Prepared For:

Kennecott Greens Creek Mining Company

P.O. Box 32199

Juneau, AK 99803

Prepared by:

Environmental Design Engineering

23 N. Scott St. Suite 23

Sheridan, WY 82801

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1.0 Introduction

Kennecott Greens Creek Mining Company (KGCMC) is a precious and base metal mine producing gold, silver, lead and zinc from underground operations. The mine is located approximately 18 air miles southwest of Juneau, Alaska on Admiralty Island. The mined ore is milled and concentrated at the mine site to produce three bulk concentrates for shipping offsite to contracted smelting operations. The mining and milling sequences also produce materials that are not of economic value to KGCMC. These materials consist of production rock (waste rock) from the mining process and tailings from the milling process.

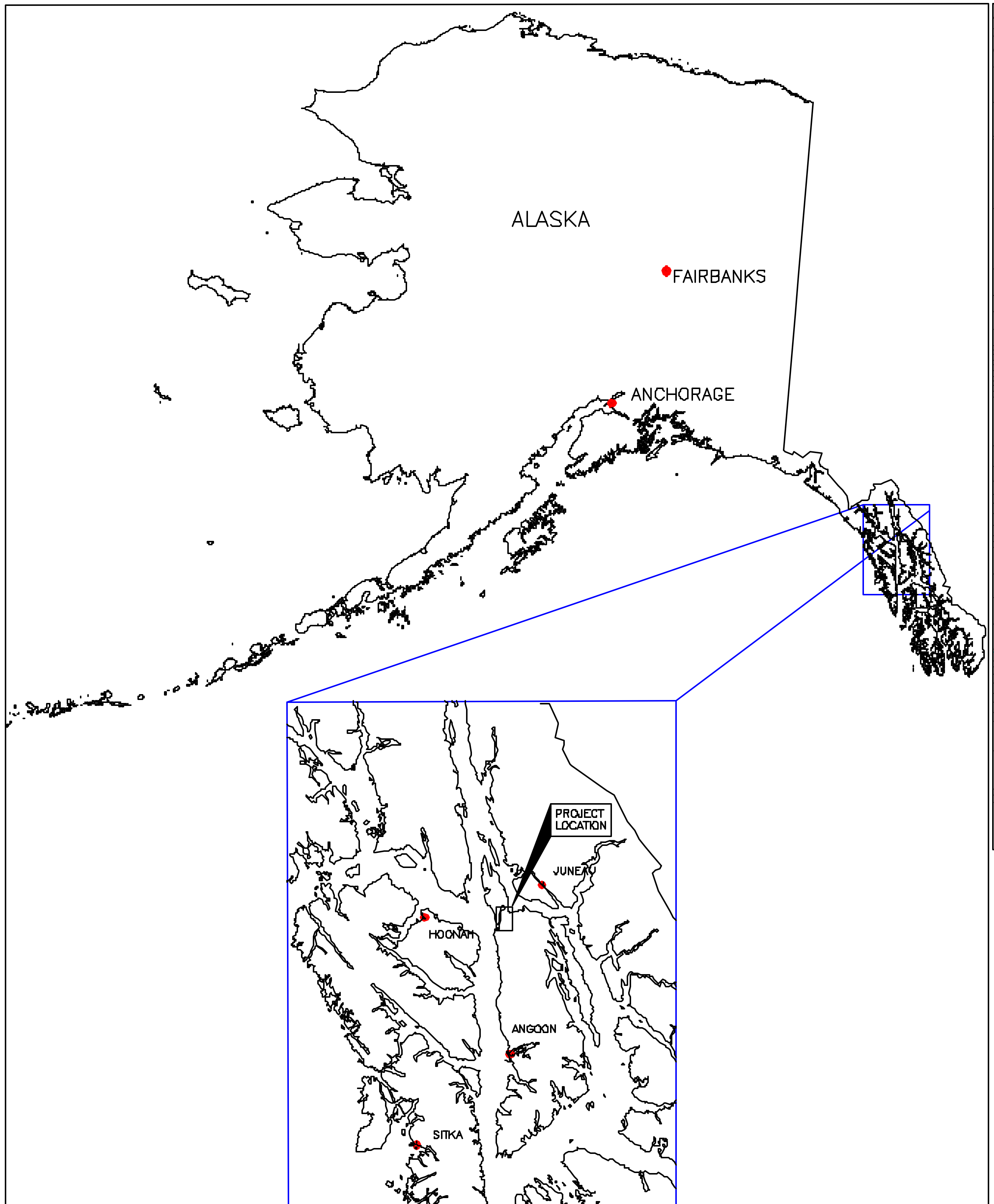
In January 2001, KGCMC received approval for a Solid Waste Permit (#9900-BA006) from the State of Alaska, Department of Environmental Conservation to address the disposal and storage of the production rock and tailings products from the mining and milling processes. Within the permit (Section 3.4.3), a revised stormwater facility design criteria was stipulated to KGCMC requiring increased stormwater capacities at Pond 6 to be completed within a four year period from the receipt of the permit. The stipulations placed onto KGCMC increase the current stormwater design criteria from the 10yr-24 hr event to the 25yr-24hr event.

KGCMC seconded Environmental Design Engineering (EDE) from Sheridan, Wyoming to investigate and update the site water balance to address these Solid Waste Permit requirements. In addition to revising the water balance for permit requirements, KGCMC added scope to the update to address the proposed Stage II Tailings Expansion at the Existing Tailings Impoundment Facility. KGCMC proposed the expansion of the existing surface tailings repository in January 2001, and the proposal is currently being evaluated through a National Environmental Policy Act process by the United States Forest Service (USFS). The timing for the Solid Waste Permit required upgrades for the existing stormwater systems match the Stage II planning and design schedules. Therefore, KGCMC focused the scope of this revised water balance report to address the potential tailings site expansion as well as satisfy the required Solid Waste Permit stipulations.

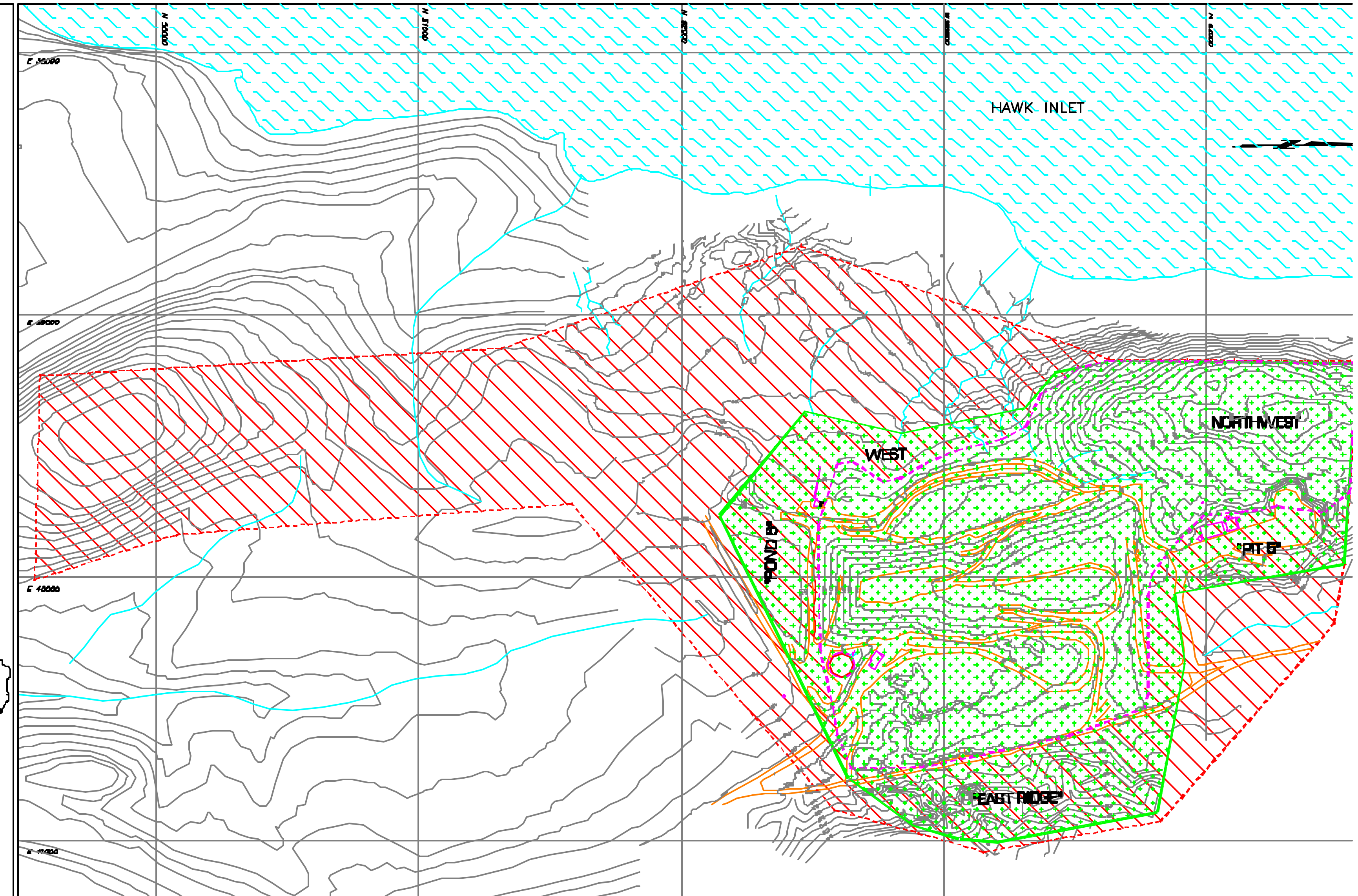
This report describes the water collection, treatment, and disposal systems for the existing facilities and the proposed expansion using the revised Solid Waste Permit design criteria. Figure 1 shows the site location and the proposed expansion lease and tailings placement areas that will affect the water balance investigations covered in this report.

The purpose of this document is to describe current water management and water management plans for the Solid Waste Permit requirements, including a focus on the Stage II Tailings Expansion. Water handling is an important component of the current site systems and the proposed expansion project. The water balance identifies and quantifies water management at the surface tailings site and peripheral sites that impinge on collection and treatment facilities at the surface tailings repository. These other sites include the 920 Site (mill facilities area), Site 23, Site D, and the Cannery/Hawk Inlet facilities area. The development of an integrated water management plan requires the identification and quantification of all inflows and outflows. The water balance is used to ensure the reliability of the raw water supply for all process and potable needs, protect operations from flooding and erosion, capture and treat water that comes in contact with project facilities, and meet all applicable regulatory requirements in an environmentally sound manner.

Water management is detailed in Sections 2.0 and 3.0 of this report. Section 2.0 is formatted to examine the current water management practices and current water sources, volumes, and storm capacities. Section 3.0 examines the anticipated water management practices, water sources, flow volumes, and storm capacities under the proposed expansion, as well as potential increased permitted discharge requirements for the proposed expansion. Although only the proposed surface tailings area is expanding, changes to the current water management collection capacities at Site 23 and Site D will be required to manage the increase in design storm water volumes associated with the increase in the design event (by 2005). No changes to the water management facilities at Hawk Inlet are anticipated. The detailed analysis of water management in this report is restricted to the surface tailings area and the Site D and Site 23 areas. Section 4.0 presents the summary and conclusions.



KEY PLAN
NOT TO SCALE



SITE LOCATION MAP
SCALE: 1" = 600'

LEGEND

- NORTHWEST TAILINGS BOUNDARY
- PROPOSED LEASE AREA (140.4 ACRES)
- STAGE II AREA OF TAILINGS PLACEMENT (57
- STREAMS
- ROADS
- 10' CONTOUR LINE

FIGURE 1

KENNECOTT GREENS CREEK MI
ADMIRALTY ISLAND, ALASKA

SITE LOCATION MAP

DATE: 07/29/02	PREPARED BY: EDE CONSULTANTS SHERIDAN, WYOMING PHONE: (307)672-3793
DRAWING BY: CDG	
DESIGN BY: BNN	
REVIEWED BY: BNN	EDE DWG # WATER BALANC
PROJ OR REF. ----	
SCALE: AS NOTED	SHEET: 1 OF

2.0 Current Water Management

The cycle of water management at KGCMC begins with the collection of raw water for mine, mill, and potable use. Fresh (raw water) intake diversions are located at Greens Creek near the 920 mill site and at Cannery Creek near the Hawk Inlet camp and shipping dock facilities. These raw water sources provide water for milling operations, domestic use, equipment wash-down, and fire suppression. Fresh water storage is provided at two locations; the 1160 storage tank above the 920 mill and office facilities, and in three head tanks near the cannery offices and man camp facilities at Hawk Inlet. Figure 2 presents the general arrangement of the existing water management facilities at KGCMC.

Wastewater sources include mill process water, domestic wastewater, and facilities stormwater. Although the 920 water treatment plants (WTP) and sewage treatment plant provide treatment at the 920 mine/mill facilities area, ultimately KGCMC routes all wastewater to the surface tailings area treatment, containment, and discharge facilities. Wastewater is collected and then routed to the tailings area water containment/treatment facilities from three primary locations. They are:

- Domestic wastewater and stormwater from the upper and lower facilities pads at the Hawk Inlet operations area at de-gritting basin 04 (DB–04).
- Surface tailings contact water and stormwater from tailings area facilities.
- 920 facilities area stormwater, 920 domestic wastewater and mill WTP discharges, and Site 23/Site D stormwater and mill WTP discharges.

The central wastewater collection and redistribution facilities at KGCMC are Tank 6 and Pond 6 at the surface tailings area. From these surge/storage facilities, wastewater can be routed via pipeline to the Pit 5 WTP, to the Pit 5 filter plant, or directly to Wet Well 1. From Wet Well 1 water is gravity discharged by pipeline through a submerged diffuser within Hawk Inlet at KGCMC National Pollutant Discharge Elimination System (NPDES) discharge point 002. The wastewater can also be routed directly from Pond 6 and Tank 6 by pipeline to Wet Well 1, where the wastewater can be routed by pipeline to the WTP or the filter plant at Pit 5 for treatment, and then back to Wet Well 1 for discharge after treatment.

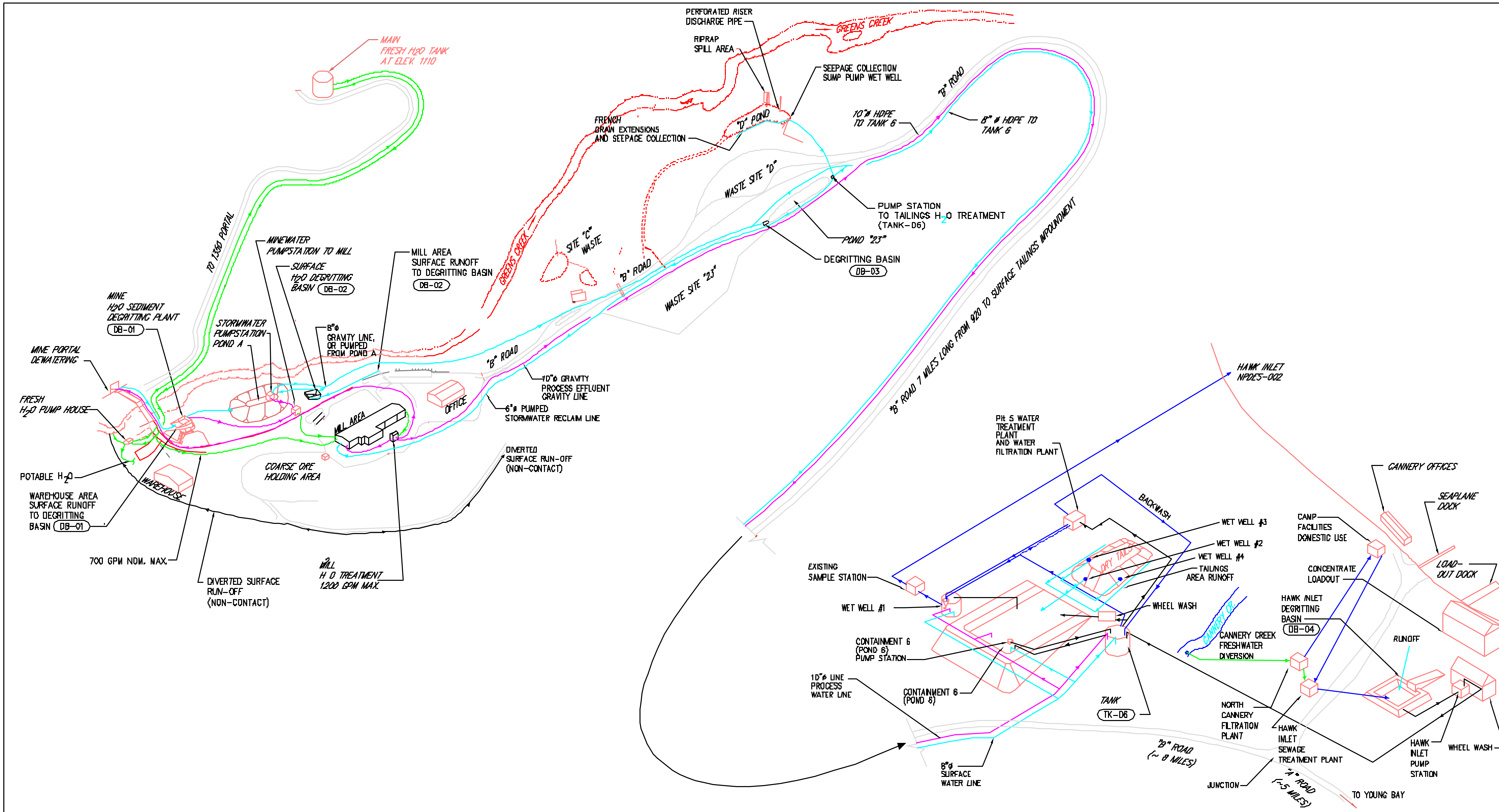


FIGURE 2

LEGEND:

- PROCESS WATER
- FRESH WATER
- RUNOFF WATER
- TREATED WATER
- COMBINED WATERS

KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA

EXISTING GENERAL WATER MANAGEMENT LAYOUT

DATE: 07/29/02 DRAWN BY: CDC DESIGN BY: RWH REVIEWED BY: BNN PROJ OR REF: ----	PREPARED BY: EDE CONSULTANTS SHERIDAN, WYOMING PHONE (307)672-3793 EDE DWG #: WATER BALANCE FIGURE 2
SCALE: AS NOTED	SHEET: 1 OF 1

There are two permitted discharge points at the KGCMC under EPA Permit #AK0043206, KGCMC NPDES-001 and KGCMC NPDES-002. KGCMC NPDES-001 is the original discharge point for the Hawk Inlet sewage treatment plant and is currently only used as a backup effluent line. In June 1999, KGCMC rerouted the Hawk Inlet sewage treatment effluent flow toward the tailings area water management system for discharge at the KGCMC NPDES-002 site to ensure compliance with lowered regulatory chlorine discharge standards. The addition of this relatively small amount of treated water from the sewage plant, within the large volume of water handled at tailings, allows the blended water to meet the chlorine discharge standard at KGCMC NPDES-002. KGCMC NPDES-001 remains permitted for use, if needed.

Consequently, KGCMC NPDES-002 is the primary discharge point for all wastewaters collected at KGCMC. Figure 3 presents a flow chart that shows fresh water and waste water points of origin, flow rates, and flow routing under the current site conditions. Recorded flow rates and average flows at current water management area reporting stations and discharge at KGCMC NPDES-002 for the recent discharge period from April 2001 through October 2001 are presented in Appendix A. Although this is a relatively short time frame of collected data, this data best reflects the current water management configuration and present water use rates, and allows derivation of average flows associated with those rates. These average flows are useful in conceptualizing the basic water management and operational collection and discharge practices at KGCMC. However, to evaluate the required system discharge and system capacities, flow rates for peak precipitation and use periods, and design event flow rates are necessary.

The following Sections 2.1, 2.2, and 2.3 detail the wastewater reporting to the Tank 6/Pond 6 containment facilities from Hawk Inlet, the surface tailings area, and 920 Site/Site 23/Site D sources respectively. Average flow rates, design event flow rates, and peak flow rates for wastewaters reporting to Tank 6/Pond 6 are listed in Table 1. Section 2.4 details the water management practices from Tank 6/Pond 6 containment, to discharge at KGCMC NPDES-002, and Section 2.5 details design event containment and water management and discharge practices.

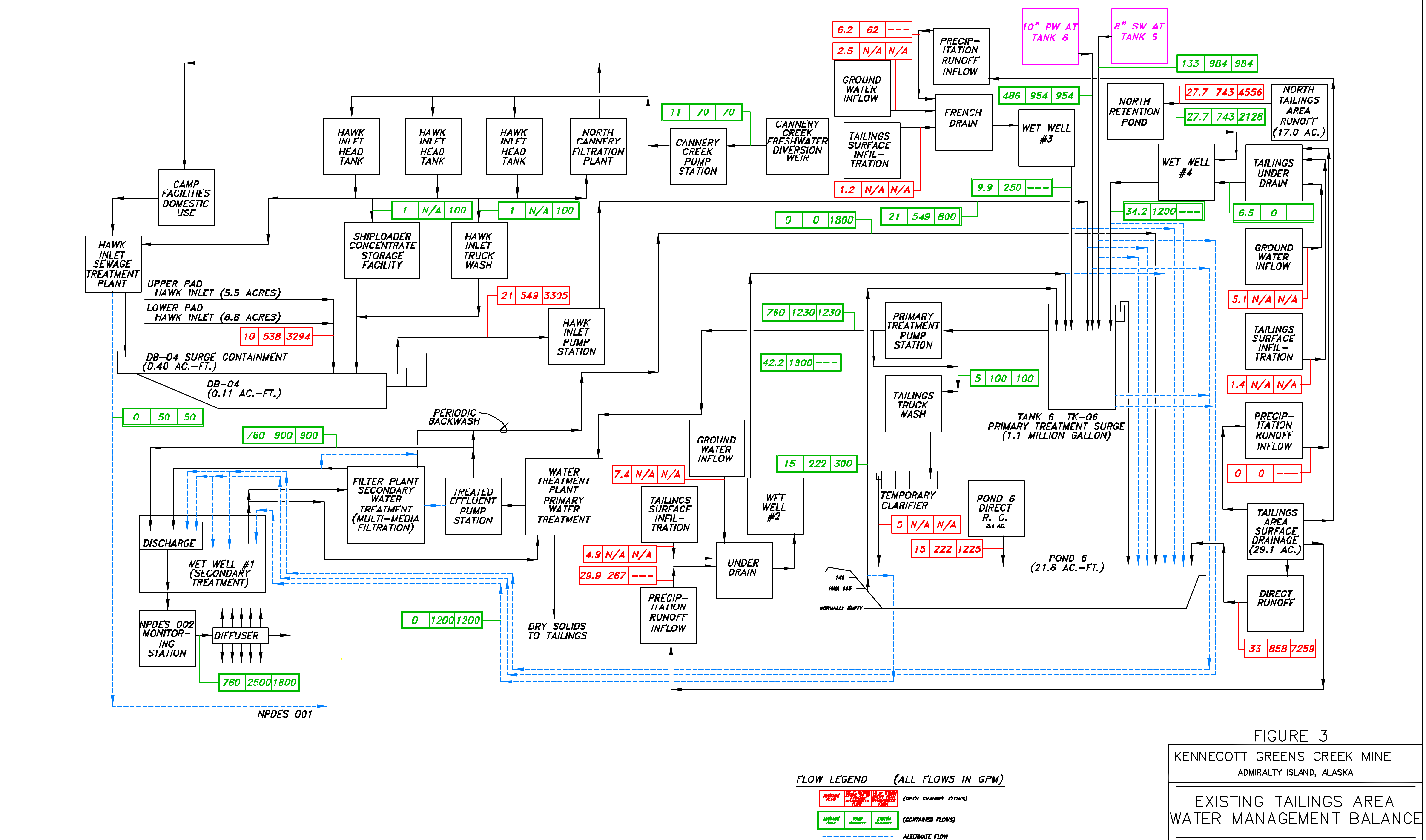


FIGURE 3

KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA

EXISTING TAILINGS AREA WATER MANAGEMENT BALANCE

DATE: 07/29/02
DRAWING BY: RWH
DESIGN BY: RWH
REVIEWED BY: BJS
PROJ OR REF: GCM0103

PREPARED BY:
EDE CONSULTANTS
SHERIDAN, WYOMING
PHONE: (307) 672-3763

CONC DWG # WATER BALANCE FIGURE 3

SCALE: NONE

SHEET: 1 OF 1

Table 1
Flows Reporting to Existing Tailings Area Water Management

Source	average gpm	10yr-24hr avg. gpm	10yr-24hr peak gpm
Cannery Creek Intake	11	11	11
Hawk Inlet Area Runoff	10	538	3,294
DB-04 Effluent	**21**	**549**	**3,305**
Wet Well 2 Groundwater Inflow	7.4	7.4	7.4
Wet Well 2 Surface Infiltration	4.9	4.9	4.9
Wet Well 2 Area Runoff	29.9	267	--
Wet Well 2 Effluent	**42**	**279**	--
Wet Well 3 Groundwater Inflow	2.5	2.5	2.5
Wet Well 3 Surface Infiltration	1.2	1.2	1.2
Wet Well 3 Area Runoff	6.2	62	N/A
Wet Well 3 Effluent	**10**	**66**	--
Wet Well 4 Groundwater Inflow	5.1	5.1	5.1
Wet Well 4 Surface Infiltration	1.4	1.4	1.4
Wet Well 4 Area Runoff	0.0	0.0	0.0
North Retention Pond	27.7	743	2,128
Wet Well 4 Effluent	**34**	**750**	**2,135**
Wet Well 2 Direct Runoff	0.0	267	3,268
Wet Well 3 Direct Runoff	0.0	62	750
Wet Well 4 Direct Runoff	17.7	284	1,742
Tailings Area Direct Runoff to Pond 6	11.2	180	1,097
Pond 6 Surface Collection	4.1	65	402
Total Direct Runoff	**33**	**858**	**7,259**
10" Process Water Line	**486**	**684**	**954**
8" Surface Water Line	**133**	**984**	**984**
Total Flow Reporting to Pond 6/Tank 6	**759**	**4,170**	**N/A**

-- Peak flows indeterminate for runoff reporting to wet wells, total peak flow assigned as direct runoff in the table.

N/A Peak flows occur at different times, total peak flow is not necessarily the sum of the parts.

2.1 Hawk Inlet Facilities Wastewater

2.1.1 Average Flow

Fresh water is collected from Cannery Creek via the Cannery Creek diversion weir for the Hawk Inlet facilities. Daily readings are taken from a supply line flowmeter revealing an average flow of 11 gpm (Appendix B). The fresh water is routed from the weir to one of three head tanks. From the head tanks the water can take one of several paths as needed. The water can be routed to the cannery filtration/chlorination treatment plant and then to camp facilities for domestic use. The domestic wastewater is routed to the Hawk Inlet sewage treatment plant. Sewage treatment plant effluent is routed from the Hawk Inlet sewage treatment plant to DB-04, and then pumped up to the tailings water management systems. Freshwater is also routed from the head tanks to the ship loader concentrate storage facility and the Hawk Inlet truck wash. Wastewater from these locations is routed to DB-04. DB-04 is equipped with a flowmeter and daily readings are taken of the amount of flow passing through the basin. Average flow leaving DB-04 is 21 gpm based on summer/fall 2001 usage (Appendix A, Table 1). Stormwater is collected from the Hawk Inlet facilities area, off of the upper and lower facility pads, and routed to DB-04 at an average flow of 10 gpm (this stormwater estimate is the difference between DB-04 effluent and Cannery Creek withdrawal). The 21 gpm DB-04 effluent is routed from DB-04 through a pump station to Tank 6 at the surface tailings wastewater storage area. Water and wastewater routing at the Hawk Inlet facilities area is shown on Figure 3.

2.1.2 Design Flow

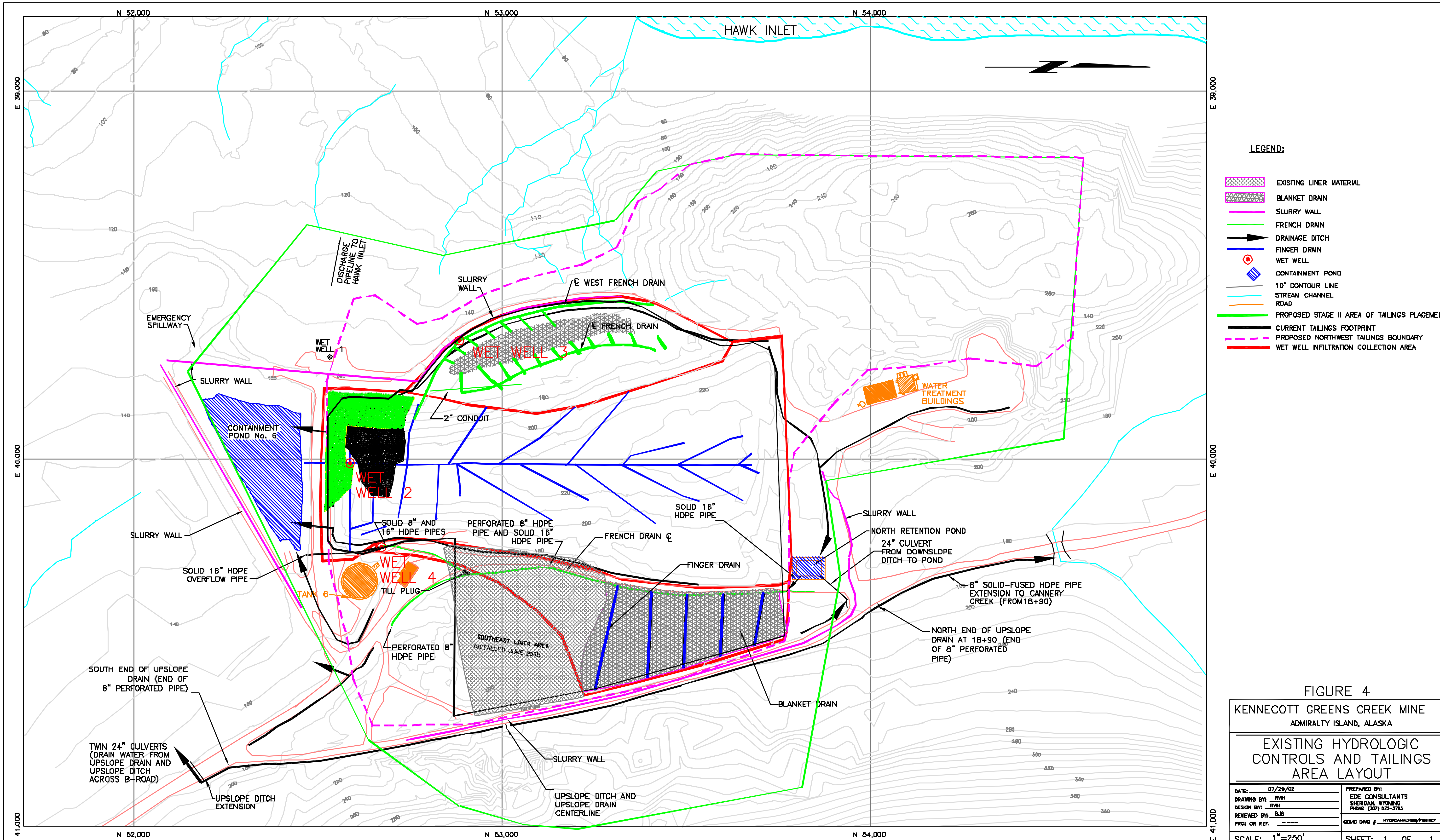
The 10yr-24hr precipitation event is the current design storm for all KGCMC operations. The 10yr-24hr precipitation event rainfall at Hawk Inlet and the Tailings area is 3.36 inches. The average design flow (Table 1) for the Hawk Inlet facilities area is based on the average influent rate from the freshwater intake at Cannery Creek of 11gpm, and the average stormwater runoff flow rate from the 10yr-24hr storm runoff event of 538 gpm, or about 549 gpm total. Stormwater modeling for the upper and lower pads at Hawk Inlet was conducted using the computer modeling program SEDCAD 4. Printouts from this stormwater model are presented in Appendix C. The pump station lifting water from DB-04 to Tank 6 is capable of 800 gpm.

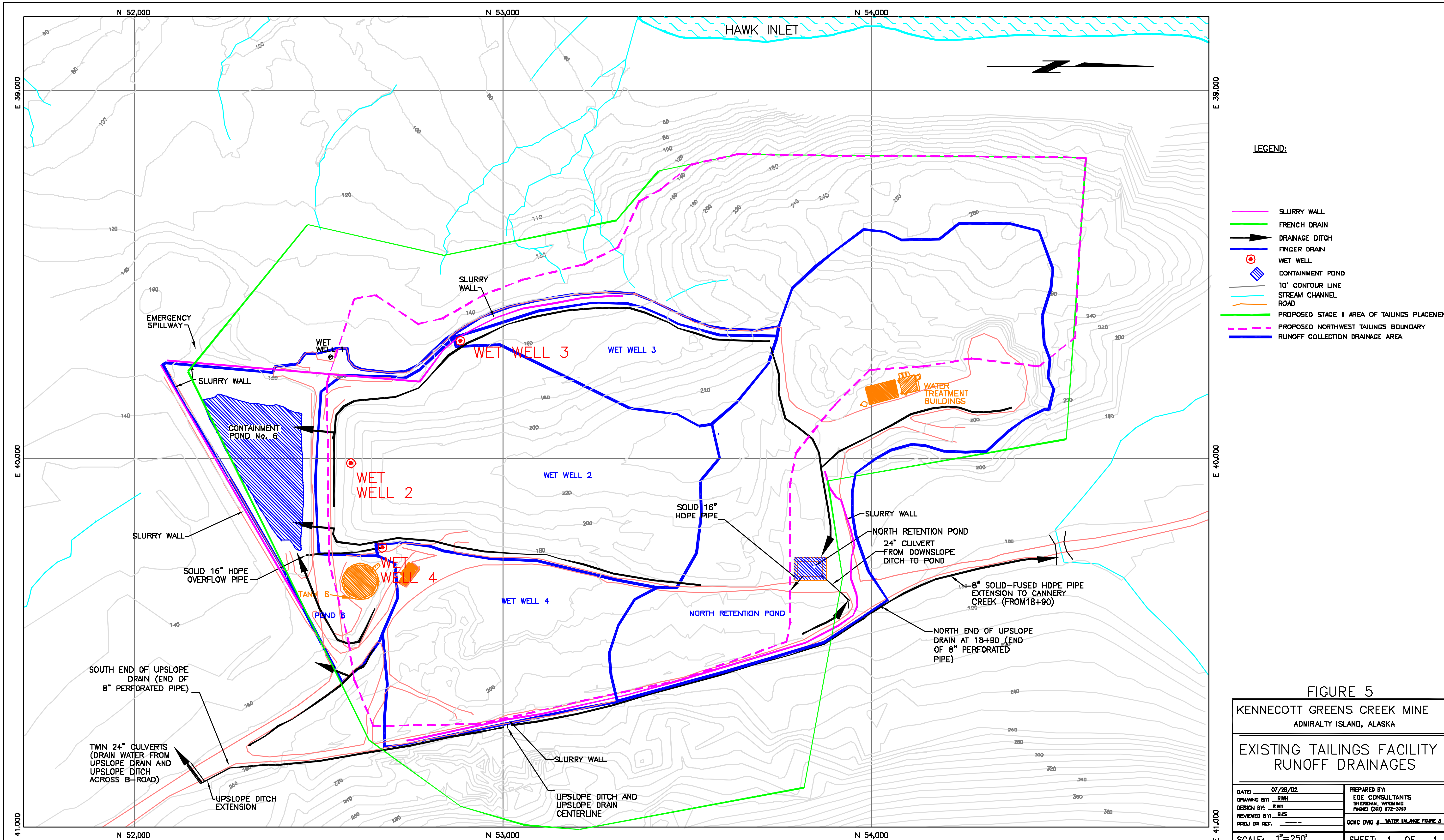
2.2 Surface Tailings Impoundment Contact Water

Water contacting tailings at the surface tailings repository consists of both surface water and groundwater. The surface water is precipitation stormwater. The groundwater is a combination of infiltration through the surface tailings pile (within containment boundaries) to the under-drain collection system, and native groundwater that has not been intercepted or routed around the pile, by pile perimeter up-gradient groundwater diversions and barriers. A discussion of the groundwater hydrology and control facilities is presented in the report “Stage II Tailings Expansion Hydrologic Analysis” (EDE 2002).

Contact stormwater is captured via a series of perimeter ditches around the surface tailings pile and by wet wells. Wet wells are constructed collection sumps equipped with submersible pumps to pump water to Tank 6 or Pond 6 for surge storage, and redistribution to treatment. The tailings impoundment currently has three wet wells that capture ground and surface flows; Wet Wells 2, 3, and 4. These wet wells receive flow from groundwater, tailings infiltration, and precipitation stormwater. The stormwater is tributary to the wet wells via pile perimeter french drain infiltration. Each wet well pump system is equipped with a flowmeter and daily readings are taken of the cumulative amount of water pumped from each wet well. The flowmeters record only effluent from the wet wells, so the actual contribution to the flow rate at each wet well from groundwater, infiltration, and stormwater is not precisely known.

For purposes of the water balance/management liberal approximations of the contributions from the three flow sources were made for each wet well to provide a conservative analysis with respect to volumes of water to be handled and treated at the wet wells during operations. Appendices D, E, and F present the flow meter readings for Wet Wells 2 (01/01/00 thru 10/23/01), 3 (10/28/00 thru 10/23/01), and 4 (01/22/01 thru 10/16/01) respectively. The Wet Well 4 flowmeter readings were erratic through most of 2001 until 8/25/01, due to installation problems (see Appendix F), so only data from 8/25/01 to 10/16/01 was used for the average flow calculations in this report after the unit was relocated. Figure 4 shows the existing surface tailings area water management site, hydrologic controls, and wet well infiltration areas. Figure 5 shows the stormwater drainage areas associated with each wet well.


HAWK INLET
N 52,000
N 53,000
N 54,000
E 39,000
E 40,000
E 41,000
LEGEND:
EXISTING LINER MATERIAL
BLANKET DRAIN
SLURRY WALL
FRENCH DRAIN
DRAINAGE DITCH
FINGER DRAIN
WET WELL
CONTAINMENT POND
10' CONTOUR LINE
STREAM CHANNEL
ROAD
PROPOSED STAGE II AREA OF TAILINGS PLACEMENT
CURRENT TAILINGS FOOTPRINT
PROPOSED NORTHWEST TAILINGS BOUNDARY
WET WELL INFILTRATION COLLECTION AREA
DISCHARGE PIPELINE TO HAWK INLET
SLURRY WALL
℄ WEST FRENCH DRAIN
℄ FRENCH DRAIN
EMERGENCY SPILLWAY
WET WELL 1
WET WELL 3
SLURRY WALL
CONTAINMENT POND No. 6
2" CONDUIT
WET WELL 2
WATER TREATMENT BUILDINGS
SOLID 16" HDPE PIPE
SLURRY WALL
SOLID 8" AND 16" HDPE PIPES
PERFORATED 8" HDPE PIPE AND SOLID 16" HDPE PIPE
FRENCH DRAIN ℄
NORTH RETENTION POND
24" CULVERT FROM DOWNSLOPE DITCH TO POND
SOLID 16" HDPE OVERFLOW PIPE
WET WELL 4
TANK 6
TILL PLUG
FINGER DRAIN
8" SOLID-FUSED HDPE PIPE EXTENSION TO CANNERY CREEK (FROM 18+90)
NORTH END OF UPSLOPE DRAIN AT 18+90 (END OF 8" PERFORATED PIPE)
PERFORATED 8" HDPE PIPE
SOUTHEAST LINER AREA
SOUTH END OF UPSLOPE DRAIN (END OF 8" PERFORATED PIPE)
BLANKET DRAIN
TWIN 24" CULVERTS (DRAIN WATER FROM UPSLOPE DRAIN AND UPSLOPE DITCH ACROSS B-ROAD)
SLURRY WALL
UPSLOPE DITCH EXTENSION
UPSLOPE DITCH AND UPSLOPE DRAIN CENTERLINE
FIGURE 4
KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA
EXISTING HYDROLOGIC CONTROLS AND TAILINGS AREA LAYOUT
DATE: 07/29/02
PREPARED BY: EDE CONSULTANTS SHERIDAN, WYOMING
SCALE: 1"=250'
SHEET: 1 OF 1


HAWK INLET
N 52,000
N 53,000
N 54,000
E 39,000
E 40,000
E 41,000
LEGEND:
SLURRY WALL
FRENCH DRAIN
DRAINAGE DITCH
FINGER DRAIN
WET WELL
CONTAINMENT POND
10' CONTOUR LINE
STREAM CHANNEL
ROAD
PROPOSED STAGE I AREA OF TAILINGS PLACEMENT
PROPOSED NORTHWEST TAILINGS BOUNDARY
RUNOFF COLLECTION DRAINAGE AREA
EMERGENCY SPILLWAY
SLURRY WALL
WET WELL 1
WET WELL 3
WET WELL 2
WET WELL 4
CONTAINMENT POND No. 6
TANK 6
POND 6
SOLID 16" HDPE OVERFLOW PIPE
SOLID 16" HDPE PIPE
NORTH RETENTION POND
24" CULVERT FROM DOWNSLOPE DITCH TO POND
8" SOLID-FUSED HDPE PIPE EXTENSION TO CANNERY CREEK (FROM18+90)
NORTH END OF UPSLOPE DRAIN AT 18+90 (END OF 8" PERFORATED PIPE)
SOUTH END OF UPSLOPE DRAIN (END OF 8" PERFORATED PIPE)
TWIN 24" CULVERTS (DRAIN WATER FROM UPSLOPE DRAIN AND UPSLOPE DITCH ACROSS B-ROAD)
UPSLOPE DITCH EXTENSION
UPSLOPE DITCH AND UPSLOPE DRAIN CENTERLINE
WATER TREATMENT BUILDINGS
FIGURE 5
KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA
EXISTING TAILINGS FACILITY RUNOFF DRAINAGES
DATE: 07/29/02
DRAWN BY: RWH
DESIGN BY: RWH
PREPARED BY:
EDE CONSULTANTS
SHERIDAN, WYOMING
SCALE: 1"=250'
SHEET: 1 OF 1

Calculations of estimated flow contributions at each wet well and tailings area stormwater flows are presented in Appendix G. Wet wells are constructed to capture subsurface flows from groundwater and infiltration. However, in assigning proportions of the average flow out of the wet wells (based on flowmeter readings) to one of each of the three possible sources, it becomes apparent that the majority of the average stormwater flow in the drainage areas up-gradient of Wet Wells 2 and 3 reports to the wet wells rather than passing beyond them in the perimeter ditch system. Therefore, the average stormwater flow expected in the drainage areas associated with Wet Wells 2 and 3 is assigned as reporting entirely to those wet wells in the flow approximations presented here. Conversely, the total flow recorded at the flowmeter on Wet Well 4 can apparently be accounted for without inclusion of stormwater from the drainage area up-gradient of the wet well. Consequently, in approximating flow contributions at Wet Well 4, no surface drainage component is used under current conditions.

Above average runoffs from precipitation events create direct surface stormwater discharges. It can be shown by graphing precipitation versus wet well flow, that precipitation events increase the flows within Wet Wells 2 and 3. Precipitation also increases flows within Wet Well 4, where collected stormwater from the North Retention Pond is directly discharged to the wet well (Figure 3). Figures 6, 7, and 8 reveal the flow versus precipitation relationships at the wet wells. The remainder of the stormwater not captured at the wet wells reports directly to Pond 6 via the perimeter collection ditches.

Regardless of the assignment of the conveyance of these stormwater event flows to Pond 6 or Tank 6 via the wet wells, or to direct runoff to Pond 6 via collection trenches and toe ditches, the total volume of stormwater reaching the Pond 6/Tank 6 collection area is the same. Water routing in the surface tailings area is shown on Figures 3 and 4.

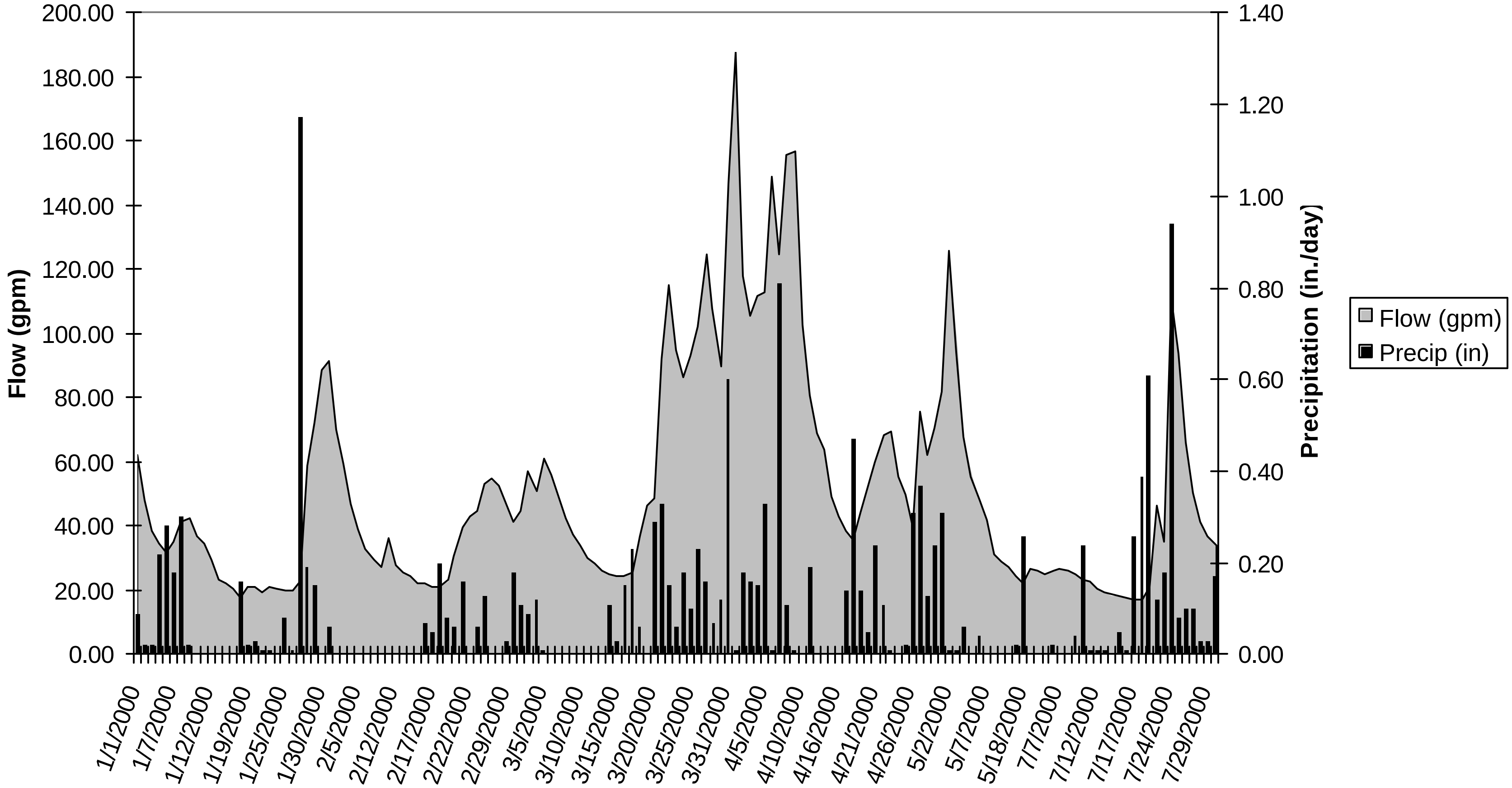
2.2.1 Average Flow

Table 1 summarizes the measured and calculated average flow rates from the wastewater sources contributing to the surface tailings area water management system. Calculations of these flow rates are presented in Appendix G.

The total water expected to be collected and directed to Tank 6/Pond 6 from the three wet wells is 86 gpm on average.

Direct stormwater runoff from the tailings pile and tailings area facilities collected

Figure 6 - Wet Well 2 Flow vs Precip



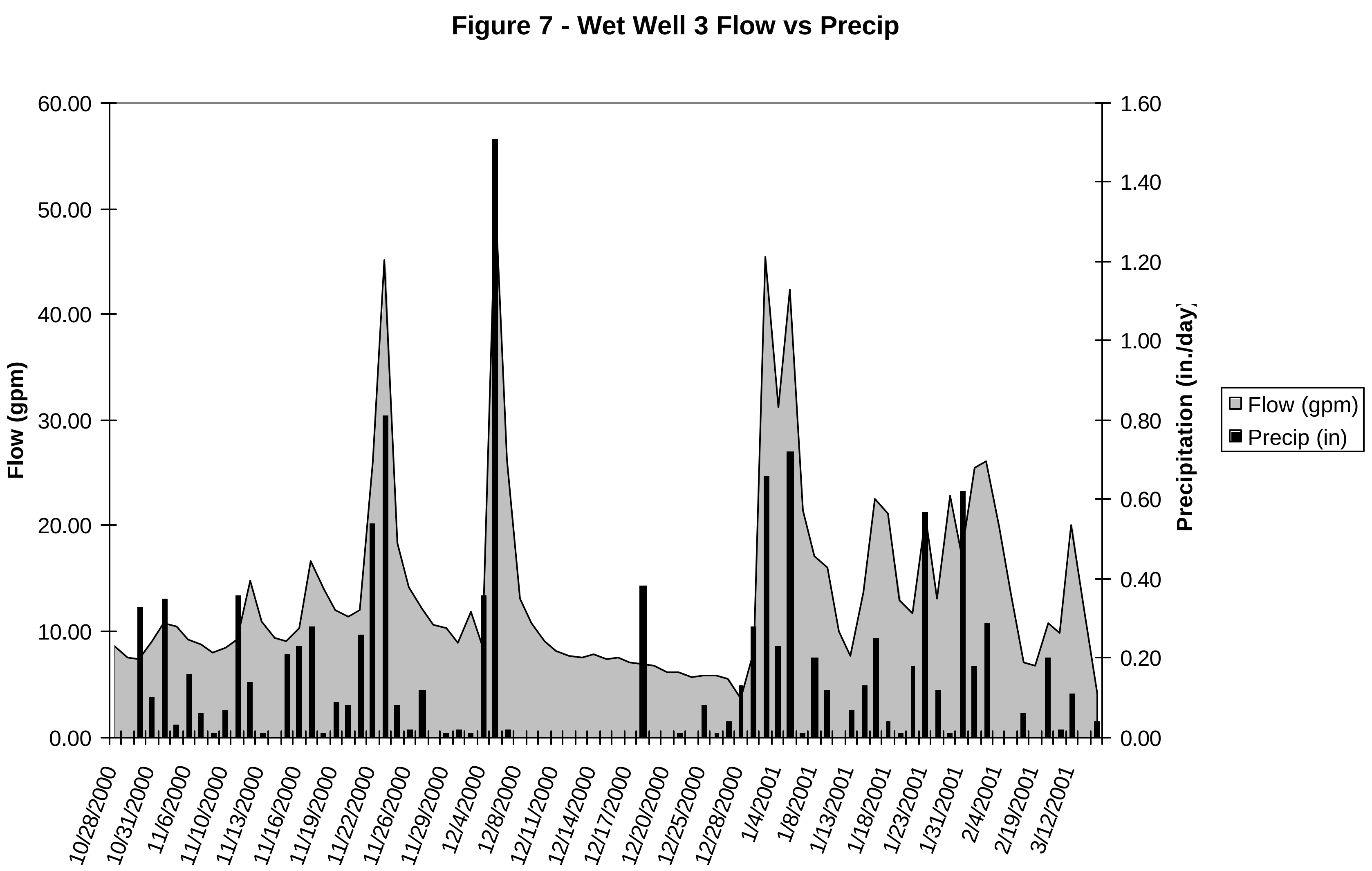
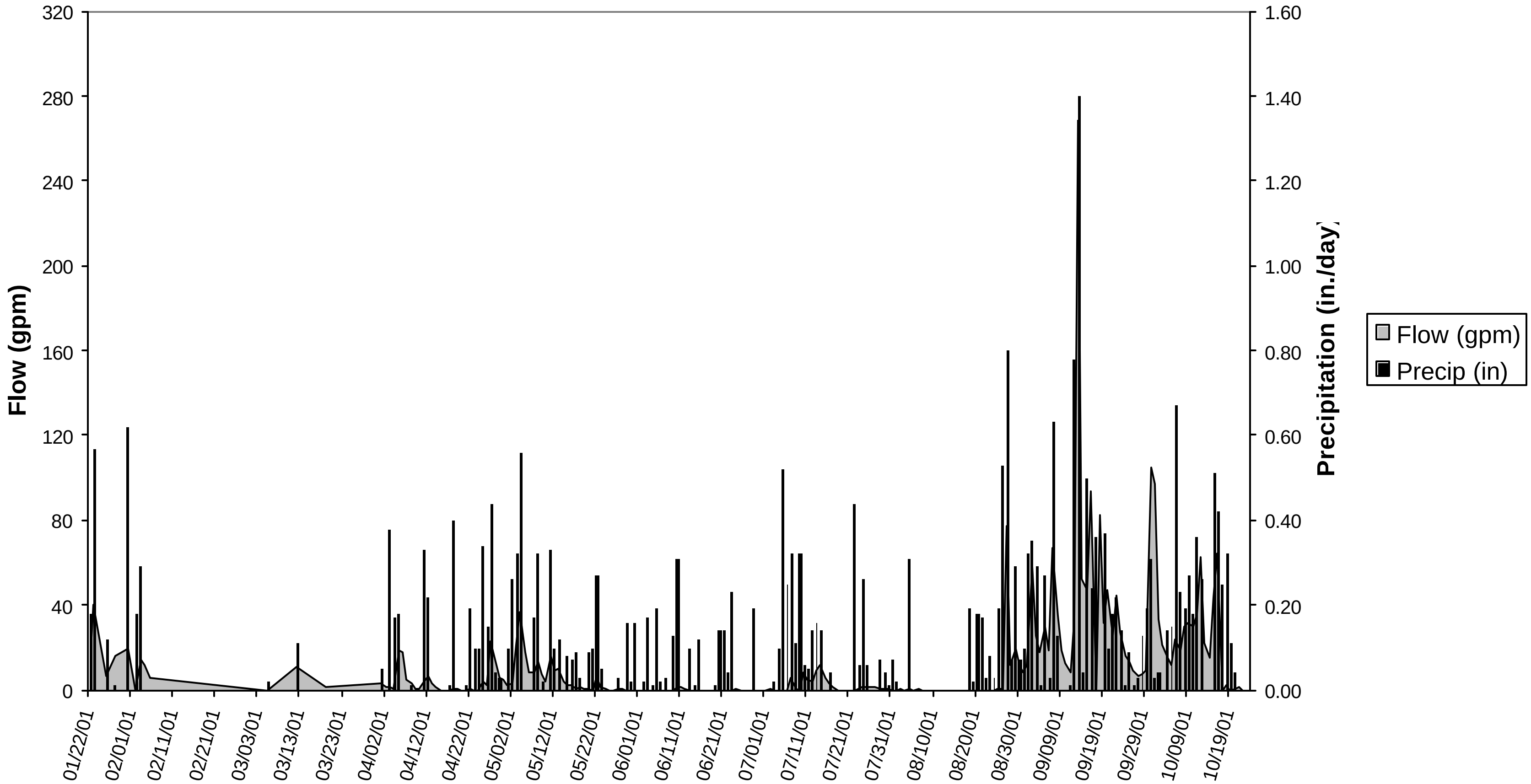


Figure 7 - Wet Well 3 Flow vs Precip
Flow (gpm)
Precipitation (in./day)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Flow (gpm)
Precip (in)
10/28/2000
10/31/2000
11/6/2000
11/10/2000
11/13/2000
11/16/2000
11/19/2000
11/22/2000
11/26/2000
11/29/2000
12/4/2000
12/8/2000
12/11/2000
12/14/2000
12/17/2000
12/20/2000
12/25/2000
12/28/2000
1/4/2001
1/8/2001
1/13/2001
1/18/2001
1/23/2001
1/31/2001
2/4/2001
2/19/2001
3/12/2001

Figure 8 - Wet Well 4 Flow vs Precip



in ditches and routed to Pond 6 (excluding north tailings stormwater collected in the North Retention Pond and conveyed to Pond 6 via Wet Well 4) is 29 gpm on average. Additionally, the influent rate to Pond 6, resulting from precipitation falling on the surface of Pond 6, is 4 gpm on average. Total direct stormwater flow to Pond 6 therefore averages 33 gpm.

2.2.2 Design Flow

Average design flow estimates through existing Wet Wells 2, 3, and 4 to Pond 6 and Tank 6 are based on the 10yr-24hr design storm event. Native groundwater and infiltration contribution to the wet wells are expected to stay at the average flows presented above. Estimated stormwater flows for the design event have been calculated using SEDCAD 4. SEDCAD 4 model runs for the 10yr-24hr event stormwater runoffs for wet wells and direct discharge are provided in Appendix H. SEDCAD 4 model runs for the 10yr-24hr event stormwater runoff for the current North Retention Pond are provided in Appendix I. Note that some portion of the stormwater is tributary to Pond 6 and Tank 6 via surface collection ditch/under-drain interaction at Wet Wells 2 and 3 (Figures 6 and 7).

The portion of design event flow routed to Pond 6/Tank 6 via wet wells is not quantifiable, and with the limited data would be difficult to compute. To provide a conservative estimate of the necessary current flow handling ability of the wet wells, 50% of the stormwater runoff from the 10yr-24hr events is assigned to the wet wells. There is insufficient monitoring data to determine the actual proportion of the design storm reporting to the wet wells. Assignment of 50% to the wet well flows provides a wet well effluent discharge larger in proportion than those monitored under the lesser storm conditions as shown on Figures 6, 7, and 8. Table 1 summarizes the average and peak flows from the 10yr-24hr design storm event for the surface tailings impoundment area. Stormwater flows not captured by the wet well system report to Pond 6 via surface drainage ditching (Figure 4). Figure 3 shows the sources of water reporting to the wet wells, the peak and average flows for the design event and the pump capacity of the wet wells.

The total water expected to be collected and directed to Tank 6/Pond 6 from the three wet wells during the design event (over a 24 hour period) is 1,095 gpm on average.

Design event stormwater from the surface tailings pile and tailings area facilities collected in ditches and routed to Pond 6 (excluding north tailings stormwater collected in the North Retention Pond and conveyed to Pond 6 via Wet Well 4) will be 793 gpm on average. Additionally, the average design event influent rate to Pond 6, resulting from precipitation falling on the surface of Pond 6, will be 65 gpm on average. Total direct flow to Pond 6 from the design event stormwater runoff is 858 gpm on average.

2.3 920 Site, Site 23, and Site D Wastewater

2.3.1 Average Flow

The mine facilities, located up the B Road from the surface tailings impoundment area, at the 920 Site collect fresh water from Greens Creek for use in mine processing. After use in the 920 mill, the wastewater is treated at the mill WTP and forwarded via a 10” gravity flow HDPE line to Tank 6 or Wet Well 1. Stormwater runoff is also collected at the 920 Site, Site 23, and Site D. After passing through degritting basins, these stormwaters are discharged, by gravity or pumping, via an 8” HDPE line to Tank 6, Pond 6, or Wet Well 1. These pipelines are equipped with flowmeters at the 920 Site and at Tank 6. The average flow from the 10” process water line to the tailings impoundment area is 486 gpm. The average flow from the 8” stormwater collection line to the surface tailings impoundment area is 133 gpm. Total influent water flow to the surface tailings impoundment area water management system from the 920 Site, Site 23, and D site is therefore 619 gpm on average (Table 1). Appendix A contains flowmeter readings and average flow numbers for the process water and stormwater lines reporting to Tank 6. Figures 2 and 3 show the flow routing configuration for these lines.

2.3.2 Design Flow

The 10yr-24hr design storm (4.2 inches) produces stormwater runoff that is collected and temporarily contained at the 920 Site, Site 23, and Site D. This runoff is collected and contained in the network of ponds at these sites consisting of Pond A, Pond 23, and Pond D, until it can be routed to the surface tailings area water management facilities (Figure 2). When the stormwater/wastewater collected in these ponds reaches a set level, pumps within the ponds are tripped on and begin routing the water into the 8” stormwater discharge line. If more stormwater runoff is encountered than can be transferred or pumped from the sites via the 8” pipeline, then additional water management options are available. The 920 mill can be run partially on stormwater discharge when necessary, and the 10” process water line is capable of conveying runoff from large storm events when necessary. Under extreme conditions the mill process is shutdown and the 920 WTP are dedicated to treating the 920 area stormwater runoff, such that the resultant water quality meets NPDES discharge standards.

The stormwater discharges from the 920 Site, Site 23, and Site D to the 8” and 10” pipelines are dependent on the amount of water being dealt with, and the routing decisions of water operations personnel at the time of the event. The maximum possible discharges from the 8” line and the 10” line to Tank 6/Pond 6 are 984 gpm and 954 gpm respectively, based on the worst case storm water routing and system pump capabilities.

The 10yr-24 hr event would produce a combined average stormwater runoff flow of 1,182 gpm effluent from the 920 Site, Site 23, and Site D. This is based on the assumption that Pond A, Pond 23, and Pond D each have 30% of their storage capacity available at the beginning of the event (this is a conservative estimate, normal operating capacities of these ponds are typically less than 30% of total, leaving over 70% of their capacity available) and that these ponds are filled to capacity during the course of the event (retaining 5.28 ac-ft, 1.72 MG, of the stormwater volume for discharge after the event). Under normal conditions pond capacities at the 920 Site, Site D, and Site 23 may be compromised up to 15-25% with sediment, illustrating the practicality of this conservative estimate. The capacity of Pond A is 3.76 ac-ft, Pond 23 is 3.28 ac-ft, and the D pond is 0.50 ac-ft (these ponds are sized for the 10yr-24hr event). Appendix J presents the 10yr-24hr event SEDCAD 4 model results for the 920 Site, Site 23, and Site D.

The 1,182 gpm design event effluent flow could be handled as 984 gpm in the 8” line and 198 gpm in the 10” line plus the 10” line average flow of 486 gpm for a total 10” flow of 684 gpm (as shown in Table 1). For this analysis, it was assumed this combined average flow of 1,668 gpm would be discharged to Tank 6/Pond 6 from these supply lines during the design event (Table 1).

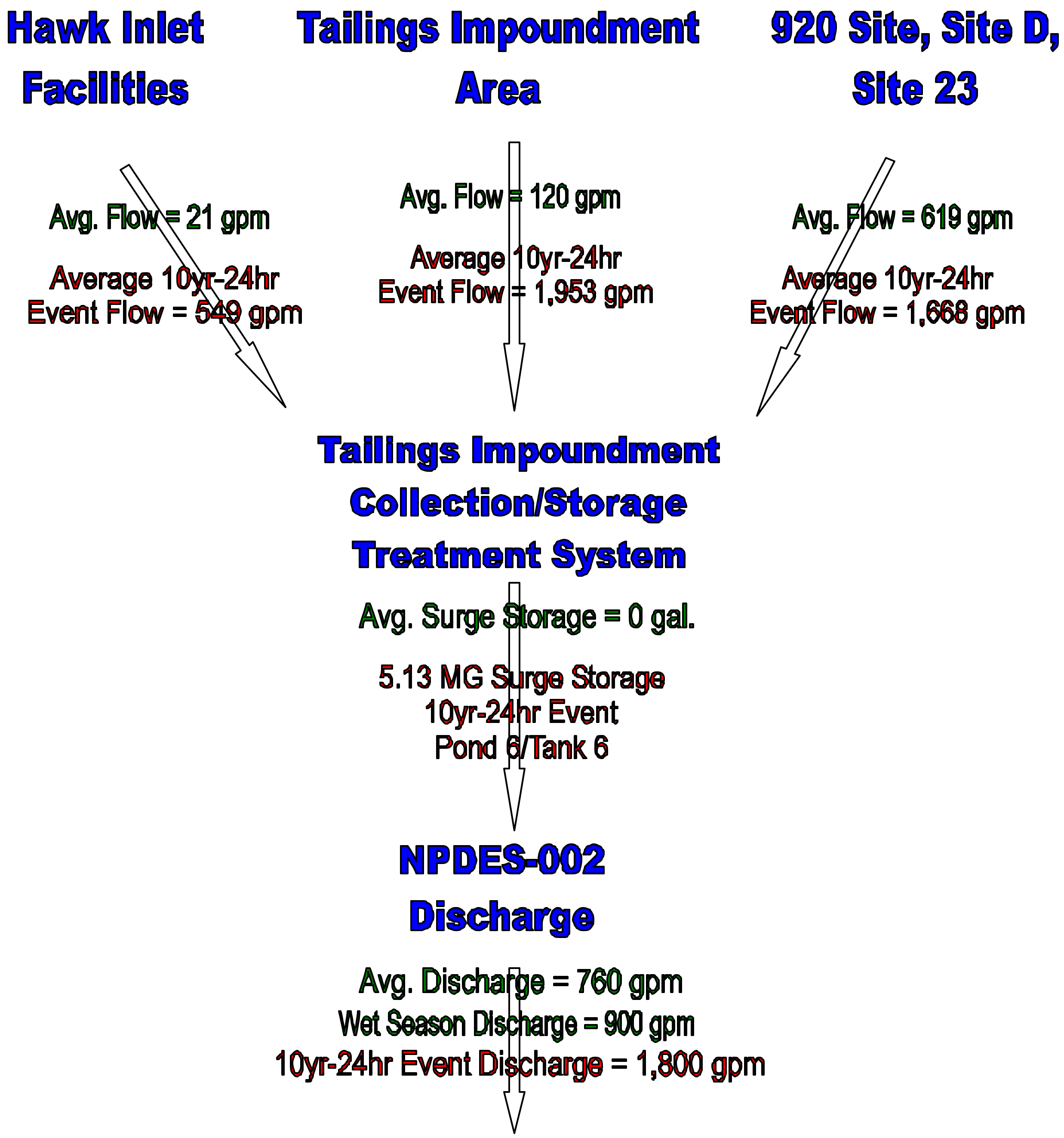
2.4 Surface Tailings Impoundment Area Water Discharge

Typically, water is collected in Tank 6 and can be sent to primary water treatment at the Pit 5 WTP at as much as 1,230 gpm maximum flow (pump ability at the primary treatment pump station from Tank 6). Although the WTP can treat this maximum flow if necessary, normal operational flow is well below the maximum. Discharge from the Pit 5 WTP is typically sent directly to Wet Well 1 for discharge at KGCMC NPDES-002, but can be optioned to the filter plant for secondary treatment if necessary. Water reporting to Tank 6 in excess of the Pit 5 WTP capacity is contained within Tank 6/Pond 6 as surge storage until it can be sent to treatment. Under large stormwater influent conditions to the Tank6/Pond 6 containment facilities, water can be routed directly from Tank 6 or Pond 6 to Wet Well 1 at a maximum pump rate of 1,200 gpm and sent from there to either the Pit 5 WTP or the filter plant to be treated. Currently, under large storm runoff treatment conditions, a maximum of 1,800 gpm can be discharged through KGCMC NPDES-002, by gravity or non-mechanical means. This is accomplished by routing 900 gpm through the water treatment plant and 900 gpm through the filter plant, combining the flows, and sending them to Wet Well 1 for discharge. Once the water has been treated and/or pumped to Wet Well 1, it is discharged through a buried pipeline and into a diffuser on the ocean floor within Hawk Inlet at KGCMC NPDES-002. Maximum daily permitted discharge at KGCMC NPDES-002 is 2,500 gpm, but the maximum discharge by gravity methods currently possible, is limited by the system capacity, to 1,800 gpm. Therefore, because the system discharge rates could be increased to reach the 2,500 gpm allowable discharge, modeling at 1,800 gpm discharge presents the potential worst case scenario and further aids the conservative nature of these estimates. Figure 3 details the routing possibilities from Tank 6 and Pond 6. Figure 9 presents a simplified flow chart showing flow rates into Tank 6/Pond 6 and corresponding discharge rates from the system.

2.4.1 Average Flow

The average rate of water discharged at KGCMC NPDES-002 is equal to the average rate of water received from DB-04 (21 gpm) plus the average rate of water received from tailings wet wells and tailings area stormwater runoff (119 gpm) plus the average rate of water sent to Tank 6/Pond 6 from the 920 Site, Site 23, and D Site (619

Figure 9 – Current Water Management Balance



gpm), totaling an average flow of 759 gpm (Table 1). The average flowmeter reading taken from the KGCMC NPDES-002 discharge point is 734 gpm (Appendix A), which is only a 3% discrepancy from contributing source monitoring and estimates as presented above. It should be noted, that the storm water portions of the average flows from DB-04 and the 920/23/D Sites are based on recent flowmeter readings and are reflective of the below normal precipitation conditions experienced at KGCMC over the summer/fall of 2001. As such, these averages are slightly less than what could be expected during an average precipitation year. Additionally, these averages are lower than the flow rates that could be expected during wetter periods of the year (tailings stormwater calculations in Appendix G are averaged over an entire year). Currently during the wettest portions of the year KGCMC water operations experiences an average inflow and discharge of about 900 gpm. Allowable discharge must be modeled from this larger flow rate to achieve compliance during the wettest (greatest precipitation) portions of the year.

2.4.2 Design Flow

The average design event discharge (10yr-24hr) from KGCMC NPDES-002 is composed of the average design event flow influent to Tank 6/Pond 6 from DB-04 (549 gpm), tailings wet wells and stormwater runoff (1,953 gpm), and the 10" process and 8" surface water pipelines (1,668 gpm), of about 4,170 gpm (Table 1). Since this influent rate is greater than the current maximum gravity discharge rate of 1,800 gpm, design event discharge at KGCMC NPDES-002 should be set to 1,800 gpm in order to use up the least amount of surge capacity in Pond 6.

2.5 Water Management System Capacity

2.5.1 Average Flow

The Hawk Inlet facilities and the location of the surface tailings impoundment site are in an area that receives an average of 52.9 inches of rain annually. Average rainfall runoff and infiltration collection at these areas has been accounted for in the water management flow numbers presented in the preceding sections. Average stormwater and treated water effluents from the 920 Site, Site D, and Site 23 as presented in the previous sections are derived from flowmeter readings where these discharges report to the surface tailings area in the 10 inch and 8 inch HDPE pipelines. Under the calculations presented above and as shown in the flow summary in Table 1, the average amount of water passing through the management system and reporting to KGCMC NPDES-002 is 759 gpm under current conditions. During the portions of the year with greatest precipitation the observed flow rate is about 900 gpm passing through the management system and reporting to KGCMC NPDES-002. Currently the water treatment facilities at Pit 5 adequately keeps up with this amount of water flow and can handle approximately 1,800 gpm indefinitely based on the gravity flow system maximum discharge capacity.

2.5.2 Design Flow

Under current average flow conditions with total treatment of the collected water: 759 gpm (or at the peak 900 gpm), and using the Tank 6 capacity of 1.1 MG for surge storage, it is possible to leave Pond 6 near empty. The Pond 6 capacity is 7.04 MG. By operating with Pond 6 at near empty conditions, the capacity of the pond is available for water storage that may become necessary due to water treatment shutdown or a large precipitation/stormwater runoff event.

Observed storm events at the mine since the completion of Pond 6 have filled the pond to capacity but have never resulted in discharge from the pond through the emergency spillway. The current water management system at KGCMC has been designed to handle the 10yr-24hr storm event. The stormwater produced from the design event reports relatively quickly to Pond 6 due to the close proximity of the runoff areas and the direct routing of collection sumps and ditches to the Pond. To obtain the worst case design event flow scenario from the design event flow numbers presented above, the total volume of water delivered to Tank 6/Pond 6 was assumed to be delivered within the 24 hour storm duration during the wettest portion of the year (base flow = 900 gpm).

During the design event 4,170 gpm on average is predicted to report to Tank 6/Pond 6 (Table 1). All of this water cannot be treated immediately (treatment rate = 1,800 gpm) and so some must be stored using Pond 6 as surge storage. To reduce the amount of water being routed to storage in Pond 6, the water management system is run at maximum discharge of 1,800 gpm as described in Section 2.4. Thus, on average, 2,370 gpm enters Pond 6 during the 24 hour storm influent period. This results in 3.41 MG of water being sent to storage in Pond 6, or about 48% of the Pond 6 total capacity. During the management of the storm water discharge, 1.72 MG is retained in Ponds A, 23, and D as described in Section 2.3.2. The total volume of captured water from the storm is 3.41 MG + 1.72 MG or 5.13 MG. The retained water is treated and discharged through the established water systems, as the storm event subsides.

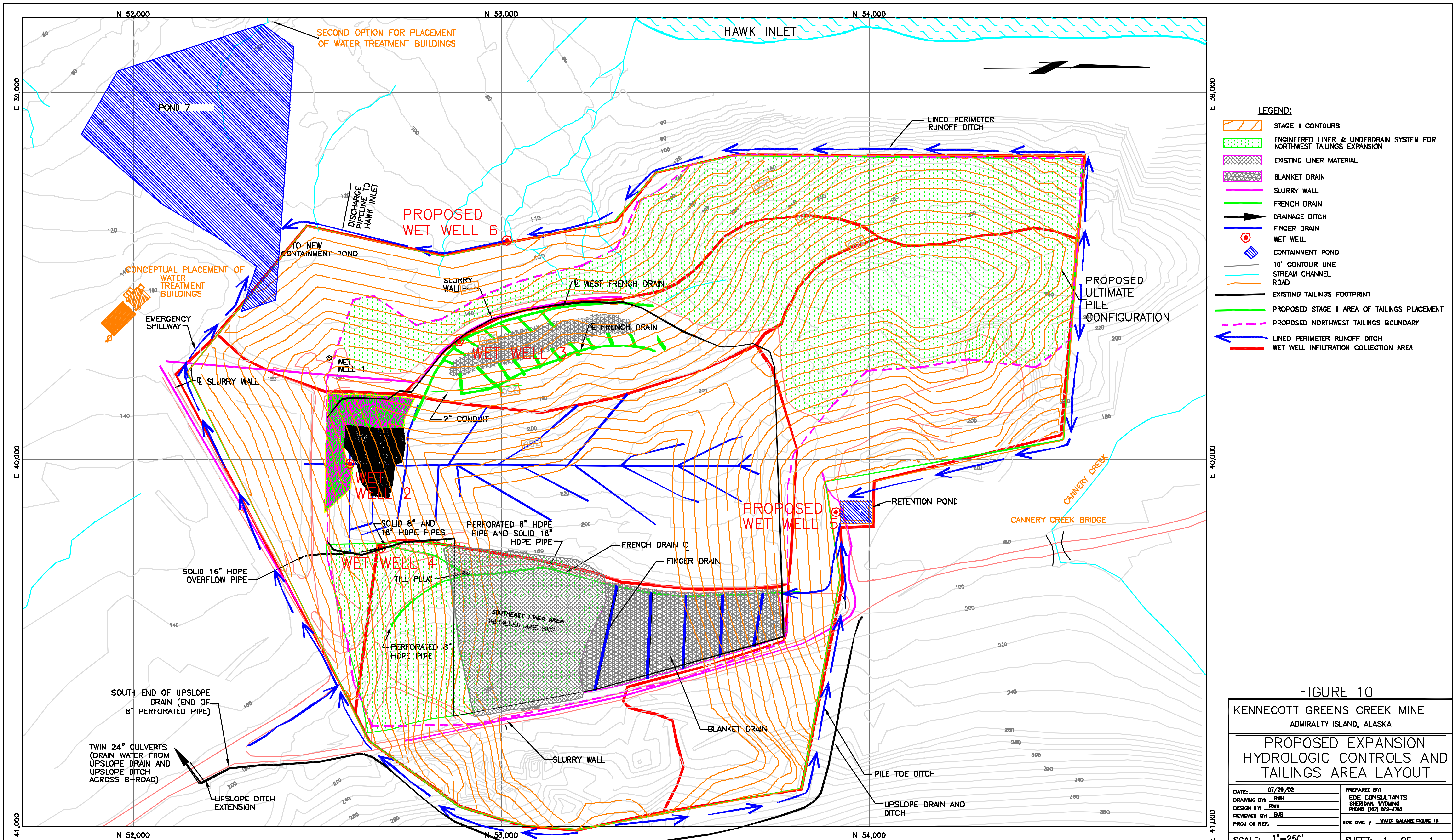
To completely drain the ponds after the event capacity has been contained, the wet season influent to Tank 6/Pond 6 of 900 gpm must be dealt with while discharging at the maximum 1,800 gpm rate. This results in 900 gpm being removed from the stored water volume in the ponds. At this rate it takes 95 hours to dewater the ponds to pre-storm conditions. Because the current design storm can be contained within the water management system, the current storage capacities of the pond and treatment system are adequate for the 10yr-24hr design storm.

3.0 Proposed Stage II Expansion Water Management

KGCMC proposes to expand the surface tailings storage area and associated facilities as part of the Stage II expansion. The ultimate or full proposed Stage II surface tailings expansion will consist of progressively enlarging the surface tailings footprint in several areas including the Northwest, Pit 5, Pond 6, Wide Corner, and East Ridge areas (Figure 10). This proposed expansion will create a larger disturbance area at the surface tailings impoundment, and this will increase the amount of stormwater from precipitation events that is collected for treatment. The proposed full expansion area will also eventually cover the present areas where Tank 6 and Pond 6 are located. Current water storage locations will be supplemented with a newly constructed proposed Pond 7 at the southwest corner of the proposed expansion area. Figure 10 presents the proposed expansion area surface tailings footprint and associated collection structures and infiltration drainage areas.

The diversion of fresh water quantities from Greens Creek and Cannery Creek will not change as a result of the proposed expansion. Wastewater sources to the surface tailings area water management facilities at Tank 6/Pond 6 will remain the same:

- Domestic wastewater and stormwater from the upper and lower facilities pads at the Hawk Inlet operations area at DB–04.
- Surface tailings contact water and stormwater from tailings area facilities.
- 920 facilities area stormwater, 920 domestic wastewater and mill WTP discharges, and Site 23/Site D stormwater discharges.



N 52,000
N 53,000
N 54,000
E 39,000
E 40,000
E 41,000
HAWK INLET
SECOND OPTION FOR PLACEMENT OF WATER TREATMENT BUILDINGS
POND 7
DISCHARGE PIPELINE TO HAWK INLET
PROPOSED WET WELL 6
TO NEW CONTAINMENT POND
CONCEPTUAL PLACEMENT OF WATER TREATMENT BUILDINGS
EMERGENCY SPILLWAY
SLURRY WALL
℄ WEST FRENCH DRAIN
℄ FRENCH DRAIN
WET WELL 3
WET WELL 1
℄ SLURRY WALL
2" CONDUIT
WET WELL 2
LINED PERIMETER RUNOFF DITCH
PROPOSED ULTIMATE PILE CONFIGURATION
PROPOSED WET WELL 5
RETENTION POND
CANNERY CREEK
CANNERY CREEK BRIDGE
SOLID 8" AND 16" HDPE PIPES
PERFORATED 8" HDPE PIPE AND SOLID 16" HDPE PIPE
FRENCH DRAIN ℄
FINGER DRAIN
WET WELL 4
TILL PLUG
SOLID 16" HDPE OVERFLOW PIPE
SOUTHEAST LINER AREA INSTALLED JUNE 2002
PERFORATED 3" HDPE PIPE
BLANKET DRAIN
SLURRY WALL
PILE TOE DITCH
UPSLOPE DRAIN AND DITCH
SOUTH END OF UPSLOPE DRAIN (END OF 8" PERFORATED PIPE)
TWIN 24" CULVERTS (DRAIN WATER FROM UPSLOPE DRAIN AND UPSLOPE DITCH ACROSS B-ROAD)
UPSLOPE DITCH EXTENSION
LEGEND:
STAGE I CONTOURS
ENGINEERED LINER & UNDERDRAIN SYSTEM FOR NORTHWEST TAILINGS EXPANSION
EXISTING LINER MATERIAL
BLANKET DRAIN
SLURRY WALL
FRENCH DRAIN
DRAINAGE DITCH
FINGER DRAIN
WET WELL
CONTAINMENT POND
10' CONTOUR LINE
STREAM CHANNEL
ROAD
EXISTING TAILINGS FOOTPRINT
PROPOSED STAGE I AREA OF TAILINGS PLACEMENT
PROPOSED NORTHWEST TAILINGS BOUNDARY
LINED PERIMETER RUNOFF DITCH
WET WELL INFILTRATION COLLECTION AREA
FIGURE 10
KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA
PROPOSED EXPANSION HYDROLOGIC CONTROLS AND TAILINGS AREA LAYOUT
DATE: 07/29/02
DRAWING BY: RWH
DESIGN BY: RWH
REVIEWED BY: BJB
PROJ OR REF. ---
PREPARED BY:
EDE CONSULTANTS
SHERIDAN, WYOMING
SCALE: 1"=250'
SHEET: 1 OF 1

The two NPDES discharge points for the KGCMC water management system will remain after the proposed surface tailings expansion, with NPDES-002 continuing to be used as the primary discharge. NPDES-001 remains inactive as an emergency backup outfall site.

By the requirements of the State of Alaska Solid Waste Permit, the design event flows and peak flows for the proposed Stage II Expansion surface tailings footprint area are to be based on the 25yr-24hr storm instead of the current 10yr-24hr storm design event. The areas at the surface tailings impoundment, Site 23, and Site D all fall under the Solid Waste Permit, and the design event applied to these areas in the following expansion water management discussions will be the 25yr-24hr event. The areas at the 920 Site and at the Hawk Inlet facilities do not fall under the Solid Waste Permit design criteria revision. The 25yr-24hr precipitation is 4.2 inches at the tailings impoundment and 5.25 inches at Site D and Site 23.

The following Sections 3.1, 3.2, and 3.3 characterize the wastewater reporting to the proposed Pond 7 containment facilities from Hawk Inlet, surface tailings area, and 920 Site/Site 23/Site D sources respectively. Average flow rates, design event flow rates and peak flow rates for wastewaters reporting to Tank 6/Pond 6 are listed in Table 2. Section 3.4 describes the water management practices from proposed Pond 7 containment to discharge at KGCMC NPDES-002, and Section 3.5 details design event containment and water management practices, and proposed expansion driven NPDES discharge requirements and revisions. The proposed surface tailings expansion area water routing flow chart is shown on Figure 11.

3.1 Hawk Inlet Facilities Wastewater

No change in freshwater diversion and use rates or stormwater collection is expected at the Hawk Inlet facilities/pad area as a result of the surface tailings area proposed expansion.

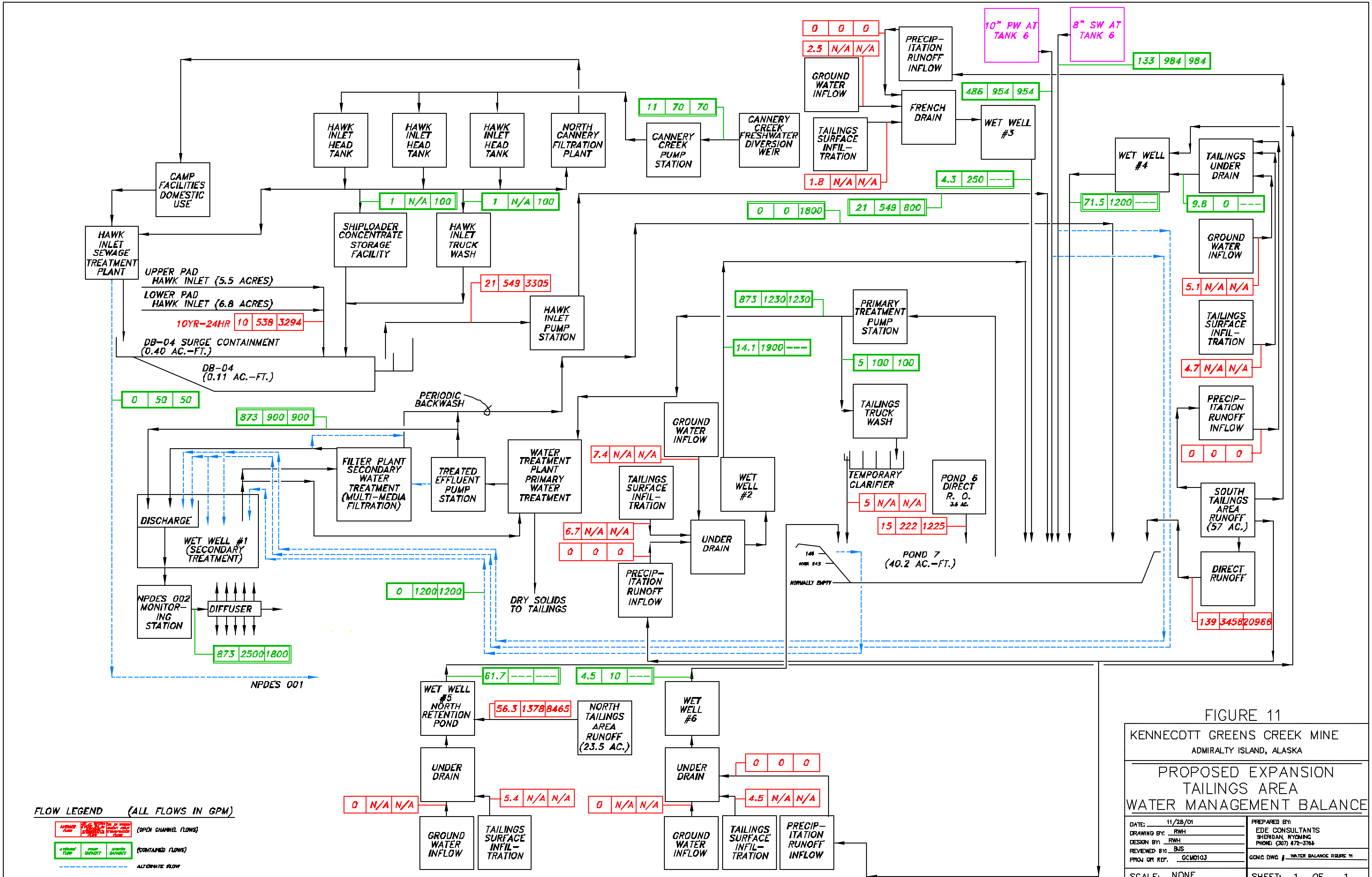
Average flows are expected to remain as reported in Section 2.1.1 above. Average DB-04 effluent is 21 gpm.

Average design event flows are expected, therefore, to remain as reported in Section 2.1.2 above. Average design event DB-04 effluent is 549 gpm. The design event for the Hawk Inlet facilities area remains the 10yr-24hr event.

Table 2
Flows Reporting to Full Expansion Tailings Area Water Management

Source	average gpm	10yr-24hr avg. gpm	10yr-24hr peak gpm
Cannery Creek Intake	11	11	11
Hawk Inlet Area Runoff	10	538	3,294
DB-04 Effluent	**21**	**549**	**3,305**
		25yr-24hr avg. gpm	**25yr-24hr peak gpm**
Wet Well 2 Groundwater Inflow	7.4	7.4	7.4
Wet Well 2 Surface Infiltration	6.7	6.7	6.7
Wet Well 2 Effluent	**14.1**	**14.1**	**14.1**
Wet Well 3 Groundwater Inflow	2.5	2.5	2.5
Wet Well 3 Surface Infiltration	1.8	1.8	1.8
Wet Well 3 Effluent	**4.3**	**4.3**	**4.3**
Wet Well 4 Groundwater Inflow	5.1	5.1	5.1
Wet Well 4 Surface Infiltration	4.7	4.7	4.7
Wet Well 5 Groundwater Inflow	0.0	0.0	0.0
Wet Well 5 Surface Infiltration	5.4	5.4	5.4
North Retention Pond	56.3	1,378	2,383
Wet Well 4 Effluent	**71.5**	**1,393**	**2,398**
Wet Well 6 Groundwater Inflow	0.0	0.0	0.0
Wet Well 6 Surface Infiltration	4.5	4.5	4.5
Wet Well 6 Effluent	**4.5**	**4.5**	**4.5**
Tailings Area Direct Runoff to Pond 7	123	3,014	18,520
Pond 7 Surface Collection	15	444	2,446
Total Direct Runoff	**138**	**3,458**	**20,966**
10" Process Water Line*	**486**	**954**	**954**
8" Surface Water Line	**133**	**984**	**984**
Total Flow Reporting to Pond 7	**873**	**7,361**	**N/A**

N/A Peak flows occur at different times, total peak flow is not necessarily the sum of the parts.
* average process water discharge = 486 gpm



CAMP FACILITIES DOMESTIC USE
HAWK INLET HEAD TANK
HAWK INLET HEAD TANK
HAWK INLET HEAD TANK
NORTH CANNERY FILTRATION PLANT
CANNERY CREEK PUMP STATION
CANNERY CREEK FRESHWATER DIVERSION WEIR
GROUND WATER INFLOW
TAILINGS SURFACE INFIL-TRATION
PRECIP-ITATION RUNOFF INFLOW
FRENCH DRAIN
WET WELL #3
10" PW AT TANK 6
8" SW AT TANK 6
HAWK INLET SEWAGE TREATMENT PLANT
SHIPLOADER CONCENTRATE STORAGE FACILITY
HAWK INLET TRUCK WASH
HAWK INLET PUMP STATION
UPPER PAD HAWK INLET (5.5 ACRES)
LOWER PAD HAWK INLET (6.8 ACRES)
10YR-24HR
DB-04 SURGE CONTAINMENT (0.40 AC.-FT.)
DB-04 (0.11 AC.-FT.)
PERIODIC BACKWASH
WET WELL #4
TAILINGS UNDER DRAIN
GROUND WATER INFLOW
TAILINGS SURFACE INFIL-TRATION
PRECIP-ITATION RUNOFF INFLOW
SOUTH TAILINGS AREA RUNOFF (57 AC.)
DIRECT RUNOFF
PRIMARY TREATMENT PUMP STATION
TAILINGS TRUCK WASH
TEMPORARY CLARIFIER
POND 6 DIRECT R. O.
POND 7 (40.2 AC.-FT.)
NORMALLY EMPTY
FILTER PLANT SECONDARY WATER TREATMENT (MULTI-MEDIA FILTRATION)
TREATED EFFLUENT PUMP STATION
WATER TREATMENT PLANT PRIMARY WATER TREATMENT
DISCHARGE
WET WELL #1 (SECONDARY TREATMENT)
NPDES 002 MONITOR-ING STATION
DIFFUSER
NPDES 001
DRY SOLIDS TO TAILINGS
GROUND WATER INFLOW
WET WELL #2
TAILINGS SURFACE INFIL-TRATION
UNDER DRAIN
PRECIP-ITATION RUNOFF INFLOW
WET WELL #5 NORTH RETENTION POND
NORTH TAILINGS AREA RUNOFF (23.5 AC.)
UNDER DRAIN
GROUND WATER INFLOW
TAILINGS SURFACE INFIL-TRATION
WET WELL #6
UNDER DRAIN
GROUND WATER INFLOW
TAILINGS SURFACE INFIL-TRATION
PRECIP-ITATION RUNOFF INFLOW
0 | 0 | 0
2.5 | N/A | N/A
133 | 984 | 984
486 | 954 | 954
11 | 70 | 70
1.8 | N/A | N/A
4.3 | 250 | ---
1 | N/A | 100
1 | N/A | 100
0 | 0 | 1800
21 | 549 | 800
71.5 | 1200 | ---
9.8 | 0 | ---
21 | 549 | 3305
10 | 538 | 3294
873 | 1230 | 1230
14.1 | 1900 | ---
5 | 100 | 100
5.1 | N/A | N/A
4.7 | N/A | N/A
0 | 0 | 0
0 | 50 | 50
873 | 900 | 900
7.4 | N/A | N/A
5 | N/A | N/A
15 | 222 | 1225
6.7 | N/A | N/A
0 | 0 | 0
0 | 1200 | 1200
139 | 3458 | 20986
873 | 2500 | 1800
61.7 | --- | ---
4.5 | 10 | ---
56.3 | 1378 | 8465
0 | 0 | 0
5.4 | N/A | N/A
0 | N/A | N/A
4.5 | N/A | N/A
0 | N/A | N/A
FLOW LEGEND (ALL FLOWS IN GPM)
(OPEN CHANNEL FLOWS)
(CONTAINED FLOWS)
ALTERNATE FLOW
FIGURE 11
KENNECOTT GREENS CREEK MINE
ADMIRALTY ISLAND, ALASKA
PROPOSED EXPANSION TAILINGS AREA WATER MANAGEMENT BALANCE
DATE: 11/28/01
DRAWING BY: RWH
DESIGN BY: RWH
REVIEWED BY: BJS
PROJ OR REF. GCM0103
PREPARED BY: EDE CONSULTANTS SHERIDAN, WYOMING PHONE: (307) 672-3786
CONC DWG # WATER BALANCE FIGURE 11
SCALE: NONE
SHEET: 1 OF 1

3.2 Surface Tailings Impoundment Contact Water

Water within the proposed surface tailings expansion area will still be collected from the surface tailings impoundment via the three Wet Wells 2, 3, and 4 and by direct stormwater runoff to proposed Pond 7. This assumes that for preliminary proposed expansion consideration purposes, these wet wells can remain during pile build out, and that discharges from these wet wells can be routed to proposed Pond 7 by pipelines. Additionally, proposed expansion of the surface tailings footprint may result in the addition of new wet wells to collect under-drain waters that will not be reportable to Wet Wells 2, 3, and 4 as a result of flow gradients under some portions of the proposed expansion pile footprint (Figure 10). Also, the North Retention Pond may need to be resized for the 25yr-24hr event and relocated approximately 250 feet northwest of its present location to be outside of the proposed expansion surface tailings footprint (Figure 10).

The amount of stormwater, surface infiltration, and groundwater collected from the proposed expansion area will be greater than under the current conditions. The proposed expansion of the surface tailings will take place in several phases at several areas within the full potential area of surface tailings placement projected for the Stage II Expansion. To consider the maximum water management volumes produced from the surface tailings area, the proposed expansion water management detailed in this section will assume full potential Stage II surface tailings expansion build out. Under full build out, the surface tailings pile will be expanded from the current configuration in all directions. For preliminary design consideration, and to help visualize water collection areas and management volumes, two additional wet wells are added to this proposed expansion water management evaluation. These are Wet Wells 5 and 6. Figure 10 shows the proposed expansion area footprint and the conceptual locations of the additional wet wells. Wet Well 5 will be the collection point for the infiltration collection drain under the north central portion of the pile and is located at, and reports directly to, the relocated North Retention Pond. Effluent from the North Retention Pond under expansion is routed by pipeline to Wet Well 4, as it is under the current configuration. Wet Well 6 will provide a collection point for the infiltration collection drain that will underlay the west portion of the proposed expanded tailings pile. Wet Well 6 will report to proposed Pond 7 by pipeline.

The under-drain infiltration collection areas associated with all three existing wet wells will increase as a result of the proposed expansion. This will increase infiltration flows reporting to the wet wells. Conversely, additional groundwater contribution to the existing under-drain collection system will be prevented by under laying the expanded surface tailings pile areas with a geomembrane liner material. Consequently, the groundwater flow contribution to Wet Wells 2, 3, and 4 will remain unchanged. Because the infiltration collection drains reporting to Wet Wells 5 and 6 will be underlain entirely with the geomembrane liner material, water reporting to these wet wells will be almost entirely infiltration water with little or no groundwater component.

Under the current pile configuration a large amount of stormwater is seen to report to the wet wells mainly as a result of communication between stormwater runoff collection ditches which overlay infiltration collection french drain systems. The current wet well water management was modeled to reflect this in Section 2.2 above. Construction and placement of the surface tailings pile infiltration collection galleries and stormwater runoff collection systems under the proposed expansion build out will be done to alleviate this toe ditch-under-drain interaction. Consequently, the wet wells at full expansion build out will primarily receive tailings infiltration water with virtually no stormwater runoff contribution. The proposed expansion wet well water management is modeled to reflect this.

3.2.1 Average Flow

Table 2 summarizes the calculated average flow rates from the wastewater sources contributing to the proposed expansion surface tailings area water management system. Calculations of these flow rates are presented in Appendix K.

The total water expected to be collected and directed to proposed Pond 7 from the five wet wells in the proposed expansion area is 94 gpm on average.

Direct stormwater runoff from surface tailings also reports to Pond 7. Stormwater from the surface tailings pile and tailings area facilities collected in ditches and routed to proposed Pond 7 (excluding north tailings stormwater collected in the North Retention Pond and conveyed to proposed Pond 7 via Wet Well 4) will be 123 gpm on average.

Additionally, the influent rate to proposed Pond 7, resulting from precipitation falling on the surface of proposed Pond 7, will be 15 gpm on average. Total flow to proposed Pond 7 from the surface tailings area stormwater runoff is 138 gpm on average.

3.2.2 Design Flow

Design event flows through Wet Wells 2, 3, 5, and 6 will be approximately the same as the average flows. This is because the groundwater and infiltration contribution to these wet wells is expected to stay at the average flow rates presented above, and these proposed expansion area wet wells will collect no significant amount of stormwater. The increased design event flow within Wet Well 4 will result from the design event stormwater runoff collected at the North Retention Pond and discharged to the wet well. The storm event used to predict maximum flows within the surface tailings area proposed Stage II Expansion water management system is the 25yr-24hr precipitation event. SEDCAD 4 modeling for the proposed surface tailings expansion area 25yr-24hr event is presented in Appendix L.

The majority of the design event flows will be conveyed by collection ditches as stormwater runoff to proposed Pond 7, fall directly on the surface area of proposed Pond 7, or be conveyed to proposed Pond 7 via Wet Well 4 from stormwater collected in ditches and routed to the North Retention Pond.

The total water predicted to be collected and directed to proposed Pond 7 from the five wet wells in the proposed expansion area during the design event, is 1,416 gpm on average.

Design event stormwater runoff from the surface tailings pile and tailings area facilities collected in ditches and routed to proposed Pond 7 (excluding north tailings stormwater collected in the North Retention Pond and conveyed to proposed Pond 7 via Wet Well 4) is predicted to be 3,014 gpm on average. Additionally, the average design event influent rate to proposed Pond 7, resulting from precipitation falling on the surface of proposed Pond 7, is predicted to be 444 gpm on average. Therefore, average predicted tailings area flow to proposed Pond 7 from the design event stormwater runoff is 3,458 gpm.

3.3 920 Site, Site 23, and Site D Wastewater

No change in average flow rates reporting from process use or 920 Site, Site 23, and Site D stormwater runoff to the surface tailings area water management system is expected as a result of the proposed surface tailings area expansion.

Average flow rates are expected to remain as reported in Section 2.3.1 above. Average 8” surface water pipeline and 10” process water pipeline effluents are 133 gpm and 486 gpm respectively.

3.3.1 Design Flow

Although no changes will be made to the average water intake and management practices at Site 23 and Site D, the stormwater runoff design event flows from these facilities will increase from those presented in Section 2.3.2. This is due to the increase in design event size from the 10yr-24hr event to the 25yr-24hr event required by the State for the Solid Waste Program. Pond A does not fall under the Solid Waste Permit. However, Pond 23 and Pond D must be designed to control the 25yr-24hr event, and excessive Pond A stormwater is typically sent to Pond 23 (Pond A capacity, 3.76 ac-ft, will not contain the Pond A area 10yr-24hr event storm volume, 4.71 ac-ft, alone). The 920 Site is only several hundred feet from Site 23 and Site D, and so it must be assumed that during a 25yr-24hr event at Site 23 and Site D, 25yr-24hr event runoff will occur at the 920 Site which may affect storm water collection at Ponds 23 and D. Therefore, to adequately model design event runoff to Ponds 23 and D the 25yr-24hr design event must be used at the 920 Site also. A detailed discussion of Site 23, D Site, and the 920 Site water management is provided in Appendix R.

Runoff flow collected at Pond 23 will increase from current conditions as more development rock is placed at the site. This is because the development rock traps more precipitation (via runoff and infiltration to finger drains) than the stripped area upslope of the 23 pile where significant infiltration occurs that is not directed to Pond 23. Consequently, as the pile footprint expands, so does the runoff produced at Site 23. To address this variation at Site 23, the runoff produced is modeled under two conditions, current and estimated full Site 23 pile build out for the 25yr-24hr event. While these two scenarios affect the storm water collection system at Site 23/D they both result in the same amount of flow leaving Site 23/D during the 25yr-24hr event, because, the design storm runoff produced under either scenario is greater than the 8" and 10" HDPE discharge lines maximum conveyance to the surface tailings impoundment area of 1,938 gpm. Complete capture of the 25yr-24hr event runoff volume (with discharge to Pond 7) will require increase of the runoff storage volumes currently available at Site 23/D/920. Appendix R provides detailed discussion of Site 23/D/920 water management and design storm calculations.

As discussed in Section 2.3.2, the stormwater discharges from the 920 Site, Site 23, and Site D into the 8" and 10" pipelines directed to Tank 6/Pond 6 are dependent on the amount of water being dealt with, and the routing decisions of water operations personnel at the time of the event. However, in the case of the 25yr-24hr event both the 8" and 10" discharge lines would need to be run at capacity in order to remove as much stormwater as possible from the 920/D/23 Site area. The 25yr-24hr event would therefore produce a total average stormwater flow of 1,938 gpm effluent from the 920 Site, Site 23, and the D Site. This is based on the assumption that current storm water collection capacities exist and that Pond A, Pond 23, and Pond D each have 30% of their storage capacity available at the beginning of the event (this is a conservative estimate, the normal operating capacities are typically less than 30% of total), and that these ponds are filled to capacity during the course of the event. Appendix M presents the 25yr-24hr SEDCAD 4 model results for the 920 Site, Site 23, and Site D.

The existing sizes of Ponds 23 and Pond D were used for the 25yr-24hr event calculation above. Full retention of the event runoff requires these ponds storage capacities in tandem with some Pond 7 storage, under the 30% available storage capacity scenario outlined above. This is because the 25yr-24hr event evaluation of the current sizes of these ponds, indicates that these ponds will not contain the 25yr-24hr event as is. Under the 25yr-24hr sizing, 2.40 acre feet of storm water would report to Pond D which, having a capacity of only 0.35 ac-ft (70% of 0.5), would have to discharge to Pond 23. Pond 23 would receive 6.55 ac-ft of Site 23 runoff from the storm, which would allow for no storage for water received from Pond D (Pond 23 available capacity = 70% of 3.28 ac-ft = 2.30 ac-ft). Pond A would deliver 3.61 ac-ft to Ponds 23/D after receiving 6.24 ac-ft of storm runoff (Pond A available capacity = 70% of 3.76 ac-ft = 2.63 ac-ft). This means 9.91 ac-ft of event runoff, 2,243 gpm, cannot be collected in Ponds 23/D/A under current conditions. 1,938 gpm of this flow can be sent to Pond 6 or Pond 7. The existing Site 23/D/920 collection facilities/practices must be modified to control the remaining 305 gpm, 1.35 ac-ft, for complete storm control of all 920 Site, Site 23, and Site D runoff. Under estimated full Site 23 development rock build out a total of 857 gpm, 3.79 ac-ft, would need to be controlled at the Site 23/D/920 facilities beyond that collected in the existing volumes and beyond that sent to Pond 7.

If use of Pond 6 or Pond 7 in conjunction with Pond 23 and Pond D for retention of the 25yr-24hr event is not acceptable to the State, then extensive enlargement of one or all of the ponds at the 920 Site, Site 23, or Site D will need to be undertaken. Based on the preliminary design evaluation outlined above at worst case (Site 23 development rock full build out), an additional 10.09 acre feet is necessary to achieve only full retention and an additional 12.35 acre feet is necessary to achieve full retention plus the existing 30% sediment/operating capacity. If the pond(s) are enlarged then a reevaluation of the Pond A, Pond 23, and Pond D drainage areas should be done to ensure that design acreages and parameters used match new site conditions.

Options for best managing the 25yr-24hr design storm runoff at Site 23/D/920 are presented in Appendix R. For purposes of the mine wide water balance it is assumed that:

- Continuous discharge throughout the event from Site 23/D/920 is possible/permissible at full available conveyance to Pond 7 of 1,938 gpm.
- Capacity to contain the worst case storm water volume (Site 23 full build out) with discharge of 1,938 gpm is available at Site 23/D/920.

Using the existing pond capacities, plus an additional 3.79 ac-ft capacity, and assuming they are 30% of the existing capacities full prior to the event, and conveying the excess storm water to Pond 7 for containment for the 25yr-24hr event expansion area evaluation results in a conservative design runoff evaluation of the facilities. The 1,938 gpm effluent flow from the 920 Site, Site 23, and Site D could be handled as 984 gpm in the 8” line (it’s maximum possible stormwater discharge rate) and the remainder routed in the 10” line (assuming shut down of the average process water discharge, 486 gpm, during this high stormwater flow period) resulting in a 10" line average flow of 954 gpm (its maximum possible stormwater discharge rate).

3.4 Surface Tailings Impoundment Expansion Area Water Discharge

Proposed expansion area water management will evolve as the surface tailings area is expanded in phases. It is conceivable that during at least the initial portion of the proposed expansion, Pond 6 and Tank 6 will remain and will be used in conjunction with proposed Pond 7 to contain and store collected waters from mining operations. Allowing Tank 6 and Pond 6 to remain as long as possible will provide extra storage capacity within the water management system and will result in a best case water management scenario. Also, if proposed Pond 7 is constructed to full capacity (based on the entire proposed expansion area needs) prior to the full proposed tailings pile build out, there will be less surface tailings area water reporting to it than designed. This will allow additional storage capacity for water management and also provide a best-case management scenario. For these reasons, the proposed expansion area water management system is modeled in this report assuming full surface tailings build out, to provide predicted management volumes under the minimum available storage capacity to the system. If the system is seen to function under minimum capacity, it can be assumed to function with the increased capacity available, and reduced influent flows, prior to full expansion build out.

Proposed expansion area water management is assumed to follow the same procedures currently in use, with proposed Pond 7 eventually replacing the role of Tank 6 and Pond 6 in the current management scheme. Figure 11 shows the flow chart for the proposed expansion area water management routing. Discharge from proposed Pond 7 to treatment, and design event stormwater flow routing to treatment, is assumed to be conducted using the same procedures and equipment currently in place and outlined in Section 2.

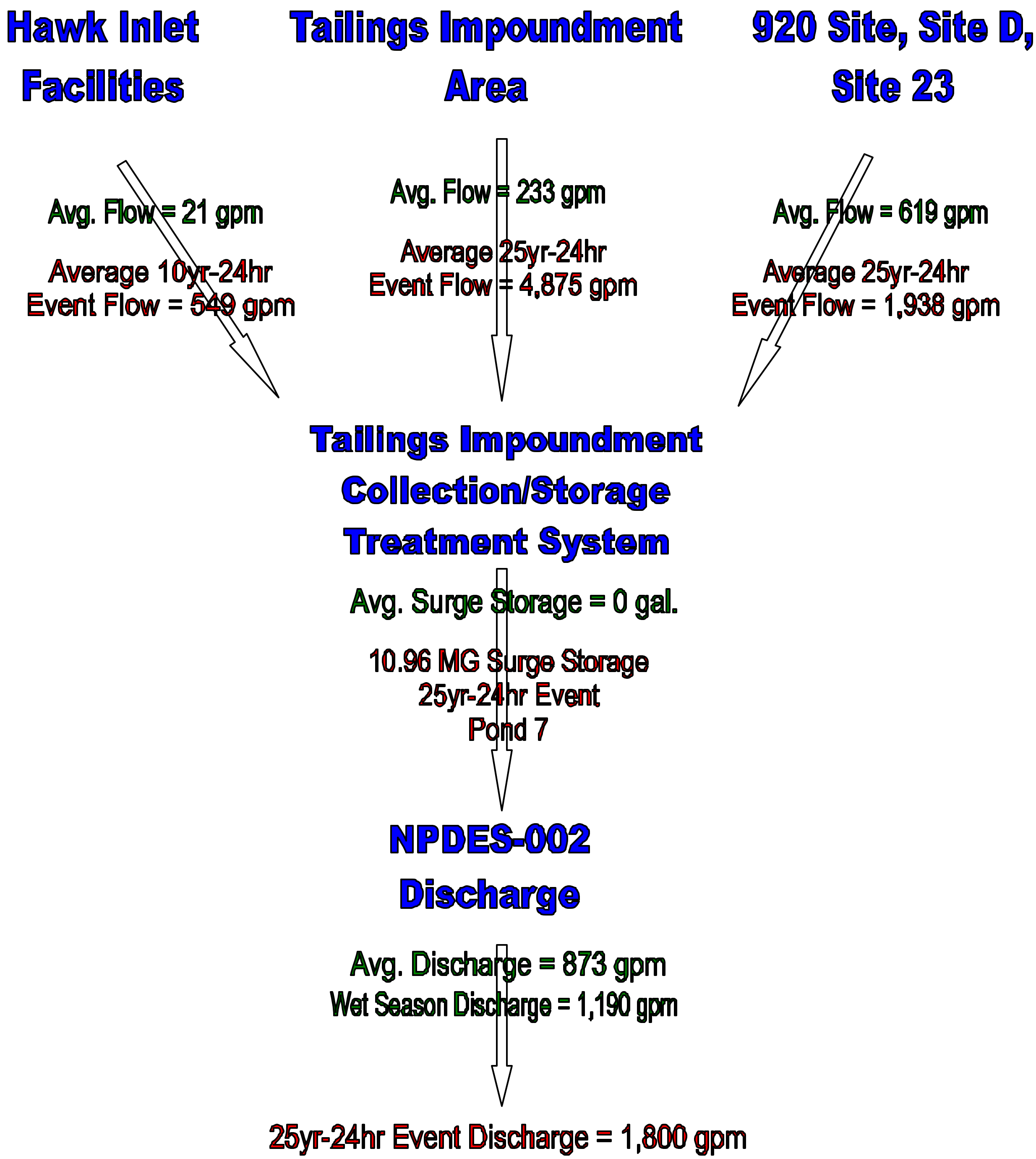
As the proposed full Stage II Expansion occurs, the Pit 5 WTP will eventually need to be moved due to the expansion area footprint of surface tailings placement. Conceptual placement of the WTP at a location near proposed Pond 7 will minimize pumping distances to treatment and discharge from water collection. Unless treatment system components are modified for the proposed expansion, under large stormwater treatment conditions, a maximum of 1,800 gpm will be treatable and discharged from the water treatment plant. This is the same discharge rate currently achieved. For the proposed expansion system evaluation presented in this report, it is assumed that no discharge rate increase will be made by modifying the existing gravity system at the NPDES-002 site, (1,800 gpm). With this assumption, additional pond stormwater storage capacity remains a conservative estimate given that discharge increases can be systematically made up to the permitted Maximum Daily Flow of 3.6 Million gallons/day (2500gpm). By increasing the final discharge rate capability up to the permitted Maximum Daily Level (2,500 gpm), KGCMC can enhance the operation and recovery of the water system storage capacities. KGCMC will need to apply for a minor permit modification to increase the permitted Monthly Average Daily Discharge rate over the current effluent limitation of 1.66 Million gallons/day (1158gpm) as will be shown in Section 3.4.1. And, it is logical for KGCMC to pursue increasing the allowable NPDES Monthly Average Daily Discharge permitted discharge rate of 1.66 MGD (1158 gpm) to reflect the changes due to the State Solid Waste Permit requirements at NPDES-002 up to at least 2.39 MGD (1,660 gpm) (Section 3.5.6). There is no need as this time to change the permitted Maximum Daily Discharge Allowance of 3.6 Million gallons/day (2500 gpm) under these scenarios.

The current achievable 1,800 gpm discharge is accomplished by routing 900 gpm through the WTP and 900 gpm through the filter plant, combining the flows, and sending them to Wet Well 1 for discharge. Once the water has been treated and pumped to Wet Well 1 it is discharged through the existing pipeline via the existing diffuser within Hawk Inlet at KGCMC NPDES-002. Figure 11 details the proposed expansion routing possibilities from proposed Pond 7. Figure 12 presents a simplified flow chart showing expansion flow rates into proposed Pond 7 and the corresponding discharge rates from the system.

3.4.1 Average Flow

The average rate of water predicted to be discharged at KGCMC NPDES-002 for the proposed full build out tailings expansion is equal to the average rate of water received from DB-04 (21 gpm) plus the average rate of water received from the surface tailings wet wells and surface tailings area runoff (233 gpm) plus the average rate of

Figure 12 – Proposed Expansion Water Management Balance



water sent to proposed Pond 7 from the 920 Site, Site 23, and Site D (619 gpm), this is 873 gpm. It should be noted as was done in Section 2.4.1 above, that the storm water portions of the average flows from DB-04 and the 920/23/D Sites are based on recent flowmeter readings and are reflective of the below normal precipitation conditions experienced at KGCMC over the summer/fall of 2001. As such, these averages are slightly less than what could be expected during an average precipitation year. Additionally, these averages are lower than the flow rates that could be expected during wetter periods of the year (tailings stormwater calculations in Appendix K are averaged over an entire year).

As shown in Section 2, the current system has an average discharge rate of 759 gpm and a discharge rate of 900 gpm is seen during portions of the year with the highest precipitation. Applying this ratio, 759/900, to the 873 gpm average predicted proposed expansion discharge rate, gives a rainy season proposed expansion area discharge rate of 1,035 gpm. Rainy season flows from the Hawk Inlet and the 920/23/D Sites will not change from the current flows seen during these rainy season times, due to the nature of the proposed expansion affecting only the surface tailings area flows. Therefore, the increase in rainy season discharge seen will be attributable to increases in stormwater, infiltration, and groundwater flows from the proposed surface tailings expansion area.

While these flows have been modeled as accurately as possible from available data in the preceding sections, direct application of the flow rates to water management operations warrants some additional conservatism. This is because, slight changes in the development of the expansion area facilities, surface tailings placement, or groundwaters encountered could result in flow rates greater than what is foreseeable using the currently available data, and therefore, to relate them to water management operations a factor of safety should be applied. Applying a factor of safety of 1.15 to the estimated 1,035 gpm wet season discharge rate yields a predicted proposed full expansion area overall rainy season discharge rate of 1,190 gpm. Allowable Monthly Average Daily discharge (currently 1153 gpm or 1.66 Million gallons/day) should be derived from this larger more conservative flow rate to achieve compliance during the wettest (greatest precipitation) portions of the year.

3.4.2 Design Flow

The average predicted proposed expansion design event discharge from KGCMC NPDES-002 is dependent on the average design event flow influent to proposed Pond 7 from DB-04 (549 gpm, 10yr-24hr), tailings wet wells and runoff (4,874 gpm, 25yr-24hr), and the 10" process and 8" surface water pipelines (1,938 gpm), of about 7,361 gpm. Since this calculated influent rate is greater than the currently achievable gravity diffuser discharge rate of 1,800 gpm, design event discharge at KGCMC NPDES-002 should be 1,800 gpm to minimize the necessary surge capacity required in proposed Pond 7.

3.5 Expansion Water Management System Capacity

3.5.1 Average Flow

Under the calculations presented above and the flow tallies collected in Table 2, the average amount of water predicted to pass through the proposed expansion management system and report to KGCMC NPDES-002 is 873 gpm. During the portions of the year with greatest precipitation the proposed expansion flow rate is calculated to approach 1,190 gpm passing through the management system, and reporting to KGCMC NPDES-002. Assuming the water treatment facilities after the proposed expansion will be able to manage at least as much water as they can currently (Section 2), the expansion water treatment facilities can keep up with the average amount of influent water flow. However, the current treatment system handles flows over 900 gpm only during large runoff events for short time periods, and using the treatment system to continually discharge flows greater than 900 gpm (approaching 1,190 gpm) may require some modifications to the current water treatment facilities.

3.5.2 Design Flow

Under proposed expansion average flow conditions, with total treatment of the collected water, it should be possible to leave proposed Pond 7 near empty. By operating with proposed Pond 7 at near empty conditions, the majority of the pond capacity will be available for water storage that may become necessary due to water treatment shutdown or a large precipitation/stormwater runoff event. The proposed expansion capacity of Pond 7 for the full Stage II Expansion is 13.10 MG. The proposed expansion water management system at KGCMC will need to be designed to handle the 25yr-24hr storm event from the surface tailings impoundment area, 920 Site, Site 23, and Site D, and the 10yr-24hr event from the Hawk Inlet facilities area. The stormwater produced from the design storm will report relatively quickly to proposed Pond 7, due to the close proximity of the stormwater runoff areas and the direct routing of collection sumps and ditches to the pond. To obtain the worst case average design flow numbers as presented above for the design event, the total volume of water delivered to proposed Pond 7 was assumed to be delivered within the 24 hour storm during the wettest portion of the year (base flow = 1,190 gpm).

During the design event (25yr-24hr) 7,361 gpm (Table 2) on average is predicted to report to proposed Pond 7. All of this water cannot be discharged immediately (maximum achievable gravity discharge rate = 1,800 gpm) and so some must be stored using proposed Pond 7 as surge storage. To reduce the amount of water being routed to storage in proposed Pond 7, the water treatment system should be run at the maximum gravity discharge of 1,800 gpm. This means that, on average, 5,561 gpm enters proposed Pond 7 during the 24 hour storm influent period. This results in 8.0 MG of the design event water being sent to storage in proposed Pond 7, or about 61% of the proposed Pond 7 total capacity. During the management of the storm water discharge, 2.96 MG must be retained in Ponds A, 23, and D as described in Section 3.3.1. The total volume of retained water from the storm is 8.0 MG + 2.96 MG, or 10.96 MG.

To completely drain the ponds after the event capacity has been contained, the average influent to proposed Pond 7 of 1,190 gpm (predicted flow for wettest portion of the year) must be dealt with, while discharging at the maximum gravity rate of 1,800 gpm. This results in 610 gpm being removed from the stored water volume in the ponds. At this rate, it takes 281 hours (11.7 days) to dewater the ponds to pre-storm conditions. Because the current design storm can be contained within the proposed expansion water management system, the proposed storage capacity of the pond and system is adequate for the design storm.

If the achievable gravity discharge (1800gpm) at KGCMC NPDES-002 was increased up to the NPDES permitted Maximum Daily Discharge of 2,500 (3.6 MGD) gpm throughout the event and afterwards, the design storm would result in 7.00 MG of surge storage that would take 127 hours (5.3 days) to dewater.

3.5.3 Storm Water Collection Adequacy

As presented above, the proposed Pond 7 size adequately contains the 25yr-24 hour storm event runoff. This assumes that proposed expansion treatment and discharge capabilities are at least what they are under current conditions. The 25yr-24hr storm for the proposed expansion results in filling Pond A, Pond 23, and Pond D from 30% of capacity, to capacity plus 3.79 ac-ft (Section 3.3.1), as such, no surge storage is left available in these ponds for a back to back storm occurrence.

The proposed Pond 7 size contains the 25yr-24hr design event in 24 hours with approximately 39% of the capacity unused. This should allow significant protection from a large precipitation event that occurs in tandem with a snowmelt runoff event at KGCMC.

Another technique used to predict worst case storm runoff flows of the type caused by both precipitation and snowmelt at the same time, is the back to back storm analysis. For the life expectancy of the proposed KGCMC surface tailings impoundment operations, the 10yr-24hr design storm should provide adequate analysis for back to back event design. Under the 10yr-24hr event for proposed expansion conditions, the average influent to proposed Pond 7 will be 5,845 gpm. The 10yr-24hr stormwater runoff calculations for the proposed expansion area were made using SEDCAD 4 and are provided in Appendix N. Discharging during the 10yr-24hr event at 1,800 gpm leaves 4,045 gpm influent to proposed Pond 7. This results in a total storm contribution to proposed Pond 7 of 5.82 MG. Again assuming Ponds A, 23, and D are returned immediately to 30% capacity (existing capacities), by discharge to proposed Pond 7 (at 1,319 gpm = 21.7 hours), an additional 1.72 MG is added to proposed Pond 7. This leaves a total 10yr-24hr storm volume in proposed Pond 7 of 5.82 MG +1.72 MG = 7.54 MG. If a back to back 10yr-24hr event then occurs, the total volume of water accumulated in proposed Pond 7 (not including the event surge contained at Ponds A, 23, and D of 1.72 MG) from the back to back events would be 13.36 MG. This is 102% of the proposed Pond 7 capacity. Discharge of all storage ponds to pre-storm conditions (assuming 1,190 gpm continuous influent to the proposed water management system during the wettest portion of the year) (and assuming Pond 7 contained this entire storm volume, all 102%) would take 412 hours (17.2 days). This analysis indicates that the back to back 10yr-24hr event cannot be entirely contained within the proposed capacity of Pond 7 (260,000 gallons would overflow) under existing 1,800 gpm maximum discharge conditions. However, if the achievable maximum discharge at KGCMC NPDES-002 was increased to the NPDES permitted Maximum Daily Discharge of 2,500 gpm throughout the back to back event and afterwards, the storm would result in 11.36 MG of stormwater accumulation in Pond 7 and 13.08 MG in total accumulation in Ponds 7, A, 23, and D. To dewater the 13.08 MG total surge storage would take 166 hours (6.9 days).

3.5.4 25yr-24hr Event Discharge with no Expansion

In the event that proposed tailings expansion does not take place, the existing tailings area was evaluated to ensure the adequacy of the existing water containment/treatment facilities to handle the 25yr-24hr event. Table 3 shows the expected design storm flows under current conditions for the facilities that will require the 25yr-24hr design event. Appendix P and Appendix Q show 25yr-24hr storm modeling SEDCAD results under current conditions for the tailings area wet wells/direct runoff and for the North Retention Pond respectively. The average flow reporting to the tailings area management system will remain 759 gpm. During wet portions of the year the peak flow of 900 gpm can be expected. Average flow reporting to tailings area water management during a 25yr–24hr design storm is modeled to be 5,094 gpm (Table 3). This will produce 4.7 MG retained in Pond 6 (capacity = 7.04 MG) assuming 1,800 gpm treated and discharged throughout the event. At least 205 gpm would have to be discharged during the event to keep Pond 6 from overflowing.

As shown above the current capacity of Pond 6, with treatment and discharge, is capable of retaining the 25yr-24hr design event required by the state of Alaska. However, under back to back 10yr-24hr storm conditions the capacity of Pond 6 (with 1,800 gpm discharge during the event) falls short of total containment with 8.5 MG directed to containment at Pond 6 versus it's 7.04 MG total capacity. While the back to back event control is not a state requirement, it does help to assess the ability of the current water management system to contain a series of runoff events or runoff induced snowmelt events at KGCMC. This illustrates the value of increasing the discharge capability at NPDES-002 to the NPDES allowable Maximum Daily Discharge of 2,500

Table 3
Flows Reporting to Tailings Area Water Management
25yr-24hr Design Storm Requirement with Current Conditions

Source	average gpm	10yr-24hr avg. gpm	10yr-24hr peak gpm
Cannery Creek Intake	11	11	11
Hawk Inlet Area Runoff	10	538	3,294
DB-04 Effluent	**21**	**549**	**3,305**
		25yr-24hr avg. gpm	**25yr-24hr peak gpm**
Wet Well 2 Groundwater Inflow	7.4	7.4	7.4
Wet Well 2 Surface Infiltration	4.9	4.9	4.9
Wet Well 2 Area Runoff	29.9	267	--
Wet Well 2 Effluent	**42**	**279**	**--**
Wet Well 3 Groundwater Inflow	2.5	2.5	2.5
Wet Well 3 Surface Infiltration	1.2	1.2	1.2
Wet Well 3 Area Runoff	6.2	62	N/A
Wet Well 3 Effluent	**10**	**66**	**--**
Wet Well 4 Groundwater Inflow	5.1	5.1	5.1
Wet Well 4 Surface Infiltration	1.4	1.4	1.4
Wet Well 4 Area Runoff	0.0	0.0	0.0
North Retention Pond	27.7	996	2,226
Wet Well 4 Effluent	**34**	**1,003**	**2,233**
Wet Well 2 Direct Runoff	0.0	448	4,394
Wet Well 3 Direct Runoff	0.0	103	1,010
Wet Well 4 Direct Runoff	17.7	380	2,343
Tailings Area Direct Runoff to Pond 6	11.2	240	1,475
Pond 6 Surface Collection	4.1	88	540
Total Direct Runoff	**33**	**1,259**	**9,762**
10" Process Water Line	**486**	**954**	**954**
8" Surface Water Line	**133**	**984**	**984**
Total Flow Reporting to Pond 7	**759**	**5,094**	**N/A**

-- Peak flows indeterminate for runoff reporting to wet wells, total peak flow assigned as direct runoff in table.

N/A Peak flows occur at different times, total peak flow is not necessarily the sum of the parts.

gpm (3.6 MGD), even if no expansion of the tailings area takes place.

3.5.5 Required Discharge Containment By Expansion Phases

Proposed expansion of the tailings impoundment will not occur all at once. The proposed expansion construction will be a phased project with the Tank 6 Area Expansion, Pit 5 Expansion, West Expansion, and Pond 6 Area Expansion beginning and being completed at different times. Consequently, the amount of storm water containment required will vary over the course of the proposed expansion relating mainly to the amount of surface area disturbed at the tailings impoundment site. Table 4 gives an approximate overview of required containment sizes throughout the proposed expansion, based on proposed expansion disturbances at tailings in 3 acre increments. As the proposed expansion occurs, the existing Pond 6 (capacity = 21.6 acre feet) will be adequate to contain the 25yr-24hr event (with continuous event discharge of 1,800 gpm at NPDES-002) through 30 acres of expansion (beyond the existing initial tailings area disturbance size of 22.6 acres). Total acres of expansion will be 45. Total tailings area disturbance after full expansion will be 67.6 acres.

Review of Table 4 shows that the ability of Pond 6 to contain the design event without discharging at 1,800 gpm and the ability of Pond 6 to contain back to back 10yr-24hr runoff events is nonexistent from current conditions (as shown in the preceding section) up through total expansion build out. Couple this with the possibility of treatment system downtime or failure during an event precluding continuous discharge at NPDES-002, or there being some amount of storage capacity already taken up in Pond 6 at the beginning of an event, and the need for more than design event storage becomes apparent.

To ensure adequate storm water retention ability (back to back storms) during proposed expansion, Pond 7 may need to be constructed as soon as the proposed expansion begins. However, the total 40.2 acre feet capacity of Pond 7 need not be completed until the final phases of expansion. Proposed Pond 7's total capacity can be constructed incrementally as necessary and as appropriate to construction requirements.

Table 4 – Required Containment Pond Size for Phased Expansion

25yr-24hr design storm million gallons		back to back 10yr-24hr storms million gallons		acres of expansion	pond size required design storm acre feet		pond size required back to back acre feet
produced	retained	produced	retained		w/o discharge	w discharge	w discharge
7.3	4.7	13.7	8.5	0	22.4	14.4	26.1
7.5	4.9	14.0	8.8	3	23.1	15.1	27.1
7.7	5.1	14.4	9.2	6	23.8	15.8	28.1
8.0	5.4	14.7	9.5	9	24.4	16.5	29.1
8.2	5.6	15.0	9.8	12	25.1	17.1	30.1
8.4	5.8	15.3	10.1	15	25.8	17.8	31.1
8.6	6.0	15.7	10.5	18	26.5	18.5	32.1
8.8	6.2	16.0	10.8	21	27.1	19.2	33.1
9.1	6.5	16.3	11.1	24	27.8	19.8	34.1
9.3	6.7	16.6	11.4	27	28.5	20.5	35.1
9.5	6.9	17.0	11.8	30	29.2	21.2	36.1
9.7	7.1	17.3	12.1	33	29.8	21.9	37.1
9.9	7.3	17.6	12.4	36	30.5	22.5	38.1
10.2	7.6	17.9	12.7	39	31.2	23.2	39.1
10.4	7.8	18.3	13.1	42	31.9	23.9	40.1
10.6	8.0	18.6	13.4	45	32.5	24.6	41.0

3.5.6 Permitted Discharge Requirements

Because the increase in surface tailings area size resulting from the proposed expansion and the increased design event will result in greater flow rates and discharges than are seen under the current conditions, a minor modification of the NPDES-002 permit may be warranted. As was shown above, under the current possible gravity discharge of 1,800 gpm, the proposed expansion water management facilities will handle the 25yr-24hr design event. However, under the current possible discharge, a significant amount of storm water is predicted to be collected in the expansion containment ponds as surge storage during the event, and it takes a substantial amount of time, 11.7 days, to dewater these containment ponds to pre-storm conditions. Longer, 17.2 days, under back to back storm occurrences. It is in the best interest of water management operations to return these storage facilities to pre-storm conditions as soon as possible to have the most storage capacity available for additional events or water management difficulties requiring surge storage. Therefore, increasing the current system's discharge capability (1800 gpm) up to the permitted Maximum Daily 2,500 gpm, is recommended to better enable the system to respond to the required State Solid Waste Permit and proposed expansion changes.

Although, the average discharge for the full proposed expansion area was predicted above to be 873 gpm, the permitted Monthly Average Daily discharge rate must be based on the largest flow rate that can be expected under normal site rainfall conditions, so that NPDES permitted discharge rates will not be exceeded during those times. For wetter discharge portions of the year (higher precipitation), the Monthly Average Daily Discharge rate of 1.66 MGD (1,153 gpm) should be increased to account for the changes in the design criteria in the Solid Waste Permit and the proposed increased footprint of the Tailings area facility. As calculated above, the discharge during the rainy season of the year may approach 1,190 gpm, which is currently over the NPDES allowable Monthly Average Daily Discharge Limit for KGCMC NPDES 002 of 1.66 million gallons per day (approximately 1,153 gpm).

Therefore, the Monthly Average Daily Discharge rate within the NPDES permit should be increased to account for the Solid Waste Permit design storm criteria and the proposed tailings expansion area. The design storm produces 13.6 MG and back to back 10yr-24hr events produce 20.32 MG, for the proposed expansion. The worst case of 20.32 MG should be used to evaluate discharge requirements.

The wet season average normal discharge is predicted to be 1,190 gpm, or 51.4 MG in 30 days. During a worst case 30 day period, the back to back event will be discharged along with the rainy season average discharge for a total of 71.7 MG in 30 days. So, the Monthly Average Daily Discharge in the NPDES permit should be revised from 1.66 MG to at least 2.39 MG (71.7 MG/30 days).

4.0 Summary and Conclusions

The current water management system at the KGCMC surface tailings impoundment handles about 759 gpm on average. Average flow through DB-04 is 21 gpm. Average flow from collection of water at the surface tailings impoundment area is 119 gpm. Average flow of process water to Tank 6 is 486 gpm. Average flow of stormwater to Tank 6 from the 920 Site, Site 23, and Site D is 133 gpm. Average flow through the water management system to discharge at KGCMC NPDES-002 during the wettest portion of the year is about 900 gpm.

During the current system design event (10yr-24hr), about 4,170 gpm report to collection at Tank 6 and Pond 6. The current system is capable of containing the 10yr-24hr design event flow, while gravity discharging at 1,800 gpm.

At full build out of the proposed Stage II surface tailings expansion, the surface tailings area water management system is predicted to handle 873 gpm on average. Average flow through DB-04 remains 21 gpm. Average flow from collection of water at the surface tailings impoundment is 233 gpm (up 114 gpm). Average flow of process water to the proposed Pond 7 remains 486 gpm. Average flow of stormwater to proposed Pond 7 from the 920 Site, Site 23, and Site D remains 133 gpm. Average flow through the water management system during the wettest portion of the year is calculated at 1,190 gpm.

Collection of water from the surface tailings proposed expansion area may require the addition of several new wet wells and extension of under-drain areas associated with Wet Wells 2, 3, and 4. The Pit 5 WTP and the North Retention Pond may have to be relocated if full Stage II Expansion pile build out occurs, the North Retention Pond may require additional stormwater capacity, and proposed Pond 7 will need to be constructed to supplement and eventually replace Tank 6 and Pond 6. The water management/stormwater retention capacity at Site 23/D/920 will have to be modified/increased to attain adequate control of the 25yr-24hr design event runoff. The proposed ultimate capacity of Pond 7 is 13.1 MG or 40.2 ac-ft, which will adequately handle the proposed expansion Solid Waste Program required storm event (25yr-24hr).

Following proposed expansion full build out, the design event (25yr-24hr) average flow of about 7,361 gpm is predicted to report to collection at proposed Pond 7.

The proposed expansion system treatment and surge capacity is capable of containing the 25yr-24hr design event flow. The proposed expansion WTP capacities and water routing and management capacities must be at least equal to the current capacities. The discharge capacity at the KGCMC NPDES-002 site must remain at least at the current system achieved rate of 1,800 gpm. Increasing the system capacity up to discharge at least equal to the allowable NPDES permitted Maximum Daily Discharge of 2,500 gpm would provide the ability to treat and discharge water more quickly. This would result in less water being routed to surge containment during stormwater runoff events, and increase the amount of storage left in containment facilities during and following events. In conjunction with the greater maximum discharge rate, this would significantly decrease the amount of time necessary to dewater the surge storage in the ponds following an event.

In order to ensure that the proposed expansion area water management system has the surge containment and treatment ability to handle the significant stormwater/snowmelt events that are possible at KGCMC, the expansion water management system was modeled for back to back 10yr-24hr storms. The 10yr-24hr back to back event cannot be entirely contained by the proposed expansion water management system unless the discharge rate at KGCMC NPDES-002 is increased.

Adequate management and discharge of water at KGCMC would be aided for the proposed expansion by the revision of the current NPDES permit for discharge at NPDES-002. While the water management discharge system as it is currently configured will discharge the 25yr-24hr design event and almost handle back to back 10yr-24hr events, dewatering of the event surge storage takes days (11.7 days for design event, 17.2 days for back to back storms). The increase in overall water discharged as a result of the increased size of the proposed expansion area will require increasing the currently permitted 1.66 MG Monthly Average Daily Discharge rate to 2.39 MG (per 30 day average discharge). This will adequately allow discharge of proposed expansion normal influent flows along with design event storm water volumes within the Solid Waste Permit requirements, and warrant only minor modifications of the NPDES-002 Permit for increasing the Monthly Daily Average Discharge rate.

Date	DB 4	10" PW-Tank 6	8" SW-Tank 6	NPDES-002 CR 10
04/01/01	14,000	698,800	198,800	1,190,000
04/02/01	10,200	685,500	152,400	1,290,000
04/03/01	11,700	672,800	186,600	1,280,000
04/04/01	16,300	648,400	186,800	1,270,000
04/05/01	61,600	688,500	205,200	1,270,000
04/06/01	37,800	673,000	182,500	1,260,000
04/07/01	23,100	707,400	198,000	1,230,000
04/08/01	12,800	743,200	223,000	1,260,000
04/09/01	14,400	698,600	139,200	1,300,000
04/10/01	30,600	723,600	149,700	730,000
04/11/01	26,000	476,400	293,800	1,060,000
04/12/01	29,800	569,700	185,400	1,160,000
04/13/01	16,300	702,200	240,000	1,420,000
04/14/01	9,900	745,800	228,400	1,300,000
04/15/01	12,500	771,100	160,300	1,380,000
04/16/01	10,200	714,700	149,200	1,330,000
04/17/01	13,900	693,900	126,700	1,220,000
04/18/01	32,100	697,500	116,100	1,260,000
04/19/01	24,200	663,700	47,400	810,000
04/20/01	11,500	664,700	67,500	1,150,000
04/21/01	6,800	666,200	131,600	1,090,000
04/22/01	21,900	678,900	88,600	1,200,000
04/23/01	12,600	669,700	163,900	1,180,000
04/24/01	11,300	679,900	148,100	1,160,000
04/25/01	35,200	720,700	49,200	1,150,000
04/26/01	20,300	751,600	44,300	1,220,000
04/27/01	56,800	761,300	176,000	1,340,000
04/28/01	22,600	764,000	115,700	1,420,000
04/29/01	13,800	800,600	262,000	1,200,000
04/30/01	12,400	757,000	179,100	1,240,000
05/01/01	18,700	687,600	173,400	1,230,000
05/02/01	20,200	647,800	172,300	1,180,000
05/03/01	61,100	627,800	281,100	840,000
05/04/01	81,400	624,100	372,500	1,060,000
05/05/01	35,200	684,700	138,100	1,100,000
05/06/01	15,000	684,300	285,000	920,000
05/07/01	16,800	665,600	225,300	1,030,000
05/08/01	31,700	713,400	263,500	1,380,000
05/09/01	24,300	659,600	181,900	980,000
05/10/01	12,600	689,900	148,000	820,000
05/11/01	34,200	688,100	133,900	960,000
05/12/01	42,100	683,200	167,800	1,040,000
05/13/01	29,600	662,900	132,600	980,000
05/14/01	13,700	669,900	116,000	940,000
05/15/01	13,000	709,400	115,100	950,000
05/16/01	11,400	712,900	139,100	990,000
05/17/01	28,100	718,700	156,600	1,060,000

Date	DB 4	10" PW-Tank 6	8" SW-Tank 6	NPDES-002 CR 10
05/18/01	11,300	724,400	128,900	790,000
05/19/01	8,700	748,500	146,700	990,000
05/20/01	11,200	731,200	135,900	1,020,000
05/21/01	14,900	735,700	140,500	870,000
05/22/01	30,000	760,000	241,200	900,000
05/23/01	14,800	772,800	170,600	1,020,000
05/24/01	16,000	710,600	173,800	1,000,000
05/25/01	9,800	693,600	110,400	870,000
05/26/01	7,400	667,000	106,200	250,000
05/27/01	12,400	719,200	140,500	710,000
05/28/01	10,300	710,200	112,800	990,000
05/29/01	12,700	757,300	102,600	850,000
05/30/01	11,200	644,200	97,700	980,000
05/31/01	25,000	662,400	93,500	1,000,000
06/01/01	22,900	695,800	235,600	870,000
06/02/01	11,300	794,700	97,500	910,000
06/03/01	16,200	728,900	171,300	1,010,000
06/04/01	10,000	730,800	140,100	1,020,000
06/05/01	18,500	722,800	148,500	840,000
06/06/01	11,200	716,400	96,500	910,000
06/07/01	13,700	729,200	117,500	920,000
06/08/01	9,200	730,200	118,100	930,000
06/09/01	15,100	726,200	89,100	930,000
06/10/01	29,700	754,900	152,100	940,000
06/11/01	11,100	773,900	139,300	970,000
06/12/01	12,500	716,600	91,600	1,000,000
06/13/01	17,500	744,000	87,500	970,000
06/14/01	14,800	706,800	132,500	940,000
06/15/01	18,700	718,700	94,800	950,000
06/16/01	12,300	696,200	88,300	940,000
06/17/01	9,300	683,500	85,700	940,000
06/18/01	9,000	588,800	70,000	930,000
06/19/01	18,300	528,600	64,400	540,000
06/20/01	14,800	169,600	128,900	
06/21/01	27,000	233,500	115,200	
06/22/01	13,600	296,400	172,000	
06/23/01	40,500	197,800	184,400	480,000
06/24/01	13,300	201,800	205,300	900,000
06/25/01	9,800	252,700	116,400	650,000
06/26/01	38,000	626,700	161,100	890,000
06/27/01	12,800	782,500	119,700	890,000
06/28/01	13,500	756,800	130,600	990,000
06/29/01	10,900	708,500	108,900	960,000
06/30/01	9,700	719,700	89,200	920,000
07/01/01	8,500	691,500	83,500	880,000
07/02/01	11,800	694,600	112,700	920,000
07/03/01	12,300	699,000	89,800	930,000
07/04/01	15,100	720,900	118,500	950,000

Date	DB 4	10" PW-Tank 6	8" SW-Tank 6	NPDES-002 CR 10
07/05/01	45,100	718,800	131,000	960,000
07/06/01	40,300	834,000	176,300	810,000
07/07/01	42,100	736,400	258,000	920,000
07/08/01	31,000	780,800	96,700	1,080,000
07/09/01	48,000	770,600	89,400	1,090,000
07/10/01	23,600	875,200	95,400	1,080,000
07/11/01	32,400	663,700	76,300	1,070,000
07/12/01	22,200	556,900	43,700	960,000
07/13/01	28,000	838,800	90,800	1,020,000
07/14/01	31,000	753,300	87,800	1,040,000
07/15/01	13,600	732,400	81,700	980,000
07/16/01	12,400	740,800	82,000	780,000
07/17/01	12,400	714,700	42,500	980,000
07/18/01	13,600	700,700	81,200	970,000
07/19/01	14,600	728,100	41,800	980,000
07/20/01	13,600	678,200	39,400	1,000,000
07/21/01	14,700	722,500	80,300	990,000
07/22/01	47,100	788,000	39,500	990,000
07/23/01	75,300	720,700	77,300	960,000
07/24/01	40,700	804,100	62,000	500,000
07/25/01	21,100	760,500	57,600	670,000
07/26/01	10,000	866,100	79,500	990,000
07/27/01	11,200	748,600	40,000	1,010,000
07/28/01	10,000	656,800	40,000	1,020,000
07/29/01	13,500	668,500	81,000	990,000
07/30/01	12,100	690,100	39,600	970,000
07/31/01	13,100	663,900	67,000	960,000
08/01/01	15,500	660,300	52,500	980,000
08/02/01	28,500	703,100	40,700	990,000
08/03/01	8,400	748,700	40,000	970,000
08/04/01	19,600	707,600	80,700	660,000
08/05/01	9,800	701,800	80,100	970,000
08/06/01	8,600	703,100	39,900	960,000
08/07/01	11,600	701,200	39,800	950,000
08/08/01	11,200	701,600	40,100	960,000
08/09/01	10,100	755,300	70,800	950,000
08/10/01	10,000	744,500	48,900	960,000
08/11/01	7,600	678,200	40,000	960,000
08/12/01	8,500	741,700	39,900	390,000
08/13/01	6,300	737,900	39,600	930,000
08/14/01	7,500	689,400	39,500	940,000
08/15/01	8,700	663,600	40,100	930,000
08/16/01	6,300	720,700	40,400	950,000
08/17/01	7,700	728,600	40,700	960,000
08/18/01	16,200	709,900	65,400	970,000
08/19/01	6,300	701,600	46,000	950,000
08/20/01	9,600	736,200	43,600	500,000
08/21/01	14,900	695,700	87,000	610,000

Date	DB 4	10" PW-Tank 6	8" SW-Tank 6	NPDES-002 CR 10
08/22/01	13,400	702,800	83,500	980,000
08/23/01	13,600	670,000	84,900	990,000
08/24/01	11,000	687,500	88,000	970,000
08/25/01	27,100	598,700	86,000	950,000
08/26/01	34,600	653,900	150,700	770,000
08/27/01	170,600	836,300	531,700	1,480,000
08/28/01	17,100	761,400	147,600	1,000,000
08/29/01	40,000	768,800	246,600	1,090,000
08/30/01	18,500	759,600	196,300	1,470,000
08/31/01	20,800	690,300	135,000	980,000
09/01/01	28,700	678,800	156,100	980,000
09/02/01	89,700	807,300	457,500	1,050,000
09/03/01	42,000	748,900	233,100	1,200,000
09/04/01	28,300	671,200	142,700	990,000
09/05/01	67,400	714,000	263,000	1,000,000
09/06/01	26,800	760,200	203,000	1,010,000
09/07/01	114,200	754,400	382,800	1,300,000
09/08/01	48,000	804,200	342,700	1,670,000
09/09/01	32,100	727,700	214,100	1,130,000
09/10/01	20,500	696,400	264,500	1,040,000
09/11/01	9,700	725,400	199,200	1,100,000
09/12/01	70,100	656,600	397,200	1,160,000
09/13/01	413,900	862,200	1,158,600	1,570,000
09/14/01	84,200	847,100	502,400	1,610,000
09/15/01	61,400	565,800	672,800	1,060,000
09/16/01	127,400	787,600	661,100	1,440,000
09/17/01				1,190,000
09/18/01	128,900	365,200	2,412,700	980,000
09/19/01	50,500	667,900	240,900	1,340,000
09/20/01	66,900	761,600	430,400	1,590,000
09/21/01	45,400	878,800	256,700	1,550,000
09/22/01	55,200	812,500	296,100	1,740,000
09/23/01	34,300	716,400	289,900	1,620,000
09/24/01	15,600	699,700	230,500	1,060,000
09/25/01	29,200	762,300	239,200	1,300,000
09/26/01	13,300	675,700	157,600	1,020,000
09/27/01	14,500	706,400	180,600	1,040,000
09/28/01	23,000	723,100	227,600	1,030,000
09/29/01	33,000	726,400	256,200	1,020,000
09/30/01	160,700	811,500	734,900	1,840,000
10/01/01	190,700	866,200	544,000	1,640,000
10/02/01	39,000	792,400	310,900	990,000
10/03/01	22,000	799,700	256,800	1,010,000
10/04/01	16,500	752,700	207,600	1,020,000
10/05/01	19,300	748,700	196,700	1,530,000
10/06/01	40,300	750,600	288,400	1,510,000
10/07/01	29,100	738,200	202,700	1,020,000
10/08/01	41,300	733,700	244,900	1,020,000

Date	DB 4	10" PW-Tank 6	8" SW-Tank 6	NPDES-002 CR 10
10/09/01	59,000	706,900	350,800	1,190,000
10/10/01	41,400	564,400	294,600	1,350,000
10/11/01	50,500	809,900	413,200	1,230,000
10/12/01	72,800	75,800	728,200	1,920,000
10/13/01	22,700	813,900	343,800	1,500,000
10/14/01	18,100	664,200	264,700	990,000
10/15/01	70,600	839,600	386,600	1,350,000
10/16/01	88,200	884,800	598,600	1,580,000
10/17/01	14,400	618,800	383,100	270,000
10/18/01	35,300	756,700	480,500	440,000
10/19/01	29,000	767,200	458,100	1,640,000
10/20/01	38,800	723,300	245,500	1,640,000
10/21/01	47,900	770,500	342,900	
10/22/01	18,700	744,600	286,300	
10/23/01	22,300	686,100	330,300	

Date	DB 4	10" PW-Tank 6	8" SW-Tank 6	Outfall CR 10
	gpm	**gpm**	**gpm**	**gpm**
average	21	486	133	734
maximum	287	614	1,675	1,333

04/01/01 to 10/23/01 = 205 days

Cannery Creek Intake	
date	**daily flow gallons**
01/01/00	8,660
01/02/00	11,140
01/03/00	9,330
01/04/00	11,060
01/05/00	15,590
01/06/00	14,050
01/07/00	13,000
01/08/00	10,400
01/09/00	12,170
01/10/00	8,760
01/11/00	11,340
01/12/00	11,810
01/13/00	13,200
01/14/00	11,990
01/15/00	12,530
01/16/00	23,450
01/17/00	26,690
01/18/00	21,920
01/19/00	21,400
01/20/00	20,960
01/21/00	13,240
01/22/00	15,200
01/23/00	16,960
01/24/00	12,320
01/25/00	14,010
01/26/00	14,810
01/27/00	14,680
01/28/00	16,290
01/29/00	13,590
01/30/00	12,800
01/31/00	13,740
02/01/00	14,200
02/02/00	14,720
02/03/00	14,520
02/04/00	23,270
02/05/00	16,960
02/06/00	16,960
02/07/00	16,240
02/08/00	12,060
02/09/00	13,400
02/10/00	14,900
02/11/00	14,230
02/12/00	10,580
02/13/00	10,880
02/14/00	14,360
02/15/00	10,030
02/16/00	14,620
02/17/00	13,750
02/18/00	14,500
02/19/00	15,370
02/20/00	11,540

Cannery Creek Intake	
date	daily flow gallons
02/21/00	16,960
02/22/00	15,670
02/23/00	11,970
02/24/00	11,040
02/25/00	14,380
02/26/00	16,280
02/27/00	13,360
02/28/00	8,400
02/29/00	11,840
03/01/00	10,560
03/02/00	14,280
03/03/00	15,550
03/04/00	13,320
03/05/00	12,850
03/06/00	12,640
03/07/00	13,680
03/08/00	12,760
03/09/00	15,580
03/10/00	16,960
03/11/00	14,640
03/12/00	15,580
03/13/00	16,960
03/14/00	16,960
03/15/00	14,810
03/16/00	14,100
03/17/00	15,740
03/18/00	15,660
03/19/00	16,960
03/20/00	16,960
03/21/00	23,700
03/22/00	16,960
03/23/00	16,960
03/24/00	12,450
03/25/00	16,960
03/26/00	10,040
03/27/00	13,460
03/28/00	14,760
03/29/00	16,960
03/30/00	10,720
03/31/00	22,900
04/01/00	14,420
04/02/00	15,020
04/03/00	11,900
04/04/00	16,960
04/05/00	16,960
04/06/00	16,960
04/07/00	14,580
04/08/00	12,290
04/09/00	10,120
04/10/00	12,100
04/11/00	9,970

Cannery Creek Intake	
date	**daily flow gallons**
04/12/00	16,890
04/13/00	13,640
04/14/00	15,090
04/15/00	11,130
04/16/00	17,560
04/17/00	11,080
04/18/00	13,720
04/19/00	16,960
04/20/00	16,680
04/21/00	15,610
04/22/00	12,690
04/23/00	9,250
04/24/00	9,010
04/25/00	11,360
04/26/00	8,250
04/27/00	16,960
04/28/00	10,550
04/29/00	9,930
04/30/00	16,960
05/01/00	14,600
05/02/00	16,700
05/03/00	12,730
05/04/00	8,850
05/05/00	17,600
05/06/00	8,100
05/07/00	7,740
05/08/00	7,400
05/09/00	10,210
05/10/00	15,820
05/11/00	14,170
05/12/00	17,610
05/13/00	16,960
05/14/00	10,040
05/15/00	16,960
05/16/00	15,340
05/17/00	13,560
05/18/00	12,630
05/19/00	14,300
05/20/00	9,340
05/21/00	11,550
05/22/00	9,500
05/23/00	12,060
05/24/00	14,350
05/25/00	10,660
05/26/00	10,880
05/27/00	16,820
05/28/00	12,340
05/29/00	9,410
05/30/00	10,510
05/31/00	15,030
06/01/00	16,740

Cannery Creek Intake	
date	**daily flow gallons**
06/02/00	15,810
06/03/00	17,060
06/04/00	16,970
06/05/00	16,960
06/06/00	16,960
06/07/00	16,960
06/08/00	16,970
06/09/00	16,960
06/10/00	15,590
06/11/00	10,040
06/12/00	10,980
06/13/00	13,450
06/14/00	16,960
06/15/00	16,960
06/16/00	16,960
06/17/00	15,240
06/18/00	13,340
06/19/00	15,470
06/20/00	13,040
06/21/00	16,960
06/22/00	12,350
06/23/00	15,600
06/24/00	16,980
06/25/00	15,570
06/26/00	14,690
06/27/00	17,000
06/28/00	16,980
06/29/00	16,980
06/30/00	17,020
07/01/00	17,020
07/02/00	15,630
07/03/00	12,530
07/04/00	13,600
07/05/00	17,050
07/06/00	16,850
07/07/00	13,960
07/08/00	16,990
07/09/00	17,070
07/10/00	36,180
07/11/00	17,070
07/12/00	17,090
07/13/00	17,080
07/14/00	17,100
07/15/00	17,050
07/16/00	23,430
07/17/00	12,600
07/18/00	14,610
07/19/00	16,210
07/20/00	16,530
07/21/00	14,940
07/22/00	17,040

Cannery Creek Intake	
date	**daily flow gallons**
07/23/00	16,960
07/24/00	17,040
07/25/00	16,960
07/26/00	21,520
07/27/00	16,990
07/28/00	17,010
07/29/00	17,000
07/30/00	21,520
07/31/00	14,070
08/01/00	16,970
08/02/00	16,970
08/03/00	16,960
08/04/00	17,000
08/05/00	17,000
08/06/00	15,510
08/07/00	16,970
08/08/00	15,910
08/09/00	15,330
08/10/00	17,000
08/11/00	12,830
08/12/00	16,990
08/13/00	28,730
08/14/00	17,000
08/15/00	12,640
08/16/00	17,040
08/17/00	17,030
08/18/00	17,080
08/19/00	17,010
08/20/00	16,470
08/21/00	9,320
08/22/00	12,110
08/23/00	10,290
08/24/00	12,950
08/25/00	13,620
08/26/00	8,870
08/27/00	12,380
08/28/00	12,520
08/29/00	12,760
08/30/00	9,600
08/31/00	13,810
09/01/00	17,080
09/02/00	17,020
09/03/00	14,980
09/04/00	16,970
09/05/00	26,580
09/06/00	19,970
09/07/00	12,020
09/08/00	14,850
09/09/00	8,440
09/10/00	13,440
09/11/00	8,600

Cannery Creek Intake	
date	**daily flow gallons**
09/12/00	24,640
09/13/00	23,910
09/14/00	10,200
09/15/00	13,590
09/16/00	13,650
09/17/00	11,250
09/18/00	9,180
09/19/00	16,130
09/20/00	14,870
09/21/00	16,710
09/22/00	10,510
09/23/00	12,260
09/24/00	8,910
09/25/00	16,850
09/26/00	14,510
09/27/00	14,470
09/28/00	15,790
09/29/00	17,000
09/30/00	15,510
10/01/00	11,130
10/02/00	11,120
10/03/00	21,580
10/04/00	10,220
10/05/00	24,710
10/06/00	8,420
10/07/00	15,330
10/08/00	13,930
10/09/00	10,950
10/10/00	13,560
10/11/00	30,160
10/12/00	10,770
10/13/00	20,220
10/14/00	16,280
10/15/00	13,040
10/16/00	14,060
10/17/00	16,900
10/18/00	15,930
10/19/00	13,040
10/20/00	18,390
10/21/00	18,170
10/22/00	8,920
10/23/00	13,340
10/24/00	12,380
10/25/00	14,940
10/26/00	8,250
10/27/00	19,380
10/28/00	9,790
10/29/00	14,430
10/30/00	6,300
10/31/00	15,890
11/01/00	22,680

Cannery Creek Intake	
date	**daily flow gallons**
11/02/00	15,760
11/03/00	19,280
11/04/00	24,490
11/05/00	12,610
11/06/00	12,270
11/07/00	22,360
11/08/00	15,110
11/09/00	11,440
11/10/00	13,030
11/11/00	9,940
11/12/00	14,260
11/13/00	13,310
11/14/00	15,910
11/15/00	24,770
11/16/00	11,430
11/17/00	19,980
11/18/00	10,600
11/19/00	14,040
11/20/00	13,870
11/21/00	11,850
11/22/00	25,620
11/23/00	25,070
11/24/00	13,740
11/25/00	11,810
11/26/00	14,060
11/27/00	10,360
11/28/00	14,310
11/29/00	11,480
11/30/00	13,800
12/01/00	14,350
12/02/00	22,030
12/03/00	17,970
12/04/00	20,030
12/05/00	16,740
12/06/00	16,400
12/07/00	14,210
12/08/00	20,680
12/09/00	16,380
12/10/00	14,740
12/11/00	15,240
12/12/00	15,280
12/13/00	19,290
12/14/00	16,530
12/15/00	35,820
12/16/00	15,850
12/17/00	18,220
12/18/00	20,630
12/19/00	18,790
12/20/00	21,760
12/21/00	29,030
12/22/00	20,650

Cannery Creek Intake	
date	**daily flow gallons**
12/23/00	20,060
12/24/00	21,800
12/25/00	21,450
12/26/00	23,400
12/27/00	19,230
12/28/00	25,510
12/29/00	14,680
12/30/00	12,830
12/31/00	12,270

average gpm **11**

10yr-24hr Runoff at Hawk Inlet facility Pads

Kennecott KGCMC Tailings Area Water Balance

Appendix C

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

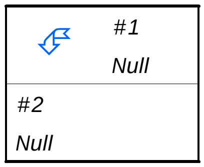
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.360 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	upper pad
Null	#2	==>	End	0.000	0.000	lower pad



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	5.500	5.500	3.28	1.06
#2	6.800	12.300	7.34	2.38

Structure Detail:

Structure #1 (Null)

upper pad

Structure #2 (Null)

lower pad

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	5.500	0.039	0.000	0.000	90.000	M	3.28	1.062
	S	**5.500**						**3.28**	**1.062**
#2	1	6.800	0.012	0.000	0.000	90.000	M	4.06	1.313
	S	**12.300**						**7.34**	**2.375**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	9.22	40.00	434.00	3.030	0.039
#1	**1**	**Time of Concentration:**					**0.039**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	20.00	40.00	200.00	4.470	0.012
#2	**1**	**Time of Concentration:**					**0.012**

wet well 2

date	flow
01/01/00	62.08
01/03/00	48.06
01/04/00	38.75
01/05/00	34.79
01/06/00	31.46
01/07/00	35.14
01/08/00	41.53
01/09/00	42.71
01/10/00	36.53
01/11/00	34.38
01/12/00	29.65
01/14/00	23.61
01/15/00	21.94
01/16/00	20.76
01/18/00	17.78
01/19/00	20.97
01/20/00	20.90
01/22/00	19.31
01/23/00	20.83
01/24/00	20.63
01/25/00	19.93
01/26/00	20.14
01/27/00	22.57
01/28/00	58.61
01/29/00	72.01
01/30/00	88.82
01/31/00	91.53
02/01/00	70.21
02/02/00	59.10
02/04/00	47.01
02/05/00	39.03
02/06/00	32.99
02/07/00	29.31
02/08/00	26.94
02/10/00	36.32
02/12/00	28.19
02/13/00	25.49
02/14/00	24.24
02/15/00	22.29
02/16/00	21.94
02/17/00	20.83
02/18/00	20.83
02/19/00	23.13
02/20/00	30.42
02/21/00	39.79
02/22/00	43.19
02/24/00	44.72
02/26/00	53.13
02/27/00	54.58

wet well 2

date	flow
02/28/00	52.57
02/29/00	47.22
03/01/00	41.67
03/02/00	44.93
03/03/00	57.15
03/04/00	50.76
03/05/00	61.18
03/06/00	56.04
03/07/00	48.96
03/08/00	42.71
03/09/00	37.64
03/10/00	33.89
03/11/00	30.07
03/12/00	28.68
03/13/00	26.25
03/14/00	25.21
03/15/00	24.72
03/16/00	24.38
03/17/00	25.63
03/18/00	36.53
03/19/00	46.46
03/20/00	48.82
03/21/00	91.88
03/22/00	115.07
03/23/00	94.86
03/24/00	86.04
03/25/00	93.19
03/26/00	102.43
03/27/00	124.86
03/28/00	107.92
03/30/00	90.00
03/31/00	146.88
04/01/00	187.57
04/02/00	117.64
04/03/00	105.49
04/04/00	111.60
04/05/00	112.57
04/06/00	148.96
04/07/00	124.44
04/08/00	155.63
04/09/00	156.81
04/10/00	102.92
04/11/00	80.49
04/12/00	68.75
04/13/00	63.75
04/15/00	49.24
04/16/00	42.99
04/17/00	38.82
04/18/00	35.63

wet well 2

date	flow
04/18/00	43.96
04/20/00	52.08
04/21/00	60.21
04/22/00	68.54
04/23/00	69.79
04/24/00	55.42
04/25/00	49.72
04/26/00	39.65
04/27/00	75.90
04/29/00	62.43
04/30/00	70.42
05/01/00	81.81
05/02/00	125.83
05/03/00	94.31
05/04/00	67.71
05/05/00	55.76
05/06/00	48.26
05/07/00	42.08
05/10/00	31.32
05/11/00	28.89
05/12/00	27.15
05/15/00	24.58
05/18/00	22.01
07/02/00	26.53
07/03/00	26.04
07/04/00	25.00
07/05/00	26.25
07/07/00	26.74
07/08/00	26.32
07/09/00	24.86
07/10/00	23.61
07/11/00	22.57
07/12/00	20.63
07/13/00	19.44
07/14/00	18.61
07/15/00	18.26
07/16/00	17.78
07/17/00	17.22
07/18/00	17.01
07/19/00	21.04
07/20/00	46.46
07/22/00	35.00
07/24/00	111.32
07/25/00	93.82
07/26/00	65.90
07/27/00	50.21
07/28/00	41.32
07/29/00	36.94
07/30/00	34.03

wet well 2

date	flow
07/31/00	32.15
08/01/00	32.15
08/02/00	31.18
08/03/00	26.18
08/04/00	21.11
08/05/00	23.54
08/06/00	22.64
08/07/00	21.81
08/08/00	27.64
08/09/00	38.82
08/10/00	32.78
08/11/00	28.19
08/12/00	26.04
08/13/00	23.96
08/14/00	24.65
08/15/00	37.29
08/16/00	34.65
08/17/00	31.39
08/18/00	29.93
08/19/00	28.47
08/20/00	61.25
08/21/00	76.04
08/22/00	108.26
08/23/00	70.07
08/24/00	52.01
08/25/00	25.35
08/26/00	
08/27/00	
08/28/00	
08/29/00	16.74
08/30/00	35.00
08/31/00	31.94
09/01/00	28.54
09/02/00	27.29
09/03/00	24.93
09/04/00	52.50
09/05/00	46.81
09/06/00	77.64
09/09/00	53.96
09/11/00	38.40
09/12/00	28.13
09/14/00	52.22
09/15/00	69.72
09/16/00	122.08
09/17/00	165.14
09/18/00	132.78
09/19/00	76.18
09/21/00	216.74
09/22/00	204.17

wet well 2

date	flow
09/23/00	250.83
09/24/00	230.56
09/25/00	144.24
09/26/00	59.65
09/27/00	27.43
02/28/01	25.42
09/29/00	33.54
09/30/00	46.39
10/01/00	38.54
10/02/00	32.36
10/03/00	29.38
10/04/00	25.90
10/05/00	22.92
10/06/00	33.75
10/07/00	35.97
10/08/00	39.93
10/09/00	32.08
10/10/00	29.51
10/11/00	32.50
10/12/00	38.68
10/13/00	47.01
10/14/00	34.93
10/15/00	30.42
10/16/00	22.01
10/19/00	25.90
10/20/00	29.65
10/21/00	31.67
10/22/00	36.81
10/23/00	46.67
10/24/00	45.49
10/25/00	36.60
10/26/00	32.57
10/28/00	27.08
10/29/00	24.03
10/30/00	22.01
10/31/00	21.74
11/02/00	37.78
11/03/00	25.49
11/05/00	26.74
11/06/00	24.17
11/07/00	20.56
11/09/00	19.86
11/10/00	23.33
11/11/00	21.74
11/12/00	21.18
11/13/00	24.51
11/14/00	22.01
11/15/00	20.07
11/16/00	21.53

wet well 2

date	flow
11/17/00	21.46
11/18/00	25.76
11/19/00	24.38
11/20/00	20.83
11/21/00	19.51
11/22/00	25.07
11/23/00	46.32
11/25/00	35.07
11/26/00	30.07
11/27/00	28.13
11/28/00	25.69
11/29/00	26.81
11/30/00	37.29
12/02/00	20.00
12/03/00	20.90
12/04/00	36.04
12/05/00	52.64
12/06/00	38.89
12/08/00	54.58
12/09/00	
12/10/00	
12/11/00	
12/12/00	
12/13/00	
12/14/00	
12/15/00	
12/16/00	
12/17/00	
12/18/00	
12/19/00	27.36
12/20/00	
12/23/00	
12/24/00	
12/25/00	
12/26/00	
12/27/00	
12/28/00	105.76
12/30/00	54.03
01/01/01	39.24
01/02/01	42.36
01/03/01	49.03
01/04/01	72.64
01/05/01	85.07
01/07/01	43.82
01/08/01	36.39
01/09/01	41.11
01/11/01	80.69
01/13/01	90.28
01/15/01	50.56

wet well 2

date	flow
01/17/01	48.96
01/18/01	36.81
01/20/01	45.90
01/22/01	31.53
01/23/01	45.69
01/26/01	39.72
01/28/01	42.15
01/31/01	36.18
02/02/01	47.01
02/03/01	52.64
02/04/01	42.43
02/05/01	36.67
02/12/01	127.15
02/19/01	59.93
02/26/01	159.31
03/05/01	254.86
03/12/01	266.67
03/19/01	122.43
03/26/01	204.65
04/02/01	
04/09/01	
04/16/01	
04/01/01	27.57
04/02/01	27.85
04/03/01	26.67
04/04/01	25.69
04/05/01	26.67
04/06/01	30.69
04/07/01	34.58
04/08/01	32.71
04/09/01	30.56
04/10/01	28.96
04/11/01	26.53
04/12/01	25.83
04/13/01	26.18
04/14/01	25.49
04/15/01	25.56
04/16/01	25.90
04/17/01	24.44
04/18/01	23.54
04/19/01	21.88
04/20/01	22.71
04/21/01	22.57
04/22/01	22.57
04/23/01	21.18
04/24/01	21.74
04/25/01	21.18
04/26/01	20.76
04/27/01	21.25

wet well 2

date	flow
04/28/01	26.67
04/29/01	29.65
04/30/01	30.49
05/01/01	28.33
05/02/01	25.63
05/03/01	26.32
05/04/01	28.54
05/05/01	36.39
05/06/01	37.57
05/07/01	33.68
05/08/01	31.88
05/09/01	30.35
05/10/01	29.93
05/11/01	29.44
05/12/01	29.03
05/13/01	29.93
05/14/01	29.17
05/15/01	29.03
05/16/01	27.50
05/17/01	26.81
05/18/01	25.56
05/19/01	23.96
05/20/01	24.44
05/21/01	23.33
05/22/01	22.08
05/23/01	22.92
05/24/01	22.57
05/25/01	21.88
05/26/01	22.01
05/27/01	21.04
05/28/01	21.88
05/29/01	20.76
05/30/01	19.58
05/31/01	20.76
06/01/01	19.31
06/02/01	18.89
06/03/01	19.72
06/04/01	18.06
06/05/01	18.82
06/06/01	18.82
06/07/01	18.54
06/08/01	16.74
06/09/01	18.13
06/10/01	18.96
06/11/01	17.85
06/12/01	19.24
06/13/01	18.96
06/14/01	17.78
06/15/01	19.10

wet well 2

date	flow
06/16/01	18.13
06/17/01	18.33
06/18/01	18.26
06/19/01	18.19
06/20/01	18.33
06/21/01	17.71
06/22/01	16.88
06/23/01	17.78
06/24/01	17.50
06/25/01	18.13
06/26/01	17.43
06/27/01	17.50
06/28/01	17.50
06/29/01	16.46
06/30/01	16.18
07/01/01	16.46
07/02/01	15.28
07/03/01	15.21
07/04/01	14.17
07/05/01	15.35
07/06/01	14.86
07/07/01	15.69
07/08/01	18.61
07/09/01	21.94
07/10/01	27.36
07/11/01	29.10
07/12/01	27.29
07/13/01	26.39
07/14/01	25.69
07/15/01	27.15
07/16/01	26.53
07/17/01	25.83
07/18/01	25.14
07/19/01	23.96
07/20/01	23.19
07/21/01	21.25
07/22/01	22.22
07/23/01	20.83
07/24/01	20.49
07/25/01	20.63
07/26/01	21.81
07/27/01	21.67
07/28/01	22.36
07/29/01	21.67
07/30/01	21.32
07/31/01	21.11
08/01/01	20.97
08/02/01	20.21
08/03/01	19.31

wet well 2

date	flow
08/04/01	19.51
08/05/01	18.75
08/06/01	17.99
08/07/01	17.29
08/08/01	16.94
08/09/01	16.39
08/10/01	16.39
08/11/01	15.42
08/12/01	16.04
08/13/01	15.56
08/14/01	14.86
08/15/01	14.51
08/16/01	13.75
08/17/01	14.86
08/18/01	13.89
08/19/01	13.82
08/20/01	13.40
08/21/01	13.61
08/22/01	13.13
08/23/01	13.06
08/24/01	12.78
08/25/01	12.78
08/26/01	12.31
08/27/01	39.72
08/28/01	36.53
08/29/01	30.63
08/30/01	29.44
08/31/01	25.83
09/01/01	24.86
09/02/01	43.19
09/03/01	37.36
09/04/01	33.40
09/05/01	29.93
09/06/01	33.13
09/07/01	43.26
09/08/01	44.03
09/09/01	39.86
09/10/01	32.43
09/11/01	18.06
09/12/01	
09/13/01	104.72
09/14/01	103.19
09/15/01	72.15
09/16/01	96.32
09/17/01	
09/18/01	160.69
09/19/01	68.54
09/20/01	74.58
09/21/01	61.32

wet well 2

date	flow
09/22/01	58.82
09/23/01	47.99
09/24/01	40.28
09/25/01	33.68
09/26/01	30.00
09/27/01	27.99
09/28/01	26.25
09/29/01	25.07
09/30/01	44.31
10/01/01	72.15
10/02/01	59.24
10/03/01	45.76
10/04/01	37.71
10/05/01	32.15
10/06/01	29.38
10/07/01	28.89
10/08/01	29.38
10/09/01	31.25
10/10/01	32.78
10/11/01	34.44
10/12/01	40.63
10/13/01	46.88
10/14/01	39.79
10/15/01	35.42
10/16/01	37.78
10/17/01	50.90
10/18/01	53.75
10/19/01	71.94
10/20/01	64.79
10/21/01	52.08
10/22/01	46.81
10/23/01	42.36

average gpm **42.20**

minimum gpm **12.31**

wet well 3

date	flow
10/28/00	8.61
10/29/00	7.57
10/30/00	7.36
10/31/00	9.10
11/02/00	10.69
11/05/00	10.49
11/06/00	9.24
11/07/00	8.78
11/09/00	7.99
11/10/00	8.40
11/11/00	9.24
11/12/00	14.79
11/13/00	10.97
11/14/00	9.38
11/15/00	9.10
11/16/00	10.28
11/17/00	16.67
11/18/00	13.96
11/19/00	12.01
11/20/00	11.39
11/21/00	11.94
11/22/00	26.18
11/23/00	45.21
11/25/00	18.26
11/26/00	14.24
11/27/00	12.22
11/28/00	10.63
11/29/00	10.35
11/30/00	8.96
12/02/00	11.88
12/04/00	8.61
12/05/00	50.69
12/06/00	26.25
12/08/00	13.06
12/09/00	10.69
12/10/00	9.10
12/11/00	8.19
12/12/00	7.71
12/13/00	7.50
12/14/00	7.78
12/15/00	7.36
12/16/00	7.57
12/17/00	7.15
12/18/00	6.94
12/19/00	6.74
12/20/00	6.11
12/23/00	6.11
12/24/00	5.69
12/25/00	5.90

wet well 3

date	flow
12/26/00	5.90
12/27/00	5.49
12/28/00	3.68
12/30/00	8.19
01/03/01	45.42
01/04/01	31.18
01/05/01	42.43
01/07/01	21.39
01/08/01	17.08
01/09/01	16.11
01/11/01	10.07
01/13/01	7.71
01/15/01	13.68
01/17/01	22.50
01/18/01	21.11
01/20/01	12.99
01/22/01	11.67
01/23/01	20.90
01/26/01	13.06
01/28/01	22.85
01/31/01	17.22
02/02/01	25.42
02/03/01	26.11
02/04/01	19.86
02/05/01	13.68
02/12/01	7.15
02/19/01	6.81
02/26/01	10.69
03/05/01	9.79
03/12/01	20.14
03/19/01	11.94
03/26/01	4.10
04/02/01	
04/09/01	
04/16/01	
04/01/01	7.64
04/02/01	6.81
04/03/01	6.04
04/04/01	5.49
04/05/01	8.68
04/06/01	11.46
04/07/01	8.61
04/08/01	7.29
04/09/01	6.39
04/10/01	6.39
04/11/01	6.11
04/12/01	7.01
04/13/01	7.50
04/14/01	6.39

wet well 3

date	flow
04/15/01	6.32
04/16/01	6.31
04/17/01	6.39
04/18/01	6.32
04/19/01	6.18
04/20/01	5.69
04/21/01	5.63
04/22/01	5.56
04/23/01	5.56
04/24/01	5.69
04/25/01	5.69
04/26/01	6.04
04/27/01	9.51
04/28/01	10.83
04/29/01	8.54
04/30/01	7.01
05/01/01	5.97
05/02/01	5.69
05/03/01	9.03
05/04/01	15.14
05/05/01	13.82
05/06/01	9.03
05/07/01	7.57
05/08/01	8.40
05/09/01	8.33
05/10/01	7.85
05/11/01	7.99
05/12/01	8.89
05/13/01	9.03
05/14/01	8.40
05/15/01	7.43
05/16/01	6.88
05/17/01	6.60
05/18/01	6.39
05/19/01	6.04
05/20/01	5.83
05/21/01	5.83
05/22/01	6.18
05/23/01	6.04
05/24/01	5.63
05/25/01	5.21
05/26/01	5.83
05/27/01	5.97
05/28/01	5.97
05/29/01	5.83
05/30/01	5.42
05/31/01	5.42
06/01/01	5.42
06/02/01	5.42

wet well 3

date	flow
06/03/01	5.00
06/04/01	5.00
06/05/01	5.00
06/06/01	4.86
06/07/01	4.86
06/08/01	4.44
06/09/01	5.00
06/10/01	5.42
06/11/01	5.21
06/12/01	5.21
06/13/01	5.21
06/14/01	4.79
06/15/01	4.86
06/16/01	4.44
06/17/01	4.44
06/18/01	4.44
06/19/01	4.44
06/20/01	4.65
06/21/01	4.24
06/22/01	4.44
06/23/01	4.44
06/24/01	4.38
06/25/01	4.38
06/26/01	4.31
06/27/01	4.31
06/28/01	4.10
06/29/01	4.10
06/30/01	4.10
07/01/01	3.89
07/02/01	40.97
07/03/01	3.96
07/04/01	4.10
07/05/01	4.51
07/06/01	5.69
07/07/01	7.15
07/08/01	7.36
07/09/01	7.50
07/10/01	8.13
07/11/01	6.53
07/12/01	5.69
07/13/01	6.11
07/14/01	8.33
07/15/01	6.94
07/16/01	5.90
07/17/01	5.49
07/18/01	5.00
07/19/01	49.37
07/20/01	4.93
07/21/01	4.79

wet well 3

date	flow
07/22/01	5.14
07/23/01	5.00
07/24/01	5.00
07/25/01	5.00
07/26/01	5.00
07/27/01	5.00
07/28/01	4.79
07/29/01	4.58
07/30/01	4.79
07/31/01	4.58
08/01/01	4.58
08/02/01	4.44
08/03/01	4.58
08/04/01	4.44
08/05/01	4.44
08/06/01	4.44
08/07/01	4.03
08/08/01	3.82
08/09/01	4.03
08/10/01	4.24
08/11/01	4.03
08/12/01	4.03
08/13/01	4.10
08/14/01	4.10
08/15/01	3.89
08/16/01	3.89
08/17/01	3.89
08/18/01	3.89
08/19/01	3.89
08/20/01	4.17
08/21/01	4.38
08/22/01	4.17
08/23/01	4.17
08/24/01	4.17
08/25/01	3.75
08/26/01	4.65
08/27/01	47.99
08/28/01	10.00
08/29/01	8.61
08/30/01	7.50
08/31/01	6.39
09/01/01	6.11
09/02/01	22.92
09/03/01	10.83
09/04/01	9.03
09/05/01	10.69
09/06/01	10.14
09/07/01	20.42
09/08/01	16.04

wet well 3

date	flow
09/09/01	10.00
09/10/01	6.81
09/11/01	5.56
09/12/01	7.71
09/13/01	61.94
09/14/01	20.28
09/15/01	11.60
09/16/01	24.31
09/17/01	
09/18/01	31.18
09/19/01	10.42
09/20/01	15.49
09/21/01	11.39
09/22/01	14.51
09/23/01	13.06
09/24/01	10.07
09/25/01	8.33
09/26/01	7.29
09/27/01	6.81
09/28/01	6.39
09/29/01	6.39
09/30/01	18.06
10/01/01	25.14
10/02/01	14.58
10/03/01	10.07
10/04/01	8.33
10/05/01	7.64
10/06/01	7.85
10/07/01	8.47
10/08/01	10.14
10/09/01	11.11
10/10/01	12.08
10/11/01	12.22
10/12/01	18.54
10/13/01	12.36
10/14/01	9.24
10/15/01	10.21
10/16/01	17.71
10/17/01	4.17
10/18/01	3.68
10/19/01	16.04
10/20/01	13.06
10/21/01	12.43
10/22/01	12.50
10/23/01	10.76

average gpm 9.90

minimum gpm 3.68

wet well 4

date	Flow (gpm)
01/22/01	8.89
01/23/01	40.35
01/26/01	6.39
01/28/01	16.18
01/31/01	19.38
02/02/01	
02/03/01	14.72
02/04/01	11.18
02/05/01	5.90
03/05/01	
03/12/01	10.63
03/19/01	1.32
04/01/01	2.64
04/02/01	1.32
04/03/01	1.11
04/04/01	0.56
04/05/01	18.54
04/06/01	18.06
04/07/01	4.65
04/08/01	2.64
04/09/01	0.83
04/10/01	0.35
04/11/01	2.64
04/12/01	6.60
04/13/01	3.26
04/14/01	1.32
04/15/01	
04/16/01	
04/17/01	
04/18/01	0.56
04/19/01	0.76
04/20/01	
04/21/01	
04/22/01	0.21
04/23/01	
04/24/01	
04/25/01	3.89
04/26/01	2.22
04/27/01	22.85
04/28/01	12.92
04/29/01	6.18
04/30/01	4.38
05/01/01	2.50
05/02/01	3.13
05/03/01	21.32
05/04/01	36.94
05/05/01	17.36
05/06/01	8.61
05/07/01	8.40

wet well 4

date	Flow (gpm)
05/08/01	13.82
05/09/01	7.50
05/10/01	3.68
05/11/01	15.90
05/12/01	8.89
05/13/01	9.79
05/14/01	4.24
05/15/01	2.50
05/16/01	1.94
05/17/01	0.63
05/18/01	1.39
05/19/01	0.63
05/20/01	0.28
05/21/01	
05/22/01	6.81
05/23/01	1.25
05/24/01	0.63
05/25/01	
05/26/01	
05/27/01	0.14
05/28/01	0.21
05/29/01	
05/30/01	
05/31/01	
06/01/01	
06/02/01	
06/03/01	
06/04/01	
06/05/01	
06/06/01	
06/07/01	
06/08/01	
06/09/01	
06/10/01	1.32
06/11/01	1.18
06/12/01	0.90
06/13/01	
06/14/01	
06/15/01	
06/16/01	
06/17/01	0.07
06/18/01	
06/19/01	
06/20/01	
06/21/01	
06/22/01	
06/23/01	
06/24/01	0.42
06/25/01	

wet well 4

date	Flow (gpm)
06/26/01	
06/27/01	
06/28/01	
06/29/01	
06/30/01	
07/01/01	
07/02/01	0.42
07/03/01	
07/04/01	
07/05/01	
07/06/01	0.07
07/07/01	5.42
07/08/01	0.14
07/09/01	
07/10/01	8.26
07/11/01	4.65
07/12/01	3.47
07/13/01	8.89
07/14/01	11.94
07/15/01	5.83
07/16/01	2.99
07/17/01	1.18
07/18/01	
07/19/01	
07/20/01	
07/21/01	
07/22/01	
07/23/01	0.56
07/24/01	1.18
07/25/01	1.74
07/26/01	1.74
07/27/01	1.18
07/28/01	0.63
07/29/01	0.56
07/30/01	0.14
07/31/01	
08/01/01	
08/02/01	0.56
08/03/01	
08/04/01	0.56
08/05/01	
08/06/01	0.69
08/07/01	
08/08/01	
08/09/01	
08/10/01	
08/11/01	
08/12/01	
08/13/01	

wet well 4 date	Flow (gpm)
08/14/01	
08/15/01	
08/16/01	
08/17/01	
08/18/01	
08/19/01	
08/20/01	
08/21/01	
08/22/01	
08/23/01	
08/24/01	
08/25/01	0.56
08/26/01	0.76
08/27/01	77.22
08/28/01	12.01
08/29/01	19.24
08/30/01	12.08
08/31/01	8.61
09/01/01	12.22
09/02/01	58.26
09/03/01	25.28
09/04/01	17.43
09/05/01	29.51
09/06/01	19.17
09/07/01	67.36
09/08/01	34.79
09/09/01	18.68
09/10/01	12.29
09/11/01	8.06
09/12/01	34.51
09/13/01	268.54
09/14/01	52.64
09/15/01	47.43
09/16/01	93.19
09/17/01	
09/18/01	82.78
09/19/01	31.53
09/20/01	47.01
09/21/01	25.76
09/22/01	44.79
09/23/01	27.43
09/24/01	16.04
09/25/01	13.61
09/26/01	9.38
09/27/01	6.46
09/28/01	7.64
09/29/01	9.44
09/30/01	104.58
10/01/01	97.08

wet well 4

date	**Flow (gpm)**
10/02/01	32.99
10/03/01	21.32
10/04/01	14.93
10/05/01	11.25
10/06/01	23.96
10/07/01	18.40
10/08/01	29.44
10/09/01	31.67
10/10/01	29.65
10/11/01	35.49
10/12/01	62.50
10/13/01	22.29
10/14/01	14.79
10/15/01	43.68
10/16/01	64.38

average gpm **34.20**

minimum gpm **6.46**

based on 8/25/01 thru 10/16/01

Appendix G

Calculations for Tailings Area Surface Runoff and Impoundment Infiltration Rates

Calculations of the amount of average stormwater runoff, resulting from average precipitation over mine operation areas at Hawk Inlet and the surface tailings impoundment, were made to estimate average stormwater flows at the Hawk Inlet pads and to the surface tailings wet wells in Section 2.0. These estimates were made by using the average annual rainfall of 52.9 inches/year (4.41 feet /year) at KGCMC, breaking that down to a yearly volume over a known surface area (for example the known surface area associated with up-gradient drainage to Wet Well 2, Figure 5), and then converting that volume per year, to gpm. For instance, the approximate size of the up-gradient drainage area associated with Wet Well 2 is 12.2 acres. 12.2 acres multiplied by 43,560 square feet per acre, multiplied by 4.41 feet per year, gives 2,343,615 cubic feet per year, or 33.4 gpm. Appendix O tabulates drainage area size and calculated precipitation stormwater runoff reaching the wet wells, the North Retention Pond, and Pond 6.

A portion of the surface water from precipitation on the surface tailings impoundment runs off and is collected at wet wells or basins, and a portion infiltrates into the tailings pile. Methodology is outlined in the "KGCMC Stage II Tailings Expansion Hydrologic Analysis" report prepared for KGCMC by EDE consultants, Feb. 5, 2002, to evaluate the infiltration rate of water within the surface tailings pile. That report details the process for arriving at a conservative infiltration rate of $7.7x10^{-6}$ gpm/ft^2 for the surface tailings pile material based on observations of surface tailings water levels during capped and uncapped pile conditions. Using this infiltration rate and areas associated with the under-drains reporting to Wet Wells 2, 3, and 4, of 14.6 acres, 3.7 acres, and 4.3 acres respectively, infiltration flow rates entering the wet wells were calculated. The infiltration flow rates are calculated at 4.9 gpm, 1.2 gpm, and 1.4 gpm for Wet Wells 2, 3, and 4 respectively. Appendix O lists infiltration collection rates and infiltration collection area sizes.

Infiltration rate lost from stormwater runoff for surface tailings drainage areas up-gradient of the wet wells was attained in the same manner as the infiltration rates calculated above. For instance, as calculated above, average precipitation volume reporting to the surface drainage area up-gradient of Wet Well 2 is 33.4 gpm. Subtracting the infiltration rate of 4.2 gpm associated with the 12.2 acres of the Wet Well 2 runoff area from the 33.4 gpm, gives 29.2 gpm of drainage area stormwater runoff (Appendix O). Completing the same calculation for Wet Well 3 gives 8.4 gpm of drainage area stormwater runoff (Appendix O).

To attain the amount of flow at Wet Wells 2 and 3 attributable to groundwater, base flow conditions at the wet wells were observed from Figures 6 and 7. These base flows are representative of the flow at the wet wells without any contribution from precipitation induced stormwater runoff. Therefore, the graphed base flow is the sum of the infiltration flow and the groundwater flow at the wet well (Appendix O). For Wet Wells 2 and 3, the base flows are 12.3 gpm and 3.7 gpm respectively. These base flows result in groundwater flows of 7.4 gpm and 2.5 gpm for Wet Wells 2 and 3 respectively (Appendix O). Flowmeter readings for Wet Wells 2 and 3 show average flow at these wells of 42.2 and 9.9 respectively (Appendix O). Subtracting the infiltration and groundwater flow rates from the average flow recorded by the flowmeters at the wet wells gives the stormwater contribution to the wet well flow. Stormwater contribution calculated in this manner for Wet Well 2 is 29.9 gpm and for Wet Well 3 is 6.2 gpm. Appendices D and E show Wet Well 2 and 3 flowmeter readings, average flow, and minimum flow (base flow) in gpm.

Comparison of the stormwater contribution calculated from wet well base flow (Wet Well 2 = 29.9 gpm, Wet Well 3 = 6.2 gpm) to the drainage area stormwater calculated from average precipitation and infiltration (Wet Well 2 = 29.2 gpm, Wet Well 3 = 8.4 gpm) reveals that the numbers are very similar (Appendix O). Slight variation in the areas used to calculate stormwater and infiltration, could account for the differences between the methods. It appears that all runoff water associated with the drainage areas up-gradient from Wet Wells 2 and 3 reports to the wet wells. The conveyance of this stormwater to the wet wells is thought to be through unlined tailings runoff collection toe ditches around the tailings pile that overlay under-drain collection piping to the wet wells. There appears to be direct communication between the toe ditches and the under-drain collection system. Since the values for stormwater contribution derived from the base flow method are tailored to the average flowmeter readings, these values were used for the flow estimations at Wet Wells 2 and 3.

Estimation of flow contribution at Wet Well 4 was done similarly to that for Wet Wells 2 and 3, but with the inclusion of a fourth water source at the wet well: effluent from the North Retention Pond. The base flow for Wet Well 4 from, Figure 8, is 6.5 gpm. Infiltration contribution to the Wet Well 4 flow is 1.4 gpm. Groundwater flow at Wet Well 4 is therefore 5.1 gpm (Appendix O). The flowmeter at Wet Well 4 has malfunctioned through much of 2001. From 8/25/01 until the present, the Wet Well 4 flowmeter has provided a more accurate reading. Using this most recent, most accurate, data the average flow recorded at the Wet Well 4 flowmeter is found to be 34.2 gpm. Given the short time frame of accurate recorded data this average may not be representative of a true average flow at Wet Well 4. Subtracting infiltration and groundwater flows leaves 27.7 gpm of flow to be accounted for by stormwater runoff. Precipitation volume over the 17 acres draining to the North Retention Pond is calculated at 46.4 gpm based on average daily rainfall. The North Retention Pond discharges directly to Wet Well 4. The North Retention Pond drainage area includes some tailings at the northern edge of the pile, some disturbed areas and roadways, and native areas of peat and forest. A portion of the water volume over the North Retention Pond drainage area can therefore be expected to be lost to abstractions including interceptions, infiltration, evaporation, surface storage, surface detention, etc. The least possible abstraction rate for the North Retention Pond runoff would be 40% or (1 - 27.7/46.4)*100. Given the large portion of native lands and the potential drainage interceptions within the drainage area, 40% abstraction is possible. A greater abstraction rate, however, seems unlikely and is not justified within this area. Using this abstraction rate, an effluent rate of 27.7 gpm from the North Retention Pond to Wet Well 4 is derived. This accounts for all of the stormwater flow reporting to Wet Well 4 and leaves no room for runoff to the well from the Wet Well 4 up-gradient surface drainage area. All stormwater runoff from the up-gradient drainage area from Wet Well 4 is assumed to report to Pond 6 as direct runoff collected in toe ditches and trenches. The results from above for Wet Well 4 are tallied in Appendix O.

Stormwater runoff from the pad areas at Hawk Inlet is calculated as approximately the difference of the flow rate out of DB-04 and the influent rate from Cannery Creek (see Figure 3) or 10 gpm, and divided proportionally for each pad based on acreage. This gives average stormwater flow from the upper pad of 4.5 gpm and from the lower pad of 5.5 gpm. Calculating the precipitation flow for the upper and lower pads at Hawk Inlet from the average annual rainfall gives 15.1 gpm for the 5.5 acre upper pad and 18.5 gpm for the 6.8 acre lower pad. Comparison between the total precipitation flow calculated from average rainfall and the stormwater runoff calculated from the DB-04 flow, shows that the pad area must have an abstraction rate (attributable to interceptions, infiltration, evaporation, surface storage, surface detention, etc) of around 70% of the total precipitation.

Precipitation falling in the tailings area that reports directly to Pond 6 via collection ditches falls mainly on compacted soil types and roadways. The total precipitation induced average flow from the 4.1 acres draining directly to Pond 6 is 11.2 gpm. Additionally the surface area of Pond 6 (1.5 acres) receives 4.1 gpm from direct precipitation influent.

Calculations for 10yr-24hr storm average stormwater flows and peak runoff rates were made using the storm runoff modeling program SEDCAD 4 using the drainage areas presented in Appendix O. Design runs from SEDCAD 4 for the current tailings area and Hawk Inlet facilities pad areas are provided in Appendices C, H, and I.

Current Wet Well and Direct Runoff Area 10yr-24hr flows

Kennecott KGCMC Tailings Area Water Balance

Appendix H

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

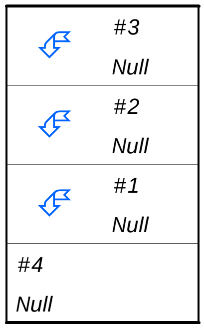
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.360 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.000	0.000	wet well 2
Null	#2	==>	#4	0.000	0.000	wet well 3
Null	#3	==>	#4	0.000	0.000	wet well 4
Null	#4	==>	End	0.000	0.000	Pond 6



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	6.500	6.500	3.88	1.26
#2	2.800	2.800	1.67	0.54
#1	12.200	12.200	7.28	2.36
#4	5.600	27.100	16.18	5.23

Structure Detail:

Structure #3 (Null)

wet well 4

Structure #2 (Null)

wet well 3

Structure #1 (Null)

wet well 2

Structure #4 (Null)

Pond 6

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	6.500	0.049	0.000	0.000	90.000	M	3.88	1.255
	S	**6.500**						**3.88**	**1.255**
#2	1	2.800	0.032	0.000	0.000	90.000	M	1.67	0.541
	S	**2.800**						**1.67**	**0.541**
#1	1	12.200	0.113	0.000	0.000	90.000	M	7.28	2.356
	S	**12.200**						**7.28**	**2.356**
#4	1	5.600	0.013	0.000	0.000	90.000	M	3.34	1.081
	S	**27.100**						**16.18**	**5.233**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	6.00	60.00	1,000.00	2.440	0.113
#1	**1**	**Time of Concentration:**					**0.113**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.67	20.00	300.00	2.580	0.032
#2	**1**	**Time of Concentration:**					**0.032**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	8.00	40.00	500.00	2.820	0.049
#3	**1**	**Time of Concentration:**					**0.049**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	30.00	30.00	100.00	5.470	0.005
		8. Large gullies, diversions, and low flowing streams	5.00	10.00	200.00	6.700	0.008
#4	**1**	**Time of Concentration:**					**0.013**

10yr-24hr Runoff to North Retention Pond Current Area

Kennecott KGCMC Tailings Area Water Balance

Appendix I

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.360 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	North Retention Pond

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	17.000	17.000	10.15	3.28
	Out			4.74	3.28

Structure Detail:

Structure #1 (Pond)

North Retention Pond

Pond Inputs:

Initial Pool Elev:	2.00
Initial Pool:	0.25 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
14.12	1200.00	1.00	0.0150	2.00	0.90	0.00

Pond Results:

Peak Elevation:	4.37
Dewater Time:	0.87 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
0.00	0.110	0.000	0.000		
0.50	0.120	0.057	0.000		
1.00	0.130	0.120	0.000		
1.50	0.135	0.186	0.000		
2.00	0.140	0.255	0.000		Spillway #1
2.50	0.150	0.327	0.876	5.15	
3.00	0.160	0.405	2.447	13.05	
3.50	0.170	0.487	4.314	1.30	
4.00	0.180	0.575	4.674	0.60	
4.37	0.183	0.643	4.741	0.70	Peak Stage
4.50	0.185	0.666	4.764		
5.00	0.190	0.760	4.854		
5.50	0.200	0.857	4.944		
6.00	0.210	0.960	5.034		
6.50	0.220	1.067	5.124		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7.00	0.230	1.179	5.213	
7.50	0.240	1.297	5.303	
8.00	0.250	1.419	5.393	
8.50	0.260	1.547	5.483	
9.00	0.270	1.679	5.573	
9.50	0.280	1.817	5.650	
10.00	0.290	1.959	5.720	

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	(3)>0.876	0.876
3.00	(3)>2.447	2.447
3.50	(5)>4.314	4.314
4.00	(5)>4.674	4.674
4.50	(5)>4.764	4.764
5.00	(5)>4.854	4.854
5.50	(5)>4.944	4.944
6.00	(5)>5.034	5.034
6.50	(6)>5.124	5.124
7.00	(6)>5.213	5.213
7.50	(6)>5.303	5.303
8.00	(6)>5.393	5.393
8.50	(6)>5.483	5.483
9.00	(6)>5.573	5.573
9.50	(6)>5.650	5.650
10.00	(6)>5.720	5.720

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	17.000	0.026	0.000	0.000	90.000	M	10.15	3.283
	S	**17.000**						**10.15**	**3.283**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	37.50	75.00	200.00	12.320	0.004
		7. Paved area and small upland gullies	3.33	10.00	300.00	3.670	0.022
#1	**1**	**Time of Concentration:**					**0.026**

10yr-24hr Storm Runoff to Pond 23

current disturbance at Site 23: best case

10yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

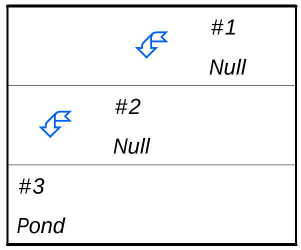
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	native/disturbed interface
Null	#2	==>	#3	0.000	0.000	Pond 23 influent
Pond	#3	==>	End	0.000	0.000	Pond 23



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		35.920	35.920	0.00	0.00
#2		26.740	62.660	12.67	4.37
#3	In	0.000	62.660	12.67	4.37
	Out			4.07	4.37

Structure Detail:

Structure #1 (Null)

native/disturbed interface

Structure #2 (Null)

Pond 23 influent

Structure #3 (Pond)

Pond 23

Pond Inputs:

Initial Pool Elev:	8.00
Initial Pool:	2.37 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	100.00	1.00	0.0140	8.00	0.90	0.00

Pond Results:

Peak Elevation:	10.13
Dewater Time:	1.43 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
0.00	0.170	0.000	0.000	
0.50	0.185	0.089	0.000	
1.00	0.200	0.185	0.000	
1.50	0.215	0.289	0.000	
2.00	0.231	0.400	0.000	
2.50	0.246	0.519	0.000	
3.00	0.262	0.646	0.000	
3.50	0.278	0.781	0.000	
4.00	0.295	0.925	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4.50	0.311	1.076	0.000		
5.00	0.327	1.236	0.000		
5.50	0.344	1.403	0.000		
6.00	0.361	1.580	0.000		
6.50	0.378	1.764	0.000		
7.00	0.395	1.957	0.000		
7.50	0.413	2.159	0.000		
8.00	0.431	2.370	0.000		Spillway #1
8.50	0.448	2.590	0.751	17.75	
9.00	0.466	2.819	2.094	7.50	
9.50	0.484	3.056	3.347	5.45	
10.00	0.503	3.303	3.922		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	0.000	0.000
6.00	0.000	0.000
6.50	0.000	0.000
7.00	0.000	0.000
7.50	0.000	0.000
8.00	0.000	0.000
8.50	(3)>0.751	0.751
9.00	(3)>2.094	2.094
9.50	(5)>3.347	3.347
10.00	(6)>3.922	3.922

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	35.920	0.303	0.000	0.000	30.000	S	0.00	0.000
	S	**35.920**						**0.00**	**0.000**
#2	1	12.620	0.035	0.000	0.000	45.000	S	0.28	0.232
	2	14.120	0.087	0.000	0.000	94.000	F	12.67	4.142
	S	**62.660**						**12.67**	**4.374**
#3	S	**62.660**						**12.67**	**4.374**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	44.61	820.00	1,838.00	1.680	0.303
#1	**1**	**Time of Concentration:**					**0.303**
#2	1	4. Cultivated, straight row	41.67	125.00	300.00	5.770	0.014
		8. Large gullies, diversions, and low flowing streams	11.73	95.00	810.00	10.270	0.021
#2	**1**	**Time of Concentration:**					**0.035**
#2	2	7. Paved area and small upland gullies	19.61	100.00	510.00	8.910	0.015
		8. Large gullies, diversions, and low flowing streams	0.74	5.00	675.00	2.580	0.072
#2	**2**	**Time of Concentration:**					**0.087**

10yr-24hr Storm Runoff to Pond 23

full disturbance at Site 23: worst case

10yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

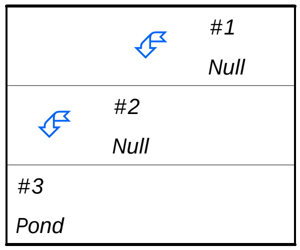
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	native/disturbed interface
Null	#2	==>	#3	0.000	0.000	Pond 23 influent
Pond	#3	==>	End	0.000	0.000	Pond 23



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		35.920	35.920	0.00	0.00
#2		26.740	62.660	18.60	6.19
#3	In	0.000	62.660	18.60	6.19
	Out			5.31	6.19

Structure Detail:

Structure #1 (Null)

native/disturbed interface

Structure #2 (Null)

Pond 23 influent

Structure #3 (Pond)

Pond 23

Pond Inputs:

Initial Pool Elev:	8.00
Initial Pool:	2.37 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	100.00	1.00	0.0140	8.00	0.90	0.00

Pond Results:

Peak Elevation:	11.21
Dewater Time:	1.45 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
0.00	0.170	0.000	0.000	
0.50	0.185	0.089	0.000	
1.00	0.200	0.185	0.000	
1.50	0.215	0.289	0.000	
2.00	0.231	0.400	0.000	
2.50	0.246	0.519	0.000	
3.00	0.262	0.646	0.000	
3.50	0.278	0.781	0.000	
4.00	0.295	0.925	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4.50	0.311	1.076	0.000		
5.00	0.327	1.236	0.000		
5.50	0.344	1.403	0.000		
6.00	0.361	1.580	0.000		
6.50	0.378	1.764	0.000		
7.00	0.395	1.957	0.000		
7.50	0.413	2.159	0.000		
8.00	0.431	2.370	0.000		Spillway #1
8.50	0.448	2.590	0.751	17.75	
9.00	0.466	2.819	2.094	2.10	
9.50	0.484	3.056	3.347	5.90	
10.00	0.503	3.303	3.922		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	0.000	0.000
6.00	0.000	0.000
6.50	0.000	0.000
7.00	0.000	0.000
7.50	0.000	0.000
8.00	0.000	0.000
8.50	(3)>0.751	0.751
9.00	(3)>2.094	2.094
9.50	(5)>3.347	3.347
10.00	(6)>3.922	3.922

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	35.920	0.303	0.000	0.000	30.000	S	0.00	0.000
	S	**35.920**						**0.00**	**0.000**
#2	1	20.730	0.067	0.000	0.000	94.000	F	18.60	6.082
	2	6.010	0.035	0.000	0.000	45.000	S	0.13	0.110
	S	**62.660**						**18.60**	**6.192**
#3	S	**62.660**						**18.60**	**6.192**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	44.61	820.00	1,838.00	1.680	0.303
#1	**1**	**Time of Concentration:**					**0.303**
#2	1	4. Cultivated, straight row	25.00	50.00	200.00	4.460	0.012
		8. Large gullies, diversions, and low flowing streams	4.32	54.00	1,250.00	6.230	0.055
#2	**1**	**Time of Concentration:**					**0.067**
#2	2	4. Cultivated, straight row	41.67	125.00	300.00	5.770	0.014
		8. Large gullies, diversions, and low flowing streams	11.73	95.00	810.00	10.270	0.021
#2	**2**	**Time of Concentration:**					**0.035**

10yr-24hr Storm Runoff to Pond D

Site D Runoff

10yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

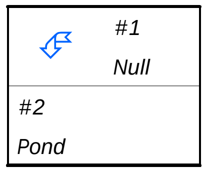
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	Pond D influent
Pond	#2	==>	End	0.000	0.000	Pond D



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		7.720	7.720	4.20	1.42
#2	In	0.000	7.720	4.20	1.42
	Out			4.13	1.42

Structure Detail:

Structure #1 (Null)

Pond D influent

Structure #2 (Pond)

Pond D

Pond Inputs:

Initial Pool Elev:	5.00
Initial Pool:	0.49 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5.00	12.00	3.00:1	3.00:1	8.00

Pond Results:

Peak Elevation:	5.55
Dewater Time:	0.76 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
0.00	0.069	0.000	0.000		
0.50	0.074	0.036	0.000		
1.00	0.080	0.074	0.000		
1.50	0.085	0.116	0.000		
2.00	0.091	0.160	0.000		
2.50	0.097	0.207	0.000		
3.00	0.104	0.257	0.000		
3.50	0.110	0.311	0.000		
4.00	0.117	0.368	0.000		
4.50	0.124	0.428	0.000		
5.00	0.131	0.492	0.000		Spillway #1
5.50	0.138	0.559	1.656	17.70	
5.55	0.139	0.567	4.128	0.60	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6.00	0.145	0.630	24.441	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	1.656	1.656
6.00	24.441	24.441

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.720	0.022	0.000	0.000	80.000	M	4.20	1.421
	S	**7.720**						**4.20**	**1.421**
#2	S	**7.720**						**4.20**	**1.421**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	21.82	48.00	220.00	3.730	0.016
		8. Large gullies, diversions, and low flowing streams	12.00	30.00	250.00	10.390	0.006
#1	**1**	**Time of Concentration:**					**0.022**

10yr-24hr 920 Site

920 Site Runoff

10yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

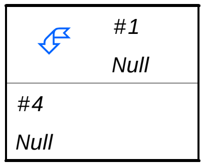
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.000	0.000	920 Site
Null	#4	==>	End	0.000	0.000	collection



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	18.180	18.180	14.59	4.71
#4	0.000	18.180	14.59	4.71

Structure Detail:

Structure #1 (Null)

920 Site

Structure #4 (Null)

collection

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	18.180	0.100	0.000	0.000	90.000	M	14.59	4.711
	S	**18.180**						**14.59**	**4.711**
#4	S	**18.180**						**14.59**	**4.711**

Appendix K

Calculations for Expansion Tailings Area Wastewater Flow Rates

Calculations for average stormwater runoff from precipitation for the proposed expansion surface tailings impoundment area were made to estimate average flows for the various surface tailings areas presented in Section 3.0. These estimations were made using the same procedure outlined in Appendix G. That is, taking the average annual rainfall on a daily basis over a known runoff drainage area, and converting it to gpm. For the stormwater runoff areas draining over tailings materials, a proportion of the rainfall volume equal to the infiltration volume was subtracted from the overall rainfall volume, to attain the volume of water leaving the area as stormwater runoff (Appendix O). The procedure presented in the "KGCMC Stage II Tailings Expansion Hydrologic Analysis" (EDE 2002) report was used to calculate infiltration volume over the stormwater runoff areas.

Because the design and construction of the proposed expansion area wet well under-drain systems and collection ditches should alleviate the current problem of stormwater in toe ditches being directed to drain systems, no stormwater runoff water is expected to report directly to the wet wells after the proposed Stage II Expansion. Stormwater collected on the north end of the surface tailings pile and routed to the North Retention Pond will be subsequently routed to Wet Well 4 from the pond discharge.

Direct stormwater runoff from the area immediately south of the proposed expansion surface tailings pile was modeled as above (Appendix O) with no infiltration loss assumed. This stormwater runoff is mainly collected at the southwest corner of the proposed expanded surface tailings pile from compacted areas and roadways. Stormwater falling directly over the Pond 7 surface area of 5.6 acres was considered as direct stormwater runoff to Pond 7 with no loss to abstractions.

Calculations for average infiltration flow rates reporting to the wet wells from the infiltration areas associated with the wet wells were made using the procedure from the "KGCMC Stage II Tailings Expansion Hydrologic Analysis" (EDE 2002) report. The surface tailings filling the proposed expansion footprint are expected to be placed on geomembrane liner material. Under-drains to the wet well locations will be placed atop this geomembrane material where necessary. This geomembrane material will curtail groundwater flow to the under-drain systems, consequently, no attributable groundwater flow component is expected to be seen at Wet Wells 5 and 6 which drain tailings placed on this material. Groundwater flow contribution at Wet Wells 2, 3, and 4 will remain the same as current conditions because the proposed expanded infiltration areas at these wells will be underlain by liner material. The infiltration collection area at these wet wells will be expanded so infiltration flow rates will increase.

Calculations for 25yr-24hr storm average stormwater flows and peak runoff rates were made using the storm modeling program SEDCAD 4. Design runs from SEDCAD for the expansion area are provided in Appendix L.

The calculations and values presented in this report for the surface tailings proposed expansion area water management should be considered estimates. In particular the predicted flow volumes from the new wet wells are subject to actual as-built pile and under-drain configurations. The locations of these new wet wells are conceptual and subject to change as deemed necessary in the field at the time of the proposed expansion. These wet wells (5 and 6) have been selected to provide a means to address all of the areas encompassed by the proposed surface tailings expansion footprint. The exact location and actual number of additional wet wells needed is subject to change during build out. However, the amount of water to be dealt with is proportional to the area of the proposed pile footprint and therefore will not change regardless of the addition, deletion, or movement of the proposed wet wells.

If geomembrane lining material is not placed underneath all of the proposed new surface tailings expansion, or does not seal completely, there will be an additional amount of flow reporting to the affected wet wells from groundwater. Based on the current groundwater contribution of 15 gpm under 22.6 acres of tailings, a prediction of potential groundwater flow contribution (unlined tailings) under the 67.6 acre proposed expanded surface tailings footprint of 44.9 gpm can be made. This indicates 29.9 gpm of additional groundwater flow could possibly be added to the surface tailings water collection at the wet wells if the geomembrane liners are not used or leak substantially. It should be noted that this prediction assumes potential groundwater flow contribution beneath the pile to be uniform with the average flow seen at Wet Wells 2, 3, and 4. This may not be the case, some areas may produce more or less flow than has been seen to date at the three locations under the existing tailings pile.

Expansion Area 25yr-24hr flows

Kennecott KGCMC Tailings Area Water Balance

Appendix L

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

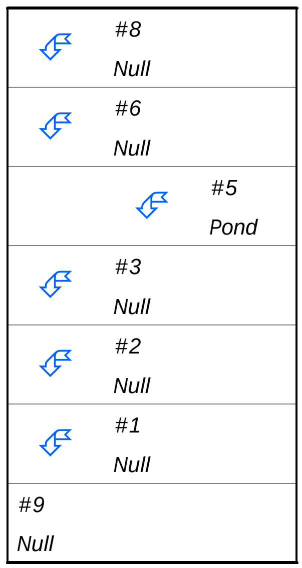
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#9	0.000	0.000	wet well 2
Null	#2	==>	#9	0.000	0.000	wet well 3
Null	#3	==>	#9	0.000	0.000	wet well 4
Pond	#5	==>	#3	0.000	0.000	North Retention Pond
Null	#6	==>	#9	0.000	0.000	wet well 6
Null	#8	==>	#9	0.000	0.000	Pond 7 direct run off
Null	#9	==>	End	0.000	0.000	Pond 7 surface area



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#8		28.500	28.500	22.88	7.38
#6		16.200	16.200	13.00	4.20
#5	In	23.500	23.500	18.86	6.09
	Out			5.31	6.09
#3		2.800	26.300	7.36	6.81
#2		3.100	3.100	2.49	0.80
#1		0.800	0.800	0.64	0.21
#9		5.600	80.500	51.82	21.37

Structure Detail:

Structure #8 (Null)

Pond 7 direct run off

Structure #6 (Null)

wet well 6

Structure #5 (Pond)

North Retention Pond

Pond Inputs:

Initial Pool Elev:	2.00
Initial Pool:	0.25 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
14.12	1200.00	1.00	0.0150	2.00	0.90	0.00

Pond Results:

Peak Elevation:	7.56
Dewater Time:	0.86 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
0.00	0.110	0.000	0.000		
0.50	0.120	0.057	0.000		
1.00	0.130	0.120	0.000		
1.50	0.135	0.186	0.000		
2.00	0.140	0.255	0.000		Spillway #1
2.50	0.150	0.327	0.876	5.20	
3.00	0.160	0.405	2.447	5.40	
3.50	0.170	0.487	4.314	3.00	
4.00	0.180	0.575	4.674	0.65	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4.50	0.185	0.666	4.764	0.60	
5.00	0.190	0.760	4.854	0.65	
5.50	0.200	0.857	4.944	0.65	
6.00	0.210	0.960	5.034	0.75	
6.50	0.220	1.067	5.124	0.75	
7.00	0.230	1.179	5.213	0.85	
7.50	0.240	1.297	5.303	1.40	
7.56	0.241	1.311	5.314	0.70	Peak Stage
8.00	0.250	1.419	5.393		
8.50	0.260	1.547	5.483		
9.00	0.270	1.679	5.573		
9.50	0.280	1.817	5.650		
10.00	0.290	1.959	5.720		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	(3)>0.876	0.876
3.00	(3)>2.447	2.447
3.50	(5)>4.314	4.314
4.00	(5)>4.674	4.674
4.50	(5)>4.764	4.764
5.00	(5)>4.854	4.854
5.50	(5)>4.944	4.944
6.00	(5)>5.034	5.034
6.50	(6)>5.124	5.124
7.00	(6)>5.213	5.213
7.50	(6)>5.303	5.303
8.00	(6)>5.393	5.393
8.50	(6)>5.483	5.483
9.00	(6)>5.573	5.573
9.50	(6)>5.650	5.650

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
10.00	(6)>5.720	5.720

Structure #3 (Null)

wet well 4

Structure #2 (Null)

wet well 3

Structure #1 (Null)

wet well 2

Structure #9 (Null)

Pond 7 surface area

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#8	1	28.500	0.095	0.000	0.000	90.000	M	22.88	7.385
	S	**28.500**						**22.88**	**7.385**
#6	1	16.200	0.046	0.000	0.000	90.000	M	13.00	4.198
	S	**16.200**						**13.00**	**4.198**
#5	1	23.500	0.078	0.000	0.000	90.000	M	18.86	6.089
	S	**23.500**						**18.86**	**6.089**
#3	1	2.800	0.038	0.000	0.000	90.000	M	2.25	0.725
	S	**26.300**						**7.36**	**6.814**
#2	1	3.100	0.030	0.000	0.000	90.000	M	2.49	0.803
	S	**3.100**						**2.49**	**0.803**
#1	1	0.800	0.020	0.000	0.000	90.000	M	0.64	0.207
	S	**0.800**						**0.64**	**0.207**
#9	1	5.600	0.000	0.000	0.000	100.000	F	5.45	1.960
	S	**80.500**						**51.82**	**21.367**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	26.67	100.00	375.00	5.160	0.020
#1	**1**	**Time of Concentration:**					**0.020**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	25.45	140.00	550.00	5.040	0.030
#2	**1**	**Time of Concentration:**					**0.030**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	17.39	100.00	575.00	4.170	0.038
#3	**1**	**Time of Concentration:**					**0.038**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	26.37	120.00	455.00	5.130	0.024
		8. Large gullies, diversions, and low flowing streams	1.43	10.00	700.00	3.580	0.054
#5	**1**	**Time of Concentration:**					**0.078**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	40.00	200.00	500.00	6.320	0.021

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	11.11	100.00	900.00	9.990	0.025
#6	**1**	**Time of Concentration:**					**0.046**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	16.00	80.00	500.00	4.000	0.034
		8. Large gullies, diversions, and low flowing streams	2.73	30.00	1,100.00	4.950	0.061
#8	**1**	**Time of Concentration:**					**0.095**

25yr-24hr Storm Runoff to Pond 23

25yr-24hr current disturbance at Site 23: best case

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

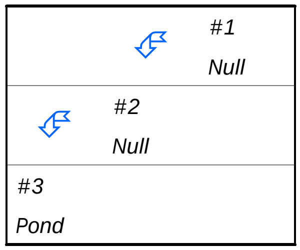
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.250 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	native/disturbed interface
Null	#2	==>	#3	0.000	0.000	Pond 23 influent
Pond	#3	==>	End	0.000	0.000	Pond 23



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		35.920	35.920	0.12	0.04
#2		26.740	62.660	16.24	5.95
#3	In	0.000	62.660	16.24	5.95
	Out			4.88	5.95

Structure Detail:

Structure #1 (Null)

native/disturbed interface

Structure #2 (Null)

Pond 23 influent

Structure #3 (Pond)

Pond 23

Pond Inputs:

Initial Pool Elev:	8.00
Initial Pool:	2.37 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	100.00	1.00	0.0140	8.00	0.90	0.00

Pond Results:

Peak Elevation:	10.83
Dewater Time:	1.46 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
0.00	0.170	0.000	0.000	
0.50	0.185	0.089	0.000	
1.00	0.200	0.185	0.000	
1.50	0.215	0.289	0.000	
2.00	0.231	0.400	0.000	
2.50	0.246	0.519	0.000	
3.00	0.262	0.646	0.000	
3.50	0.278	0.781	0.000	
4.00	0.295	0.925	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4.50	0.311	1.076	0.000		
5.00	0.327	1.236	0.000		
5.50	0.344	1.403	0.000		
6.00	0.361	1.580	0.000		
6.50	0.378	1.764	0.000		
7.00	0.395	1.957	0.000		
7.50	0.413	2.159	0.000		
8.00	0.431	2.370	0.000		Spillway #1
8.50	0.448	2.590	0.751	17.75	
9.00	0.466	2.819	2.094	2.15	
9.50	0.484	3.056	3.347	6.75	
10.00	0.503	3.303	3.922		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	0.000	0.000
6.00	0.000	0.000
6.50	0.000	0.000
7.00	0.000	0.000
7.50	0.000	0.000
8.00	0.000	0.000
8.50	(3)>0.751	0.751
9.00	(3)>2.094	2.094
9.50	(5)>3.347	3.347
10.00	(6)>3.922	3.922

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	35.920	0.303	0.000	0.000	30.000	S	0.12	0.043
	S	**35.920**						**0.12**	**0.043**
#2	1	12.620	0.035	0.000	0.000	45.000	S	0.51	0.551
	2	14.120	0.087	0.000	0.000	94.000	F	16.24	5.359
	S	**62.660**						**16.24**	**5.953**
#3	S	**62.660**						**16.24**	**5.953**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	44.61	820.00	1,838.00	1.680	0.303
#1	**1**	**Time of Concentration:**					**0.303**
#2	1	4. Cultivated, straight row	41.67	125.00	300.00	5.770	0.014
		8. Large gullies, diversions, and low flowing streams	11.73	95.00	810.00	10.270	0.021
#2	**1**	**Time of Concentration:**					**0.035**
#2	2	7. Paved area and small upland gullies	19.61	100.00	510.00	8.910	0.015
		8. Large gullies, diversions, and low flowing streams	0.74	5.00	675.00	2.580	0.072
#2	**2**	**Time of Concentration:**					**0.087**

25yr-24hr Storm Runoff to Pond 23

interceptor trench flows around Site 23

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

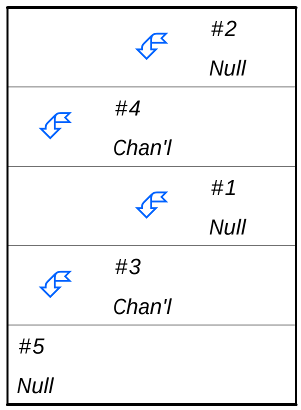
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.250 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.000	0.000	west native/disturbed interface
Null	#2	==>	#4	0.000	0.000	east native/disturbed
Channel	#3	==>	#5	0.000	0.000	west interceptor
Channel	#4	==>	#5	0.000	0.000	east interceptor
Null	#5	==>	End	0.000	0.000	false node



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	21.480	21.480	0.22	0.19
#4	0.000	21.480	0.22	0.19
#1	26.460	26.460	0.16	0.12
#3	0.000	26.460	0.16	0.12
#5	0.000	47.940	0.38	0.31

Structure Detail:

Structure #2 (Null)

east native/disturbed

Structure #4 (Nonerodible Channel)

east interceptor

Trapezoidal Nonerodible Channel Inputs:

Material: Plastic

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	3.0:1	3.0:1	9.0	0.0130	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.22 cfs	
Depth:	0.02 ft	1.02 ft
Top Width:	3.14 ft	9.14 ft
Velocity:	2.79 fps	
X-Section Area:	0.07 sq ft	
Hydraulic Radius:	0.023	
Froude Number:	3.23	

Structure #1 (Null)

west native/disturbed interface

Structure #3 (Nonerodible Channel)

west interceptor

Trapezoidal Nonerodible Channel Inputs:

Material: Plastic

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	3.0:1	3.0:1	13.0	0.0130	1.00		

Nonerodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.16 cfs	
Depth:	0.02 ft	1.02 ft
Top Width:	3.10 ft	9.10 ft
Velocity:	2.70 fps	
X-Section Area:	0.05 sq ft	
Hydraulic Radius:	0.017	
Froude Number:	3.68	

Structure #5 (Null)

false node

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	17.490	0.234	0.000	0.000	30.000	S	0.06	0.021
	2	3.990	0.004	0.000	0.000	45.000	S	0.16	0.174
	S	**21.480**						**0.22**	**0.195**
#4	S	**21.480**						**0.22**	**0.195**
#1	1	24.440	0.234	0.000	0.000	30.000	S	0.08	0.029
	2	2.020	0.004	0.000	0.000	45.000	S	0.08	0.088
	S	**26.460**						**0.16**	**0.117**
#3	S	**26.460**						**0.16**	**0.117**
#5	S	**47.940**						**0.38**	**0.312**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	50.00	750.00	1,500.00	1.780	0.234
#1	**1**	**Time of Concentration:**					**0.234**
#1	2	4. Cultivated, straight row	44.00	44.00	100.00	5.930	0.004
#1	**2**	**Time of Concentration:**					**0.004**
#2	1	4. Cultivated, straight row	41.67	125.00	300.00	5.770	0.014
		8. Large gullies, diversions, and low flowing streams	11.73	95.00	810.00	10.270	0.021
#2	**1**	**Time of Concentration:**					**0.234**

25yr-24hr Storm Runoff to Pond 23

full disturbance at Site 23: worst case

25yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

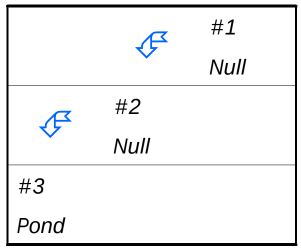
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.250 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	native/disturbed interface
Null	#2	==>	#3	0.000	0.000	Pond 23 influent
Pond	#3	==>	End	0.000	0.000	Pond 23



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		35.920	35.920	0.12	0.04
#2		26.740	62.660	23.84	8.17
#3	In	0.000	62.660	23.84	8.17
	Out			6.54	8.17

Structure Detail:

Structure #1 (Null)

native/disturbed interface

Structure #2 (Null)

Pond 23 influent

Structure #3 (Pond)

Pond 23

Pond Inputs:

Initial Pool Elev:	8.00
Initial Pool:	2.37 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	100.00	1.00	0.0140	8.00	0.90	0.00

Pond Results:

Peak Elevation:	12.28
Dewater Time:	1.49 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
0.00	0.170	0.000	0.000	
0.50	0.185	0.089	0.000	
1.00	0.200	0.185	0.000	
1.50	0.215	0.289	0.000	
2.00	0.231	0.400	0.000	
2.50	0.246	0.519	0.000	
3.00	0.262	0.646	0.000	
3.50	0.278	0.781	0.000	
4.00	0.295	0.925	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4.50	0.311	1.076	0.000		
5.00	0.327	1.236	0.000		
5.50	0.344	1.403	0.000		
6.00	0.361	1.580	0.000		
6.50	0.378	1.764	0.000		
7.00	0.395	1.957	0.000		
7.50	0.413	2.159	0.000		
8.00	0.431	2.370	0.000		Spillway #1
8.50	0.448	2.590	0.751	17.75	
9.00	0.466	2.819	2.094	2.15	
9.50	0.484	3.056	3.347	1.50	
10.00	0.503	3.303	3.922		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	0.000	0.000
6.00	0.000	0.000
6.50	0.000	0.000
7.00	0.000	0.000
7.50	0.000	0.000
8.00	0.000	0.000
8.50	(3)>0.751	0.751
9.00	(3)>2.094	2.094
9.50	(5)>3.347	3.347
10.00	(6)>3.922	3.922

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	35.920	0.303	0.000	0.000	30.000	S	0.12	0.043
	S	**35.920**						**0.12**	**0.043**
#2	1	20.730	0.067	0.000	0.000	94.000	F	23.84	7.868
	2	6.010	0.035	0.000	0.000	45.000	S	0.24	0.262
	S	**62.660**						**23.84**	**8.173**
#3	S	**62.660**						**23.84**	**8.173**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	1. Forest with heavy ground litter	44.61	820.00	1,838.00	1.680	0.303
#1	**1**	**Time of Concentration:**					**0.303**
#2	1	4. Cultivated, straight row	25.00	50.00	200.00	4.460	0.012
		8. Large gullies, diversions, and low flowing streams	4.32	54.00	1,250.00	6.230	0.055
#2	**1**	**Time of Concentration:**					**0.067**
#2	2	4. Cultivated, straight row	41.67	125.00	300.00	5.770	0.014
		8. Large gullies, diversions, and low flowing streams	11.73	95.00	810.00	10.270	0.021
#2	**2**	**Time of Concentration:**					**0.035**

25yr-24hr Storm Runoff to Pond 23

Pond 23 with upslope interceptor trenching and probable full pile build out footprint.

Russell Hamilton

Environmental Design Engineering
23 N Scott St. Suite 23
Sheridan, WY 82801

Phone: 307-672-3793
Email: ederuss@wavecom.net

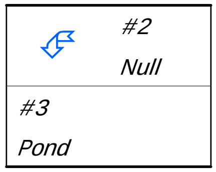
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.250 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#2	==>	#3	0.000	0.000	Pond 23 influent
Pond	#3	==>	End	0.000	0.000	Pond 23



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2		20.730	20.730	23.84	7.87
#3	In	0.000	20.730	23.84	7.87
	Out			6.53	7.87

Structure Detail:

Structure #2 (Null)

Pond 23 influent

Structure #3 (Pond)

Pond 23

Pond Inputs:

Initial Pool Elev:	8.00
Initial Pool:	2.37 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
12.00	100.00	1.00	0.0140	8.00	0.90	0.00

Pond Results:

Peak Elevation:	12.27
Dewater Time:	1.47 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
0.00	0.170	0.000	0.000	
0.50	0.185	0.089	0.000	
1.00	0.200	0.185	0.000	
1.50	0.215	0.289	0.000	
2.00	0.231	0.400	0.000	
2.50	0.246	0.519	0.000	
3.00	0.262	0.646	0.000	
3.50	0.278	0.781	0.000	
4.00	0.295	0.925	0.000	
4.50	0.311	1.076	0.000	
5.00	0.327	1.236	0.000	
5.50	0.344	1.403	0.000	
6.00	0.361	1.580	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6.50	0.378	1.764	0.000		
7.00	0.395	1.957	0.000		
7.50	0.413	2.159	0.000		
8.00	0.431	2.370	0.000		Spillway #1
8.50	0.448	2.590	0.751	17.75	
9.00	0.466	2.819	2.094	2.10	
9.50	0.484	3.056	3.347	2.65	
10.00	0.503	3.303	3.922		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	0.000	0.000
6.00	0.000	0.000
6.50	0.000	0.000
7.00	0.000	0.000
7.50	0.000	0.000
8.00	0.000	0.000
8.50	(3)>0.751	0.751
9.00	(3)>2.094	2.094
9.50	(5)>3.347	3.347
10.00	(6)>3.922	3.922

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	20.730	0.067	0.000	0.000	94.000	F	23.84	7.868
	Σ	**20.730**						**23.84**	**7.868**
#3	Σ	**20.730**						**23.84**	**7.868**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	4. Cultivated, straight row	25.00	50.00	200.00	4.460	0.012
		8. Large gullies, diversions, and low flowing streams	4.32	54.00	1,250.00	6.230	0.055
#2	**1**	**Time of Concentration:**					**0.067**

25yr-24hr Storm Runoff to Pond D

Site D Runoff

25yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

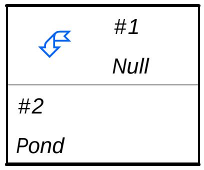
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.250 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.000	0.000	Pond D influent
Pond	#2	==>	End	0.000	0.000	Pond D



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		7.720	7.720	6.07	2.00
#2	In	0.000	7.720	6.07	2.00
	Out			5.99	2.00

Structure Detail:

Structure #1 (Null)

Pond D influent

Structure #2 (Pond)

Pond D

Pond Inputs:

Initial Pool Elev:	5.00
Initial Pool:	0.49 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5.00	12.00	3.00:1	3.00:1	8.00

Pond Results:

Peak Elevation:	5.60
Dewater Time:	0.77 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
0.00	0.069	0.000	0.000		
0.50	0.074	0.036	0.000		
1.00	0.080	0.074	0.000		
1.50	0.085	0.116	0.000		
2.00	0.091	0.160	0.000		
2.50	0.097	0.207	0.000		
3.00	0.104	0.257	0.000		
3.50	0.110	0.311	0.000		
4.00	0.117	0.368	0.000		
4.50	0.124	0.428	0.000		
5.00	0.131	0.492	0.000		Spillway #1
5.50	0.138	0.559	1.656	16.90	
5.60	0.139	0.572	5.993	1.55	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6.00	0.145	0.630	24.441	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	1.656	1.656
6.00	24.441	24.441

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	7.720	0.022	0.000	0.000	80.000	M	6.07	2.002
	S	**7.720**						**6.07**	**2.002**
#2	S	**7.720**						**6.07**	**2.002**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	3. Short grass pasture	21.82	48.00	220.00	3.730	0.016
		8. Large gullies, diversions, and low flowing streams	12.00	30.00	250.00	10.390	0.006
#1	**1**	**Time of Concentration:**					**0.022**

25yr-24hr 920 Site

920 Site Runoff

25yr-24hr

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

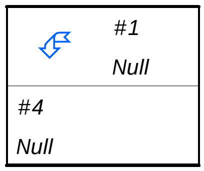
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	5.250 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.000	0.000	920 Site
Null	#4	==>	End	0.000	0.000	collection



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	18.180	18.180	19.27	6.24
#4	0.000	18.180	19.27	6.24

Structure Detail:

Structure #1 (Null)

920 Site

Structure #4 (Null)

collection

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	18.180	0.100	0.000	0.000	90.000	M	19.27	6.238
	S	**18.180**						**19.27**	**6.238**
#4	S	**18.180**						**19.27**	**6.238**

Expansion Area 10yr-24hr flows

Kennecott KGCMC Tailings Area Water Balance

Appendix N

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

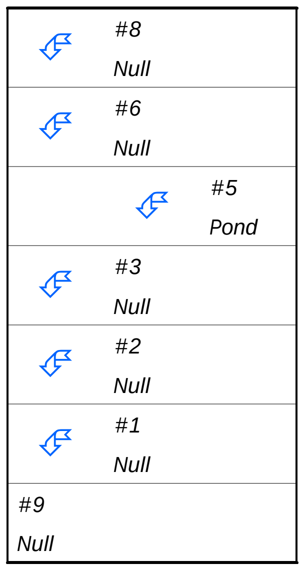
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	10 yr - 24 hr
Rainfall Depth:	3.360 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#9	0.000	0.000	wet well 2
Null	#2	==>	#9	0.000	0.000	wet well 3
Null	#3	==>	#9	0.000	0.000	wet well 4
Pond	#5	==>	#3	0.000	0.000	North Retention Pond
Null	#6	==>	#9	0.000	0.000	wet well 6
Null	#8	==>	#9	0.000	0.000	Pond 7 direct run off
Null	#9	==>	End	0.000	0.000	Pond 7 surface area



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#8		28.500	28.500	17.01	5.50
#6		16.200	16.200	9.67	3.13
#5	In	23.500	23.500	14.03	4.54
	Out			4.98	4.54
#3		2.800	26.300	6.56	5.08
#2		3.100	3.100	1.85	0.60
#1		0.800	0.800	0.48	0.15
#9		5.600	80.500	39.93	16.03

Structure Detail:

Structure #8 (Null)

Pond 7 direct run off

Structure #6 (Null)

wet well 6

Structure #5 (Pond)

North Retention Pond

Pond Inputs:

Initial Pool Elev:	2.00
Initial Pool:	0.25 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
14.12	1200.00	1.00	0.0150	2.00	0.90	0.00

Pond Results:

Peak Elevation:	5.72
Dewater Time:	0.85 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
0.00	0.110	0.000	0.000		
0.50	0.120	0.057	0.000		
1.00	0.130	0.120	0.000		
1.50	0.135	0.186	0.000		
2.00	0.140	0.255	0.000		Spillway #1
2.50	0.150	0.327	0.876	5.20	
3.00	0.160	0.405	2.447	9.75	
3.50	0.170	0.487	4.314	2.35	
4.00	0.180	0.575	4.674	0.60	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
4.50	0.185	0.666	4.764	0.55	
5.00	0.190	0.760	4.854	0.70	
5.50	0.200	0.857	4.944	0.80	
5.72	0.204	0.902	4.983	0.55	Peak Stage
6.00	0.210	0.960	5.034		
6.50	0.220	1.067	5.124		
7.00	0.230	1.179	5.213		
7.50	0.240	1.297	5.303		
8.00	0.250	1.419	5.393		
8.50	0.260	1.547	5.483		
9.00	0.270	1.679	5.573		
9.50	0.280	1.817	5.650		
10.00	0.290	1.959	5.720		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	(3)>0.876	0.876
3.00	(3)>2.447	2.447
3.50	(5)>4.314	4.314
4.00	(5)>4.674	4.674
4.50	(5)>4.764	4.764
5.00	(5)>4.854	4.854
5.50	(5)>4.944	4.944
6.00	(5)>5.034	5.034
6.50	(6)>5.124	5.124
7.00	(6)>5.213	5.213
7.50	(6)>5.303	5.303
8.00	(6)>5.393	5.393
8.50	(6)>5.483	5.483
9.00	(6)>5.573	5.573
9.50	(6)>5.650	5.650

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
10.00	(6)>5.720	5.720

Structure #3 (Null)

wet well 4

Structure #2 (Null)

wet well 3

Structure #1 (Null)

wet well 2

Structure #9 (Null)

Pond 7 surface area

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#8	1	28.500	0.095	0.000	0.000	90.000	M	17.01	5.503
	S	**28.500**						**17.01**	**5.503**
#6	1	16.200	0.046	0.000	0.000	90.000	M	9.67	3.128
	S	**16.200**						**9.67**	**3.128**
#5	1	23.500	0.078	0.000	0.000	90.000	M	14.03	4.538
	S	**23.500**						**14.03**	**4.538**
#3	1	2.800	0.038	0.000	0.000	90.000	M	1.67	0.541
	S	**26.300**						**6.56**	**5.079**
#2	1	3.100	0.030	0.000	0.000	90.000	M	1.85	0.599
	S	**3.100**						**1.85**	**0.599**
#1	1	0.800	0.020	0.000	0.000	90.000	M	0.48	0.154
	S	**0.800**						**0.48**	**0.154**
#9	1	5.600	0.000	0.000	0.000	100.000	F	4.36	1.568
	S	**80.500**						**39.93**	**16.031**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	26.67	100.00	375.00	5.160	0.020
#1	**1**	**Time of Concentration:**					**0.020**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	25.45	140.00	550.00	5.040	0.030
#2	**1**	**Time of Concentration:**					**0.030**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	17.39	100.00	575.00	4.170	0.038
#3	**1**	**Time of Concentration:**					**0.038**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	26.37	120.00	455.00	5.130	0.024
		8. Large gullies, diversions, and low flowing streams	1.43	10.00	700.00	3.580	0.054
#5	**1**	**Time of Concentration:**					**0.078**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	40.00	200.00	500.00	6.320	0.021

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	11.11	100.00	900.00	9.990	0.025
#6	**1**	**Time of Concentration:**					**0.046**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	16.00	80.00	500.00	4.000	0.034
		8. Large gullies, diversions, and low flowing streams	2.73	30.00	1,100.00	4.950	0.061
#8	**1**	**Time of Concentration:**					**0.095**

Tailings Area Water Balance
Intermediary Flow Calculations/Comparison Tabulation

current	surface drainage area acres	infiltration collection area acres	infiltration collection rate gpm	graphed base flow (Figures 6, 7,& 8) gpm A	average well flow flowmeters gpm B	groundwater collection rate gpm	surface runoff reaching wells from A & B gpm	average surface runoff based on annual precipitation gpm
wet well 2	12.2	14.6	4.9	12.3	42.2	7.4	29.9	29.2
wet well 3	3.5	3.7	1.2	3.7	9.9	2.5	6.2	8.4
wet well 4	6.5	4.3	1.4	6.5	34.2	5.1	0.0	17.7
ret. Pond	17.0	-----	-----	-----	-----	-----	-----	46.4
pond 6 run off	4.1	-----	-----	-----	-----	-----	-----	11.2
pond 6 area	1.5	-----	-----	-----	-----	-----	-----	4.1
expansion								
wet well 2	0.8	20.0	6.7	-----	**14.1**	7.4	**0.0**	1.9
wet well 3	3.1	5.3	1.8	-----	**4.3**	2.5	**0.0**	7.4
wet well 4	2.8	14.0	4.7	-----	**71.4**	5.1	**0.0**	6.7
wet well 5	0.0	16.0	5.4	-----	**5.4**	**0.0**	**0.0**	0.0
wet well 6	16.2	13.4	4.5	-----	**4.5**	**0.0**	**0.0**	38.8
ret. Pond	23.5	-----	-----	-----	-----	-----	-----	56.3
pond 7 run off	28.5	-----	-----	-----	-----	-----	-----	68.2
pond 7 area	5.6	-----	-----	-----	-----	-----	-----	15.3

Current Wet Well and Direct Runoff Area 25yr-24hr flows

Kennecott KGCMC Tailings Area Water Balance

Appendix P

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

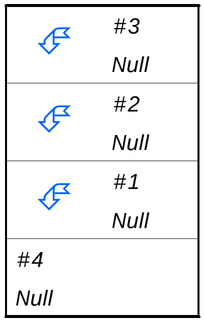
General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	0.000	0.000	wet well 2
Null	#2	==>	#4	0.000	0.000	wet well 3
Null	#3	==>	#4	0.000	0.000	wet well 4
Null	#4	==>	End	0.000	0.000	Pond 6



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	6.500	6.500	5.22	1.68
#2	2.800	2.800	2.25	0.73
#1	12.200	12.200	9.79	3.16
#4	5.600	27.100	21.75	7.02

Structure Detail:

Structure #3 (Null)

wet well 4

Structure #2 (Null)

wet well 3

Structure #1 (Null)

wet well 2

Structure #4 (Null)

Pond 6

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	6.500	0.049	0.000	0.000	90.000	M	5.22	1.684
	S	**6.500**						**5.22**	**1.684**
#2	1	2.800	0.032	0.000	0.000	90.000	M	2.25	0.725
	S	**2.800**						**2.25**	**0.725**
#1	1	12.200	0.113	0.000	0.000	90.000	M	9.79	3.161
	S	**12.200**						**9.79**	**3.161**
#4	1	5.600	0.013	0.000	0.000	90.000	M	4.49	1.451
	S	**27.100**						**21.75**	**7.022**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	6.00	60.00	1,000.00	2.440	0.113
#1	**1**	**Time of Concentration:**					**0.113**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.67	20.00	300.00	2.580	0.032
#2	**1**	**Time of Concentration:**					**0.032**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	8.00	40.00	500.00	2.820	0.049
#3	**1**	**Time of Concentration:**					**0.049**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	30.00	30.00	100.00	5.470	0.005
		8. Large gullies, diversions, and low flowing streams	5.00	10.00	200.00	6.700	0.008
#4	**1**	**Time of Concentration:**					**0.013**

25yr-24hr Runoff to North Retention Pond Current Area

Kennecott KGCMC Tailings Area Water Balance

Appendix Q

Russell Hamilton

Environmental Design Engineering
23 N. Scott St. Suite 23
Sheridan, WY 82801

Phone: (307)-672-3793
Email: ederuss@wavecom.net

General Information

Storm Information:

Storm Type:	NRCS Type IA
Design Storm:	25 yr - 24 hr
Rainfall Depth:	4.200 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	North Retention Pond

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	17.000	17.000	13.65	4.40
	Out			4.96	4.40

Structure Detail:

Structure #1 (Pond)

North Retention Pond

Pond Inputs:

Initial Pool Elev:	2.00
Initial Pool:	0.25 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
14.12	1200.00	1.00	0.0150	2.00	0.90	0.00

Pond Results:

Peak Elevation:	5.62
Dewater Time:	0.87 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
0.00	0.110	0.000	0.000		
0.50	0.120	0.057	0.000		
1.00	0.130	0.120	0.000		
1.50	0.135	0.186	0.000		
2.00	0.140	0.255	0.000		Spillway #1
2.50	0.150	0.327	0.876	5.15	
3.00	0.160	0.405	2.447	10.70	
3.50	0.170	0.487	4.314	1.75	
4.00	0.180	0.575	4.674	0.55	
4.50	0.185	0.666	4.764	0.60	
5.00	0.190	0.760	4.854	0.60	
5.50	0.200	0.857	4.944	0.85	
5.62	0.202	0.881	4.964	0.70	Peak Stage
6.00	0.210	0.960	5.034		
6.50	0.220	1.067	5.124		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7.00	0.230	1.179	5.213	
7.50	0.240	1.297	5.303	
8.00	0.250	1.419	5.393	
8.50	0.260	1.547	5.483	
9.00	0.270	1.679	5.573	
9.50	0.280	1.817	5.650	
10.00	0.290	1.959	5.720	

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Combined Total Discharge (cfs)
0.00	0.000	0.000
0.50	0.000	0.000
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	(3)>0.876	0.876
3.00	(3)>2.447	2.447
3.50	(5)>4.314	4.314
4.00	(5)>4.674	4.674
4.50	(5)>4.764	4.764
5.00	(5)>4.854	4.854
5.50	(5)>4.944	4.944
6.00	(5)>5.034	5.034
6.50	(6)>5.124	5.124
7.00	(6)>5.213	5.213
7.50	(6)>5.303	5.303
8.00	(6)>5.393	5.393
8.50	(6)>5.483	5.483
9.00	(6)>5.573	5.573
9.50	(6)>5.650	5.650
10.00	(6)>5.720	5.720

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	17.000	0.026	0.000	0.000	90.000	M	13.65	4.405
	S	**17.000**						**13.65**	**4.405**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	7. Paved area and small upland gullies	37.50	75.00	200.00	12.320	0.004
		7. Paved area and small upland gullies	3.33	10.00	300.00	3.670	0.022
#1	**1**	**Time of Concentration:**					**0.026**

Site 23/D and 920 Site Surface Water Hydrology and Management

Surface water flows within the Site 23 and Site D areas result from precipitation and from groundwater discharge as springs. Surface water flow from the hill above Site 23/D is not contained or routed around the site. This heavily vegetated/forested hill slope, retains nearly all moisture under normal precipitation conditions by infiltration and vegetative consumption. Surface water entering, or initiating within, the site is captured in toe ditches around the development rock piles and is collected in one of the two containment ponds on site, Pond 23 or Pond D. A lined ditch system conveys runoff from Site 23 along the toe of the facility to Pond 23 while an unlined ditch similarly collects water off of Site D to Pond D.

At least eleven seeps that have perceptible flow occur across the placed development rock/fill on Site D. Discharges from these Site D seeps are captured in the Site D toe ditch and routed to Pond D. It should also be noted that during/after significant precipitation events, seeps have been noted at a number of locations on the unexcavated back-slope of Site 23. These ephemeral seeps flow intensely for several days following rainfall and then gradually decrease as the precipitation charged shallow perched aquifer is depleted. These ephemeral seeps are an artifact of storage and re-release of water in the shallow colluvium layers.

Pond 23 and Pond D were constructed primarily as stormwater retention structures, but Pond 23 also assists as a holding/storage facility for water from the mill. Additionally, flows from a curtain drain between Site 23 and Site D, and finger drains beneath the 23 and D piles are routed to Pond 23 and Pond D. The finger drains directed to Pond 23 can be charged by precipitation events, and display a very rapid time to concentration for waters infiltrating through the development rock pile. This is due to the relatively high permeability and low saturation of the site foundation materials and the development rock material. Consequently, it takes a large storm event to produce runoff surface flow over the surface of the development rock pile itself.

Ponds 23 and D are normally operated at about 30% of their capacity, leaving 70% available for stormwater runoff from large events. Water collected in these two ponds is pump discharged to the Tank 6/Pond 6 holding facilities and then to the Pit 5 treatment plant at the surface tailings impoundment site via a combination of an 8” dia. pipeline and a 10” dia. pipeline that parallel the B road. Average flow through the 10” pipeline is 486 gpm and it is typically from the 920 Mill process. Average flow through the 8” diameter pipeline is 133 gpm of stormwater collection. The maximum discharge rate through these pipelines is governed by pumping and valving options at Site 23, Site D, and the 920 Site, and is 984 gpm in the 8” pipeline and 954 gpm in the 10” pipeline. Following conveyance down the mountain to the surface tailings impoundment area, the water is treated and discharged under the approved NPDES permit.

Site 23 and Site D Design Event Runoff Control

The design storm for Site 23 and Site D at KGCM is currently the 10yr-24hr event but will be changed to the 25yr-24hr event as required by the State of Alaska for the Solid Waste Program at the mine. This increase in design criterion is a significant change from the 10yr-24 hr. design criteria required in 1995-96 during the mine and mill re-permitting and refurbishment upon which the current facilities were sized and constructed. The 25yr-24hr event results in 5.25 inches of rain in the vicinity of Site 23, Site D, and the 920 Mill Area (10yr-24hr rainfall = 4.20 inches).

Pond 23 has a volume of 3.28 ac-ft., with a normal operating capacity (water collection and sediment storage) of 30% or less of the total pond volume. The capacity of Pond 23 available for runoff collection is then, 2.30 ac-ft. Pond D has a volume of 0.50 ac-ft., with a normal operating capacity (water collection and sediment storage) of 30% or less of the total pond volume. The capacity of Pond D available for runoff collection is then, 0.35 ac-ft.

Pond 23 can receive water from the 920 mill process or the 920 facilities runoff collection pond, Pond A. Pond A has a volume of 3.76 ac-ft., with a normal operating capacity (water collection and sediment storage) of 30% or less of the total pond volume. The capacity of Pond A available for runoff collection is then, 2.63 ac-ft. The 920 Site is not controlled within the Solid Waste Program, and thusly the design event required for Pond A and the 920 Site is the 10yr-24hr event. The 10yr-24hr event rainfall at Site 23, Site D, and the 920 Site is 4.20 inches. However, Pond 23 and Pond D must be designed to control the 25yr-24hr event, and excessive Pond A stormwater is typically sent to Pond 23. The 920 Site is only several hundred feet from Site 23 and Site D, and so it must be assumed that during a 25yr-24hr event at Site 23 and Site D, 25yr-24hr event runoff will occur at the 920 Site which will affect storm water collection at Ponds 23 and D. Therefore, to adequately model design event runoff to Ponds 23 and D the 25yr-24hr design event must be used at the 920 Site also.

Event Analysis for Current Site 23 Conditions

Approximately 12.62 acres of the available lease area are not covered by the current development rock pile footprint at Site 23. Development rock continues to be added to the pile. The currently projected final pile build out (current mine plan) will reach approximately to the 1,040 top of pile elevation. Projecting the associated final pile build out boundary conservatively within the lease area, leaves approximately 6 acres that will contain no development rock at the currently estimated full build out. The expansion of the development rock pile within the lease area will alter the runoff produced during the design storm due to increasing the area with greater runoff potential (development rock) and decreasing the area with greater infiltration (cleared area). Therefore, it is prudent to evaluate Site 23 under the design storm for two conditions: 1) the current pile footprint (best case, less runoff produced) and 2) the final pile build out (worst case, most runoff produced).

Table Appendix R-1 summarizes the design storm parameters and results for the 25yr-24hr storm at Site 23/D and the 920 Site under current conditions and under Site 23 full build out conditions. Appendix M contains the SEDCAD 4 printouts for the 25yr-24hr event models at Site 23/D and the 920 Site.

The runoff modeling program SEDCAD 4 was used to model the 25yr-24hr event flows contributing to Pond 23 and Pond D. Under current conditions, the model estimates that 5.95 ac-ft of runoff reports to Pond 23 during a design event, and an additional 21.45 ac-ft of precipitation in the Pond 23 drainage area (upslope of Site 23), is retained by vegetation or infiltrates to the colluvial/slide material. Typically, small storm events recharge the shallow aquifer system, which discharges flow down gradient that is

Table Appendix R-1 – Site 23/D and 920 Mill Area 25yr-24hr

Design Event Parameters

Parameter	Units	Pond 23	Pond D	Pond A
Existing Pond Capacity	acre-feet	3.28	0.50	3.76
Drainage Area	acres	62.66	7.72	18.18
Runoff Volume (current)	acre-feet	5.95	2.00	6.24
Influent Peak Discharge (current)	gpm	7,289	2,724	8,649
Average Discharge (current)	gpm	1,347	453	1,412
Operating Capacity	acre-feet	0.98	0.15	1.13
Runoff Volume (full build out)	acre-feet	8.17	------	------
Influent Peak Discharge (full build out)	gpm	10,700	------	------
Average Discharge (full build out)	gpm	1,849	------	------

eventually collected in the curtain drain beneath Site 23. The recharge of the shallow soils/peat by precipitation, results in a constant curtain drain discharge to Pond D through the curtain drain collection system of about 56 gpm (historical average of 1995 and 2002 data). Because the 21.5 ac-ft of infiltration during a design event is much more than would normally be directed to the aquifer under smaller storm conditions, it is reasonable to assume that some of this infiltration will saturate aquifer conditions and result in seeps, forming some amount of runoff flow additional to the 5.95 ac-ft modeled. Note that mine personnel have observed the appearance and subsequent disappearance of seeps on the unexcavated back-slope above Site 23 during and after times of heavy precipitation. It is difficult to quantify this additional amount without more site storm-runoff data. To provide for prudent design conservatism accounting for this additional flow, the 5.95 ac-ft of runoff was increased by a nominal 10% to 6.55 ac-ft of total runoff reporting to Pond 23 during the design storm under current conditions. Precisely how much additional flow of this nature is actually tributary is indeterminate. If Pond 23 were to be designed to completely contain the design event (no discharge) under current site conditions and maintain the current operating capacity (0.98 ac-ft), it would need to be 7.53 ac-ft as compared to the current capacity of 3.28 ac-ft.

The design event at Site D would produce 2.0 ac-ft of direct runoff and potentially, 0.40 ac-ft of infiltration water to Pond D via the curtain drain. While the average curtain drain discharge is 56 gpm and Pond D flow from May to October 2001 was 51 gpm, under design event induced increased saturated aquifer conditions (increasing saturated curtain drain thickness), it is expected that the curtain drain discharge to Pond 23 could increase dramatically. The largest curtain drain flow on record was 89 gpm, at less than 100% aquifer saturation. Adding this 89 gpm over 24 hours, to the runoff volume during the event, total water collection at Pond D during the storm period would be 2.40 ac-ft. If Pond D were to be designed to completely contain the design runoff event along with the maximum curtain drain flow component, and maintain the current normal operating capacity, it would need to be 2.55 ac-ft. During the same event, Pond A would receive 6.24 ac-ft and must discharge 3.61 ac-ft to keep from overtopping.

In order to optimize available containment during the design event, two conditions must be met:

1) Ponds 23 and D must be able to discharge to Pond 6 or Pond 7 (as the case may be) continuously during the event.

2) Mill discharge down the 10" line must cease and the line must be made available to accommodate the additional runoff flows.

Thus, if Pond A collected 2.63 ac-ft (runoff collection capacity) of runoff during the 25yr-24hr event, then 817 gpm would leave Pond A to Ponds 23/D; and if, Pond 23 collected 2.30 ac-ft (runoff collection capacity) during the design event under current conditions then 962 gpm would be sent to the surface tailings impoundment water management from Pond 23. If Pond D collected 0.35 ac-ft (runoff collection capacity) during the design event then 464 gpm would be sent to the surface tailings impoundment water management from Pond D. Therefore, discharge to the surface tailings impoundment water management from the 920 Site, Site 23, and Site D would average 2,243 gpm during a 25yr-24hr event. However, discharge from the 920 Site, Site 23, and Site D to the surface tailings impoundment water management is limited by the discharge pipeline/pumps/valving to 1,938 gpm. This leaves a 305 gpm discharge deficit in the existing systems ability to handle the Site 23 and Site D design storm (25yr-24hr) under current site conditions. In order to improve the existing system to handle the design event flow, the size of Pond 23 or Pond D, or some proportion of both, would need to be increased to create at least an additional 1.35 ac-ft of runoff storage under current Site 23 build out conditions. Table Appendix R-2 outlines the scenario described above as well as the required additional capacities if continuous discharge and/or cessation of mill outflow are not possible.

Event Analysis with the Addition of Interceptor Ditches

To minimize the amount of runoff water reaching Pond 23 during a design event, interceptor ditches could be constructed along the uphill side of the final development rock pile build out disturbance at Site 23. These ditches would be used to capture runoff from native forest lands and to route the runoff around the Site 23/Site D area. Keeping this runoff from contacting the development rock areas would thereby preclude it from the containment and treatment requirement prior to discharge. SEDCAD modeling of these ditches indicate that they could be expected to divert 0.31 ac-ft from the native land and potentially 0.60 ac-ft of the total runoff of 6.55 ac-ft. Addition of the 0.60 acre feet of runoff from the cleared areas above the development rock pile (5.95 ac-ft x 10%) brings the total runoff expected to be captured in the ditches to 0.91 acre feet. Table Appendix R-2 summarizes capacity changes with the addition of interceptor ditches at current site conditions and at full Site 23 build out.

Event Analysis for Site 23 Full Build Out Conditions

Expansion of the development rock at Site 23 to full build-out capacity would result in increased runoff and decreased infiltration. The runoff reaching Pond 23 would increase to 8.17 ac-ft due to the less pervious development rock material compared to the native forest material currently existing where the trees have been removed. This would result in about 19.23 ac-ft of rainfall infiltrating to the shallow aquifers. Incorporating the conservative 10% increase in the runoff amount as above, results in 8.99 ac-ft of runoff reporting to Pond 23 during the design event. Note that the runoff curve number (RCN) for the development rock was kept conservatively high at 94 to account for compacting as well as post-closure, capped conditions where infiltration will be kept to a minimum. Table Appendix R-2 summarizes the requirements for full build-out

Table Appendix R-2 – Site 23/D and 920 Mill Area Required Runoff Collection Capacity

Water Management Scenarios	Necessary Capacity 25yr-24hr Runoff + Operating (ac-ft)			Additional Capacity Required (ac-ft)	Discharge to Tank 6/Pond 6 During Event (ac-ft)
	Pond 23	Pond D	Pond A		
Current Conditions w/Continuous Discharge 920 Mill off	3.28	0.50	3.76	1.35	8.56
Current Conditions w/Continuous Discharge 920 Mill Operating	3.28	0.50	3.76	3.50	8.56
Current Conditions w/Interceptor Ditches w/Continuous Discharge 920 Mill off	3.28	0.50	3.76	0.44	8.56
Current Conditions w/Interceptor Ditches w/Continuous Discharge 920 Mill Operating	3.28	0.50	3.76	2.59	8.56
Current Conditions w/o Continuous Discharge *	7.53	2.55	7.37	9.91	2.15*
Current Conditions w/Interceptor Ditches w/o Continuous Discharge *	6.62	2.55	7.37	9.00	2.15*
Full 23 Build Out w/Continuous Discharge 920 Mill off	3.28	0.50	3.76	3.79	8.56
Full 23 Build Out w/Continuous Discharge 920 Mill Operating	3.28	0.50	3.76	5.94	8.56
Full 23 Build Out w/Interceptor Ditches w/Continuous Discharge 920 Mill off	3.28	0.50	3.76	2.88	8.56
Full 23 Build Out w/Interceptor Ditches w/Continuous Discharge 920 Mill Operating	3.28	0.50	3.76	5.03	8.56
Full 23 Build Out w/o Continuous Discharge *	9.97	2.55	7.37	12.35	2.15*
Full 23 Build Out w/Interceptor Ditches w/o Continuous Discharge *	9.06	2.55	7.37	11.44	2.15*

* The 920 Mill discharge and operation is assumed to be continuous when the runoff water is not discharged to the surface tailings impoundment water management.

containment under a variety of scenarios.

If the Site 23 development rock pile is enlarged to full build out capacity, then the amount of runoff water discharging from Pond 23 during the design event will be 1,514 gpm on average. This will result in an 857 gpm discharge deficit in the existing systems ability to discharge the design event flow to Tank 6. In order to improve the existing system to handle the design event flow under Site 23 full build out conditions, the size of Pond 23 or Pond D, or some proportion of both, would need to be increased to create at least an additional 3.79 ac-ft of runoff storage under current conditions.

Water Management Operation Solutions

In addition to increasing available runoff storage capacity or routing non-contact runoff away from collection, changes in the existing water management techniques may allow the existing facilities to come closer to meeting the stormwater retention requirements of the 25yr-24hr event. As mentioned above, shutting down the 920 Mill operation as soon as the intensity of the storm becomes apparent will greatly aid stormwater collection ability (Table Appendix R-2). Additionally, reducing the current operating capacities of the Site 23/D/920 ponds from 30% of total to the minimum possible would aid operations significantly. This would require more frequent cleaning of sediment form the ponds. Pond D is small enough that a decrease in operation capacity from 30% of total is not practical. However, if operating capacity in Ponds 23 and A could be reduced to 10% of total, an additional 1.4 ac-ft of storm water storage becomes available. This is enough to allow the design storm to be met under current site conditions (Table Appendix R-2). Also, if an additional 1.48 ac-ft of stormwater runoff retention capacity (in conjunction with the above reduction in operating capacities) could be created with means such as interceptor trenches and pond enlargement or temporary runoff traps up-gradient of Pond 23, then the design storm runoff may be manageable under Site 23 full build out conditions.

Summary of Design Event Scenarios

The numbers presented in Table Appendix R-2 for necessary pond storage during the 25yr-24hr event should be regarded as cursory. If pond enlargements are to be made then a full design model relating all three ponds: discharge capabilities/capacities and peak runoff flows and times should be created to fine tune capacity requirements. The numbers provided above, while providing for a conservative estimate, show the average runoff discharge occurring over a 24 hour period, but do not relate the peak runoff rates or times to the discharge system.

Since all ponds are assumed to have their full stormwater retention capacity available at the beginning of the event, it is reasonable to assume that peak flows may be handled within these capacities, i.e. the pond storage will allow containment of peak flow volumes while discharging at a lesser rate than the runoff peak flow. To fully address these issues and derive necessary pond volumes if the ponds are to be modified, a full pond design runoff and hydraulics model beyond the evaluation here should be completed.

In summary, under current Site 23 build out conditions, the installation of interceptor ditches above Site 23, shut down of the 920 Mill during the event, and continuous discharge (at present maximum capacity) from Ponds 23 and D to the surface tailings impoundment water management, would require the least amount of additional capacity (0.44 ac-ft). Without ditches, under current conditions, continuous discharge and cessation of mill discharge would result in 1.35 ac-ft of necessary additional volume expansion with no operational changes of existing water management. Note that 0.44 ac-ft and even 1.35 ac-ft may be attainable if either Pond A or Pond 23 can be operated at less than 30% capacity or if smaller, intermediary, runoff traps were installed up-stream of Pond 23.

Under full build out conditions, the installation of interceptor ditches above Site 23, shut down of the 920 Mill during the event, and continuous discharge (at present maximum capacity) from Ponds 23 and D to the surface tailings impoundment water management, would require the least amount of additional capacity (2.88 ac-ft). Without ditches, under current conditions, continuous discharge and cessation of mill discharge would result in 3.79 ac-ft of necessary additional volume expansion. As under current conditions, note that 2.88 ac-ft and even 3.79 ac-ft may be attainable if either Pond A or Pond 23 can be operated at less than 30% capacity and if smaller, intermediary, runoff traps are installed up-stream of Pond 23.