mine for this alternative is 545,000 acre-feet (**Table 4**).

Table 4. Alternative 5 Summary

Description (years 1-41)	Volume (ac-ft)
Total amount makeup water need over mine life	545,000
Total amount dewatering over mine life	160,000
Max. annual dewatering amount	7,000

3.5. ALTERNATIVE 6 – SKUNK CAMP

Alternative 6 would be located at the Dripping Springs Wash Basin which is located approximately 13 miles upstream of its confluence with the Gila River. Land consists of State Trust Lands and private parcels. The Dripping Springs Mountains define the western boundary of the site and the Pinal and Mescal Mountains define the eastern boundary. **Figures 13 through 15** show the process water supply and balance for Alternative 6 for years 1 through 7, 8 through 31, and 32 through 41, respectively. Consumptive water use for years 1 through 7 averages to 5,578 acre-feet/year; for years 8 through 31 to averages 17,948 acre-feet/year; and for years 32 through 41 averages to 7,506 acre-feet/year. Total water use over the life of the mine for this alternative is 545,000 acre-feet (**Table 5**).

Table 5. Alternative 6 Summary

Description (years 1-41)	Volume (ac-ft)
Total amount makeup water need over mine life	545,000
Total amount dewatering over mine life	160,000
Max. annual dewatering amount	7,000

4. DISCUSSION OF COMPARATIVE WATER USE

The water balance analyses show that there is wide variation in the amount of makeup water needed between tailings alternatives (**Table 6**). Total makeup water required for the life of the Project ranges from a low of 176,000 acre-feet for Alternative 4 to a high of 587,000 acre-feet for Alternative 2. Makeup water requirements for Alternatives 3, 5, and 6 are all similar ranging from 494,000 to 545,000 acre-feet. All Alternatives have equal total amounts of dewatering over the mine life, roughly 160,000 acre-feet. Passive water sources such as precipitation and runoff differ between alternatives.

Table 6. Alternatives 2 through 6 Makeup Summary

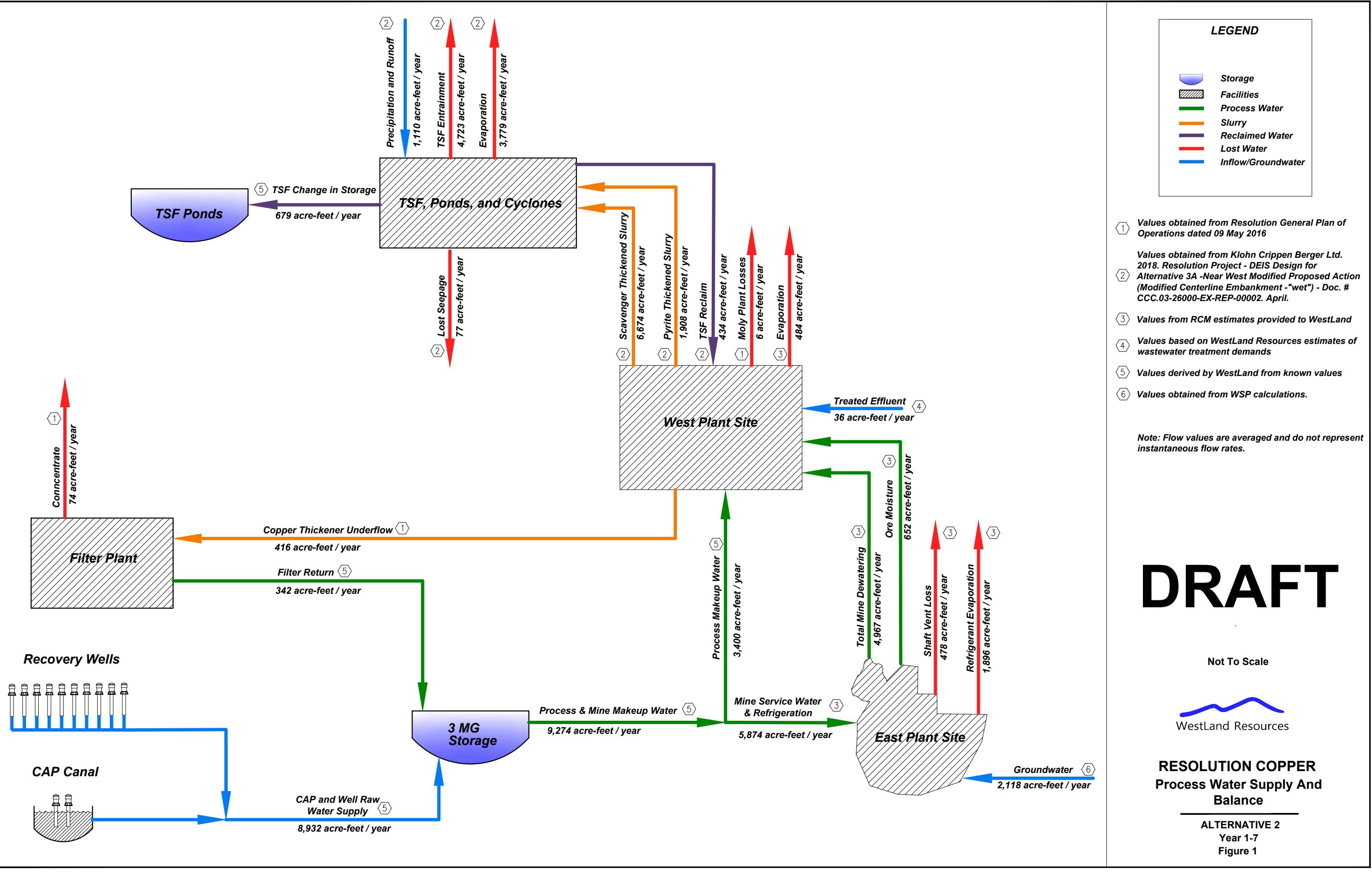
Alternative	Total Makeup Water Required (ac-ft)
Alternative 2 – Modified Proposed Action	587,000
Alternative 3 – Modified Proposed Action, Thin Lift/Pag Cell	494,000
Alternative 4 – Silver King Filtered	176,000
Alternative 5 – Peg Leg	545,000
Alternative 6 – Skunk Camp	545,000

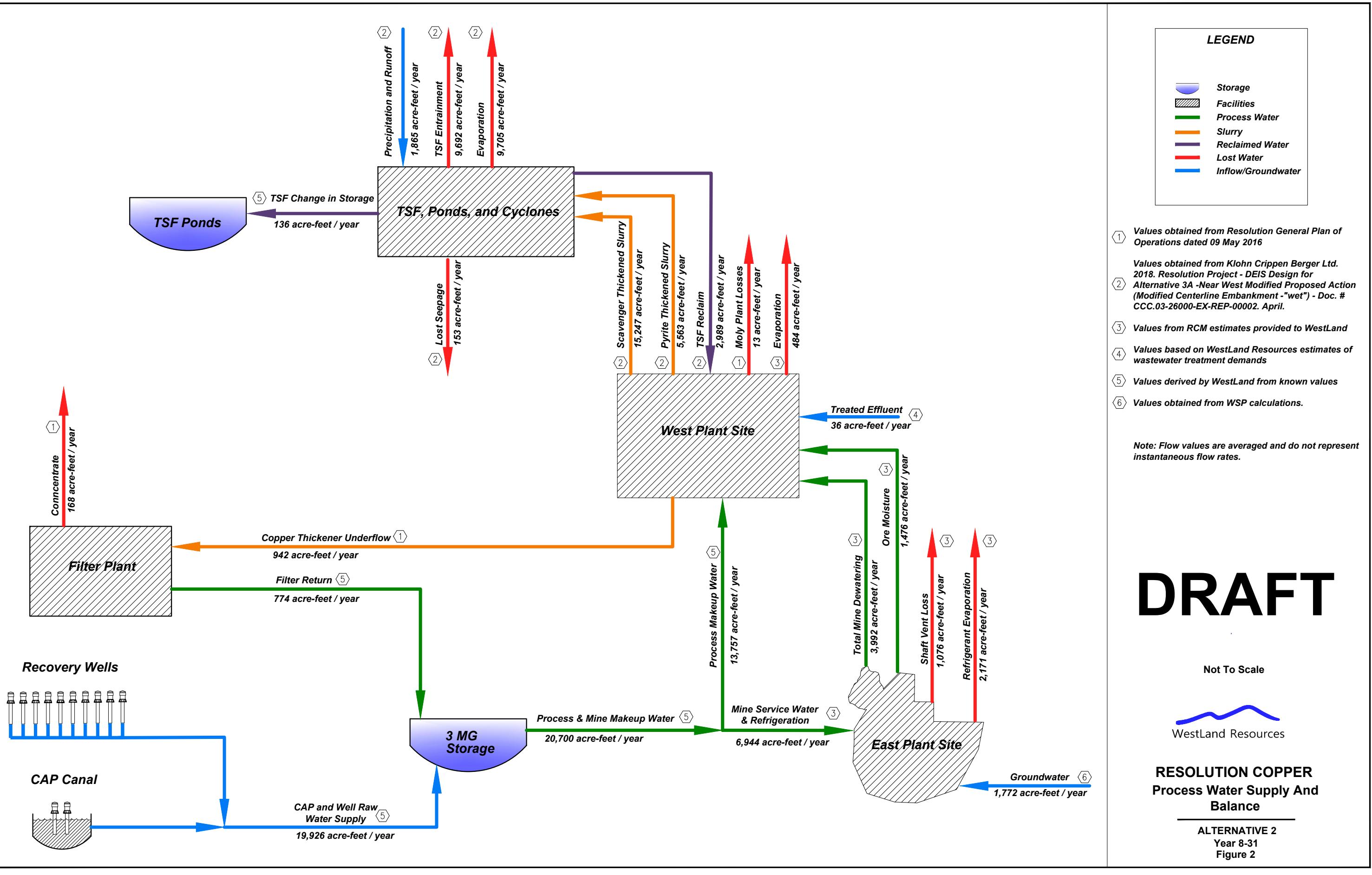
5. REFERENCES

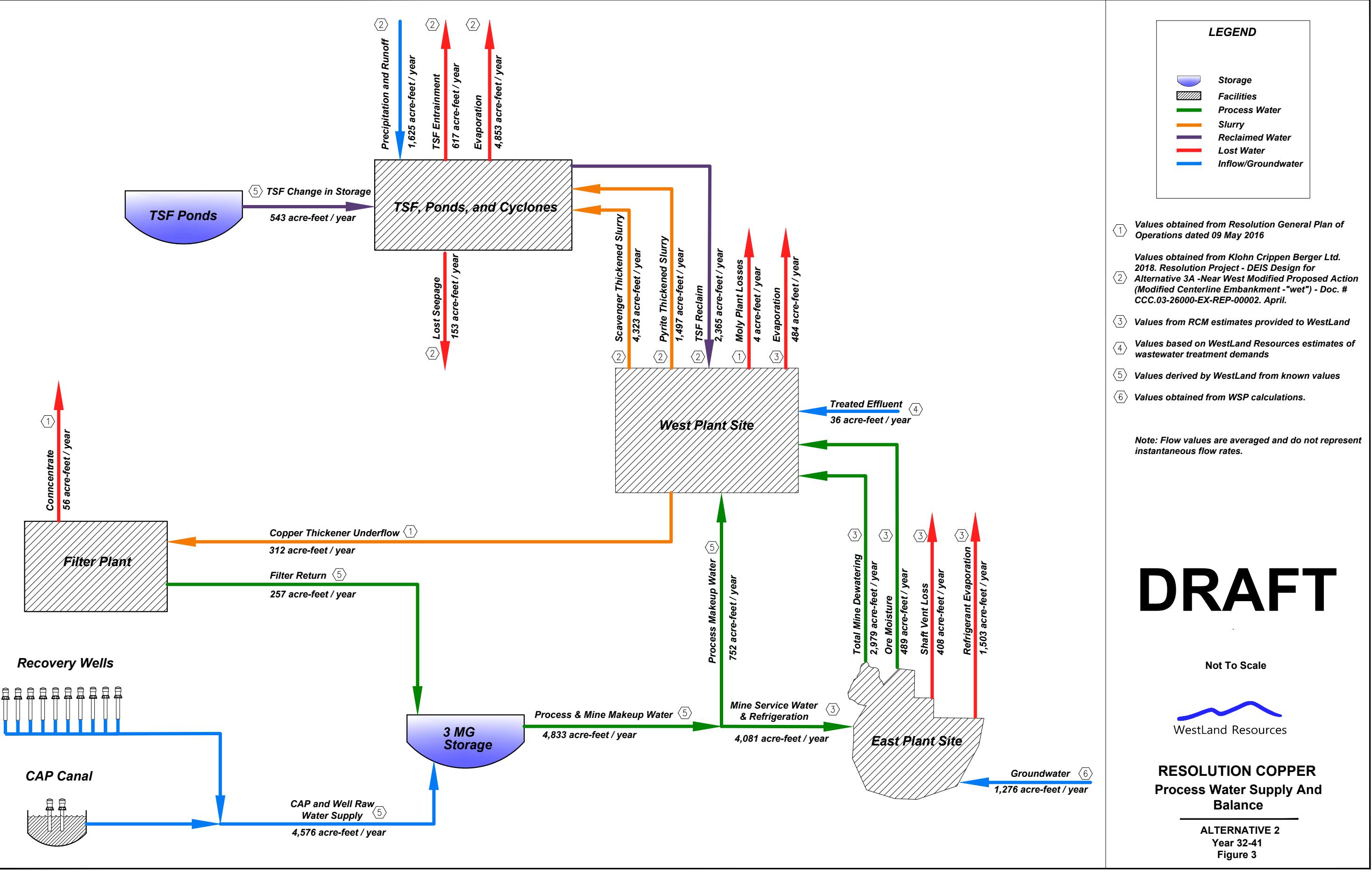
- Golder Associates, Inc. (Golder) 2018. Draft EIS Design Peg Leg Site Alternative 5. *Prepared for Resolution Copper Mining LLC.* June 20, 2018.
- Klohn Crippen Berger, Ltd. (Klohn) 2018a. Resolution Copper Project DEIS Design for Alternative 3A – Near West Modified Proposed Action; Modified Centerline Embankment - “wet”; Doc. # CCC.03-2600-EX-REP-00002. April 2018.
- _____. 2018b. Resolution Copper Project DEIS Design for Alternative 3B – Near West Modified Proposed Action; High-density Thickened NPAG Scavenger and Segregated PAG Pyrite Cell; Doc. # CCC.03-26000-EX-REP-00005. April 2018.
- _____. 2018c. Resolution Copper Project DEIS Design for Alternative 4 – Silver King Filtered; Doc. # CCC.03-26000-EX-REP-00006. April 2018.
- _____. 2018d. Resolution Copper Project DEIS Design for Alternative 6 – Skunk Camp; Doc. # CCC.03-81600-EX-MMO-00006-Rev. 1. August 2018

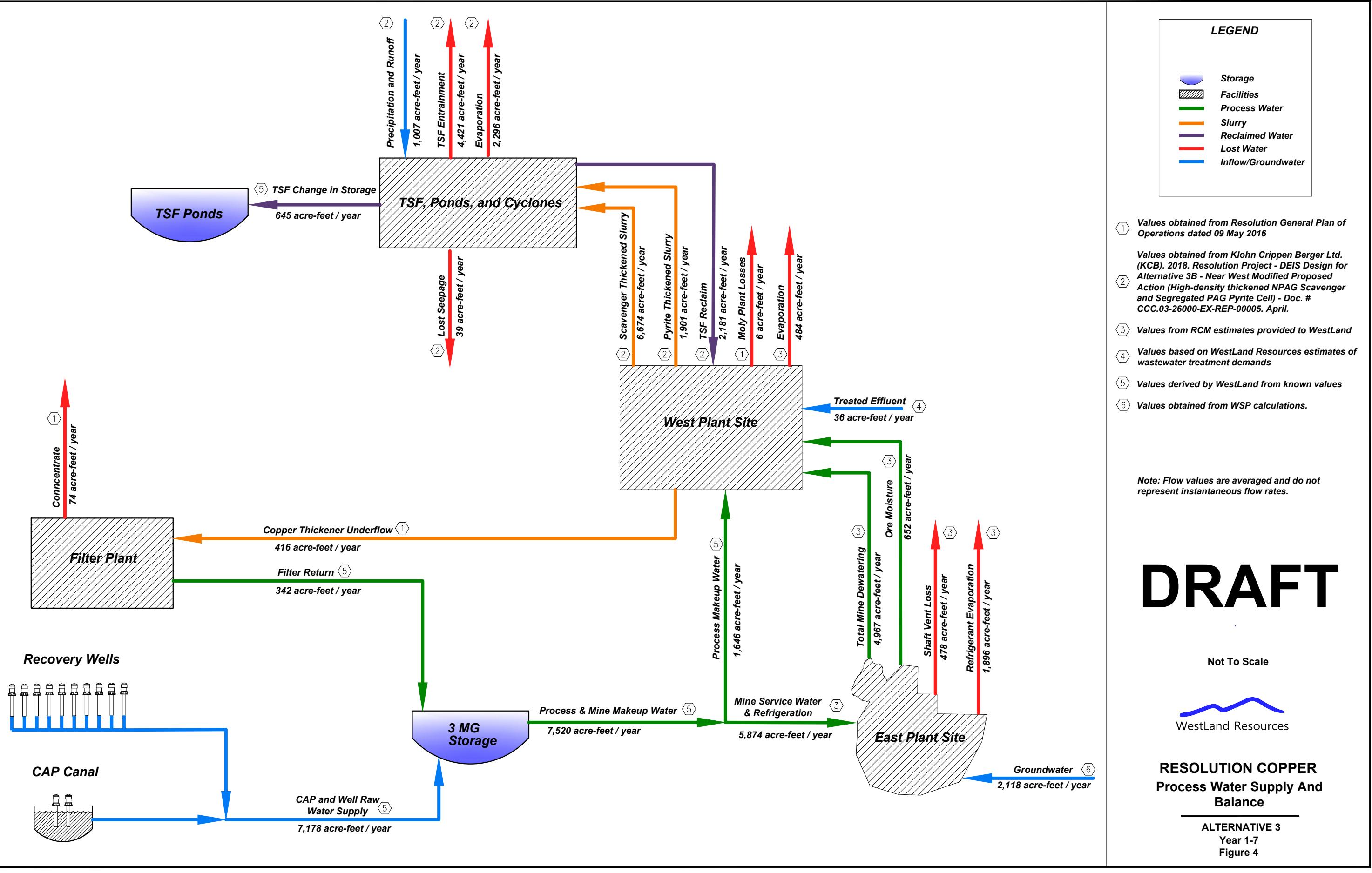
Resolution Copper Mining. 2016. General Plan of Operations, Resolution Copper Mining. Initial Submittal November 15, 2013. Revised May 9, 2016. Available at <http://www.resolutionmineeis.us>.

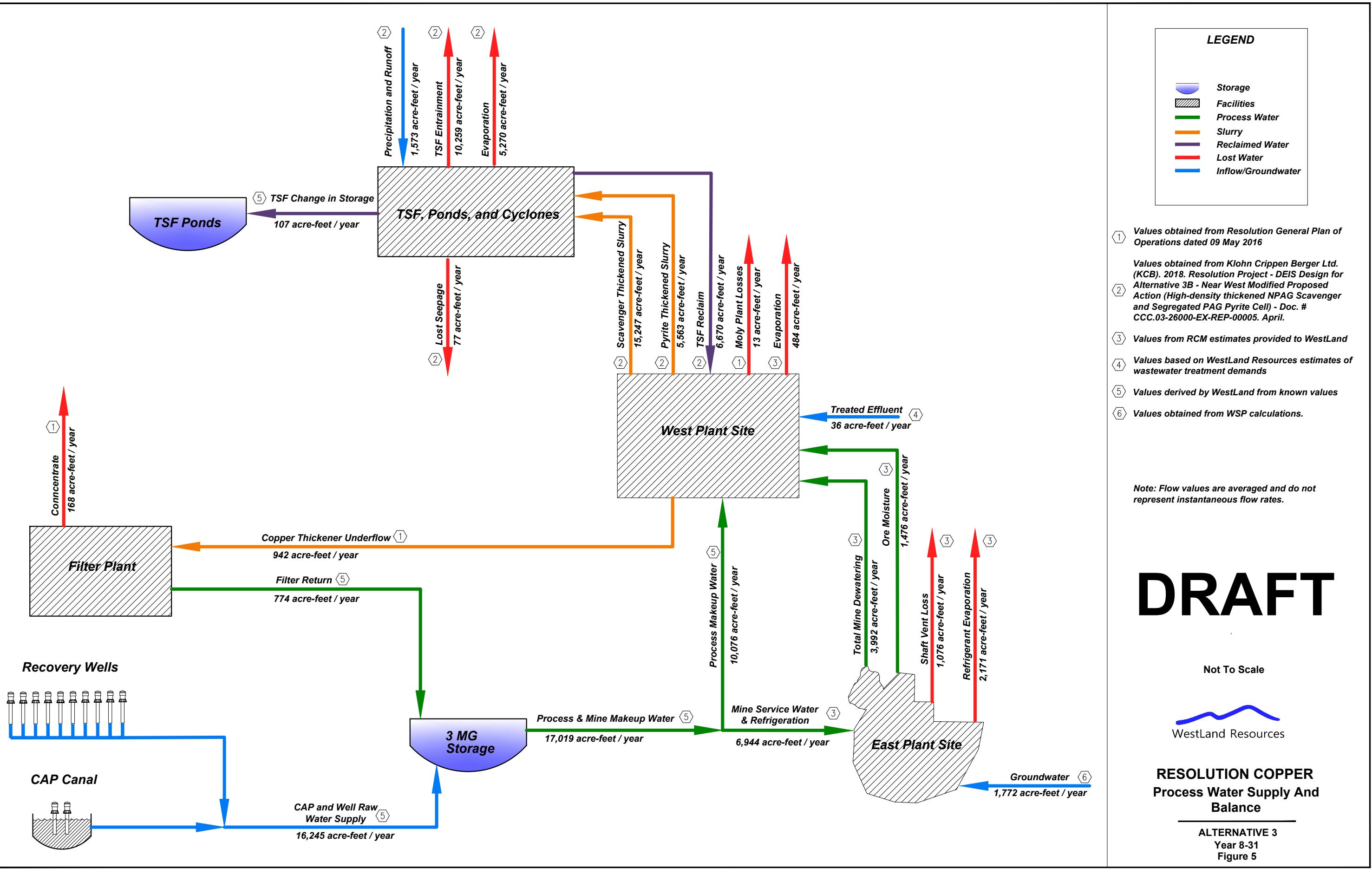
FIGURES

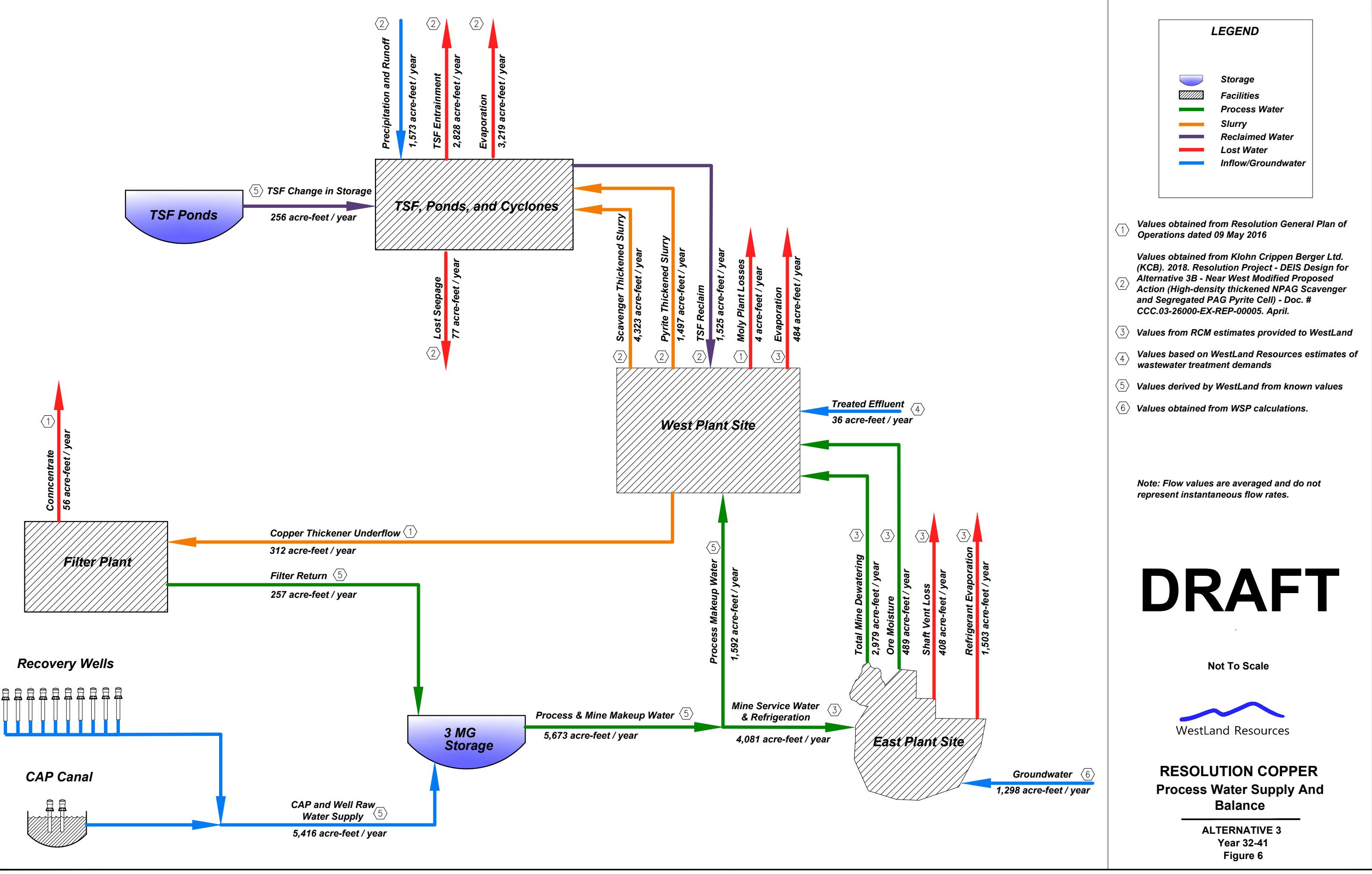


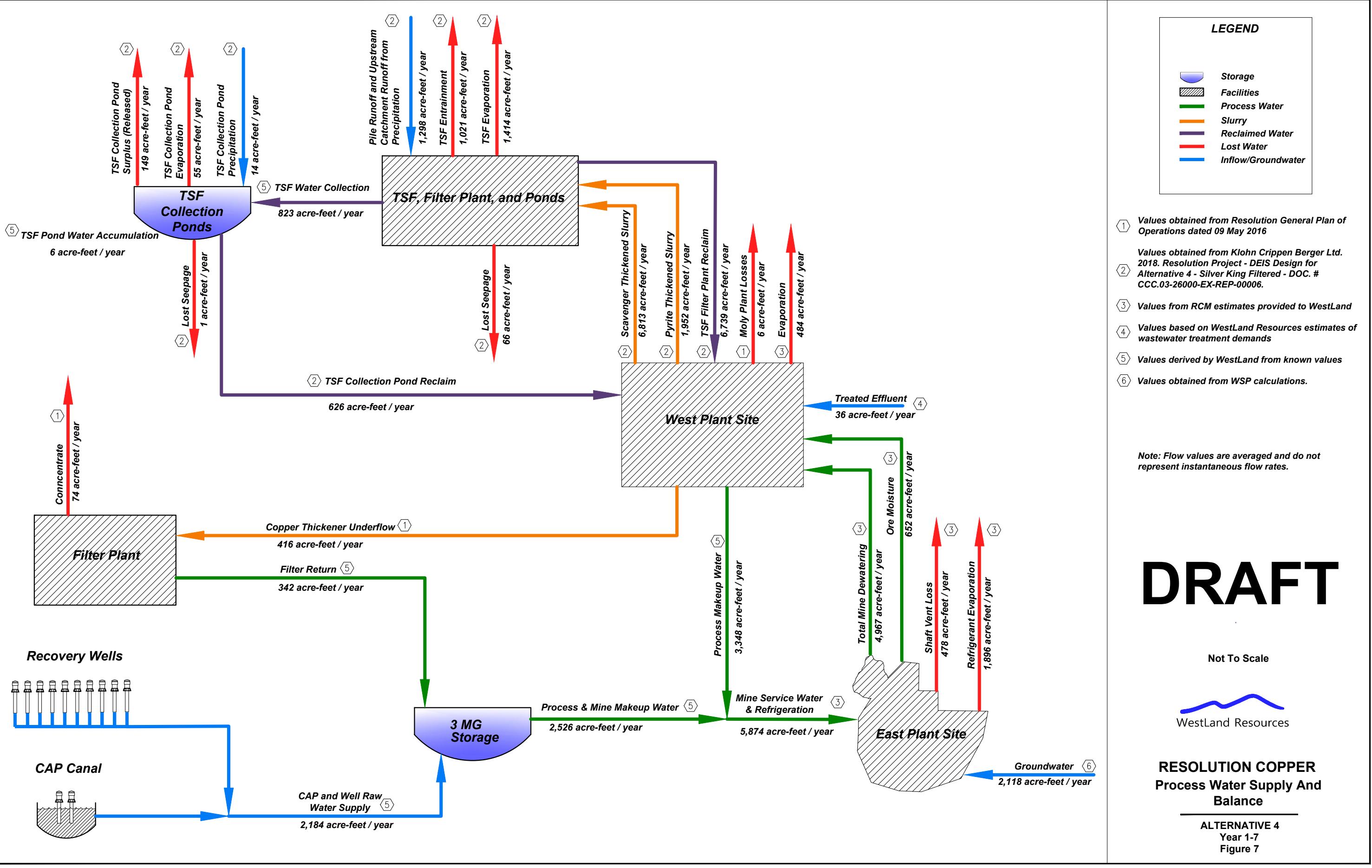


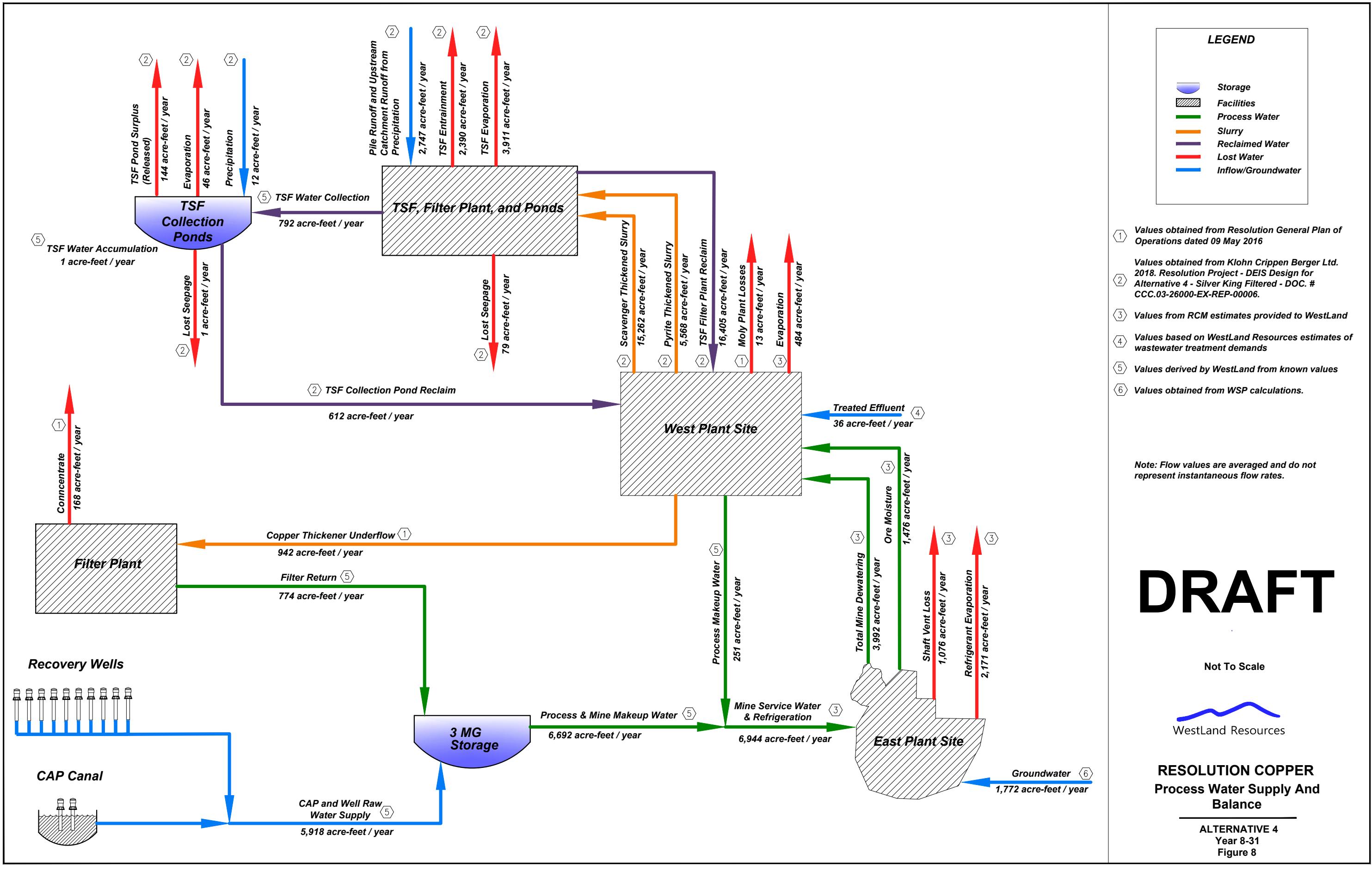


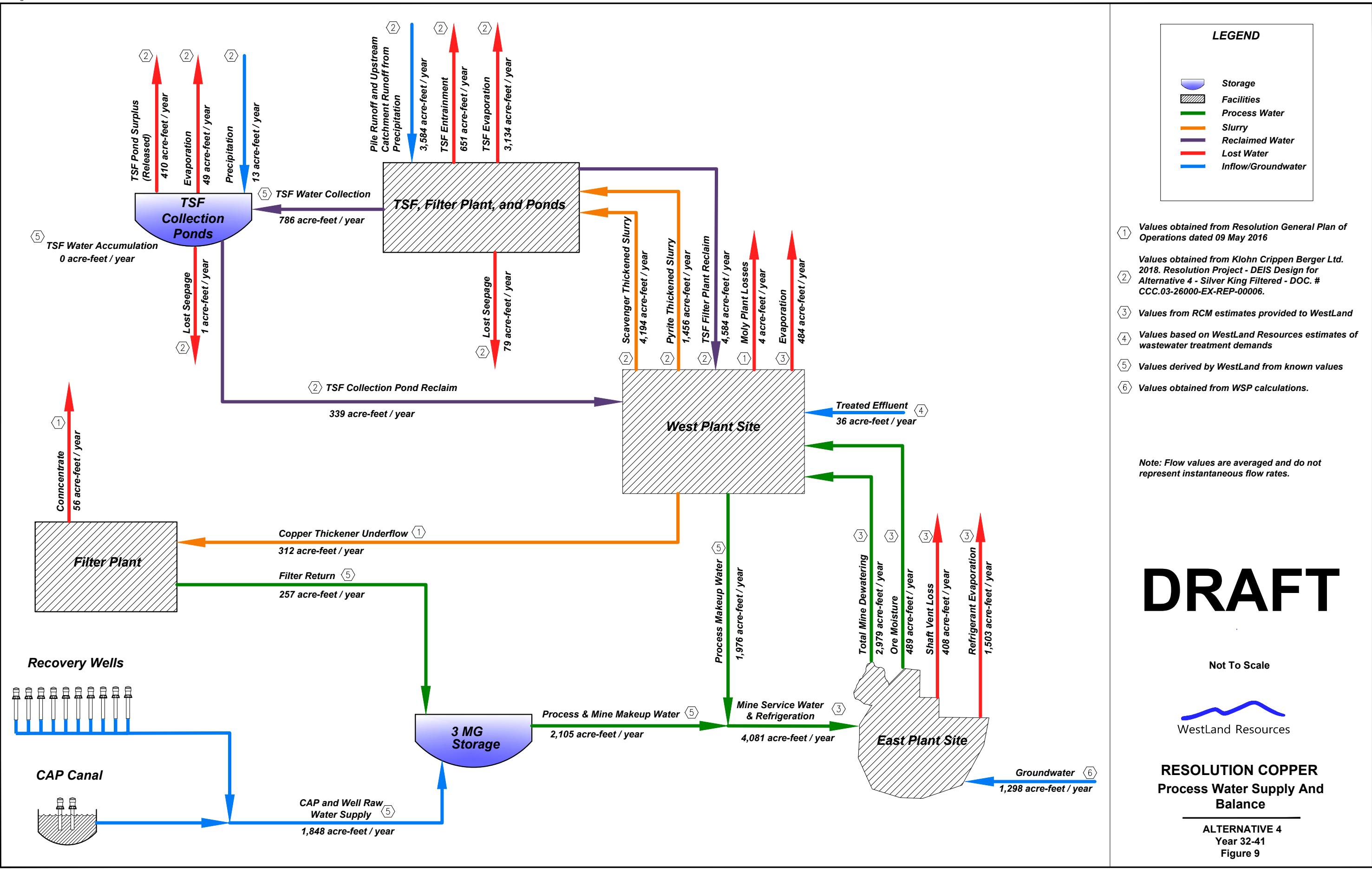


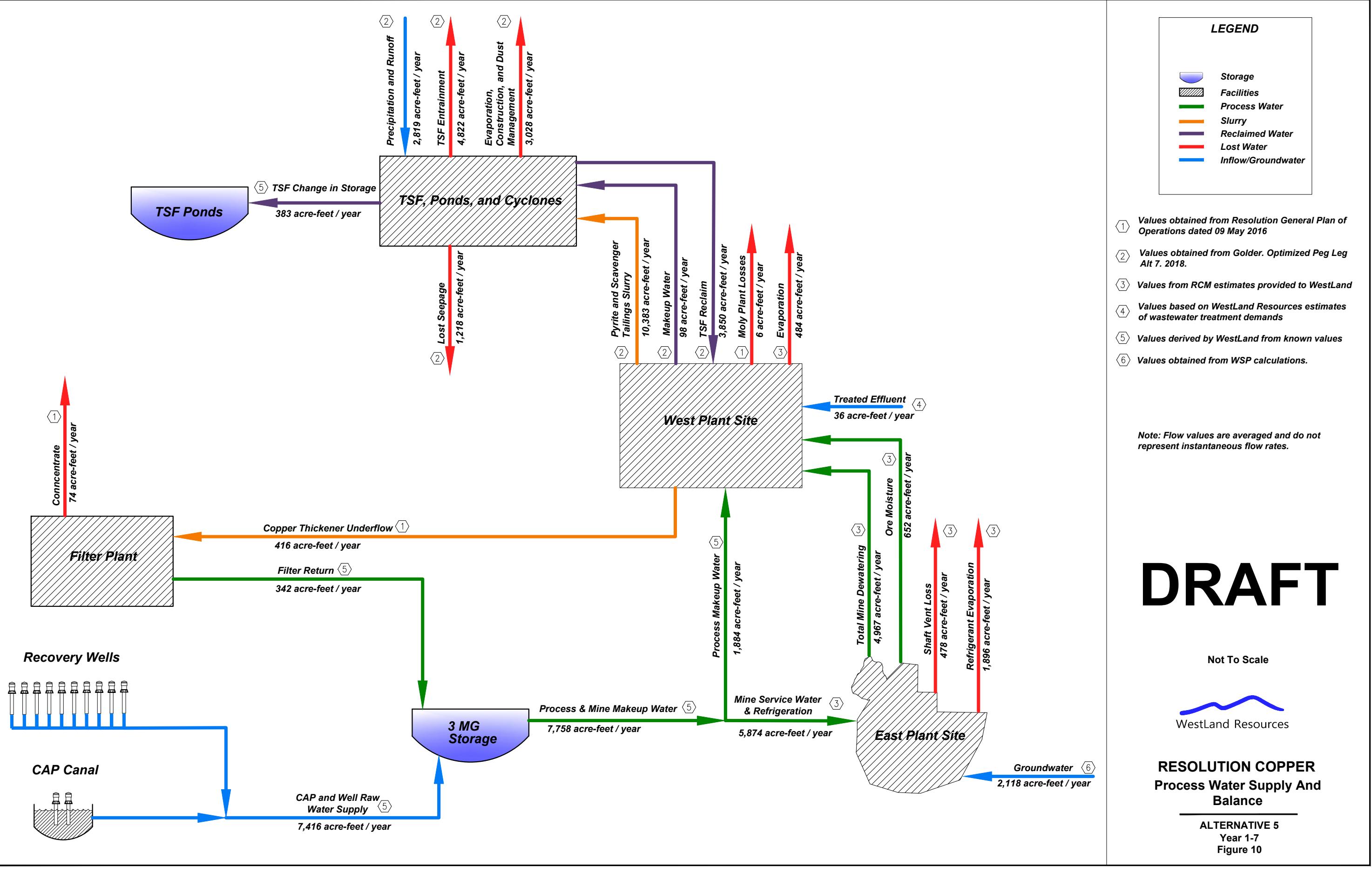


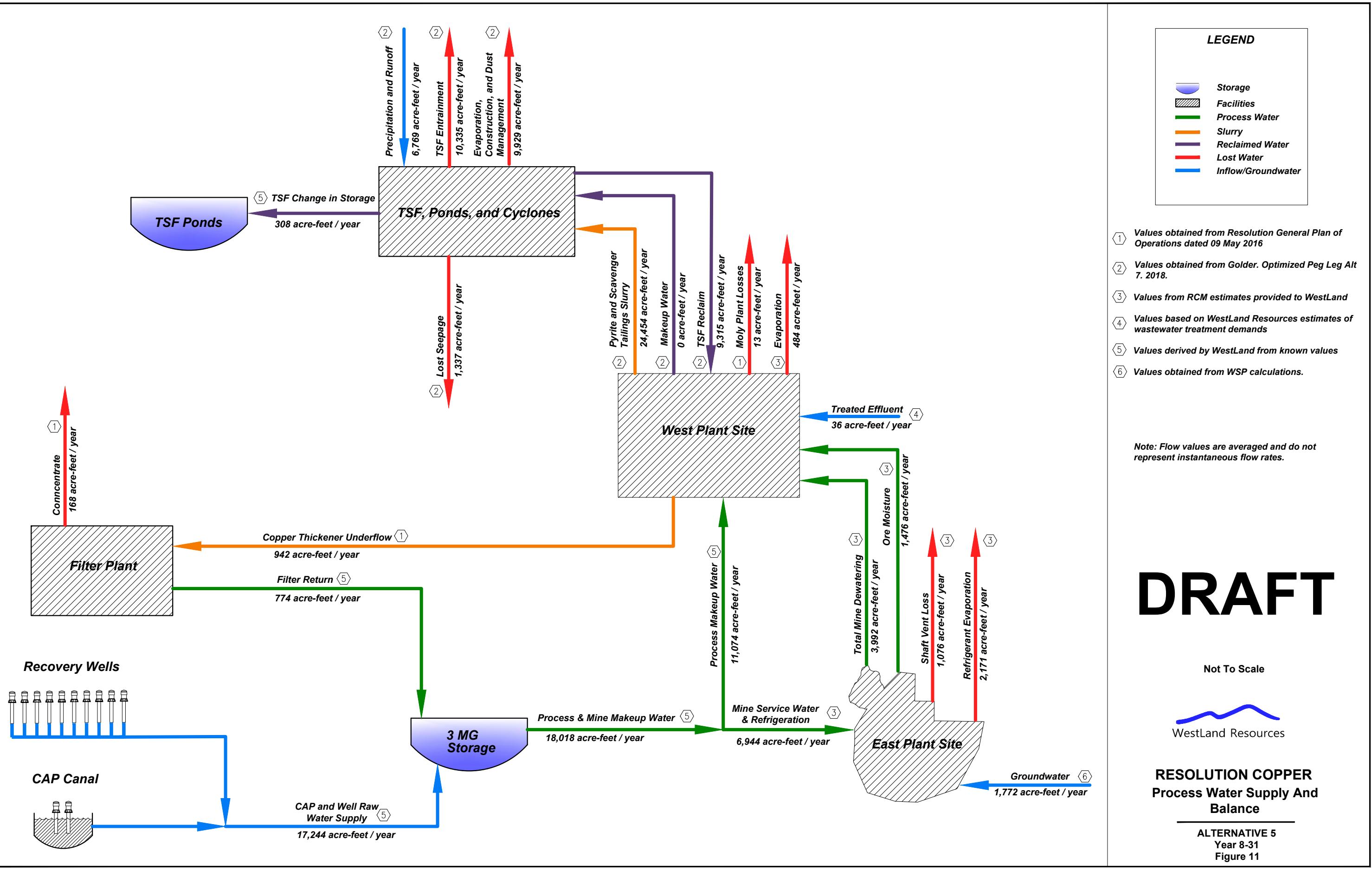


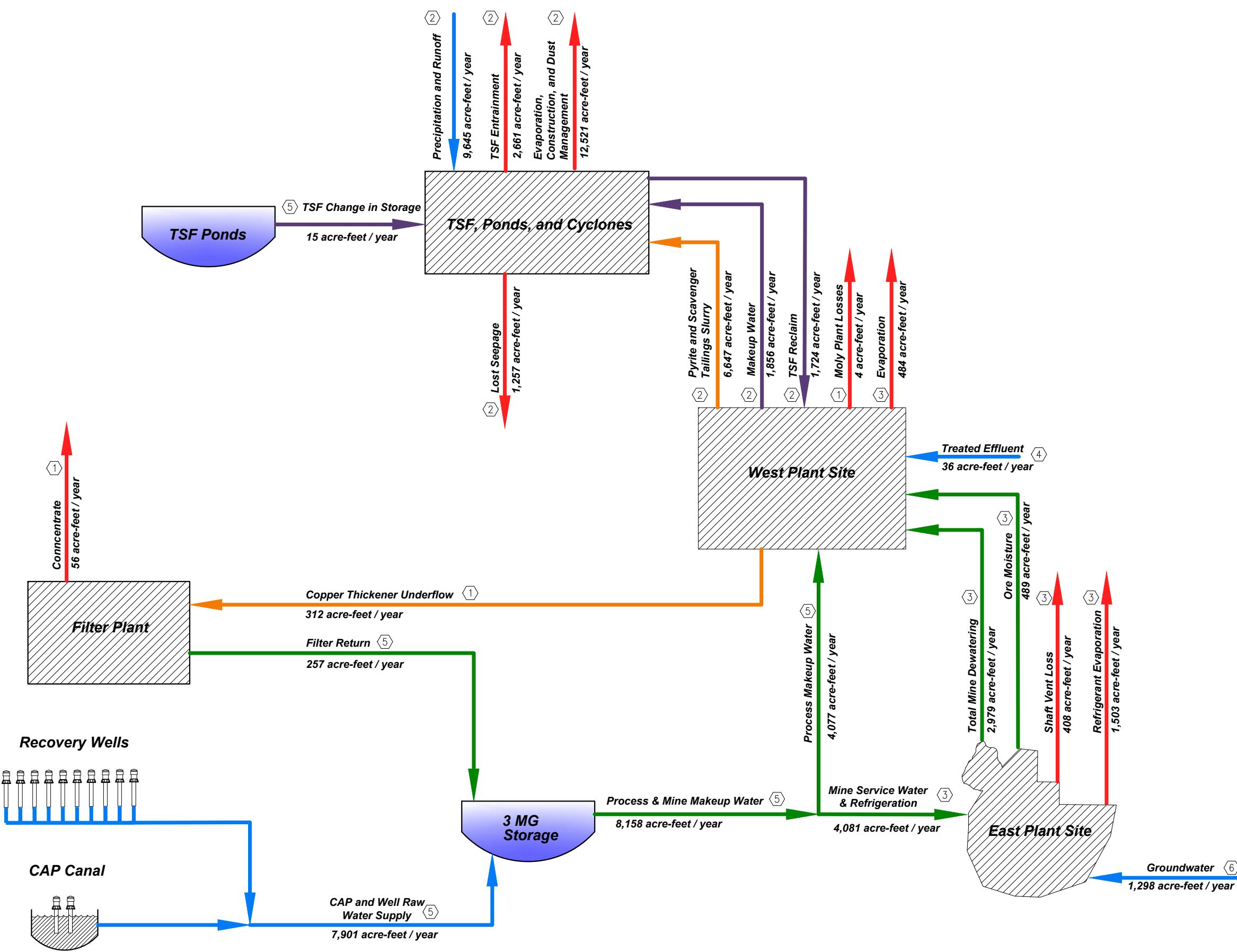












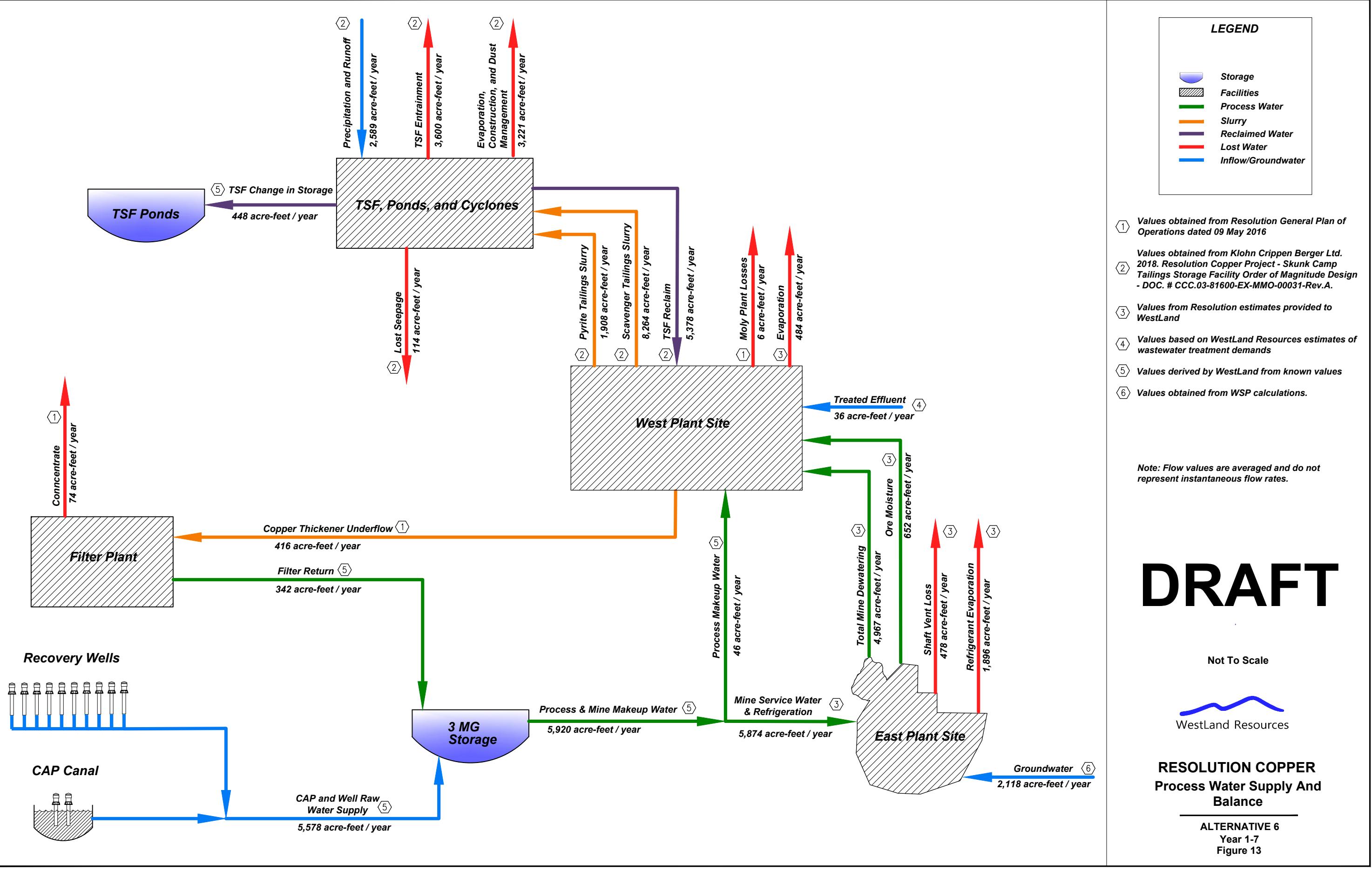
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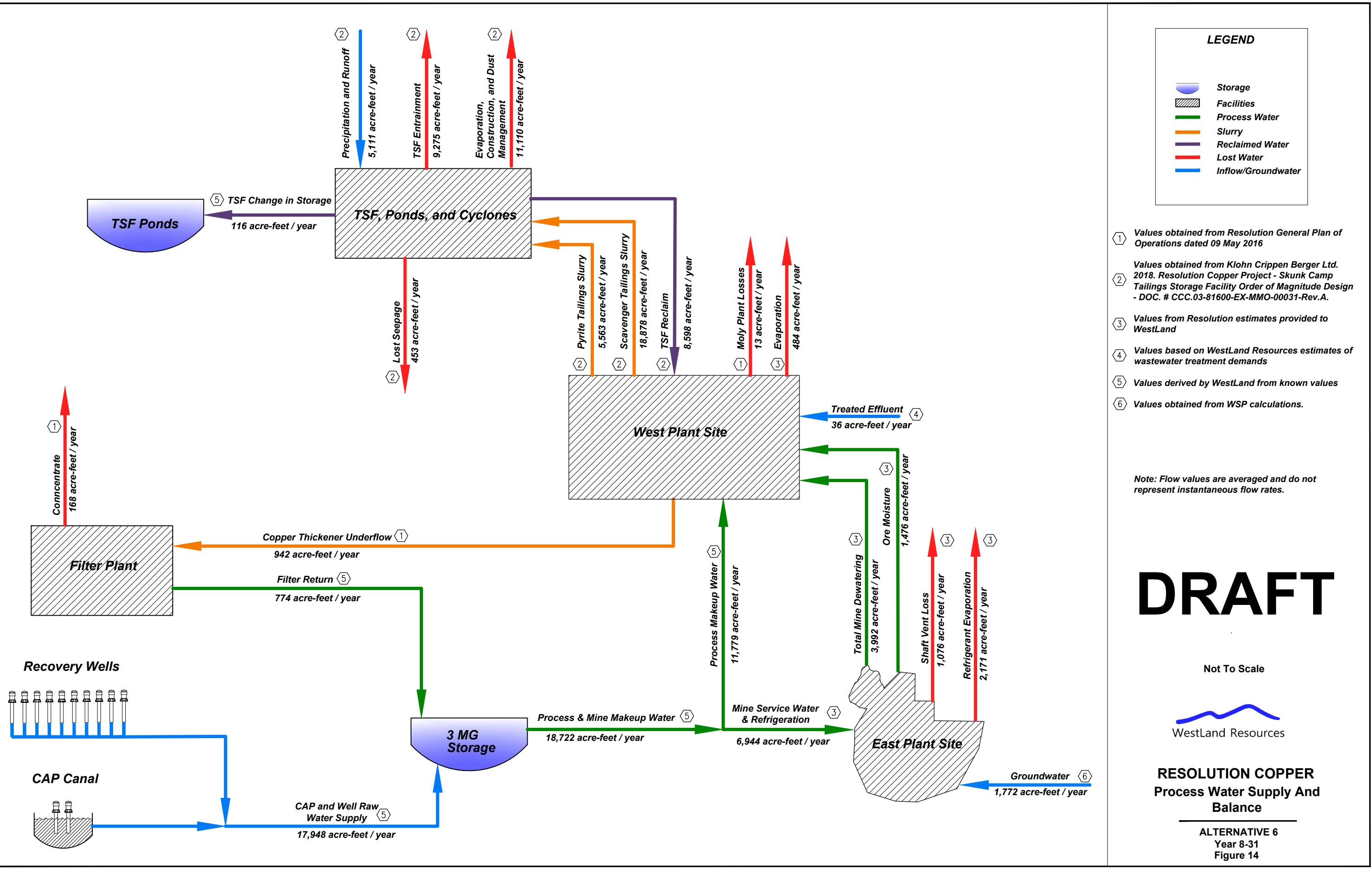
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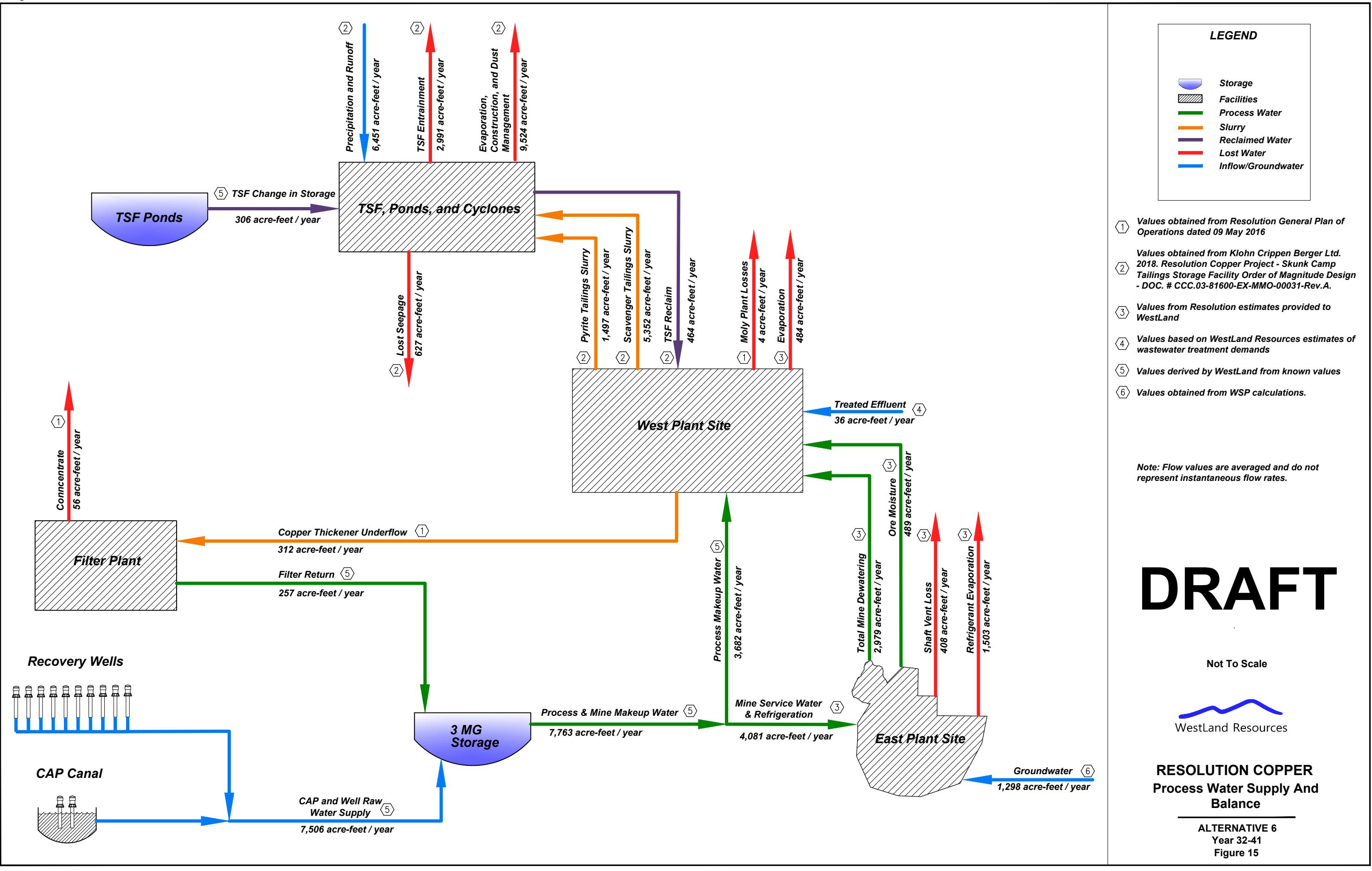
WestLand Resources

RESOLUTION COPPER
Process Water Supply And
Balance

ALTERNATIVE 5
Year 32-41
Figure 12







From: Peacey, Victoria (RC)
To: mcrasmussen@fs.fed.us
Cc: [Chris Garrett](#); [Donna Morey](#); [Charles Coyle](#)
Subject: GPO Water Balanceace - TSF Comparasons
Date: Thursday, September 6, 2018 1:36:36 PM
Attachments: [image001.png](#)
[2018-09-04 Tailings Water Balance Memo.pdf](#)

Hi Mary – As a follow-up to the tailings DEIS design reports, completed GPO water balances for each TSF alternative are contained in the attached report to help with alternatives comparisons.

Please let me know if you have any questions.

Thanks,

Vicky Peacey
Senior Manager – Environmental, Permitting and Approvals



102 Magma Heights
Superior, AZ 85173, United States
T: +1 520.689.3313 M: +1 520.827.1136
victoria.peacey@riotinto.com www.resolutioncopper.com