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DRAINAGE PLAN UPDATE (REVISION 5)

FOR

Golden Queen Mining Company, LLC
Soledad Mountain Mine
2818 Silver Queen Road
Mojave, Kern County, California

October 2019

Prepared for: Golden Queen Mining Company, LLC
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DRAINAGE PLAN UPDATE

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Soledad Mountain Mine
Kern County, California

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1.0 INTRODUCTION

Golden Queen Mining Company, LLC (GQM) operates an open pit gold and silver mine, referred to as the Soledad Mountain Project (Project), in Kern County, California. The Project site is located approximately five (5) miles south of Mojave, California, and two (2) miles west of State Highway 14. Access to the Project site is from Silver Queen Road, which borders the northern portion of the property.

GQM is proposing a modification of their existing reclamation plan for mining operations on Soledad Mountain. This modification is proposed to address the need for mining activities and facilities that support GQM's existing operations. The proposed activities and facilities are extensions of mining activities that are currently permitted by the Bureau of Land Management (BLM) and Kern County.

This report (Site Drainage Plan, Revision 5) presents the results of updated surface water calculations, modeled after the hydrologic calculations that were previously prepared for the Project.

1.1 Background and Purpose

In 2007, Golder Associates (Golder) prepared an initial drainage report for the project. Since 2007, GQM has revised the overall mine development plan and facilities layouts to incorporate a three-stage construction of the Heap Leach Facility (HLF) and to address open pit backfilling requirements mandated by the Surface Mining and Reclamation Act (SMARA). Revision 1 to the Site Drainage Plan was submitted in January 2007 and included the design of a drainage channel between Silver Queen Road and the northern limits of the Phase 1 heap leach pad and site facilities. Revision 2 of the Site Drainage Plan was submitted in February 2011 and incorporated a Conditional Letter of Map Revision (CLOMR) that was submitted to Kern County Engineering, Surveying, and Permit Services Department for approval. Kern County could not form a Floodplain Maintenance District in reasonable time; therefore, GQM decided to relocate certain facilities to avoid any intrusion into the 100-year floodplain. This necessitated Revision 3 of the Site Drainage Plan.

Revision 4 of the Site Drainage Plan, prepared in March 2012, analyzed three phases of the Soledad Mountain Project open pit mining and heap leach facility operation: Pre-Mining, Phase 1 / Stage 1, and Post Mining. In addition, the 2012 Drainage Report analyzed a mining scenario in which no material was sold as aggregate and material that remained on site post-reclamation was reclaimed in accordance with California Code of Regulations Title 14, Section 3704.1 (14 CCR 3704.1), referred to as the "What-If" Scenario.

This report, Revision 5 of the Site Drainage Plan, is necessitated by the proposed modification of the existing Reclamation Plan, which does not take into account the 14 CCR 3704.1 backfill requirements for the Project.

1.2 Summary of the Drainage Plan Update

The modification of the surge piles, revised pit backfilling, and aggregate sales planned as part of the revised mine plan being considered by GQM have necessitated an update of the Site Drainage Plan. This report, Revision 5 of the Site Drainage Plan, has been developed to meet the following design objectives:

1. Set site drainage criteria as follows:
    A. Zero discharge of runoff from mine process areas (heap leach facilities [HLF] and Merrill-Crowe Plant) resulting from precipitation events up to the 100-year design storm event.
    B. Control of runoff from disturbed, active, non-reclaimed, and reclaimed mining areas through sediment ponds designed for containment of runoff from the 10-year, 24-hour storm event and safe passage of flows through the facilities of the 100-year peak runoff.
    C. Diversion of runoff from undisturbed areas into adjacent drainages using diversion ditches and Best Management Practices (BMP) to control erosion and scouring of receiving drainages.
2. Segregation of runoff from disturbed areas such as access roads, parking areas, and undisturbed areas to the extent practical.
3. Temporary diversion ditches and channels, as well as erosion BMPs, will be designed for the 20-year peak runoff.
4. Routing of runoff either into the open pits or to sediment ponds on site such that, to the extent feasible, runoff from the Project area is diverted from areas outside the limits of disturbance. Note that, in few instances on the southern portion of the Project, it is not feasible to capture or divert runoff from the site due to property boundaries and topographic limitations.

2.0 PROJECT DESCRIPTION

Conventional, open pit mining methods employed at the site include crushing and screening ore, adding cement, conveying the crushed ore to the heap leach pads, and applying a sodium cyanide (NaCN) solution that will percolate through the ore on the heap to leach precious metals. All NaCN solutions will be contained on site. From the heap leach pad, solution flows to the Merrill-Crowe plant where gold and silver are extracted from the pregnant solution.

In addition to precious metal recovery, waste rock and aggregate (referred to as surge piles) is stockpiled for the production and sale as construction materials and aggregate, and backfilled in mined out phases of the open pit.

Construction activities related to preparation of the mining and processing structures were initiated at the site in July 2013 and completed in early 2016. Once construction activities concluded, industrial activities commenced. Currently, the Project is operating at full capacity and includes access and haul roads, a workshop-warehouse, crushing-screening plant, Merrill-Crowe plant and assay laboratory, heap leach pad (Phase 1) and associated solution management facilities (referred to as the HLF), mining pits, aggregate processing operations, waste rock surge piles, and associated solution management facilities.

Figure 2 presents the existing drainage basin delineation based on the current topography. Figure 2 also identifies the required surface water and erosion control measures that must be implemented as a result of this study. Figure 3 presents the anticipated drainage basin delineation and the surface water, erosion, and control plan at the end of mining operations. Figure 4 presents the proposed post-mining (reclaimed) configuration after the completion of reclamation activities. This configuration assumes that all revegetation requirements in the reclamation plan have been satisfied. The access roads and sediment ponds as shown in Figure 4 would remain to provide surface water and erosion controls for the post-mining condition.

3.0 SITE CONDITIONS

The Project is located in the historical Mojave Mining District. Historically, Soledad Mountain rose to an elevation of 4,150 feet above mean sea level (amsl). The topography varies from steep (upwards of 70% slopes), rugged hillsides in the middle to upper elevations to a gently sloping desert floor around the toe of Soledad Mountain. According to previous drainage reports, mining has occurred onsite since 1894.

Soledad Mountain is located in an extremely arid area of California. Evaporative losses of surface flow under these dry conditions are typically so significant that stream flow in this region rarely occurs at elevations less than 3,500 feet amsl. Precipitation that reaches the desert floor is usually subjected immediately to high losses from evaporation and transpiration. Nevertheless, runoff occasionally originates on or crosses the desert floor and sometimes reaches the dry lake beds or playas following high intensity rainfall events. Nearly all of the water that reaches the playas is eventually lost to evaporation as these features are not sources of aquifer recharge (Arcadis, 2015).

There are no springs, seeps, or intermittent streams in the Project area. The closest intermittent stream is located approximately three (3) miles to the west (Golder, 2012).

3.1 Rainfall

The Project is located in an arid region typical of the western Mojave Desert. Typical patterns of precipitation are winter rains and summer thunderstorms, which tend to be of short duration and high intensity. The area receives an average annual precipitation of approximately 6.3 inches. The maximum 100-year, 24-hour storm precipitation is 4.39 inches. The area has an evaporation loss potential of approximately 80 inches per year.

Runoff on the northern and western sides of Soledad Mountain is via a series of gullies or channels, which direct surface flows to the northwest, north, and northeast and eventually to the east to the Gloster and Chaffe Hydrologic Areas of the Antelope Hydrologic Unit. Ephemeral drainages direct flow off Soledad Mountain in all directions (Golder, 2012). Runoff on the southern side of Soledad Mountain will flow via natural, typically shallow channels which direct surface flows to the south and east to the Lancaster Hydrologic Area of the Antelope Hydrologic Unit.

3.2 Existing 100-Year Floodplain

The floodplain is described herein only to ensure that its existence is recognized. None of the Project facilities (existing or proposed) encroach into the 100-year floodplain as currently mapped on FEMA FIRM Panel 06029C3675E (revised October 26, 2008) and as presented in Appendix 2.

Hydrologic calculations for the contributing onsite and offsite basins were analyzed in the Soledad Mountain Hydrology Study prepared by Rivertech, Inc. (Rivertech, 2009). The proposed changes to the project analyzed in this report are not expected to substantially alter the findings presented in the Rivertech report.

3.3 Soil Types and Runoff Curve Numbers

Pre-mining soil types for the site were taken from a custom soil resource report for the Project site and surrounding areas based on the United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) web soil survey (NRCS, 2006) and TR-55 tables (NRCS, 1986). Table 1 presents the hydrologic soil groups (HSG) for the Project site and surrounding areas and their respective Soil Conservation Service (SCS) curve numbers (CN). Ground cover is minimal with desert grasses and shrubs.

Table 1: Soil Types and Runoff Curve Numbers

Area Description	Soil Type	Description for CN	CN
Undisturbed Desert Shrub	Arizo gravelly loamy sand (2 to 9% slopes) Cajon loamy sand (0 to 5% slopes) Cajon gravelly loamy sand (0 to 9% slopes)	Desert Shrub, poor condition, HSG A	63
	Garlock loamy sand (2 to 9% slopes) Porterville cobbly clay (5 to 9% slopes) Rosamond clay loam (saline-alkali)	Desert Shrub, poor condition, HSG C	85
	Torriorthents-Rock outcrop complex (very steep) Dumps, mine	Desert Shrub, poor condition, HSG D	88
Mined Benches, Pits, and Haul Roads	Mined or compacted areas	Gravel, HSG B	85
Waste Rock Overburden, Tops	Waste rock	Porous Rock Material, HSG A	77
Waste Rock Overburden, Outslopes	Waste rock	Porous Rock Material, HSG A	70
Reclaimed Areas	Revegetated mined areas	Gravel, HSG A	65

4.0 PRE-MINING, END OF EXCAVATION, AND POST-MINING HYDROLOGY

The Site Drainage Plans have been developed as a guide for management of site drainage, sediment, and erosion controls during operations and for the post-mining conditions. The pre-mining site conditions are based on historic topography provided by GQM. The Existing (2019), End of Mining, and Post-Mining (Reclamation) site conditions are based on the site facilities and anticipated conditions developed by GQM for the heap leach pads, mining areas, waste rock surge piles, and access roads.

The contributing watersheds for the diversion ditches in the plant area and heap leach pad areas will be changing frequently over the life of the mine. This is due to the phased development of the heap leach pads and open pits. The Site Drainage Plans have been developed based upon an analysis of a number of watershed subbasins during the pre-mining, existing conditions, end of mining, and post-mining periods. To account for the changing watershed configuration on site during operations, design criteria are provided to evaluate intermediate runoff control and diversion requirements on an ongoing basis as conditions change throughout the life of mine. The sediment ponds have been sized based on the larger of four possible pond sizes required by either: existing conditions (Figure 2), end of mining (Figure 3), post-mining configuration (Figure 4), or as previously prescribed in the Golder Drainage Plans.

The pre-mining site model was divided into ten (10) drainage basins as shown in Figure 1. The existing site configuration was divided into eleven (11) drainage basins as shown on Figure 2. The end of mine / final reclamation site configuration was divided into ten (10) drainage basins as shown on Figures 3 and 4. The facilities and mining layouts developed by GQM were used to delineate the basins expected to contribute runoff from the Project area. Peak runoff resulting from the 20-year and 100-year storm events are shown for each of the drainage basins.

The existing, end of mining, and post-mining basins were delineated assuming diversion channels are constructed around the Phase 1 heap leach pad as planned. Additional diversion ditches are required on the east, southwest, and western side of the property to direct runoff flows from mining areas (i.e., backfilled pits and the rock storage and aggregate processing area) to sediment ponds around the Project site. Diversion ditches in the post-mining configuration are required on the north, east, and western side of the property to direct flows from the reclaimed areas to sediment ponds.

Runoff CN values were assigned to each basin based on a soil survey of the site (NRCS, 2006) and TR-55 tables (NRCS, 1986). NOAA Atlas 14 Precipitation-Frequency estimates were used to determine the precipitation for the 100-year, 1-hour point rainfall and the 20-year, 1-hour point rainfall which were used to determine the Intensity-Duration Curves used in the Rational Method (see Reference B in Appendix 1). For each basin, the longest flow path was identified and the time of concentration (Tc) was calculated (see Table B in Appendix 1). The times of concentration, basin areas, and composite CN values were used with the Kern County Rational Method to determine the pre- and post-mining peak runoff.

4.1 Criteria for Rational Method Hydrology

The pre-mining, existing, end of mining, and post-mining (reclamation) runoff rates were calculated using the Kern County Rational Method procedure; calculations are included in Appendix 1. The following criteria were selected for the Kern County Rational Method for the site:

- Precipitation for the storm events was obtained from NOAA Atlas 14 (NOAA, 2006);
- 100-year, 1-hour point rainfall of 0.958 inches along with a slope of 0.55 on a log-log graph was used to determine Intensity-Duration Curve used in the Rational Method for 100-year peak runoff;
- 20-year, 1-hour point rainfall of 0.672 inches along with a slope of 0.55 on a log-log graph was used to determine Intensity-Duration Curve used in the Rational Method for erosion control facilities;
- 10-year, 24-hour point rainfall of 2.64 inches was used for sediment pond volume calculations based on basin yield per Kern County procedure;
- Runoff CN values were selected based on Table 1 descriptions and soil types;
- Sheet flow occurs for a maximum of 100 feet;
- The time of concentration (Tc) calculations are separated by lengths of similar slope and assumed channel geometries; and
- The assumed roughness coefficients for Tc calculations are detailed in Appendix 1.

4.2 Peak Flow Estimates

Basins were delineated based on existing and anticipated topographic conditions, and runoff CN values were assigned to the various land uses and vegetative covers as presented in Appendix 1. Times of concentration were calculated using TR-55 methodology. Peak flows for all basins were estimated using the Kern County Rational Method using the basin areas, CN values, and times of concentration; the resulting values are shown on Table 2 below and in Appendix 1.

Table 2: Peak Flow Summary

Basin ID	Pre-Mining Basin Area (acres)	Composite CN	Pre-Mining Peak Runoff Q_{20} (cfs)	Pre-Mining Peak Runoff Q_{100} (cfs)	Final Reclamation Basin Area (acres)	Composite CN	Final Reclamation Peak Runoff Q_{20} (cfs)	Final Reclamation Peak Runoff Q_{100} (cfs)
W1	237.4	78	238.0	390.9	128.1	66	70.0	135.7
NW1[A]	48.0	77	67.3	106.4	179.1	81	239.5	365.9
NW2	202.1	76	196.1	326.9	110.9	75	100.2	168.0
N1	221.3	73	207.6	350.8	183.8	66	107.9	204.9
N2	62.8	79	63.6	103.2	129.0	69	142.2	233.4
E1	286.4	85	347.1	542.8	186.0	73	209.1	335.4
E2	319.4	81	343.3	553.2	165.8	76	276.2	428.6
SW1	421.6	81	275.6	473.2	340.3	75	380.0	623.0
S1	195.9	82	271.2	420.0	215.6	80	293.5	461.9
SE1	156.1	84	222.9	344.2	150.0	82	210.2	326.8
[A] Note that in the final site configuration, Basin NW1 is a pit that will collect storm water and does not discharge.								

5.0 SITE-WIDE STORM WATER CONTROLS

This section presents a discussion of the design of storm water runoff and erosion controls across the site. The various planned diversion and retention structures required to meet the design objectives are described in the following subsections.

In general, the methodology employed in this report for surface water calculations have been modeled after the hydrologic calculations that were previously prepared for the Project.

The conceptual channel and sediment pond designs included herein shall be verified prior to and during operations as the contributing watersheds change. The designs will be completed in general accordance with the design criteria and typical details provided in this Site Drainage Plan. Through experience in development and implementation of BMPs, it is recommended that actual locations and details for BMP installations be determined at the time of construction rather than presented in detail in proposed design drawings. Therefore, only typical details and approximate locations are presented in the figures.

5.1 Runoff and Erosion Controls

The main storm water channels will be designed to safely pass the estimated 100-year peak flow with erosion control BMPs designed for the 20-year, 1-hour intensity storm event per SMARA regulations. Peak flow for diversion channels (ditches) will be estimated using the 20-year, 1-hour intensity storm event and the rational method per the Kern County Hydrology Manual; channel flow depths and velocities were evaluated with the Manning's equation. A 6-inch freeboard is required for all channels in accordance with Kern County Development Standards.

California Title 27 regulations require that storm water channels around the Class B and Class C mine waste facilities (i.e., the heap leach pad, overflow pond, and waste rock surge piles) be designed for the 10-year, 24-hour peak flow. The general locations of the channels are shown in Figure 2 for the existing configuration and Figures 3 and 4 for the end of mining and post-mining (reclaimed) conditions. Typical sediment pond details and a typical channel section are shown on Figure 2.

The natural drainage channel located between the Phase 1 heap leach pad and Silver Queen Road will remain unchanged to receive flows from the south and the west. Smaller and temporary drainage ditches and maintenance activities will be constructed as part of ongoing mine operations.

Erosion control will primarily be provided by placing riprap in key areas. Large quantities of waste rock suitable for riprap are available on site. Sediment will be managed through BMP alternatives such as placing rock check dams in the collection channels at select locations.

The top surfaces of the waste rock surge piles, outside the open pits, will be graded to promote runoff into the backfilled open pits where possible, discouraging runoff down the dump faces. Runoff directed into the backfilled open pits will seep into the surge piles; therefore, water accumulation is not expected. Furthermore, the majority of the precipitation falling directly on the surge piles will seep into the waste rock and/or will evaporate before runoff occurs (Golden Queen, 2007).

5.2 Sediment Pond Design

Sediment ponds design capacity is based on the 10-year, 24-hour design storm runoff volumes as shown on Figure 2, 3 and 4. Ponds are required in Basins NW2, N2, E1, E2, and SW1. The runoff volume to be detained in sediment ponds for Subbasin W1 will be diverted to Pond SW1, which will have capacity to detain the 10-year, 24-hour runoff from both basins. In the post-mining scenario, the sediment ponds from the end of mining will remain in place and the existing HLF overflow pond will be reclaimed for use in storm water management. The pond locations and estimated required capacities are summarized in Table 3.

Note that, as identified on Figure 2, a temporary sediment basin is required to be installed in Basin L1 prior to the completion of construction of the Phase 1 Heap Leach Pad. Although the are no specific sizing requirements for the sediment basin (the 10-year, 24-hour storm is not expected to produce substantial runoff from Basin L1), the sediment basin is necessary to prevent sediment from being carried offsite.

Table 3: Sediment Pond Summary

Pond Identifier	Location	Required Minimum Volume (ac-ft)	Site Condition Governing Design Criteria
NW2	Adjacent to the northwest corner of the Phase 1 HLF, east of Silver Queen Road	11.9	Phase 1 and Post-Mining (from Drainage Report Revision 4 [Golder 2012])[A]
N2	Northeast corner of the site (currently existing)	12.4	Phase 1 (from Drainage Report Revision 4 [Golder 2012])[A]
E1	East side of the site, east of the maintenance warehouse and north of the East Surge Pile	13.1	End of Mining
E2	Easternmost side of the site, east of the East Surge Pile	19.7	Existing Conditions
SW1	Southwest corner of the property, east of Silver Queen Road, southwest of the West Surge Pile	40.5	Existing Conditions (contains runoff from Basin W1 and SW1)
HLF[B]	Northeast corner of site, near existing processing facilities	85.3	Final Reclamation

[A] In instances where the storm water ponds prescribed in the Drainage Report Revision 4 (Golder, 2012) had a greater capacity than the calculated minimum capacity in this report, the larger pond volume has been selected. As-built capacities and conditions of the ponds prescribed in the Golder report have not been verified as a part of this study. The minimum required pond capacity calculated in this iteration of the Drainage Plan for Pond NW2 is 8.7 acre-feet and for Pond N2 is 8.9 acre-feet.

[B] It is assumed that the existing HLF overflow pond (85.3 ac-ft) will be reclaimed and remain in place post-metallic mining and can be used to capture storm water runoff.

Generally, runoff from disturbed areas will be diverted directly into the sediment ponds. As mining operations progress, temporary sediment ponds may be required. Requirements and locations for such ponds will be determined as part of the ongoing mine design and operation.

Final configuration of the sediment ponds may incorporate a combination of excavation and fill in order to meet the required capacity. Ponds will be constructed with an emergency spillway sized to pass the peak flow of the 100-year storm in the event of a major storm occurring while ponds are full or the outlet pipe does not function as designed. The embankment design will have a configuration of 2H:1V upstream and downstream slopes with a 15-foot wide access road along the crest. The embankments will also be engineered and designed to current applicable standards and sized to avoid classification as jurisdictional dams under the California Department of Water Resources Division of Safety of Dams' statutes.

Storm water flow from large storms or successive storms that exceed the required design capacity will be routed through the sediment ponds via an emergency spillway protected with riprap. Five (5) sediment ponds identified in Table 3 (NW2, N2, E1, E2, and SW1) will remain active through the life of the mine. Pond HLF refers to the existing HLF overflow pond (85.3 ac-ft); it is assumed that the overflow pond will be reclaimed and remain in place post-metallic mining and can be used to capture storm water runoff from reclaimed areas.

5.3 Processing and Support Facilities

The layout and drainage associated with the workshop-warehouse, Merrill-Crowe plant, crushing-screening plan, and laboratory are shown in Figure 2, the Existing Condition Drainage Plan. Runoff from areas around facilities such as the workshop-warehouse, Merrill-Crowe plant, crushing-screening plant, and assay laboratory will be collected within each facility boundary and then routed via surface water channels to sediment ponds. Further, runoff from areas upgradient of the Phase 1 heap leach pad will be collected in ditches and routed both east and west along the southern side of the overland conveyor route and thus around the perimeter of the pad.

5.4 Heap Leach Facility(ies)

The HLF consists of the Phase 1 heap leach pad, lined solution conveyance channel, pump box and overflow pond. The HLF has been designed as a zero-discharge facility. According to the WDR, the overflow ponds were designed to contain up to eight (8) hours of draindown volume and 1,000-year, 24-hour storm event runoff emanating from the entire lined area (approximately 27.8 million gallons or 85.3 acre-feet) allowing adequate capacity to account for operational upsets and extraordinary rainfall events.

For the purpose of this report, the HLF is considered to be a self-contained basin and no additional analyses were performed.

5.5 Surge Pile Management

The approach that GQM has adopted for waste rock and aggregate management allows for sequential backfilling of mined-out areas of the open pits. Backfill in the mined-out areas of the open pit will typically consist of end-dumped and therefore loose, coarse waste rock. The crests of the backfilled waste rock will be reworked with a dozer to minimize straight lines so they blend with the natural topography. The backfill and waste rock surge piles will be recontoured to an overall slope of 2H:1V. The contouring is designed to provide stable surfaces and to control and minimize erosion. This approach, referred to as micro-contouring, creates microbasins and results in features that trap moisture and seeds. The prepared areas will provide a suitable roughness for desert flora and will be seeded with either a commercial seed mix or seeds collected and stored on site.

Processing and sale of aggregate will continue on site for at least 40 years after the termination of metallic mining.

5.6 Reclaimed Condition

As shown in the end of mining drainage plan (Figure 3), excess aggregate materials from the waste rock surge piles that are not processed and sold as aggregate prior to the termination of the mining permit will have side slopes reduced to 2:1 (H:V). In the post-mining (final reclamation) phase (Figure 4), revegetation will provide longer-term soil stability, reduce visual contrasts, and provide wildlife habitat. Steep slopes and benches in the open pits that are not covered by backfilled waste rock will not be revegetated.

In some areas, specifically on the southwestern portion of the site, it may not be possible to capture all storm water runoff in sediment ponds prior to discharging from the site. In these instances, sediment and erosion control BMPs will be constructed along the perimeter of the waste rock placement slopes to mitigate the migration of sediment offsite, as identified on the detail on Figure 3.

6.0 SUMMARY OF IMPACTS

The modification of the surge piles and revised pit backfilling and aggregate sales planned as part of the revised mine plan being considered by GQM, as described in this report, are not expected to cause any adverse flooding effects on the surrounding properties. Storm water channels will be designed to safely pass the estimated 100-year peak flow, sediment ponds will be designed to retain 10-year, 24-hour runoff volumes, and temporary diversion ditches and channels capacity, as well as erosion BMPs, will be designed for the 20-year peak runoff in accordance with SMARA and Kern County development requirements.

Additionally, as identified below, implementation of the Project is in conformance with SMARA performance standards.

6.1 Potential Impacts to Surrounding Water Bodies

No direct encroachment into the existing floodplain is planned during the mining project. Local drainage within the mining operation will be collected in the sediment ponds. Erosion control methods implemented at the site must be designed to handle runoff from not less than the 20-year, 1-hour storm. As mining operations progress, temporary sediment ponds may be required. Requirements and locations for such ponds will be determined as part of the ongoing mine design and operation.

SMARA regulations require surface mining and reclamation activities to be conducted in such a way to protect both on-site and downstream beneficial uses of water. In addition, erosion and sedimentation control is necessary during all phases of construction, operation, reclamation, and final closure of the mine. As described previously, sediment ponds, micro-contouring, temporary sediment control BMPs, and revegetation are expected to minimize erosion and sedimentation caused by mining operations. It is important to note that storm water runoff from the Project area is not expected to degrade on-site or downstream beneficial uses of water; in addition to the structural control measures presented in this report, previous studies of the project have concluded that:

- Results of the geochemical characterization program…indicate that the potential of the ore to generate ARD [Acid Rock Drainage] or ML [Metal Leaching] is low to non-existent (Golden Queen, 2007).
- The Site is not hydrologically connected to the waters of the U.S., as there are no waters of the U.S. in the vicinity of Soledad Mountain. Storm water runoff emanating from the Site may migrate vertically towards the water table. However, groundwater is relatively deep (250 to 300 feet bgs), and the lithology under the Site consists of low permeability, fine-grained soil. As a result, the probability of storm water at the Site to adversely impact groundwater quality is low (Arcadis, 2015).
- Occasionally, runoff may originate on or cross the desert floor to reach the dry lake beds or playas following high intensity rainfall events. The nearest dry lake beds to the Site; Rosamond Lake, Buckhorn Lake, and Rogers Lake; are located more than 10 miles from the Site. In addition, per 40 CFR Part 230.3, ephemeral features, such as dry lake beds, are not classified as waters of the U.S. (Arcadis, 2015).

The project, as described herein, is not expected to have any significant impacts to downstream areas.

7.0 REFERENCES

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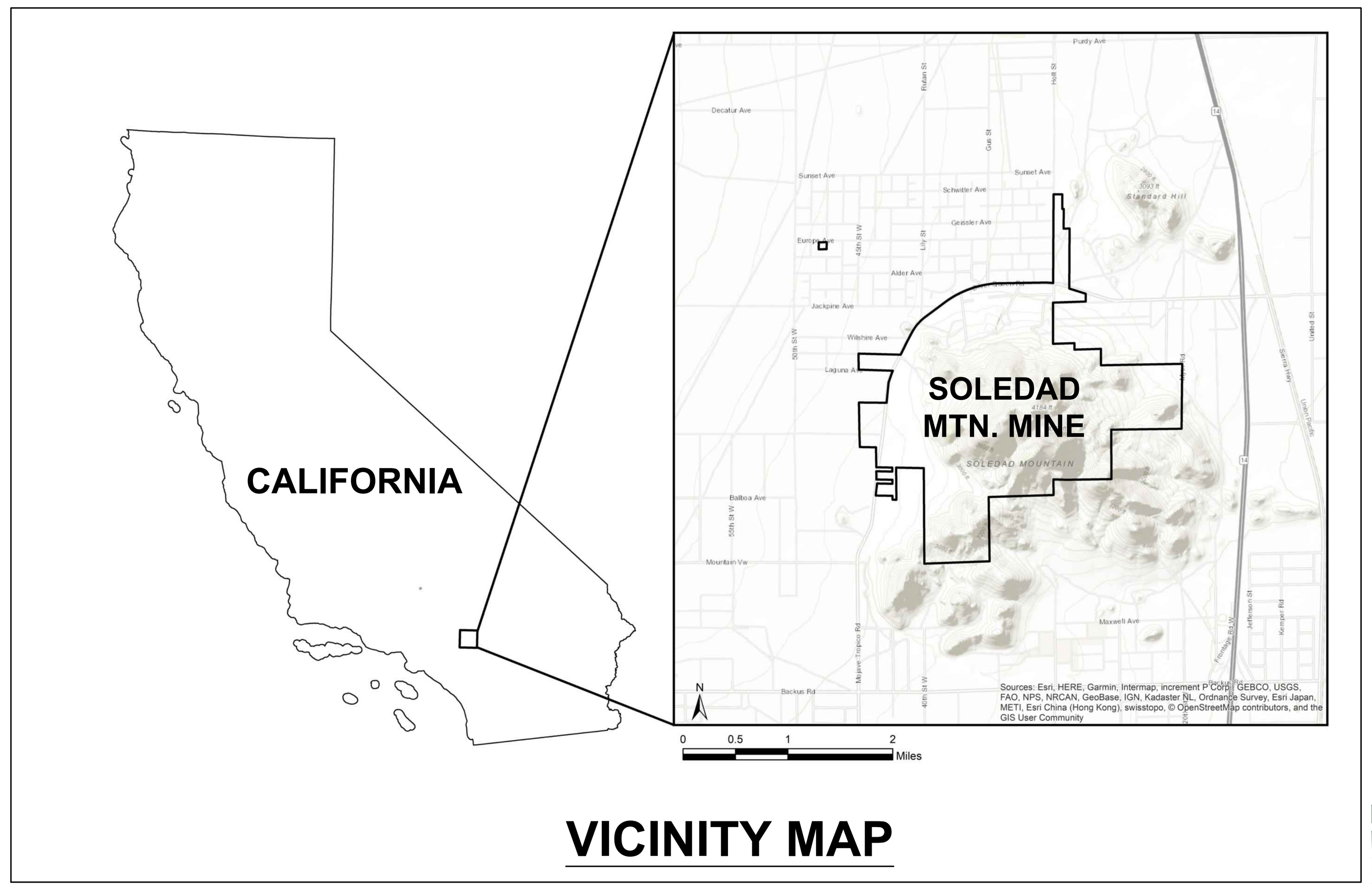
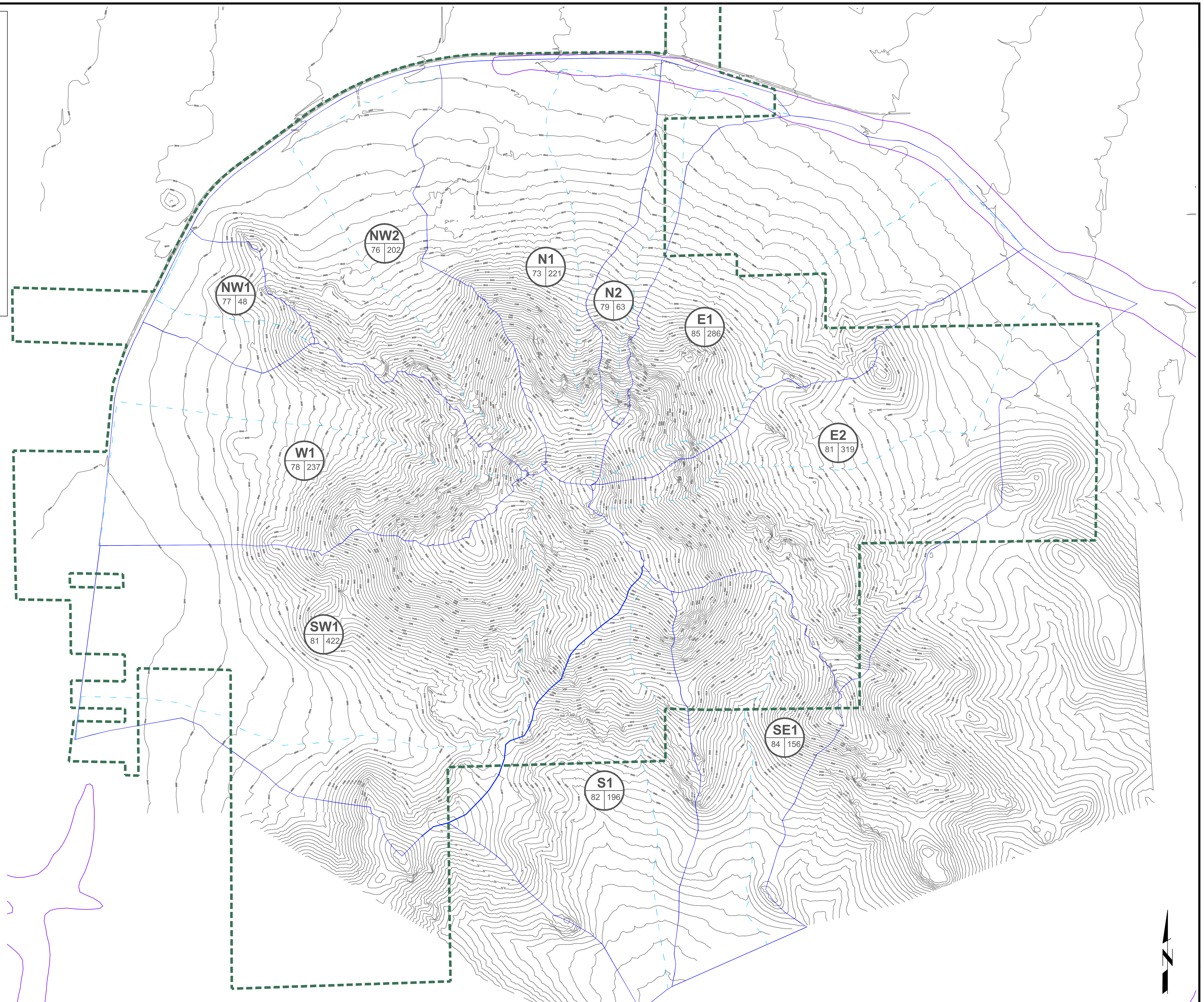
Figures





LEGEND:

PROJECT BOUNDARY

DRAINAGE BASIN BOUNDARY

PRE-MINING CONTOURS

HYDROLOGIC FLOW PATH FOR Tc

NW1 (77 | 48) SUBBASIN DESIGNATION

AREA (ACRES)
CURVE NUMBER

FEMA 100-YEAR FLOODWAY

RATIONAL PEAK FLOWS BY SUBBASIN			
SUBBASIN DESIGNATION	AREA (acres)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOWS (cfs)
W1	237.4	238.0	390.9
NW1	48.0	67.3	106.4
NW2	202.1	196.1	326.9
N1	221.3	207.6	350.8
N2	62.8	63.6	103.2
E1	286.4	347.1	542.8
E2	319.4	343.3	553.2
SW1	421.6	275.6	473.2
S1	195.9	271.2	420.0
SE1	156.1	222.9	344.2

600 0 600 1200
SCALE IN FEET
SCALE: 1" = 600'
SCALE INDICATED IS BASED ON A
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CONTOURS PROVIDED BY GOLDEN QUEEN MINING COMPANY, LLC.
DATUM: HORZ= NAD83, CALIFORNIA ZONE 5, US FOOT
VERT= NAVD88

NOT FOR CONSTRUCTION

REGISTERED PROFESSIONAL ENGINEER
A. PEARCE SWERDFEGER
NO. C87466
CIVIL
STATE OF CALIFORNIA

A. PEARCE SWERDFEGER R.C.E. 87466 EXP. 09-30-2021

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374 Poli Street, Ste. 200 • Ventura, CA 93001
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P.O. BOX 1030
MOJAVE, CALIFORNIA 93502

LAND USE CONSULTANT
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374 POLI STREET, SUITE 200
VENTURA, CALIFORNIA 93001
(805) 275-1515

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	10/22/19	INITIAL DRAFT	GJC

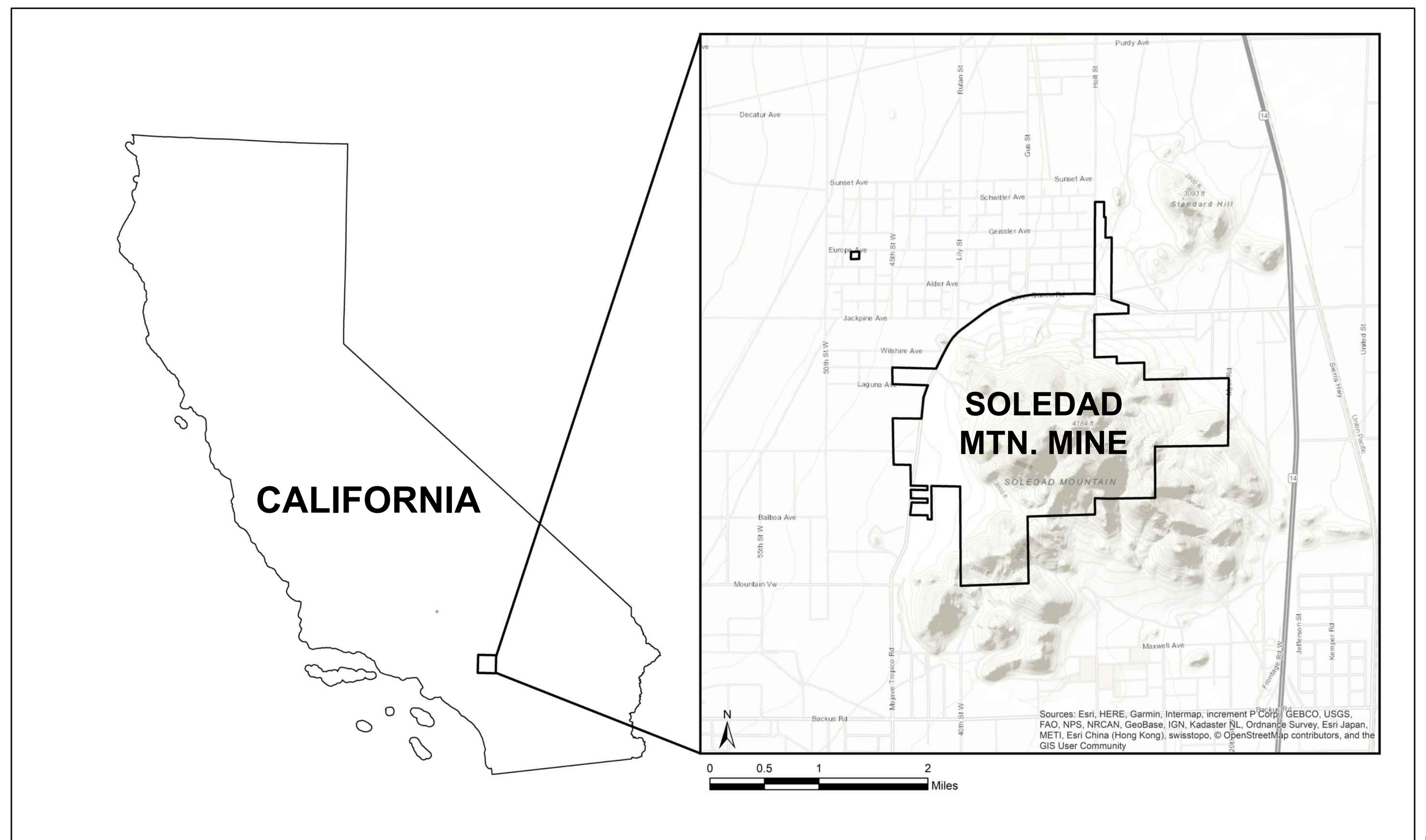
REVIEWED BY: DATE DATE

GOLDEN QUEEN MINING COMPANY, LLC
SOLEDAD MOUNTAIN MINE

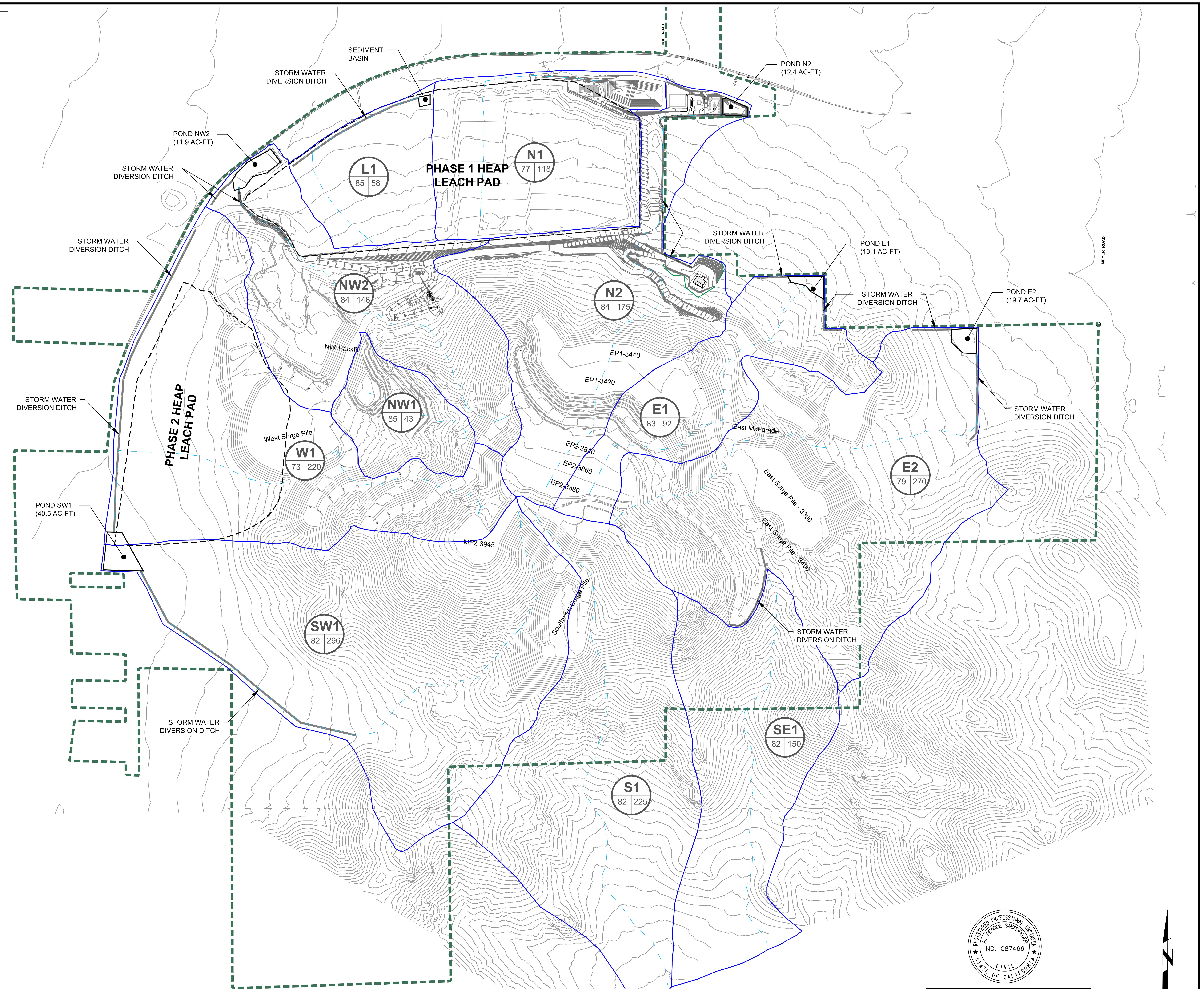
PRE-MINING DRAINAGE PLAN

SCALE: HORIZ. AS SHOWN VERT. AS SHOWN
DRAWN BY: G.CAMUS
CHECKED BY: APS
FIGURE NUMBER 1

Plot Date: S:\G001 – Golden Queen\CAD\Drainage Study 2019\PreMining-Drainage.dwg Oct 22, 2019, 9:43am temp



VICINITY MAP

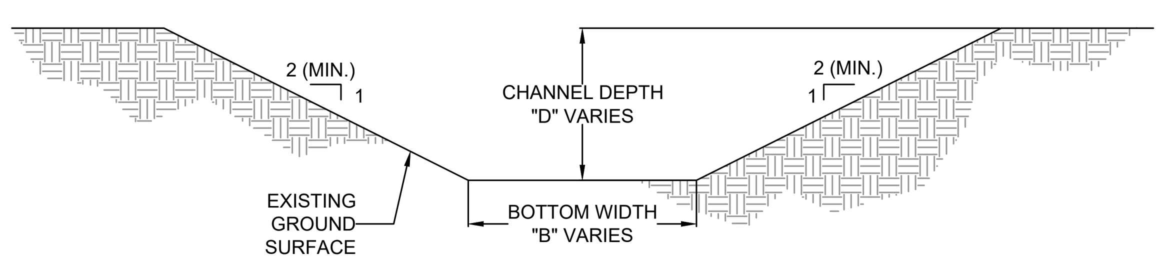


A. PEARCE SWERDFEGER R.C.E. 87466 EXP. 09-30-2021

LEGEND:

- PROJECT BOUNDARY
- DRAINAGE BASIN BOUNDARY
- EXISTING (2019) CONTOURS
- HYDROLOGIC FLOW PATH FOR Tc
- NW1 — SUBBASIN DESIGNATION
- 77 — AREA (ACRES)
- 48 — CURVE NUMBER

RATIONAL PEAK FLOWS BY SUBBASIN			
SUBBASIN DESIGNATION	AREA (acres)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOWS (cfs)
W1	220.0	189.6	325.8
NW1	42.5	133.7	195.3
NW2	146.3	199.1	315.1
L1	57.6	85.8	130.9
N1	117.8	192.3	296.3
N2	174.6	204.5	315.4
E1	91.8	137.8	213.2
E2	270.4	333.6	541.6
SW1	295.6	399.9	637.2
S1	224.7	405.6	628.9
SE1	150.0	301.1	467.6



DITCH CROSS SECTION (TYP.)

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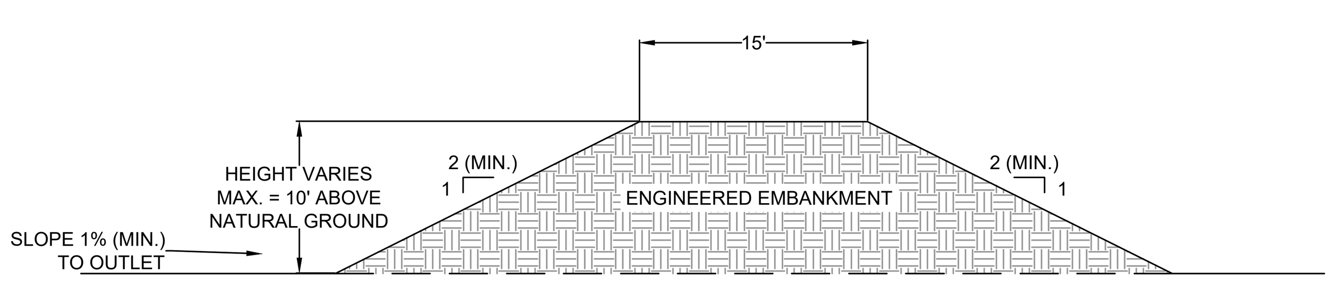

SEDIMENT POND EMBANKMENT CROSS SECTION (TYP.)

N.T.S.

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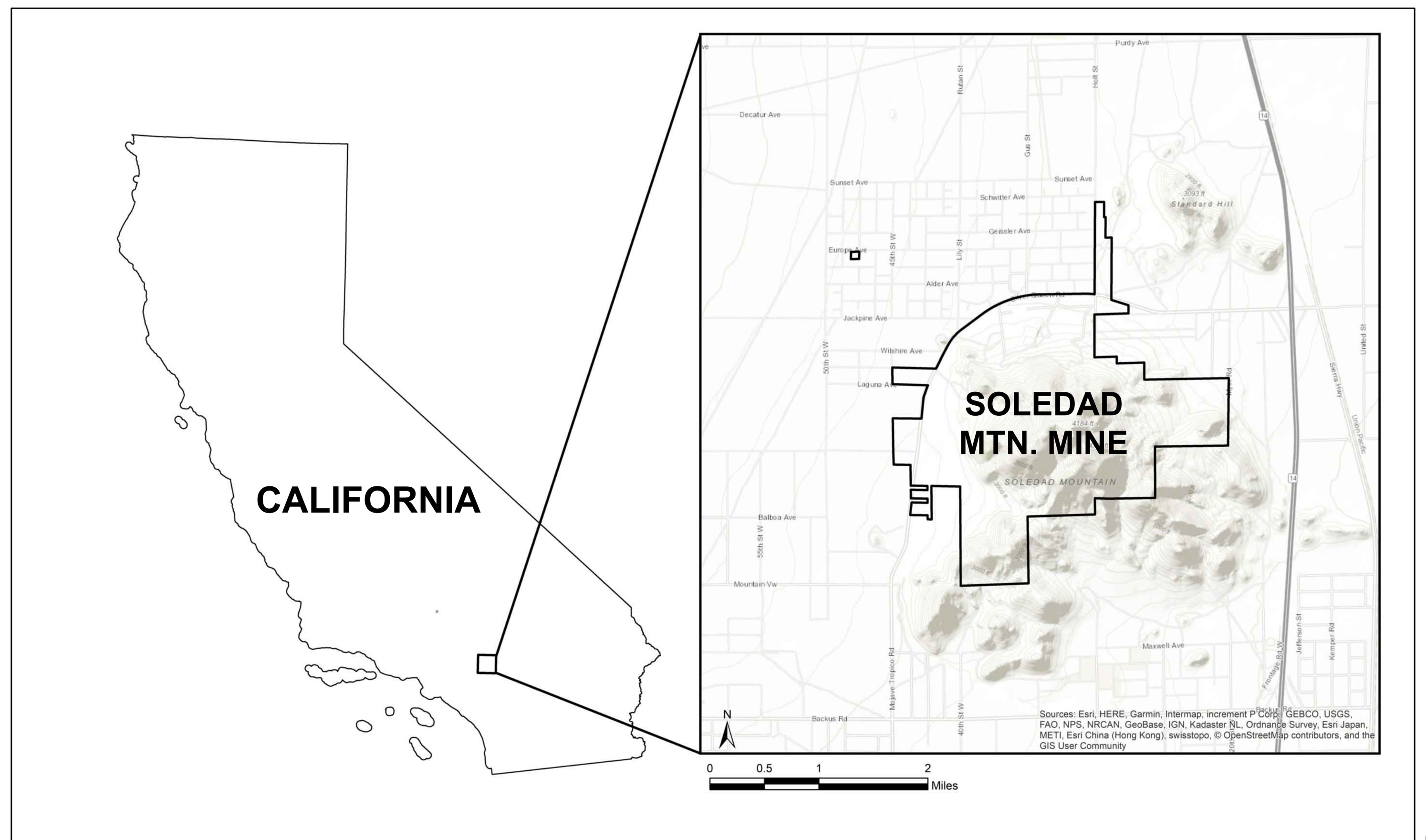
DATE
DATE

GOLDEN QUEEN MINING COMPANY, LLC
SOLEDAD MOUNTAIN MINE

EXISTING CONDITIONS (2019) DRAINAGE PLAN

SCALE: HORIZ. AS SHOWN; VERT. AS SHOWN
DRAWN BY: G.CAMUS
CHECKED BY: APS
FIGURE NUMBER 2

Plot Date: S:\G001 – Golden Queen\CAD\Drainage Study 2019\Sequence-EndofJune-2019-Drainage-d3.dwg Oct 22, 2019, 9:44am temp

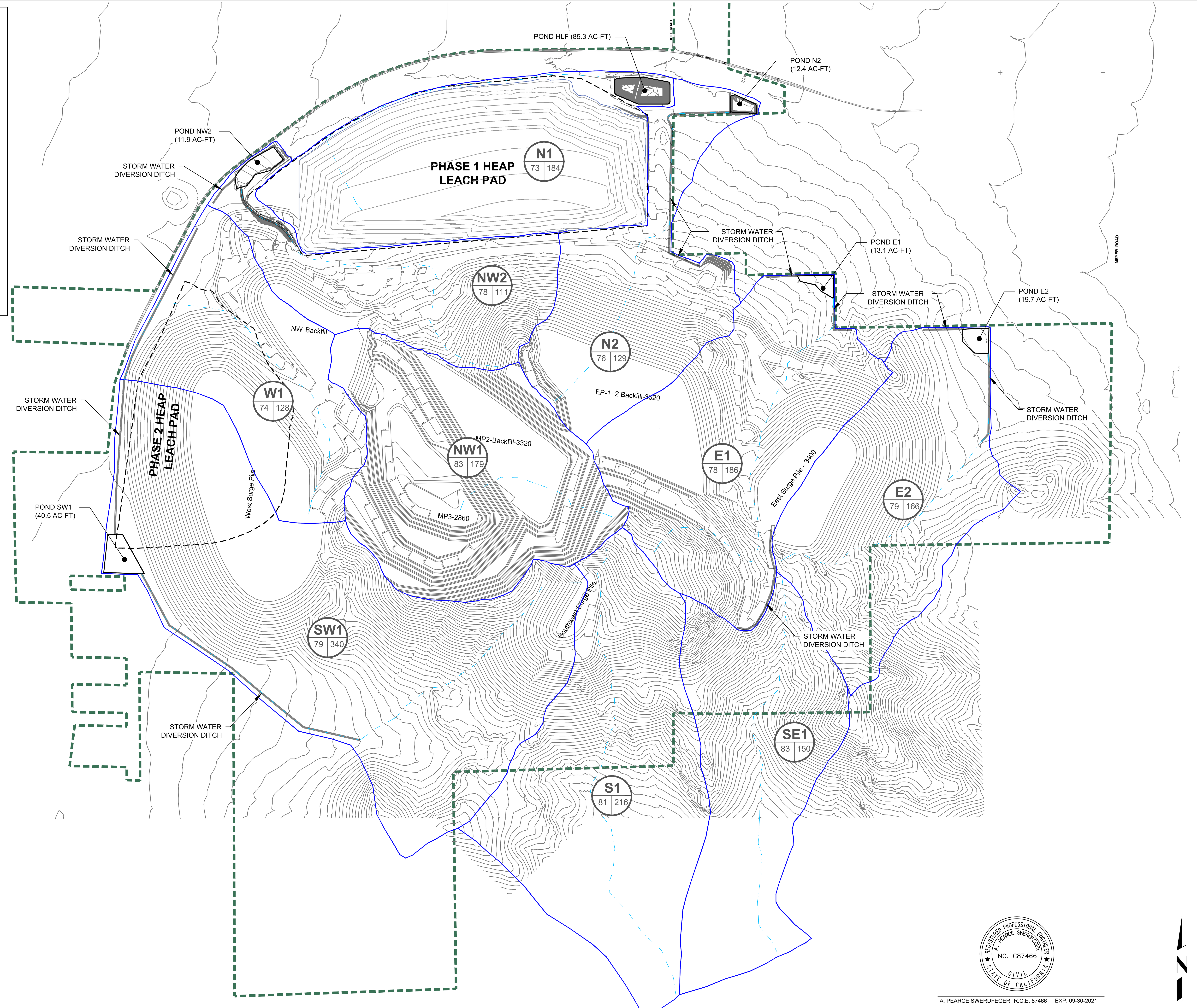


VICINITY MAP

LEGEND:

- PROJECT BOUNDARY
- DRAINAGE BASIN BOUNDARY
- FINAL RECLAIMED CONTOURS
- HYDROLOGIC FLOW PATH FOR Tc
- NW1 SUBBASIN DESIGNATION
- 77 AREA (ACRES)
- 48 CURVE NUMBER

RATIONAL PEAK FLOWS BY SUBBASIN			
SUBBASIN DESIGNATION	AREA (acres)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOWS (cfs)
W1	128.1	112.0	193.4
NW1	179.1	435.7	642.9
NW2	110.9	123.4	201.0
N1	183.8	166.3	285.8
N2	129.0	181.6	285.7
E1	186.0	222.3	348.6
E2	165.8	424.1	647.6
SW1	340.3	512.4	818.2
S1	215.6	297.4	465.7
SE1	150.0	212.8	329.5



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SCALE: 1" = 600'
SCALE INDICATED IS BASED ON A 24" X 36" FORMAT PRINT

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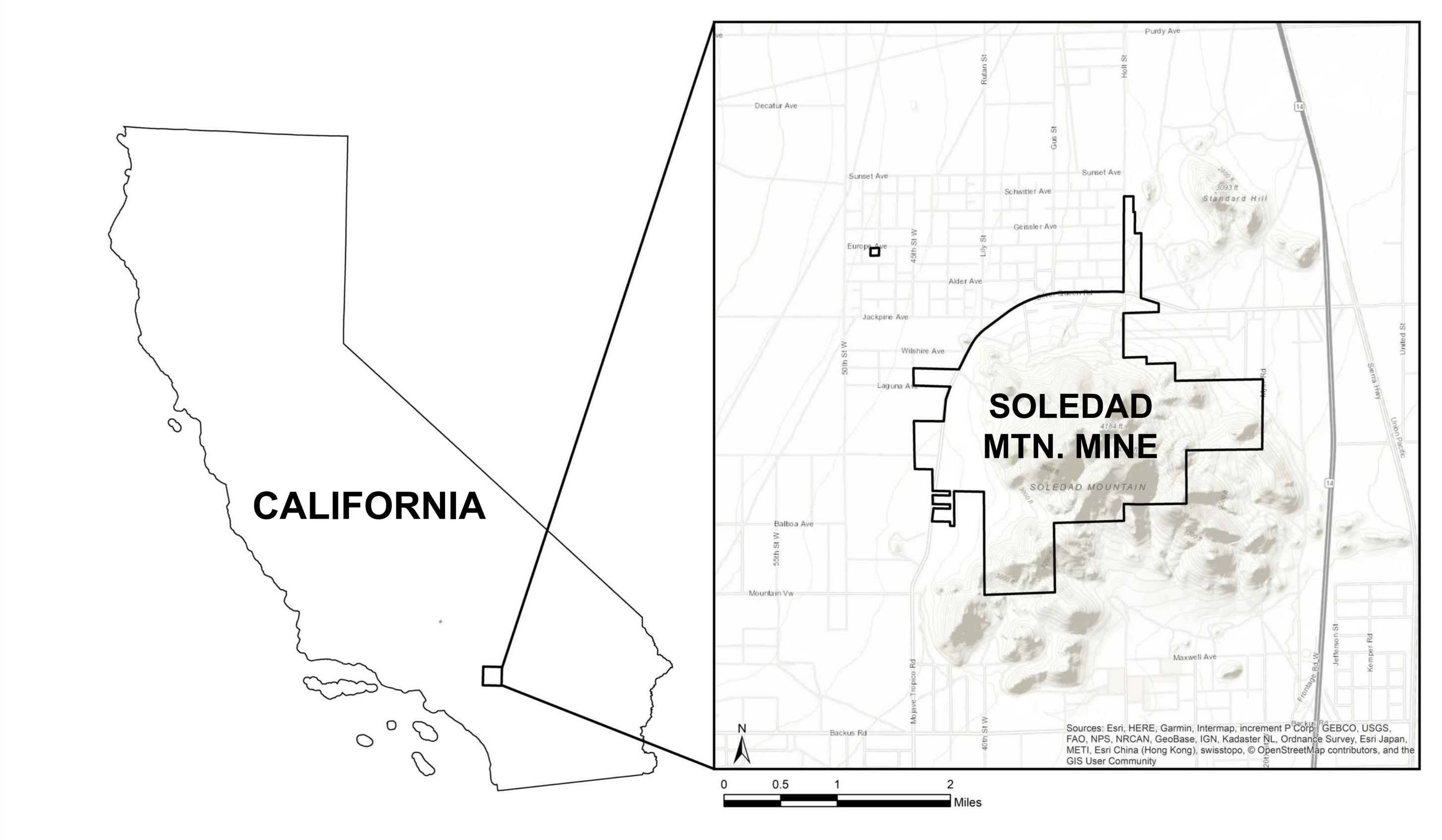
SOLEDAD MOUNTAIN MINE

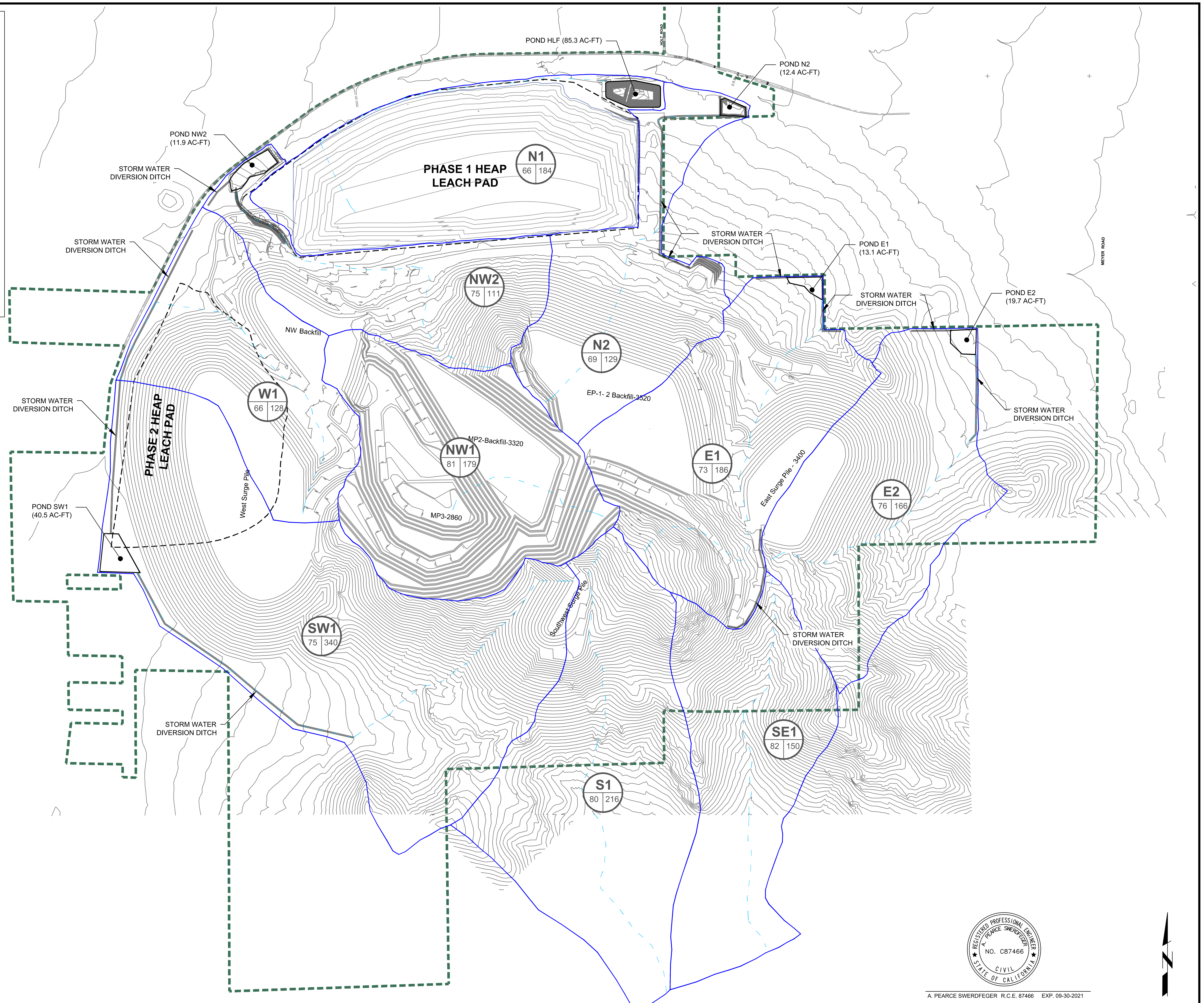
END OF MINING DRAINAGE PLAN

SCALE: HORIZ. AS SHOWN VERT. AS SHOWN
DRAWN BY: G.CAMUS
CHECKED BY: APS
FIGURE NUMBER 3

Plot Date: S:\G001 – Golden Queen\CAD\Drainage Study 2019\Sequence–LOM–2to1–FinalReclaimedContours–Drainage–d3.dwg Oct 22, 2019, 9:49am temp



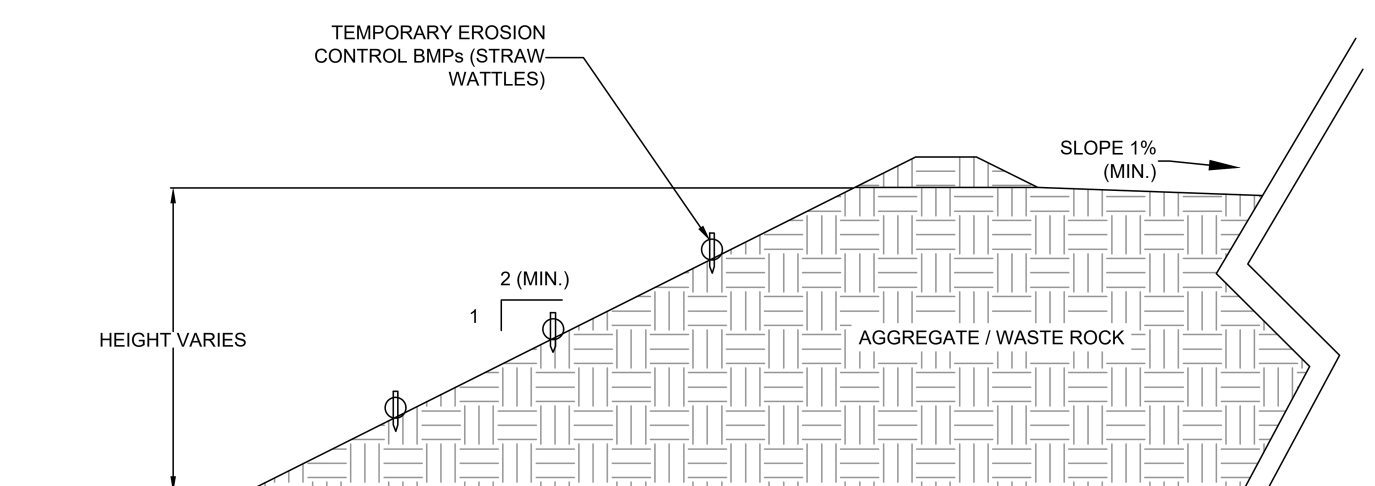
VICINITY MAP



LEGEND:

- PROJECT BOUNDARY
- DRAINAGE BASIN BOUNDARY
- FINAL RECLAIMED CONTOURS
- HYDROLOGIC FLOW PATH FOR Tc
- NW1 77 | 48 — SUBBASIN DESIGNATION; AREA (ACRES); CURVE NUMBER

RATIONAL PEAK FLOWS BY SUBBASIN			
SUBBASIN DESIGNATION	AREA (acres)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOWS (cfs)
W1	128.1	70.0	135.7
NW1	179.1	239.5	365.9
NW2	110.9	100.2	168.0
N1	183.8	107.9	204.9
N2	129.0	142.2	233.4
E1	186.0	209.1	335.4
E2	165.8	276.2	428.6
SW1	340.3	380.0	623.0
S1	215.6	293.5	461.9
SE1	150.0	210.2	326.8



WASTE ROCK FILL PERIMETER CROSS SECTION (TYP.)

N.T.S.

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SCALE IN FEET
SCALE: 1" = 600'
SCALE INDICATED IS BASED ON A 24" X 36" FORMAT PRINT

CONTOURS PROVIDED BY GOLDEN QUEEN MINING COMPANY, LLC.
DATUM: HORZ= NAD83, CALIFORNIA ZONE 5, US FOOT
VERT= NAVD88

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REVISIONS			
MARK	DATE	DESCRIPTION	BY
	10/22/19	INITIAL DRAFT	GJC

REVIEWED BY:
DATE
DATE

GOLDEN QUEEN MINING COMPANY, LLC
SOLEDAD MOUNTAIN MINE

FINAL RECLAMATION DRAINAGE PLAN

SCALE: HORIZ. AS SHOWN VERT. AS SHOWN
DRAWN BY: G.CAMUS
CHECKED BY: APS

FIGURE NUMBER 4

Plot Date: S:\G001 – Golden Queen\CAD\Drainage Study 2019\Sequence-Reclaimed-2to1-FinalContours-Drainage-d3.dwg Oct 22, 2019, 9:50am temp

Appendix 1

Soledad Mountain Hydrology Calculations

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HYDROLOGY CALCULATIONS
SOLEDAD MOUNTAIN PROJECT

In support of Revision 5 of the Site Drainage Plan, an evaluation of peak flow rates generated by the 20-year and 100-year precipitation events at the Soledad mountain mining site for pre-mining, existing (end of 2019), end of mining, and post-mining (reclaimed) conditions has been prepared. The methodology, data sources, assumptions, conclusions, and calculations are presented herein.

To comply with the Surface Mining and Reclamation Act (SMARA) regulations, diversion ditches constructed for mining operations are designed to convey the 20-year, 1-hour storm event. Since the ditches and ponds must also pass the 100-year flows, the 100-year flows are also estimated and presented in these calculations. For volume calculations, the 10-year, 24-hour precipitation is used to estimate runoff volumes during mining operations to be used for sediment pond volumes as required in California Title 27 regulations. Sediment ponds will also be required to remain post mine closure. Riser pipe outlets should be designed to release sediment pond volume over 24-72 hours and emergency overflow weirs in embankments to release 100-year flows. Note that this level of design is beyond the scope of this report and calculations and specifications for riper pipe outlets and overflow weirs are not included.

1.0 METHODOLOGY

Using the pre-mining topographic survey data and proposed mine plan topographic design contours, drainage subbasins were delineated for the pre-mining, existing (end of 2019), and end of mining / post-mining (reclaimed) conditions. Refer to Figures 1, 2, 3, and 4 of the Site Drainage Plan for subbasin delineation of the three conditions. NOAA Atlas 14 Precipitation Frequency Estimates were used to provide precipitation values for the 20-year, 1-hour; the 100-year, 1-hour; and the 10-year, 24-hour storm events (see Attachment C). Peak flow rates for the 20-year and 100-year storms were calculated using the Rational Method as set forth in the Kern County Hydrology Manual (Hromadka). Rational Method peak flow rates are used in the Site Drainage Plan as an initial estimate of ditch and channel sizing for the overall layout and comparison of all development conditions.

Sediment ponds are sized to contain storm runoff up to the 10-year, 24-hour storm volume, with larger storms passing over an emergency weir in the pond embankment. Runoff volume estimation for the 10-year, 24-hour storm uses the catchment yield fraction, Y, as set forth in the Kern County Hydrology Manual for disturbed basins during mining operations as well as areas active in the post-mining phase.

2.0 DATA & ASSUMPTIONS

The following data sources and assumptions were used in the hydrologic and hydraulic calculations in this report:

- NRCS soil survey maps were used to aid in curve number selection;
- Unless otherwise indicated, subbasins are assumed to contain 2% impervious area;
- Precipitation depths for the various storms were obtained from NOAA Atlas 14; full tables are presented in Attachment C (NOAA, 2004). The NOAA Point Precipitation Frequency Estimates do not include a 20-year recurrence interval, so data for the 25-year recurrence interval was conservatively used;
- Time of concentration is calculated using TR-55 methodology for 100-year flow calculation.
- The calculated time of concentration for the 20-year flow calculation was increased by a factor of 1.09 for flow segments 3-5, per the Kern County Hydrology Manual;
- All direct precipitation on the active heap leach facility is fully contained within the lined facility; and
- Mining pit areas are assumed to act as retention ponds with no contribution to runoff.

3.0 CALCULATIONS

Basins were delineated and area-weighted composite curve numbers were calculated based on different cover and soil types, as presented in Table A. Times of concentration for all basins were calculated using TR-55 methodology and are presented in Table B. The 20-year and 100-year peak flow rates were calculated using the Rational Method in accordance with the Kern County Hydrology Manual. Rational Method calculations are presented in Table C.

Basin information and calculations for the 10-year, 24-hour runoff volumes using the Kern County runoff volume estimation are presented in Table D. The 10-year, 24-hour runoff volumes were used to determine sediment pond volumes for the existing and post-mining condition. Runoff volume to be detained in sediment ponds for Subbasin W1 will be diverted to Pond SW1, which will have capacity to detain the 10-year, 24-hour runoff from both basins.

4.0 CONCLUSIONS / RESULTS

A summary of the estimated peak flows calculated with the Rational Method in accordance with the Kern County Hydrology Manual for the pre-mining, existing, and post-mining conditions are presented in Table C. Required sediment basin volumes for the 10-year, 24-hour storm event are presented in Table D. The sediment ponds have been sized based on the larger of four possible pond sizes required by either: existing conditions (Figure 2), end of mining (Figure 3), post-mining configuration (Figure 4), or as previously prescribed in the Golder Drainage Plans.

These calculations are summarized below.

Developed Condition	Basin ID	Area (acres)	Composite CN	20-year Rational Method Peak Flow (cfs)	100-year Rational Method Peak Flow (cfs)	10-year, 24-hour Runoff Volume (ac-ft)
Pre-Mining	W1	237.4	78	238.0	390.9	--
Pre-Mining	NW1	48.0	77	67.3	106.4	--
Pre-Mining	NW2	202.1	76	196.1	326.9	--
Pre-Mining	N1	221.3	73	207.6	350.8	--
Pre-Mining	N2	62.8	79	63.6	103.2	--
Pre-Mining	E1	286.4	85	347.1	542.8	--
Pre-Mining	E2	319.4	81	343.3	553.2	--
Pre-Mining	SW1	421.6	81	275.6	473.2	--
Pre-Mining	S1	195.9	82	271.2	420.0	--
Pre-Mining	SE1	156.1	84	222.9	344.2	--
Existing (2019)	W1	220.0	73	189.6	325.8	10.9
Existing (2019)	NW1	42.5	85	133.7	195.3	4.6
Existing (2019)	NW2	146.3	84	199.1	315.1	4.9
Existing (2019)	L1	57.6	85	85.8	130.9	0.0
Existing (2019)	N1	117.8	77	192.3	296.3	5.9
Existing (2019)	N2	174.6	84	204.5	315.4	8.9
Existing (2019)	E1	91.8	83	137.8	213.2	4.8
Existing (2019)	E2	270.4	79	333.6	541.6	19.7
Existing (2019)	SW1	295.6	82	399.9	637.2	29.5
Existing (2019)	S1	224.7	82	405.6	628.9	21.6
Existing (2019)	SE1	150.0	82	301.1	467.6	15.2
End of Mining	W1	128.1	74	112.0	193.4	7.5
End of Mining	NW1	179.1	83	435.7	642.9	3.0
End of Mining	NW2	110.9	78	123.4	201.0	8.7
End of Mining	N1	183.8	73	166.3	285.8	8.7
End of Mining	N2	129.0	76	181.6	285.7	6.9
End of Mining	E1	186.0	78	222.3	348.6	13.1
End of Mining	E2	165.8	79	424.1	647.6	13.9
End of Mining	SW1	340.3	79	512.4	818.2	28.2
End of Mining	S1	215.6	81	297.4	465.7	20.5
End of Mining	SE1	150.0	83	212.8	329.5	15.5
Final Reclamation	W1	128.1	66	70.0	135.7	4.5
Final Reclamation	NW1	179.1	81	239.5	365.9	1.5
Final Reclamation	NW2	110.9	75	100.2	168.0	7.5
Final Reclamation	N1	183.8	66	107.9	204.9	5.2
Final Reclamation	N2	129.0	69	142.2	233.4	5.0
Final Reclamation	E1	186.0	73	209.1	335.4	10.3
Final Reclamation	E2	165.8	76	276.2	428.6	12.6
Final Reclamation	SW1	340.3	75	380.0	623.0	20.7
Final Reclamation	S1	215.6	80	293.5	461.9	20.1
Final Reclamation	SE1	150.0	82	210.2	326.8	15.4

5.0 LIST OF TABLES & ATTACHMENTS

TABLE A:
SUBBASIN SUMMARY

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	100	-Year Reccurance Interval	
Storm Duration (hours)	2-Year Depth (inches)	100-Year Depth (inches)	Storm Distribution
24	1.5	4.39	II

				CN = 63	CN = 77	CN = 85	CN = 88	CN = 65	CN = 85	CN = 77	CN = 70					
	Subbasin ID	Subbasin Area (acres)	Subbasin Area (sq mile)	Undisturbed Desert Shrub HSG A (acres)	Undisturbed Desert Shrub HSG B (acres)	Undisturbed Desert Shrub HSG C (acres)	Undisturbed Desert Shrub HSG D (acres)	Reclaimed Areas (acres)	Mined Benches, Pits, and Roads (acres)	Rock Dump Tops (acres)	Rock Dump Outslopes (acres)	Composite SCS Curve Number, CN	Estimated Soil Capacity, S (in)	Unit Runoff, Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
Pre-Mining	W1	237.35	0.3709	89.62		7.15	140.59					78	2.82	2.20	43.56	1,897,480
	NW1	47.97	0.0749	20.67			27.29					77	2.99	2.12	8.48	369,418
	NW2	202.05	0.3157	97.41		7.31	97.33					76	3.16	2.04	34.39	1,497,965
	N1	221.30	0.3458	135.96		7.45	77.90					73	3.70	1.81	33.44	1,456,546
	N2	62.76	0.0981	19.80		21.32	21.64					79	2.66	2.28	11.95	520,427
	E1	286.39	0.4475	19.13		155.07	112.19					85	1.76	2.81	67.04	2,920,368
	E2	319.37	0.4990	91.34		30.50	197.54					81	2.35	2.45	65.29	2,844,071
	SW1	421.64	0.6588	108.60		29.13	283.91					81	2.35	2.45	86.20	3,754,740
	S1	195.94	0.3062	46.02		0.42	149.50					82	2.20	2.54	41.47	1,806,523
	SE1	156.08	0.2439	27.83			128.26					84	1.90	2.72	35.35	1,539,846
Existing (2019)	W1	219.97	0.3437	89.28		5.57	38.87		23.95	22.58	39.73	73	3.70	1.81	33.24	1,447,779
	NW1	42.52	0.0664				34.17		0.25	0.12	7.98	85	1.76	2.81	9.95	433,550
	NW2	146.29	0.2286	4.61		2.95	31.45		95.63	2.20	9.45	84	1.90	2.72	33.13	1,443,213
	L1	57.64	0.0901	0.28					57.36			85	1.76	2.81	13.49	587,781
	N1	117.79	0.1840	2.55		0.06			22.12	69.24	23.82	77	2.99	2.12	20.82	907,129
	N2	174.59	0.2728	3.79		12.99	53.67		89.10		15.05	84	1.90	2.72	39.54	1,722,418
	E1	91.81	0.1435			14.05	21.25		42.50	0.40	13.62	83	2.05	2.63	20.11	875,857
	E2	270.36	0.4224	45.52		143.56			24.41	24.18	32.69	79	2.66	2.28	51.47	2,241,980
	SW1	295.64	0.4619	48.38		5.75	207.80		0.38	11.24	22.10	82	2.20	2.54	62.57	2,725,706
	S1	224.72	0.3511	45.95		0.46	156.21		4.41	5.98	11.72	82	2.20	2.54	47.56	2,071,865
	SE1	149.99	0.2344	30.92			113.99		0.00		5.07	82	2.20	2.54	31.75	1,382,823
End of Mining	W1	128.10	0.2002	11.33			8.23		0.22	55.70	52.62	74	3.51	1.89	20.16	877,965
	NW1	179.08	0.2798				3.43		139.03	36.54	0.08	83	2.05	2.63	39.22	1,708,403
	NW2	110.89	0.1733	5.30		2.95	42.71		1.84	14.54	43.54	78	2.82	2.20	20.35	886,500
	N1	183.79	0.2872	1.74					16.30	56.29	109.47	73	3.70	1.81	27.77	1,209,662
	N2	129.01	0.2016	3.71		10.97	6.07		17.15	35.97	55.14	76	3.16	2.04	21.96	956,436
	E1	186.00	0.2906	0.45		13.98	42.71		12.64	45.96	70.26	78	2.82	2.20	34.14	1,486,967
	E2	165.78	0.2590	20.92			82.02			15.06	47.78	79	2.66	2.28	31.56	1,374,715
	SW1	340.29	0.5317	23.52		7.82	147.26		0.42	50.02	111.26	79	2.66	2.28	64.78	2,821,849
	S1	215.63	0.3369	45.95		0.46	145.46		0.11	5.40	18.26	81	2.35	2.45	44.08	1,920,248
	SE1	149.99	0.2344	30.92			116.74				2.33	83	2.05	2.63	32.85	1,430,824

TABLE A:
SUBBASIN SUMMARY

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	100	-Year Reccurance Interval	
Storm Duration (hours)	2-Year Depth (inches)	100-Year Depth (inches)	Storm Distribution
24	1.5	4.39	II

				CN = 63	CN = 77	CN = 85	CN = 88	CN = 65	CN = 85	CN = 77	CN = 70					
	Subbasin ID	Subbasin Area (acres)	Subbasin Area (sq mile)	Undisturbed Desert Shrub HSG A (acres)	Undisturbed Desert Shrub HSG B (acres)	Undisturbed Desert Shrub HSG C (acres)	Undisturbed Desert Shrub HSG D (acres)	Reclaimed Areas (acres)	Mined Benches, Pits, and Roads (acres)	Rock Dump Tops (acres)	Rock Dump Outslopes (acres)	Composite SCS Curve Number, CN	Estimated Soil Capacity, S (in)	Unit Runoff, Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
Final Reclamation	W1	128.10	0.2002	11.33			8.23	108.32	0.22			66	5.15	1.33	14.16	616,667
	NW1	179.08	0.2798				3.43	36.62	139.03			81	2.35	2.45	36.61	1,594,756
	NW2	110.89	0.1733	5.30		2.95	42.71	58.08	1.84			75	3.33	1.96	18.15	790,794
	N1	183.79	0.2872	1.74			0.00	175.77	6.29			66	5.15	1.33	20.31	884,799
	N2	129.01	0.2016	3.71		10.97	6.07	102.86	5.40			69	4.49	1.53	16.41	714,984
	E1	186.03	0.2907	0.45		13.98	42.71	116.25	12.64			73	3.70	1.81	28.11	1,224,385
	E2	165.78	0.2590	20.92			82.02	62.84				76	3.16	2.04	28.21	1,229,043
	SW1	340.29	0.5317	23.52		7.82	116.57	161.28	31.11			75	3.33	1.96	55.71	2,426,686
	S1	215.63	0.3369	45.95		0.46	145.46	23.65	0.11			80	2.50	2.37	42.55	1,853,618
	SE1	149.99	0.2344	30.92			116.74	2.33				82	2.20	2.54	31.75	1,382,814

Calculation Summary:

Estimated Soil Capacity, S

$$S = \frac{1000}{CN} - 10$$

Where: S = estimated soil capacity (in)
CN = composite SCS curve number

Initial Abstraction, Ia

$$I_a = 0.2S$$

Where: I_a = initial abstraction (in)
S = estimated soil capacity (in)

Unit Runoff, Q

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

Where: Q = unit runoff (in)
P = rainfall, 100 year (in)
I_a = initial abstraction (in)
S = estimated soil capacity (in)

Runoff Volume

$$V = \frac{Q}{12} \times A$$

Where: Q = unit runoff (in)
A = subbasin area (acres)

TABLE B:
BASIN TIME OF CONCENTRATION CALCULATIONS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

						Flow Segment 1						
	Subbasin ID	Subbasin Area (sq mile)	Composite SCS Curve Number, CN	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition (1)		Total Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
Pre-Mining	W1	0.3709	78	10.4	12.9	Sheet	100	0.339	H	Range		4.11
	NW1	0.0749	77	6.5	8.2	Sheet	100	0.463	H	Range		3.63
	NW2	0.3157	76	10.4	13.0	Sheet	100	0.530	H	Range		3.44
	N1	0.3458	73	10.3	12.8	Sheet	100	0.400	H	Range		3.85
	N2	0.0981	79	10.6	13.2	Sheet	100	0.348	H	Range		4.07
	E1	0.4475	85	9.2	11.5	Sheet	100	0.570	H	Range		3.34
	E2	0.4990	81	10.1	12.6	Sheet	100	0.570	H	Range		3.34
	SW1	0.6588	81	19.1	23.9	Sheet	100	0.430	H	Range		3.74
	S1	0.3062	82	7.3	9.1	Sheet	100	0.400	H	Range		3.85
	SE1	0.2439	84	7.1	8.9	Sheet	100	0.260	H	Range		4.57
Existing (2019)	W1	0.3437	73	11.3	14.1	Sheet	100	0.500	A	Smooth		0.49
	NW1	0.0664	85	2.1	2.6	Sheet	100	0.400	A	Smooth		0.53
	NW2	0.2286	84	7.4	9.3	Sheet	100	0.200	A	Smooth		0.70
	L1	0.0901	85	6.9	8.6	Sheet	100	0.100	A	Smooth		0.93
	N1	0.1840	77	5.4	6.7	Sheet	100	0.200	A	Smooth		0.70
	N2	0.2728	84	9.8	12.3	Sheet	100	0.100	A	Smooth		0.93
	E1	0.1435	83	6.5	8.2	Sheet	100	0.100	A	Smooth		0.93
	E2	0.4224	79	7.8	9.8	Sheet	100	0.400	A	Smooth		0.53
	SW1	0.4619	82	7.3	9.1	Sheet	100	0.500	A	Smooth		0.49
	S1	0.3511	82	4.8	5.9	Sheet	100	0.200	A	Smooth		0.70
	SE1	0.2344	82	4.0	5.0	Sheet	100	0.260	A	Smooth		0.63
End of Mining	W1	0.2002	74	11.2	14.0	Sheet	100	0.100	A	Smooth		0.93
	NW1	0.2798	83	3.2	4.0	Sheet	100	0.100	A	Smooth		0.93
	NW2	0.1733	78	9.0	11.2	Sheet	100	0.600	A	Smooth		0.45
	N1	0.2872	73	10.6	13.2	Sheet	100	0.150	A	Smooth		0.79
	N2	0.2016	76	6.5	8.1	Sheet	100	1.300	A	Smooth		0.33
	E1	0.2906	78	8.5	10.7	Sheet	100	0.400	H	Range		3.85
	E2	0.2590	79	2.7	3.3	Sheet	100	0.500	A	Smooth		0.49
	SW1	0.5317	79	5.9	7.3	Sheet	100	0.400	A	Smooth		0.53
	S1	0.3369	81	7.1	8.9	Sheet	100	0.500	H	Range		3.52
	SE1	0.2344	83	7.1	8.9	Sheet	100	0.260	H	Range		4.57
Final Reclamation	W1	0.2002	66	15.8	19.8	Sheet	100	0.100	H	Range		6.70
	NW1	0.2798	81	7.8	9.7	Sheet	100	0.100	H	Range		6.70
	NW2	0.1733	75	11.2	14.0	Sheet	100	0.600	H	Range		3.27
	N1	0.2872	66	14.9	18.6	Sheet	100	0.150	H	Range		5.70
	N2	0.2016	69	8.1	10.2	Sheet	100	1.300	H	Range		2.40
	E1	0.2907	73	8.5	10.7	Sheet	100	0.400	H	Range		3.85
	E2	0.2590	76	5.1	6.4	Sheet	100	0.500	H	Range		3.52
	SW1	0.5317	75	8.5	10.7	Sheet	100	0.400	H	Range		3.85
	S1	0.3369	80	7.1	8.9	Sheet	100	0.500	H	Range		3.52
	SE1	0.2344	82	7.1	8.9	Sheet	100	0.260	H	Range		4.57

Notes:
(1) Refer to Reference A for roughness condition descriptions and assumed coefficients.

TABLE B:
BASIN TIME OF CONCENTRATION CALCULATIONS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

						Flow Segment 2						
	Subbasin ID	Subbasin Area (sq mile)	Composite SCS Curve Number, CN	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition [1]		Total Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
Pre-Mining	W1	0.3709	78	10.4	12.9	Shallow	585	0.396	U	Unpaved		0.96
	NW1	0.0749	77	6.5	8.2	Shallow	550	0.492	U	Unpaved		0.81
	NW2	0.3157	76	10.4	13.0	Shallow	570	0.468	U	Unpaved		0.86
	N1	0.3458	73	10.3	12.8	Shallow	770	0.408	U	Unpaved		1.25
	N2	0.0981	79	10.6	13.2	Shallow	1,660	0.510	U	Unpaved		2.40
	E1	0.4475	85	9.2	11.5	Shallow	1,250	0.576	U	Unpaved		1.70
	E2	0.4990	81	10.1	12.6	Shallow	745	0.537	U	Unpaved		1.05
	SW1	0.6588	81	19.1	23.9	Shallow	624	0.412	U	Unpaved		1.00
	S1	0.3062	82	7.3	9.1	Shallow	1,337	0.449	U	Unpaved		2.06
	SE1	0.2439	84	7.1	8.9	Shallow	189	0.233	U	Unpaved		0.40
Existing (2019)	W1	0.3437	73	11.3	14.1	Shallow	2,187	0.354	U	Unpaved		3.80
	NW1	0.0664	85	2.1	2.6	Shallow	1,383	0.463	U	Unpaved		2.10
	NW2	0.2286	84	7.4	9.3	Shallow	467	0.514	U	Unpaved		0.67
	L1	0.0901	85	6.9	8.6	Shallow	1,302	0.077	U	Unpaved		4.85
	N1	0.1840	77	5.4	6.7	Shallow	1,568	0.115	U	Unpaved		4.78
	N2	0.2728	84	9.8	12.3	Shallow	4,206	0.231	U	Unpaved		9.05
	E1	0.1435	83	6.5	8.2	Shallow	1,174	0.145	U	Unpaved		3.19
	E2	0.4224	79	7.8	9.8	Channel	1,747	0.406	M	Mountain Channel	1.5	1.03
	SW1	0.4619	82	7.3	9.1	Channel	1,482	0.283	M	Mountain Channel	2.2	0.82
	S1	0.3511	82	4.8	5.9	Channel	1,731	0.144	M	Mountain Channel	2.3	1.33
	SE1	0.2344	82	4.0	5.0	Shallow	189	0.233	U	Unpaved		0.40
End of Mining	W1	0.2002	74	11.2	14.0	Channel	634	0.244	M	Mountain Channel	1.9	0.42
	NW1	0.2798	83	3.2	4.0	Shallow	2,058	0.491	U	Unpaved		3.03
	NW2	0.1733	78	9.0	11.2	Shallow	1,813	0.298	U	Unpaved		3.43
	N1	0.2872	73	10.6	13.2	Shallow	879	0.267	U	Unpaved		1.76
	N2	0.2016	76	6.5	8.1	Shallow	2,602	0.246	U	Unpaved		5.42
	E1	0.2906	78	8.5	10.7	Shallow	2,880	0.271	U	Unpaved		5.72
	E2	0.2590	79	2.7	3.3	Channel	1,628	0.264	M	Mountain Channel	1.8	1.08
	SW1	0.5317	79	5.9	7.3	Channel	1,469	0.272	M	Mountain Channel	2.6	0.75
	S1	0.3369	81	7.1	8.9	Shallow	509	0.236	U	Unpaved		1.08
	SE1	0.2344	83	7.1	8.9	Shallow	189	0.233	U	Unpaved		0.40
Final Reclamation	W1	0.2002	66	15.8	19.8	Channel	634	0.244	M	Mountain Channel	1.9	0.42
	NW1	0.2798	81	7.8	9.7	Shallow	2,058	0.491	U	Unpaved		3.03
	NW2	0.1733	75	11.2	14.0	Shallow	1,813	0.298	U	Unpaved		3.43
	N1	0.2872	66	14.9	18.6	Shallow	879	0.267	U	Unpaved		1.76
	N2	0.2016	69	8.1	10.2	Shallow	2,602	0.246	U	Unpaved		5.42
	E1	0.2907	73	8.5	10.7	Shallow	2,880	0.271	U	Unpaved		5.72
	E2	0.2590	76	5.1	6.4	Channel	1,628	0.264	M	Mountain Channel	1.8	1.08
	SW1	0.5317	75	8.5	10.7	Channel	1,469	0.272	M	Mountain Channel	2.6	0.75
	S1	0.3369	80	7.1	8.9	Shallow	509	0.236	U	Unpaved		1.08
	SE1	0.2344	82	7.1	8.9	Shallow	189	0.233	U	Unpaved		0.40

Notes:
(1) Refer to Reference A for roughness condition descriptions and assumed coefficients.

TABLE B:
BASIN TIME OF CONCENTRATION CALCULATIONS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

						Flow Segment 3						
	Subbasin ID	Subbasin Area (sq mile)	Composite SCS Curve Number, CN	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition [1]		Total Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
Pre-Mining	W1	0.3709	78	10.4	12.9	Channel	1,700	0.357	M	Mountain Channel	1.38	1.16
	NW1	0.0749	77	6.5	8.2	Channel	490	0.194	M	Mountain Channel	0.84	0.63
	NW2	0.3157	76	10.4	13.0	Channel	2,380	0.310	M	Mountain Channel	1.27	1.83
	N1	0.3458	73	10.3	12.8	Channel	1,890	0.115	M	Mountain Channel	1.34	2.31
	N2	0.0981	79	10.6	13.2	Channel	1,350	0.156	M	Mountain Channel	0.91	1.83
	E1	0.4475	85	9.2	11.5	Channel	2,480	0.216	M	Mountain Channel	1.78	1.83
	E2	0.4990	81	10.1	12.6	Channel	2,500	0.262	M	Mountain Channel	1.70	1.73
	SW1	0.6588	81	19.1	23.9	Channel	3,172	0.202	M	Mountain Channel	1.40	2.84
	S1	0.3062	82	7.3	9.1	Channel	1,722	0.276	M	Mountain Channel	1.41	1.31
	SE1	0.2439	84	7.1	8.9	Channel	1,572	0.175	M	Mountain Channel	1.76	1.30
Existing (2019)	W1	0.3437	73	11.3	14.1	Channel	1,193	0.147	M	Mountain Channel	2.5	0.85
	NW1	0.0664	85	2.1	2.6							
	NW2	0.2286	84	7.4	9.3	Channel	1,114	0.305	M	Mountain Channel	1.8	0.67
	L1	0.0901	85	6.9	8.6	Channel	1,474	0.014	E	Earth-lined	1.4	2.83
	N1	0.1840	77	5.4	6.7	Channel	1,567	0.020	Pl	Plastic	1.3	1.24
	N2	0.2728	84	9.8	12.3	Channel	2,091	0.077	R	Riprap	1.8	2.29
	E1	0.1435	83	6.5	8.2	Channel	636	0.566	M	Mountain Channel	1.6	0.31
	E2	0.4224	79	7.8	9.8	Channel	1,223	0.229	M	Mountain Channel	1.3	1.08
	SW1	0.4619	82	7.3	9.1	Channel	1,421	0.260	M	Mountain Channel	2.6	0.75
	S1	0.3511	82	4.8	5.9	Shallow	1,363	0.448	U	Unpaved		2.10
	SE1	0.2344	82	4.0	5.0	Channel	1,572	0.175	M	Mountain Channel	1.8	1.30
End of Mining	W1	0.2002	74	11.2	14.0	Shallow	1,956	0.051	U	Unpaved		8.94
	NW1	0.2798	83	3.2	4.0							
	NW2	0.1733	78	9.0	11.2	Shallow	1,713	0.070	U	Unpaved		6.69
	N1	0.2872	73	10.6	13.2	Channel	3,680	0.017	R	Riprap	1.3	10.65
	N2	0.2016	76	6.5	8.1	Channel	2,086	0.072	R	Riprap	1.8	2.35
	E1	0.2906	78	8.5	10.7	Channel	1,306	0.214	E	Earth-lined	2.5	0.43
	E2	0.2590	79	2.7	3.3	Channel	1,387	0.094	E	Earth-lined	2.2	0.75
	SW1	0.5317	79	5.9	7.3	Channel	1,375	0.247	M	Mountain Channel	2.3	0.80
	S1	0.3369	81	7.1	8.9	Channel	550	0.127	M	Mountain Channel	2.6	0.41
	SE1	0.2344	83	7.1	8.9	Channel	1,572	0.175	M	Mountain Channel	1.8	1.30
Final Reclamation	W1	0.2002	66	15.8	19.8	Shallow	1,956	0.051	U	Unpaved		8.94
	NW1	0.2798	81	7.8	9.7							
	NW2	0.1733	75	11.2	14.0	Shallow	1,713	0.070	U	Unpaved		6.69
	N1	0.2872	66	14.9	18.6	Channel	3,680	0.015	R	Riprap	1.30	11.11
	N2	0.2016	69	8.1	10.2	Channel	2,086	0.072	R	Riprap	1.80	2.35
	E1	0.2907	73	8.5	10.7	Channel	1,306	0.214	E	Earth-lined	2.50	0.43
	E2	0.2590	76	5.1	6.4	Channel	1,387	0.094	E	Earth-lined	2.22	0.75
	SW1	0.5317	75	8.5	10.7	Channel	1,375	0.247	M	Mountain Channel	2.31	0.80
	S1	0.3369	80	7.1	8.9	Channel	550	0.127	M	Mountain Channel	2.65	0.41
	SE1	0.2344	82	7.1	8.9	Channel	1,572	0.175	M	Mountain Channel	1.76	1.30

Notes:
(1) Refer to Reference A for roughness condition descriptions and assumed coefficients.

TABLE B:
BASIN TIME OF CONCENTRATION CALCULATIONS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

						Flow Segment 4						
	Subbasin ID	Subbasin Area (sq mile)	Composite SCS Curve Number, CN	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition [1]		Total Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
Pre-Mining	W1	0.3709	78	10.4	12.9	Channel	2,920	0.11	M	Mountain Channel	1.64	3.25
	NW1	0.0749	77	6.5	8.2	Channel	960	0.59	M	Mountain Channel	0.67	0.82
	NW2	0.3157	76	10.4	13.0	Channel	2,220	0.09	M	Mountain Channel	1.46	2.88
	N1	0.3458	73	10.3	12.8	Channel	2,560	0.12	M	Mountain Channel	1.34	3.13
	N2	0.0981	79	10.6	13.2	Channel	1,320	0.08	M	Mountain Channel	1.05	2.30
	E1	0.4475	85	9.2	11.5	Channel	2,525	0.08	M	Mountain Channel	2.07	2.80
	E2	0.4990	81	10.1	12.6	Channel	3,360	0.04	M	Mountain Channel	2.24	4.94
	SW1	0.6588	81	19.1	23.9	Channel	4,903	0.055	M	Mountain Channel	1.74	7.30
	S1	0.3062	82	7.3	9.1	Channel	658	0.122	M	Mountain Channel	1.19	0.85
	SE1	0.2439	84	7.1	8.9	Channel	1,323	0.208	M	Mountain Channel	1.39	1.17
Existing (2019)	W1	0.3437	73	11.3	14.1	Shallow	1,690	0.056	U	Unpaved		7.36
	NW1	0.0664	85	2.1	2.6							
	NW2	0.2286	84	7.4	9.3	Shallow	2,174	0.120	U	Unpaved		6.49
	L1	0.0901	85	6.9	8.6							
	N1	0.1840	77	5.4	6.7							
	N2	0.2728	84	9.8	12.3							
	E1	0.1435	83	6.5	8.2	Shallow	1,560	0.231	U	Unpaved		3.35
	E2	0.4224	79	7.8	9.8	Shallow	2,027	0.109	U	Unpaved		6.36
	SW1	0.4619	82	7.3	9.1	Shallow	1,138	0.123	U	Unpaved		3.35
	S1	0.3511	82	4.8	5.9	Channel	3,446	0.102	E	Earth-lined	2.2	1.81
	SE1	0.2344	82	4.0	5.0	Channel	1,323	0.208	M	Mountain Channel	1.4	1.17
End of Mining	W1	0.2002	74	11.2	14.0	Channel	1,139	0.127	E	Earth-lined	1.5	0.67
	NW1	0.2798	83	3.2	4.0							
	NW2	0.1733	78	9.0	11.2	Channel	923	0.078	E	Earth-lined	1.7	0.65
	N1	0.2872	73	10.6	13.2							
	N2	0.2016	76	6.5	8.1							
	E1	0.2906	78	8.5	10.7	Channel	443	0.237	E	Earth-lined	1.5	0.20
	E2	0.2590	79	2.7	3.3	Channel	1,077	0.037	E	Earth-lined	1.9	1.02
	SW1	0.5317	79	5.9	7.3	Shallow	524	0.115	U	Unpaved		1.60
	S1	0.3369	81	7.1	8.9	Shallow	1,363	0.448	U	Unpaved		2.10
	SE1	0.2344	83	7.1	8.9	Channel	1,323	0.208	M	Mountain Channel	1.4	1.17
Final Reclamation	W1	0.2002	66	15.8	19.8	Channel	1,139	0.127	E	Earth-lined	1.5	0.67
	NW1	0.2798	81	7.8	9.7							
	NW2	0.1733	75	11.2	14.0	Channel	923	0.078	E	Earth-lined	1.7	0.65
	N1	0.2872	66	14.9	18.6							
	N2	0.2016	69	8.1	10.2							
	E1	0.2907	73	8.5	10.7	Channel	443	0.237	E	Earth-lined	1.5	0.20
	E2	0.2590	76	5.1	6.4	Channel	1,077	0.037	E	Earth-lined	1.9	1.02
	SW1	0.5317	75	8.5	10.7	Shallow	524	0.115	U	Unpaved		1.60
	S1	0.3369	80	7.1	8.9	Shallow	1,363	0.448	U	Unpaved		2.10
	SE1	0.2344	82	7.1	8.9	Channel	1,323	0.208	M	Mountain Channel	1.4	1.17

Notes:
(1) Refer to Reference A for roughness condition descriptions and assumed coefficients.

TABLE B:
BASIN TIME OF CONCENTRATION CALCULATIONS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

						Flow Segment 5						
	Subbasin ID	Subbasin Area (sq mile)	Composite SCS Curve Number, CN	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition [1]		Total Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
Pre-Mining	W1	0.3709	78	10.4	12.9	Channel	1,820	0.009	E	Earth-lined	1.92	3.47
	NW1	0.0749	77	6.5	8.2	Channel	970	0.013	E	Earth-lined	1.06	2.29
	NW2	0.3157	76	10.4	13.0	Channel	2,160	0.012	E	Earth-lined	1.64	3.96
	N1	0.3458	73	10.3	12.8	Channel	1,305	0.014	E	Earth-lined	1.54	2.31
	N2	0.0981	79	10.6	13.2	Channel	1,200	0.021	E	Earth-lined	0.85	2.58
	E1	0.4475	85	9.2	11.5	Channel	1,140	0.014	E	Earth-lined	1.74	1.86
	E2	0.4990	81	10.1	12.6	Channel	900	0.014	E	Earth-lined	1.64	1.53
	SW1	0.6588	81	19.1	23.9	Shallow	534	0.004	U	Unpaved		9.01
	S1	0.3062	82	7.3	9.1	Channel	1,539	0.081	E	Earth-lined	1.66	1.08
	SE1	0.2439	84	7.1	8.9	Shallow	392	0.077	U	Unpaved		1.46
Existing (2019)	W1	0.3437	73	11.3	14.1	Channel	1,010	0.015	E	Earth-lined	1.7	1.63
	NW1	0.0664	85	2.1	2.6							
	NW2	0.2286	84	7.4	9.3	Channel	983	0.073	E	Earth-lined	1.7	0.71
	L1	0.0901	85	6.9	8.6							
	N1	0.1840	77	5.4	6.7							
	N2	0.2728	84	9.8	12.3							
	E1	0.1435	83	6.5	8.2	Channel	800	0.138	E	Earth-lined	2.1	0.37
	E2	0.4224	79	7.8	9.8	Channel	875	0.046	E	Earth-lined	1.8	0.77
	SW1	0.4619	82	7.3	9.1	Channel	3,470	0.037	E	Earth-lined	1.6	3.66
	S1	0.3511	82	4.8	5.9							
	SE1	0.2344	82	4.0	5.0	Shallow	392	0.077	U	Unpaved		1.46
End of Mining	W1	0.2002	74	11.2	14.0	Channel	1,060	0.005	E	Earth-lined	1.7	3.03
	NW1	0.2798	83	3.2	4.0							
	NW2	0.1733	78	9.0	11.2							
	N1	0.2872	73	10.6	13.2							
	N2	0.2016	76	6.5	8.1							
	E1	0.2906	78	8.5	10.7	Channel	339	0.015	E	Earth-lined	2.1	0.48
	E2	0.2590	79	2.7	3.3							
	SW1	0.5317	79	5.9	7.3	Channel	3,470	0.037	E	Earth-lined	1.6	3.66
	S1	0.3369	81	7.1	8.9	Channel	3,446	0.102	E	Earth-lined	2.2	1.81
	SE1	0.2344	83	7.1	8.9	Shallow	392	0.077	U	Unpaved		1.46
Final Reclamation	W1	0.2002	66	15.8	19.8	Channel	1,060	0.005	E	Earth-lined	1.7	3.03
	NW1	0.2798	81	7.8	9.7							
	NW2	0.1733	75	11.2	14.0							
	N1	0.2872	66	14.9	18.6							
	N2	0.2016	69	8.1	10.2							
	E1	0.2907	73	8.5	10.7	Channel	339	0.015	E	Earth-lined	2.1	0.48
	E2	0.2590	76	5.1	6.4							
	SW1	0.5317	75	8.5	10.7	Channel	3,470	0.037	E	Earth-lined	1.6	3.66
	S1	0.3369	80	7.1	8.9	Channel	3,446	0.102	E	Earth-lined	2.2	1.81
	SE1	0.2344	82	7.1	8.9	Shallow	392	0.077	U	Unpaved		1.46

Notes:
(1) Refer to Reference A for roughness condition descriptions and assumed coefficients.

TABLE C:
RATIONAL METHOD FLOW RESULTS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

	Subbasin ID	Subbasin Area (acres)	Pervious Area Fraction[(1)], a_p	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[(2)], F_p (in/hr)	Maximum Loss Rate, F_m (in/hr)	20-year, 1-hour Point Rainfall Depth (in) 0.672: Time of Concentration[(3)], Tc (min)	20-year: Rainfall Intensity, I (in/hr)	20-year: Peak Flow Rate, Q (cfs)	100-year, 1-hour Point Rainfall Depth (in) 0.958: Time of Concentration, Tc (min)	100-year: Rainfall Intensity, I (in/hr)	100-year: Peak Flow Rate, Q (cfs)
Pre-Mining	W1	237.35	0.98	78	0.42	0.41	13.7	1.52	238	12.9	2.23	391
	NW1	47.97	0.98	77	0.43	0.42	8.5	1.97	67	8.2	2.87	106
	NW2	202.05	0.98	76	0.45	0.44	13.8	1.51	196	13.0	2.22	327
	N1	221.30	0.98	73	0.50	0.49	13.5	1.52	208	12.8	2.24	351
	N2	62.76	0.98	79	0.40	0.39	13.8	1.51	64	13.2	2.20	103
	E1	286.39	0.98	85	0.29	0.28	12.1	1.62	347	11.5	2.37	543
	E2	319.37	0.98	81	0.36	0.35	13.3	1.54	343	12.6	2.26	553
	SW1	421.64	0.98	81	0.36	0.35	25.6	1.07	276	23.9	1.59	473
	S1	195.94	0.98	82	0.34	0.33	9.4	1.86	271	9.1	2.70	420
	SE1	156.08	0.98	84	0.31	0.30	9.3	1.88	223	8.9	2.73	344
Existing (2019)	W1	219.97	0.98	73	0.50	0.49	15.0	1.44	190	14.1	2.12	326
	NW1	42.52	0.98	85	0.29	0.28	2.6	3.75	134	2.6	5.35	195
	NW2	146.29	0.98	84	0.31	0.30	10.0	1.80	199	9.3	2.68	315
	L1	57.64	0.98	85	0.29	0.28	8.9	1.92	86	8.6	2.79	131
	N1	117.79	0.98	77	0.43	0.42	6.8	2.22	192	6.7	3.19	296
	N2	174.59	0.98	84	0.31	0.30	12.5	1.59	205	12.3	2.29	315
	E1	91.81	0.98	83	0.32	0.31	8.5	1.97	138	8.2	2.87	213
	E2	270.36	0.98	79	0.40	0.39	10.5	1.75	334	9.8	2.60	542
	SW1	295.64	0.98	82	0.34	0.33	9.8	1.82	400	9.1	2.71	637
	S1	224.72	0.98	82	0.34	0.33	6.3	2.32	406	5.9	3.42	629
	SE1	149.99	0.98	82	0.34	0.33	5.3	2.55	301	5.0	3.77	468
End of Mining	W1	128.10	0.98	74	0.48	0.47	15.1	1.43	112	14.0	2.13	193
	NW1	179.08	0.98	83	0.32	0.31	4.0	2.99	436	4.0	4.27	643
	NW2	110.89	0.98	78	0.42	0.41	11.9	1.64	123	11.2	2.41	201
	N1	183.79	0.98	73	0.50	0.49	14.2	1.49	166	13.2	2.20	286
	N2	129.01	0.98	76	0.45	0.44	8.3	1.99	182	8.1	2.88	286
	E1	186.00	0.98	78	0.42	0.41	10.8	1.73	222	10.7	2.48	349
	E2	165.78	0.98	79	0.40	0.39	3.5	3.21	424	3.3	4.70	648
	SW1	340.29	0.98	79	0.40	0.39	7.9	2.05	512	7.3	3.04	818
	S1	215.63	0.98	81	0.36	0.35	9.3	1.87	297	8.9	2.73	466
	SE1	149.99	0.98	83	0.32	0.31	9.3	1.88	213	8.9	2.73	329

TABLE C:
RATIONAL METHOD FLOW RESULTS

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

							20-year, 1-hour Point Rainfall Depth (in)			100-year, 1-hour Point Rainfall Depth (in)		
							0.672			0.958		
	Subbasin ID	Subbasin Area (acres)	Pervious Area Fraction[(1)], a_p	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[(2)], F_p (in/hr)	Maximum Loss Rate, F_m (in/hr)	Time of Concentration[(3)], Tc (min)	Rainfall Intensity, I (in/hr)	Peak Flow Rate, Q (cfs)	Time of Concentration, Tc (min)	Rainfall Intensity, I (in/hr)	Peak Flow Rate, Q (cfs)
Final Reclamation	W1	128.10	0.98	66	0.61	0.60	20.9	1.20	70	19.8	1.76	136
	NW1	179.08	0.98	81	0.36	0.35	9.7	1.83	240	9.7	2.60	366
	NW2	110.89	0.98	75	0.47	0.46	14.7	1.46	100	14.0	2.13	168
	N1	183.79	0.98	66	0.61	0.60	19.6	1.24	108	18.6	1.83	205
	N2	129.01	0.98	69	0.56	0.55	10.4	1.76	142	10.2	2.54	233
	E1	186.03	0.98	73	0.50	0.49	10.8	1.73	209	10.7	2.48	335
	E2	165.78	0.98	76	0.45	0.44	6.5	2.28	276	6.4	3.29	429
	SW1	340.29	0.98	75	0.47	0.46	11.2	1.69	380	10.7	2.48	623
	S1	215.63	0.98	80	0.38	0.37	9.3	1.87	294	8.9	2.73	462
	SE1	149.99	0.98	82	0.34	0.33	9.3	1.88	210	8.9	2.73	327

Notes:
(1) Unless otherwise indicated, subbasins are assumed to contain 2% impervious area.
(2) The infiltration rate for pervious areas (F_p) was determined using the graph in Figure C-5 of the Kern County Hydrology Manual.
(3) The calculated time of concentration for the 20-year flow calculation (see "Basin Time of Concentration Calculations" table) was increased by a factor of 1.09 for flow segments 3-5 per Kern County Hydrology Manual.

Calculation Summary:

Maximum Loss Rate, F_m

$$F_m = a_p F_p$$

Where:
F_m = maximum loss rate (in/hr)
a_p = pervious area fraction
F_p = infiltration rate for pervious area (in/hr)

Rainfall Intensity, I
(as derived from the I-D graph in Reference B)

$$I_{100} = 10.333 \times Tc^{-0.54}$$

$$I_{20} = 6.747 \times Tc^{-0.55}$$

Where:
I_{100} = rainfall intensity, 100-year (in/hr)
I_{20} = rainfall intensity, 20-year (in/hr)
Tc = time of concentration (min)

Peak Flow Rate, Q

$$Q = 0.90(I - F_m)A$$

Where:
Q = peak flow rate (cfs)
I - rainfall intensity (in/hr)
F_m = maximum loss rate (in/hr)
A = area (acre)

TABLE D:
SEDIMENT POND SIZING

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	10-year, 24-hour	
	2.64	in.

	Subbasin	Area (ac.)	Subarea Fraction, A_j	Subarea Soil Group	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[(1)], F_p (in/hr)	Pervious Area Fraction[(2)], a_p (decimal)	Estimated Soil Capacity, S (in)	Initial Abstraction, I_a (in)	Subarea Yield Fraction, Y_j (in)	Subbasin Yield Fraction, Y (in)	10-year, 24-hour Volume (acre-ft)
Existing (2019)	W1	220.0	0.406	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.025	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.177	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.109	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.103	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.181	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.226	10.9
Existing (2019)	NW1	42.5	0.000	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.804	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.006	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.003	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.188	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.495	4.6
Existing (2019)	NW2	146.3	0.032	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.020	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.215	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.654	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.015	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.065	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.153	4.9
Existing (2019)	L1	57.6	0.005	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.995	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.000	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.000	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.001	0.0
Existing (2019)	N1	117.8	0.022	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.188	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.588	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.202	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.227	5.9
Existing (2019)	N2	174.6	0.022	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.074	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.307	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.510	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.086	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.231	8.9

TABLE D:
SEDIMENT POND SIZING

Company	Golden Queen	
Location	Soledad Mountain	
Project ID	GO01.19.06	
Design Storm	10-year, 24-hour	
	2.64	in.

	Subbasin	Area (ac.)	Subarea Fraction, A_j	Subarea Soil Group	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[(1)], F_p (in/hr)	Pervious Area Fraction[(2)], a_p (decimal)	Estimated Soil Capacity, S (in)	Initial Abstraction, I_a (in)	Subarea Yield Fraction, Y_j (in)	Subbasin Yield Fraction, Y (in)	10-year, 24-hour Volume (acre-ft)
Existing (2019)	E1	91.8	0.000	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.153	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.231	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.463	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.004	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.148	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.237	4.8
Existing (2019)	E2	270.4	0.168	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.531	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.090	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.089	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.121	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.330	19.7
Existing (2019)	SW1	295.6	0.164	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.019	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.703	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.001	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.038	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.075	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.454	29.5
Existing (2019)	S1	224.7	0.204	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.002	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.695	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.020	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.027	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.052	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.438	21.6
Existing (2019)	SE1	150.0	0.206	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.760	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.034	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.462	15.2
End of Mining	W1	128.1	0.088	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.064	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.002	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.435	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.411	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.264	7.5

TABLE D:
SEDIMENT POND SIZING

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	10-year, 24-hour	
	2.64	in.

	Subbasin	Area (ac.)	Subarea Fraction, A_j	Subarea Soil Group	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[(1)], F_p (in/hr)	Pervious Area Fraction[(2)], a_p (decimal)	Estimated Soil Capacity, S (in)	Initial Abstraction, I_a (in)	Subarea Yield Fraction, Y_j (in)	Subbasin Yield Fraction, Y (in)	10-year, 24-hour Volume (acre-ft)
End of Mining	NW1	179.1	0.000	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.019	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.776	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.204	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
											0.075	3.0
End of Mining	NW2	110.9	0.048	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.027	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.385	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.017	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.131	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.393	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.357	8.7
End of Mining	N1	183.8	0.009	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.089	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.306	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.596	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.215	8.7
End of Mining	N2	129.0	0.029	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.085	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.047	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.133	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.279	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.427	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.244	6.9
End of Mining	E1	186.0	0.002	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.075	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.230	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.068	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.247	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.378	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.320	13.1
End of Mining	E2	165.8	0.126	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.495	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.091	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.288	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.381	13.9

TABLE D:
SEDIMENT POND SIZING

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	10-year, 24-hour	
	2.64	in.

	Subbasin	Area (ac.)	Subarea Fraction, A_j	Subarea Soil Group	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[(1)], F_p (in/hr)	Pervious Area Fraction[(2)], a_p (decimal)	Estimated Soil Capacity, S (in)	Initial Abstraction, I_a (in)	Subarea Yield Fraction, Y_j (in)	Subbasin Yield Fraction, Y (in)	10-year, 24-hour Volume (acre-ft)
End of Mining	SW1	340.3	0.069	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.023	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.433	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.001	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.147	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.327	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.376	28.2
End of Mining	S1	215.6	0.213	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.002	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.675	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.001	Mined Benches and Pits	85	0.29	0.98	1.76	0.35	0.489		
			0.025	Rock Dump Tops	77	0.43	0.98	2.99	0.60	0.314		
			0.085	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.433	20.5
End of Mining	SE1	150.0	0.206	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.778	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.016	Rock Dump Slopes	70	0.55	0.98	4.29	0.86	0.198		
											0.469	15.5
Final Reclamation	W1	128.1	0.088	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.000	Undist. Desert Shrub, HSG B	77	0.43	0.98	2.99	0.60	0.314		
			0.064	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.846	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.159	4.5
Final Reclamation	NW1	179.1	0.000	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.000	Undist. Desert Shrub, HSG B	77	0.43	0.98	2.99	0.60	0.314		
			0.019	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.204	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.038	1.5
Final Reclamation	NW2	110.9	0.048	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.027	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.385	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.524	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.307	7.5

TABLE D:
SEDIMENT POND SIZING

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	10-year, 24-hour	
	2.64	in.

	Subbasin	Area (ac.)	Subarea Fraction, A_j	Subarea Soil Group	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area(1), F_p (in/hr)	Pervious Area Fraction(2), a_p (decimal)	Estimated Soil Capacity, S (in)	Initial Abstraction, I_a (in)	Subarea Yield Fraction, Y_j (in)	Subbasin Yield Fraction, Y (in)	10-year, 24-hour Volume (acre-ft)
Final Reclamation	N1	183.8	0.009	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.000	Undist. Desert Shrub, HSG B	77	0.43	0.98	2.99	0.60	0.314		
			0.000	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.956	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.128	5.2
Final Reclamation	N2	129.0	0.029	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.085	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.047	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.797	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.178	5.0
Final Reclamation	E1	186.0	0.002	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.075	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.230	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.625	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.251	10.3
Final Reclamation	E2	165.8	0.126	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.000	Undist. Desert Shrub, HSG B	77	0.43	0.98	2.99	0.60	0.314		
			0.495	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.379	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.346	12.6
Final Reclamation	SW1	340.3	0.069	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.023	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.343	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.474	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.277	20.7
Final Reclamation	S1	215.6	0.213	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.002	Undist. Desert Shrub, HSG C	85	0.29	0.98	1.76	0.35	0.489		
			0.675	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.110	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.423	20.1
Final Reclamation	SE1	150.0	0.206	Undist. Desert Shrub, HSG A	63	0.66	0.98	5.87	1.17	0.111		
			0.000	Undist. Desert Shrub, HSG B	77	0.43	0.98	2.99	0.60	0.314		
			0.778	Undist. Desert Shrub, HSG D	88	0.24	0.98	1.36	0.27	0.569		
			0.016	Reclaimed Area	65	0.63	0.98	5.38	1.08	0.133		
											0.468	15.4

TABLE D:
SEDIMENT POND SIZING

Company	Golden Queen
Location	Soledad Mountain
Project ID	GO01.19.06

Design Storm	10-year, 24-hour	
	2.64	in.

Subbasin	Area (ac.)	Subarea Fraction, A_j	Subarea Soil Group	Composite SCS Curve Number, CN	Infiltration Rate for Pervious Area[1], F_p (in/hr)	Pervious Area Fraction[2], a_p (decimal)	Estimated Soil Capacity, S (in)	Initial Abstraction, I_a (in)	Subarea Yield Fraction, Y_j (in)	Subbasin Yield Fraction, Y (in)	10-year, 24-hour Volume (acre-ft)

Notes:
(1) The infiltration rate for pervious areas (F_p) was determined using the graph in Figure C-5 of the Kern County Hydrology Manual.
(2) Unless otherwise indicated, subbasins are assumed to contain 2% impervious area.

Calculation Summary:

Estimated Soil Capacity, S

$$S = \frac{1000}{CN} - 10$$

Where: S = estimated soil capacity (in)
CN = composite SCS curve number

Initial Abstraction, Ia

$$I_a = 0.2S$$

Where: I_a = initial abstraction (in)
S = estimated soil capacity (in)

Storm Runoff Rield Fraction, Y_j

$$Y_j = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S) \times P_{24}}$$

Where: Y_j = 24-hour storm runoff yield fraction for subarea A_j
P_{24} = rainfall, 24-hour (in)
I_a = initial abstraction (in)
S = estimated soil capacity (in)

Runoff Volume, V

$$V = A \times Y \times \frac{P}{12}$$

Where: V = runoff volume (acre-ft)
Y = area weighted yield fraction
A = subbasin area (ac.)
P = rainfall (in)

Attachment A

Time of Concentration and Manning's Flow Coefficients

REFERENCE A:
TIME OF CONCENTRATION AND MANNINGS FLOW COEFFICIENTS

TR-55 (1986)

Sheet Flow Travel Time (SCS Upland Method)

$$T_t = \frac{0.007(n'L)^{0.8}}{(P_2)^{0.5} \times S^{0.4}}$$

Where: T_t = travel time (hr)
n' = roughness coefficient
L = flow length (ft)
P_2 = 2-year storm depth (inches)
s = slope (ft/ft)
flow velocity = $\frac{L}{60T_t}$

Flow Type	Surface Type	Roughness n	Surface Description	Short Description
Sheet / Overland Flow	A	0.011	Smooth surfaces (concrete, asphalt, gravel, bare soil)	Smooth
	B	0.05	Fallow (no residue)	Fallow
	C	0.06	Cultivated soils: Residue cover <= 20%	Cover<20%
	D	0.17	Cultivated soils: Residue cover > 20%	Cover>20%
	G1	0.15	Grass: Short grass prairie	Short Grass
	G2	0.24	Grass: Dense grasses	Dense Grass
	G3	0.41	Grass: Bermuda grass	Bermuda Grass
	H	0.13	Range (natural)	Range
	I	0.4	Woods: Light underbrush	Light woods
	J	0.8	Woods: Heavy underbrush	Heavy Woods

Shallow Concentrated Flow Velocity (SCS Upland Method)

$$v = mS^{0.5}$$

Where: v = velocity (ft/sec)
m = roughness coeffiction
S = slope (ft/ft)

Flow Type	Surface Type	Roughness m	Surface Description	Short Description
Shallow Conc. Flow	P	20.3282	Paved Surfaces	Paved
	U	16.1345	Unpaved Surfaces	Unpaved

Channel Flow Velocity (Manning Velocity)

$$v = \frac{1.49Rh^{2/3}S^{1/2}}{n}$$

Where: v = velocity (ft/sec)
n = roughness coefficient
Rh = hydraulic radius (ft)
S = slope (ft/ft)

Flow Type	Lining Type	Manning n for Depth	Channel Surface	Short Description	Maximum Velocity	Maximum Shear Stress
Channel Flow	A	0.026	ACS	ACS	25	
	C	0.024	Corrugated Steel Pipe	CSP	50	
	E	0.025	Earth-lined	Earth-lined	3	
	G	0.035	Grass-lined	Grass-lined	5	
	I	0.017	Ductile Iron	Ductile Iron	50	
	M	0.045	Mountain Channel per Kern County Manual (1)	Mountain Channel		
	Pl	0.012	Plastic	Plastic	25	
	R	0.040	Riprap	Riprap	15	
	T	0.035	Turf Reinf.	Turf Reinf.	10	1.5
	Z	0.060	Other	Other	25	

Notes:
(1) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

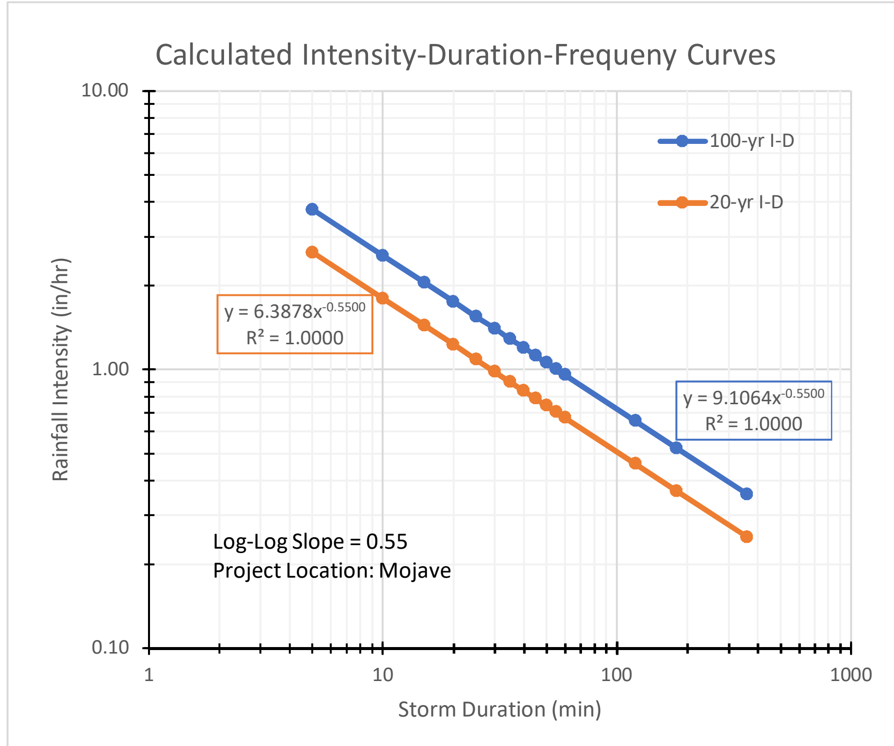
Attachment B

Intensity-Duration-Frequency Curves

REFERENCE B:
INTENSITY-DURATION-FREQUENCY CURVES

log-log slope	0.55

100-yr I-D		20-yr I-D[(1)]		10-yr I-D	
t (min)	I (in/hr)	t (min)	I (in/hr)	t (min)	I (in/hr)
5	3.76	5	2.64	5	2.04
10	2.57	10	1.80	10	1.39
15	2.05	15	1.44	15	1.11
20	1.75	20	1.23	20	0.95
25	1.55	25	1.09	25	0.84
30	1.40	30	0.98	30	0.76
35	1.29	35	0.90	35	0.70
40	1.20	40	0.84	40	0.65
45	1.12	45	0.79	45	0.61
50	1.06	50	0.74	50	0.57
55	1.00	55	0.70	55	0.55
60	0.96	60	0.67	60	0.52
120	0.65	120	0.46	120	0.36
180	0.52	180	0.37	180	0.28
360	0.36	360	0.25	360	0.19



Notes:
Source: NOAA Atlas 14, Volume 6, Version 2, Point Precipitation Frequency Estimates. Location: Mojave CA (Latitude: 34.9833°, Longitude: -118.192°)
(1) NOAA PFDS does not include a 20-year reccurence interval, so data for the 25-year recurrence interval was conservatively used.

Attachment C

NOAA Atlas 14 Precipitation Tables

NOAA Atlas 14, Volume 6, Version 2
Location name: Mojave, California, USA*
Latitude: 34.9833°, Longitude: -118.192°
Elevation: 3912.64 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.073 (0.060-0.089)	0.095 (0.078-0.116)	0.127 (0.104-0.156)	0.157 (0.128-0.195)	0.203 (0.160-0.260)	0.243 (0.187-0.319)	0.289 (0.217-0.388)	0.342 (0.250-0.472)	0.443 (0.311-0.637)	0.592 (0.402-0.881)
10-min	0.105 (0.086-0.128)	0.136 (0.112-0.167)	0.182 (0.149-0.224)	0.225 (0.183-0.279)	0.291 (0.229-0.373)	0.348 (0.269-0.457)	0.414 (0.312-0.556)	0.490 (0.359-0.677)	0.635 (0.446-0.914)	0.848 (0.576-1.26)
15-min	0.126 (0.104-0.155)	0.164 (0.135-0.202)	0.220 (0.181-0.271)	0.272 (0.221-0.337)	0.351 (0.277-0.451)	0.421 (0.325-0.552)	0.501 (0.377-0.672)	0.593 (0.434-0.818)	0.768 (0.540-1.11)	1.03 (0.696-1.53)
30-min	0.171 (0.141-0.210)	0.222 (0.183-0.273)	0.298 (0.244-0.367)	0.368 (0.299-0.457)	0.475 (0.374-0.610)	0.570 (0.440-0.747)	0.678 (0.510-0.910)	0.802 (0.587-1.11)	1.04 (0.730-1.50)	1.39 (0.942-2.07)
60-min	0.242 (0.199-0.297)	0.314 (0.258-0.386)	0.421 (0.346-0.519)	0.520 (0.423-0.646)	0.672 (0.529-0.863)	0.806 (0.622-1.06)	0.958 (0.721-1.29)	1.13 (0.830-1.57)	1.47 (1.03-2.11)	1.96 (1.33-2.92)
2-hr	0.372 (0.307-0.457)	0.473 (0.389-0.581)	0.616 (0.506-0.759)	0.742 (0.604-0.922)	0.929 (0.731-1.19)	1.09 (0.837-1.42)	1.26 (0.945-1.69)	1.45 (1.06-2.00)	1.73 (1.21-2.49)	1.97 (1.34-2.93)
3-hr	0.468 (0.385-0.574)	0.594 (0.488-0.729)	0.769 (0.631-0.947)	0.920 (0.749-1.14)	1.14 (0.897-1.46)	1.32 (1.02-1.73)	1.51 (1.14-2.03)	1.72 (1.26-2.38)	2.03 (1.43-2.92)	2.28 (1.55-3.40)
6-hr	0.643 (0.529-0.788)	0.828 (0.681-1.02)	1.08 (0.886-1.33)	1.29 (1.05-1.60)	1.59 (1.25-2.04)	1.82 (1.41-2.39)	2.07 (1.56-2.78)	2.33 (1.71-3.22)	2.70 (1.90-3.88)	3.00 (2.03-4.46)
12-hr	0.803 (0.662-0.986)	1.11 (0.913-1.36)	1.51 (1.24-1.86)	1.84 (1.50-2.28)	2.28 (1.80-2.93)	2.62 (2.02-3.44)	2.97 (2.24-3.99)	3.33 (2.44-4.60)	3.83 (2.69-5.50)	4.21 (2.86-6.27)
24-hr	1.02 (0.903-1.17)	1.50 (1.33-1.73)	2.13 (1.88-2.46)	2.64 (2.31-3.07)	3.33 (2.82-4.00)	3.85 (3.20-4.74)	4.39 (3.55-5.53)	4.93 (3.88-6.40)	5.68 (4.28-7.68)	6.26 (4.56-8.76)
2-day	1.27 (1.13-1.46)	1.83 (1.62-2.10)	2.57 (2.28-2.97)	3.20 (2.80-3.72)	4.07 (3.45-4.90)	4.77 (3.96-5.86)	5.49 (4.44-6.92)	6.25 (4.92-8.11)	7.33 (5.53-9.91)	8.19 (5.96-11.5)
3-day	1.44 (1.28-1.66)	2.03 (1.80-2.34)	2.84 (2.51-3.28)	3.53 (3.10-4.11)	4.52 (3.83-5.44)	5.31 (4.41-6.53)	6.15 (4.98-7.76)	7.06 (5.55-9.15)	8.35 (6.30-11.3)	9.40 (6.85-13.2)
4-day	1.56 (1.38-1.79)	2.18 (1.93-2.51)	3.03 (2.68-3.50)	3.76 (3.29-4.37)	4.80 (4.07-5.78)	5.65 (4.69-6.94)	6.54 (5.30-8.25)	7.51 (5.91-9.74)	8.90 (6.71-12.0)	10.0 (7.31-14.0)
7-day	1.76 (1.56-2.02)	2.44 (2.16-2.81)	3.35 (2.97-3.87)	4.13 (3.62-4.80)	5.22 (4.43-6.28)	6.10 (5.06-7.50)	7.02 (5.69-8.85)	8.01 (6.30-10.4)	9.40 (7.09-12.7)	10.5 (7.68-14.8)
10-day	1.86 (1.65-2.13)	2.57 (2.28-2.95)	3.51 (3.10-4.05)	4.30 (3.77-5.00)	5.40 (4.58-6.50)	6.28 (5.21-7.72)	7.19 (5.82-9.06)	8.16 (6.42-10.6)	9.53 (7.19-12.9)	10.6 (7.74-14.9)
20-day	2.22 (1.97-2.55)	3.07 (2.72-3.53)	4.18 (3.70-4.82)	5.10 (4.47-5.94)	6.37 (5.40-7.66)	7.36 (6.11-9.05)	8.39 (6.79-10.6)	9.47 (7.45-12.3)	11.0 (8.29-14.9)	12.2 (8.89-17.1)
30-day	2.57 (2.28-2.95)	3.56 (3.15-4.09)	4.85 (4.28-5.59)	5.90 (5.18-6.87)	7.35 (6.23-8.85)	8.49 (7.05-10.4)	9.67 (7.83-12.2)	10.9 (8.59-14.2)	12.7 (9.55-17.1)	14.1 (10.2-19.7)
45-day	3.09 (2.74-3.55)	4.28 (3.79-4.92)	5.83 (5.15-6.73)	7.10 (6.23-8.27)	8.85 (7.50-10.6)	10.2 (8.47-12.6)	11.6 (9.41-14.7)	13.1 (10.3-17.0)	15.2 (11.5-20.6)	16.9 (12.3-23.7)
60-day	3.49 (3.10-4.01)	4.80 (4.26-5.52)	6.52 (5.76-7.52)	7.93 (6.95-9.22)	9.86 (8.36-11.9)	11.4 (9.44-14.0)	12.9 (10.5-16.3)	14.6 (11.5-19.0)	17.0 (12.8-23.0)	18.9 (13.8-26.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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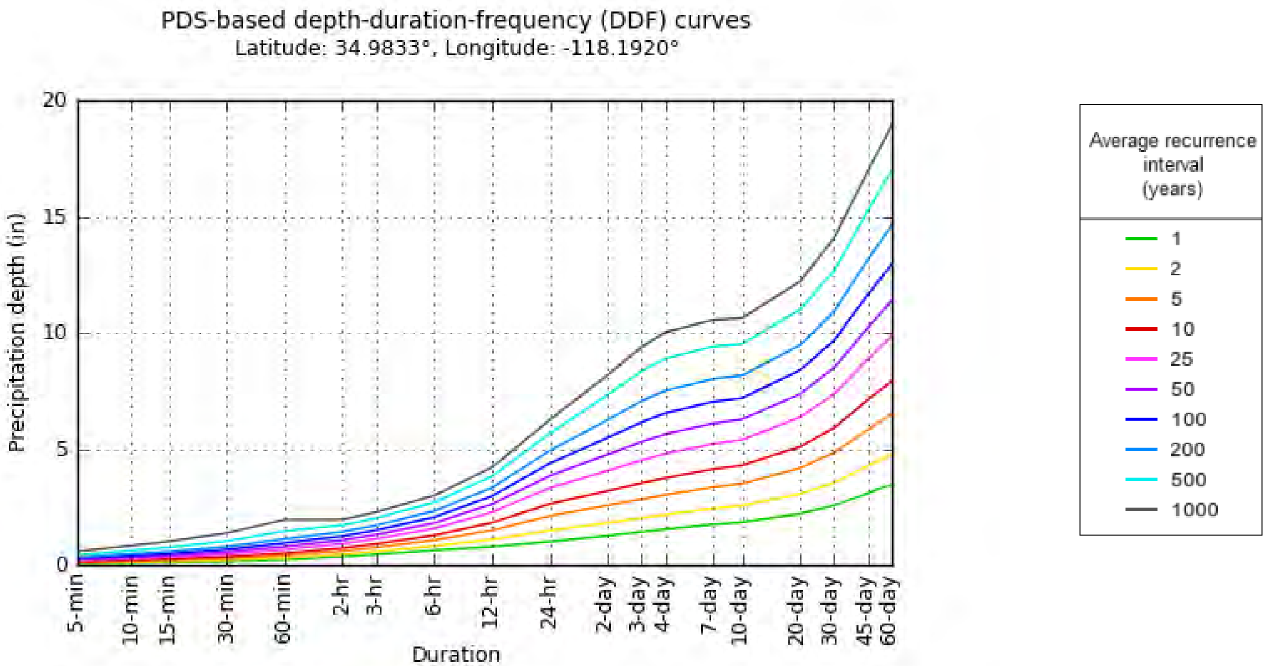
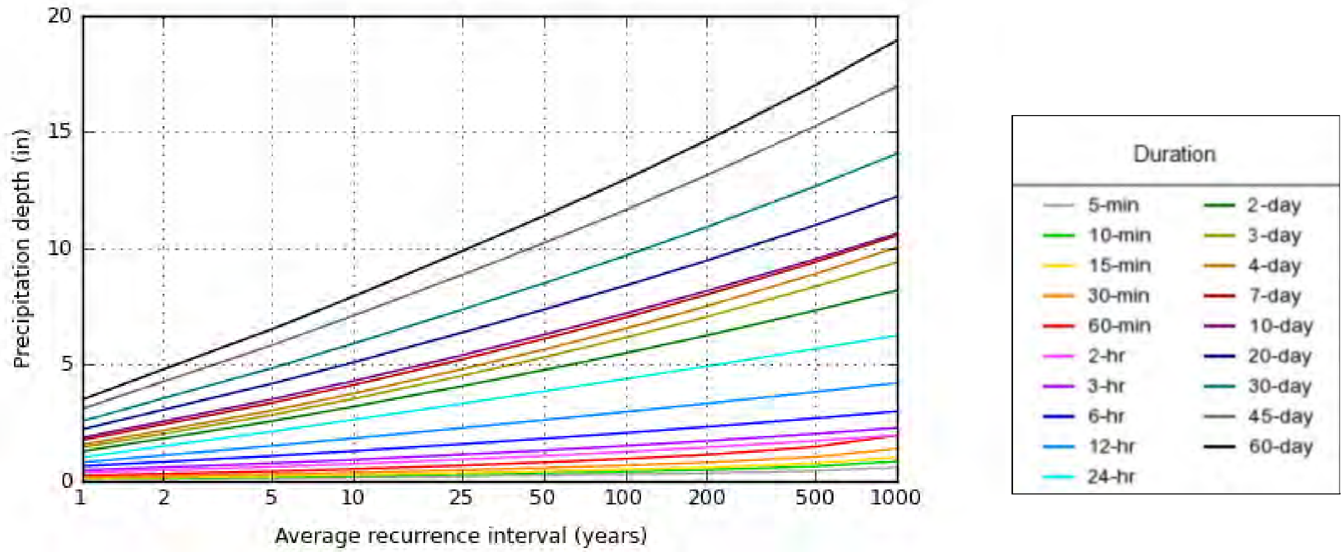
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Jun 6 19:33:14 2019

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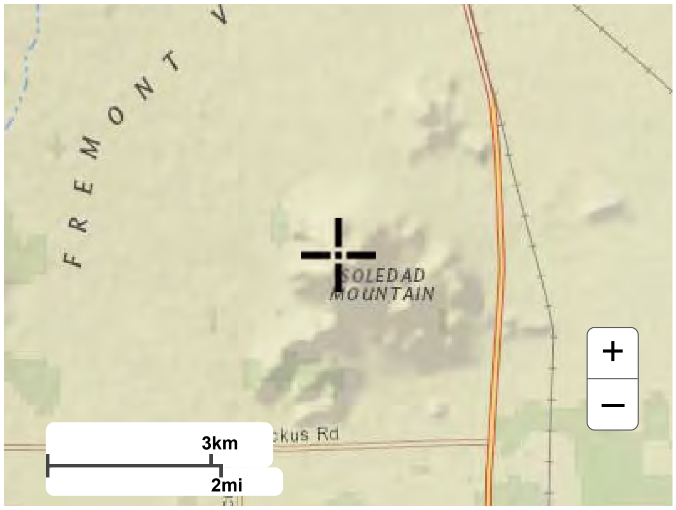
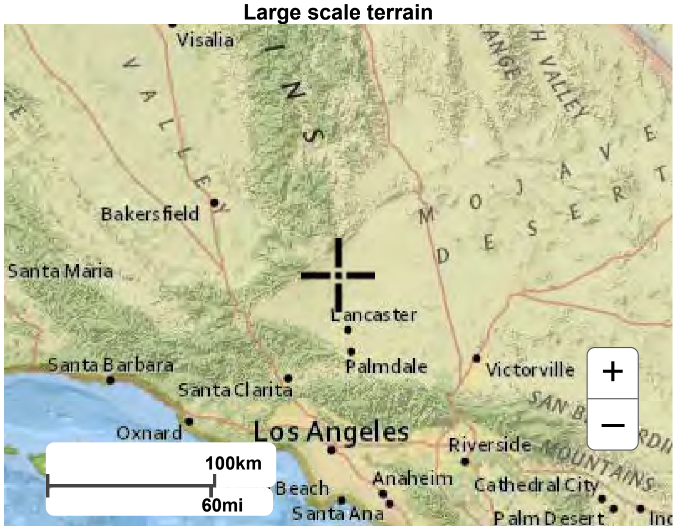
Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

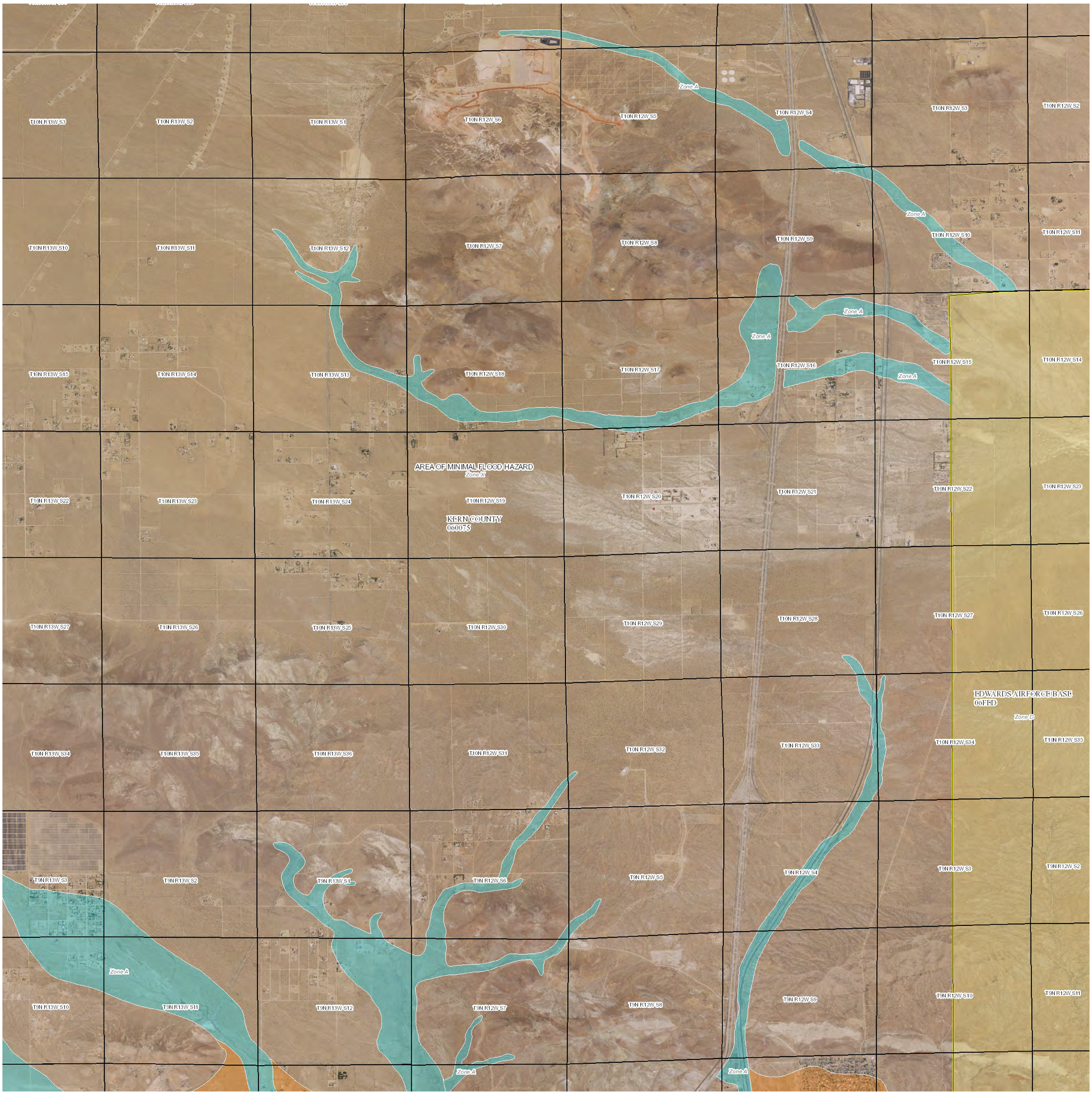
Disclaimer

Appendix 2

FEMA Flood Insurance Rate Map

35°0'26.65"N

118°15'2.01"W



USGS The National Map: Orthoimagery. Data refreshed October, 2017.

118°7'28.08"W

34°52'3.38"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes. *Zone X*
	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 Cross Sections with 1% Annual Chance
	17.5 Water Surface Elevation
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can beordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **2/26/2019 4:58:36 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: No elevation features on this FIRM
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 2,000 feet 1:24,000

0 1,000 2,000 4,000 6,000 8,000 Feet

Meters 0 210 420 840 1,260 1,680

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

KERN COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL **3675** OF **4025**

Panel Contains:

COMMUNITY	NUMBER	PANEL
KERN COUNTY CALIFORNIA	060075	3675
EDWARDS AIRFORCE BASE CALIFORNIA	06FED	3675

MAP NUMBER
06029C3675E

EFFECTIVE DATE
09/26/2008

Appendix 3

Soledad Mountain Site Drainage Plan, Revision 4 (Golder, 2012)

REPORT

SOLEDAD MOUNTAIN

Site Drainage Plan, Revision 4

Submitted To: Golden Queen Mining Co., Inc.
6411 Imperial Avenue
West Vancouver, British Columbia V7W 2J5 Canada

Submitted By: Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, Colorado 80228 USA

REGISTERED PROFESSIONAL ENGINEER
RICHARD E. KIEL
No. C047477
EXP. 12/31/13
CIVIL
STATE OF CALIFORNIA

Distribution: Golden Queen Mining Co., Ltd., West Vancouver, BC (3 copies)
Golder Associates Inc., Denver, CO (2 copies)

March 8, 2012

043-2299D

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1.0 INTRODUCTION

Golden Queen Mining Co., Inc. (GQM) is planning the development of an open pit, gold and silver mine, referred to as the Soledad Mountain Project (Project) in Kern County, California. The Project site is located approximately 5 miles (8 km) south of Mojave, California, and 2 miles (3.2 km) west of State Highway 14. Access to the Project site is from Silver Queen Road, which borders the northern portion of the property.

GQM tasked Golder Associates Inc. (Golder) with development of a Site Drainage Plan to demonstrate that the Project complies with the applicable provisions of the Surface Mining and Reclamation Act (SMARA) with regards to drainage and erosion control [i.e., 2773(b)(4), 3503(a), (b), (d) & (e), & 3706].

1.1 Land Use – Conditional Use Permits

The Kern County Planning Commission unanimously approved the Project at its regularly scheduled meeting in Bakersfield on April 8, 2010. All appeals that were subsequently filed against the Planning Commission's decision have been withdrawn and the decision made by the Planning Commission is now final. The Planning Commission certified the Supplemental Environmental Impact Report and adopted a Mitigation Measures Monitoring Program and Conditions of Approval for the Project (CUPs). The CUPs for the Project were amended by Kern County Planning Commission Resolution No. 171-10 adopted on October 28, 2010.

There are 114 conditions of approval and mitigation measures in the CUPs.

The Bureau of Land Management (BLM) confirmed that its Record of Decision approving the Plan of Operations under National Environmental Policy Act in November 1997 remains valid.

1.2 Water Quality – Waste Discharge Requirements

The Lahontan Regional Water Resources Control Board (Regional Board) unanimously approved Waste Discharge Requirements (WDRs) and a Monitoring and Reporting Program for the Project at a public hearing held in South Lake Tahoe on July 14, 2010. The Board Order was subsequently signed by the Executive Officer of the Regional Board and is now in effect.

Open pit mining and reclamation activities on site will be conducted in compliance with the conditions set in the CUPs and the WDRs.

Since 2007, GQM has revised the overall mine development plan and facilities layouts to incorporate a three-stage construction of the Heap Leach Facility (HLF) and to address open pit backfilling requirements mandated by SMARA. Revision 1 to the Site Drainage Plan was submitted in January 2007 and this included the design of a drainage channel between Silver Queen Road and the northern limits of the Phase 1 heap leach pad and site facilities. Revision 2 of the Site Drainage Plan was submitted in February 2011 and this incorporated a Conditional Letter of Map Revision (CLOMR) that was submitted to Kern County Engineering, Surveying and Permit Services Department for approval. GQM held a number of meetings with the Department in early 2011 and it was apparent that Kern County could not form a Floodplain Maintenance District in reasonable time. GQM therefore decided to relocate certain facilities to avoid any incursion into the 100-year floodplain. This has necessitated a Revision 3 of the Site Drainage Plan.

Revision 3 of the Site Drainage Plan is dated December 2011 and has been developed to meet the following design objectives:

1. Set site drainage criteria for the Storm Water Pollution Prevention Plan (SWPPP) as follows:
    A. Zero discharge of runoff over mine process areas (heap leach pad [pad] and Merrill-Crowe Plant) resulting from precipitation events up to the 100-year design storm event
    B. Control of runoff from disturbed active, non-reclaimed, and reclaimed mining areas through sediment ponds designed for containment of runoff from the 10-year, 24-hour storm event and safe passage through the facilities of the 100-year peak runoff
    C. Diversion of runoff from undisturbed areas into adjacent drainages using Best Management Practices (BMP) to control erosion and scouring of the diversion ditches and receiving drainages
2. Segregation of runoff from disturbed areas such as access roads, parking areas, and undisturbed areas to the extent practical.
3. Temporary diversion ditches and channels capacity will be designed for the 20-yr peak runoff as well as erosion BMP.
4. Routing of runoff from the waste rock management units into the open pits to the extent possible.
5. All runoff is routed either into the open pits or to sediment ponds on site such that no runoff diversion from the Project area occurs into areas outside the limits of disturbance.

2.0 SITE CONDITIONS

The Project is located in the historical Mojave Mining District. Soledad Mountain rises to an elevation of 4,150 ft (1,265 m) above mean sea level. The topography varies from steep (upwards of 70 percent slopes), rugged hillsides in the middle to upper elevations to a gently sloping desert floor around the toe of Soledad Mountain. Soledad Mountain is a silicic volcanic outcrop with minimal soil cover. Desert alluvium covers the base of Soledad Mountain and creates topography that is moderately sloped (10 to 20 percent) near the bedrock contact and flattens to a gentler slope (less than 10 percent) towards the valley floor. Mining has occurred onsite since 1894 and a variety of mine adits, shafts, shallow pits, and old mining structures that vary from wooden buildings to concrete foundations are present on the northern side of the property. Several historical tailings piles are also located within the boundary of the proposed Phase 1 heap leach pad. Runoff from storms flows within a shallow meandering natural drainage channel from west to east just south of Silver Queen Road. Figure 1A presents a topographic map of the existing onsite pre-mining drainage basins and the Approved Project Boundary. Figure 1B presents a topographic map of the existing onsite and offsite drainage basins as they relate to the surface water runoff in the natural drainage channel.

2.1 Rainfall

The Project is located in an arid region typical of the western Mojave Desert. The area receives an average annual precipitation of about 6.3 inches (160 mm). The area has an evaporation loss potential of about 80 inches per year. Typical patterns of precipitation are winter rains and summer thunderstorms, which tend to be of short duration and high intensity. Runoff on the northern and western sides of Soledad Mountain is via a series of gullies or channels, which direct surface flows to the northwest, north, and northeast and eventually to the east to the Gloster and Chaffe Hydrologic Areas of the Antelope Hydrologic Unit (RWQCB Lahontan Region, 1994). Ephemeral drainages direct flow off Soledad Mountain in all directions.

2.2 Existing Site Hydrologic Conditions

A 100-year floodplain is identified along the northeast corner of the Project area on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), which defines it as an approximate Zone A, as shown in Appendix B. This floodplain, as mapped by FEMA, is located within the natural drainage channel south of Silver Queen Road and ranges from approximately 150 to 550 feet in width extending from a point approximately 2,100 feet west of the intersection of Holt Road and Silver Queen Road to the east of the Project boundary all the way to State Highway 14 where State Highway 14 bisects the floodplain before it continues to the east of State Highway 14 as shown in Appendix B.

There are no springs, seeps, or intermittent streams in the Project area. The closest intermittent stream is located approximately 3 miles (5 km) to the west.

Runoff rates for onsite and offsite basins that are tributary to the natural drainage channel are presented in the Soledad Mountain Hydrology Study by Rivertech Inc. (Appendix A). This work was performed to support the design of an engineered drainage channel and a culvert crossing for a permanent access to site. The engineered drainage channel has been eliminated as GQM has relocated certain Project facilities to avoid incursion into the 100-year floodplain and the culvert crossing has been replaced by a dip crossing that has been designed to avoid any changes to the hydraulic properties of the 100-year floodplain, as agreed to by the Kern County Engineering, Surveying and Permit Services Department.

In addition to the Hydrology Study that was prepared by Rivertech Inc. to address watersheds tributary to the drainage channel, Golder calculated the existing hydrology for all onsite watersheds including those that drain to the west and to the east. The existing hydrology was used as the pre-mining condition to be used as a comparison with the post-mining hydrology. The pre-mining, post-mining, and Phase 1, Stage 1 runoff rates were calculated using the Kern County Rational Method procedure and are presented in Section 4.0 with the calculation included in Appendix C.

2.3 Soil Types and Runoff Curve Numbers

Existing soil types for the site were taken from the Soil Survey for Kern County, California, Southeastern part based on National Resources Conservation Service (NRCS) web survey data (NRCS, 2006) and TR-55 tables (NRCS, 1986). Table 1 presents the hydrologic soil groups (HSG) for the Project site and surrounding areas and their respective Soil Conservation Service (SCS) curve numbers (CN). Ground cover is minimal with desert grasses and bushes.

Table 1 Project Soil Types and Runoff Curve Numbers

Location	Soil Type	Description for CN	CN
Steep Mountainous Areas	Torriorthents – rock outcrop complex, very steep	Desert Shrub, poor condition, HSG D	88
Flatter sloped areas near proposed pad	Arizo gravelly loamy sand	Desert Shrub, poor condition, HSG A	63
Areas between road and roadside channel	Garlock loamy sand	Desert Shrub, poor condition, HSG B	77
Area between road and western edge of Project	Rosamond clay loam	Desert Shrub, poor condition HSG C	85
Reclaimed Heap	Growth Media	Gravel HSG A	65
Waste Rock Overburden, Tops	Waste Rock	Porous Rock Material, HSG A	77
Waste Rock Overburden, Outslopes	Waste Rock	Porous Rock Material, HSG A	70

3.0 PROJECT DESCRIPTION

Open pit mining and heap leach facility operation as presently defined is approximately one year of construction, twelve years of mining (Phase 1 through Phase 8), thirteen years of leaching for the production of gold and silver (which overlaps with the twelve years of mining), and a further two years of rinsing and draindown. Crushed and agglomerated ore will be leached on two permanent, single-use heap leach pads, viz. the Phase 1 pad and the Phase 2 pad along the northern and western base slopes of Soledad Mountain. Waste rock will be disposed of in a number of waste rock management units.

Development of the Project will require construction of access roads, workshop-warehouse, crushing-screening plant, Merrill-Crowe plant and assay laboratory, the heap leach pads and associated solution management facilities, also referred to as the HLF. At the initial phase of development, designated as Phase 1/Stage 1, the buildout will include the Stage 1 portion of the Phase 1 pad, development of the site infrastructure noted above, and mining of the North-West pit and a temporary waste rock stockpile. Figure 2 presents the drainage basin delineation and the Stage 1 surface water, erosion, and control plan at the Phase 1/Stage 1 phase of development.

Figure 3 presents the post-mining configuration after the 8 phases of mining mentioned above. This configuration assumes that processing and sale of waste rock as aggregate has continued until the stockpile of quality waste rock has been exhausted and that leached and rinsed residues on the Phase 1 and Phase 2 heap leach pads have been reclaimed to within approximately 25 feet of existing ground surface in compliance with the reclamation requirements set in the CUPs. The access roads and sediment ponds as shown in Figure 3 would remain to provide surface water and erosion controls for the post-mining condition.

4.0 PRE-MINING, PHASE 1/STAGE 1 AND POST-MINING HYDROLOGY

The Site Drainage Plan was developed as a guide for management of site drainage, sediment, and erosion controls during operations and for the post-mining conditions. The pre-mining (existing) site conditions are based on existing ground topography provided by Triathlon, 2004 with a detailed ground survey of the natural drainage channel adjacent to Silver Queen Road provided by DeWalt Corporation in 2007. The Phase 1/Stage 1 and post-mining site conditions are based on the site facilities developed by Golder for the heap leach pads, the mine plan, waste rock management units, access roads developed by GQM and an Approved Project Boundary.

The contributing watersheds for the diversion ditches in the plant area and heap leach pad areas will be changing frequently over the life of the mine. This is due to the phased development of the two pads and open pits. The Site Drainage Plans have been developed based upon an analysis of a number of watersheds at the pre-mining, Phase 1/Stage 1, and post-mining periods. To account for the changing watershed configuration on site during operations, design criteria are provided to evaluate intermediate runoff control and diversion requirements on an ongoing basis as conditions change throughout the life of mine. The sediment ponds have been sized based on the larger of two possible pond sizes required for either the Phase 1/Stage 1 (Figure 2) or post-mining configuration (Figure 3). Therefore, interim facilities will be limited to select BMP and diversion ditch relocations as the Project develops from the Phase 1/Stage 1 configuration to the post-mining configuration.

The pre-mining site model was divided into seven (7) drainage basins as shown in Figure 1A. Peak runoffs resulting from the 20-year and 100-year storm events are shown for each of the drainage basins. The post-mining site configuration was divided into seven (7) drainage basins shown in Figure 3. The facilities layout developed by Golder and grading provided by GQM, were used to delineate the basins expected to contribute runoff to the west and north side of the Approved Project Boundary.

The post-mining basins were delineated assuming diversion channels are constructed around the Phase 1 and Phase 2 heap leach pads as planned with additional diversion required on the east side of the property from the active aggregate processing area. Runoff flows from areas along the eastern part of the site (i.e., backfilled open pits and the waste rock storage and aggregate processing area) will be routed via diversion channels to the east side of the site. Runoff from the aggregate processing area and reclaimed waste rock storage pad in Basin E2, an area of 223 acres, will be directed to a 17.0 acre-feet pond on the east side of the Project. Zero-discharge requirements for the site will be maintained during operations and the post-mining period.

Runoff CN values were assigned to each basin based on a soil survey of the site (NRCS, 2006) and TR-55 tables (NRCS, 1986). NOAA Atlas 14 Precipitation-Frequency estimates were used to determine the precipitation for the 100-year, one-hour point rainfall and the 20-year, one-hour point rainfall which were used to determine the Intensity-Duration Curves used in the Rational Method (see Appendix C). For each basin, the longest flow path was identified and the time of concentration (Tc) was calculated (Appendix C). The times of concentration, basin areas, and composite CN values were used with the Kern County Rational Method to determine the pre- and post-mining peak runoff.

4.1 Criteria for Rational Method Hydrology

The following criteria were selected for the Kern County Rational Method for the site:

- Precipitation for the storm events was obtained from NOAA Atlas 14 (NOAA, 2006).
- 100-year, one-hour point rainfall of 1.13 inches along with a slope of 0.55 on a log-log graph was used to determine Intensity-Duration Curve used in the Rational Method for 100-year peak runoff.
- 20-year, one-hour point rainfall of 0.74 inches along with a slope of 0.55 on a log-log graph was used to determine Intensity-Duration Curve used in the Rational Method for erosion control facilities.
- 10-year, 24-hour point rainfall of 2.28 inches was used for sediment pond volume calculations based on basin yield per Kern County procedure.
- Runoff CN values from Table 1.
- Sheet flow occurs for a maximum of 100 feet.
- The Tc calculations are separated by lengths of similar slope and assumed channel geometries.
- The assumed roughness coefficients for Tc calculations are detailed in Appendix C.

4.2 Peak Flow Estimates

Basins were delineated and runoff CN values assigned to the various vegetative covers as presented in Appendix C. Times of concentration were calculated using TR-55 methodology. Peak flows for all basins were estimated using the Kern County Rational Method using the basin areas, CN values, and times of concentration; the resulting values are shown on Table 2 and in Appendix C.

Table 2 Project Peak Flow Summary

Basin ID	Pre-Mining Basin Area (acres)	Composite CN	Pre-Mining Peak Runoff Q_{20} (cfs)	Pre-Mining Peak Runoff Q_{100} (cfs)	Post-Mining Basin Area (acres)	Composite CN	Post-Mining Peak Runoff Q_{20} (cfs)	Post-Mining Peak Runoff Q_{100} (cfs)
W1	241.7	79	266.9	481.6	228.2	72	150.6	307.8
NW1	48.9	77	75.2	131.9	52.0	72	72.6	131.2
NW2	206.1	76	217.5	401.6	143.8	80	127.9	237.0
N1	226.0	72	228.2	429.8	177.4	65	140.1	277.9
N2	64.1	81	72.3	128.3	138.2	78	163.1	292.2
E1	291.7	85	380.1	653.0	100.2	82	123.1	214.0
E2	325.3	80	372.3	666.8	222.6	82	306.9	524.9

5.0 SITE-WIDE STORM WATER CONTROLS

This section presents a discussion of the design of storm water runoff and erosion controls across the site. The various planned diversion and retention structures required to meet the design objectives are described in the following subsections. The storage volumes of the sediment ponds were based on the 10-year/24-hour storm event as determined using the Kern County Hydrology Manual methodology.

5.1 Runoff and Erosion Controls

The main storm water channels will be designed to safely pass the estimated 100-year peak flow with erosion control BMPs designed for the 20-year, one-hour intensity storm event per Surface Mining and Reclamation Act (SMARA) regulations. Peak flow for diversion channels (ditches) will be estimated using the 20-year, one-hour intensity storm event and the rational method per the Kern County Hydrology Manual; channel flow depths and velocities were evaluated with the Manning's equation. A 6-inch (150 mm) freeboard is provided for all channels as required by Kern County Development Standards. California Title 27 regulations require that storm water channels around the Class B and Class C mine waste facilities (i.e., the heap leach pad, overflow pond, and waste rock disposal areas) be designed for the 10-year, 24-hour peak flow and this will also be evaluated during final design of storm water channels. The general locations of the channels are shown in Figure 2 for the Phase 1/Stage 1 configuration and Figure 3 for the post-mining (reclaimed) conditions. Typical sediment pond details and a typical channel section are shown in Figure 2.

The natural drainage channel located between the Phase 1 heap leach pad and Silver Queen Road will remain unchanged to receive flows from the south and the west. Smaller and temporary drainage ditches and maintenance activities will be completed as part of ongoing mine operations. The conceptual channel designs included herein will be verified prior to and during operations as the contributing watersheds change. The designs will be completed in general accordance with the design criteria and typical details provided in this Site Drainage Plan.

Erosion control will primarily be provided by placing riprap in key areas. Large quantities of waste rock suitable for riprap will be available once mining begins. Sediment will be managed through BMP alternatives such as placing rock check dams in the collection channels at select locations. Through experience in development and implementation of BMPs, it is recommended that actual locations and details for BMP installations be determined at the time of construction rather than presented in detail in current design and construction drawings. Therefore, only typical details and approximate locations are presented in the figures.

5.2 Sediment Pond Design

Sediment ponds are based on the 10-year/24-hour design storm runoff volumes as shown on Figure 2 and Figure 3, for the Phase 1/Stage 1 and the post-mining conditions, respectively. Ponds are required in

Basins W1, NW2, L1, N2, and E1 for the Phase 1, Stage 1 condition. The post-mining scenario requires sediment ponds in Basins NW2, N2, E1, and E2. Basin NW1 in the Phase 1, Stage 1 scenario and post-mining scenario will have runoff diverted to Basin NW2 where it will be collected in the pond for Basin NW2. This pond will be sized to adequately contain runoff from both basins. The pond locations and estimated required capacities are summarized in Table 3.

Table 3 Sediment Pond Summary

Pond I.D.	Location	Required Volume (acre-feet)	Based on Layout
W1	Southwest corner of Phase 2 pad	15.7	Phase 1/Stage 1 HLF operations
NW2	West side of Silver Queen Road, adjacent to the northwest corner of Phase 2 pad (Contains runoff volume from Basin NW1 in Phase 1, Stage 1 scenario)	11.9	Phase 1/Stage 1 HLF operations and post-mining condition
L1	Northeast corner of Phase 1 pad	1.8	Phase 1/Stage 1 HLF operations
N2	Northeast corner of the site	12.4	Phase 1/Stage 1 HLF operations and post-mining condition
E1	East side of the site	9.5	Phase 1/Stage 1 HLF operations and post-mining condition
E2	Southeast side of the site	17.0	Post-mining condition

All runoff from disturbed areas will be diverted directly into the sediment ponds. As mining operations progress, temporary sediment ponds may be required. Requirements and locations for such ponds will be determined as part of the ongoing mine design and operation.

Final configuration of the sediment ponds will incorporate a combination of excavation and fill in order to meet the required capacity. An emergency spillway will be sized to pass the peak flow of the 100-year storm in the event of a major storm occurring while ponds are full or the outlet is clogged. The embankment design will have a configuration of 2H:1V upstream and downstream slopes with a 15-foot wide access road along the crest. The embankments will also be engineered and designed to current applicable standards and sized to be classified as non-jurisdictional dams under the California Department of Water Resources Dam Safety Division's statutes.

Runoff from non-contact, disturbed, and reclaimed areas will be dissipated through evaporation, through use in dust control, or through controlled release as allowed under the SWPPP and NPDES permits. Sediment will be removed as necessary to maintain the design storage capacity and disposed of in a waste rock management unit in a manner that does not cause a release or affect the stability of any slope. Storm water flow from large storms or successive storms that exceed the required design capacity will be routed through the sediment ponds via an emergency spillway protected with riprap. Four sediment ponds identified in Table 3 (W1, NW2, N2, and E1) will remain active through the life of the mine. Pond L1 is an intermediate pond, and will be removed during completion of Stage 2 of the Phase 1 heap leach pad. Sediment pond W1 will be decommissioned in conjunction with the post-mining reclamation and closure activities. Sediment ponds NW2, N2, E1, and E2 will be required after actual mining has ended.

5.3 Processing and Support Facilities

The layout and drainage associated with the workshop-warehouse, Merrill-Crowe plant, crushing-screening plan, and laboratory are shown in Figure 3, the Post-Mining Drainage Plan. Runoff from areas around facilities such as the workshop-warehouse, Merrill-Crowe plant, crushing-screening plant, and assay laboratory will be collected within each facility boundary and then routed via surface water channels to sediment ponds. Further, runoff from other areas up gradient of the Phase 1 heap leach pad will be collected in ditches and routed both east and west along the southern side of the overland conveyor route and thus around the perimeter of the pad.

Detailed designs for spill control and containment of potential release of contaminants from the production facilities are not included in the Site Drainage Plan. A site-specific Spill Prevention, Control and Countermeasures Plan (SPCC Plan) will be prepared prior to the start of operations. The SPCC Plan will contain details specific to each operating facility, for example the Merrill-Crowe plant. The following details will be incorporated in the final designs to meet relevant local and state code requirements:

1. The fuel storage tanks will be double-walled tanks and any spills will be contained in an approved receptacle.
2. Solvents, waste oil, contaminated fuel and other similar residues from the workshop will be collected in a waste oil tank located in the immediate vicinity of the workshop and will be recycled as required.
3. The residues from the equipment wash slab will be strained and stored in a concrete tank that is part of the wash slab. Residues that accumulate will be disposed of in an approved manner.
4. Precipitation falling in the area of the heavy equipment ready-line will be contained in the immediate area.
5. The laboratory has been designed as a self-contained and fully enclosed facility with no discharge.
6. Provision has been made in the design of the Merrill-Crowe plant for containment of spills. The liner under the plant will be seamlessly connected to the overflow pond liner for containment in case of a spill.
7. Sodium cyanide used in the heap leach process, will be delivered as a 30% aqueous solution with a pH of 12.5 in a tanker truck directly from the producer's plant in Nevada. The contained weight of sodium cyanide will be approximately 15,000 lb per load. The cyanide solution will be transferred to a 20,000-gallon storage tank on site. The producer will supply and install a complete handling and fully protected storage system and this will include telemetry for a managed inventory.

8. Domestic waste such as the waste from the offices and lunchrooms will be collected and removed by the local contractor charged with cleaning the offices, the first aid station and the toilet facilities both during construction and once the mine is in production.

5.4 Access Roads

The paved access road to the 3025-foot level, also known as New Eagle Road, will be used for immediate access during construction. New Eagle Road will be vacated once production starts and prior to construction of the Phase 1/Stage 2 heap leach pad.

A new access road has been designed as shown in Figure 2. The overland conveyor will follow the same alignment along the southern edge of the Phase 1 heap leach pad. Provision has been made for drainage ditches along the eastern side of the access road and the southern side of the overland conveyor route and thus route runoff around the perimeter of the Phase 1 heap leach pad.

GQM is required to construct a left-hand turning lane onto the new access road off Silver Queen Road. The detailed design of the intersection of the access road and Silver Queen Road has been completed by T.J. Cross Engineers, Inc., Bakersfield and submitted to the Kern County Road Department for approval. The new access road will use a dip crossing to cross the existing natural drainage channel approximately 1,000 feet east of where Gold Town Road intersects Silver Queen Road. This type of crossing was approved by the Kern County Engineering, Surveying and Permit Services Department in 2011. Since the sediment ponds will be constructed to capture all runoff from the site once construction begins, peak flow rate in the drainage channel will likely decrease during the first phase of mining.

5.5 Heap Leach Facility

The HLF consists of the Phase 1 heap leach pad, lined solution conveyance channel, pump box and overflow pond. The HLF has been designed as a zero-discharge facility and precipitation, which falls on components of the HLF will be fully contained within the limits of the lined facility. Excess solutions will be collected in the overflow pond and returned to the heap.

Golder has completed an evaluation of solution management within the limits of the HLF as part of a Revised Geotechnical Design that will be included in the updated Report of Waste Discharge that is currently being prepared and that will be submitted to the Regional Board in early 2012.

5.6 Waste Rock Management

The approach adopted for waste rock management allows for sequential backfilling of mined-out phases of the open pits. The following are basic considerations:

- Use waste rock to construct a level pad suitable for stockpiling quality waste rock to support the processing and sale of aggregate by a sub-contractor.

- Maximize backfill in mined-out phases of the open pit with a minimum of double handling of waste rock at the end of the mine life.
- Minimize re-sloping required for closure and reclamation by using appropriate techniques to build the waste rock management units.

Closing reclamation will be done as per the approved Surface Mining and Reclamation Plan, which is designed to return the site to a post-mining land use similar to the pre-mining land use, which includes future mining, wildlife habitat and open space.

Backfill in the mined-out phases of the open pit will typically consist of end-dumped and therefore loose, coarse waste rock. The crests of the backfilled waste rock will be reworked with a dozer to eliminate straight lines so they blend with the natural topography. The backfill will be recontoured to 2H:1V or approximately 27°. The contouring is designed to provide stable surfaces and to control and minimize erosion. Similar dozing patterns, such as those planned, have been used successfully at other heap leach operations in the California deserts. This approach, referred to as micro-contouring, creates micro-basins and results in features that trap moisture and seeds. Growth media will be spread as required in the lower parts of the micro-basins to create garden spots. The prepared areas will provide a suitable texture for desert plants and will be seeded with either a commercial seed mix or seed that has been collected and stored on site.

Revegetation will provide longer-term stability, reduce visual contrasts, and provide wildlife habitat.

The steep slopes in the open pits that are not covered by backfilled waste rock will not be reclaimed.

It is expected that processing and sale of aggregate will continue on site for 30 years or until the stockpile of quality waste rock has been exhausted. The East Waste Rock Storage and Aggregate Production Pad, located on the eastern flank of Soledad Mountain, will be constructed from waste rock to accommodate the aggregate production facilities.

5.7 East Waste Rock Storage and Aggregate Production Pad

Runoff from the East Waste Rock Storage and Aggregate Production Pad is currently projected to be diverted in surface water ditches and routed to the sediment pond located east of and below the pad.

6.0 CONDITIONAL USE PERMIT CONDITIONS

The following are conditions in the CUPs that specifically address site drainage and erosion control:

- **(13) 1997 FEIR/EIS MM #9**

  Site drainage will be inspected periodically to ensure that excessive erosion is not occurring. In the event excessive erosion is identified, the drainage plan will be revised in consultation with Kern County Planning Department.

- **(14) 1997 FEIR/EIS MM #10**

  Additional erosion prevention techniques include:

  - Site drainage will be retained on site
  - Site roads and drainages will be inspected by GQM personnel after rainfall events, which result in surface flow to ensure erosion prevention is maintained and upgraded as needed
  - Drainage from the tops of overburden piles will be directed away from the slopes towards the pit
  - Salvaged growth media will be stockpiled away from areas of concentrated drainage
  - Reclamation of disturbed areas will occur as soon as possible

- **(91) MM 4.1-1**

  Prior to commencement of mining operations or issuance of building or grading permits, the project proponent shall demonstrate the project's adherence with the Kern County Floodplain Management Ordinance and applicable Standards and Title 44 of the Code of Federal Regulations, Section 65.10 of the National Flood Insurance Program regulations. Compliance with this measure will necessitate that the project's design be recognized as providing protection from the base flood and the following maintenance criteria:

  - Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to Federal Emergency Management Agency by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner.
  - All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the National Flood Insurance Program that must assume ultimate responsibility for maintenance.
  - The maintenance plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained.
  - At a minimum, the maintenance plan shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.
  - Should the project proponent be unable to obtain the requisite public maintenance entity or maintenance plan approval from the Federal Emergency Management Agency, the approved surface mining and reclamation plan shall be amended to eliminate the project's encroachment into the 100-year floodplain in accordance with the applicable provisions of the Surface Mining and Reclamation Act of 1975.

7.0 FLOOD HAZARD EVALUATION

Hydrologic calculations were prepared in accordance with the Kern County Hydrology Manual. Due to the relatively small sizes of the individual onsite basins, the Rational Method as set forth in the Kern County Hydrology Manual was utilized for the peak discharge and runoff volume calculations. For the existing natural drainage channel, which collects runoff from the much larger combined offsite and onsite basins and meanders through the floodplain, the unit hydrograph method prescribed in the Kern County Hydrology Manual was applied. Hydrologic calculations for the contributing onsite and offsite basins are presented in the *Soledad Mountain Hydrology Study* prepared by Rivertech, Inc. (Appendix A) and this has not changed since submittal of the previous Site Drainage Plan.

7.1 Off-Site Contribution to Drainage

Storm water discharge from a large offsite drainage area located to north and west of Silver Queen Road is primarily conveyed through two sets of two culverts under Silver Queen Road that are located approximately 3,000 feet west of Gold Town Road and just beside Gold Town Road, respectively. Storm water also flows across Silver Queen Road to the west where Silver Queen Road turns into Mojave Tropico Road. The offsite area is comprised of approximately 1,636 acres (2.56 square miles) of mostly undeveloped land and is the larger of two contributing areas to flows in the existing natural drainage channel. In existing conditions, the 1,636-acre offsite area is estimated to contribute approximately 808 cubic feet per second (cfs) to the two sets of culverts referred to above. The estimated contribution to the drainage channel from the 510-acre basin area in which the Project is located is estimated to be approximately 826 cfs for a combined discharge of 1,226 cfs after routing and summing the offsite and onsite hydrographs. Assuming a fully developed offsite basin, defined by the Kern County General Plan and Zoning Map, it is estimated that the offsite area will contribute approximately 953 cfs and the onsite area will contribute 826 cfs assuming the onsite basins are returned to at least the existing curve numbers upon closure. The routed and summed hydrographs result with a combined discharge of approximately 1,362 cfs. The offsite hydrology is presented in the *Soledad Mountain Hydrology Study* prepared by Rivertech Inc. (Appendix A).

7.2 Existing 100-Year Floodplain

The floodplain is described here only to ensure that its existence is recognized.

None of the Project facilities encroach into the 100-year floodplain as currently mapped on FEMA FIRM Panel 06029C3675E (revised September 26, 2008) and as presented in Appendix B. It should be noted that the floodplain extends a distance of approximately 2,200 feet to the west of Gold Town Road. The Zone A, special flood hazard area designation applies to areas that may be affected by the 100-year flood but at locations mapped by FEMA where the base flood elevations and flood hazard factors have not yet been determined by a detailed hydraulic analysis.

8.0 IMPACTS TO THE 100-YEAR FLOODPLAIN FROM DEVELOPMENT

8.1 Existing Natural Drainage Channel

The existing 100-year, 3-hour peak storm discharge is estimated to be about 1,265 cfs, from both the offsite and onsite areas that are approximately 1,636 acres and 510 acres in size. As required by Kern County Development Standards, other unit hydrograph durations, including 1-hour and 6-hours were used to generate hydrographs for comparison. It was confirmed that the highest peak discharge of the various durations is generated by the 3-hour hydrograph.

No construction is now planned within the existing natural drainage channel. It is expected that the existing natural drainage channel will see reduced peak flow rates and reduced average flows during the operating timeframe of the mine due to construction of the HLF and other facilities on site south of the drainage channel.

8.2 New Mine Access Road Dip-Crossing

The new mine access road will cross the existing natural drainage channel and the Zone A 100-year floodplain approximately 1,000 feet east of where Gold Town Road intersects Silver Queen Road, as shown in Figure 2. A dip-crossing has been designed to minimize impacts on the 100-year floodplain and the previous design, which included a series of culverts, has been replaced. The dip-crossing was approved by the Kern County Engineering, Surveying and Permit Services Department in 2011. The design of the dip-crossing was done by Fielden Engineering Group, Lancaster and has been submitted to the Kern County Roads Department for approval.

9.0 POST-MINING "WHAT-IF" SCENARIO

As revised on October 28, 2010 (Planning Commission Resolution No. 171-10), Condition 107 of the Surface Mining and Reclamation Plan (the "Approved Plan") for the Project requires that, prior to commencement of mining activities, GQM must submit certain information for incorporation into the Approved Plan. One requirement was to provide revised maps and cross sections that represent a mining scenario in which no material is transported off site with reclamation completed in accordance with California Code of Regulations Title 14, Section 3704.1. GQM has prepared such a plan which has been provided to the Kern County Planning Department to address this scenario and that has been referred to as the "What-If" Scenario.

In support of the "What-If" Scenario, Golder prepared a hydrologic analysis and calculation package to provide verification that the surface water drainage plans and erosion control will comply with Title 14, Article 9, Section 3706. The supporting hydrologic calculations are presented in Appendix D. Figure 4 presents an overview of the Post-Mining Drainage Plan showing the subbasin delineations and peak flows for the 20-year, 1-hour intensity storm event. Should the "What-If" scenario be realized, GQM would complete and provide detailed designs for the surface water diversions and erosion control features required as part of a final reclamation plan using these peak flows as the basis for that design.

10.0 USE OF THIS REPORT

This Site Drainage Plan has been prepared exclusively for the use of GQM for the specific application to the Project. The engineering analyses reported herein were performed in accordance with accepted engineering practices.

Golder appreciates the opportunity to support GQM on the Project. Please contact the undersigned for additional information or clarification regarding the contents of this report.

Respectfully submitted,

GOLDER ASSOCIATES INC.

Tamim Atayee, P.E.
Senior Hydrologist

Richard E. Kiel, P.E.
Associate

Brent R. Bronson, P.E.
Principal

TA/REK/BRB/rjg

11.0 REFERENCES

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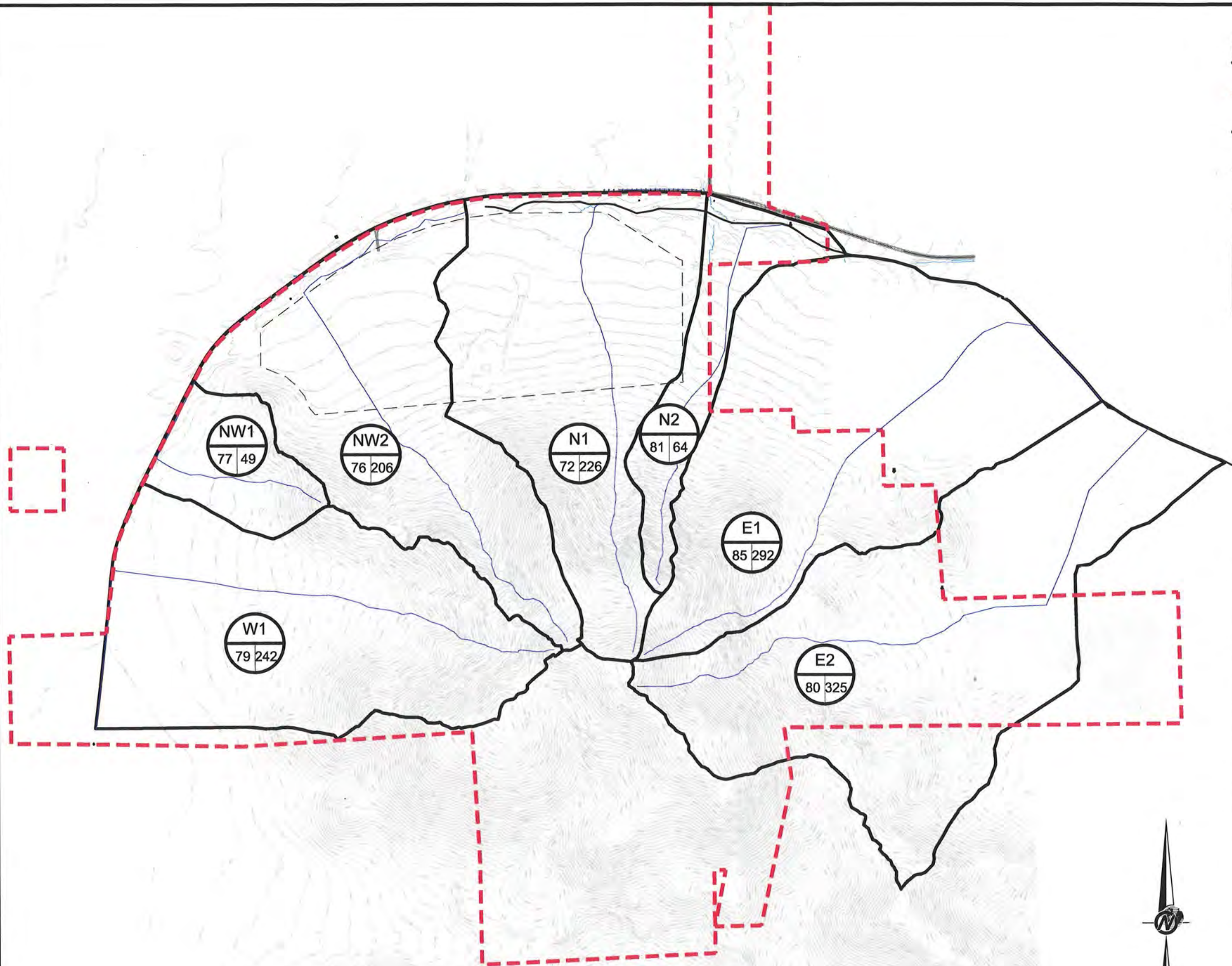
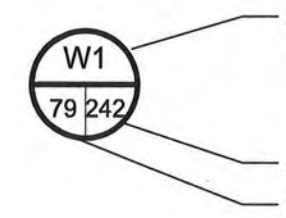
FIGURES



LEGEND

- PROPERTY BOUNDARY
- BASIN BOUNDARY
- HEAP LEACH PAD LIMIT BOUNDARY
- HYDROLOGIC FLOW PATH FOR Tc
- EXISTING CONTOURS



RATIONAL PEAK FLOWS BY SUBBASIN

SUBBASIN DESIGNATION	AREA (ac)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOW (cfs)
W1	241.7	266.9	481.6
NW1	48.9	75.2	131.9
NW2	206.1	217.5	401.6
N1	226.0	228.2	429.8
N2	64.1	72.3	128.3
E1	291.7	380.1	653.0
E2	325.3	372.3	666.8

EXISTING ONSITE PRE-MINING DRAINAGE BASINS

FIGURE 1A

Golder Associates
DENVER, COLORADO

PROJECT No. 043-2299D CADD AKW DATE 05/13/09 FILE No. 0432299CF001.dwg

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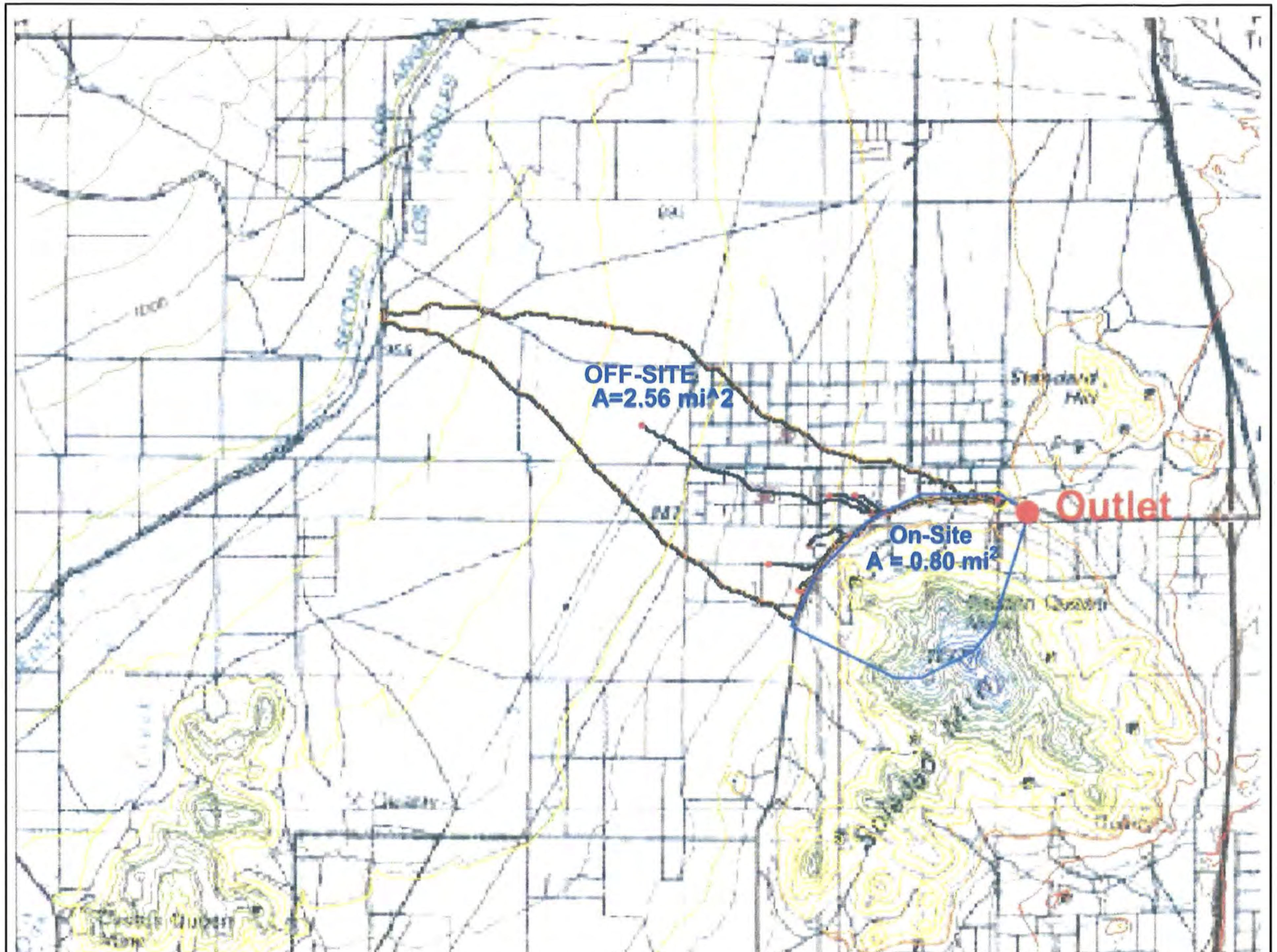

NOTES

1. FIGURE FROM "SOLEDAD MOUNTAIN, HYDROLOGY STUDY" RIVERTECH INC. FEBRUARY, 2008.

OFFSITE AND ONSITE DRAINAGE BASINS

FIGURE 1B

Golder Associates
DENVER, COLORADO

PROJECT No. 043-2299D CADD AKW DATE 05/13/09 FILE No. 0432299CF002.dwg

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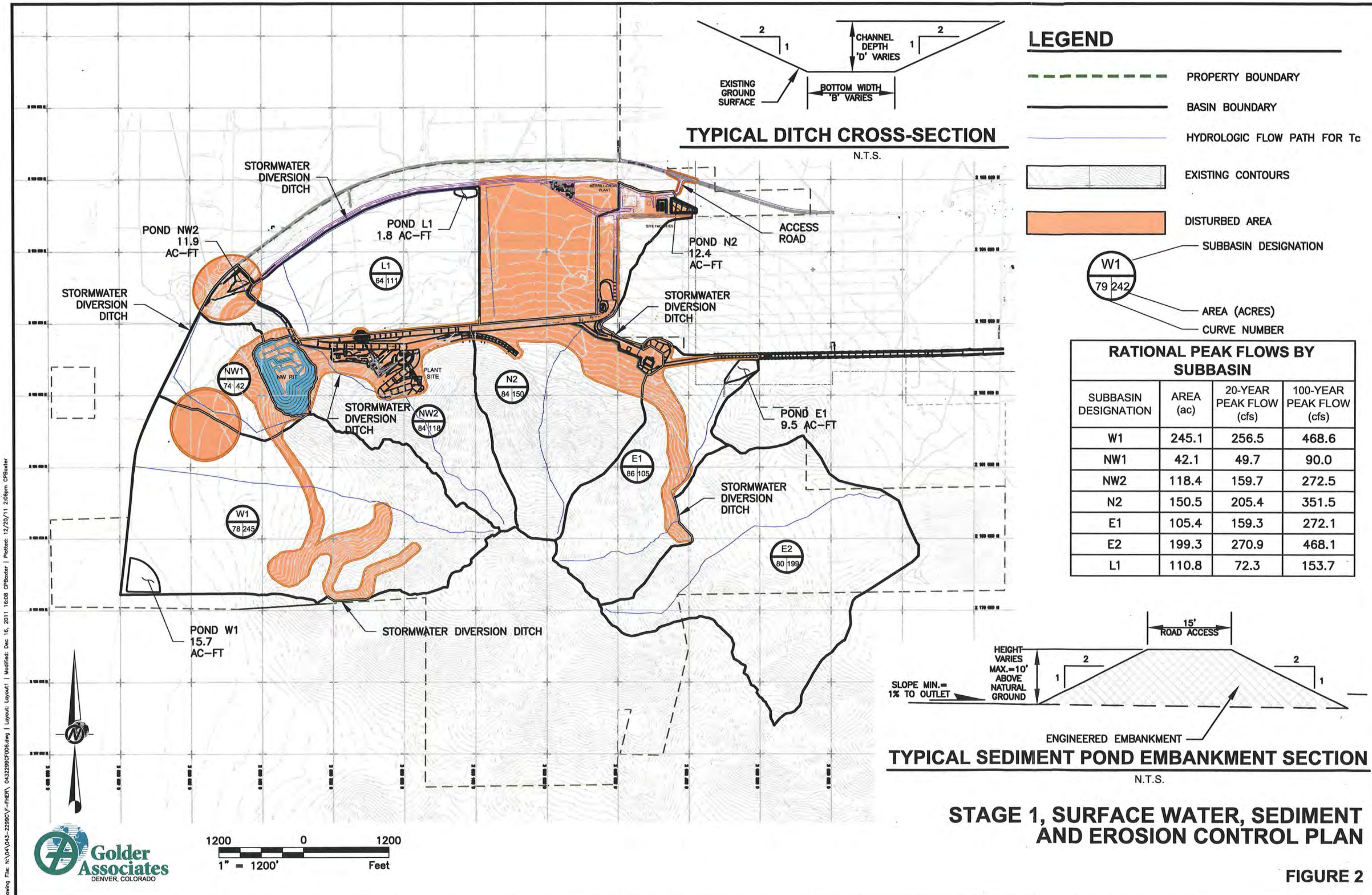
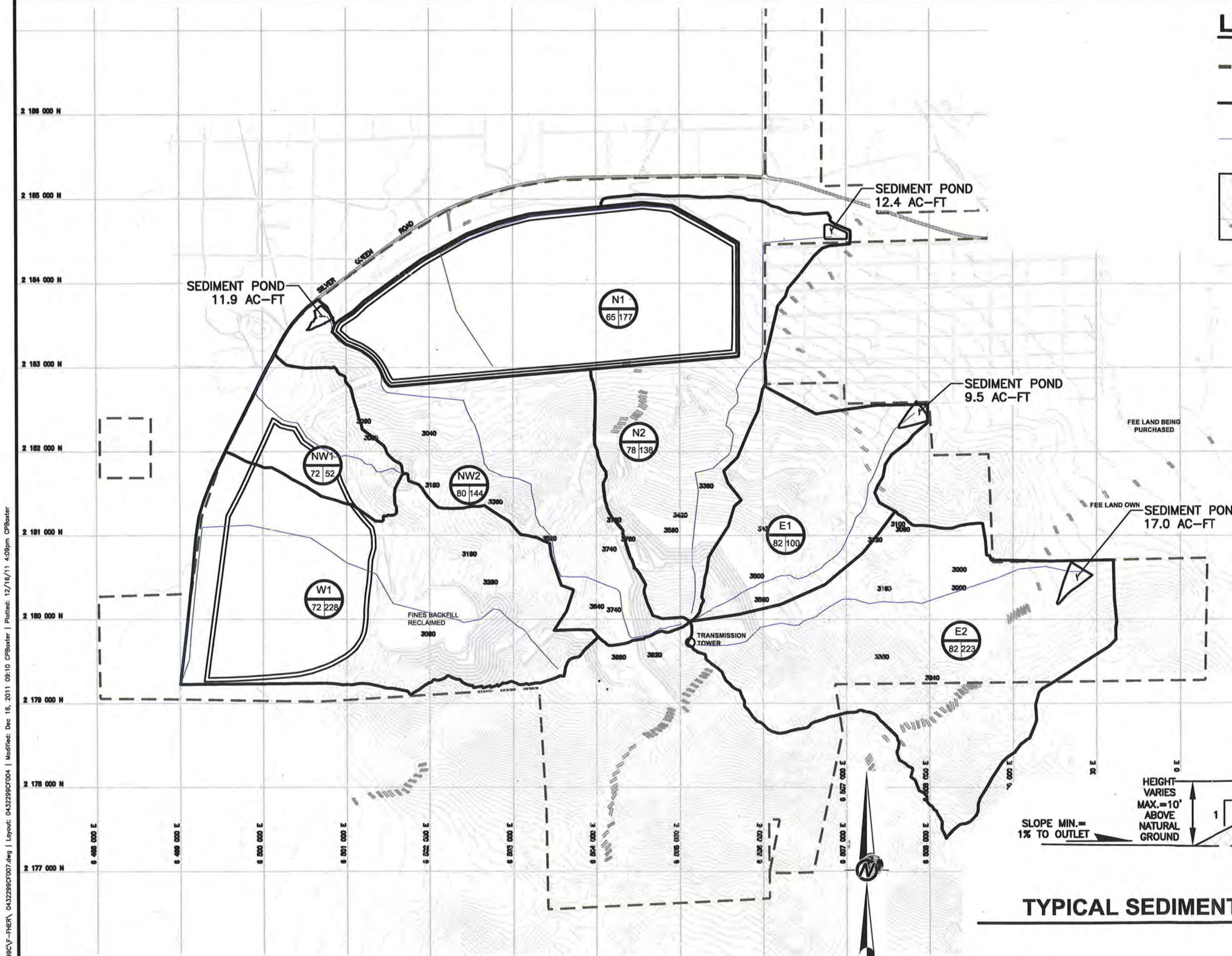


RATIONAL PEAK FLOWS BY SUBBASIN

SUBBASIN DESIGNATION	AREA (ac)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOW (cfs)
W1	245.1	256.5	468.6
NW1	42.1	49.7	90.0
NW2	118.4	159.7	272.5
N2	150.5	205.4	351.5
E1	105.4	159.3	272.1
E2	199.3	270.9	468.1
L1	110.8	72.3	153.7

STAGE 1, SURFACE WATER, SEDIMENT AND EROSION CONTROL PLAN

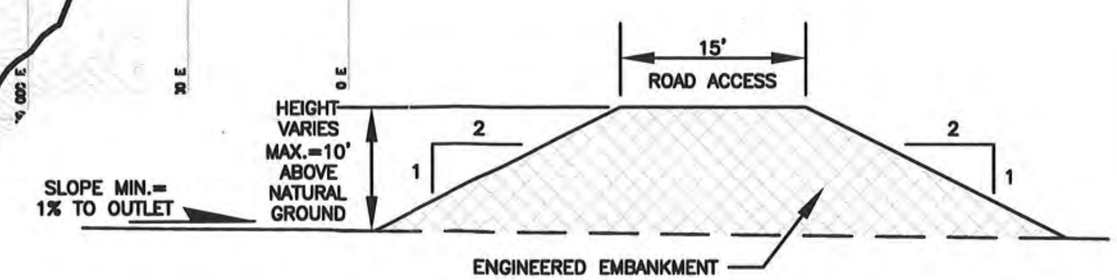
FIGURE 2



LEGEND

- PROPERTY BOUNDARY
- BASIN BOUNDARY
- HYDROLOGIC FLOW PATH FOR Tc
- POST MINING CONTOURS (PROVIDED BY GQM)
- W1 — SUBBASIN DESIGNATION; 79 — AREA (ACRES); 242 — CURVE NUMBER

RATIONAL PEAK FLOWS BY SUBBASIN			
SUBBASIN DESIGNATION	AREA (ac)	20-YEAR PEAK FLOW (cfs)	100-YEAR PEAK FLOW (cfs)
W1	228.2	150.6	307.8
NW1	52.0	72.6	131.2
NW2	143.8	127.9	237.0
N1	177.4	140.1	277.9
N2	138.2	163.1	292.2
E1	100.2	123.1	214.0
E2	222.6	306.9	524.9



TYPICAL SEDIMENT POND EMBANKMENT SECTION

N.T.S.

POST-MINING DRAINAGE PLAN

FIGURE 3

Golder Associates
DENVER, COLORADO

PROJECT No. 043-2299D CADD AKW DATE 05/13/09 FILE No. 0432299CF007.dwg

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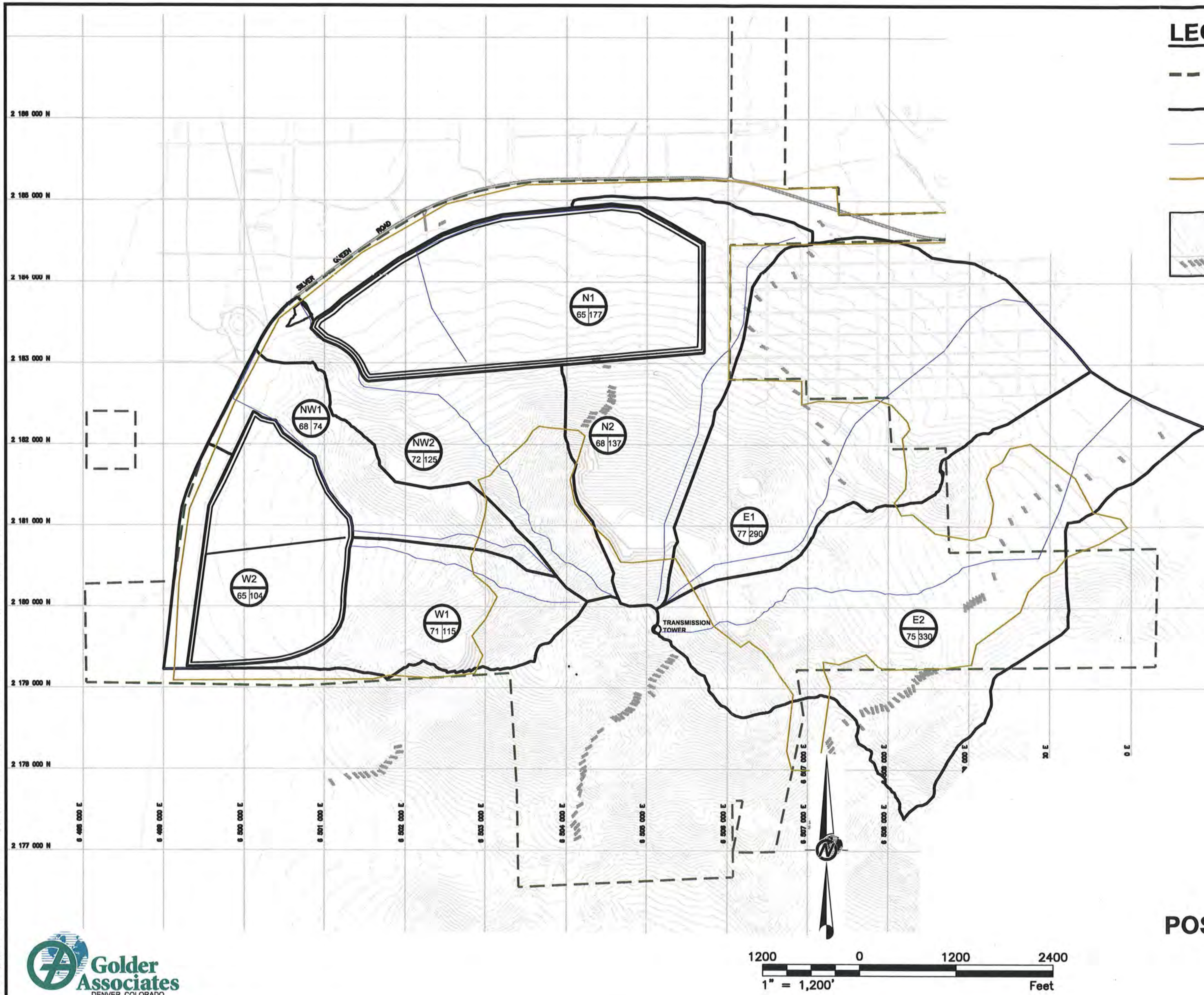

LEGEND

- PROPERTY BOUNDARY
- BASIN BOUNDARY
- HYDROLOGIC FLOW PATH FOR Tc
- RECLAIMED AREA
- POST MINING "WHAT IF" CONTOURS (PROVIDED BY NORWEST)

W1 — SUBBASIN DESIGNATION; 79 — AREA (ACRES); 242 — CURVE NUMBER

RATIONAL PEAK FLOWS BY SUBBASIN

SUBBASIN DESIGNATION	AREA (ac)	20-YEAR PEAK FLOW (cfs)
W1	115.2	158.8
W2	104.2	71.0
NW1	74.2	84.6
NW2	125.0	123.0
N1	177.4	102.4
N2	136.8	133.9
E1	290.2	306.2
E2	330.0	298.2

POST-MINING DRAINAGE PLAN FOR "WHAT IF" SCENARIO

FIGURE 4

Golder Associates
DENVER, COLORADO

PROJECT No. 043-2299D CADD AKW DATE 05/13/09 FILE No. 0432299CF008.dwg

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APPENDIX A
SOLEDAD MOUNTAIN HYDROLOGY STUDY, RIVERTECH INC., APRIL 2009

SOLEDAD MOUNTAIN
HYDROLOGY STUDY

Near Mojave,
KERN COUNTY, CALIFORNIA
FINAL

Owner: **GOLDEN QUEEN MINING CO., INC.**
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Prepared by:
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September 2009

RIVERTECH INC

Introduction

Golden Queen Mining Co., Ltd. (GQM) is planning the development of a gold/silver mine referred to as the Soledad Mountain Project (Project) in Kern County, California. The project site is located approximately 5 miles south-southwest of the City of Mojave, California and 2 miles west of State Highway 14, as shown in Figure 1. The on-site and off-site drainage areas of the project site is approximately 510 acres (0.80 mi^2) and 1,636 acres (2.56 mi^2), respectively.

Figure 1. Vicinity Map of Project Site[i].

The objective of this study is to perform the hydrologic analysis to meet the criteria of the Kern County Department of Public Works.[ii] The design storm modeled in this study is the 100-year event. Much of the on-site data was obtained from the Golder Site Drainage Plan.[iii]

Watershed Characteristics

The total watershed drainage area that drains at the site outlet is 3.35 mi^2. The hydrology map that illustrates the drainage divides is provided as an attached exhibit. Table 1 summarizes the watershed delineation into smaller sub-areas. The ultimate scenario CN is an assumed value in the absence of a master drainage plan or other local agency guidance.

The off-site watershed is a partially-developed, predominantly natural condition desert valley. Some of the watershed characteristics are shown in Table 1. The terrain is a flat valley. These parameters were applied in the hydrology model.

Two sources were considered for characterizing ultimate condition: the Kern County General Plan and Zoning Map[iv]. A comparison of land uses revealed that both were consistent for the project watershed. Using these sources, the weighted curve number is 70 for the off-site area. The detailed watershed is exhibited in Appendix A.

Table 1. Watershed Parameters

Basin	Drainage Area (ac)	Length (ft)	Slope (ft/ft)	Lag Time t_{Lag} (hr)	SCS Soil Type[v]	Isohyet 100-yr[ii] (in)	SCS Curve No., CN	
							Existing	Ultimate
Off-Site	1,636	24,914	0.0155	1.02	B	3.75	66	70
On-Site	510	5,500	0.01-0.21	0.22	A,B,C,D	3.75	80	80

The intensity-duration-frequency (IDF) curve and effective rainfall hyetograph are plotted in Figures 2 and 3, respectively. The soils map and properties is exhibited in Appendix B. The precipitation frequency data is exhibited in Appendix C.

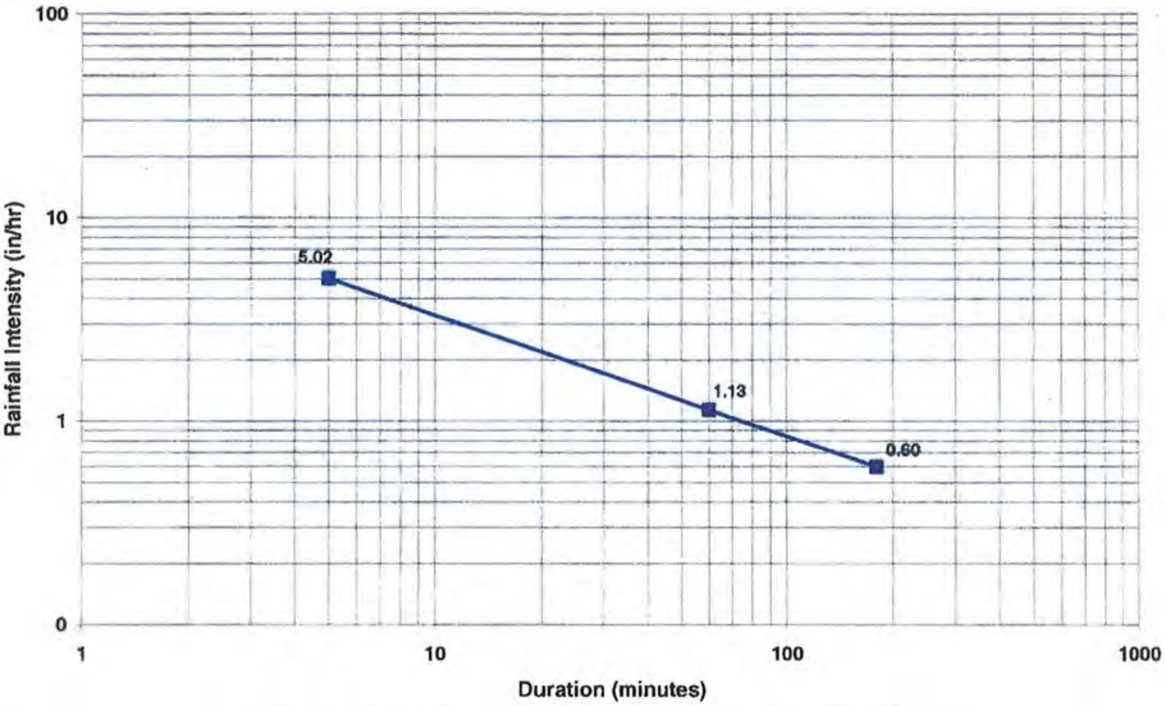

Figure 2. 100-year, Intensity-duration-frequency curve[vi]

RIVERTECH INC

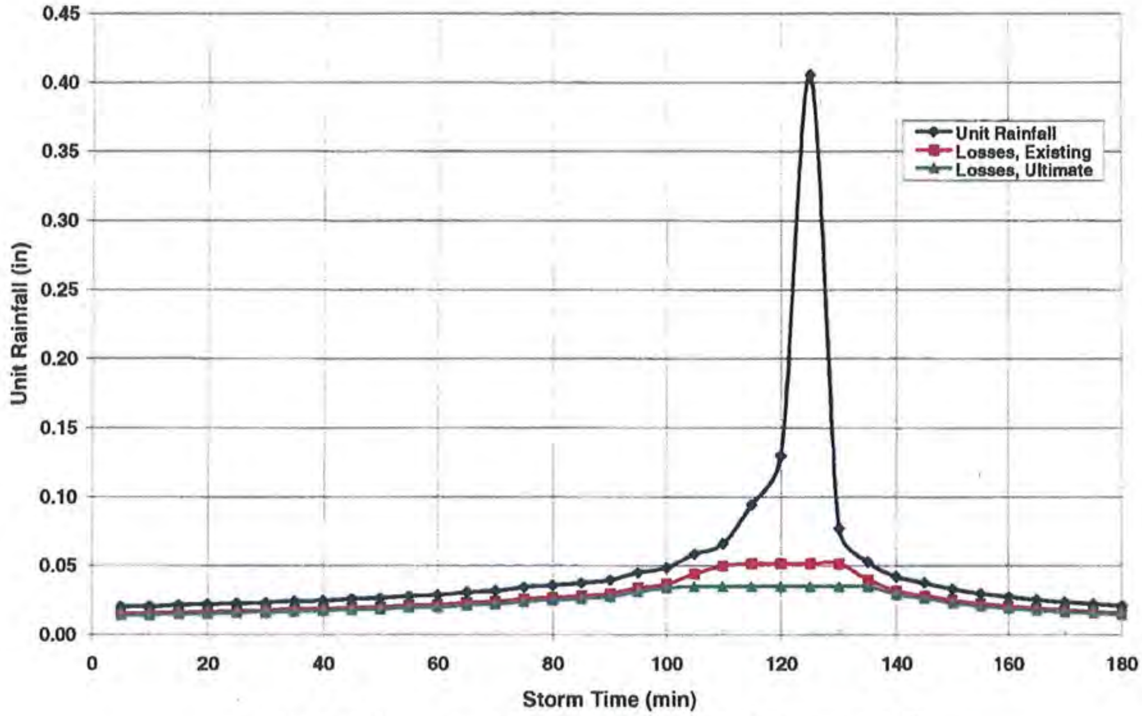

Figure 3. 100-year, 3-hour effective rainfall hyetograph.[vii]

Losses

Losses were estimated using the loss rate model prescribed in the Kern County Hydrology Manual. Table 2 summarizes the loss rate model parameters for the project watershed.

Table 2. Loss Rate Model Parameters.

Land Use	F_p (in/hr)	a_p	F_m (in/hr)	CN	S	Y	$\overline{Y}$
Existing	0.62	1.0	0.62	66	5.15	0.244	0.756
Ultimate (On-Site)	0.38	0.90	0.34	80	2.50	0.483	0.517
Ultimate (Off-Site)	0.55	0.75	0.41	70	4.29	0.304	0.696

Where: F_p = pervious area infiltration rate; a_p = pervious fraction; F_m = maximum loss rate; S = maximum potential retention; Y = 24-hour yield; $\overline{Y}$ = low loss fraction

More detailed data is exhibited in the Appendix D.

Lag Time

Using the provided site data and using the Kern County hydrology methodology, lag times, T_{lag}, of 1.0 and 0.5 hours were calculated for the off-site and on-site drainage basins, respectively:

$$T_{Lag} = 24\bar{n}\left(\frac{LL_{ca}}{S^{0.5}}\right)^{0.38}$$

where: L = drainage length (mi); L_{ca} = drainage length from basin centroid (mi); n = visually estimated basin factor of all collections streams and watershed channels; and S = basin slope (ft/mi).

Hydrology Model

Figure 4 is the hydrology map that illustrates the hydrologic model, whose digital terrain model (DTM), was generated using the *Watershed Modeling System* (WMS).[viii] Using the *WMS GIS* interface, we downloaded the USGS digital elevation model (DEM)[ix] shown in Figure 4, and determined the watershed delineation. Figure 4 also has the USGS quadrangle scanned image layer.[x] The on-site watershed was delineated in a prior study. The watershed characteristics, drainage area, maximum drainage length, centroid drainage length and basin slope were obtained from the *WMS* DTM.

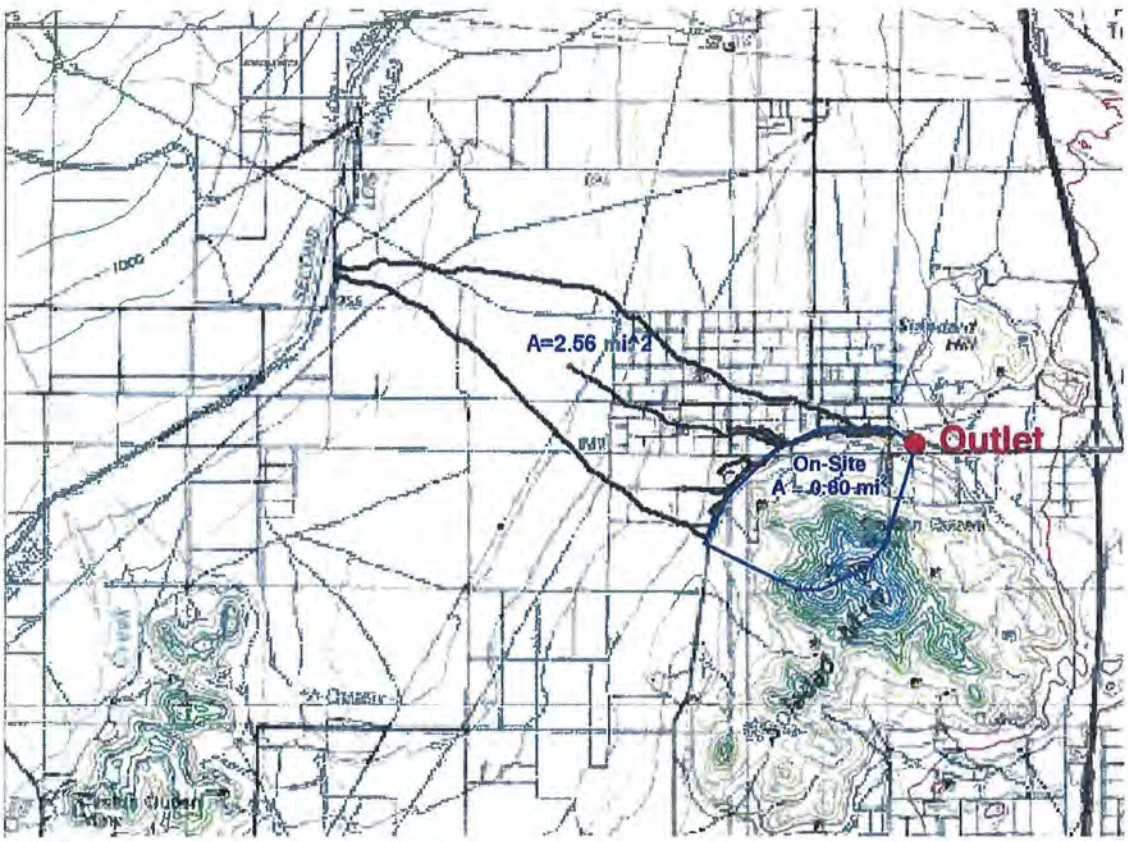

Figure 4. Hydrology Map

The Desert S-graph would be most hydrologically appropriate for the existing condition of the watershed. However, the Valley-Developed S-graph was used to represent the ultimate developed condition as the most representative and conservative approach for fully developed discharge to the channel for floodplain mapping purposes. The following relationship for a developed valley was applied to generate the runoff hydrograph for both existing and ultimate conditions, for consistency:

$$K = \frac{645A}{D}$$

where: K = ultimate unit hydrograph discharge (ft^3/s); A = drainage area (mi^2); D = duration (sec).

Routing

Using the convex channel routing method, as prescribed by the Kern County Hydrology Manual, the hydrograph for the western on-site sub-basins was routed through the channel along the north boundary of the site to the proposed access road culvert crossing. The following relationships from the manual apply:

$$O_{T+dT} = (1-C)O_T + CI_T$$

$$C = \frac{V}{V+1.7}$$

$$C* = 1-(1-C)^E$$

$$E = \frac{dT*+0.5dT}{1.5dT}$$

Where:

I_T =	hydrograph inflow at time, T (ft^3/s)
O_T =	channel outflow at time, T (ft^3/s)
O_{T+dT} =	channel outflow at time, T + dT (ft^3/s)
C =	a routing coefficient (ranges from 0 to 1.0)
V =	mean velocity (ft/s)
C =	modified routing coefficient
dT* =	time step (hr)

The average velocity was estimated based on a normal-depth approximation of flow conveyed by the proposed trapezoidal channel.

The off-site basin and easterly on-site sub-basin hydrographs were not routed but added to the routed western on-site sub-basin hydrograph to produce the total hydrograph. To clarify, the off-site runoff is sheet and shallow concentrated flows that do not exhibit well-defined flow paths, so performing channel routing is not appropriate. The easterly on-site sub-basin drains directly to the outlet point.

Results

The peak discharge and time to peak of the 3-hour 100-year existing condition off-site runoff hydrograph is 808 ft^3/s and 3.08 hours, respectively. Table 3 summarizes the results for the on-site and off-site hydrographic analysis. Figure 5 is a plot of the hydrograph at the site outlet. The detailed results are exhibited in the Appendix D.

Table 3. Results of Hydrographic Analysis

Hydrograph	Drainage Area		Existing Condition		Ultimate Condition	
	(ac)	(mi^2)	Peak Flow (cfs)	Time to Peak, t_p (hr)	Peak Flow (cfs)	Time to Peak, t_p (hr)
Off-Site	1,636.4	2.56	808	3.08	953	3.08
On-Site*	432	0.68	734	2.33	734	2.33
Routed On-Site at Outlet⁺	510	0.80	826	2.42	826	2.42
Combined (Total) at Site Outlet	2,146.4	3.35	1,265	2.42	1,362	2.42

* Unrouted western on-site sub-basins;

⁺ Total on-site basin, which is eastern on-site sub-basin added to routed western on-site sub-basins

The hydrologic model routes the on-site runoff through the flood channel to the outlet at the eastern property limit at the access road. At this outlet, the off-site runoff concentrates after sheet flowing over an extended length of Silver Queen Road and eventually to the culverts at the access road. It is at this point in the hydrologic model that the routed on-site and off-site hydrographs are added. The flow increase of 97 ft^3/s (at outlet) – from existing to ultimate scenarios – is due to the urbanized runoff from the off-site basin.

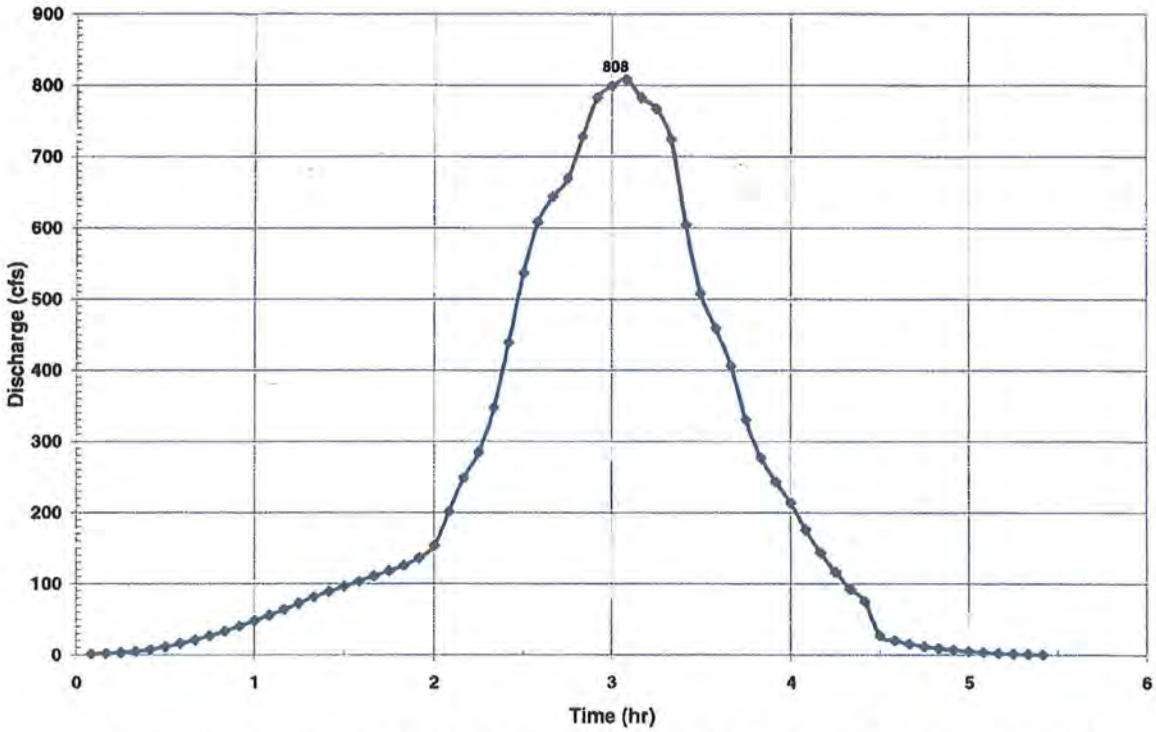

Figure 5. 100-Year 3-Hour Off-Site Existing Condition Hydrograph at Watershed Outlet

We also developed the 1-hour 100-year existing condition off-site runoff hydrograph to verify the storm event that generates the highest peak discharge. As illustrated in Figure 6, the peak discharge and time to peak of the off-site hydrograph is 704 ft^3/s and 1.75 hours, respectively. Therefore, the 3-hour hydrograph, which has a higher peak flow, is used as the design discharge.

Figure 7 illustrates the off-site and combined routed hydrograph at the outlet for the existing condition. It can be seen that the combined hydrograph has a peak discharge and time to peak of 1,265 ft^3/s and 2.42 hours, respectively.

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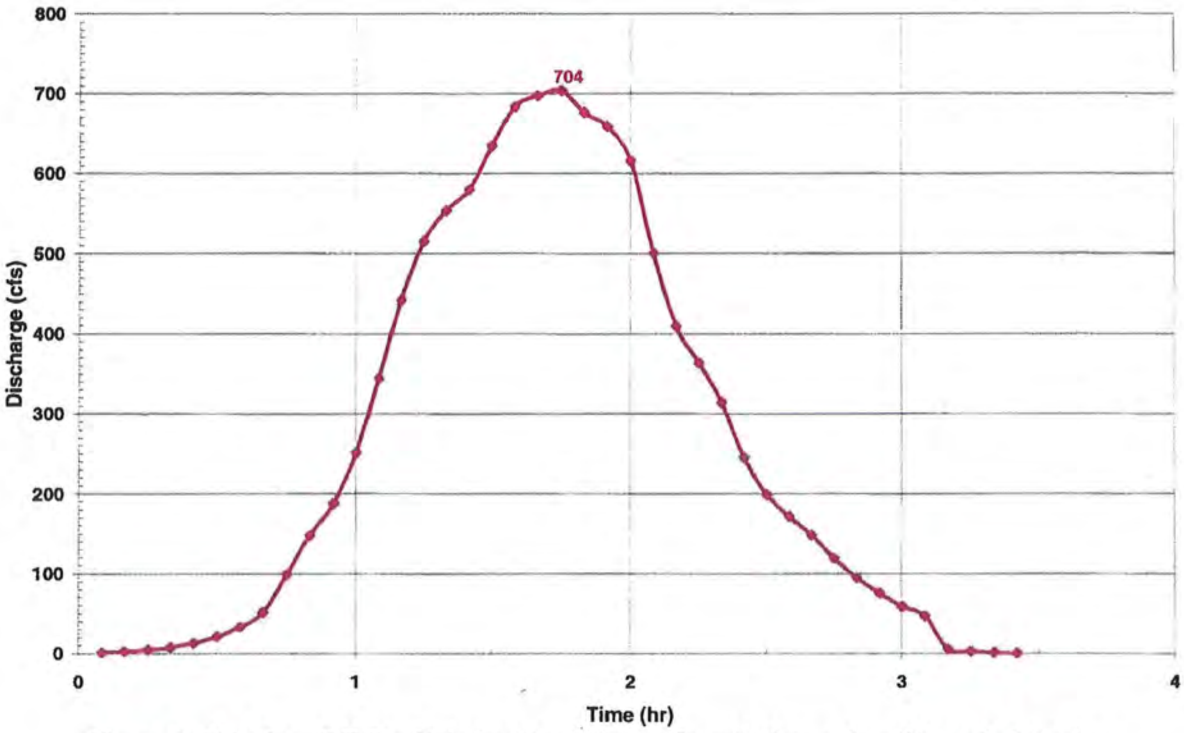

Figure 6. 100-Year Off-Site Existing Condition 1-Hour Hydrograph at Watershed Outlet

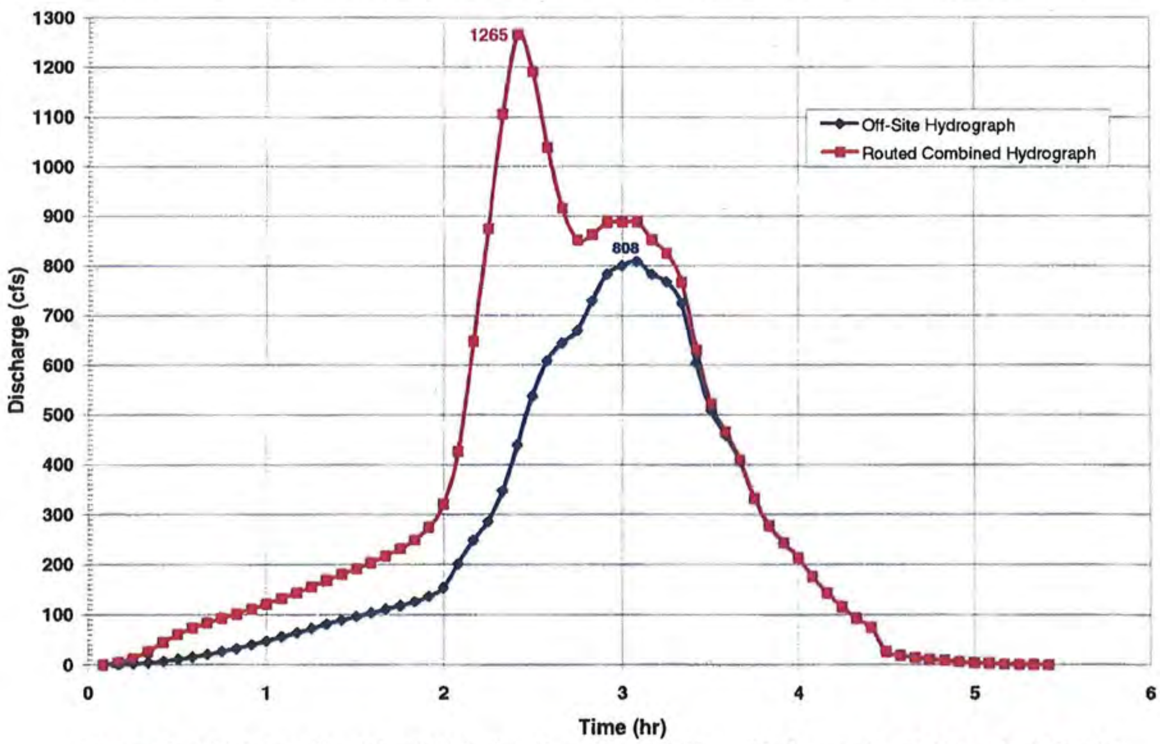

Figure 7. 100-Year Combined Existing Condition 3-Hour Hydrograph at Watershed Outlet

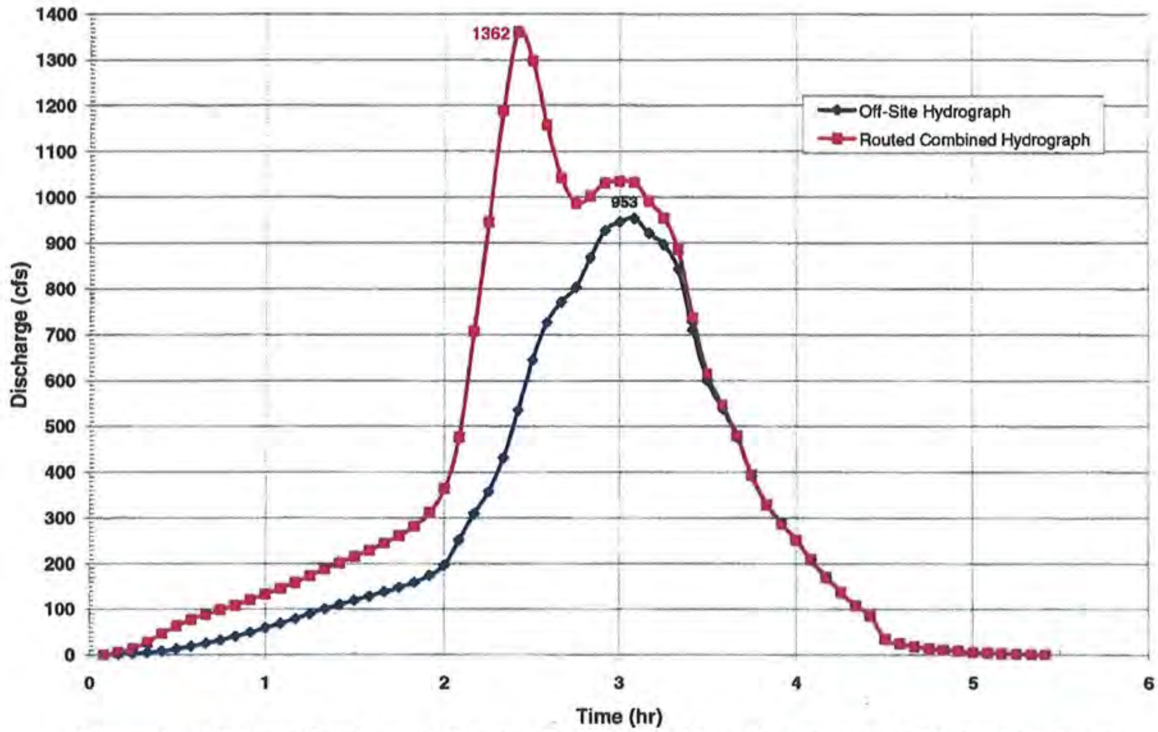

Figure 8. 100-Year Combined Ultimate Condition 3-Hour Hydrograph at Watershed Outlet

Figures 7 and 8 are the combined and routed on-site hydrographs for existing and ultimate conditions, respectively. The hydrologic models, including the loss models, effective rainfall hyetographs and hydrograph generation, are provided in detail in Appendix D.

A 10-year hydrographic analysis was performed for the purposes of sizing the culverts at the proposed access road located between stations 12+10 and 13+20. The existing and ultimate peak discharges are 502 and 550 ft^3/s, respectively. The detailed analysis is exhibited in Appendix D.

Alternative Hydrologic Models

The risk and reliability of the recommended design discharge is an important issue to examine. In order to assess the reliability of the hydrographic analysis that we performed, we compared our recommended peak discharge using the Kern County hydrographic method to two other nationwide hydrologic methods.

SCS (NRCS) Peak Flow Method

Using the National Resource Conservation Service (NRCS) formerly the soil Conservation Service (SCS) graphical peak flow method (a.k.a., CN method), applying the same aforementioned watershed and meteorological data, yields a peak flow of 345 and 496 ft^3/s for existing and ultimate scenarios, respectively. This methodology yields peak discharges that are much less conservative than the recommended hydrographic method discussed earlier.

USGS Regression

Using the National Flood Frequency (NFF) computer program implementation of the US Geological Service (USGS) rural regression equations for this area – classified as *South Lahontan-Colorado Desert* – we determined the 100-year peak discharges (standard error of

99%) for the original USGS rural, revised USGS rural and FEMA regression equations, respectively.

$$Q_{100} = 1080A^{0.71} = 2{,}548\,ft^3/s$$

$$Q_{100} = 850A^{0.69} = 1{,}957\,ft^3/s$$

$$Q_{100} = 661A^{0.62} = 1{,}398\,ft^3/s$$

Therefore, using the revised USGS regression equation, the upper and lower limits of the standard error (±1.0 SE) are 20 and 3,894 ft^3/s.

Conclusions and Recommendations

The Kern County hydrographic results clearly fall within the wide range of the standard error estimated by the regression analysis.

The 100-year existing discharge, 1,265 ft^3/s, will be used in the *Conditional Letter of Map Revision* (CLOMR) application, which will include the hydrologic analysis documented in this report. The CLOMR will be to the Federal Emergency Management Agency (FEMA) in compliance with the National Flood Insurance Program (NFIP) requirements. The flood hazard data – including all the relevant Flood Insurance Rate Maps (FIRMs), site data, hydrologic and hydraulic analyses, and floodplain maps – will be included in the CLOMR submittal. As a requirement of the CLOMR submittal, Kern County's Floodplain Administrator (Community Official) will need to issue a signed concurrence.

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i *Google Earth®*, 2007.

ii *Hydrology Manual*, Kern County, Department of Planning and Development Services. 1992.

iii *Site Drainage Plan, Revision 1, Golden Queen Mining Co., Inc., Soledad Mountain Project*, Prepared by Golder Associates Inc. for Golden Queen Mining Co., Inc., May 2009.

iv *County of Kern Online Mapping System, Geocortex IMF*, http://maps.co.kern.ca.us/imf/imf.jsp?site=krn_pub, 2009.

v *Web Soil Survey*, National Resource Conservation Service, http://websoilsurvey.nrcs.usda.gov/.

vi *NOAA Atlas 14, Point Precipitation Frequency Estimates*, Generated by the on-line Precipitation Frequency Data Server, National Weather Service, National Oceanic and Atmospheric Administration (NOAA).

vii *Hydrology Manual*. Figures C-2, C-4, C-5 and E-5, Kern County, Department of Planning and Development Services, 1992.

viii *Watershed Modeling System*, Version 8.0, Brigham Young University, 2007.

ix *USGS Seamless Data Distribution System*, http://seamless.usgs.gov/, 2007.

x *TerraServer®*, http://terraserver.microsoft.com/.

APPENDIX A

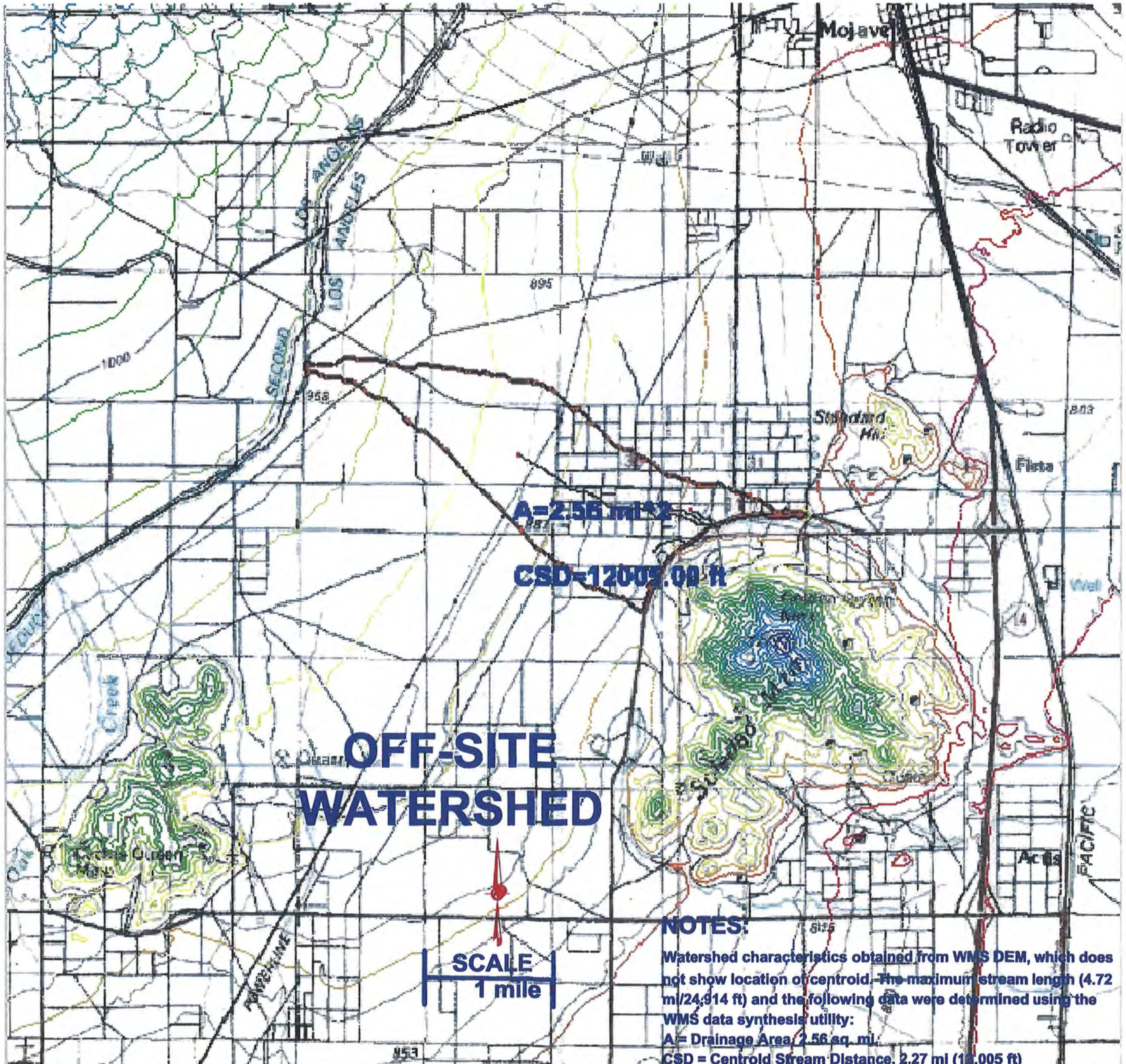
Offsite Basin Map

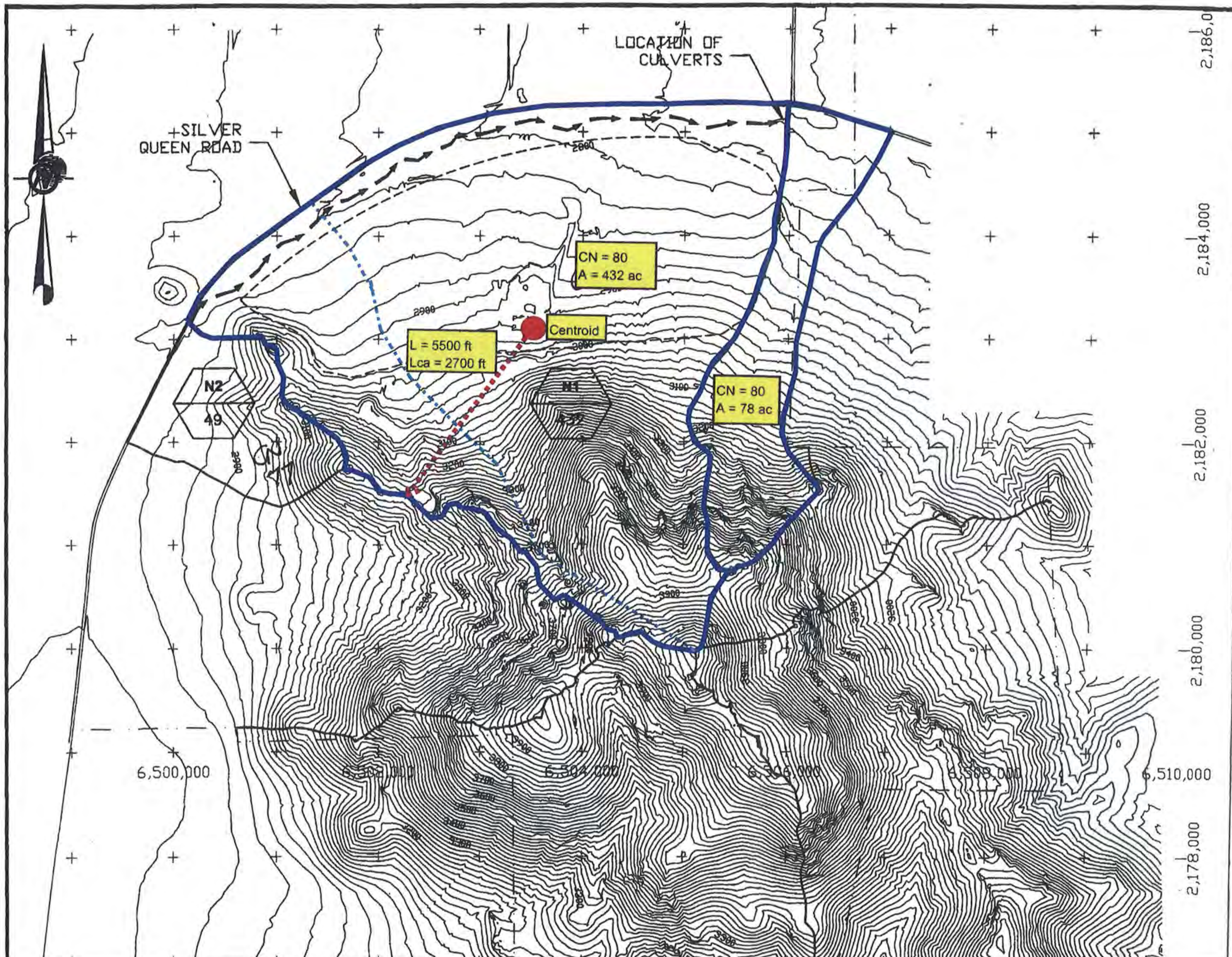
Onsite Basin Map

Kern County General Plan

Kern County Zoning Map

C:\Projects\Mojave\Maps\OffsiteWatershed0809.dwg, 8/25/2009 5:48:58 PM, 1:2.33604





LEGEND

3000	EXISTING CONTOURS (20 FOOT INTERVAL)
	BASIN BOUNDARY
	DISTURBED AREA BOUNDARY
	LEACH PAD BOUNDARY (FOR REFERENCE ONLY)
	ROAD
	ROADSIDE CHANNEL
N1	BASIN NAME
432	BASIN AREA (ACRES)

Dwg Name: J:\04JOBS\043-2299 S … rainage Plan\sw basins.dwg
Layout Name: 11x17 Landscape Machine: NOT SET
Last Update: Apr 24, 2006 12:05 By:
Last Plot: Apr 24, 2006 12:06 By: sallen

Golder Associates
Denver, Colorado

1000 0 1000
1" = 1,000' Feet

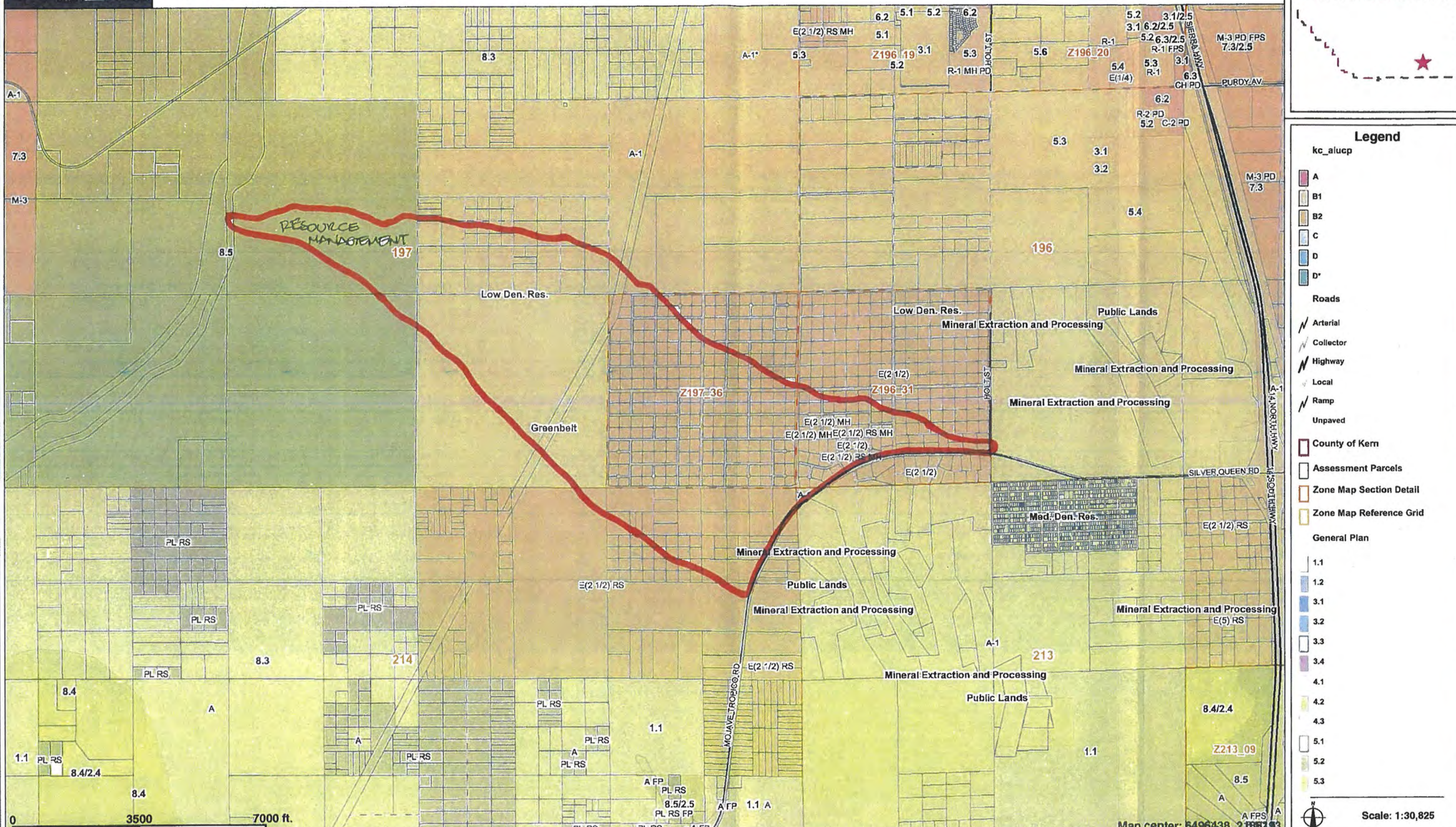
ON-SITE EXISTING CONDITION

BASIN DELINEATION

FIGURE 1

Kern County Online Mapping System

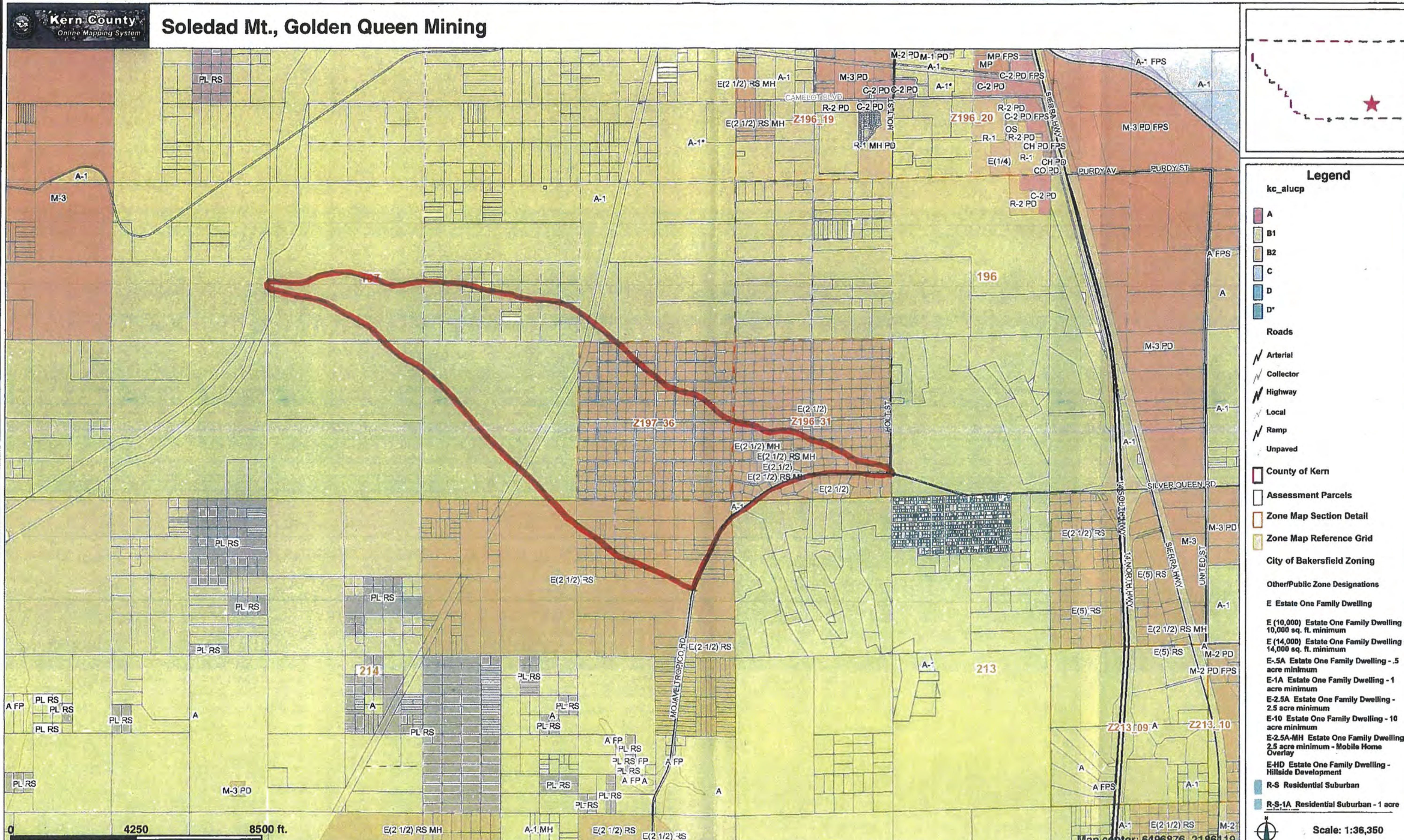
Golden QUeen Mining, Soledad Mtn., General Plan



This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Kern County Online Mapping System

Soledad Mt., Golden Queen Mining

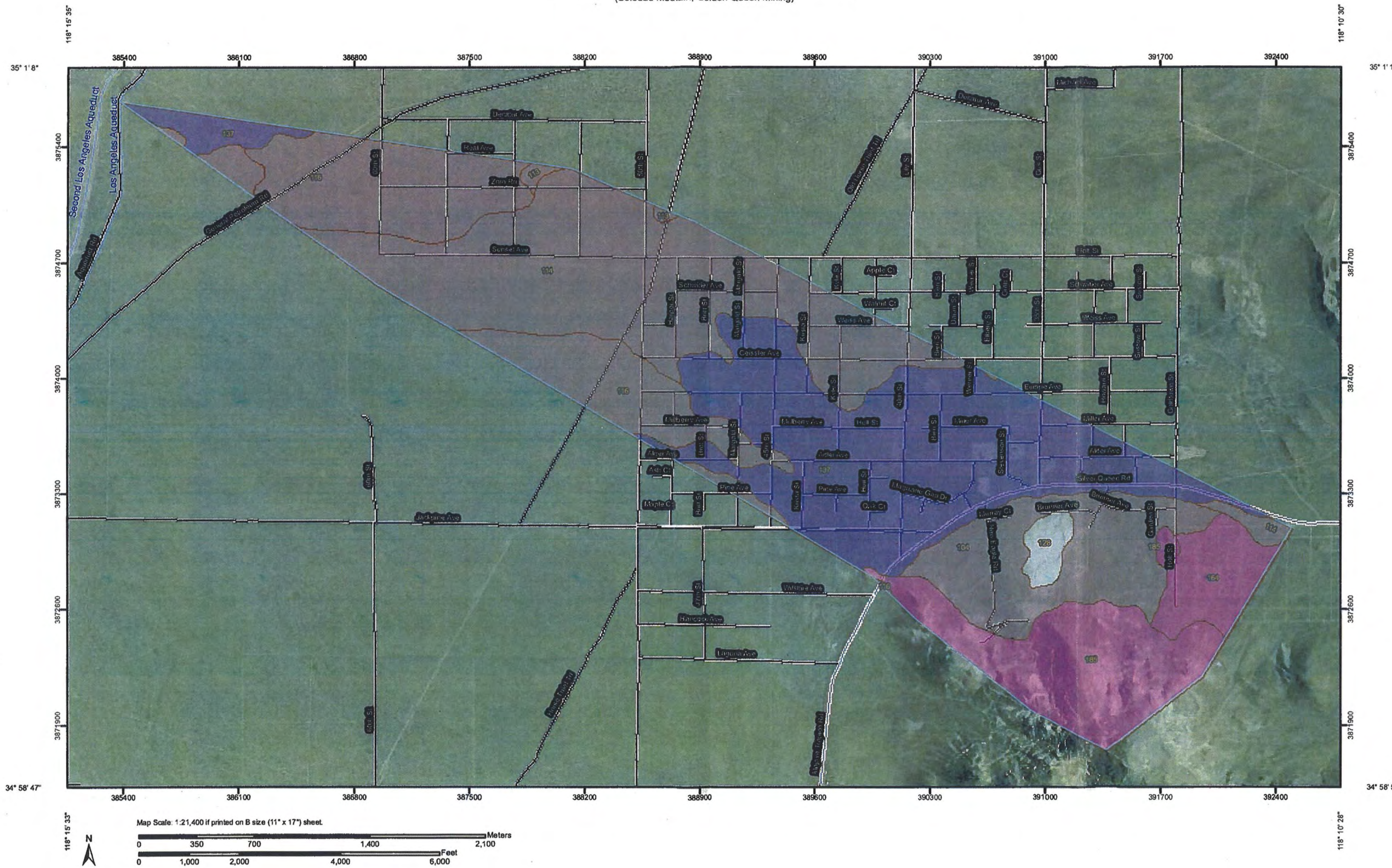


This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

APPENDIX B

Soils Map and Properties

Soil Properties and Qualities—Kern County, California, Southeastern Part
(Soledad Moutain, Golden Queen Mining)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:21,400 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kern County, California, Southeastern Part
Survey Area Data: Version 4, Dec 10, 2007

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Properties and Qualities

Soil Properties and Qualities— Summary by Map Unit — Kern County, California, Southeastern Part				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
104	Arizo gravelly loamy sand, 2 to 9 percent slopes	A	222.0	10.5%
113	Cajon sand, 5 to 15 percent slopes	A	7.3	0.3%
114	Cajon loamy sand, 0 to 5 percent slopes	A	589.3	27.8%
116	Cajon gravelly loamy sand, 0 to 9 percent slopes	A	341.9	16.1%
128	Dumps, mine		25.9	1.2%
137	Garlock loamy sand, 2 to 9 percent slopes	B	612.9	28.9%
164	Porterville cobbly clay, 5 to 9 percent slopes	D	84.8	4.0%
185	Torriorthents-Rock outcrop complex, very steep	D	238.8	11.2%
Totals for Area of Interest			**2,122.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

APPENDIX C

Point Precipitation Frequency Estimates from NOAA Atlas 14

Kern County 100-Year, 24-Hour Rainfall Isohyet Map

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

California 35.0492 N 118.1619 W 2742 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Fri Feb 8 2008

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.08	0.12	0.15	0.21	0.26	0.36	0.46	0.62	0.81	1.02	1.16	1.31	1.47	1.60	1.87	2.13	2.40	2.69
2	0.11	0.16	0.20	0.27	0.34	0.48	0.59	0.81	1.07	1.35	1.54	1.76	1.98	2.17	2.54	2.90	3.31	3.67
5	0.15	0.23	0.29	0.39	0.48	0.68	0.84	1.13	1.50	1.89	2.18	2.53	2.87	3.14	3.69	4.22	4.95	5.50
10	0.19	0.29	0.36	0.48	0.59	0.85	1.02	1.39	1.81	2.28	2.65	3.13	3.55	3.86	4.53	5.16	6.18	6.87
25	0.25	0.38	0.47	0.63	0.79	1.09	1.30	1.76	2.24	2.82	3.28	3.95	4.49	4.85	5.63	6.41	7.86	8.78
50	0.30	0.46	0.56	0.76	0.94	1.30	1.53	2.05	2.58	3.24	3.77	4.60	5.23	5.62	6.47	7.36	9.20	10.31
100	0.36	0.55	0.68	0.91	1.13	1.54	1.79	2.37	2.94	3.67	4.28	5.29	6.02	6.42	7.33	8.32	10.59	11.91
200	0.42	0.65	0.80	1.08	1.33	1.80	2.06	2.71	3.30	4.11	4.80	6.02	6.85	7.24	8.20	9.29	12.04	13.59
500	0.52	0.80	0.99	1.33	1.65	2.19	2.45	3.20	3.81	4.71	5.51	7.04	8.01	8.37	9.36	10.58	14.06	15.96
1000	0.61	0.93	1.15	1.55	1.92	2.52	2.78	3.61	4.21	5.17	6.07	7.86	8.94	9.26	10.25	11.56	15.65	17.86

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

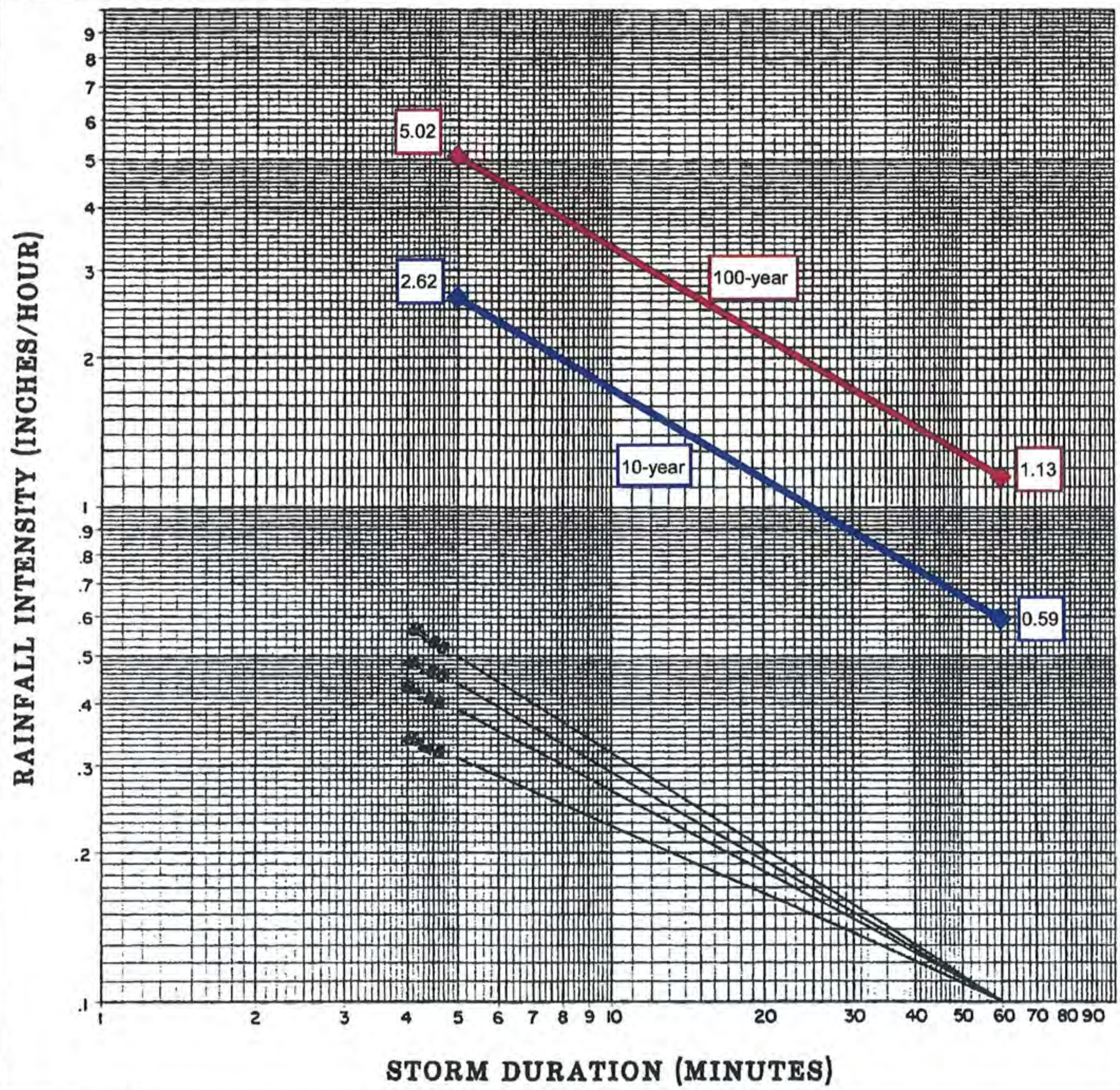
*** Upper bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.10	0.15	0.18	0.25	0.31	0.42	0.53	0.71	0.94	1.16	1.33	1.53	1.73	1.89	2.21	2.51	2.88	3.21
2	0.13	0.20	0.24	0.33	0.41	0.56	0.69	0.93	1.23	1.53	1.77	2.05	2.33	2.56	3.00	3.41	3.97	4.38
5	0.18	0.28	0.35	0.47	0.58	0.79	0.96	1.29	1.70	2.14	2.49	2.95	3.39	3.69	4.36	4.96	5.92	6.53
10	0.23	0.35	0.43	0.58	0.72	0.98	1.18	1.58	2.07	2.59	3.03	3.65	4.18	4.53	5.33	6.07	7.39	8.17
25	0.30	0.46	0.57	0.77	0.95	1.27	1.49	2.00	2.55	3.21	3.77	4.61	5.27	5.67	6.62	7.52	9.38	10.43
50	0.36	0.55	0.68	0.92	1.14	1.51	1.75	2.33	2.95	3.68	4.35	5.37	6.17	6.60	7.64	8.67	10.92	12.24
100	0.44	0.67	0.83	1.11	1.38	1.78	2.06	2.70	3.36	4.18	4.95	6.21	7.12	7.56	8.68	9.82	12.57	14.14
200	0.52	0.79	0.98	1.32	1.64	2.10	2.38	3.12	3.80	4.69	5.57	7.08	8.14	8.58	9.75	11.03	14.34	16.20
500	0.65	0.98	1.22	1.64	2.03	2.59	2.87	3.72	4.42	5.42	6.46	8.34	9.57	9.98	11.17	12.60	16.85	19.13
1000	0.76	1.16	1.43	1.93	2.39	3.01	3.29	4.24	4.95	5.98	7.17	9.36	10.73	11.09	12.28	13.84	18.80	21.43

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval
Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.07	0.10	0.13	0.17	0.22	0.31	0.40	0.54	0.70	0.88	1.00	1.12	1.24	1.36	1.58	1.79	2.00	2.24
2	0.09	0.14	0.17	0.23	0.28	0.41	0.52	0.70	0.93	1.16	1.33	1.51	1.67	1.84	2.16	2.45	2.75	3.07
5	0.13	0.19	0.24	0.32	0.40	0.59	0.72	0.98	1.29	1.62	1.86	2.17	2.42	2.65	3.11	3.56	4.10	4.55
10	0.16	0.24	0.30	0.40	0.50	0.73	0.88	1.20	1.57	1.97	2.26	2.67	2.98	3.25	3.81	4.34	5.11	5.65
25	0.20	0.31	0.38	0.52	0.64	0.92	1.12	1.49	1.90	2.42	2.78	3.35	3.75	4.06	4.71	5.37	6.46	7.19
50	0.24	0.37	0.45	0.61	0.76	1.09	1.29	1.72	2.18	2.76	3.18	3.87	4.33	4.67	5.39	6.12	7.51	8.41
100	0.28	0.43	0.54	0.72	0.89	1.27	1.49	1.97	2.45	3.11	3.58	4.40	4.94	5.29	6.07	6.88	8.58	9.62



DESIGN STORM FREQUENCY = 10/100 YEARS

ONE HOUR POINT RAINFALL= noted INCHES

LOG-LOG SLOPE= 0.60

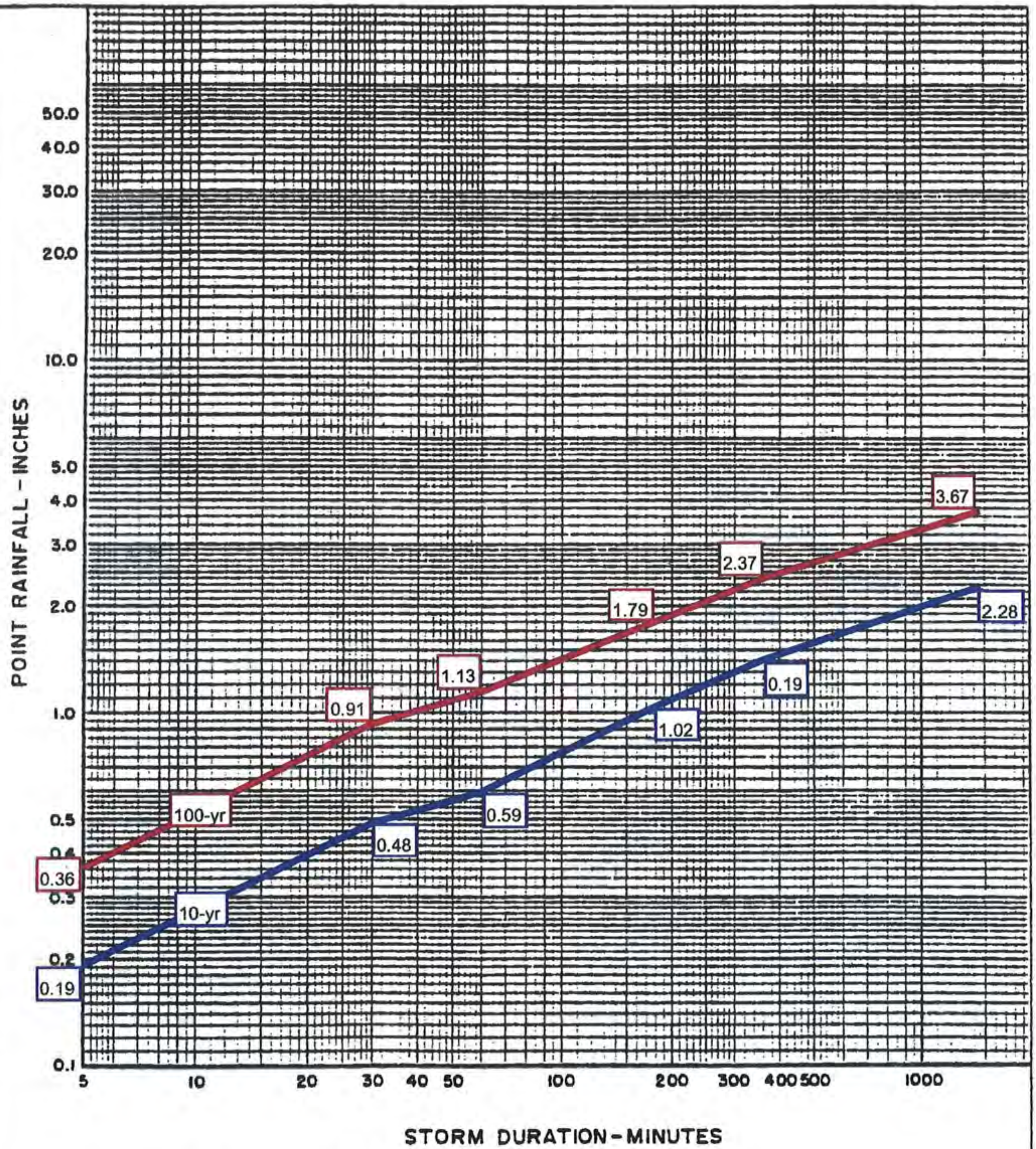
PROJECT LOCATION= Soledad Mountain

KERN COUNTY
Hydrology Manual

INTENSITY-DURATION CURVES

CALCULATION SHEET

FIGURE D-4



PROJECT LOCATION Soledad Mountain

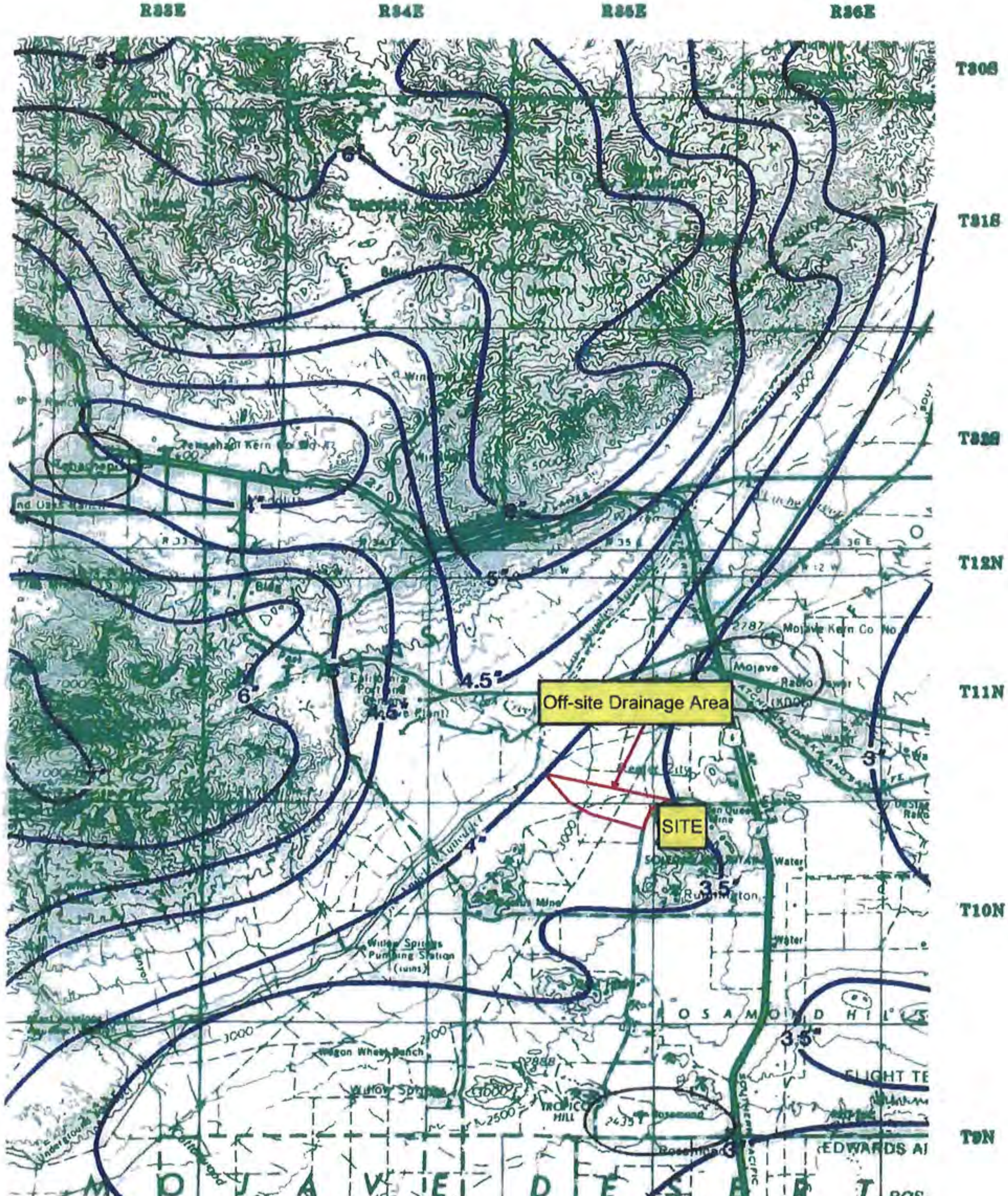
NOTES Watershed is located approximately 5 miles south-southwest of City of Mojave

KERN COUNTY

HYDROLOGY MANUAL

AREA - AVERAGED MASS RAINFALL PLOTTING SHEET

FIGURE E-8



KERN COUNTY HYDROLOGY MANUAL

RAINFALL ISOHYET MAP

APPROXIMATE SCALE
1"=4 miles

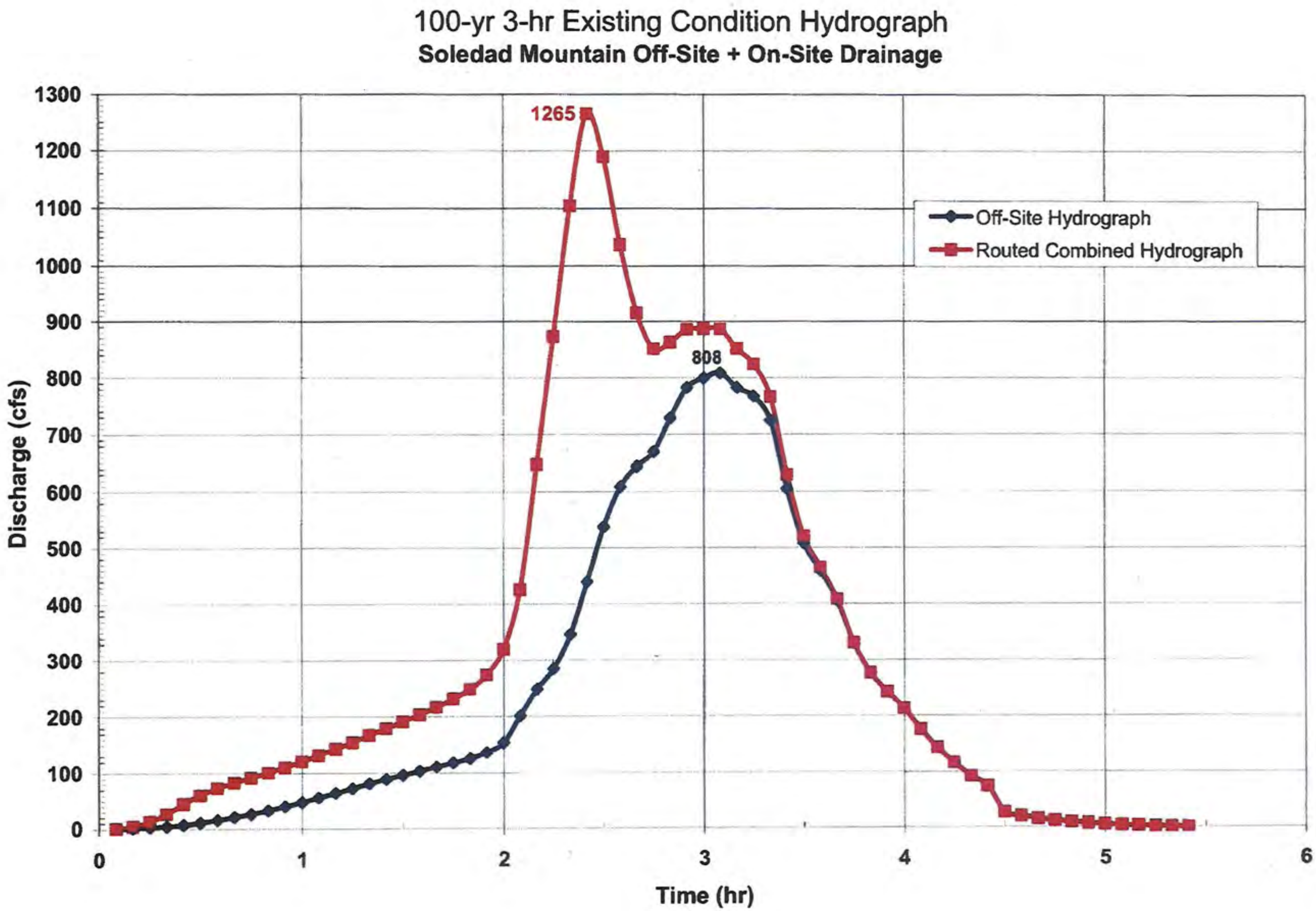
——— 100-Year, 24-Hour Isohyet

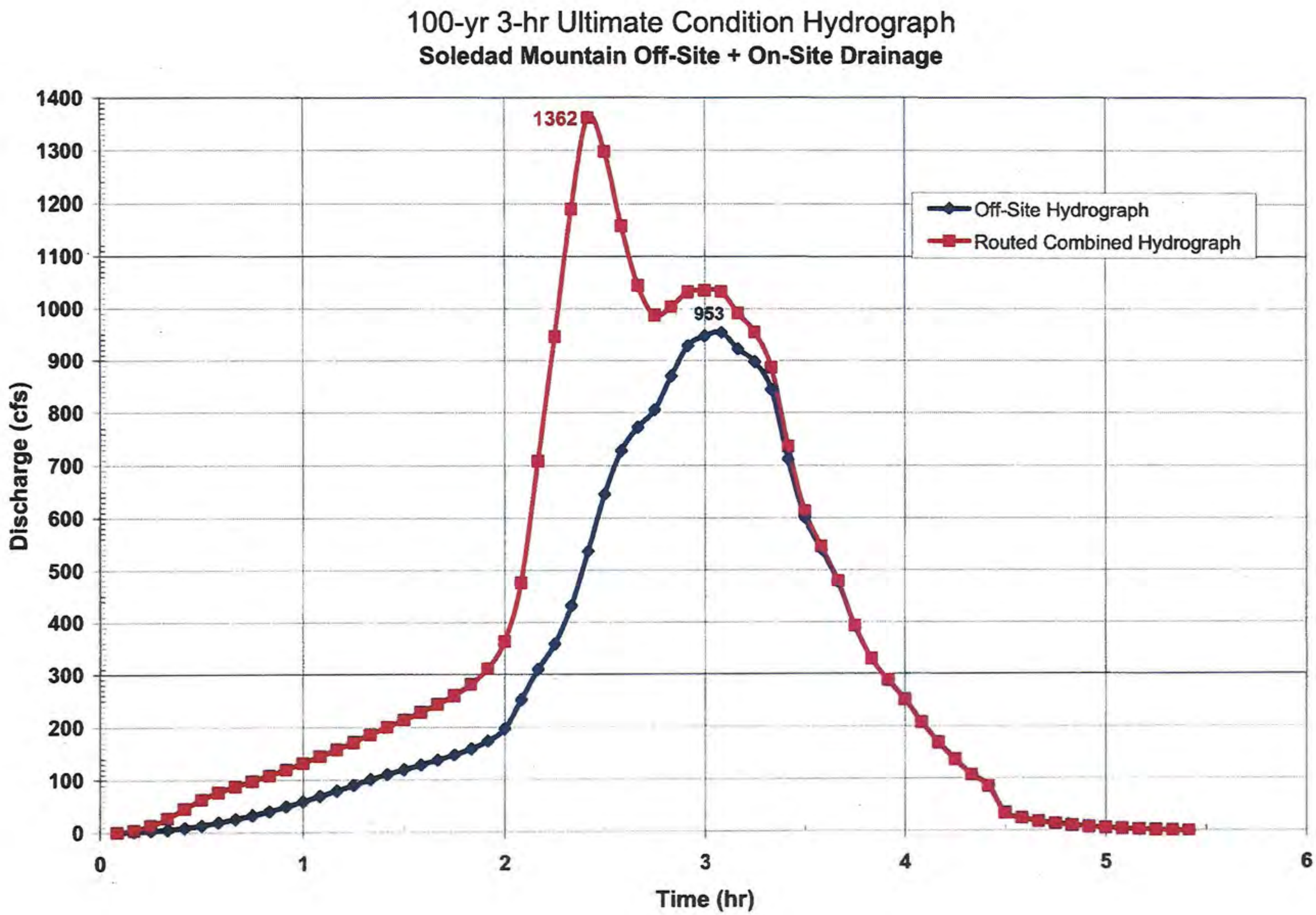
NORTH

FIGURE B-54

APPENDIX D

Hydrologic Calculations


100-yr 3-hr Existing Condition Hydrograph
Soledad Mountain Off-Site + On-Site Drainage
Discharge (cfs)
Time (hr)
Off-Site Hydrograph
Routed Combined Hydrograph
1265
808
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
0
1
2
3
4
5
6


100-yr 3-hr Ultimate Condition Hydrograph
Soledad Mountain Off-Site + On-Site Drainage
Discharge (cfs)
Time (hr)
Off-Site Hydrograph
Routed Combined Hydrograph
1362
953
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6

SCS Analysis

	Area (mi2)	3.36			
	Elev (u/s)	3120			
	Elev (d/s)	2760			
Total	L (ft)	20800			
Average	S (ft/ft)	0.0173			
Shallow	K	0.305	Elev (u/s)	3150	source: WMS model output
Concentrated	V (ft/s)	1.44	Elev (d/s)	2820	
	S (ft/ft)	0.0204			
	L (ft)	16180			
	t1 (min)	187.6			
	t1 (hr)	3.13			
Channel	L (ft)	4620	Elev (u/s)	2820	
	S (ft/ft)	0.0121	Elev (d/s)	2764	<-- source: WMS model output
	n	0.030	S (ft/mi)	81.80	
	R (ft)	2.5	S (ft/ft)	0.0155	
	V (ft/s)	10.05			
	t1 (min)	7.7			
	t1 (hr)	0.13			
	tc (hr)	3.25			
	CN	73			
	S	3.6986			
	Ia	0.7397			
	P (in)	3.75			
	Q (in)	1.3507			
	Ia/P	0.19726			
	C0	2.3055			
	C1	-0.51429			
	C2	-0.01175			
	qu (cfs/in-mi2)	109.3572			
	q (cfs)	496			

Lag Time Computations

	Off-Site	L	Lca
	Avg. Elev	Max Channel Length (ft),(mi)	Centroid Length (ft), (mi)
	2933.1	24914	12005
		4.72	2.27
	source: WMS model output		
	On-Site	L	Lca
	Avg. Elev	Max Channel Length (ft),(mi)	Centroid Length (ft), (mi)
	2090		
u/s elev	4180	5500	2700
d/s elev	2840	1.04	0.51
	slope (ft/mi) =	1286.4	

On-Site Hydrology				
		Weighted		
A (ac)	CN	CN	A (ac)	CN
9.17	91	834.47	6.6	80
13.64	91	1241.24	25.86	80
15.56	90	1400.4	24.38	80
71.18	80	5694.4	39.53	80
30.16	87	2623.92	18.79	80
26.7	85	2269.5	80.89	80
4.33	82	355.06		
2.76	82	226.32		
4.36	82	357.52		
4.62	82	378.84		
4.71	82	386.22		
3.4	82	278.8		
190.59		84	196.05	80
				use CN
	CN(avg) =	82	Area (ac) =	510

Source: TJ Cross, Hydrology Study, DS-06225-34 Rev. B (10/18/2007)

Soil Group				
A	B	C	D	Source: NRCS
0.559	0.289		0.152	1.000

Symbol	Land Use	Area (acres) General Plan	Curve Number Soil Group A	B	C	D	CN	% Imp	
E	Estate (2.5 acres)		46	65	77	82	0.00	0.10	0.0
GB	Greenbelt (fair)	35	49	69	79	84	1.29	0.00	0.0
LA	Limited Agriculture						0.00	0.00	0.0
LDR	Low Density Residential	821.4	61	75	83	87	34.63	0.30	246.4
MDR	Medium Density Residential	50	77	85	90	92	2.49	0.60	30.0
MEP	Mineral Extraction and Processing	300	77	77	77	77	14.12	0.15	45.0
PL	Public Lands	190	72	82	87	89	9.00	0.15	28.5
RM	Resource Management	240	49	69	79	84	8.81	0.15	36.0
		1636.4			Off-site	Weighted	70.3		0.24
	2146					Total	73		

Project	**Soledad Mountain**		
Engineer	Tamim Atayee		
	Rivertech Inc.		
Enter design storm return frequency (years)	100		10
Enter catchment lag (hr)	1.02		1.02
Enter catchment area (ac)	1636.4		1636.4
Enter base flow (cfs/sq.mi.)	0		
Enter S-graph proportions (dec.)			
Valley: Developed	100		100
Foothill	0		0
Mountain	0		0
Valley: Undeveloped	0		0
Desert	0		0
Enter maximum loss rate F_m (in/hr)	0.62		0.62
Enter low loss fraction ¥ (dec)	0.76		0.76
Enter watershed area-averaged 5-minute point rainfall (in)	0.36		0.19
Enter watershed area-averaged 30-minute point rainfall (in)	0.91		0.48
Enter watershed area-averaged 1-hr point rainfall (in)	1.13		0.59
Enter watershed area-averaged 3-hr point rainfall (in)	1.79	1.4	1.02
Enter watershed area-averaged 6-hr point rainfall (in)	2.37	2.0	1.39
Enter watershed area-averaged 24-hr point rainfall (in)	3.67	3.7	2.28
Enter 24-hr storm unit interval (min)	5		5
Slope (Desert) Figure B-56	0.6		0.6
Precipitation source	NOAA 14	NOAA Atlas 2	NOAA 14

	NOAA Atlas 14		
	Duration (min)	**Rainfall intensity**	**slope**
	5	5.02	-0.60
	60	1.13	
straight-line approximation	180	0.60	-0.58

Project	**Soledad Mountain**		
Engineer	Tamim Atayee		
	Rivertech Inc.		
Watersheds (On-Site Sub-Basins)			
Enter design storm return frequency	100		100
Enter catchment lag (hr)	0.49		0.22
Enter catchment area (ac)	432.0		0.0
Enter base flow (cfs/sq.mi.)	0		0
Enter S-graph proportions (dec.)			
Valley: Developed	100		100
Foothill	0		0
Mountain	0		0
Valley: Undeveloped	0		0
Desert	0		0
Enter maximum loss rate F_m (in/hr)	0.62		5.151515
Enter low loss fraction Ӯ (dec)	0.76		0.24
Enter watershed area-averaged 5-minute point rainfall (in)	0.36		0.4
Enter watershed area-averaged 30-minute point rainfall (in)	0.91		0.9
Enter watershed area-averaged 1-hr point rainfall (in)	1.13		1.1
Enter watershed area-averaged 3-hr point rainfall (in)	1.79	1.4	1.8
Enter watershed area-averaged 6-hr point rainfall (in)	2.37	2.0	2.4
Enter watershed area-averaged 24-hr point rainfall (in)	3.67	3.7	3.75
Enter 24-hr storm unit interval (min)	5		5
Slope (Figure B-56)	0.6		0.6
Precipitation source	NOAA 14	NOAA Atlas 2	

	NOAA Atlas 14		
	Duration (min)	**Rainfall intensity**	**slope**
	5	5.02	-0.60
	60	1.13	
straight-line approximation	180	0.60	-0.58

depth-area reduction	0.97	for d=5 minutes (Fig. E-4)							Off-Site Existing Condition		Off-Site Ultimate Condition		On-Site Ultimate Condition	
Timestep #	Time (min)	Rainfall Intensity (in/hr)	Rainfall Depth (in)	Adjusted Depth (in)	Incremental Depth (in)	Storm Time (min)	3-hour Re-ordered Timestep #	Unit Rainfall Depth (in)	Unit Loss, F* (in)	Effective Rainfall Depth (in)	Unit Loss, F* (in)	Effective Rainfall Depth (in)	Unit Loss, F* (in)	Effective Rainfall Depth (in)
1	5	5.02	0.418	0.406	0.406	840	36	0.020	0.015	0.005	0.014	0.006	0.011	0.010
2	10	3.31	0.552	0.535	0.130	845	35	0.021	0.016	0.005	0.014	0.006	0.011	0.010
3	15	2.60	0.649	0.630	0.094	850	33	0.021	0.016	0.005	0.015	0.007	0.011	0.010
4	20	2.18	0.728	0.706	0.077	855	32	0.022	0.017	0.005	0.015	0.007	0.011	0.011
5	25	1.91	0.796	0.772	0.066	860	30	0.023	0.017	0.006	0.016	0.007	0.012	0.011
6	30	1.71	0.856	0.831	0.058	865	29	0.023	0.017	0.006	0.016	0.007	0.012	0.011
7	35	1.56	0.911	0.884	0.053	870	27	0.024	0.018	0.006	0.017	0.007	0.012	0.012
8	40	1.44	0.961	0.932	0.048	875	26	0.025	0.019	0.006	0.017	0.007	0.013	0.012
9	45	1.34	1.007	0.977	0.045	880	24	0.026	0.020	0.006	0.018	0.008	0.013	0.012
10	50	1.26	1.051	1.019	0.042	885	23	0.027	0.020	0.006	0.018	0.008	0.014	0.013
11	55	1.19	1.091	1.059	0.040	890	21	0.028	0.021	0.007	0.020	0.009	0.014	0.014
12	60	1.13	1.130	1.096	0.037	895	20	0.029	0.022	0.007	0.020	0.009	0.015	0.014
13	65	1.08	1.169	1.133	0.037	900	18	0.031	0.023	0.007	0.021	0.009	0.016	0.015
14	70	1.03	1.205	1.169	0.036	905	17	0.032	0.024	0.008	0.022	0.010	0.016	0.015
15	75	0.99	1.241	1.203	0.034	910	15	0.034	0.026	0.008	0.024	0.010	0.018	0.017
16	80	0.96	1.275	1.236	0.033	915	14	0.036	0.027	0.009	0.025	0.011	0.018	0.017
17	85	0.92	1.307	1.268	0.032	920	12	0.037	0.028	0.009	0.026	0.011	0.019	0.018
18	90	0.89	1.339	1.299	0.031	925	11	0.040	0.030	0.010	0.028	0.012	0.020	0.019
19	95	0.87	1.370	1.329	0.030	930	9	0.045	0.034	0.011	0.031	0.014	0.023	0.022
20	100	0.84	1.399	1.358	0.029	935	8	0.048	0.037	0.012	0.034	0.015	0.025	0.023
21	105	0.82	1.428	1.386	0.028	940	6	0.058	0.044	0.014	*0.035*	0.024	0.030	0.028
22	110	0.79	1.456	1.413	0.027	945	5	0.066	0.050	0.016	*0.035*	0.031	*0.029*	0.037
23	115	0.77	1.484	1.439	0.027	950	3	0.094	*0.052*	0.043	*0.035*	0.059	*0.029*	0.066
24	120	0.76	1.511	1.465	0.026	955	2	0.130	*0.052*	0.078	*0.035*	0.095	*0.029*	0.101
25	125	0.74	1.537	1.490	0.025	960	1	0.406	*0.052*	0.354	*0.035*	0.371	*0.029*	0.377
26	130	0.72	1.562	1.515	0.025	965	4	0.077	*0.052*	0.025	*0.035*	0.042	*0.029*	0.048
27	135	0.71	1.587	1.539	0.024	970	7	0.053	0.040	0.013	*0.035*	0.018	0.027	0.026
28	140	0.69	1.611	1.563	0.024	975	10	0.042	0.032	0.010	0.029	0.013	0.022	0.020
29	145	0.68	1.635	1.586	0.023	980	13	0.037	0.028	0.009	0.026	0.011	0.019	0.018
30	150	0.66	1.658	1.609	0.023	985	16	0.033	0.025	0.008	0.023	0.010	0.017	0.016
31	155	0.65	1.681	1.631	0.022	990	19	0.030	0.022	0.007	0.021	0.009	0.015	0.014
32	160	0.64	1.704	1.653	0.022	995	22	0.027	0.021	0.007	0.019	0.008	0.014	0.013
33	165	0.63	1.726	1.674	0.021	1000	25	0.025	0.019	0.006	0.018	0.008	0.013	0.012
34	170	0.62	1.748	1.695	0.021	1005	28	0.024	0.018	0.006	0.016	0.007	0.012	0.011
35	175	0.61	1.769	1.716	0.021	1010	31	0.022	0.017	0.005	0.015	0.007	0.011	0.011
36	180	0.60	1.790	1.736	0.020	1015	34	0.021	0.016	0.005	0.015	0.006	0.011	0.010
				Total =	1.736					0.751		0.899		1.095
								F_m =	*0.052*					

depth-area reduction =		0.92	for d=5 minutes (Fig. E-4)							
		Rainfall					1-hour	Unit		Effective
Timestep #	Time (min)	Intensity (in/hr)	Depth (in)	Adjusted Depth (in)	Incremental Depth (in)	Storm Time (min)	Re-ordered Timestep #	Rainfall Depth (in)	Unit Loss, F* (in)	Rainfall Depth (in)
1	5	5.02	0.418	0.385	0.385	920	12	0.036	0.027	0.009
2	10	3.31	0.552	0.508	0.123	925	11	0.038	0.028	0.009
3	15	2.60	0.649	0.597	0.089	930	9	0.043	0.032	0.010
4	20	2.18	0.728	0.670	0.073	935	8	0.046	0.035	0.011
5	25	1.91	0.796	0.732	0.063	940	6	0.055	0.042	0.014
6	30	1.71	0.856	0.788	0.055	945	5	0.063	0.047	0.015
7	35	1.56	0.911	0.838	0.050	950	3	0.089	***0.052***	0.037
8	40	1.44	0.961	0.884	0.046	955	2	0.123	***0.052***	0.071
9	45	1.34	1.007	0.927	0.043	960	1	0.385	***0.052***	0.333
10	50	1.26	1.051	0.966	0.040	965	4	0.073	***0.052***	0.021
11	55	1.19	1.091	1.004	0.038	970	7	0.050	0.038	0.012
12	60	1.13	1.130	1.040	0.036	975	10	0.040	0.030	0.010
								F_m =	***0.052***	

Source:		NRCS	(Fig. C-5)	(Fig. C-3)		(Fig. C-2)		100-yr			10-yr		
Land Use	Area Fraction	Soil Group	F_p	a_p	F_m	CN	S	Pervious Area Yield, Y	Low Loss ¥	F*	Pervious Area Yield, Y	Low Loss ¥	F*
Units	(dec.)		(in/hr)	(dec.)	(in/hr)		(in)	(dec.)	(dec.)	(in/hr)	(dec.)	(dec.)	(in/hr)
Open Brush, fair condition	1.0	A/B/D	0.62	1.0	0.62	66	5.15	0.244	0.756		0.244	0.756	
					0.052	(inches in 5 minutes)							
Ultimate (Based on On-Site)	1.0	A/B	0.38	0.90	0.34	80	2.50	0.483	0.517		0.483	0.517	
					0.029	(inches in 5 minutes)							
Ultimate (Based on Off-Site)	1.0	A/B/D	0.55	0.76	0.42	70	4.29	0.304	0.696		0.304	0.696	
					0.035	(inches in 5 minutes)							
Ultimate (Weighted)	1.0	A/B/D	0.51	0.79	0.40	72	3.82	0.342	0.658		0.342	0.658	
					0.034	(inches in 5 minutes)							

Figure E-3a

Valley Developed S-Graph % Volume	Decimal	% Lag
0	0.00	0.00
2	0.02	17.50
4	0.04	29.00
6	0.06	35.25
8	0.08	40.00
10	0.10	43.75
12	0.12	47.75
14	0.14	51.75
16	0.16	54.25
18	0.18	58.00
20	0.20	61.75
22	0.22	64.75
24	0.24	67.25
26	0.26	70.75
28	0.28	74.25
30	0.30	76.75
32	0.32	79.75
34	0.34	81.75
36	0.36	84.25
38	0.38	88.00
40	0.40	89.25
42	0.42	92.00
44	0.44	94.25
46	0.46	96.87
48	0.48	98.75
50	0.50	100.00
52	0.52	103.00
54	0.54	106.00
56	0.56	109.50
58	0.58	112.00
60	0.60	114.00
62	0.62	115.00
64	0.64	117.25
66	0.66	120.50
68	0.68	123.50
70	0.70	125.25
72	0.72	129.00
74	0.74	132.00
76	0.76	136.00
78	0.78	140.00
80	0.80	145.00
82	0.82	149.00
84	0.84	153.50
86	0.86	158.75
88	0.88	165.25
90	0.90	173.75
92	0.92	183.25
94	0.94	193.75
96	0.96	209.50
98	0.98	235.00
100	1.00	315.00

Off-Site Basin

Time (hr) for Lag of 1.02	Time (min)	% S-Curve Averaged	% S-Curve Interpolated	Time (min)	
0.00	0.0	0.005	0.009	5	
0.18	10.8	0.014	0.019	10	
0.30	17.8	0.025	0.032	15	
0.36	21.7	0.042	0.051	20	
0.41	24.6	0.067	0.084	25	
0.45	26.9	0.104	0.125	30	
0.49	29.3	0.150	0.174	35	
0.53	31.8	0.199	0.223	40	
0.56	33.3	0.248	0.274	45	0.051
0.59	35.6	0.305	0.336	50	0.062
0.63	38.0	0.369	0.402	55	0.065
0.66	39.8	0.435	0.468	60	0.066
0.69	41.3	0.503	0.538	65	0.070
0.72	43.5	0.569	0.599	70	0.061
0.76	45.6	0.635	0.670	75	0.071
0.79	47.2	0.699	0.728	80	0.058
0.82	49.0	0.750	0.771	85	
0.84	50.2	0.789	0.807	90	
0.86	51.8	0.826	0.844	95	
0.90	54.1	0.858	0.872	100	
0.91	54.9	0.883	0.893	105	
0.94	56.5	0.902	0.911	110	
0.97	57.9	0.919	0.927	115	
0.99	59.5	0.935	0.942	120	
1.01	60.7	0.947	0.952	125	
1.02	61.5	0.957	0.962	130	
1.06	63.3	0.965	0.968	135	
1.09	65.1	0.971	0.974	140	
1.12	67.3	0.977	0.980	145	
1.15	68.8	0.981	0.982	150	
1.17	70.1	0.983	0.984	155	
1.18	70.7	0.985	0.986	160	
1.20	72.1	0.987	0.988	165	
1.23	74.1	0.989	0.990	170	
1.27	75.9	0.991	0.992	175	
1.28	77.0	0.993	0.994	180	
1.32	79.3	0.995	0.997	185	
1.35	81.1	0.998	0.999	190	
1.39	83.6	0.999	1.000	195	
1.43	86.0				
1.49	89.1				
1.53	91.6				
1.57	94.3				
1.63	97.6				
1.69	101.6				
1.78	106.8				
1.88	112.6				
1.98	119.1				
2.15	128.8				
2.41	144.4				
3.23	193.6				

On-Site Basin

Time (hr) for Lag of 0.22	Time (min)	% S-Curve Averaged	% S-Curve Interpolated	Time (min)
0.00	0.0	0.080	0.161	5
0.04	2.3	0.229	0.297	10
0.06	3.8	0.455	0.612	15
0.08	4.6	0.725	0.837	20
0.09	5.2	0.886	0.935	25
0.10	5.7	0.955	0.975	30
0.10	6.2	0.982	0.988	35
0.11	6.8	0.993	0.998	40
0.12	7.1	0.999	1.000	45
0.13	7.6			
0.13	8.1			
0.14	8.5			
0.15	8.8			
0.15	9.3			
0.16	9.7			
0.17	10.0			
0.17	10.4			
0.18	10.7			
0.18	11.0			
0.19	11.5			
0.19	11.7			
0.20	12.0			
0.21	12.3			
0.21	12.7			
0.22	12.9			
0.22	13.1			
0.22	13.5			
0.23	13.9			
0.24	14.3			
0.24	14.7			
0.25	14.9			
0.25	15.1			
0.26	15.3			
0.26	15.8			
0.27	16.2			
0.27	16.4			
0.28	16.9			
0.29	17.3			
0.30	17.8			
0.31	18.3			
0.32	19.0			
0.32	19.5			
0.33	20.1			
0.35	20.8			
0.36	21.6			
0.38	22.7			
0.40	24.0			
0.42	25.4			
0.46	27.4			
0.51	30.8			
0.69	41.2			

A (mi²) = 2.56

K (cfs) = 19790.6

Step #	tstep, T = 5 Time (min)	(hr)	S-Graph (%)	Valley-Dev Unit Hydrograph (cfs/in)	1 0.009	2 0.009	3 0.010	4 0.011	5 0.014	6 0.015	7 0.037	8 0.071	9 0.333	10 0.021	11 0.012	12 0.010	Runoff Hydrograph (cfs)
1	5	0.083	0.5	92.0	0.80												**0.8**
2	10	0.167	1.4	184.0	1.59	0.84											**2.4**
3	15	0.250	2.5	224.7	1.95	1.68	0.96										**4.6**
4	20	0.333	4.2	323.9	2.81	2.06	1.91	1.03									**7.8**
5	25	0.417	6.7	510.6	4.42	2.96	2.34	2.06	1.24								**13.0**
6	30	0.500	10.4	732.0	6.34	4.67	3.37	2.52	2.48	1.40							**20.8**
7	35	0.583	15.0	898.3	7.78	6.70	5.31	3.63	3.03	2.80	3.44						**32.7**
8	40	0.667	19.9	963.3	8.35	8.22	7.61	5.72	4.37	3.43	6.88	6.53					**51.1**
9	45	0.750	24.8	986.7	8.55	8.82	9.33	8.20	6.89	4.94	8.40	13.05	30.61				**98.8**
10	50	0.833	30.5	1121.8	9.72	9.03	10.01	10.06	9.88	7.78	12.11	15.94	61.23	1.92			**147.7**
11	55	0.917	36.9	1262.9	10.94	10.27	10.25	10.79	12.13	11.16	19.09	22.98	74.79	3.83	1.12		**187.4**
12	60	1.000	43.5	1306.0	11.32	11.56	11.66	11.05	13.01	13.69	27.37	36.22	107.79	4.68	2.25	0.89	**251.5**
13	65	1.083	50.3	1352.3	11.72	11.95	13.12	12.57	13.32	14.68	33.59	51.93	169.90	6.74	2.74	1.79	**344.1**
14	70	1.167	56.9	1295.5	11.23	12.38	13.57	14.15	15.15	15.04	36.02	63.72	243.59	10.63	3.96	2.18	**441.6**
15	75	1.250	63.5	1304.2	11.30	11.86	14.05	14.63	17.05	17.10	36.90	68.33	298.91	15.24	6.23	3.15	**514.8**
16	80	1.333	69.9	1274.8	11.05	11.94	13.46	15.15	17.64	19.25	41.95	69.99	320.55	18.70	8.94	4.96	**553.6**
17	85	1.417	75.0	1002.4	8.69	11.67	13.55	14.51	18.26	19.91	47.23	79.58	328.34	20.05	10.97	7.11	**579.9**
18	90	1.500	78.9	785.8	6.81	9.17	13.25	14.61	17.49	20.61	48.84	89.59	373.30	20.54	11.76	8.73	**634.7**
19	95	1.583	82.6	718.2	6.22	7.19	10.42	14.28	17.61	19.75	50.57	92.64	420.26	23.35	12.05	9.36	**683.7**
20	100	1.667	85.8	643.2	5.57	6.57	8.17	11.23	17.21	19.88	48.45	95.92	434.60	26.29	13.70	9.59	**697.2**
21	105	1.750	88.3	485.6	4.21	5.89	7.46	8.80	13.54	19.43	48.77	91.90	449.99	27.19	15.42	10.90	**703.5**
22	110	1.833	90.2	384.3	3.33	4.44	6.68	8.05	10.61	15.28	47.67	92.52	431.11	28.15	15.95	12.28	**676.1**
23	115	1.917	91.9	338.4	2.93	3.52	5.05	7.21	9.70	11.98	37.49	90.43	434.00	26.97	16.51	12.69	**658.5**
24	120	2.000	93.5	305.8	2.65	3.10	3.99	5.44	8.68	10.95	29.39	71.11	424.19	27.15	15.82	13.14	**615.6**
25	125	2.083	94.7	246.2	2.13	2.80	3.52	4.31	6.56	9.80	26.86	55.74	333.57	26.54	15.93	12.59	**500.3**
26	130	2.167	95.7	194.8	1.69	2.25	3.18	3.79	5.19	7.40	24.05	50.94	261.49	20.87	15.57	12.68	**409.1**
27	135	2.250	96.5	155.7	1.35	1.78	2.56	3.43	4.57	5.86	18.16	45.62	238.99	16.36	12.24	12.39	**363.3**
28	140	2.333	97.1	126.3	1.09	1.42	2.02	2.76	4.13	5.16	14.37	34.45	214.02	14.95	9.60	9.74	**313.7**
29	145	2.417	97.7	121.4	1.05	1.16	1.62	2.18	3.32	4.66	12.66	27.26	161.60	13.39	8.77	7.64	**245.3**
30	150	2.500	98.1			1.11	1.31	1.74	2.63	3.75	11.43	24.01	127.86	10.11	7.85	6.98	**198.8**
31	155	2.583	98.3				1.26	1.41	2.10	2.97	9.21	21.69	112.61	8.00	5.93	6.25	**171.4**
32	160	2.667	98.5					1.36	1.71	2.37	7.28	17.46	101.74	7.05	4.69	4.72	**148.4**
33	165	2.750	98.7						1.64	1.92	5.82	13.82	81.91	6.37	4.13	3.73	**119.3**
34	170	2.833	98.9							1.85	4.72	11.04	64.81	5.12	3.73	3.29	**94.6**
35	175	2.917	99.1								4.54	8.96	51.80	4.05	3.01	2.97	**75.3**
36	180	3.000	99.3									8.61	42.02	3.24	2.38	2.39	**58.6**
37	185	3.083	99.5										40.40	2.63	1.90	1.89	**46.8**
38	190	3.167	99.8											2.53	1.54	1.51	**5.6**
39	195	3.250	99.9												1.48	1.23	**2.7**
40	200	3.333														1.18	**1.2**
41	205	3.417															**0.0**

	On-Site Watersheds: NW-A, NW-B, NW-C, NW-D, NW-E																																						On- + Off-Site
	Valley-Dev	K (cfs) =	5224.5																																				No Routing
	Unit																																					Runoff	Total
S-Graph	Hydrograph	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Hydrograph	Hydrograph
(%)	(cfs/in)	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.014	0.014	0.015	0.016	0.017	0.017	0.018	0.019	0.022	0.023	0.028	0.037	0.066	0.101	0.377	0.048	0.026	0.020	0.018	0.016	0.014	0.013	0.012	0.011	0.011	0.010	(cfs)	(cfs)
8.0	420.2	4.13																																				4.1	4.6
22.9	776.6	7.84	4.20																																			11.8	13.2
45.5	1179.3	11.59	7.76	4.35																																		23.7	26.2
72.5	1409.8	13.86	11.79	8.04	4.43																																	38.1	42.3
88.8	842.5	8.28	14.09	12.21	8.18	4.60																																47.4	54.2
95.5	361.8	3.56	8.42	14.59	12.43	8.50	4.89																															52.2	62.8
98.2	139.2	1.37	3.62	8.72	14.86	12.91	8.68	4.90																														55.0	70.4
99.3	56.0	0.57	1.39	3.74	8.88	15.44	13.17	9.05	5.01																													57.3	77.8
99.9	31.1	0.31	0.58	1.44	3.81	9.22	15.75	13.74	9.25	5.25																												59.4	85.4
		0.00	0.31	0.60	1.47	3.96	9.41	16.43	14.05	9.70	5.39																											61.3	93.6
		0.00	0.00	0.32	0.61	1.52	4.04	9.82	16.80	14.74	9.95	5.69																										63.5	103.0
		0.00	0.00	0.00	0.33	0.63	1.56	4.22	10.04	17.62	15.12	10.51	5.85																									65.9	113.0
		0.00	0.00	0.00	0.00	0.34	0.65	1.62	4.31	10.53	18.07	15.96	10.82	6.23																								68.5	123.8
		0.00	0.00	0.00	0.00	0.00	0.35	0.68	1.66	4.52	10.80	19.07	16.43	11.52	6.45																							71.5	134.9
		0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.69	1.74	4.64	11.40	19.64	17.49	11.92	6.95																						74.8	146.8
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.72	1.78	4.89	11.73	20.91	18.10	12.85	7.25																					78.8	159.3
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.74	1.88	5.04	12.50	21.64	19.52	13.40	7.61																				82.7	171.2
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.78	1.94	5.37	12.93	23.33	20.34	14.06	8.04																			87.2	182.8
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.81	2.07	5.55	13.94	24.32	21.35	14.85	9.12																		92.4	195.3
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.86	2.14	5.99	14.53	25.53	22.55	16.86	9.84																	98.7	209.1
			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.89	2.30	6.24	15.25	26.96	25.60	18.18	11.86																107.7	225.5
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.96	2.40	6.55	16.11	30.61	27.61	21.91	15.73															122.4	247.8
					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	1.00	2.52	6.92	18.29	33.00	33.27	29.06	27.63														152.2	288.3
						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	1.05	2.66	7.85	19.72	39.78	44.16	51.06	42.49													209.3	362.5
							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	1.11	3.02	8.47	23.77	52.79	77.54	78.52	158.50												404.3	605.0
								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	1.26	3.26	10.21	31.54	92.70	119.25	292.90	20.29											672.0	920.3
									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	1.36	3.93	13.55	55.39	142.56	444.80	37.49	10.72										710.5	995.2
										0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	1.64	5.21	23.79	85.19	531.75	56.93	19.81	8.53									733.6	1080.3
											0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	2.17	9.15	36.58	317.75	68.06	30.09	15.77	7.58								488.0	927.1
												0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	3.81	14.08	136.46	40.67	35.97	23.95	14.01	6.69							276.8	813.7
													0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.04	5.86	52.51	17.47	21.49	28.63	21.28	12.36	6.04						167.7	775.8
														0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.14	21.86	6.72	9.23	17.11	25.43	18.77	11.15	5.53					118.9	762.5
															0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.72	2.80	3.55	7.35	15.20	22.44	16.94	10.22	5.13				95.3	764.8
																0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.48	2.83	6.53	13.41	20.25	15.52	9.47	4.79			75.8	803.9
																	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	1.18	2.51	5.76	12.10	18.55	14.38	8.86	4.51		68.6	851.0
																		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	1.05	2.22	5.20	11.09	17.20	13.45	8.34	4.27	63.4	862.4
																			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.82	2.00	4.76	10.28	16.08	12.66	7.90	55.2	863.2
																				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.83	1.83	4.41	9.61	15.14	11.99	44.3	826.7
																					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.76	1.70	4.13	9.05	14.34	30.4	787.4
																						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.71	1.59	3.89	8.57	15.2	739.2
																							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.66	1.50	3.68	6.2	610.2
																								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.62	1.42	2.4	509.9
																									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.59	0.9	459.7
																										0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.3	406.1
																											0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	330.4
																												0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	278.8
																													0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	242.9
																														0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	213.2
																															0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	175.9
																																0.00	0.00	0.00	0.00	0.00	0.00	0.0	143.0
																																	0.00	0.00	0.00	0.00	0.00	0.0	116.2
																																		0.00	0.00	0.00	0.00	0.0	92.1
																																			0.00	0.00	0.00	0.0	74.5
																																				0.00	0.00	0.0	28.8
																																					0.00	0.0	19.9
																																						0.0	15.1
																																						0.0	11.6
																																						0.0	8.9
																																						0.0	6.7
																																						0.0	4.8
																																						0.0	3.3
																																						0.0	2.2
																																						0.0	1.3
																																						0.0	0.6
																																						0.0	0.0

	A (mi^2) =	0.12		On-Site Watersheds: N1-A												
				Valley-Dev	K (cfs) =	943.3										
	tstep, T =	5		Unit												
Step	Time		S-Graph	Hydrograph	1	2	3	4	5	6	7	8	9	10	11	12
#	(min)	(hr)	(%)	(cfs/in)	0.010	0.010	0.010	0.011	0.011	0.011	0.012	0.012	0.012	0.013	0.014	0.014
1	5	0.083	8.0	75.9	0.75											
2	10	0.167	22.9	140.2	1.38	0.76										
3	15	0.250	45.5	212.9	2.09	1.40	0.79									
4	20	0.333	72.5	254.6	2.50	2.13	1.45	0.80								
5	25	0.417	88.8	152.1	1.50	2.54	2.20	1.48	0.83							
6	30	0.500	95.5	65.3	0.64	1.52	2.63	2.24	1.54	0.85						
7	35	0.583	98.2	25.1	0.25	0.65	1.57	2.88	2.33	1.57	0.88					
8	40	0.667	99.3	10.5	0.10	0.25	0.68	1.80	2.79	2.38	1.63	0.90				
9	45	0.750	99.9	5.8	0.06	0.10	0.26	0.69	1.67	2.84	2.48	1.67	0.95			
10	50	0.833			0.00	0.06	0.11	0.28	0.72	1.70	2.97	2.54	1.75	0.97		
11	55	0.917			0.00	0.00	0.06	0.11	0.28	0.73	1.77	3.03	2.66	1.60	1.03	
12	60	1.000			0.00	0.00	0.00	0.06	0.11	0.28	0.78	1.61	3.16	2.73	1.90	1.06
13	65	1.083			0.00	0.00	0.00	0.00	0.06	0.12	0.29	0.78	1.90	3.28	2.88	1.95
14	70	1.167			0.00	0.00	0.00	0.00	0.00	0.06	0.12	0.30	0.82	1.95	3.44	2.97
15	75	1.250			0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.12	0.31	0.84	2.06	3.55
16	80	1.333			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.32	0.88	2.12
17	85	1.417			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.34	0.91
18	90	1.500			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.35
19	95	1.583			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.15
20	100	1.667			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
21	105	1.750			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	110	1.833			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	115	1.917			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	120	2.000			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	125	2.083			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	130	2.167			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	135	2.250			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	140	2.333			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	145	2.417			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	150	2.500				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	155	2.583					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	160	2.667						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	165	2.750							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	170	2.833								0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	175	2.917									0.00	0.00	0.00	0.00	0.00	0.00
36	180	3.000										0.00	0.00	0.00	0.00	0.00
37	185	3.083											0.00	0.00	0.00	0.00
38	190	3.167												0.00	0.00	0.00
39	195	3.250													0.00	0.00
40	200	3.333														0.00
41	205	3.417														
42	210	3.500														
43	215	3.583														
44	220	3.667														
45	225	3.750														
46	230	3.833														
47	235	3.917														
48	240	4.000														
49	245	4.083														
50	250	4.167														
51	255	4.250														
52	260	4.333														
53	265	4.417														
54	270	4.500														
55	275	4.583														
56	280	4.667														
57	285	4.750														
58	290	4.833														
59	295	4.917														
60	300	5.000														
61	305	5.083														
62	310	5.167														
63	315	5.250														
64	320	5.333														
65	325	5.417														

Step	13	14	15	16	17	18	19	20	21	22	23	24
#	0.015	0.015	0.017	0.017	0.018	0.019	0.022	0.023	0.028	0.037	0.088	0.101
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13	1.13											
14	2.08	1.16										
15	3.18	2.15	1.26									
16	3.78	3.27	2.32	1.31								
17	2.26	3.91	3.52	2.42	1.37							
18	0.97	2.33	4.21	3.87	2.54	1.45						
19	0.37	1.00	2.52	4.39	3.68	2.88	1.65					
20	0.16	0.39	1.08	2.82	4.61	4.07	3.04	1.78				
21	0.06	0.16	0.42	1.13	2.75	4.87	4.82	3.28	2.14			
22	0.00	0.09	0.17	0.43	1.18	2.91	5.53	4.98	3.96	2.84		
23	0.00	0.00	0.09	0.18	0.46	1.25	3.30	5.96	6.01	5.25	4.99	
24	0.00	0.00	0.00	0.10	0.19	0.48	1.42	3.56	7.18	7.97	9.22	7.67
25	0.00	0.00	0.00	0.00	0.10	0.20	0.55	1.53	4.29	9.53	14.00	14.18
26	0.00	0.00	0.00	0.00	0.00	0.11	0.23	0.59	1.84	5.70	16.74	21.53
27	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.24	0.71	2.45	10.00	25.74
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.30	0.94	4.30	15.38
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.39	1.65	6.81
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.69	2.54
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	1.06
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46						0.00	0.00	0.00	0.00	0.00	0.00	0.00
47							0.00	0.00	0.00	0.00	0.00	0.00
48								0.00	0.00	0.00	0.00	0.00
49									0.00	0.00	0.00	0.00
50										0.00	0.00	0.00
51											0.00	0.00
52												0.00
53												
54												
55												
56												
57												
58												
59												
60												
61												
62												
63												
64												
65												

Step	25	26	27	28	29	30	31	32	33	34	35	36	Runoff Hydrograph
#	0.377	0.048	0.028	0.020	0.018	0.016	0.014	0.013	0.012	0.011	0.011	0.010	(cfs)
1													0.7
2													2.1
3													4.3
4													6.9
5													8.6
6													9.4
7													9.9
8													10.3
9													10.7
10													11.1
11													11.5
12													11.8
13													12.4
14													12.9
15													13.6
16													14.2
17													14.9
18													15.7
19													16.7
20													17.6
21													18.6
22													22.1
23													27.5
24													37.8
25	28.82												73.0
26	52.69	3.66											103.3
27	80.31	6.77	1.94										128.3
28	96.01	10.28	3.58	1.54									132.5
29	57.37	12.29	5.43	2.85	1.37								88.1
30	24.64	7.34	6.49	4.32	2.53	1.21							60.0
31	9.46	3.15	3.88	5.17	3.84	2.23	1.09						30.3
32	3.95	1.21	1.87	3.09	4.59	3.39	2.01	1.00					21.5
33	2.12	0.51	0.84	1.33	2.74	4.05	3.06	1.65	0.93				17.2
34	0.00	0.27	0.27	0.51	1.18	2.42	3.68	2.80	1.71	0.87			13.7
35	0.00	0.00	0.14	0.21	0.45	1.04	2.18	3.35	2.60	1.80	0.81		12.4
36	0.00	0.00	0.00	0.11	0.19	0.40	0.94	2.00	3.11	2.43	1.51	0.77	11.6
37	0.00	0.00	0.00	0.00	0.10	0.17	0.38	0.86	1.88	2.90	2.29	1.43	10.0
38	0.00	0.00	0.00	0.00	0.00	0.09	0.15	0.33	0.80	1.73	2.73	2.17	8.0
39	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.14	0.31	0.75	1.83	2.59	5.8
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.29	0.70	1.55	2.7
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.12	0.27	0.66	1.1
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.11	0.26	0.4
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.11	0.2
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.1
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
54		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
55			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
56				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
57					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
58						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
59							0.00	0.00	0.00	0.00	0.00	0.00	0.0
60								0.00	0.00	0.00	0.00	0.00	0.0
61									0.00	0.00	0.00	0.00	0.0
62										0.00	0.00	0.00	0.0
63											0.00	0.00	0.0
64												0.00	0.0
65													0.0

A (mi^2) = 2.56 | tstep, T = 5

Kern County 3-Hour Unit Hydrograph, Existing Condition | Off-Site

Valley-Dev | K (cfs) = 19790.6

Step #	Time (min)	Time (hr)	S-Graph (%)	Unit Hydrograph (cfs/in)	1 (0.005)	2 (0.005)	3 (0.005)	4 (0.005)	5 (0.006)	6 (0.006)	7 (0.006)	8 (0.006)	9 (0.006)	10 (0.006)	11 (0.007)	12 (0.007)
1	5	0.083	0.5	92.0	0.46											
2	10	0.167	1.4	184.0	0.91	0.46										
3	15	0.250	2.5	224.7	1.12	0.83	0.48									
4	20	0.333	4.2	323.9	1.61	1.13	0.86	0.49								
5	25	0.417	6.7	510.6	2.53	1.63	1.17	0.98	0.51							
6	30	0.500	10.4	732.0	3.63	2.58	1.69	1.20	1.02	0.52						
7	35	0.583	16.0	898.3	4.46	3.69	2.67	1.72	1.24	1.04	0.54					
8	40	0.667	19.9	963.3	4.78	4.53	3.82	2.72	1.79	1.27	1.08	0.55				
9	45	0.750	24.8	888.7	4.90	4.86	4.69	3.89	2.82	1.83	1.32	1.11	0.58			
10	50	0.833	30.5	1121.8	5.57	4.98	5.03	4.78	4.04	2.88	1.91	1.35	1.16	0.60		
11	55	0.917	36.9	1262.8	6.27	5.66	5.15	5.12	4.96	4.13	3.00	1.95	1.42	1.19	0.63	
12	60	1.000	43.5	1308.0	6.48	6.37	5.86	5.25	5.32	5.06	4.30	3.07	2.04	1.45	1.26	0.65
13	65	1.083	50.3	1352.3	6.71	6.59	6.60	5.97	5.45	5.43	5.28	4.40	3.22	2.10	1.53	1.29
14	70	1.167	56.9	1295.6	6.43	6.82	6.82	6.72	6.20	5.56	5.66	5.40	4.62	3.30	2.21	1.58
15	75	1.250	63.5	1304.2	6.47	6.54	7.06	6.95	6.98	6.32	5.80	5.79	5.66	4.73	3.49	2.28
16	80	1.333	69.9	1274.8	6.32	6.58	6.77	7.19	7.22	7.12	6.60	5.83	6.07	5.81	5.00	3.59
17	85	1.417	75.0	1002.4	4.97	6.43	6.81	6.89	7.47	7.36	7.43	6.75	6.22	6.23	6.13	5.15
18	90	1.500	78.9	785.6	3.90	5.06	6.66	6.94	7.16	7.62	7.66	7.80	7.07	6.38	6.58	6.31
19	95	1.583	82.8	718.2	3.56	3.96	5.24	6.78	7.21	7.30	7.95	7.85	7.98	7.26	6.74	6.77
20	100	1.667	85.8	643.2	3.19	3.62	4.10	5.33	7.04	7.35	7.82	8.13	8.24	8.17	7.66	6.94
21	105	1.750	88.3	485.6	2.41	3.24	3.75	4.18	5.54	7.19	7.87	7.79	8.53	8.45	8.62	7.89
22	110	1.833	90.2	384.3	1.91	2.45	3.36	3.82	4.34	5.65	7.50	7.84	8.17	8.75	8.92	8.88
23	115	1.917	91.9	338.4	1.68	1.94	2.54	3.42	3.97	4.43	5.90	7.67	8.22	8.38	9.23	9.18
24	120	2.000	93.5	305.8	1.52	1.71	2.01	2.58	3.55	4.05	4.62	6.03	8.04	8.44	8.85	9.51
25	125	2.083	94.7	246.2	1.22	1.54	1.77	2.04	2.68	3.63	4.22	4.73	6.32	8.24	8.90	9.11
26	130	2.167	95.7	194.8	0.97	1.24	1.60	1.80	2.12	2.74	3.78	4.32	4.96	6.48	8.70	9.17
27	135	2.250	96.5	155.7	0.77	0.98	1.29	1.63	1.87	2.17	2.88	3.87	4.53	5.08	6.84	8.96
28	140	2.333	97.1	128.3	0.63	0.79	1.02	1.31	1.69	1.91	2.26	2.92	4.06	4.65	5.37	7.05
29	145	2.417	97.7	121.4	0.60	0.64	0.81	1.04	1.36	1.72	1.99	2.31	3.06	4.16	4.90	5.52
30	150	2.500	98.1	78.4		0.61	0.66	0.83	1.08	1.39	1.80	2.04	2.42	3.14	4.39	5.05
31	155	2.583	98.3	40.3			0.63	0.67	0.86	1.10	1.45	1.84	2.13	2.49	3.32	4.52
32	160	2.667	98.5	40.3				0.65	0.70	0.88	1.15	1.48	1.93	2.19	2.62	3.41
33	165	2.750	98.7	40.3					0.67	0.71	0.82	1.17	1.55	1.98	2.31	2.70
34	170	2.833	98.9	40.3						0.68	0.74	0.94	1.23	1.59	2.09	2.38
35	175	2.917	99.1	40.3							0.71	0.76	0.98	1.26	1.68	2.15
36	180	3.000	99.3	40.3								0.73	0.80	1.01	1.33	1.73
37	185	3.083	99.5	40.3									0.77	0.82	1.06	1.37
38	190	3.167	99.6	40.3										0.79	0.86	1.09
39	195	3.250	99.9	34.8											0.83	0.89
40	200	3.333														0.85
41	205	3.417														
42	210	3.500														
43	215	3.583														
44	220	3.667														
45	225	3.750														
46	230	3.833														
47	235	3.917														
48	240	4.000														
49	245	4.083														
50	250	4.167														
51	255	4.250														
52	260	4.333														
53	265	4.417														
54	270	4.500														
55	275	4.583														
56	280	4.667														
57	285	4.750														
58	290	4.833														
59	295	4.917														
60	300	5.000														
61	305	5.083														
62	310	5.167														
63	315	5.250														
64	320	5.333														
65	325	5.417														

Step #	13 (0.007)	14 (0.008)	15 (0.008)	16 (0.009)	17 (0.009)	18 (0.010)	19 (0.011)	20 (0.012)	21 (0.014)	22 (0.016)	23 (0.043)	24 (0.075)	25 (0.364)	26 (0.023)	27 (0.013)	28 (0.010)
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13	0.69															
14	1.38	0.71														
15	1.68	1.43	0.77													
16	2.42	1.74	1.54	0.80												
17	3.82	2.51	1.88	1.60	0.84											
18	5.48	3.95	2.71	1.96	1.68	0.89										
19	6.72	5.67	4.28	2.82	2.05	1.78	1.01									
20	7.21	6.96	6.11	4.44	2.96	2.17	2.02	1.09								
21	7.39	7.46	7.50	6.37	4.66	3.13	2.46	2.17	1.31							
22	8.40	7.64	8.04	7.82	6.69	4.93	3.55	2.65	2.62	1.48						
23	9.45	8.69	8.24	8.39	8.21	7.08	5.59	3.83	3.20	2.96	3.82					
24	9.78	9.78	9.37	8.59	8.80	8.67	8.02	6.03	4.61	3.61	7.84	7.17				
25	10.12	10.12	10.55	9.77	9.02	9.30	9.84	8.65	7.27	5.21	9.57	14.34	32.57			
26	9.70	10.47	10.91	10.99	10.25	9.52	10.55	10.61	10.42	8.20	13.80	17.52	65.14	2.31		
27	9.76	10.04	11.29	11.37	11.54	10.83	10.81	11.38	12.79	11.76	21.74	25.25	79.58	4.62	1.18	
28	9.54	10.10	10.82	11.77	11.93	12.19	12.29	11.66	13.71	14.43	31.17	39.80	114.88	5.64	2.37	0.94
29	7.50	9.87	10.89	11.28	12.36	12.60	13.84	13.25	14.05	15.48	38.25	57.06	180.74	8.13	2.89	1.89
30	5.88	7.77	10.65	11.35	11.84	13.05	14.31	14.92	15.97	15.85	41.02	70.02	259.14	12.82	4.17	2.30
31	5.38	6.09	8.37	11.10	11.92	12.50	14.82	15.43	17.98	18.03	42.02	75.09	317.99	18.38	6.57	3.32
32	4.81	5.56	6.56	8.73	11.65	12.59	14.19	15.97	18.59	20.30	47.77	78.91	341.01	22.55	9.42	5.23
33	3.64	4.98	6.00	6.84	9.16	12.30	14.29	15.30	19.25	20.99	53.78	87.45	349.31	24.19	11.56	7.50
34	2.88	3.76	5.37	6.25	7.18	9.67	13.97	15.41	18.45	21.73	55.62	98.45	397.13	24.78	12.40	9.21
35	2.53	2.98	4.06	5.60	6.56	7.58	10.98	15.06	18.57	20.82	57.59	101.80	447.09	28.17	12.70	9.87
36	2.29	2.62	3.21	4.23	5.88	6.93	8.61	11.84	18.15	20.96	55.17	105.41	462.35	31.71	14.44	10.11
37	1.84	2.37	2.83	3.34	4.44	6.21	7.87	9.28	14.27	20.49	55.54	100.99	478.72	32.79	16.26	11.50
38	1.46	1.91	2.55	2.95	3.51	4.69	7.05	8.48	11.19	16.11	54.29	101.88	458.63	33.96	16.81	12.94
39	1.17	1.51	2.06	2.66	3.09	3.71	5.32	7.60	10.23	12.63	42.69	99.37	461.71	32.53	17.41	13.38
40	0.95	1.21	1.63	2.14	2.79	3.27	4.21	5.74	9.16	11.54	33.47	78.14	451.28	32.75	16.68	13.86
41	0.91	0.98	1.30	1.70	2.25	2.95	3.71	4.54	6.91	10.34	30.59	61.25	354.87	32.01	16.79	13.28
42		0.94	1.05	1.36	1.78	2.38	3.35	4.00	5.47	7.80	27.39	55.98	278.18	25.17	16.41	13.37
43			1.01	1.10	1.42	1.88	2.70	3.61	4.82	6.17	20.88	50.13	254.24	19.73	12.91	13.08
44				1.06	1.15	1.50	2.13	2.91	4.35	5.44	16.36	37.88	227.68	18.03	10.12	10.27
45					1.11	1.22	1.71	2.30	3.50	4.91	14.41	29.95	171.92	16.15	9.25	8.05
46						1.17	1.38	1.84	2.77	3.96	13.02	26.38	136.03	12.19	8.28	7.36
47							1.33	1.49	2.22	3.13	10.46	23.83	119.80	9.65	6.25	6.59
48								1.43	1.80	2.50	8.29	19.19	108.24	8.50	4.95	4.98
49									1.73	2.03	6.63	15.18	87.14	7.68	4.36	3.94
50										1.95	5.38	12.13	68.95	6.18	3.94	3.47
51											5.17	9.84	55.11	4.89	3.17	3.13
52												9.46	44.70	3.91	2.51	2.52
53													42.98	3.17	2.00	2.00
54														3.05	1.63	1.60
55															1.56	1.29
56																1.24
57																
58																
59																
60																
61																
62																
63																
64																
65																

Step #	29 (0.009)	30 (0.008)	31 (0.007)	32 (0.007)	33 (0.006)	34 (0.006)	35 (0.005)	36 (0.005)	Runoff Hydrograph (cfs)	Combined & Routed Total Hydrograph (cfs)	Total Hydrograph (cfs)	On-Site NW Basins Routed Hydrograph (cfs)	Total Routed On-Site Hydrograph (cfs)
1									0.5	-0.20	0.84		
2									1.4	2.73	4.96		
3									2.5	9.07	13.36		
4									4.2	20.04	26.92		
5									6.8	36.28	44.82		
6									10.6	61.43	60.88		
7									16.4	63.41	73.36		
8									20.5	72.96	83.31		
9									26.0	81.38	92.07		
10									32.3	90.04	101.11		
11									39.8	99.30	110.77		
12									47.1	109.08	120.94		
13									55.3	119.43	131.80		
14									63.4	130.08	142.87		
15									72.0	141.32	154.84		
16									80.7	153.17	167.38		
17									88.5	164.47	179.41		
18									95.6	176.44	191.18		
19									102.9	188.87	203.88		
20									110.4	199.04	216.87		
21									117.7	211.78	231.20		
22									128.4	226.37	248.47		
23									138.1	246.78	274.23		
24									163.2	282.81	320.60	129.65	167.44
25									200.7	383.06	426.06	152.34	225.34
26									248.3	644.24	647.82	295.06	389.24
27									294.8	746.34	873.82	460.57	588.85
28									346.7	972.84	1106.09	625.95	756.40
29	0.84								438.1	1177.13	1265.25	738.07	826.19
30	1.68	0.74							536.9	1139.88	1169.66	602.71	852.68
31	2.05	1.48	0.87						605.3	1007.83	1038.10	399.66	429.93
32	2.95	1.81	1.33	0.81					643.6	894.07	916.64	250.50	271.97
33	4.65	2.60	1.63	1.22	0.57				669.2	834.49	881.70	165.27	182.48
34	6.68	4.10	2.35	1.49	1.13	0.53			728.2	849.25	862.93	121.08	134.77
35	8.18	5.88	3.70	2.15	1.38	1.06	0.50		762.4	873.93	886.33	91.57	103.98
36	8.77	7.22	5.31	3.39	1.99	1.29	1.00	0.47	799.6	876.83	887.29		
37	8.98	7.74	6.51	4.86	3.14	1.86	1.22	0.94	808.0	877.12	887.08		
38	10.21	7.93	6.98	5.97	4.51	2.94	1.76	1.15	782.4	843.77	861.77		
39	11.50	9.01	7.15	6.40	5.53	4.21	2.77	1.66	767.0	919.08	824.88		
40	11.89	10.15	8.13	6.55	5.93	5.17	3.97	2.62	724.0	763.91	768.88		
41	12.31	10.49	9.15	7.45	6.07	5.54	4.87	3.76	604.0	628.89	629.71		
42	11.79	10.86	9.47	8.39	6.91	5.68	5.22	4.61	607.8	620.32	620.75		
43	11.87	10.41	9.80	8.67	7.77	6.46	5.35	4.94	468.8	464.74	464.90		
44	11.61	10.48	9.39	8.98	8.04	7.27	6.08	5.06	408.8	408.43	408.49		
45	9.13	10.24	9.45	8.60	8.32	7.52	6.84	5.76	330.4	331.47	331.47		
46	7.15	8.05	9.24	8.66	7.97	7.78	7.08	6.48	276.8	277.17	277.17		
47	6.54	6.31	7.27	8.47	8.03	7.46	7.33	6.70	242.9	242.89	242.89		
48	5.88	5.77	5.70	6.66	7.86	7.51	7.02	6.94	213.2	213.20	213.20		
49	4.42	5.17	5.21	5.22	6.17	7.34	7.07	6.65	176.9	176.93	176.93		
50	3.50	3.90	4.66	4.77	4.84	5.77	6.91	6.69	143.0	143.04	143.04		
51	3.08	3.09	3.52	4.27	4.42	4.52	5.43	6.54	116.2	116.19	116.19		
52	2.78	2.72	2.78	3.23	3.96	4.13	4.26	5.14	92.1	92.11	92.11		
53	2.24	2.48	2.45	2.55	2.99	3.70	3.89	4.03	74.5	74.48	74.48		
54	1.77	1.98	2.22	2.25	2.37	2.80	3.49	3.69	28.8	28.81	28.81		
55	1.42	1.56	1.78	2.03	2.08	2.21	2.63	3.30	19.9	19.88	19.88		
56	1.15	1.25	1.41	1.63	1.88	1.95	2.08	2.49	16.1	16.09	16.09		
57	1.11	1.01	1.13	1.29	1.52	1.76	1.83	1.97	11.6	11.62	11.62		
58		0.98	0.92	1.03	1.20	1.42	1.66	1.74	8.9	8.93	8.93		
59			0.88	0.84	0.95	1.12	1.33	1.57	6.7	6.70	6.70		
60				0.81	0.78	0.90	1.06	1.26	4.8	4.80	4.80		
61					0.75	0.73	0.84	1.00	3.3	3.32	3.32		
62						0.70	0.68	0.80	2.2	2.18	2.18		
63							0.66	0.65	1.3	1.31	1.31		
64								0.62	0.8	0.82	0.82		
65									0.0	0.00	0.00		

	A (mi²) =	2.56		Kern County 3-Hour Unit Hydrograph, Ultimate Condition												
				Valley-Dev	K (cfs) =	19790.6										
	tstep, T =	5		Unit												
Step	Time		S-Graph	Hydrograph	1	2	3	4	5	6	7	8	9	10	11	12
#	(min)	(hr)	(%)	(cfs/in)	0.006	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.009	0.009
1	5	0.083	0.5	92.0	0.57											
2	10	0.167	1.4	164.0	1.14	0.58										
3	15	0.250	2.5	224.7	1.39	1.16	0.60									
4	20	0.333	4.2	323.9	2.00	1.41	1.20	0.61								
5	25	0.417	6.7	510.8	3.16	2.04	1.46	1.22	0.63							
6	30	0.500	10.4	732.0	4.53	3.21	2.11	1.49	1.27	0.65						
7	35	0.583	15.0	895.3	5.55	4.60	3.32	2.16	1.55	1.29	0.67					
8	40	0.667	19.9	963.3	5.96	5.65	4.76	3.38	2.23	1.58	1.35	0.69				
9	45	0.750	24.8	988.7	6.10	6.06	5.85	4.85	3.52	2.28	1.65	1.38	0.72			
10	50	0.833	30.5	1121.8	6.94	6.20	6.27	5.95	5.04	3.59	2.37	1.68	1.45	0.74		
11	55	0.917	36.9	1262.9	7.81	7.05	6.42	6.39	6.19	5.14	3.74	2.43	1.77	1.48	0.78	
12	60	1.000	43.5	1306.0	8.08	7.94	7.30	6.54	6.63	6.31	5.37	3.83	2.55	1.81	1.57	0.81
13	65	1.083	50.3	1352.3	8.36	8.21	8.22	7.44	6.79	6.77	6.58	5.49	4.01	2.61	1.91	1.61
14	70	1.167	56.9	1295.5	8.01	8.50	8.50	8.37	7.73	6.93	7.06	6.73	5.75	4.12	2.76	1.97
15	75	1.250	63.5	1304.2	8.06	8.15	8.80	8.66	8.70	7.88	7.23	7.22	7.06	5.90	4.34	2.84
16	80	1.333	69.9	1274.8	7.88	8.20	8.43	8.96	8.99	8.87	8.22	7.40	7.57	7.24	6.23	4.47
17	85	1.417	75.0	1002.4	6.20	8.01	8.49	8.59	9.31	9.18	9.26	8.41	7.76	7.76	7.64	6.41
18	90	1.500	78.9	785.6	4.86	6.30	8.30	8.65	8.92	9.50	9.57	9.47	8.82	7.95	8.20	7.87
19	95	1.583	82.6	716.2	4.44	4.94	6.53	8.46	8.98	9.10	9.91	9.79	9.93	9.04	8.40	8.44
20	100	1.667	85.8	643.2	3.98	4.52	5.11	6.64	8.78	9.16	9.50	10.14	10.26	10.18	9.55	8.64
21	105	1.750	88.3	485.6	3.00	4.04	4.67	5.21	6.90	8.96	9.56	9.71	10.63	10.53	10.75	9.83
22	110	1.833	90.2	384.3	2.38	3.05	4.19	4.76	5.41	7.04	9.34	9.78	10.18	10.90	11.11	11.06
23	115	1.917	91.9	338.4	2.09	2.42	3.18	4.26	4.95	5.52	7.35	9.55	10.25	10.44	11.51	11.44
24	120	2.000	93.5	305.8	1.89	2.13	2.50	3.22	4.43	5.05	5.76	7.51	10.02	10.51	11.02	11.85
25	125	2.083	94.7	246.2	1.52	1.82	2.20	2.55	3.34	4.52	5.26	5.89	7.88	10.28	11.10	11.35
26	130	2.167	95.7	194.8	1.20	1.55	1.99	2.24	2.65	3.41	4.71	5.38	6.18	8.08	10.85	11.43
27	135	2.250	96.5	155.7	0.96	1.22	1.60	2.03	2.33	2.70	3.56	4.82	5.64	6.33	8.53	11.17
28	140	2.333	97.1	120.3	0.78	0.96	1.27	1.63	2.11	2.38	2.82	3.64	5.05	5.79	6.69	8.78
29	145	2.417	97.7	121.4	0.75	0.79	1.01	1.29	1.70	2.15	2.48	2.88	3.82	5.18	6.11	6.88
30	150	2.500	98.1	78.4		0.76	0.82	1.03	1.34	1.73	2.24	2.54	3.02	3.91	5.47	6.29
31	155	2.583	98.3	40.3			0.79	0.84	1.07	1.37	1.80	2.29	2.66	3.10	4.13	5.63
32	160	2.667	98.5	40.3				0.80	0.87	1.09	1.43	1.84	2.40	2.73	3.27	4.25
33	165	2.750	98.7	40.3					0.84	0.89	1.14	1.46	1.93	2.46	2.88	3.37
34	170	2.833	98.9	40.3						0.85	0.93	1.17	1.53	1.98	2.60	2.96
35	175	2.917	99.1	40.3							0.89	0.95	1.22	1.57	2.09	2.68
36	180	3.000	99.3	40.3								0.91	0.99	1.25	1.66	2.16
37	185	3.083	99.5	40.3									0.95	1.02	1.32	1.71
38	190	3.167	99.6	40.3										0.98	1.07	1.36
39	195	3.250	99.9	34.8											1.03	1.11
40	200	3.333														1.06
41	205	3.417														
42	210	3.500														
43	215	3.583														
44	220	3.667														
45	225	3.750														
46	230	3.833														
47	235	3.917														
48	240	4.000														
49	245	4.083														
50	250	4.167														
51	255	4.250														
52	260	4.333														
53	265	4.417														
54	270	4.500														
55	275	4.583														
56	280	4.667														
57	285	4.750														
58	290	4.833														
59	295	4.917														
60	300	5.000														
61	305	5.083														
62	310	5.167														
63	315	5.250														
64	320	5.333														
65	325	5.417														

Step	13	14	15	16	17	18	19	20	21	22	23	24
#	0.009	0.010	0.010	0.011	0.011	0.012	0.014	0.016	0.024	0.031	0.069	0.095
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13	0.83											
14	1.72	0.89										
15	2.10	1.78	0.96									
16	3.02	2.17	1.91	1.00								
17	4.75	3.13	2.34	2.00	1.05							
18	6.83	4.93	3.37	2.44	2.10	1.11						
19	8.38	7.07	5.31	3.51	2.56	2.21	1.26					
20	8.99	8.67	7.62	5.54	3.69	2.70	2.51	1.35				
21	9.21	9.30	9.35	7.84	5.81	3.90	3.07	2.71	2.17			
22	10.47	9.53	10.03	9.75	8.34	6.14	4.42	3.31	4.34	2.86		
23	11.78	10.83	10.27	10.45	10.23	8.60	6.97	4.77	5.30	5.72	6.47	
24	12.19	12.19	11.68	10.71	10.97	10.80	10.00	7.52	7.64	6.99	10.93	8.72
25	12.62	12.61	13.14	12.17	11.24	11.59	12.27	10.76	12.04	10.08	13.35	17.44
26	12.09	13.06	13.59	13.70	12.77	11.87	13.15	13.22	17.27	15.88	19.25	21.30
27	12.17	12.51	14.07	14.17	14.38	13.49	13.47	14.16	21.19	22.77	30.34	30.70
28	11.89	12.59	13.48	14.67	14.87	16.19	15.32	14.53	22.73	27.94	43.50	46.39
29	9.35	12.31	13.57	14.06	15.40	15.71	17.25	16.52	23.26	29.97	53.37	69.38
30	7.33	9.68	13.27	14.15	14.76	18.28	17.83	18.59	26.47	30.70	57.24	85.14
31	6.70	7.59	10.43	13.83	14.85	15.68	16.47	19.23	29.79	34.90	68.63	91.30
32	6.00	6.93	8.18	10.88	14.52	15.69	17.69	19.91	30.81	39.29	66.68	93.52
33	4.53	6.21	7.47	8.53	11.41	15.33	17.61	19.07	31.90	40.63	75.04	106.33
34	3.58	4.69	6.69	7.79	8.96	12.06	17.41	19.20	30.56	42.07	77.60	119.71
35	3.16	3.71	5.05	6.98	8.18	9.46	13.89	16.77	30.77	40.30	80.35	123.79
36	2.85	3.27	4.00	5.27	7.32	8.64	10.73	14.76	30.07	40.57	76.98	128.17
37	2.30	2.95	3.52	4.17	5.53	7.73	9.81	11.87	23.65	39.66	77.50	122.79
38	1.82	2.38	3.18	3.67	4.38	5.84	8.76	10.57	18.54	31.19	75.75	123.62
39	1.45	1.88	2.56	3.32	3.85	4.82	6.63	9.47	16.94	24.46	59.56	120.83
40	1.18	1.50	2.03	2.67	3.48	4.07	6.25	7.16	15.17	22.34	46.69	95.01
41	1.13	1.22	1.62	2.11	2.80	3.88	4.62	5.66	11.46	20.01	42.87	74.46
42		1.17	1.31	1.69	2.22	2.96	4.17	4.98	9.07	15.11	38.22	68.07
43			1.26	1.37	1.77	2.34	3.38	4.50	7.98	11.95	28.88	60.96
44				1.32	1.44	1.87	2.68	3.62	7.21	10.53	22.83	46.03
45					1.38	1.52	2.13	2.87	5.61	9.51	20.11	36.42
46						1.46	1.72	2.29	4.59	7.66	18.17	32.08
47							1.66	1.86	3.87	6.06	14.63	28.98
48								1.79	2.98	4.84	11.57	23.33
49									2.86	3.93	9.25	18.46
50										3.78	7.50	14.78
51											7.21	11.97
52												11.51
53												
54												
55												
56												
57												
58												
59												
60												
61												
62												
63												
64												
65												

Step	25	26	27	28	29	30	31	32	33	34	35	36	Off-site Runoff Hydrograph	Off-Site & Routed Hydrograph	Total Hydrograph
#	0.371	0.042	0.018	0.013	0.011	0.010	0.009	0.008	0.008	0.007	0.007	0.006	(cfs)	(cfs)	(cfs)
1													0.8	-0.09	0.88
2													1.7	3.06	5.20
3													3.1	9.69	13.97
4													5.2	21.07	27.96
5													8.5	37.88	46.50
6													13.2	54.04	63.47
7													18.1	67.20	77.14
8													25.5	78.04	88.37
9													32.4	87.78	98.47
10													40.2	87.99	109.07
11													49.2	109.02	120.49
12													58.7	120.85	132.64
13													68.9	133.04	145.41
14													79.0	148.88	158.68
15													89.7	169.05	172.56
16													100.8	173.04	187.24
17													110.3	186.27	201.20
18													119.2	198.99	214.73
19													128.2	212.21	228.90
20													137.5	226.22	244.05
21													147.2	241.28	260.73
22													158.4	259.35	281.46
23													173.5	284.20	311.69
24													196.2	325.87	353.86
25	34.12												261.2	403.69	476.59
26	68.24	3.86											308.9	604.88	708.16
27	83.35	7.72	1.66										387.1	817.94	948.92
28	120.13	9.43	3.31	1.18									431.1	1067.01	1189.46
29	189.34	13.59	4.05	2.35	1.04								535.9	1273.84	1361.76
30	271.46	21.41	5.63	2.87	2.09	0.92							645.2	1247.88	1297.84
31	333.11	30.70	9.19	4.14	2.55	1.84	0.83						727.4	1127.01	1187.28
32	357.23	37.68	13.18	6.52	3.68	2.25	1.66	0.76					771.7	1022.21	1043.69
33	365.92	40.40	16.17	9.35	5.79	3.24	2.03	1.52	0.71				804.4	909.64	988.88
34	416.02	41.39	17.34	11.47	8.31	5.11	2.93	1.86	1.41	0.66			858.6	939.81	1003.59
35	468.35	47.05	17.76	12.30	10.19	7.33	4.81	2.68	1.72	1.32	0.62		827.8	1018.11	1031.81
36	464.33	52.97	20.19	12.60	10.93	8.99	6.61	4.23	2.49	1.61	1.24	0.69	846.4	1023.29	1034.74
37	501.48	54.78	22.73	14.33	11.20	9.64	8.11	6.06	3.92	2.32	1.52	1.18	853.4	1022.58	1032.52
38	480.44	56.72	23.51	16.13	12.73	9.88	8.70	7.43	5.62	3.66	2.19	1.44	821.8	882.87	990.97
39	483.66	54.34	24.34	18.88	14.33	11.23	8.91	7.97	6.89	5.25	3.45	2.07	896.8	948.90	954.39
40	472.73	54.70	23.32	17.27	14.82	12.64	10.13	8.17	7.39	6.44	4.94	3.27	843.4	883.31	886.04
41	371.75	53.47	23.48	18.55	15.34	13.08	11.41	9.28	7.57	6.91	6.07	4.66	711.0	735.61	736.74
42	291.41	42.05	22.94	18.66	14.70	13.54	11.80	10.46	8.61	7.08	6.51	5.74	600.8	813.22	813.86
43	266.33	32.96	18.04	16.28	14.80	12.97	12.21	10.81	9.69	8.05	6.66	6.16	539.2	845.22	645.49
44	238.51	30.12	14.14	12.60	14.46	13.06	11.70	11.19	10.02	9.06	7.58	6.31	476.5	479.13	479.19
45	180.10	26.96	12.93	10.04	11.37	12.76	11.76	10.72	10.37	9.37	8.53	7.17	391.9	392.99	392.89
46	142.50	20.37	11.58	9.17	8.92	10.04	11.51	10.79	9.94	9.70	8.82	8.08	329.4	328.78	329.75
47	125.50	16.12	8.74	8.21	8.15	7.87	9.05	10.65	10.01	9.29	9.13	8.35	257.8	287.98	287.95
48	113.38	14.19	6.92	6.20	7.30	7.19	7.10	8.30	9.78	9.36	8.78	8.65	251.8	261.68	261.66
49	91.29	12.82	6.09	4.91	5.51	6.44	6.49	6.50	7.69	9.14	8.81	8.29	206.8	208.49	208.49
50	72.22	10.32	5.50	4.32	4.36	4.86	5.81	5.94	6.03	7.19	8.61	8.34	169.8	169.68	169.66
51	57.73	8.17	4.43	3.91	3.84	3.85	4.39	5.32	5.51	5.64	6.77	8.15	135.9	136.88	136.89
52	46.83	6.53	3.51	3.14	3.47	3.39	3.47	4.02	4.93	5.16	5.31	6.41	107.7	107.87	107.87
53	45.02	5.30	2.80	2.49	2.79	3.08	3.06	3.18	3.73	4.61	4.85	5.03	85.9	85.91	85.91
54		5.09	2.27	1.99	2.21	2.46	2.76	2.80	2.95	3.48	4.34	4.59	38.0	34.96	34.96
55			2.19	1.61	1.77	1.95	2.22	2.53	2.60	2.78	3.28	4.11	25.0	25.01	25.01
56				1.55	1.43	1.56	1.78	2.04	2.35	2.43	2.80	3.11	18.8	18.81	18.81
57					1.38	1.26	1.41	1.61	1.89	2.19	2.29	2.46	14.6	14.48	14.48
58						1.22	1.14	1.29	1.49	1.77	2.07	2.16	11.1	11.13	11.13
59							1.10	1.05	1.19	1.40	1.66	1.96	8.4	8.38	8.38
60								1.00	0.97	1.12	1.32	1.57	6.0	5.98	5.98
61									0.93	0.91	1.05	1.25	4.1	4.13	4.13
62										0.87	0.85	1.00	2.7	2.72	2.72
63											0.82	0.81	1.6	1.63	1.63
64												0.78	0.8	0.78	0.78
65													0.0	0.00	0.00

tstep, dT* = 5.0						100-yr 3-hour	
Time (min)	Time (hr)	Inflow Hydrograph (cfs)	T + dT - dT* (min)	O(T+dT-dT*) (cfs)	O (T + dT) (cfs)	Outflow Hydrograph (cfs)	
0	0.000	0.00					
			6.2	0.0	0.0		
5	0.083	4.13				-0.66	
			11.2	2.80	2.80		
10	0.167	11.84				1.35	
			16.2	8.91	8.91		
15	0.250	23.71				6.54	
			21.2	18.92	18.92		
20	0.333	38.12				15.85	
			26.2	31.91	31.91		
25	0.417	47.37				29.44	
			31.2	42.37	42.37		
30	0.500	52.20				40.80	
			36.2	49.02	49.02		
35	0.583	55.05				48.05	
			41.2	53.10	53.10		
40	0.667	57.25				52.43	
			46.2	55.91	55.91		
45	0.750	59.36				55.36	
			51.2	58.25	58.25		
50	0.833	61.33				57.75	
			56.2	60.33	60.33		
55	0.917	63.49				59.82	
			61.2	62.47	62.47		
60	1.000	65.87				61.93	
			66.2	64.77	64.77		
65	1.083	68.53				64.17	
			71.2	67.31	67.31		
70	1.167	71.47				66.65	
			76.2	70.13	70.13		
75	1.250	74.83				69.37	
			81.2	73.31	73.31		
80	1.333	78.62				72.46	
			86.2	76.91	76.91		
85	1.417	82.71				75.98	
			91.2	80.83	80.83		
90	1.500	87.19				79.82	
			96.2	85.13	85.13		
95	1.583	92.43				83.97	
			101.2	90.07	90.07		
100	1.667	98.72				88.69	
			106.2	95.93	95.93		
105	1.750	107.75				94.03	
			111.2	103.93	103.93		
110	1.833	122.36				100.97	
			116.2	116.40	116.40		
115	1.917	152.23				110.66	
			121.2	140.64	140.64		
120	2.000	209.31				129.65	
			126.2	187.10	187.10		
125	2.083	404.28				152.34	
			131.2	334.05	334.05		
130	2.167	572.00				295.96	
			136.2	495.05	495.05		
135	2.250	710.47				460.57	
			141.2	640.80	640.80		
140	2.333	733.58				625.95	
			146.2	703.58	703.58		
145	2.417	488.04				738.07	Peak routed outflow
			151.2	557.74	557.74		
150	2.500	276.80				602.71	
			156.2	367.65	367.65		
155	2.583	167.68				399.66	
			161.2	232.35	232.35		
160	2.667	118.95				250.50	
			166.2	155.62	155.62		
165	2.750	95.34				165.27	
			171.2	114.83	114.83		
170	2.833	75.78				121.08	
			176.2	88.41	88.41		
175	2.917	68.65				91.57	
			181.2	75.04	75.04		

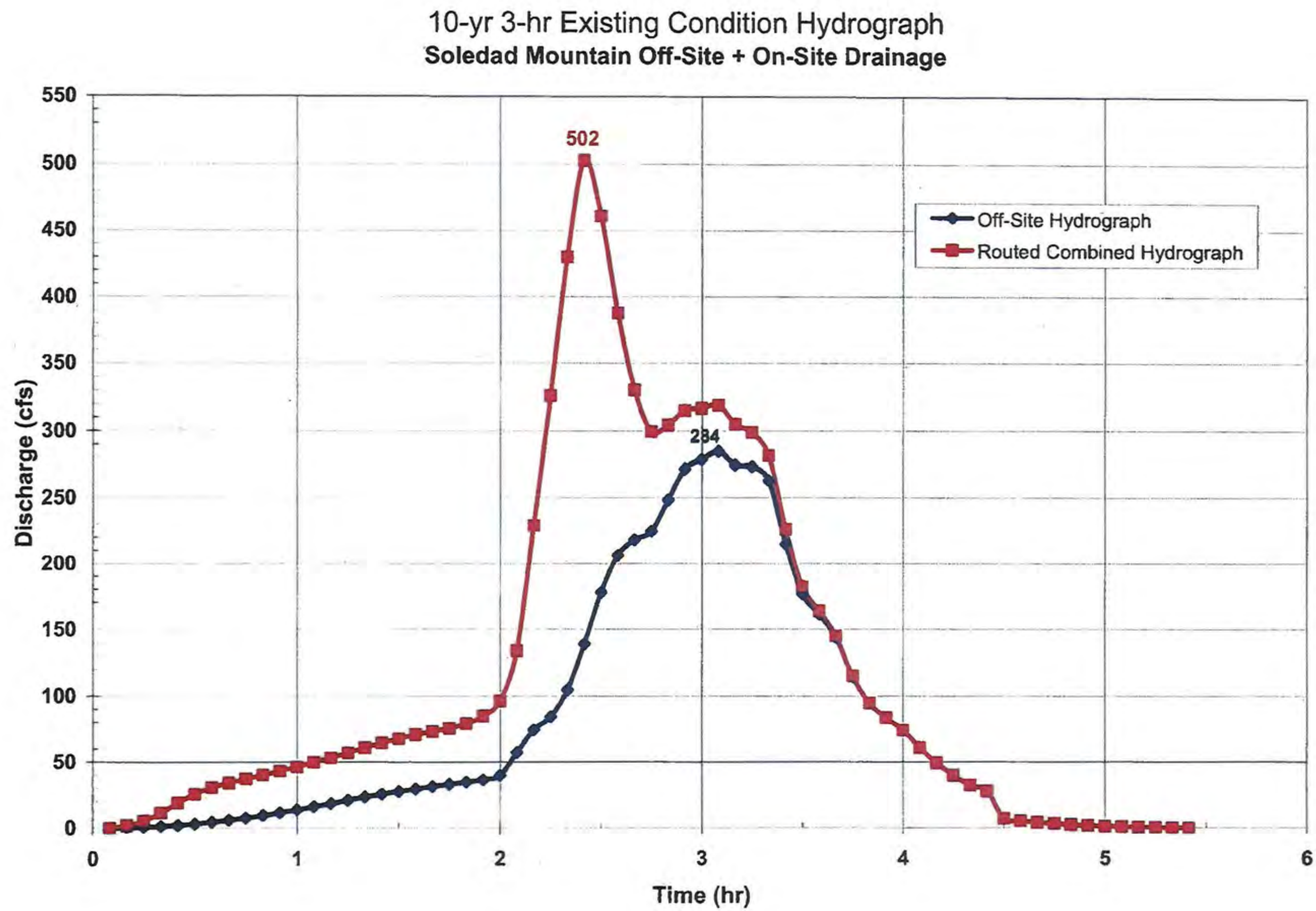
Channel Hydraulics

Parameter	Value	Comments
V (ft/s)	4.50	WMS Channel Calculator
A (ft^2)	74	WMS Channel Calculator
P (ft)	50.40	WMS Channel Calculator
R (ft)	1.47	calculated
L (ft)	2300	Design length
S (ft/ft)	0.0050	Design/assumed
n	0.030	Design/assumed
K (hr)	0.142	Eq. (H.5)
K (min)	8.52	
C	0.73	Eq. (H.4)
dT (hr)	0.103	K * C, Eq. (H.8)
dT (min)	6.18	
C*	0.68	Eq. (H.6)
E	0.872	(dT*+0.5dT)/(1.5dT)

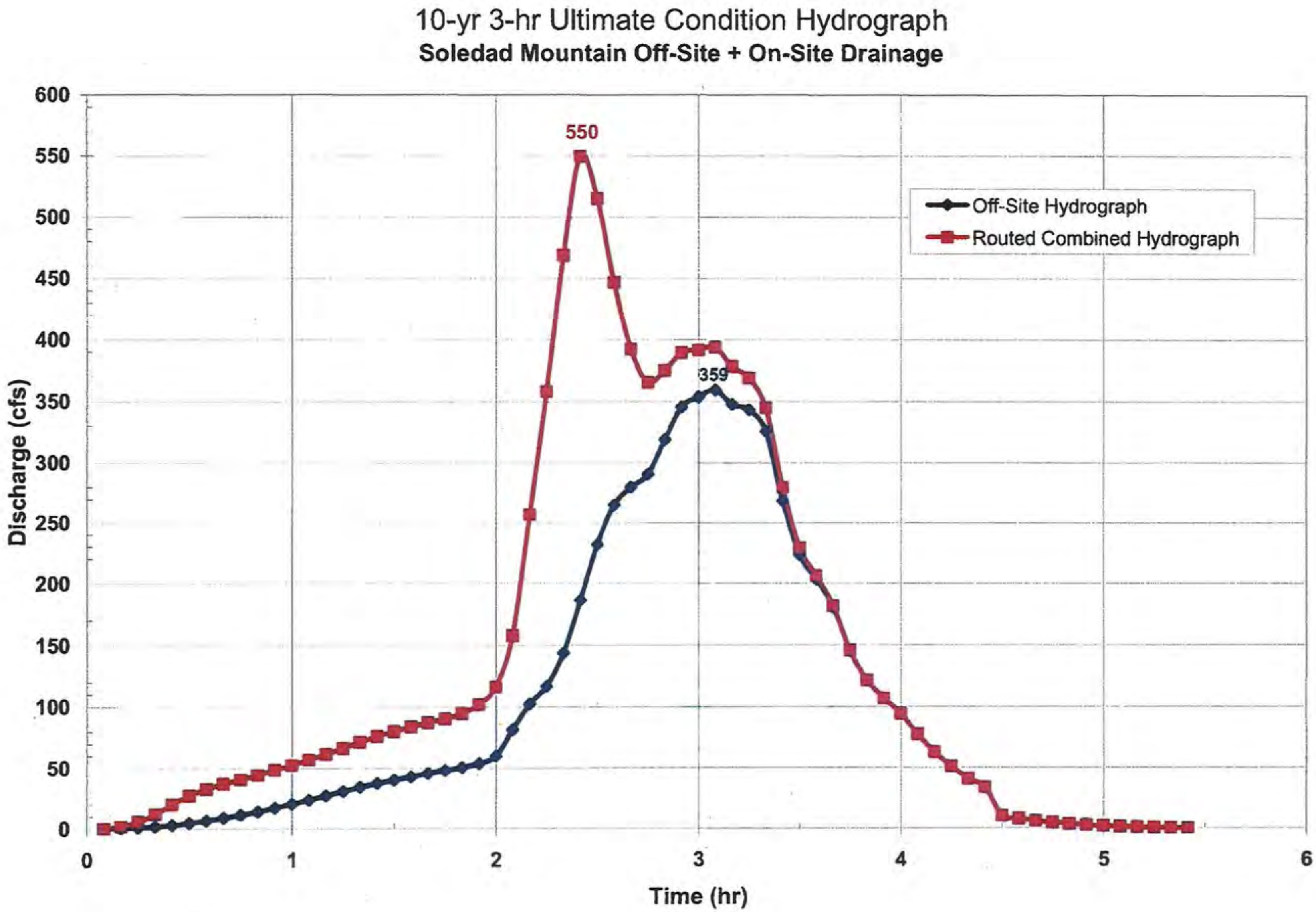
Trapezoidal channel

b = 40 ft
z1:1 = 3.0
z2:1 = 3.0

180	3.000	63.44				76.90	
			186.2	67.19	67.19		
185	3.083	55.16				69.11	
			191.2	59.05	59.05		
190	3.167	44.31				61.41	
			196.2	49.08	49.08		
195	3.250	30.42				52.07	
			201.2	36.45	36.45		
200	3.333	15.16				39.86	
			206.2	22.04	22.04		
205	3.417	6.21				24.58	
			211.2	11.33	11.33		
210	3.500	2.39				12.76	
			216.2	5.28	5.28		
215	3.583	0.92				5.98	
			221.2	2.33	2.33		
220	3.667	0.32				2.66	
			226.2	0.97	0.97		
225	3.750	0.00				1.12	
			231.2	0.31	0.31		
230	3.833	0.00				0.36	
			236.2	0.10	0.10		
235	3.917	0.00				0.12	
			241.2	0.03	0.03		
240	4.000	0.00				0.04	
			246.2	0.01	0.01		
245	4.083	0.00				0.01	
			251.2	0.00	0.00		
250	4.167	0.00				0.00	
			256.2	0.00	0.00		
255	4.250	0.00				0.00	
			261.2	0.00	0.00		
260	4.333	0.00				0.00	
			266.2	0.00	0.00		
265	4.417	0.00				0.00	
			271.2	0.00	0.00		
270	4.500	0.00				0.00	
			276.2	0.00	0.00		
275	4.583	0.00				0.00	
			281.2	0.00	0.00		
280	4.667	0.00				0.00	
			286.2	0.00	0.00		
285	4.750	0.00				0.00	
			291.2	0.00	0.00		
290	4.833	0.00				0.00	
			296.2	0.00	0.00		
295	4.917	0.00				0.00	
			301.2	0.00	0.00		
300	5.000	0.00				0.00	
			306.2	0.00	0.00		
305	5.083	0.00				0.00	
			311.2	0.00	0.00		
310	5.167	0.00				0.00	
			316.2	0.00	0.00		
315	5.250	0.00				0.00	
			321.2	0.00	0.00		
320	5.333	0.00				0.00	
			326.2	0.00	0.00		
325	5.417	0.00				0.00	



10-yr 3-hr Existing Condition Hydrograph
Soledad Mountain Off-Site + On-Site Drainage
Discharge (cfs)
Time (hr)
Off-Site Hydrograph
Routed Combined Hydrograph
502
284
0
50
100
150
200
250
300
350
400
450
500
550
0
1
2
3
4
5
6


10-yr 3-hr Ultimate Condition Hydrograph
Soledad Mountain Off-Site + On-Site Drainage
Off-Site Hydrograph
Routed Combined Hydrograph
550
359
Discharge (cfs)
Time (hr)
600
550
500
450
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6

Source:		NRCS	(Fig. C-5)	(Fig. C-3)	(Fig. C-2)			100-yr			10-yr		
Land Use	Area Fraction	Soil Group	F_p	a_p	F_m	CN	S	Pervious Area Yield, Y	Low Loss $\bar{Y}$	F*	Pervious Area Yield, Y	Low Loss $\bar{Y}$	F*
Units	(dec.)		(in/hr)	(dec.)	(in/hr)		(in)	(dec.)	(dec.)	(in/hr)	(dec.)	(dec.)	(in/hr)
Open Brush, fair condition	1.0	A/B/D	0.62	1.0	0.62	66	5.15	0.107	0.893		0.107	0.893	
					0.052	(inches in 5 minutes)							
Ultimate (Based on On-Site)	1.0	A/B	0.38	0.90	0.34	80	2.50	0.325	0.675		0.325	0.675	
					0.029	(inches in 5 minutes)							
Ultimate (Based on Off-Site)	1.0	A/B/D	0.55	0.76	0.42	70	4.29	0.156	0.844		0.156	0.844	
					0.035	(inches in 5 minutes)							
Ultimate (Weighted)	1.0	A/B/D	0.51	0.79	0.40	72	3.82	0.189	0.811		0.189	0.811	
					0.034	(inches in 5 minutes)							

depth-area reduction 0.97 for d=5 minutes (Fig. E-4)

Timestep #	Time (min)	Rainfall Intensity (in/hr)	Rainfall Depth (in)	Adjusted Depth (in)	Incremental Depth (in)	Storm Time (min)	3-hour Re-ordered Timestep #	Unit Rainfall Depth (in)	Off-Site Existing Condition Unit Loss, F* (in)	Off-Site Existing Condition Effective Rainfall Depth (in)	Off-Site Ultimate Condition Unit Loss, F* (in)	Off-Site Ultimate Condition Effective Rainfall Depth (in)	On-Site Ultimate Condition Unit Loss, F* (in)	On-Site Ultimate Condition Effective Rainfall Depth (in)
1	5	2.62	0.218	0.212	0.212	840	36	0.014	0.012	0.001	0.012	0.002	0.009	0.004
2	10	1.73	0.288	0.279	0.068	845	35	0.014	0.012	0.001	0.012	0.002	0.009	0.005
3	15	1.36	0.339	0.329	0.049	850	33	0.014	0.013	0.002	0.012	0.002	0.010	0.005
4	20	1.14	0.380	0.369	0.040	855	32	0.015	0.013	0.002	0.012	0.002	0.010	0.005
5	25	1.00	0.416	0.403	0.034	860	30	0.015	0.014	0.002	0.013	0.002	0.010	0.005
6	30	0.89	0.447	0.434	0.031	865	29	0.015	0.014	0.002	0.013	0.002	0.010	0.005
7	35	0.82	0.476	0.461	0.028	870	27	0.016	0.014	0.002	0.013	0.002	0.011	0.005
8	40	0.75	0.502	0.487	0.025	875	26	0.016	0.015	0.002	0.014	0.003	0.011	0.005
9	45	0.70	0.526	0.510	0.023	880	24	0.017	0.015	0.002	0.014	0.003	0.011	0.006
10	50	0.66	0.549	0.532	0.022	885	23	0.017	0.015	0.002	0.015	0.003	0.012	0.006
11	55	0.62	0.570	0.553	0.021	890	21	0.018	0.016	0.002	0.015	0.003	0.012	0.006
12	60	0.59	0.590	0.572	0.020	895	20	0.019	0.017	0.002	0.016	0.003	0.013	0.006
13	65	0.57	0.614	0.596	0.023	900	18	0.020	0.018	0.002	0.017	0.003	0.013	0.006
14	70	0.55	0.637	0.618	0.022	905	17	0.020	0.018	0.002	0.017	0.003	0.014	0.007
15	75	0.53	0.659	0.640	0.022	910	15	0.022	0.019	0.002	0.018	0.003	0.015	0.007
16	80	0.51	0.681	0.661	0.021	915	14	0.022	0.020	0.002	0.019	0.003	0.015	0.007
17	85	0.50	0.702	0.681	0.020	920	12	0.020	0.017	0.002	0.017	0.003	0.013	0.006
18	90	0.48	0.722	0.700	0.020	925	11	0.021	0.018	0.002	0.017	0.003	0.014	0.007
19	95	0.47	0.742	0.720	0.019	930	9	0.023	0.021	0.003	0.020	0.004	0.016	0.008
20	100	0.46	0.761	0.738	0.019	935	8	0.025	0.023	0.003	0.021	0.004	0.017	0.008
21	105	0.45	0.780	0.756	0.018	940	6	0.031	0.027	0.003	0.026	0.005	0.021	0.010
22	110	0.44	0.798	0.774	0.018	945	5	0.034	0.031	0.004	0.029	0.005	0.023	0.011
23	115	0.43	0.816	0.791	0.017	950	3	0.049	0.044	0.005	*0.035*	0.014	*0.029*	0.021
24	120	0.42	0.833	0.808	0.017	955	2	0.068	*0.052*	0.016	*0.035*	0.033	*0.029*	0.039
25	125	0.41	0.851	0.825	0.017	960	1	0.212	*0.052*	0.160	*0.035*	0.177	*0.029*	0.183
26	130	0.40	0.867	0.841	0.016	965	4	0.040	0.036	0.004	0.034	0.006	0.027	0.013
27	135	0.39	0.884	0.857	0.016	970	7	0.028	0.025	0.003	0.023	0.004	0.019	0.009
28	140	0.39	0.900	0.873	0.016	975	10	0.022	0.020	0.002	0.019	0.003	0.015	0.007
29	145	0.38	0.916	0.888	0.015	980	13	0.023	0.021	0.002	0.020	0.004	0.016	0.008
30	150	0.37	0.931	0.903	0.015	985	16	0.021	0.019	0.002	0.018	0.003	0.014	0.007
31	155	0.37	0.947	0.918	0.015	990	19	0.019	0.017	0.002	0.016	0.003	0.013	0.006
32	160	0.36	0.962	0.933	0.015	995	22	0.018	0.016	0.002	0.015	0.003	0.012	0.006
33	165	0.36	0.977	0.947	0.014	1000	25	0.017	0.015	0.002	0.014	0.003	0.011	0.005
34	170	0.35	0.991	0.962	0.014	1005	28	0.016	0.014	0.002	0.013	0.002	0.011	0.005
35	175	0.34	1.006	0.976	0.014	1010	31	0.015	0.013	0.002	0.013	0.002	0.010	0.005
36	180	0.34	1.020	0.989	0.014	1015	34	0.014	0.013	0.002	0.012	0.002	0.010	0.005
				Total =	0.989					0.252		0.327		0.458
								F_m =	*0.052*					

A (mi²) = 0.68 | On-Site Watersheds: NW-A, NW-B, NW-C, NW-D, NW-E

Valley-Dev | K (cfs) = 5224.5

tstep, T = 5

Step #	Time (min)	Time (hr)	S-Graph (%)	Unit Hydrograph (cfs/in)	1	2	3	4	5	6	7	8	9	10	11	12
					0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006
1	5	0.083	8.0	420.2	1.88											
2	10	0.167	22.9	778.6	3.48	1.91										
3	15	0.250	45.5	1179.3	5.28	3.53	1.97									
4	20	0.333	72.5	1409.8	6.31	5.36	3.63	2.00								
5	25	0.417	89.6	842.5	3.77	6.40	5.52	3.69	2.06							
6	30	0.500	95.5	361.8	1.62	3.83	6.60	5.61	3.82	2.10						
7	35	0.583	98.2	139.2	0.62	1.64	3.94	6.70	5.79	3.88	2.18					
8	40	0.667	99.3	58.0	0.26	0.63	1.69	4.01	6.93	5.90	4.03	2.22				
9	45	0.750	99.9	31.1	0.14	0.26	0.66	1.72	4.14	7.05	6.12	4.11	2.31			
10	50	0.833			0.00	0.14	0.27	0.66	1.76	4.21	7.31	6.23	4.28	2.37		
11	55	0.917			0.00	0.00	0.15	0.28	0.68	1.81	4.37	7.45	6.50	4.37	2.46	
12	60	1.000			0.00	0.00	0.00	0.15	0.28	0.70	1.88	4.45	7.77	6.64	4.58	2.54
13	65	1.083			0.00	0.00	0.00	0.00	0.15	0.29	0.72	1.91	4.64	7.94	6.98	4.70
14	70	1.167			0.00	0.00	0.00	0.00	0.00	0.16	0.30	0.74	1.99	4.74	8.32	7.13
15	75	1.250			0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.31	0.77	2.04	4.97	8.53
16	80	1.333			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.32	0.78	2.13	5.10
17	85	1.417			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.33	0.82	2.19
18	90	1.500			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.34	0.84
19	95	1.583			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.35
20	100	1.667			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
21	105	1.750				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	110	1.833					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	115	1.917						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	120	2.000							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	125	2.083								0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	130	2.167									0.00	0.00	0.00	0.00	0.00	0.00
27	135	2.250										0.00	0.00	0.00	0.00	0.00
28	140	2.333											0.00	0.00	0.00	0.00
29	145	2.417												0.00	0.00	0.00
30	150	2.500													0.00	0.00
31	155	2.583														0.00
32	160	2.667														
33	165	2.750														
34	170	2.833														
35	175	2.917														
36	180	3.000														
37	185	3.083														
38	190	3.167														
39	195	3.250														
40	200	3.333														
41	205	3.417														
42	210	3.500														
43	215	3.583														
44	220	3.667														
45	225	3.750														
46	230	3.833														
47	235	3.917														
48	240	4.000														
49	245	4.083														
50	250	4.167														
51	255	4.250														
52	260	4.333														
53	265	4.417														
54	270	4.500														
55	275	4.583														
56	280	4.667														
57	285	4.750														
58	290	4.833														
59	295	4.917														
60	300	5.000														
61	305	5.083														
62	310	5.167														
63	315	5.250														
64	320	5.333														
65	325	5.417														

Step #	13	14	15	16	17	18	19	20	21	22	23	24
	0.006	0.007	0.007	0.007	0.006	0.007	0.008	0.008	0.010	0.011	0.021	0.039
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13	2.68											
14	4.98	2.76										
15	7.53	5.11	2.95									
16	9.00	7.76	5.45	3.06								
17	5.38	9.27	8.26	5.65	2.67							
18	2.31	5.54	9.89	8.58	4.94	2.82						
19	0.89	2.38	5.91	10.26	7.50	5.21	3.20					
20	0.37	0.92	2.54	6.13	8.96	7.92	5.92	3.45				
21	0.20	0.38	0.98	2.63	5.35	9.46	8.99	6.38	4.16			
22	0.00	0.20	0.41	1.01	2.30	5.66	10.75	9.69	7.69	4.70		
23	0.00	0.00	0.22	0.42	0.88	2.43	6.42	11.59	11.68	8.68	8.70	
24	0.00	0.00	0.00	0.23	0.37	0.93	2.76	6.92	13.96	13.18	16.08	16.48
25	0.00	0.00	0.00	0.00	0.20	0.39	1.06	2.97	8.34	15.76	24.43	30.42
26	0.00	0.00	0.00	0.00	0.00	0.21	0.44	1.14	3.58	9.42	29.20	46.20
27	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.48	1.38	4.04	17.46	55.23
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.57	1.56	7.49	33.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.65	2.88	14.17
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	1.20	5.45
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	2.27
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.22
33		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37						0.00	0.00	0.00	0.00	0.00	0.00	0.00
38							0.00	0.00	0.00	0.00	0.00	0.00
39								0.00	0.00	0.00	0.00	0.00
40									0.00	0.00	0.00	0.00
41										0.00	0.00	0.00
42											0.00	0.00
43												0.00
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Step #	25	26	27	28	29	30	31	32	33	34	35	36	Runoff Hydrograph (cfs)	On- + Off-Site No Routing Total Hydrograph (cfs)
	0.183	0.013	0.009	0.007	0.008	0.007	0.006	0.005	0.005	0.005	0.005	0.005		
1													1.9	2.0
2													6.4	6.8
3													10.6	11.8
4													17.3	18.5
5													21.8	23.8
6													23.8	26.7
7													24.8	29.3
8													25.7	31.7
9													26.5	34.2
10													27.3	36.8
11													28.1	38.7
12													29.0	42.8
13													30.0	46.2
14													31.1	49.6
15													32.4	53.3
16													33.9	57.2
17													34.6	60.4
18													35.4	62.9
19													35.9	65.3
20													36.4	67.6
21													36.5	71.5
22													42.4	77.0
23													51.0	87.5
24													70.9	110.5
25	77.03												160.9	217.7
26	142.36	5.47											238.0	312.3
27	216.16	10.11	3.78										308.9	393.2
28	258.44	15.35	6.98	3.00									326.6	431.2
29	154.43	18.35	10.56	5.54	3.16								210.1	348.8
30	66.32	10.96	12.63	8.41	5.87	2.85							114.0	291.4
31	25.52	4.71	7.55	10.05	8.92	5.27	2.61						67.5	273.4
32	10.62	1.81	3.24	6.01	10.66	8.00	4.82	2.42					48.8	266.7
33	5.69	0.78	1.25	2.58	6.37	9.57	7.32	4.47	2.27				40.3	264.7
34	0.00	0.40	0.52	0.99	2.74	5.72	8.76	6.79	4.19	2.14			32.2	280.4
35	0.00	0.00	0.28	0.41	1.05	2.46	5.23	8.12	6.38	3.95	2.03		29.9	301.2
36	0.00	0.00	0.00	0.22	0.44	0.94	2.25	4.85	7.60	6.00	3.75	1.94	28.0	308.6
37	0.00	0.00	0.00	0.00	0.23	0.39	0.86	2.08	4.54	7.18	5.70	3.58	24.9	309.0
38	0.00	0.00	0.00	0.00	0.00	0.21	0.36	0.80	1.95	4.29	6.81	5.44	19.9	294.2
39	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.33	0.76	1.84	4.07	6.50	13.7	286.8
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.31	0.71	1.75	3.88	6.8	269.6
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.29	0.67	1.67	2.8	217.4
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.28	0.64	1.1	177.4
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.27	0.4	161.6
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.1	144.0
45		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	114.6
46			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	94.8
47				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	83.6
48					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	74.3
49						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	61.0
50							0.00	0.00	0.00	0.00	0.00	0.00	0.0	49.4
51								0.00	0.00	0.00	0.00	0.00	0.0	39.9
52									0.00	0.00	0.00	0.00	0.0	32.3
53										0.00	0.00	0.00	0.0	27.8
54											0.00	0.00	0.0	7.2
55												0.00	0.0	5.6
56													0.0	4.3
57													0.0	3.3
58													0.0	2.6
59													0.0	1.9
60													0.0	1.4
61													0.0	1.0
62													0.0	0.6
63													0.0	0.4
64													0.0	0.2
65													0.0	0.0

A (mi^2) = 0.12 — On-Site Watersheds: N1-A

Valley-Dev — K (cfs) = 943.3

tstep, T = 5

Step #	Time (min)	Time (hr)	S-Graph (%)	Unit Hydrograph (cfs/in)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Runoff Hydrograph (cfs)
					0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.006	0.007	0.008	0.008	0.010	0.011	0.021	0.039	0.183	0.013	0.009	0.007	0.008	0.007	0.006	0.006	0.005	0.005	0.005	0.005	
1	5	0.083	8.0	75.9	0.34																																				0.3
2	10	0.167	22.9	140.2	0.63	0.34																																			1.0
3	15	0.250	45.5	212.9	0.95	0.64	0.36																																		1.9
4	20	0.333	72.5	254.6	1.14	0.97	0.66	0.38																																	3.1
5	25	0.417	88.8	152.1	0.68	1.16	1.00	0.67	0.37																																3.9
6	30	0.500	95.5	65.3	0.29	0.69	1.19	1.01	0.69	0.38																															4.3
7	35	0.583	98.2	25.1	0.11	0.30	0.71	1.21	1.05	0.70	0.39																														4.5
8	40	0.667	99.3	10.5	0.05	0.11	0.31	0.72	1.25	1.06	0.73	0.40																													4.6
9	45	0.750	99.9	5.6	0.03	0.05	0.12	0.31	0.75	1.27	1.10	0.74	0.42																												4.8
10	50	0.833			0.00	0.03	0.05	0.12	0.32	0.76	1.32	1.13	0.77	0.43																											4.9
11	55	0.917			0.00	0.00	0.03	0.05	0.12	0.33	0.79	1.35	1.17	0.79	0.45																										5.1
12	60	1.000			0.00	0.00	0.00	0.03	0.05	0.13	0.34	0.80	1.40	1.20	0.83	0.46																									5.2
13	65	1.083			0.00	0.00	0.00	0.00	0.03	0.05	0.13	0.35	0.84	1.43	1.26	0.85	0.48																								5.4
14	70	1.167			0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.13	0.36	0.88	1.50	1.29	0.90	0.50																							5.6
15	75	1.250			0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.14	0.37	0.90	1.54	1.36	0.92	0.53																						5.8
16	80	1.333			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.14	0.39	0.92	1.63	1.40	0.98	0.55																					6.1
17	85	1.417			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.15	0.40	0.97	1.67	1.49	1.02	0.48																				6.3
18	90	1.500			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.15	0.42	1.00	1.79	1.55	0.89	0.51																			6.4
19	95	1.583			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.16	0.43	1.07	1.85	1.35	0.94	0.58																		6.5
20	100	1.667			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.17	0.46	1.11	1.62	1.43	1.07	0.62																	6.6
21	105	1.750			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.18	0.48	0.97	1.71	1.62	1.15	0.75																7.0
22	110	1.833			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.18	0.42	1.02	1.94	1.75	1.39	0.85															7.7
23	115	1.917			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.18	0.44	1.16	2.09	2.11	1.57	1.57														9.2
24	120	2.000			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.17	0.50	1.25	2.52	2.38	2.90	2.97													12.8
25	125	2.083			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.19	0.54	1.51	2.85	4.41	5.49	13.91												29.0
26	130	2.167			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.21	0.65	1.70	5.27	8.34	25.70	0.99											43.0
27	135	2.250			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.25	0.73	3.15	9.97	39.03	1.82	0.68										55.8
28	140	2.333			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.28	1.35	5.96	46.66	2.77	1.26	0.54									59.0
29	145	2.417			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.12	0.52	2.56	27.86	3.31	1.91	1.00	0.57								37.9
30	150	2.500				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.22	0.98	11.97	1.98	2.28	1.52	1.06	0.51							20.6
31	155	2.583					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.41	4.61	0.85	1.36	1.81	1.61	0.95	0.47						12.2
32	160	2.667						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	1.92	0.33	0.59	1.08	1.92	1.45	0.87	0.44					8.8
33	165	2.750							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.14	0.23	0.47	1.15	1.73	1.32	0.81	0.41				7.3
34	170	2.833								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.09	0.18	0.49	1.03	1.58	1.23	0.76	0.39			5.8
35	175	2.917									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07	0.19	0.44	0.94	1.47	1.15	0.71	0.37		5.4
36	180	3.000										0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.17	0.41	0.88	1.37	1.08	0.68	0.35	5.1
37	185	3.083											0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.16	0.38	0.82	1.30	1.03	0.65	4.4
38	190	3.167												0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.06	0.14	0.35	0.77	1.23	0.98	3.6
39	195	3.250													0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.14	0.33	0.74	1.17	2.5
40	200	3.333														0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.13	0.32	0.70	1.2
41	205	3.417															0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.12	0.30	0.5
42	210	3.500																0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.12	0.2
43	215	3.583																	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.1
44	220	3.667																		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.0
45	225	3.750																			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
46	230	3.833																				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
47	235	3.917																					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
48	240	4.000																						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
49	245	4.083																							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
50	250	4.167																								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
51	255	4.250																									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
52	260	4.333																										0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
53	265	4.417																											0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
54	270	4.500																												0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
55	275	4.583																													0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
56	280	4.667																														0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
57	285	4.750																															0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
58	290	4.833																																0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
59	295	4.917																																	0.00	0.00	0.00	0.00	0.00	0.00	0.0
60	300	5.000																																		0.00	0.00	0.00	0.00	0.00	0.0
61	305	5.083																																			0.00	0.00	0.00	0.00	0.0
62	310	5.167																																				0.00	0.00	0.00	0.0
63	315	5.250																																					0.00	0.00	0.0
64	320	5.333																																						0.00	0.0
65	325	5.417																																							0.0

	A (mi^2) =	2.58		Kern County 3-Hour Unit Hydrograph, Existing Condition							Off-Site																															Combined &		On-Site	Total
				Valley-Dev	K (cfs) =	19790.5																																			Routed		NW Basins	Routed
	tstep, T =	5		Unit																																					Runoff	Total	Total	Routed	On-Site
Step	Time		S-Graph	Hydrograph	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Hydrograph	Hydrograph	Hydrograph	Hydrograph	Hydrograph
#	(min)	(hr)	(%)	(cfs/in)	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.005	0.016	0.150	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
1	5	0.083	0.5	92.0	0.14																																				0.1	-0.17	0.17		
2	10	0.167	1.4	184.0	0.27	0.14																																			0.4	1.02	2.00		
3	15	0.250	2.8	224.7	0.33	0.28	0.14																																		0.7	3.73	6.88		
4	20	0.333	4.2	323.9	0.48	0.34	0.28	0.14																																	1.2	8.48	11.68		
5	25	0.417	6.7	510.6	0.75	0.48	0.35	0.29	0.15																																2.0	15.40	18.37		
6	30	0.500	10.4	732.0	1.08	0.76	0.50	0.35	0.30	0.15																															3.1	21.68	25.90		
7	35	0.583	15.0	898.3	1.33	1.10	0.79	0.51	0.36	0.30	0.16																														4.5	28.28	30.76		
8	40	0.667	19.9	963.3	1.42	1.34	1.13	0.80	0.52	0.37	0.31	0.16																													6.1	29.71	34.35		
9	45	0.750	24.8	996.7	1.46	1.44	1.39	1.16	0.83	0.53	0.38	0.32	0.17																												7.7	32.84	37.33		
10	50	0.833	30.8	1121.8	1.66	1.48	1.49	1.41	1.19	0.84	0.55	0.39	0.33	0.17																											9.8	35.36	40.28		
11	55	0.917	36.9	1262.9	1.86	1.68	1.52	1.51	1.46	1.21	0.87	0.56	0.41	0.34	0.18																										11.9	38.27	43.34		
12	60	1.000	43.8	1308.0	1.93	1.89	1.73	1.56	1.56	1.48	1.26	0.89	0.59	0.42	0.36	0.18																									13.8	41.30	46.83		
13	65	1.083	50.3	1352.3	2.00	1.96	1.95	1.76	1.60	1.59	1.54	1.28	0.93	0.60	0.44	0.37	0.19																								16.2	44.61	49.83		
14	70	1.167	56.9	1295.5	1.91	2.02	2.01	1.98	1.82	1.63	1.65	1.57	1.33	0.95	0.63	0.45	0.39	0.20																							18.8	47.80	53.42		
15	75	1.250	63.5	1304.2	1.92	1.94	2.09	2.05	2.05	1.85	1.69	1.68	1.63	1.38	0.99	0.65	0.47	0.40	0.21																						21.0	51.28	57.12		
16	80	1.333	69.9	1274.8	1.88	1.95	2.00	2.12	2.12	2.08	1.92	1.72	1.75	1.67	1.42	1.02	0.68	0.49	0.43	0.22																					23.5	54.82	61.02		
17	85	1.417	75.0	1002.4	1.48	1.91	2.01	2.03	2.19	2.15	2.16	1.95	1.79	1.79	1.75	1.48	1.07	0.70	0.52	0.44	0.19																				25.8	58.46	64.74		
18	90	1.500	78.9	785.8	1.16	1.50	1.97	2.04	2.10	2.23	2.23	2.20	2.04	1.83	1.87	1.79	1.54	1.11	0.76	0.54	0.39	0.20																			27.6	61.82	67.92		
19	95	1.583	82.6	718.2	1.06	1.18	1.55	2.00	2.11	2.13	2.31	2.28	2.29	2.08	1.92	1.92	1.89	1.59	1.18	0.78	0.47	0.41	0.23																		29.4	64.28	70.76		
20	100	1.667	85.8	643.2	0.95	1.08	1.21	1.57	2.06	2.15	2.21	2.38	2.37	2.34	2.16	1.87	2.03	1.95	1.69	1.22	0.68	0.50	0.48	0.25																	31.2	66.72	73.39		
21	105	1.750	88.3	485.8	0.72	0.86	1.11	1.23	1.62	2.10	2.23	2.28	2.45	2.42	2.46	2.24	2.08	2.09	2.06	1.76	1.07	0.72	0.66	0.60	0.30																32.9	68.70	75.66		
22	110	1.833	90.2	364.3	0.56	0.73	0.99	1.13	1.27	1.65	2.15	2.27	2.35	2.51	2.54	2.52	2.38	2.14	2.23	2.15	1.53	1.13	0.81	0.61	0.60	0.34															34.8	71.83	79.20		
23	115	1.917	91.9	338.4	0.50	0.56	0.75	1.01	1.18	1.29	1.71	2.22	2.37	2.40	2.63	2.60	2.66	2.43	2.28	2.31	1.66	1.62	1.28	0.88	0.73	0.68	0.48														36.5	75.74	84.06		
24	120	2.000	93.5	305.8	0.45	0.51	0.59	0.76	1.04	1.18	1.34	1.75	2.31	2.42	2.52	2.70	2.76	2.74	2.59	2.37	2.02	1.90	1.84	1.38	1.06	0.93	0.97	1.47													39.5	83.82	96.42	44.05	58.85
25	125	2.083	94.7	246.2	0.36	0.46	0.52	0.60	0.79	1.06	1.23	1.37	1.82	2.37	2.54	2.58	2.85	2.83	2.82	2.69	2.07	2.13	2.26	1.98	1.87	1.19	1.18	2.95	14.73												57.1	106.00	134.00	47.88	76.88
26	130	2.167	95.7	194.8	0.29	0.37	0.47	0.53	0.62	0.80	1.10	1.25	1.43	1.86	2.48	2.60	2.73	2.93	3.02	3.03	2.35	2.18	2.42	2.43	2.39	1.88	1.71	3.60	29.47	0.39											74.3	186.08	229.08	111.76	154.73
27	135	2.250	96.5	155.7	0.23	0.29	0.38	0.48	0.55	0.63	0.83	1.12	1.30	1.46	1.95	2.64	2.74	2.81	3.13	3.13	2.65	2.48	2.48	2.81	2.93	2.70	2.69	5.19	35.89	0.78	0.27										84.3	270.29	328.86	185.85	241.82
28	140	2.333	97.1	125.3	0.18	0.23	0.30	0.38	0.50	0.56	0.69	0.85	1.17	1.33	1.53	2.00	2.88	2.83	3.00	3.24	2.74	2.79	2.82	2.87	3.14	3.31	3.85	8.17	61.68	0.98	0.54	0.22									104.8	370.79	429.75	266.24	325.21
29	145	2.417	97.7	121.4	0.18	0.19	0.24	0.31	0.40	0.50	0.58	0.67	0.88	1.19	1.40	1.57	2.11	2.76	3.02	3.11	2.83	2.89	3.17	3.04	3.22	3.55	4.73	11.72	81.76	1.39	0.86	0.43	0.23								135.7	464.48	503.41	328.75	383.88
30	150	2.500	98.1	78.4		0.18	0.19	0.24	0.32	0.41	0.52	0.59	0.70	0.90	1.25	1.43	1.65	2.17	2.95	3.13	2.71	2.99	3.28	3.42	3.58	3.84	5.07	14.38	117.23	2.19	0.95	0.53	0.46	0.21							177.4	440.31	460.80	262.85	283.44
31	155	2.583	98.3	40.3			0.19	0.20	0.26	0.32	0.42	0.53	0.61	0.71	0.94	1.28	1.51	1.70	2.32	3.06	2.73	2.87	3.40	3.54	4.12	4.13	5.20	15.42	143.85	3.14	1.51	0.76	0.56	0.41	0.19						208.9	378.48	387.68	189.81	181.60
32	160	2.667	98.5	40.3				0.19	0.20	0.26	0.33	0.43	0.56	0.63	0.75	0.97	1.35	1.56	1.82	2.40	2.67	2.88	3.25	3.66	4.28	4.65	5.91	15.80	154.27	3.85	2.16	1.20	0.81	0.60	0.38	0.17					217.5	321.42	330.23	103.55	112.36
33	165	2.750	98.7	40.3					0.20	0.21	0.27	0.34	0.45	0.57	0.66	0.77	1.02	1.39	1.66	1.88	2.10	2.82	3.25	3.51	4.41	4.81	6.65	17.96	158.02	4.13	2.80	1.72	1.27	0.72	0.46	0.35	0.16				224.4	292.31	299.89	67.87	75.14
34	170	2.833	98.8	40.3						0.20	0.22	0.27	0.35	0.46	0.59	0.67	0.81	1.05	1.49	1.72	1.65	2.22	3.20	3.53	4.23	4.98	6.68	20.22	179.66	4.23	2.64	2.11	1.82	1.14	0.66	0.43	0.33	0.16			240.1	296.81	304.43	50.49	58.31
35	175	2.917	99.1	40.3							0.21	0.22	0.28	0.36	0.48	0.61	0.71	0.83	1.12	1.54	1.50	1.74	2.52	3.45	4.26	4.77	7.12	20.91	202.26	4.81	2.91	2.26	2.24	1.64	1.05	0.81	0.40	0.31	0.15		271.3	309.88	318.19	38.52	43.82
36	180	3.000	99.3	40.3								0.21	0.23	0.29	0.38	0.49	0.64	0.73	0.89	1.16	1.35	1.59	1.97	2.71	4.18	4.81	6.82	21.65	209.16	5.42	3.31	2.32	2.40	2.01	1.50	0.97	0.58	0.38	0.29	0.14	278.5	311.64	316.60		
37	185	3.083	99.5	40.3									0.22	0.23	0.30	0.39	0.52	0.66	0.78	0.92	1.02	1.42	1.80	2.13	3.27	4.70	6.87	20.74	216.56	5.60	3.73	2.64	2.46	2.15	1.84	1.39	0.91	0.54	0.36	0.28	284.4	314.80	316.04		
38	190	3.167	99.8	40.3										0.23	0.25	0.31	0.41	0.53	0.71	0.81	0.90	1.07	1.62	1.95	2.87	3.89	6.71	20.88	207.47	5.80	3.86	2.97	2.80	2.21	1.97	1.70	1.30	0.86	0.52	0.34	274.3	301.46	305.08		
39	195	3.250	99.9	34.8											0.24	0.26	0.33	0.42	0.57	0.73	0.71	0.85	1.22	1.74	2.34	2.90	5.28	20.41	208.87	6.56	3.99	3.07	3.15	2.51	2.02	1.83	1.60	1.23	0.61	0.49	273.1	296.31	298.78		
40	200	3.333														0.24	0.27	0.34	0.45	0.59	0.64	0.75	0.97	1.32	2.10	2.65	4.14	16.05	204.15	6.69	3.82	3.18	3.26	2.83	2.30	1.67	1.71	1.51	1.17	0.78	262.8	280.60	281.74		
41	205	3.417															0.26	0.27	0.38	0.47	0.52	0.66	0.85	1.04	1.59	2.37	3.78	12.58	160.54	6.47	3.85	3.04	3.37	2.92	2.58	2.13	1.75	1.82	1.43	1.11	214.8	228.82	228.12		
42	210	3.500																0.28	0.29	0.37	0.41	0.54	0.77	0.92	1.25	1.79	3.39	11.50	125.84	4.30	3.76	3.06	3.23	3.02	2.87	2.40	1.99	1.68	1.63	1.36	178.3	182.08	182.28		
43	215	3.583																	0.28	0.30	0.33	0.43	0.62	0.83	1.10	1.42	2.56	10.30	115.01	3.37	2.96	3.00	3.26	2.90	2.77	2.48	2.25	1.88	1.67	1.48	161.1	163.75	163.83		
44	220	3.667																		0.29	0.26	0.34	0.49	0.67	1.00	1.25	2.02	7.77	103.00	3.08	2.32	2.38	3.18	2.92	2.65	2.57	2.32	2.12	1.79	1.50	143.9	146.09	146.12		
45	225	3.750																			0.25	0.28	0.39	0.53	0.80	1.13	1.78	6.15	77.77	2.76	2.12	1.85	2.80	2.85	2.67	2.46	2.40	2.19	2.01	1.70	114.6	116.11	116.11		
46	230	3.833																				0.27	0.32	0.42	0.84	0.91	1.61	5.42	61.54	2.08	1.90	1.89	1.96	2.24	2.81	2.48	2.30	2.27	2.08	1.92	94.5	94.80	94.80		
47	235	3.917																					0.30	0.34	0.51	0.72	1.30	4.89	54.20	1.65	1.43	1.51	1.79	1.76	2.05	2.42	2.32	2.17	2.16	1.88	83.5	83.88	83.88		
48	240	4.000																						0.33	0.41	0.67	1.03	3.94	48.96	1.45	1.13	1.14	1.60	1.61	1.61	1.90	2.27	2.19	2.06	2.05	74.3	74.28	74.29		
49	245	4.083																							0.40	0.47	0.82	3.12	39.42	1.31	1.00	0.90	1.21	1.44	1.47	1.49	1.78	2.14	2.08	1.97	61.0	61.02	61.02		
50	250	4.167																								0.45	0.68	2.49	31.19	1.06	0.90	0.80	0.96	1.09	1.32	1.36	1.40	1.88	2.03	1.98	49.4	49.38	49.38		
51	255	4.250																									0.64	2.02	24.93	0.84	0.73	0.72	0.84	0.88	0.99	1.22	1.28	1.32	1.60	1.94	39.9	39.92	39.92		
52	260	4.333																										1.94	20.22	0.67	0.57	0.58	0.76	0.78	0.79	0.92	1.14	1.20	1.26	1.52	32.3	32.34	32.34		
53	265	4.417																											19.44	0.54	0.46	0.46	0.61	0.68	0.69	0.73	0.88	1.08	1.14	1.19	27.9	27.90	27.90		
54	270	4.500																												0.52	0.37	0.37	0.49	0.55	0.63	0.64	0.68	0.81	1.02	1.09	7.2	7.18	7.18		
55	275	4.583																													0.36	0.30	0.39	0.44	0.50	0.58	0.60	0.64	0.77	0.96	5.6	5.66	5.66		
56	280	4.667																														0.29	0.31	0.35	0.40	0.47	0.54	0.57	0.61	0.74	4.3	4.28	4.28		
57	285	4.750																															0.30	0.28	0.32	0.37	0.44	0.51	0.54	0.58	3.3	3.38	3.38		
58	290	4.833																																0.27	0.26	0.30	0.35	0.41	0.49	0.51	2.8	2.89	2.89		
59	295	4.917																																	0.26	0.24	0.28	0.33	0.39	0.46	1.9	1.98	1.98		
60	300	5.000																																		0.23	0.22	0.26	0.31	0.37	1.4	1.40	1.40		
61	305	5.083																																			0.22	0.21	0.25	0.30	1.0	0.97	0.97		
62	310	5.167																																				0.20	0.20	0.24	0.8	0.84	0.84		
63	315	5.250																																					0.19	0.19	0.4	0.39	0.39		
64	320	5.333																																						0.18	0.2	0.18	0.18		
65	325	5.417																																							0.0	0.00	0.00		

	A (mi²) =	2.56		Kern County 3-Hour Unit Hydrograph, Ultimate Condition																																							
				Valley-Dev	K (cfs) =	19790.6																																					
	tstep, T =	5		Unit																																					Off-site Runoff	Off-Site & Routed	
Step	Time		S-Graph	Hydrograph	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Hydrograph	Hydrograph	Total Hydrograph
#	(min)	(hr)	(%)	(cfs/in)	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.005	0.014	0.032	0.177	0.008	0.004	0.003	0.004	0.003	0.003	0.003	0.003	0.002	0.002	0.002	(cfs)	(cfs)	(cfs)
1	5	0.083	0.5	92.0	0.20																																				0.3	-0.10	0.24
2	10	0.167	1.4	184.0	0.39	0.20																																			0.6	1.21	2.16
3	15	0.250	2.5	224.7	0.48	0.40	0.21																																		1.1	4.07	6.02
4	20	0.333	4.2	323.9	0.89	0.49	0.41	0.21																																	1.9	9.02	12.14
5	25	0.417	6.7	510.8	1.10	0.70	0.50	0.42	0.22																																2.9	16.31	20.16
6	30	0.500	10.4	732.0	1.57	1.11	0.73	0.51	0.43	0.22																															4.8	23.06	27.33
7	35	0.583	15.0	898.3	1.93	1.59	1.14	0.74	0.53	0.44	0.23																														6.6	28.34	32.81
8	40	0.667	19.9	963.3	2.07	1.95	1.64	1.18	0.76	0.54	0.46	0.23																													8.8	33.46	37.10
9	45	0.750	24.8	986.7	2.12	2.10	2.01	1.67	1.20	0.78	0.56	0.47	0.24																												11.1	36.02	40.60
10	50	0.833	30.5	1121.8	2.41	2.15	2.18	2.05	1.72	1.22	0.60	0.57	0.49	0.25																											13.8	39.87	44.69
11	55	0.917	36.9	1262.9	2.71	2.44	2.21	2.19	2.11	1.75	1.27	0.82	0.59	0.50	0.26																										16.9	43.53	48.60
12	60	1.000	43.5	1308.0	2.80	2.75	2.52	2.25	2.27	2.15	1.82	1.29	0.85	0.61	0.52	0.27																									20.1	47.67	52.80
13	65	1.083	50.3	1352.3	2.90	2.84	2.83	2.56	2.32	2.31	2.23	1.85	1.35	0.87	0.64	0.53	0.26																								23.6	51.66	57.27
14	70	1.167	56.9	1295.5	2.78	2.94	2.93	2.88	2.64	2.38	2.39	2.27	1.93	1.38	0.92	0.65	0.56	0.29																							26.8	56.21	61.82
15	75	1.250	63.5	1304.2	2.80	2.82	3.03	2.97	2.97	2.89	2.45	2.44	2.37	1.97	1.44	0.94	0.69	0.58	0.31																						30.6	60.79	66.63
16	80	1.333	69.9	1274.8	2.73	2.84	2.91	3.08	3.07	3.02	2.79	2.50	2.54	2.42	2.07	1.46	0.99	0.71	0.62	0.32																					34.1	66.66	71.66
17	85	1.417	75.0	1002.4	2.15	2.77	2.92	2.95	3.18	3.13	3.14	2.84	2.60	2.80	2.54	2.12	1.56	1.02	0.78	0.64	0.28																				37.2	70.07	75.38
18	90	1.500	78.9	785.8	1.69	2.18	2.88	2.97	3.05	3.24	3.24	3.20	2.96	2.86	2.72	2.80	2.24	1.81	1.09	0.78	0.56	0.30																			40.0	73.99	80.36
19	95	1.583	82.8	718.2	1.54	1.71	2.25	2.90	3.07	3.10	3.36	3.31	3.33	3.03	2.79	2.79	2.75	2.31	1.72	1.13	0.68	0.59	0.34																		42.7	77.61	84.09
20	100	1.667	85.8	643.2	1.38	1.56	1.76	2.28	3.00	3.12	3.22	3.42	3.45	3.41	3.17	2.86	2.95	2.83	2.46	1.78	0.99	0.72	0.67	0.38																	45.4	80.89	87.46
21	105	1.750	88.3	485.6	1.04	1.40	1.81	1.79	2.38	3.05	3.24	3.28	3.57	3.52	3.57	3.25	3.02	3.04	3.02	2.85	1.55	1.04	0.82	0.72	0.44																47.9	83.64	90.60
22	110	1.833	90.2	384.3	0.82	1.06	1.44	1.64	1.85	2.40	3.17	3.30	3.42	3.65	3.89	3.66	3.43	3.11	3.24	3.13	2.23	1.64	1.16	0.88	0.87	0.49															50.3	87.33	94.89
23	115	1.917	91.9	338.4	0.73	0.84	1.09	1.47	1.89	1.88	2.49	3.23	3.44	3.49	3.82	3.78	3.88	3.53	3.32	3.36	2.74	2.35	1.88	1.28	1.07	0.99	1.32														83.6	92.91	102.12
24	120	2.000	93.5	305.8	0.66	0.74	0.86	1.11	1.51	1.72	1.95	2.54	3.38	3.52	3.88	3.92	4.00	3.98	3.77	3.44	2.93	2.89	2.67	2.01	1.54	1.20	2.65	3.02													89.4	103.69	116.49
25	125	2.083	94.7	246.2	0.53	0.67	0.76	0.88	1.14	1.54	1.78	1.99	2.65	3.44	3.69	3.75	4.14	4.12	4.25	3.91	3.00	3.10	3.28	2.88	2.42	1.73	3.23	6.04	16.28												81.2	129.06	158.08
26	130	2.167	95.7	194.8	0.42	0.54	0.69	0.77	0.90	1.16	1.60	1.82	2.07	2.70	3.60	3.78	3.96	4.26	4.39	4.40	3.42	3.17	3.62	3.54	3.47	2.73	4.66	7.38	32.56	0.57											102.1	213.86	256.83
27	135	2.250	96.5	155.7	0.33	0.42	0.55	0.70	0.80	0.92	1.21	1.63	1.90	2.12	2.83	3.69	3.99	4.08	4.55	4.65	3.85	3.61	3.60	3.79	4.28	3.92	7.34	10.64	39.78	1.15	0.39										119.6	302.46	368.21
28	140	2.333	97.1	126.3	0.27	0.34	0.44	0.58	0.72	0.81	0.95	1.23	1.70	1.94	2.22	2.90	3.90	4.11	4.36	4.71	3.98	4.06	4.10	3.88	4.57	4.81	10.53	18.77	57.33	1.40	0.79	0.31									143.7	409.93	466.80
29	145	2.417	97.7	121.4	0.26	0.27	0.35	0.44	0.58	0.73	0.84	0.97	1.28	1.73	2.03	2.28	3.07	4.02	4.39	4.51	4.12	4.20	4.61	4.42	4.88	5.18	12.92	24.04	90.36	2.02	0.98	0.63	0.33								186.2	511.99	549.89
30	150	2.500	98.1	78.4		0.26	0.28	0.35	0.46	0.59	0.76	0.88	1.01	1.31	1.62	2.08	2.40	3.16	4.29	4.55	3.94	4.35	4.77	4.97	5.32	5.25	13.85	29.50	129.65	3.18	1.39	0.77	0.67	0.30							232.0	494.88	515.46
31	155	2.583	98.3	40.3			0.27	0.29	0.37	0.47	0.61	0.77	0.89	1.04	1.37	1.86	2.20	2.48	3.37	4.44	3.97	4.17	4.94	5.14	5.99	6.01	14.19	31.64	158.97	4.56	2.19	1.11	0.81	0.60	0.27						268.0	434.80	446.80
32	160	2.667	98.5	40.3				0.28	0.30	0.37	0.48	0.62	0.81	0.91	1.09	1.41	1.97	2.26	2.64	3.49	3.88	4.19	4.73	5.32	6.20	6.76	16.13	32.41	170.48	5.60	3.14	1.74	1.17	0.73	0.55	0.25					279.8	383.46	392.29
33	165	2.750	98.7	40.3					0.29	0.30	0.39	0.49	0.65	0.82	0.96	1.11	1.49	2.03	2.41	2.74	3.05	4.10	4.76	5.10	6.42	6.99	18.18	36.84	174.63	6.01	3.85	2.50	1.85	1.05	0.87	0.51	0.24				290.4	368.28	386.86
34	170	2.833	98.9	40.3						0.29	0.31	0.39	0.51	0.66	0.86	0.98	1.18	1.53	2.18	2.50	2.39	3.22	4.85	5.13	6.15	7.24	18.78	41.48	198.54	6.15	4.13	3.07	2.65	1.66	0.96	0.62	0.48	0.22			310.9	369.42	376.24
35	175	2.917	99.1	40.3							0.30	0.32	0.41	0.53	0.70	0.89	1.04	1.21	1.83	2.24	2.19	2.53	3.66	5.02	8.19	6.94	19.44	42.89	223.61	6.99	4.23	3.29	3.25	2.38	1.52	0.89	0.58	0.45	0.21		346.4	383.98	389.38
36	180	3.000	99.3	40.3								0.31	0.33	0.42	0.55	0.71	0.94	1.07	1.29	1.69	1.96	2.31	2.87	3.95	8.05	6.98	16.83	44.41	231.14	7.87	4.81	3.37	3.49	2.92	2.18	1.41	0.84	0.55	0.43	0.20	353.7	386.67	391.72
37	185	3.083	99.5	40.3									0.32	0.34	0.44	0.56	0.75	0.96	1.14	1.34	1.48	2.07	2.62	3.09	4.76	6.83	18.75	42.55	239.33	8.14	5.42	3.83	3.87	3.13	2.87	2.02	1.32	0.79	0.62	0.41	359.2	389.32	393.76
38	190	3.167	99.8	40.3										0.33	0.38	0.45	0.60	0.78	1.03	1.18	1.17	1.66	2.35	2.83	3.73	5.37	18.33	42.83	229.28	8.43	5.60	4.31	4.06	3.21	2.87	2.48	1.89	1.25	0.75	0.50	347.9	374.88	378.24
39	195	3.250	99.9	34.6											0.34	0.37	0.48	0.61	0.83	1.07	1.03	1.24	1.77	2.53	3.41	4.21	14.41	41.87	230.82	8.08	5.80	4.46	4.57	3.65	2.94	2.66	2.32	1.79	1.16	0.72	343.1	366.34	368.82
40	200	3.333														0.35	0.39	0.49	0.65	0.86	0.93	1.09	1.40	1.91	3.05	3.85	11.30	32.92	225.81	8.13	5.56	4.82	4.73	4.11	3.34	2.72	2.49	2.19	1.69	1.13	328.6	343.37	344.81
41	205	3.417															0.37	0.40	0.52	0.88	0.75	0.98	1.24	1.51	2.30	3.44	10.33	25.81	177.41	7.95	5.60	4.42	4.90	4.25	3.76	3.10	2.65	2.35	2.08	1.62	288.3	279.38	279.86
42	210	3.500																0.38	0.42	0.54	0.59	0.79	1.12	1.33	1.82	2.80	9.25	23.89	139.07	6.25	5.47	4.45	4.89	4.40	3.89	3.46	2.90	2.41	2.23	1.98	223.7	229.41	229.81
43	215	3.583																	0.41	0.44	0.47	0.63	0.90	1.20	1.61	2.06	6.98	21.12	127.10	4.90	4.30	4.35	4.72	4.21	4.02	3.60	3.26	2.74	2.28	2.13	203.6	206.19	206.22
44	220	3.667																		0.42	0.35	0.50	0.71	0.97	1.45	1.61	5.53	15.95	113.83	4.48	3.37	3.42	4.62	4.24	3.85	3.73	3.37	3.08	2.60	2.18	180.6	181.70	181.72
45	225	3.750																			0.37	0.41	0.57	0.77	1.17	1.64	4.87	12.62	85.95	4.01	3.08	2.66	3.63	4.14	3.88	3.57	3.49	3.18	2.92	2.48	148.4	146.94	145.94
46	230	3.833																				0.38	0.46	0.61	0.92	1.32	4.40	11.11	68.00	3.03	2.78	2.45	2.85	3.26	3.79	3.60	3.35	3.30	3.02	2.79	121.4	121.68	121.68
47	235	3.917																					0.44	0.50	0.74	1.04	3.54	10.04	59.89	2.40	2.08	2.20	2.80	2.56	2.98	3.52	3.37	3.16	3.13	2.88	107.1	107.13	107.13
48	240	4.000																						0.48	0.60	0.83	2.80	8.08	54.11	2.11	1.65	1.66	2.33	2.34	2.34	2.77	3.29	3.18	3.00	2.99	94.6	94.67	94.67
49	245	4.083																							0.58	0.88	2.24	6.40	43.56	1.91	1.45	1.31	1.76	2.09	2.14	2.17	2.59	3.11	3.02	2.86	77.9	77.86	77.86
50	250	4.167																								0.85	1.82	5.11	34.47	1.53	1.31	1.16	1.39	1.58	1.91	1.98	2.03	2.44	2.95	2.86	63.2	63.22	63.22
51	255	4.250																									1.75	4.15	27.55	1.21	1.06	1.04	1.23	1.25	1.44	1.77	1.66	1.92	2.32	2.82	61.4	61.39	61.39
52	260	4.333																										3.99	22.35	0.97	0.84	0.84	1.11	1.10	1.14	1.34	1.86	1.75	1.82	2.21	41.1	41.12	41.12
53	265	4.417																											21.49	0.79	0.67	0.87	0.89	0.99	1.01	1.06	1.25	1.57	1.66	1.74	33.8	33.78	33.78
54	270	4.500																												0.76	0.54	0.53	0.71	0.80	0.91	0.93	0.99	1.16	1.49	1.59	10.4	10.43	10.43
55	275	4.583																													0.52	0.43	0.56	0.63	0.73	0.84	0.87	0.94	1.12	1.42	8.1	8.08	8.08
56	280	4.667																														0.41	0.46	0.51	0.58	0.68	0.79	0.83	0.89	1.07	6.2	6.21	6.21
57	285	4.750																															0.44	0.41	0.46	0.54	0.64	0.75	0.78	0.85	4.9	4.86	4.86
58	290	4.833																																0.39	0.38	0.43	0.50	0.60	0.71	0.75	3.8	3.78	3.78
59	295	4.917																																	0.38	0.35	0.40	0.47	0.57	0.68	2.8	2.83	2.83
60	300	5.000																																		0.33	0.33	0.38	0.45	0.54	2.0	2.04	2.04
61	305	5.083																																			0.31	0.31	0.38	0.43	1.4	1.41	1.41
62	310	5.167																																				0.30	0.29	0.34	0.9	0.93	0.93
63	315	5.250																																					0.28	0.28	0.8	0.68	0.68
64	320	5.333																																						0.27	0.3	0.27	0.27
65	325	5.417																																							0.0	0.00	0.00

tstep, dT* = 5.0

Time (min)	Time (hr)	Inflow Hydrograph (cfs)	T + dT - dT* (min)	O(T+dT-dT*) (cfs)	O (T + dT) (cfs)	10-yr 3-hour Outflow Hydrograph (cfs)	
0	0.000	0.00					
			6.2	0.0	0.0		
5	0.083	1.88				-0.30	
			11.2	1.27	1.27		
10	0.167	5.39				0.61	
			16.2	4.06	4.06		
15	0.250	10.78				2.98	
			21.2	8.60	8.60		
20	0.333	17.30				7.21	
			26.2	14.49	14.49		
25	0.417	21.45				13.37	
			31.2	19.20	19.20		
30	0.500	23.57				18.50	
			36.2	22.16	22.16		
35	0.583	24.77				21.74	
			41.2	23.93	23.93		
40	0.667	25.66				23.65	
			46.2	25.10	25.10		
45	0.750	26.50				24.88	
			51.2	26.05	26.05		
50	0.833	27.25				25.85	
			56.2	26.86	26.86		
55	0.917	28.08				26.67	
			61.2	27.69	27.69		
60	1.000	28.98				27.48	
			66.2	28.56	28.56		
65	1.083	29.99				28.34	
			71.2	29.53	29.53		
70	1.167	31.10				29.28	
			76.2	30.59	30.59		
75	1.250	32.36				30.31	
			81.2	31.78	31.78		
80	1.333	33.76				31.47	
			86.2	33.12	33.12		
85	1.417	34.76				32.86	
			91.2	34.23	34.23		
90	1.500	35.44				34.03	
			96.2	35.05	35.05		
95	1.583	35.88				34.91	
			101.2	35.61	35.61		
100	1.667	36.39				35.49	
			106.2	36.14	36.14		
105	1.750	38.54				35.75	
			111.2	37.76	37.76		
110	1.833	42.40				37.02	
			116.2	40.90	40.90		
115	1.917	51.02				39.28	
			121.2	47.75	47.75		
120	2.000	70.90				44.05	
			126.2	63.42	63.42		
125	2.083	160.60				47.86	
			131.2	129.17	129.17		
130	2.167	238.02				111.75	
			136.2	202.82	202.82		
135	2.250	308.87				185.85	
			141.2	274.57	274.57		
140	2.333	326.62				266.24	
			146.2	309.79	309.79		
145	2.417	210.07				325.75	Peak routed outflow
			151.2	242.32	242.32		
150	2.500	114.04				262.85	
			156.2	155.53	155.53		
155	2.583	67.54				169.61	
			161.2	95.99	95.99		
160	2.667	48.81				103.55	
			166.2	64.07	64.07		
165	2.750	40.28				67.87	
			171.2	47.97	47.97		
170	2.833	32.24				50.49	
			176.2	37.33	37.33		
175	2.917	29.90				38.52	
			181.2	32.30	32.30		

Channel Hydraulics

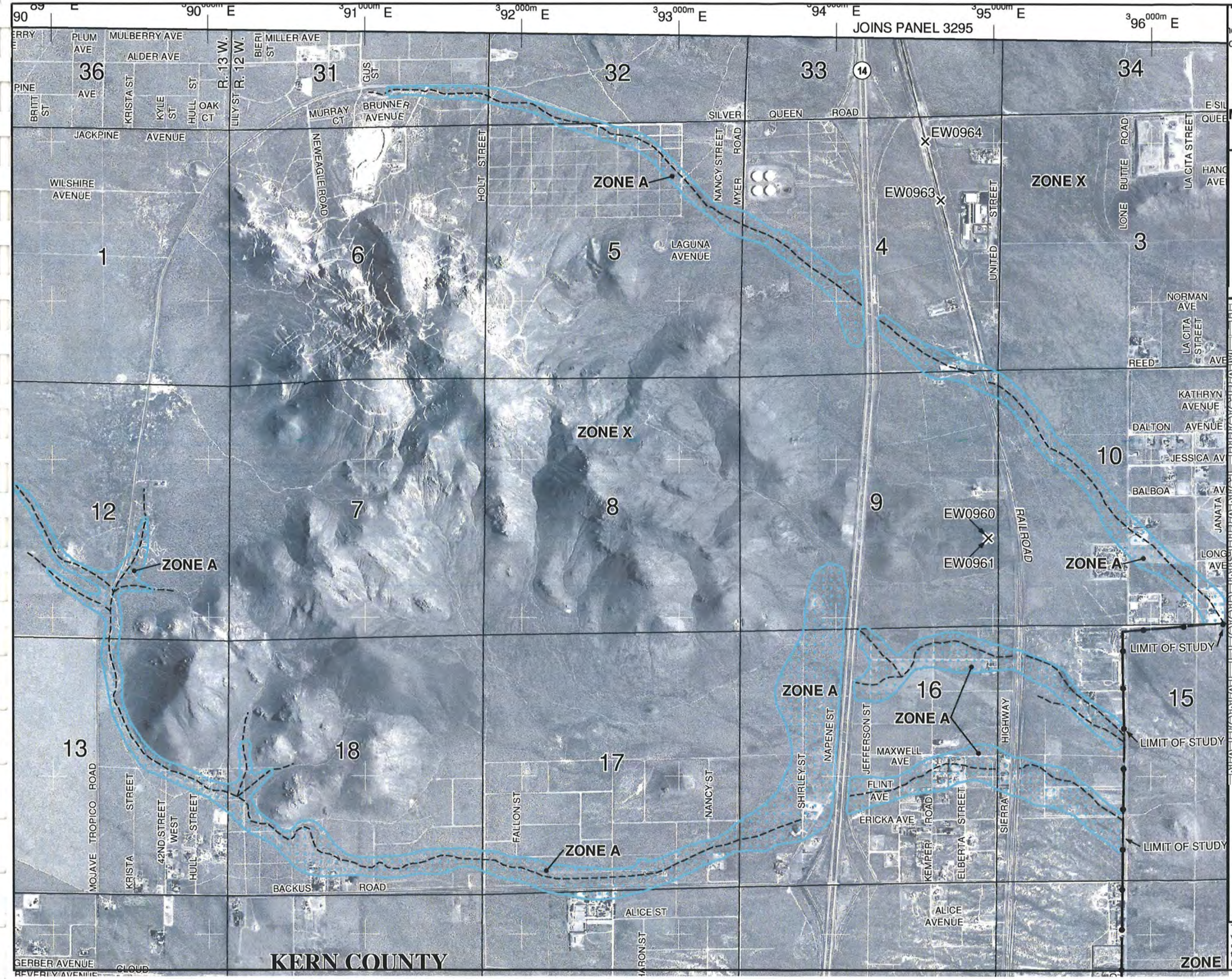
Parameter	Value	Comments
V (ft/s)	4.50	WMS Channel Calculator
A (ft^2)	74	WMS Channel Calculator
P (ft)	50.40	WMS Channel Calculator
R (ft)	1.47	calculated
L (ft)	2300	Design length
S (ft/ft)	0.0050	Design/assumed
n	0.030	Design/assumed
K (hr)	0.142	Eq. (H.5)
K (min)	8.52	
C	0.73	Eq. (H.4)
dT (hr)	0.103	K * C, Eq. (H.8)
dT (min)	6.18	
C*	0.68	Eq. (H.6)
E	0.872	(dT*+0.5dT)/(1.5dT)

Trapezoidal channel

b = 40 ft
z1:1 = 3.0
z2:1 = 3.0

180	3.000	28.00				32.99	
			186.2	29.39	29.39		
185	3.083	24.58				30.16	
			191.2	26.13	26.13		
190	3.167	19.86				27.14	
			196.2	21.89	21.89		
195	3.250	13.69				23.20	
			201.2	16.34	16.34		
200	3.333	6.83				17.86	
			206.2	9.91	9.91		
205	3.417	2.80				11.04	
			211.2	5.10	5.10		
210	3.500	1.08				5.74	
			216.2	2.38	2.38		
215	3.583	0.42				2.69	
			221.2	1.05	1.05		
220	3.667	0.14				1.20	
			226.2	0.44	0.44		
225	3.750	0.00				0.51	
			231.2	0.14	0.14		
230	3.833	0.00				0.16	
			236.2	0.05	0.05		
235	3.917	0.00				0.05	
			241.2	0.01	0.01		
240	4.000	0.00				0.02	
			246.2	0.00	0.00		
245	4.083	0.00				0.01	
			251.2	0.00	0.00		
250	4.167	0.00				0.00	
			256.2	0.00	0.00		
255	4.250	0.00				0.00	
			261.2	0.00	0.00		
260	4.333	0.00				0.00	
			266.2	0.00	0.00		
265	4.417	0.00				0.00	
			271.2	0.00	0.00		
270	4.500	0.00				0.00	
			276.2	0.00	0.00		
275	4.583	0.00				0.00	
			281.2	0.00	0.00		
280	4.667	0.00				0.00	
			286.2	0.00	0.00		
285	4.750	0.00				0.00	
			291.2	0.00	0.00		
290	4.833	0.00				0.00	
			296.2	0.00	0.00		
295	4.917	0.00				0.00	
			301.2	0.00	0.00		
300	5.000	0.00				0.00	
			306.2	0.00	0.00		
305	5.083	0.00				0.00	
			311.2	0.00	0.00		
310	5.167	0.00				0.00	
			316.2	0.00	0.00		
315	5.250	0.00				0.00	
			321.2	0.00	0.00		
320	5.333	0.00				0.00	
			326.2	0.00	0.00		
325	5.417	0.00				0.00	

APPENDIX B
FEMA FLOOD INSURANCE RATE MAP, KERN COUNTY CALIFORNIA, PANEL 06029C3675 (REVISED SEPTEMBER 26, 2008)



ne Flood Insurance Study report for this jurisdiction.

nce is available in this community, contact your insurance d Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

0 600 1200

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 3675E

FIRM
FLOOD INSURANCE RATE MAP
KERN COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 3675 OF 4125

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KERN COUNTY	060075	3675	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06029C3675E

EFFECTIVE DATE SEPTEMBER 26, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX C
SOLEDAD MOUNTAIN ONSITE HYDROLOGY CALCULATION

CALCULATIONS

Date:	December 7, 2011	**Made by:**	CPB
Project No.:	043-2299D	**Checked by:**	TA
Subject:	Appendix C - Onsite Hydrology Calculations	**Reviewed by:**	REK
Project Short Title:	**SOLEDAD MOUNTAIN**		

Conduct an evaluation of peak flow rates generated by the 20-year and 100-year precipitation events at the Soledad mountain mining site for pre-mining, post-mining, and Phase 1, Stage 1 conditions. Diversion ditches constructed for mining operations are designed for the 20-year, one-hour storm event per Surface Mining and Reclamation Act (SMARA) regulations. Since the ditches and ponds must also pass the 100-year flows, the 100-year flows are also estimated and presented in these calculations.

For volume calculations, the 10-year, 24-hour precipitation is used to estimate runoff volumes during active mining operations to be used for sediment pond volumes as allowed in California Title 27 regulations. Sediment ponds will also be required where activity will remain post mine closure. Design riser pipe outlets to release sediment pond volume over 24-72 hours and emergency overflow weirs in embankments to release 100-year flows.

1.0 METHOD

Using proposed mine plan topography and USGS quadrangle maps (USGS, 2005), subbasins were delineated for the pre- and post-mining, as well as the Phase 1, Stage 1 condition. Refer to Figures 1A, 2, and 3 of the Site Drainage Plan for subbasin delineation of the three development conditions. NOAA Atlas 14 Precipitation Frequency Estimates were used to provide precipitation values for the 20-year, one-hour, the 100-year, one-hour and the 10-year, 24-hour storm events (see Attachment B). Peak flow rates for the 20-year and 100-year storms were calculated using the Rational Method as set forth in the Kern County Hydrology Manual (Hromadka). Rational Method peak flow rates are used in the Site Drainage Plan as an initial estimate of ditch and channel sizing for the overall layout and comparison of all development conditions.

Sediment ponds are sized to contain storm runoff up to the 10-year, 24-hour storm volume and release the storm volume over 24-72 hours, with larger storms passing over an emergency weir in the pond embankment. Runoff volume estimation for the 10-year, 24-hour storm uses the catchment yield fraction, Y, as set forth in the Kern County Hydrology Manual for disturbed basins during mining operations as well as areas active in the post-mining phase.

Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, CO 80228 USA
Tel: (303) 980-0540 Fax: (303) 985-2080 www.golder.com

2.0 DATA & ASSUMPTIONS

- NRCS soil survey maps used to aid in curve number selection.
- Unless otherwise indicated, subbasins are assumed to contain 2% impervious area.
- Precipitation depths for the various storms were obtained from NOAA Atlas 14; full tables are presented in Attachment B (NOAA, 2004).
- Time of concentration is calculated using TR-55 methodology for 100-year flow calculation.
- The calculated time of concentration for the 20-year flow calculation was increased by a factor of 1.09 for flow segments 3-5 per Kern County Hydrology Manual.
- All rainfall reporting to the active heap leach facility is fully contained within the lined facility.
- Developed pit areas are assumed to act as retention ponds with no contribution to runoff.

3.0 CALCULATIONS

Basins were delineated and area-weighted composite curve numbers were calculated based on different cover and soil types, as presented in **Table 1**. Times of concentration for all basins were calculated using TR-55 methodology and are presented in **Table 2** (USSCS, 1986). The 20-year and 100-year peak flow rates were calculated using the Rational Method in accordance with the Kern County Hydrology Manual. Rational Method calculations are presented in **Table 3**.

Basin information and calculations for the 10-year, 24-hour runoff volumes using the Kern County runoff volume estimation are presented in **Table 4**. Calculations determining riser outflow pipe orifice and overflow weir sizing are presented in **Table 5**. The 10-year, 24-hour runoff volumes were used to determine sediment pond volumes for Basins W1, NW1, NW2, N2, E1, and L1 for the Stage 1, Phase 1 condition and Basins NW2, N2, E1, and E2 for post-mining operations. Runoff volume to be detained in sediment ponds for Basin NW1 for the Phase 1, Stage 1 condition will be diverted to Pond NW2, which will have capacity to detain the 10-year, 24-hour runoff from both basins.

4.0 CONCLUSIONS/RESULTS

A summary of the estimated peak flows calculated with the Rational Method in accordance with the Kern County Hydrology Manual for the pre-mining, Phase 1, Stage 1, and post-mining conditions are presented in **Table 3**. Required sediment basin volumes for the 10-year, 24-hour storm event are presented in **Table 4**. The larger calculated sediment pond size of the Phase 1, Stage 1 or post-mining scenario was used to determine required pond capacity. Flows from Basin NW1 will be conveyed to Pond NW2 in the Phase 1, Stage 1 scenario and therefore Pond NW2 is sized to contain runoff volume from Basins NW1 and NW2. Riser pipe orifice sizing and emergency overflow spillway sizes are presented in **Table 5**. These calculations are summarized in the table below.

Development Condition	Basin ID	Area (acres)	Composite CN	20-year Rational Method Peak Flow (cfs)	100-year Rational Method Peak Flow (cfs)	10-year, 24-hour Runoff Volume (acre-feet)
Pre-Mining	W1	241.7	79	266.9	481.6	-
Pre-Mining	NW1	48.9	77	75.2	131.9	-
Pre-Mining	NW2	206.1	76	217.5	401.6	-
Pre-Mining	N1	226.0	72	228.2	429.8	-
Pre-Mining	N2	64.1	81	72.3	128.3	-
Pre-Mining	E1	291.7	85	380.1	653.0	-
Pre-Mining	E2	325.3	80	372.3	666.8	-
Post-Mining	W1	228.2	72	150.6	307.8	-
Post-Mining	NW1	52.0	72	72.6	131.2	-
Post-Mining	NW2	143.8	80	127.9	237.0	9.4
Post-Mining	N1	177.4	65	140.1	277.9	-
Post-Mining	N2	138.2	78	163.1	292.2	7.8
Post-Mining	E1	100.2	82	123.1	214.0	7.4
Post-Mining	E2	222.6	82	306.9	524.9	17.0
Phase1, Stage 1	W1	245.1	78	256.5	468.6	15.7
Phase 1, Stage 1	NW1	42.1	74	49.7	90.0	2.1
Phase 1, Stage 1	NW2	118.4	84	159.7	273.5	9.8
Phase 1, Stage 1	N2	150.5	84	205.4	351.5	12.4
Phase 1, Stage 1	E1	105.4	86	159.3	272.1	9.5
Phase 1, Stage 1	E2	199.3	80	270.9	468.1	-
Phase 1, Stage 1	L1	110.8	64	72.3	153.7	1.8

5.0 REFERENCES

1. Hromadka II, T.V. *Kern County Hydrology Manual.* Date Unknown.

2. National Oceanic and Atmospheric Administration (NOAA). 2004. *Precipitation-Frequency Atlas of the United States, NOAA Atlas No. 14, Volume I, Version 3.* Silver Spring, MD: National Weather Service. http:\hdsc.nws.noaa.gov/hdsc/pfds/

3. Natural Resources Conservation Service (NRCS). Version 4 December 21, 2006. Soil Survey of Areas near Soledad Mountain.

4. USGS. Various dates. Topo Quadrangle (7.5') drawn from National Geographic TOPO! 4.0 [software] 2005: Monolith, Mojave, Sanborn, Willow Springs, Soledad Mountain, Bissell.

5. U. S. Soil Conservation Service (USSCS). 1986. *Urban Hydrology for Small Watersheds, 2nd edition* (USSCS Technical Release Number 55). Washington D.C.: United States Department of Agriculture.

6.0 LIST OF TABLES & ATTACHMENTS

TABLES

TABLE 1
SUBBASIN SUMMARY TABLE

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	[signature]
Apprvd:	[signature]

Design Storm 100 -Year Reccurance Interval

Storm Duration (hours)	2-Year Depth (inches)	100 -Year Depth (inches)	Storm Distribution
24	1.35	3.67	II

	Subbasin ID	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 63 Undisturbed DESERT SHRUB HSG A (Acres)	CN = 77 Undisturbed DESERT SHRUB HSG B (Acres)	CN = 85 Undisturbed DESERT SHRUB HSG C (Acres)	CN = 88 Undisturbed DESERT SHRUB HSG D (Acres)	CN = 65 Reclaimed Heap Leach Pad (Acres)	CN = 77 ROCK DUMP TOPS (Acres)	CN = 70 ROCK DUMP OUTSLOPES (Acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
Pre-Mining	W1	241.68	0.3776	90.91		7.68	143.09				CN = 79	2.66	1.70	34.22	1,490,662
	NW1	48.94	0.0765	21.52			27.42				CN = 77	2.99	1.56	6.35	276,782
	NW2	206.05	0.3220	96.24	13.03		96.78				CN = 76	3.16	1.49	25.58	1,114,401
	N1	225.97	0.3531	136.71	13.80		75.46				CN = 72	3.89	1.23	23.23	1,011,859
	N2	64.12	0.1002	14.87	5.33		43.92				CN = 81	2.35	1.85	9.87	429,944
	E1	291.72	0.4558	32.41	0.75		258.56				CN = 85	1.76	2.17	52.64	2,292,792
	E2	325.26	0.5082	94.56	34.26		196.44				CN = 80	2.50	1.77	48.04	2,092,535
Post-Mining	W1	228.17	0.3565	12.58		5.33	31.32	98.44	60.61	19.89	CN = 72	3.89	1.23	23.46	1,021,710
	NW1	52.02	0.0813	10.62			8.49	14.91	18.00		CN = 72	3.89	1.23	5.35	232,938
	NW2	143.82	0.2247				46.18		92.87	4.77	CN = 80	2.50	1.77	21.24	925,255
	N1	177.41	0.2772					177.41			CN = 65	5.38	0.84	12.46	542,798
	N2	138.17	0.2159	9.17	0.02		30.74	5.36	82.89	9.99	CN = 78	2.82	1.63	18.74	816,400
	E1	100.19	0.1565				48.65		47.63	3.91	CN = 82	2.20	1.92	16.06	699,698
	E2	222.62	0.3478	36.82	1.41		146.10		35.88	2.41	CN = 82	2.20	1.92	35.69	1,554,714
Phase 1, Stage 1	W1	245.05	0.3829	77.92		7.68	119.88		39.57		CN = 78	2.82	1.63	33.24	1,447,918
	NW1	42.14	0.0658	15.45			9.73		16.96		CN = 74	3.51	1.36	4.77	207,823
	NW2	118.37	0.1850	0.28			77.57		40.52		CN = 84	1.90	2.08	20.55	894,958
	N2	150.49	0.2351	2.88			99.34		48.27		CN = 84	1.90	2.08	26.12	1,137,807
	E1	105.39	0.1647	0.44			85.98		18.97		CN = 86	1.63	2.25	37.36	1,627,568
	E2	199.32	0.3114	59.83	1.41		138.08				CN = 80	2.50	1.77	15.57	678,018
	L1	110.76	0.1731	106.84			1.52		2.40		CN = 64	5.63	0.79	13.17	573,602
	Total:	3437.66	5.37											483.70	21,070,182

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	BTA
Apprvd:	REK

					Flow Segment 1							Flow Segment 2						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
W1	0.3776	79	10.6	13.2	Sheet	100.0	0.339	H	Range		4.34	Shallow	585.0	0.396	U	Unpaved		0.96
NW1	0.0765	77	6.7	8.4	Sheet	100.0	0.463	H	Range		3.83	Shallow	550.0	0.492	U	Unpaved		0.81
NW2	0.3220	76	10.6	13.2	Sheet	100.0	0.530	H	Range		3.63	Shallow	570.0	0.468	U	Unpaved		0.86
N1	0.3531	72	10.5	13.1	Sheet	100.0	0.400	H	Range		4.06	Shallow	770.0	0.408	U	Unpaved		1.25
N2	0.1002	81	10.7	13.4	Sheet	100.0	0.348	H	Range		4.29	Shallow	1660.0	0.510	U	Unpaved		2.40
E1	0.4558	85	9.4	11.7	Sheet	100.0	0.570	H	Range		3.52	Shallow	1250.0	0.576	U	Unpaved		1.70
E2	0.5082	80	10.2	12.8	Sheet	100.0	0.570	H	Range		3.52	Shallow	745.0	0.537	U	Unpaved		1.05
W1	0.3565	72	16.8	21.0	Sheet	100.0	0.300	H	Range		4.55	Shallow	1000.0	0.860	U	Unpaved		1.11
NW1	0.0813	72	7.0	8.8	Sheet	100.0	0.600	H	Range		3.45	Shallow	820.0	0.366	U	Unpaved		1.40
NW2	0.2247	80	14.2	17.8	Sheet	100.0	0.250	H	Range		4.90	Shallow	630.0	0.512	U	Unpaved		0.91
N1	0.2772	65	12.5	15.6	Sheet	100.0	0.150	H	Range		6.01	Shallow	1500.0	0.085	U	Unpaved		5.31
N2	0.2159	78	9.5	11.8	Sheet	100.0	0.400	H	Range		4.06	Shallow	570.0	0.507	U	Unpaved		0.83
E1	0.1565	82	9.8	12.3	Sheet	100.0	0.200	H	Range		5.36	Shallow	1310.0	0.564	U	Unpaved		1.80
E2	0.3478	82	8.1	10.1	Sheet	100.0	0.250	H	Range		4.90	Shallow	1250.0	0.503	U	Unpaved		1.82
W1	0.3829	78	11.0	13.8	Sheet	100.0	0.250	H	Range		4.90	Shallow	585.0	0.396	U	Unpaved		0.96
NW1	0.0658	74	8.9	11.1	Sheet	100.0	0.450	H	Range		3.87	Shallow	680.0	0.471	U	Unpaved		1.02
NW2	0.1850	84	8.7	10.9	Sheet	100.0	0.300	H	Range		4.55	Shallow	570.0	0.474	U	Unpaved		0.86
N2	0.2351	84	8.5	10.6	Sheet	100.0	0.400	H	Range		4.06	Shallow	720.0	0.451	U	Unpaved		1.11
E1	0.1647	86	7.5	9.4	Sheet	100.0	0.300	H	Range		4.55	Shallow	740.0	0.507	U	Unpaved		1.07
E2	0.3114	80	8.0	10.0	Sheet	100.0	0.250	H	Range		4.90	Shallow	1390.0	0.460	U	Unpaved		2.12
L1	0.1731	64	14.6	18.3	Sheet	100.0	0.150	H	Range		6.01	Shallow	1010.0	0.079	U	Unpaved		3.71

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	BVT
Apprvd:	RRK

			Flow Segment 3							Flow Segment 4						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
W1	0.3776	79	Channel	1700	0.357	M	Mountain Channel	1.38	1.16	Channel	2920	0.106	M	Mountain Channel	1.64	3.25
NW1	0.0765	77	Channel	490	0.194	M	Mountain Channel	0.84	0.63	Channel	960	0.590	M	Mountain Channel	0.67	0.82
NW2	0.3220	76	Channel	2380	0.310	M	Mountain Channel	1.27	1.84	Channel	2220	0.091	M	Mountain Channel	1.46	2.89
N1	0.3531	72	Channel	1890	0.115	M	Mountain Channel	1.34	2.31	Channel	2560	0.115	M	Mountain Channel	1.34	3.13
N2	0.1002	81	Channel	1350	0.156	M	Mountain Channel	0.91	1.84	Channel	1320	0.078	M	Mountain Channel	1.05	2.31
E1	0.4558	85	Channel	2480	0.216	M	Mountain Channel	1.78	1.83	Channel	2525	0.078	M	Mountain Channel	2.07	2.81
E2	0.5082	80	Channel	2500	0.262	M	Mountain Channel	1.70	1.73	Channel	3360	0.040	M	Mountain Channel	2.24	4.95
W1	0.3565	72	Shallow	1740	0.080	U	Unpaved		6.35	Channel	2240	0.054	M	Mountain Channel	1.37	3.94
NW1	0.0813	72	Channel	830	0.096	R	Riprap	0.73	1.48	Channel	440	0.045	R	Riprap	0.86	1.03
NW2	0.2247	80	Shallow	3260	0.196	U	Unpaved		7.61	Channel	1590	0.113	M	Mountain Channel	1.17	2.15
N1	0.2772	65	Channel	2860	0.122	R	Riprap	0.79	4.30							
N2	0.2159	78	Shallow	1480	0.405	U	Unpaved		2.40	Channel	810	0.296	R	Riprap	1.00	0.67
E1	0.1565	82	Channel	2590	0.210	M	Mountain Channel	0.96	2.93	Channel	1280	0.070	M	Mountain Channel	1.19	2.17
E2	0.3478	82	Channel	3670	0.193	M	Mountain Channel	1.39	3.39							
W1	0.3829	78	Channel	1700	0.357	M	Mountain Channel	1.38	1.16	Channel	2920	0.106	M	Mountain Channel	1.64	3.25
NW1	0.0658	74	Channel	1440	0.063	M	Mountain Channel	0.73	3.59	Channel	960	0.016	E	Earth-lined	0.73	2.62
NW2	0.1850	84	Channel	1830	0.328	M	Mountain Channel	1.03	1.58	Channel	1410	0.128	R	Riprap	1.27	1.51
N2	0.2351	84	Channel	2450	0.345	M	Mountain Channel	1.17	1.90	Channel	2790	0.075	R	Riprap	1.45	3.57
E1	0.1647	86	Channel	1150	0.439	M	Mountain Channel	0.96	0.90	Channel	440	0.034	R	Riprap	1.56	0.80
E2	0.3114	80	Channel	3050	0.202	M	Mountain Channel	1.26	2.94							
L1	0.1731	64	Channel	2820	0.011	E	Earth-lined	0.83	8.54							

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	ATA
Apprvd:	REK

			Flow Segment 5						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
W1	0.3776	79	Channel	1820.0	0.009	E	Earth-lined	1.92	3.48
NW1	0.0765	77	Channel	970.0	0.013	E	Earth-lined	1.06	2.29
NW2	0.3220	76	Channel	2160.0	0.012	E	Earth-lined	1.64	3.98
N1	0.3531	72	Channel	1305.0	0.014	E	Earth-lined	1.54	2.32
N2	0.1002	81	Channel	1200.0	0.021	E	Earth-lined	0.85	2.59
E1	0.4558	85	Channel	1140.0	0.014	E	Earth-lined	1.74	1.87
E2	0.5082	80	Channel	900.0	0.014	E	Earth-lined	1.64	1.53
W1	0.3565	72	Channel	1900.0	0.006	E	Earth-lined	1.61	5.01
NW1	0.0813	72	Channel	510.0	0.013	E	Earth-lined	0.84	1.41
NW2	0.2247	80	Channel	1280.0	0.061	M	Mountain Channel	1.28	2.22
N1	0.2772	65							
N2	0.2159	78	Channel	2840.0	0.092	R	Riprap	1.13	3.87
E1	0.1565	82							
E2	0.3478	82							
W1	0.3829	78	Channel	1820.0	0.009	E	Earth-lined	1.88	3.53
NW1	0.0658	74							
NW2	0.1850	84	Channel	1690.0	0.074	R	Riprap	1.27	2.38
N2	0.2351	84							
E1	0.1647	86	Channel	1850.0	0.176	M	Mountain Channel	1.11	2.08
E2	0.3114	80							
L1	0.1731	64							

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

TABLE 3
FLOW RESULTS FROM HEC-HMS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
PROJECT NO.: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	ATA
Apprvd:	REK

							20-YEAR, 1-HOUR POINT RAINFALL DEPTH (inches) 0.74			100-YEAR, 1-HOUR POINT RAINFALL DEPTH (inches) 1.13		
Phase	SUBBASIN ID	Area (ac)	Pervious Area Fraction, a_p	Composite CN	Infiltraition Rate for Pervious Areas, F_p (in/hr)	Maximum Loss Rate, F_m (in/hr)	Tc (min)	I (in/hr)	Peak Flow Rate, Q (cfs)	Tc (min)	I (in/hr)	Peak Flow Rate, Q (cfs)
Pre-Mining	W1	241.7	0.98	79	0.40	0.39	13.9	1.62	266.9	13.2	2.61	481.6
	NW1	48.9	0.98	77	0.43	0.42	8.7	2.13	75.2	8.4	3.42	131.9
	NW2	206.1	0.98	76	0.45	0.44	14.0	1.61	217.5	13.2	2.61	401.6
	N1	226.0	0.98	72	0.52	0.51	13.8	1.63	228.2	13.1	2.62	429.8
	N2	64.1	0.98	81	0.36	0.36	14.0	1.61	72.3	13.4	2.58	128.3
	E1	291.7	0.98	85	0.29	0.29	12.3	1.73	380.1	11.7	2.77	653.0
	E2	325.3	0.98	80	0.38	0.37	13.5	1.65	372.3	12.8	2.65	666.8
Post-Mining	W1	228.2	0.98	72	0.52	0.51	22.4	1.24	150.6	21.0	2.01	307.8
	NW1	52.0	0.98	72	0.52	0.51	9.1	2.06	72.6	8.8	3.31	131.2
	NW2	143.8	0.98	80	0.38	0.37	18.9	1.36	127.9	17.8	2.21	237.0
	N1	177.4	0.98	65	0.63	0.62	16.0	1.49	140.1	15.6	2.36	277.9
	N2	138.2	0.98	78	0.42	0.41	12.5	1.72	163.1	11.8	2.76	292.2
	E1	100.2	0.98	82	0.35	0.34	12.7	1.70	123.1	12.3	2.71	214.0
	E2	222.6	0.98	82	0.35	0.34	10.4	1.87	306.9	10.1	2.96	524.9
Phase 1, Stage 1	W1	245.1	0.98	78	0.42	0.41	14.5	1.57	256.5	13.8	2.54	468.6
	NW1	42.1	0.98	74	0.48	0.47	11.7	1.78	49.7	11.1	2.84	90.0
	NW2	118.4	0.98	84	0.31	0.30	11.4	1.80	159.7	10.9	2.87	273.5
	N2	150.5	0.98	84	0.31	0.30	11.1	1.82	205.4	10.6	2.90	351.5
	E1	105.4	0.98	86	0.27	0.27	9.7	1.95	159.3	9.4	3.14	272.1
	E2	199.3	0.98	80	0.38	0.37	10.2	1.88	270.9	10.0	2.98	468.1
	L1	110.8	0.98	64	0.64	0.63	19.0	1.35	72.3	18.3	2.17	153.7

TABLE 4
SEDIMENT POND SIZING

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
PROJECT NO.: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	ATA
Apprvd:	REK

DESIGN STORM: 10-Year, 24-Hour, 2.28 in.

Basin	Area	Area Fraction	Soil Group	CN	F_p	a_p	S	Ia	Y	Basin Y	10-yr, 24 hr. Volume
	(ac.)	(dec.)			(in/hr)	(dec.)	(in)	(in)	(in)	(in)	(ac-ft)
Phase 1, Stage 1 W1	245.05	0.318	A	63	0.66	0.98	5.87	1.17	0.077		
		0.031	C	85	0.29	0.98	1.76	0.35	0.441		
		0.489	D	88	0.24	0.98	1.36	0.27	0.524		
		0.161		77	0.43	0.98	2.99	0.60	0.266		
				78	**0.40**					0.338	15.7
Phase 1, Stage 1 NW1	42.14	0.367	A	63	0.66	0.98	5.87	1.17	0.077		
		0.231	D	88	0.24	0.98	1.36	0.27	0.524		
		0.402		77	0.43	0.98	2.99	0.60	0.266		
				74	**0.47**					0.256	2.1
Phase 1, Stage 1 NW2	118.37	0.002	A	63	0.66	0.98	5.87	1.17	0.077		
		0.655	D	88	0.24	0.98	1.36	0.27	0.524		
		0.342		77	0.43	0.98	2.99	0.60	0.266		
				84	**0.30**					0.435	9.8
Phase 1, Stage 1 N2	150.49	0.019	A	63	0.66	0.98	5.87	1.17	0.077		
		0.660	D	88	0.24	0.98	1.36	0.27	0.524		
		0.321		77	0.43	0.98	2.99	0.60	0.266		
				84	**0.31**					0.433	12.4
Phase 1, Stage 1 E1	105.39	0.004	A	63	0.66	0.98	5.87	1.17	0.077		
		0.816	D	88	0.24	0.98	1.36	0.27	0.524		
		0.180		77	0.43	0.98	2.99	0.60	0.266		
				86	**0.27**					0.476	9.5
Phase 1, Stage 1 L1	110.76	0.965	A	63	0.66	0.98	5.87	1.17	0.077		
		0.014	D	88	0.24	0.98	1.36	0.27	0.524		
		0.022		77	0.43	0.98	2.99	0.60	0.266		
				64	**0.65**					0.087	1.8
Post-Mining NW2	143.82	0.321	D	88	0.24	0.98	1.36	0.27	0.524		
		0.646		77	0.43	0.98	2.99	0.60	0.266		
		0.033		70	0.55	0.98	4.29	0.86	0.156		
				80	**0.37**					0.345	9.4

TABLE 4
SEDIMENT POND SIZING

Post-Mining N2	138.17	0.066	A	63	0.66	0.98	5.87	1.17	0.077		
		0.000	B	77	0.43	0.98	2.99	0.60	0.266		
		0.222	D	88	0.24	0.98	1.36	0.27	0.524		
		0.039		65	0.63	0.98	5.38	1.08	0.096		
		0.600		77	0.43	0.98	2.99	0.60	0.266		
		0.072		70	0.55	0.98	4.29	0.86	0.156		
				80	**0.37**					0.296	7.8
Post-Mining E1	100.19	0.486	D	88	0.24	0.98	1.36	0.27	0.524		
		0.475		77	0.43	0.98	2.99	0.60	0.266		
		0.039		70	0.55	0.98	4.29	0.86	0.156		
				82	**0.34**					0.387	7.4
Post-Mining E2	222.62	0.165	A	63	0.66	0.98	5.87	1.17	0.077		
		0.006	B	77	0.43	0.98	2.99	0.60	0.266		
		0.656	D	88	0.24	0.98	1.36	0.27	0.524		
		0.161		77	0.43	0.98	2.99	0.60	0.266		
		0.011		70	0.55	0.98	4.29	0.86	0.156		
				80	**0.37**					0.403	17.0

TABLE 5
SEDIMENT POND RISER OUTLET PIPE AND OVERFLOW WEIR SIZING

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
PROJECT NO.: 043-2299D

Date:	12/21/11
By:	CPB
Chkd:	ATA
Apprvd:	RCK

Sediment Pond	Surface Area at Mid Elev. (ft^2)	Top of Riser Elev. (ft)	Bottom Row of Riser Elev. (ft)	h_{max} (ft)	$h_{centroid}$ (ft)	Total Orifice Area (1) for 24-hr Drawdown (ft^2)	Total Orifice Area (1) for 40-hr Drawdown (ft^2)	Total Orifice Area (1) for 72-hr Drawdown (ft^2)	Number of 1" Dia. Holes Provided	Area Provided (ft^2)	100-Year Rational Method Peak Flow (cfs)	Routed 100-Year Peak Flow (cfs)	Weir Length (2) (ft)
Pond W1 (Phase 1, Stage 1)	122860.0	2838.0	2831.0	7.0	3.5	2.0091	1.2055	0.6697	132	0.7128	469	81.1	154
Pond NW2 (Phase 1, Stage 1)	77920.0	2832.0	2824.0	8.0	4.0	1.3622	0.8173	0.4541	96	0.5184	364	79.8	120
Pond N2 (Phase 1, Stage 1)	42990.0	2759.0	2744.0	15.0	7.5	1.0291	0.6175	0.3430	72	0.3888	352	89.1	29
Pond L1 (Phase 1, Stage 1)	21750.0	2799.0	2794.0	5.0	2.5	0.3006	0.1804	0.1002	20	0.1080	154	30	51
Pond E1 (Phase 1, Stage 1)	43760.0	2859.0	2848.0	11.0	5.5	0.8971	0.5382	0.2990	60	0.3240	272	77.6	89
Pond E2 (Post-Mining)	59380.0	2800.0	2786.0	14.0	7.0	1.3732	0.8239	0.4577	96	0.5184	525	124	41

1) The required total area of the orifices for the riser outflow pipes with multiple orifices is calculated using the following equation from the California Stormwater BMP Handbook. Pond design and riser dimensions are from Dwg 26 of the Phase 1, Stage 1 Design Drawings issued for feasibility study.

$a_t = 2A(h_{max})/3600CT[2g(h_{max}-h_{centroid})]^{0.5}$ C = 0.66

2) The required length of weir is calculated using the broad-crested weir equation, $L = Q/cH^{1.5}$, and Routed 100-Year Peak Flows.

H = 1
c = 3.04

ATTACHMENT A
TIME OF CONCENTRATION AND MANNING'S FLOW COEFFICIENTS

Attachment A
Time of Concentration and Mannings Flow Coefficients

TR-55 (1986)

Sheet Flow Travel time (SCS Upland Method)

$$T_t = \frac{0.007\,(n'\,L)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$$

Where: T_t = travel time (hr); n' = roughness coefficient; L = flow length (ft);

P_2 = 2-yr storm depth (inches); s = slope (ft/ft)

flow velocity = L/($60T_t$)

Flow Type	Surface Type	roughness n	Surface Description	Short Description
Sheet/Overland Flow	A	0.011	Smooth surfaces (concrete, asphalt, gravel, bare soil)	Smooth
	B	0.05	Fallow (no residue)	Fallow
	C	0.06	Cultivated soils: Residue cover <= 20%	Cover<20%
	D	0.17	Cultivated soils: Residue cover > 20%	Cover>20%
	E	0.15	Grass: Short grass prairie	Short Grass
	F	0.24	Grass: Dense grasses	Dense Grass
	G	0.41	Grass: Bermuda grass	Bermuda Grass
	H	0.13	Range (natural)	Range
	I	0.40	Woods: Light underbrush	Light woods
	J	0.80	Woods: Heavy underbrush	Heavy Woods

Shallow Concentrated Flow Velocity (SCS Upland Method)

$v = mS^{0.5}$

Where: v = velocity (fps); m = roughness coeffient; S = slope (ft/ft)

Flow Type	Surface Type	Roughness m	Surface Description	Short Description
Shallow Conc. Flow	P	20.3282	Paved Surfaces	Paved
	U	16.1345	Unpaved Surfaces	Unpaved

Channel Flow Velocity (Mannings Velocity)

$v = 1.49/n\ Rh^{2/3}S^{1/2}$

Where: v = velocity (fps); n = roughness coeffient; Rh = Hydraulic Radius (ft), S = slope (ft/ft)

Lining Type	Mannings n for Depth	Mannings n for Velocity	Material	Maximum Velocity	Maximum Shear Stress
A	0.026	0.026	ACB	25	
C	0.024	0.022	CSP	50	
E	0.025	0.022	Earth-lined	3	
G	0.035	0.030	Grass-lined	5	
I	0.017	0.013	Ductile Iron	50	
M	0.045	0.045	Mountain Channel per Kern County Manual		
P	0.012	0.009	Plastic	25	
R	0.040	0.035	Riprap	15	
T	0.035	0.030	Turf Reinf.	10	1.5
Z	0.060	0.005	Other	25	

ATTACHMENT B
NOAA ATLAS 14 PRECIPITATION TABLES

Attachment B
NOAA Atlas 14 Precipitation Tables

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

MOJAVE, SOUTHERN CALIFORNIA (04-5756) 35.0492 N 118.1619 W 2742 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Tue Jun 15 2010

Confidence Limits | Seasonality | Related Info | GIS data | Maps | Docs | Return to State

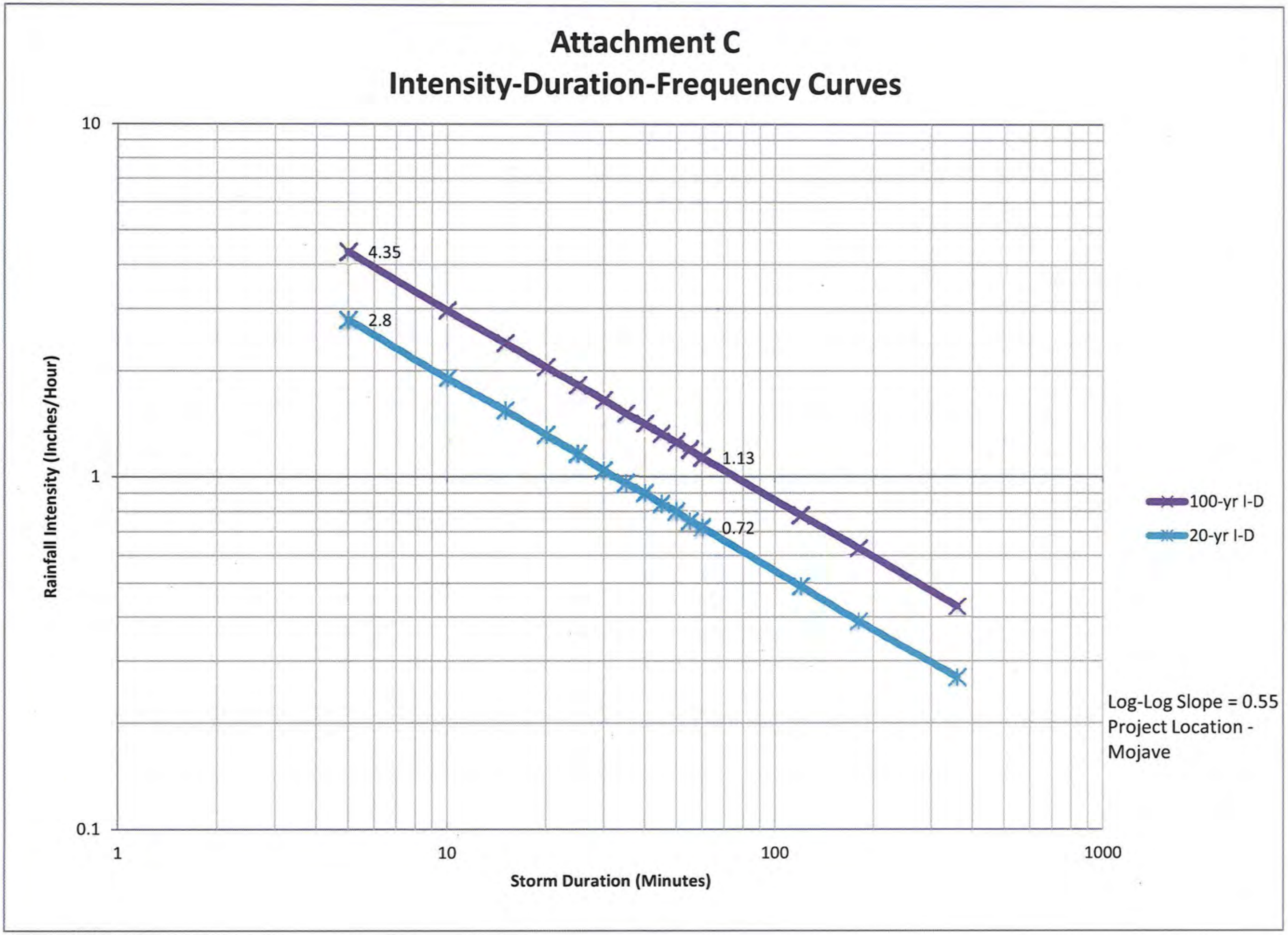
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.08	0.12	0.15	0.21	0.26	0.36	0.46	0.62	0.81	1.02	1.16	1.31	1.47	1.60	1.87	2.13	2.40	2.69
2	0.11	0.16	0.20	0.27	0.34	0.48	0.59	0.81	1.07	1.35	1.54	1.76	1.98	2.17	2.54	2.90	3.31	3.67
5	0.15	0.23	0.29	0.39	0.48	0.68	0.84	1.13	1.50	1.89	2.18	2.53	2.87	3.14	3.69	4.22	4.95	5.50
10	0.19	0.29	0.36	0.48	0.59	0.85	1.02	1.39	1.81	2.28	2.65	3.13	3.55	3.86	4.53	5.16	6.18	6.87
25	0.25	0.38	0.47	0.63	0.79	1.09	1.30	1.76	2.24	2.82	3.28	3.95	4.49	4.85	5.63	6.41	7.86	8.78
50	0.30	0.46	0.56	0.76	0.94	1.30	1.53	2.05	2.58	3.24	3.77	4.60	5.23	5.62	6.47	7.36	9.20	10.31
100	0.36	0.55	0.68	0.91	1.13	1.54	1.79	2.37	2.94	3.67	4.28	5.29	6.02	6.42	7.33	8.32	10.59	11.91
200	0.42	0.65	0.80	1.08	1.33	1.80	2.06	2.71	3.30	4.11	4.80	6.02	6.85	7.24	8.20	9.29	12.04	13.59
500	0.52	0.80	0.99	1.33	1.65	2.19	2.45	3.20	3.81	4.71	5.51	7.04	8.01	8.37	9.36	10.58	14.06	15.96
1000	0.61	0.93	1.15	1.55	1.92	2.52	2.78	3.61	4.21	5.17	6.07	7.86	8.94	9.26	10.25	11.56	15.65	17.86

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

100-yr I-D		20-yr I-D		10-yr I-D	
t (min)	I (in/hr)	t (min)	I (in/hr)	t (min)	I (in/hr)
5	4.35	5	2.8	5	2.3
10	2.97	10	1.9	10	1.56
15	2.4	15	1.54	15	1.26
20	2.05	20	1.31	20	1.07
25	1.82	25	1.16	25	0.95
30	1.65	30	1.04	30	0.85
35	1.51	35	0.96	35	0.79
40	1.41	40	0.9	40	0.73
45	1.32	45	0.84	45	0.69
50	1.25	50	0.8	50	0.65
55	1.19	55	0.75	55	0.62
60	1.13	60	0.72	60	0.59
120	0.78	120	0.49	120	0.4
180	0.63	180	0.39	180	0.32
360	0.43	360	0.27	360	0.22

ATTACHMENT C
INTENSITY-DURATION-FREQUENCY CURVE



Attachment C
Intensity-Duration-Frequency Curves
Rainfall Intensity (Inches/Hour)
10
1
0.1
1
10
100
1000
Storm Duration (Minutes)
4.35
2.8
1.13
0.72
100-yr I-D
20-yr I-D
Log-Log Slope = 0.55
Project Location -
Mojave

APPENDIX D
POST-MINING "WHAT IF" SCENARIO
HYDROLOGY ANALYSIS CALCULATION

Golder Associates

CALCULATIONS

Date:	March 7, 2012	**Made by:**	CPB
Project No.:	043-2299D	**Checked by:**	ATA
Subject:	Post-Mining "What If" Hydrology Analysis	**Reviewed by:**	REK
Project Short Title:	**SOLEDAD MOUNTAIN**		

Conduct an evaluation of peak flow rates generated by the 20-year precipitation event at the Soledad Mountain Project (Project) for the post-mining "What If" condition assuming complete closure and reclamation of the Project in accordance with Article 9 of the Surface Mining and Reclamation Act (SMARA). Section 3706 of Article 9 requires that surface runoff and drainage from the reclaimed site be controlled to ensure that surrounding land and water resources are protected from erosion, gullying, sedimentation, and contamination. Diversion channels and erosion control methods shall therefore be designed to handle runoff from not less than the 20-year, 1-hour intensity storm event. Other erosion and sedimentation controls will be developed as part of the final reclamation and revegetation plans. No operations will be present in the post-mining "What If" scenario and therefore no sediment ponds are required.

1.0 METHOD

Subbasins were delineated using proposed post-mining "What If" scenario topography provided by Norwest and are shown in Figure 4. NOAA Atlas 14 Precipitation Frequency Estimates were used to provide precipitation values for the 20-year, 1-hour storm event (see Attachment B). The peak flow rates for the 20-year storm were calculated using the Rational Method as set forth in the Kern County Hydrology Manual (Hromadka). Rational Method peak flow rates are used as an initial estimate of ditch and channel sizing for the overall layout and comparison of the post-mining "What If" condition.

2.0 DATA AND ASSUMPTIONS

- NRCS soil survey maps are used to aid in curve number selection.
- Unless otherwise indicated, subbasins are assumed to contain 2% impervious area.
- Precipitation depths for the 20-year, 1-hour storm were obtained from NOAA Atlas 14; full tables are presented in Attachment B (NOAA, 2004).
- Time of concentration is calculated using TR-55 methodology.
- The calculated time of concentration for the 20-year flow calculation was increased by a factor of 1.09 for flow segments 3 through 5 according to Kern County Hydrology Manual.
- Diversion channels will be constructed to divert flow around the Phase 1 and Phase 2 reclaimed and closed heap leach pads.

Golder Associates Inc.
44 Union Boulevard, Suite 300
Lakewood, CO 80228 USA
Tel: (303) 980-0540 Fax: (303) 985-2080 www.golder.com

3.0 CALCULATIONS

Basins were delineated and area-weighted composite curve numbers were calculated based on different cover and soil types, as presented in **Table 1**. Times of concentration for all basins were calculated using TR-55 methodology and are presented in **Table 2** (USSCS, 1986). The 20-year peak flow rates were calculated using the Rational Method in accordance with the Kern County Hydrology Manual. Rational Method calculations are presented in **Table 3**.

4.0 CONCLUSIONS/RESULTS

A summary of the estimated peak flows calculated with the Rational Method in accordance with the Kern County Hydrology Manual for the post-mining "What If" conditions are presented in **Table 3.** These calculations are summarized in the table below.

Basin ID	Area (acres)	Composite CN	20-year Rational Method Peak Flow (cfs)
W1	115.2	71	158.8
W2	104.2	65	71.0
NW1	74.2	68	84.6
NW2	125.0	72	123.0
N1	177.4	65	102.4
N2	136.8	68	133.9
E1	290.2	77	306.2
E2	330.0	75	298.2

5.0 REFERENCES

Hromadka II, T.V. *Kern County Hydrology Manual.* 1992.

National Oceanic and Atmospheric Administration (NOAA). 2004. *Precipitation-Frequency Atlas of the United States, NOAA Atlas No. 14, Volume I, Version 3.* Silver Spring, MD: National Weather Service. http://hdsc.nws.noaa.gov/hdsc/pfds

Natural Resources Conservation Service (NRCS). Version 4 December 21, 2006. Soil Survey of Areas near Soledad Mountain.

U.S. Soil Conservation Service (USSCS). 1986. *Urban Hydrology for Small Watersheds, 2nd edition* (USSCS Technical Release Number 55). Washington, DC: United States Department of Agriculture.

Attachments:
- Table 1 – Subbasin Summary Table
- Table 2 – Basin Time of Concentration Calculations
- Table 3 – Rational Method Flow Results
- Figure 4 – Post-Mining Drainage Plan for "What If" Scenario
- Attachment A – Time of Concentration and Manning's Flow Coefficients
- Attachment B – NOAA Atlas 14 Precipitation Tables
- Attachment C – Intensity-Duration-Frequency Curve

TABLES

TABLE 1
SUBBASIN SUMMARY TABLE

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	3/7/12
By:	CPB
Chkd:	
Apprvd:	

Design Storm 100 -Year Reccurance Interval

Storm Duration (hours)	2-Year Depth (inches)	100 -Year Depth (inches)	Storm Distribution
24	1.35	3.67	II

	Subbasin ID	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 63 Undisturbed DESERT SHRUB HSG A (Acres)	CN = 77 Undisturbed DESERT SHRUB HSG B (Acres)	CN = 85 Undisturbed DESERT SHRUB HSG C (Acres)	CN = 88 Undisturbed DESERT SHRUB HSG D (Acres)	CN = 65 Reclaimed Areas (Acres)	CN = 77 ROCK DUMP TOPS (Acres)	CN = 70 ROCK DUMP OUTSLOPES (Acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
"What If" Post-Mining	W1	115.20	0.1800				28.41	86.79			CN = 71	4.08	1.17	11.26	490,663
	W2	104.19	0.1628					104.19			CN = 65	5.38	0.84	7.32	318,776
	NW1	74.17	0.1159				8.24	65.93			CN = 68	4.71	1.00	6.19	269,663
	NW2	124.98	0.1953				39.80	85.18			CN = 72	3.89	1.23	12.85	559,641
	N1	177.40	0.2772					177.40			CN = 65	5.38	0.84	12.46	542,767
	N2	136.75	0.2137	2.43			18.88	115.44			CN = 68	4.71	1.00	11.41	497,188
	E1	290.23	0.4535	27.14	0.22		147.49	115.38			CN = 77	2.99	1.56	37.68	1,641,404
	E2	330.01	0.5156	4.42	20.39		130.36	174.84			CN = 75	3.33	1.42	39.15	1,705,218
	Total:	1352.93	2.11											138.32	6,025,322

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	3/7/12
By:	CPB
Chkd:	
Apprvd:	

					Flow Segment 1							Flow Segment 2						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Total Lag (0.8*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
W1	0.1800	71	7.0	8.7	Sheet	100.0	0.600	H	Range		3.45	Shallow	475.0	0.589	U	Unpaved		0.64
W2	0.1628	65	14.5	18.2	Sheet	100.0	0.150	H	Range		6.01	Shallow	1740.0	0.063	U	Unpaved		7.16
NW1	0.1159	68	8.2	10.3	Sheet	100.0	0.800	H	Range		3.08	Shallow	455.0	0.308	U	Unpaved		0.85
NW2	0.1953	72	10.9	13.7	Sheet	100.0	0.100	H	Range		7.07	Shallow	675.0	0.444	U	Unpaved		1.05
N1	0.2772	65	16.7	20.8	Sheet	100.0	0.200	H	Range		5.36	Shallow	1505.0	0.095	U	Unpaved		5.04
N2	0.2137	68	10.4	13.0	Sheet	100.0	0.200	H	Range		5.36	Shallow	2150.0	0.460	U	Unpaved		3.27
E1	0.4535	77	10.9	13.7	Sheet	100.0	0.250	H	Range		4.90	Shallow	1715.0	0.507	U	Unpaved		2.49
E2	0.5156	75	12.7	15.9	Sheet	100.0	0.100	H	Range		7.07	Shallow	745.0	0.591	U	Unpaved		1.00

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

Date:	3/7/12
By:	CPB
Chkd:	
Apprvd:	

			Flow Segment 3							Flow Segment 4						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
W1	0.1800	71	Channel	1700	0.329	M	Mountain Channel	1.38	1.21	Channel	805	0.124	M	Mountain Channel	1.64	0.83
W2	0.1628	65	Channel	1345	0.012	M	Mountain Channel	1.38	5.00							
NW1	0.1159	68	Channel	1055	0.360	M	Mountain Channel	0.84	1.00	Channel	1130	0.124	M	Mountain Channel	0.67	2.12
NW2	0.1953	72	Channel	2760	0.275	M	Mountain Channel	1.27	2.27	Channel	2325	0.077	M	Mountain Channel	1.46	3.29
N1	0.2772	65	Channel	2860	0.013	M	Mountain Channel	1.34	10.42							
N2	0.2137	68	Channel	2955	0.135	M	Mountain Channel	0.91	4.32							
E1	0.4535	77	Channel	2005	0.180	M	Mountain Channel	1.78	1.62	Channel	2525	0.078	M	Mountain Channel	2.07	2.81
E2	0.5156	75	Channel	4295	0.205	M	Mountain Channel	1.70	3.36	Channel	2355	0.059	M	Mountain Channel	2.24	2.86

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
Project Number: 043-2299D

TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

Date:	3/7/12
By:	CPB
Chkd:	
Apprvd:	

			Flow Segment 5						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
W1	0.1800	71	Channel	3355.0	0.055	E	Earth-lined	1.92	2.60
W2	0.1628	65							
NW1	0.1159	68	Channel	2965.0	0.061	E	Earth-lined	1.06	3.24
NW2	0.1953	72							
N1	0.2772	65							
N2	0.2137	68							
E1	0.4535	77	Channel	1140.0	0.014	E	Earth-lined	1.74	1.87
E2	0.5156	75	Channel	965.0	0.014	E	Earth-lined	1.64	1.64

Notes:
(1) Refer to Attachment A for Roughness Condition descriptions and Tc Coeffiecients.
(2) The Natural Mountain Channel section per Kern County Hydrology Manual was used for mountainside drainage paths.

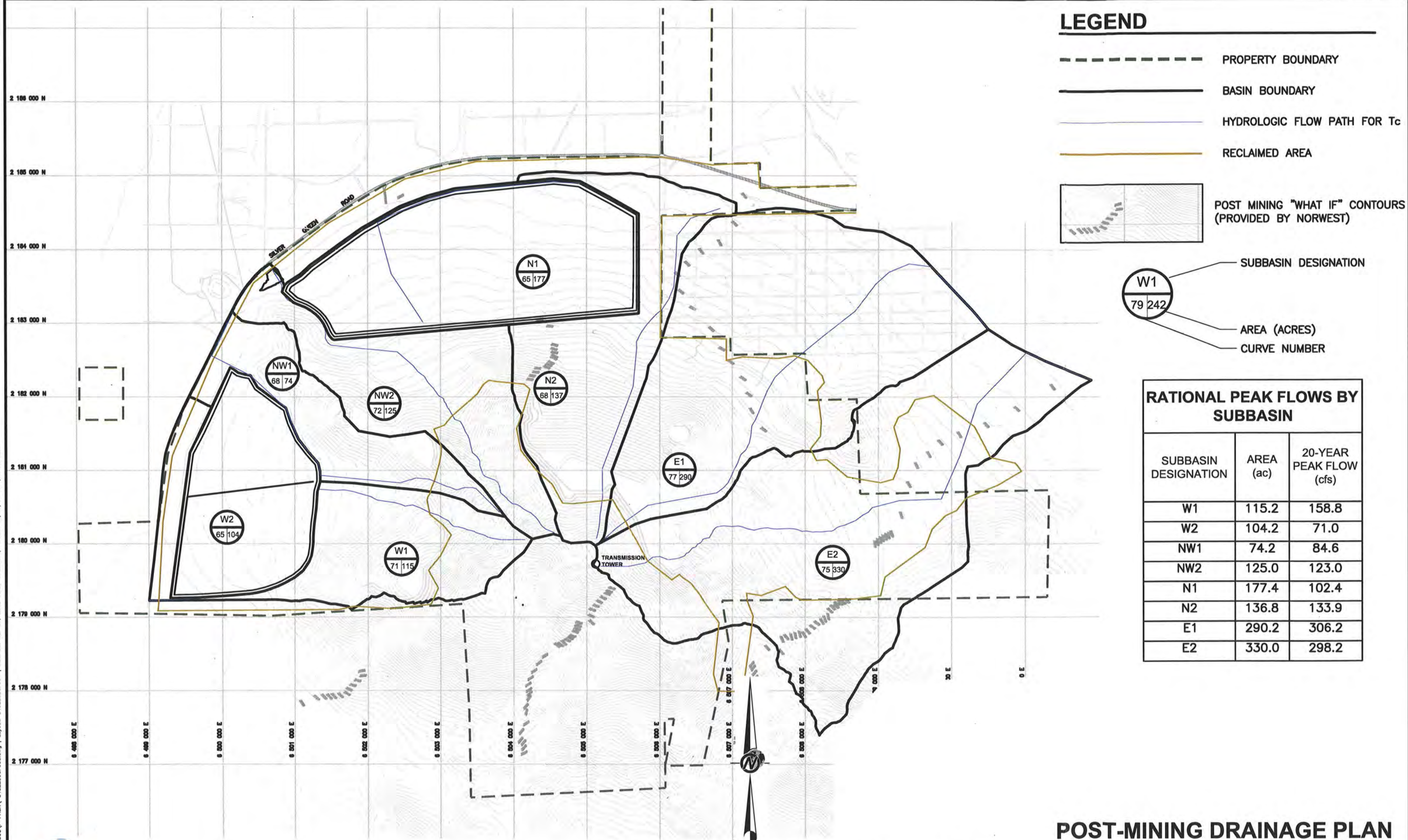
TABLE 3
RATIONAL METHOD FLOW RESULTS

GOLDEN QUEEN MINING CO. LTD.
SOLEDAD MOUNTAIN
PROJECT NO.: 043-2299D

Date:	3/7/12
By:	CPB
Chkd:	
Apprvd:	

	SUBBASIN ID	Area (ac)	Pervious Area Fraction, a_p	Composite CN	Infiltraition Rate for Pervious Areas, F_p (in/hr)	Maximum Loss Rate, F_m (in/hr)	20-YEAR, 1-HOUR POINT RAINFALL DEPTH (inches) 0.72 Tc (min)	I (in/hr)	Peak Flow Rate, Q (cfs)
Pre-Mining	W1	115.2	0.98	71	0.53	0.52	9.1	2.05	158.8
	W2	104.2	0.98	65	0.63	0.62	18.6	1.37	71.0
	NW1	74.2	0.98	68	0.58	0.57	10.8	1.84	84.6
	NW2	125.0	0.98	72	0.52	0.51	14.2	1.60	123.0
	N1	177.4	0.98	65	0.63	0.62	21.8	1.26	102.4
	N2	136.8	0.98	68	0.58	0.57	13.3	1.66	133.9
	E1	290.2	0.98	77	0.43	0.42	14.3	1.59	306.2
	E2	330.0	0.98	75	0.47	0.46	16.6	1.46	298.2

FIGURES



RATIONAL PEAK FLOWS BY SUBBASIN

SUBBASIN DESIGNATION	AREA (ac)	20-YEAR PEAK FLOW (cfs)
W1	115.2	158.8
W2	104.2	71.0
NW1	74.2	84.6
NW2	125.0	123.0
N1	177.4	102.4
N2	136.8	133.9
E1	290.2	306.2
E2	330.0	298.2

POST-MINING DRAINAGE PLAN FOR "WHAT IF" SCENARIO

FIGURE 4

Golder Associates
DENVER, COLORADO

PROJECT No. 043-2299D CADD AKW DATE 05/13/09 FILE No. 0432299CF008.dwg

Drawing File: N:\04\043-2299C\F-FHER\ 0432299CF008.dwg | Layout: 0432299CF004 | Modified: Mar 07, 2012 08:29 CPBaxter | Plotted: 03/07/12 2:39pm CPBaxter

Plot Time: 03/07/12 14:39

ATTACHMENT A
TIME OF CONCENTRATION AND MANNING'S FLOW COEFFICIENTS

Attachment A
Time of Concentration and Mannings Flow Coefficients

TR-55 (1986)

Sheet Flow Travel time (SCS Upland Method)

$$T_t = \frac{0.007\,(n' L)^{0.8}}{(P_2)^{0.5}\, s^{0.4}}$$

Where: T_t = travel time (hr); n' = roughness coefficient; L = flow length (ft); P_2 = 2-yr storm depth (inches); s = slope (ft/ft)

flow velocity = $L/(60T_t)$

Flow Type	Surface Type	roughness n	Surface Description	Short Description
Sheet/Overland Flow	A	0.011	Smooth surfaces (concrete, asphalt, gravel, bare soil)	Smooth
	B	0.05	Fallow (no residue)	Fallow
	C	0.06	Cultivated soils: Residue cover <= 20%	Cover<20%
	D	0.17	Cultivated soils: Residue cover > 20%	Cover>20%
	E	0.15	Grass: Short grass prairie	Short Grass
	F	0.24	Grass: Dense grasses	Dense Grass
	G	0.41	Grass: Bermuda grass	Bermuda Grass
	H	0.13	Range (natural)	Range
	I	0.40	Woods: Light underbrush	Light woods
	J	0.80	Woods: Heavy underbrush	Heavy Woods

Shallow Concentrated Flow Velocity (SCS Upland Method)

$v = mS^{0.5}$

Where: v = velocity (fps); m = roughness coeffient; S = slope (ft/ft)

Flow Type	Surface Type	Roughness m	Surface Description	Short Description
Shallow Conc. Flow	P	20.3282	Paved Surfaces	Paved
	U	16.1345	Unpaved Surfaces	Unpaved

Channel Flow Velocity (Mannings Velocity)

$v = 1.49/n\ Rh^{2/3}S^{1/2}$

Where: v = velocity (fps); n = roughness coeffient; Rh = Hydraulic Radius (ft), S = slope (ft/ft)

Lining Type	Mannings n for Depth	Mannings n for Velocity	Material	Maximum Velocity	Maximum Shear Stress
A	0.026	0.026	ACB	25	
C	0.024	0.022	CSP	50	
E	0.025	0.022	Earth-lined	3	
G	0.035	0.030	Grass-lined	5	
I	0.017	0.013	Ductile Iron	50	
M	0.045	0.045	Mountain Channel per Kern County Manual		
P	0.012	0.009	Plastic	25	
R	0.040	0.035	Riprap	15	
T	0.035	0.030	Turf Reinf.	10	1.5
Z	0.060	0.005	Other	25	

ATTACHMENT B
NOAA ATLAS 14 PRECIPITATION TABLES

Attachment B
NOAA Atlas 14 Precipitation Tables

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

MOJAVE, SOUTHERN CALIFORNIA (04-5756) 35.0492 N 118.1619 W 2742 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Tue Jun 15 2010

Confidence Limits | Seasonality | Related Info | GIS data | Maps | Docs | Return to State

Precipitation Frequency Estimates (inches)

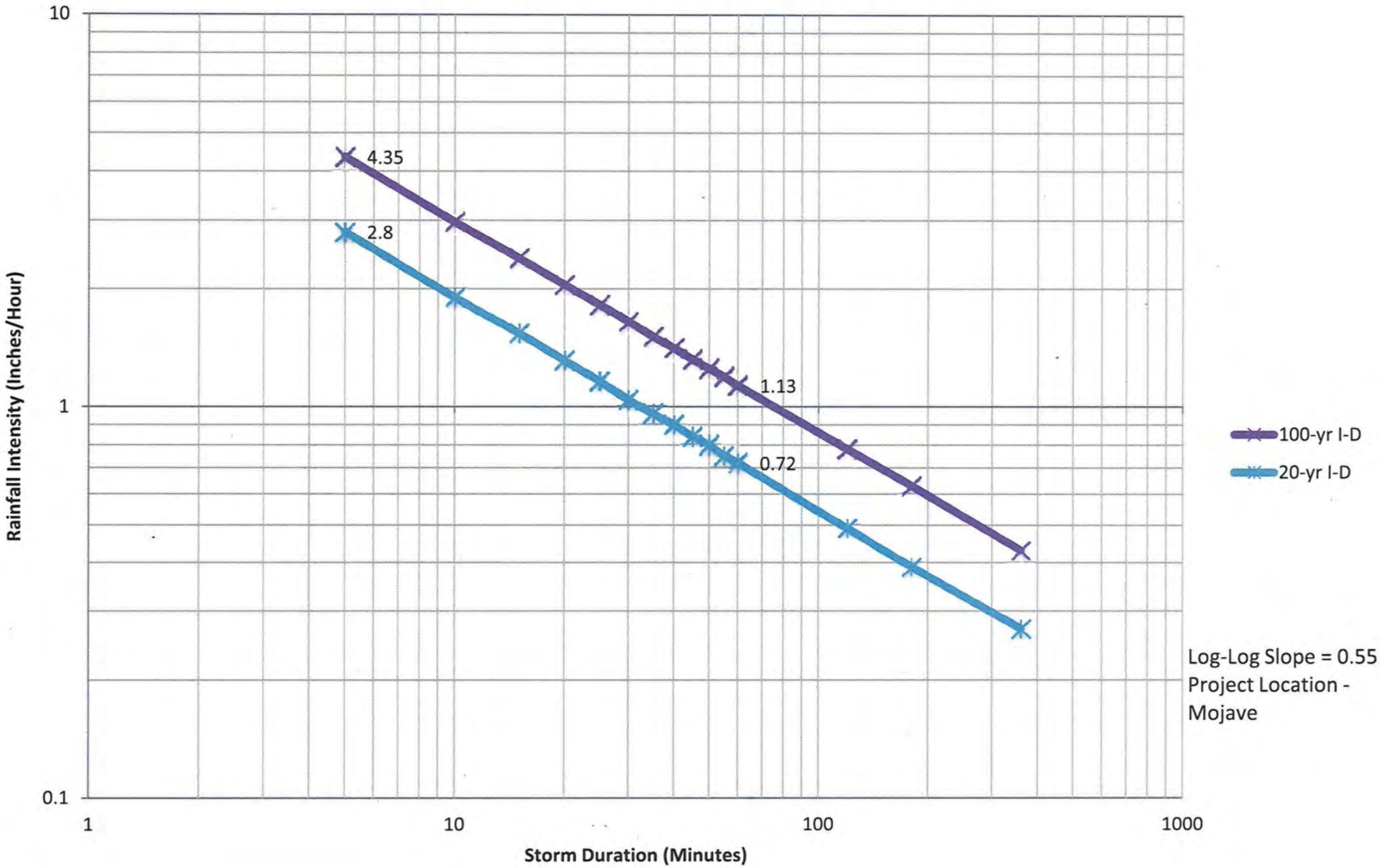
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.08	0.12	0.15	0.21	0.26	0.36	0.46	0.62	0.81	1.02	1.16	1.31	1.47	1.60	1.87	2.13	2.40	2.69
2	0.11	0.16	0.20	0.27	0.34	0.48	0.59	0.81	1.07	1.35	1.54	1.76	1.98	2.17	2.54	2.90	3.31	3.67
5	0.15	0.23	0.29	0.39	0.48	0.68	0.84	1.13	1.50	1.89	2.18	2.53	2.87	3.14	3.69	4.22	4.95	5.50
10	0.19	0.29	0.36	0.48	0.59	0.85	1.02	1.39	1.81	2.28	2.65	3.13	3.55	3.86	4.53	5.16	6.18	6.87
25	0.25	0.38	0.47	0.63	0.79	1.09	1.30	1.76	2.24	2.82	3.28	3.95	4.49	4.85	5.63	6.41	7.86	8.78
50	0.30	0.46	0.56	0.76	0.94	1.30	1.53	2.05	2.58	3.24	3.77	4.60	5.23	5.62	6.47	7.36	9.20	10.31
100	0.36	0.55	0.68	0.91	1.13	1.54	1.79	2.37	2.94	3.67	4.28	5.29	6.02	6.42	7.33	8.32	10.59	11.91
200	0.42	0.65	0.80	1.08	1.33	1.80	2.06	2.71	3.30	4.11	4.80	6.02	6.85	7.24	8.20	9.29	12.04	13.59
500	0.52	0.80	0.99	1.33	1.65	2.19	2.45	3.20	3.81	4.71	5.51	7.04	8.01	8.37	9.36	10.58	14.06	15.96
1000	0.61	0.93	1.15	1.55	1.92	2.52	2.78	3.61	4.21	5.17	6.07	7.86	8.94	9.26	10.25	11.56	15.65	17.86

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

100-yr I-D		20-yr I-D		10-yr I-D	
t (min)	I (in/hr)	t (min)	I (in/hr)	t (min)	I (in/hr)
5	4.35	5	2.8	5	2.3
10	2.97	10	1.9	10	1.56
15	2.4	15	1.54	15	1.26
20	2.05	20	1.31	20	1.07
25	1.82	25	1.16	25	0.95
30	1.65	30	1.04	30	0.85
35	1.51	35	0.96	35	0.79
40	1.41	40	0.9	40	0.73
45	1.32	45	0.84	45	0.69
50	1.25	50	0.8	50	0.65
55	1.19	55	0.75	55	0.62
60	1.13	60	0.72	60	0.59
120	0.78	120	0.49	120	0.4
180	0.63	180	0.39	180	0.32
360	0.43	360	0.27	360	0.22

ATTACHMENT C
INTENSITY-DURATION-FREQUENCY CURVE

Attachment C
Intensity-Duration-Frequency Curves



At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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