COLORADO DIVISION OF WATER RESOURCES
STATE ENGINEER'S OFFICE
MODEL FOR PREPARING A DAM SAFETY EMERGENCY PREPAREDNESS PLAN

APRIL 1997

INTRODUCTION

This model provides the directions for preparing an Emergency Preparedness Plan (EPP) in accordance with the Rules and Regulations for Dam Safety and Dam Construction, September 1988, Office of the State Engineer(SEO). It also conforms with the Guideline for Developing an Emergency Action Plan, FEMA, May 1996.

It is assumed that the dam owner has an adequate operation and maintenance plan that provides the monitoring (inspections and instrumentation) necessary to detect emerging problems and emergencies at their dams. In the case where a dam is in a remote location, Early Warning Systems should be provided to indicate that adverse conditions are occurring at the dam that require immediate response.

The purpose of this model and the attached SAMPLE DAM plan is to aid the dam owner in assembling necessary information in an accessible format that assures a timely response to emergencies at their dams.

REQUIREMENTS

The regulations require that the owners of Class 1 (High Hazard) and Class 2 (Significant Hazard) dams:

- Prepare, maintain, and exercise EPP's for immediate defensive action to prevent the failure of their dam, using the State Engineer's model plan or equivalent.
- Have the Local Emergency Manager (LEM) or Government Official responsible for public safety review their plan, and make appropriate modifications.
- Provide the principal persons and agencies responsible for executing the plan with copies, and distribute the plan to all affected entities.
- Review, update, and exercise the plan periodically.

CONTENT OF PLANS

In order for all plans to be thorough and consistent, they should include the following basic elements. (See SAMPLE DAM plan for further guidance.)

1- Cover sheet with name and identification data.

2- Notification procedures for both impending conditions (DAM EMERGENCY or DAM BREACH), and termination of the emergency. (Flowcharts are recommended as tools for quick response)

3- A description of the methods for detecting, evaluating, and classifying emergencies. (See Table 1 of SAMPLE DAM plan.)

4- A summary of the responsibilities of the principal participants in the plan.

5- A description of contingency plans for responding to emergencies at the dam. (See Table 2 of SAMPLE DAM plan.)

6- An Appendix which includes:

- Owner's plan for exercising the EPP.
- Directory of holders of the plan.
- Copies of the plans for the dam showing general details, including outlet works and spillways, and their capacities
- Copies of the inundation maps for Class 1 dams, or copies of topographic maps showing stream channels affected.

PROCESS FOR PREPARING PLANS

Preparation of an EPP requires coordinated planning with all the principal parties responsible for emergency response and public safety. The recommended process for developing a plan is as follows:

Step 1- For Class 1 dams that will affect urban areas, determine the potential inundated area by defining dam break flood profiles downstream from the dam.

For Class 1 dams in rural areas, the evacuation area may be determined by inspection.

MODEL FOR PREPARING A DAM SAFETY EPP - APRIL 1997

Step 1- For Class 2 dams, only the drainage which will be affected must be identified using a topographic or geographic map.
It is recommended that the failure of the dam during the Inflow Design Flood be used as a worst-case scenario. The area that will be inundated in the reservoir should also be identified for evacuation if there are people at risk. Prepare inundation maps which show the time and distance from the dam when the flood wave will arrive at critical areas in relation to the beginning of the dam failure hydrograph, the maximum discharge (Qp), and the depth of flow. **Critical public facilities (eg water supplies, hospitals, electric utilities, etc.)that would be affected by the flooding should be identified.** (A note should be added to the maps that the inundated areas are approximate, and should be used with caution for evacuation purposes.)

Step 2- Develop emergency procedures, and who is responsible for them. This includes evaluation of the problem, and classification of the emergency. See Tables 1 and 2 of the Sample Plan. These should be incorporated in the plan.

Step 3- Contact the jurisdictions that are responsible for public safety and coordinate the preparation of the plan with them. This is normally the LEM or Sheriff's Office. Find out what their requirements are.

Step 4- Determine the primary and auxiliary systems that will be available for communicating with the participants that need to be notified.

Step 5- Develop priority lists of the persons/agencies that need to be notified in accordance with the level of urgency per Table 1. List the Name, Title, Address, and primary and auxiliary communication systems.

Step 6- Draft Notification Flowcharts using the lists from step 5 for DAM EMERGENCY CONDITIONS and DAM BREACH CONDITION. These charts can be used by the dam owner to quickly notify other parties of the emergency conditions in recommended order. **The flowcharts in the SAMPLE DAM represent the sequence for the dam owner. There may be instances where the public discovers the problem and calls the sheriff. The dam owner should adapt the use of the flowchart accordingly.**

Step 7- Prepare a draft of the EPP in accordance with this model, or equivalent, and submit it for review and comment by the participants, including the State Engineer's Office and the Colorado Office of Emergency Management.

Step 8- Revise the plan as needed and distribute the final plan to the participants. The plan must be updated annually.

Attachment: SAMPLE DAM PLAN

RESOURCE INFORMATION

The following personnel and agencies may need to be included in the planning and participation of most emergency plans.

- Owner Personnel
- Local Emergency Managers and/or Sheriff's Office.
- Colorado Office of Emergency Management
- Colorado Division of Water Resources (SEO)
  Division Engineer's Office
  Dam Safety Branch
- Federal Agencies
  National Weather Service
  Federal Dams

Owner Personnel

All the key personnel of the dam owner should be involved in the planning, training, and exercising of an emergency plan. This includes the caretaker, superintendent, engineer, or their representatives.

Local Emergency Managers (LEM)

Local government is responsible for protecting citizens from disasters. They are required to be prepared to respond when an emergency occurs. They will be responsible for evacuating the flooded area. The name and telephone number of the LEM or Sheriff may be obtained from your telephone book, or by calling the Colorado Office of Emergency Management.

Colorado Office of Emergency Management (COEM)

The COEM provides guidance to local government in the prevention of, preparation for, response to, and recovery from disasters. The OEM may also be involved in the establishment of an Emergency Operations Center, and will mobilize other state agencies like the State Patrol and Colorado Department of Transportation of the emergency in accordance with the state's emergency plan. They may be contacted at:

Colorado Office of Emergency Management
15075 South Golden Road
Golden, CO 80401-3979

General Information	(303)273-1622
TDD	(303) 273-1794
FAX	(303) 273-1795
Disaster Officer	(303) 273-1779
24-Hr Emergency No.	(303) 279-8855

Colorado Division of Water Resources (DWR)

The Colorado Division of Water Resources (DWR), also known as the State Engineer's Office, is responsible for determining the amount of water which is safe to impound in the reservoirs in the state in accordance with the statutes and regulations promulgated by the State Engineer. The personnel of the Dam Safety Branch and the Division Engineer's Office participate in the planning for EPPs by providing information about the dams, and consultations and review of the plans. They must also be notified of emergencies so they may assist the dam owner in preventive actions, and to assure the owner is taking appropriate action for the protection of the public safety. The Division Engineer's Office, Resident Dam Safety Engineer may be contacted to obtain the following:

1- Data about the dam, location, etc. for the cover.
2- Flood inundation maps that were prepared by DWR in accordance with HB-1416. These may be used if available.
3- Names of the participants in the SEO to include in the notification lists/Flowchart.
4- Plans of the dam, outlet works, and spillways.
5- Information on dam inspection training and exercising EPPs.

See the attached Directory for the Division of Water Resources.

Federal Agencies

The National Weather Service (NWS) is responsible for issuing flood warnings. In order to predict the flooding from dam failures the NWS needs to know the National identification number (NATID) for the dam, or its height and present capacity. Following are the telephone numbers of the NWS offices in Colorado:

Denver	(303) 361-0661
Colorado Springs	(719) 596-5075
Pueblo	(719) 948-3838
Alamosa	(719) 589-9207
Grand Junction	(970) 243-7007

Where other **Federal Dams** are affected by the failure of a dam, they should be contacted so they can include the potential incident in their EAP.

Other Resources

Other persons and agencies that may need to be identified as a resource for carrying out the emergency plan are:

- News media in the area (Radio, Television, Newspapers).
- Local construction companies.
- Engineering Consultants.
- Helicopter service.
- Professional Diving Service.

DAM SAFETY BRANCH FIELD OFFICES[1]

	Mail	Location
Division 1[2]		
Greg H. Hammer Dam Safety Engineer (970) 352-8712	810 9th Street 2nd Floor Greeley, CO 80631	810 9th Street 2nd Floor Greeley, CO
Division 2[3]		
Michael L. Graber Dam Safety Engineer (719) 542-3368	310 E. Abriendo Ave., Suite B Pueblo, CO 81004	310 Abriendo Ave., Suite B Pueblo, CO
Division 3/7		
Brett G. Nordby Dam Safety Engineer (970) 247-1845	701 Camino Del Rio, Suite 205 Durango, CO 81301	701 Camino DelRio,Suite 205 Durango, CO
Division 4		
James G. Norfleet Dam Safety Engineer (970) 249-6622	PO Box 456 Montrose, CO 81402	1540 East Niagara Montrose, CO
Division 5		
John G. Blair Dam Safety Engineer (970) 945-5665	PO Box 396 Glenwood Springs, CO 81602	50633 US Hwy 6&24 Glenwood Springs, CO
Division 6		
Vacant Dam Safety Engineer (970) 879-0272	PO Box 773450 Steamboat Springs, CO 80477	1120 S. Lincoln Ave.,No.101 Steamboat Springs, CO
Division 7	See 3/7 above	

[1] Updated January 2000

[2] Also Michael Cola, Jim Dubler, and Dennis Miller

[3] Also Garrett Jackson

COLORADO DIVISION OF WATER RESOURCES
STATE ENGINEER'S OFFICE
April 1997

Emergency Preparedness Plan
for

SAMPLE DAM

Hazard Class: 1

DAMID:370123
NATID: CO-02188

EAGLE COUNTY
Section 09, Township 6S, Range 79W
6th Principal Meridian

Next Downstream City or Town: Vail
Distance to Downstream Town: 7 mile
River or Stream: Gore Creek

Damtype Code: RE (Earth)
Dam Height: 28 feet
Crest Length: 400 feet
Crest Width: 16 feet

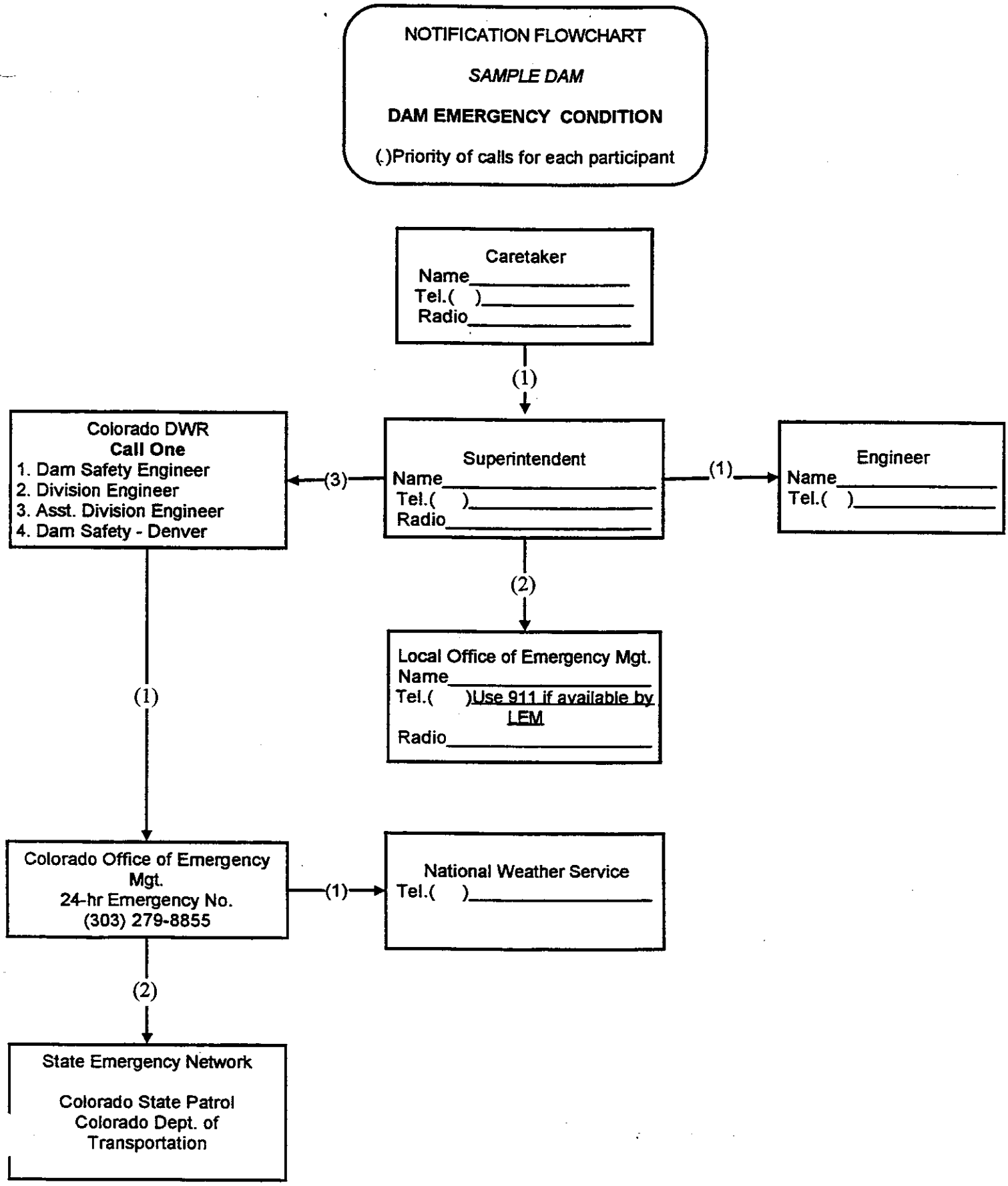
Reservoir Surface Area: 26 acres
Normal Storage Capacity: 362 acre-feet
Maximum Storage Capacity: 642 acre-feet

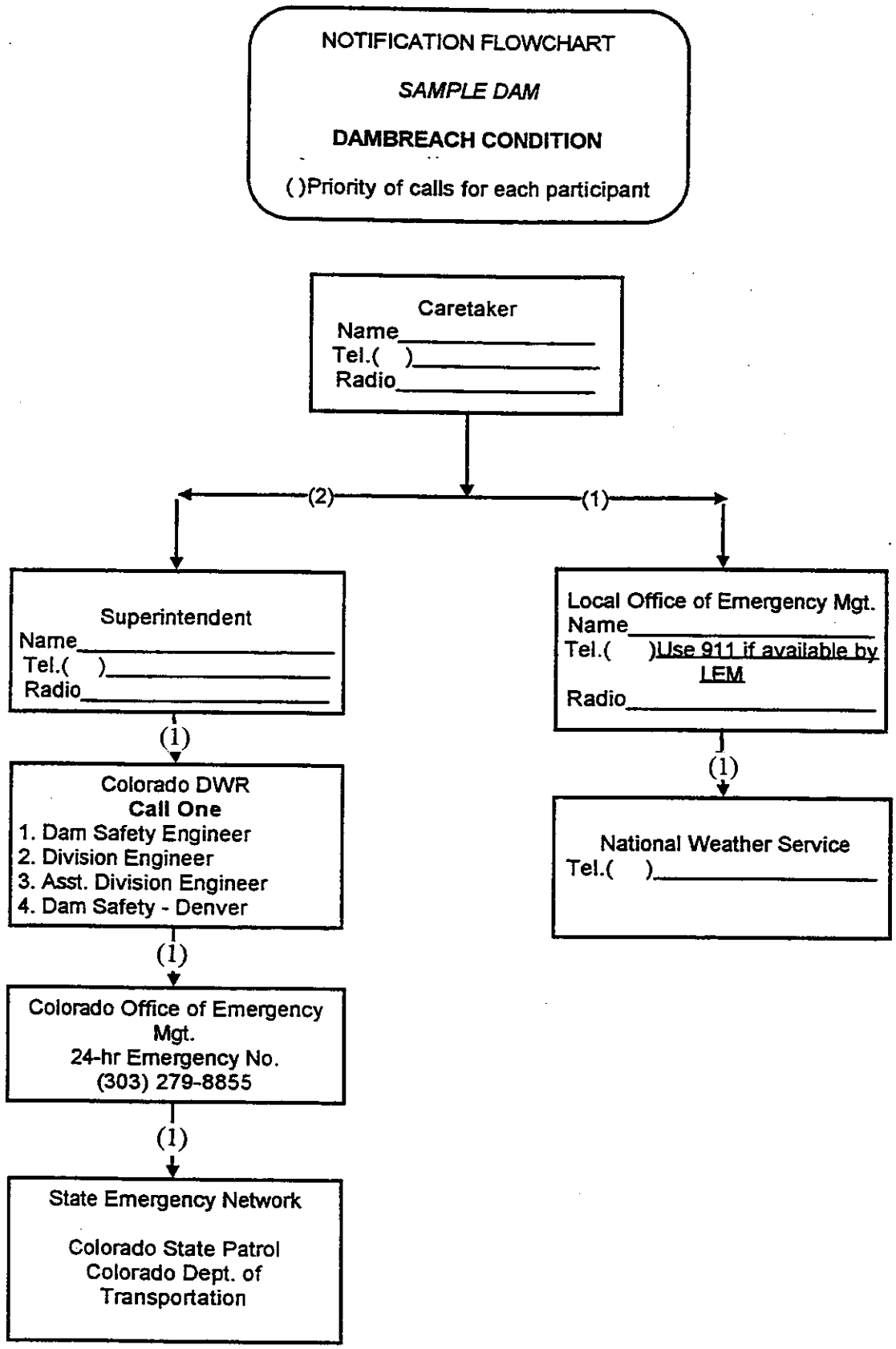
Drainage Basin Area: 663 acres

Maximum Outlet Discharge Capacity: 22 cubic feet/second(cfs)

Maximum Spillway Capacity: 1230 cfs
Service Spillway: NONE
Spillway Width: 20 feet, Freeboard: 10 feet
Emergency Spillway: UCHAN, ROCK

Date of Plan _____ _____, _____ Revision No. ____
Month Day Year


NOTIFICATION FLOWCHART
SAMPLE DAM
DAM EMERGENCY CONDITION
(.)Priority of calls for each participant
Caretaker
Name_____
Tel.( )_____
Radio_____
(1)
Colorado DWR
Call One
1. Dam Safety Engineer
2. Division Engineer
3. Asst. Division Engineer
4. Dam Safety - Denver
(3)
Superintendent
Name_____
Tel.( )_____
Radio_____
(1)
Engineer
Name_____
Tel.( )_____
(2)
Local Office of Emergency Mgt.
Name_____
Tel.( )Use 911 if available by LEM
Radio_____
(1)
Colorado Office of Emergency Mgt.
24-hr Emergency No.
(303) 279-8855
(1)
National Weather Service
Tel.( )_____
(2)
State Emergency Network
Colorado State Patrol
Colorado Dept. of Transportation


NOTIFICATION FLOWCHART
SAMPLE DAM
DAMBREACH CONDITION
( )Priority of calls for each participant
Caretaker
Name_____
Tel.( )_____
Radio_____
(2)
(1)
Superintendent
Name_____
Tel.( )_____
Radio_____
(1)
Colorado DWR
Call One
1. Dam Safety Engineer
2. Division Engineer
3. Asst. Division Engineer
4. Dam Safety - Denver
(1)
Colorado Office of Emergency Mgt.
24-hr Emergency No.
(303) 279-8855
(1)
State Emergency Network
Colorado State Patrol
Colorado Dept. of Transportation
Local Office of Emergency Mgt.
Name_____
Tel.( )Use 911 if available by LEM
Radio_____
(1)
National Weather Service
Tel.( )_____

Monitoring Plan/Notification Procedure

The dam will be observed at least twice a month when the reservoir is greater than half full in storage capacity, immediately after heavy flooding, and following an earthquake. All instrumentation will be measured and recorded. **In the case of a problem, Table 1 of this plan will be used to evaluate and classify the incident.** The _____ will be responsible for the inspections, and the _____ will be responsible for determining the urgency of any problems, and communicating the situation at the dam to the emergency office, and all other participants will notify their parties in accordance with the flowcharts. The _____ shall notify the LEM when the emergency is over. The _____ shall be responsible for developing and updating this plan, and training personnel in the exercises of this plan. **List below the dam owners representatives.**

Primary Contact:_____ ( ) _____ (O)
( ) _____ (H)

Alternate: _____ ( ) _____ (O)
( ) _____ (H)

Alternate: _____ ( ) _____ (O)
( ) _____ (H)

Engineer: _____ ( ) _____ (O)
( ) _____ (H)

Emergency Actions

Table 2 of this plan will be used to guide personnel in dealing with problems that are classified as emergencies. In addition, the materials needed for emergency action will be stockpiled at the dam. **List below the contractors, others, that are available to respond to an emergency.**

Contractors (Construction, Diving, Helicopter, Other)

_____ ( ) _____ (O)
( ) _____ (H)

_____ ( ) _____ (O)
( ) _____ (H)

_____ ( ) _____ (O)
( ) _____ (H)

_____ ( ) _____ (O)
( ) _____ (H)

News Media

_____ ( ) _____

_____ ( ) _____

TABLE 1. GUIDE FOR CLASSIFYING THE LEVEL OF URGENCY FOR DAM INCIDENTS

INCIDENT	LEVEL OF URGENCY		
	UNUSUAL CONDITION New or increased problem (Call for assistance)	EMERGENCY CONDITION Possible failure developing (Stand–by alert, begin mobilizing for failure)	FAILURE IS IMMINENT Partial failure, or dynamic failure of dam is in progress (Evacuation should begin)
NOTIFICATION PRIORITY	Consultant State Engineer's Office	Consultant Contractor State Engineer's Office Emergency Manager	Emergency Manager Consultant Contractor State Engineer's Office
PROBLEM	EXAMPLES OF POSSIBLE OBSERVATIONS		
BACKCUTTING OF SPILLWAY	Erosion of spillway is progressing slowly	Erosion of spillway is progressing rapidly	Spillway has washed out, dam is breached
CRACKING	Dry, open cracks	Cracks with displacement, or minor seepage (clear water)	Significant cracking with muddy seepage
OUTLET FAILURE	Broken gate or operator, rusty, scaling pipe, seepage	Cracked or perforated pipe, sediment in seepage, deeply scoured or undermined conduit	Significant, muddy seepage from or adjacent to outlet; Sinkholes in embankment over outlet conduit
OVERTOPPING OF DAM	Reservoir at crest due to a blocked spillway	Flood overtopping dam causing minor erosion	flood overtopping dam causing significant erosion
PIPING	Small amount of sediment in seepage or drains	Significant amount of sedimer in seepage, drains, muddy water	Sink holes in dam, whirlpool in reservoir, settlement, Significant, muddy water
SEEPAGE	Downstream slope of dam is wet, soft; minor sloughing; water running down groins	Seepage is causing slides which narrows dam cross section, or settlement of crest and loss of freeboard	Seepage has caused large slide which has reduced freeboard to the reservoir level, or dam is overtopping
SETTLEMENT	Minor settlement (Less than 1 foot)	Moderate settlement (One–half of freeboard)	Significant settlement, reservoir is overtopping dam
SINKHOLES	Small depressions in dam or foundation	Large hole over outlet, or on dam or foundation. Not increasing	Unstable hole over outlet, or on dam or foundation. Whirlpool in reservoir
SLIDES	Small, or srface slide with minor reduction of dam cross section, and minor crest settlement	Moderate slide which reduces dam cross section, but there is no seepage or overtopping problem	Large slide which reduces dam cross section significantly, with seepage or an overtopping problem
WAVE EROSION OF DAM	Minor erosion of crest height, and/or minor scarping of upstream slope	Moderate erosion of crest height, and/or significant scarping of the upstream slope which is progressing	Significant erosion of crest height and/or rapidly progressing loss of upstream slope

TABLE 2. POTENTIAL PROBLEMS AND EMERGENCY ACTIONS

The following are emergency actions that should be performed immediately for several problems that are considered to be serious, and can affect the safety of dam. The recommended actions are potential solutions to emergency conditions that can be used to prevent the breaching of a dam.

BACKCUTTING OF THE SPILLWAY

1. Lower the water level by opening the outlet (and/or pumping). Continue to lower the reservoir until the State Engineer's personnel (SEO), or your engineer, determines that the conditions are safe.

2. Provide emergency protection at the eroding surface by placing plastic sheeting, riprap, or other erosion resistant materials.

3. Mark where the spillway erosion is occurring. Monitor the rate of erosion(backcutting),and rate of flows from the spillway and outlets.

CRACKING

1. Lower the water level by opening the outlet (and/or pumping). Continue until the water is below the cracking or as advised by the SEO or your engineer.

2. Attempt to block water movement into cracks by placing plastic sheeting over them.

3. Mark the extent of cracking with adequate stakes in order to monitor any increase or change in pattern. Document the observations.

OUTLET FAILURE

1. Close the outlet gate to protect the embankment from washing out (piping).

2. Lower the water level by pumping, siphoning, or digging out a temporary spillway at the abutments. The temporary spillway should be located in an erosion resistant material and/or at a flat slope to control the discharge velocities.

3. Monitor the outlet/embankment for settlement, occurrence of sinkholes, and muddy leakage. Observe outlet discharge for changes in flow (quantities). Document observations.

OVERTOPPING

1. Open the outlet works completely to reduce overflow.

2. Divert inflow to the reservoir if possible.

3. Increase freeboard by placing sandbags, or other materials that won't wash away, on the crest of the dam.

TABLE 2. POTENTIAL PROBLEMS AND EMERGENCY ACTIONS

OVERTOPPING

4. Provide erosion protection for the crest and downstream slope using plastic sheeting and/or riprap.

5. Increase outflow by constructing temporary spillway at abutments. The spillway should be located in an erosion resistant material and/or at a flat slope to control the discharge velocities.

6. Monitor the depth, duration, and location of overtopping. Watch for erosion, backcutting, and slides. Document the observations.

PIPING

1. If the piping is not related to a problem with the outlet works, open the outlet to its safe capacity to drawdown the reservoir. Divert inflow to the reservoir if possible. Increase outflow by constructing a temporary spillway at the abutments. The spillway should be located in erosion resistant material and/or at a flat slope to control the discharge velocities.

2. If the entrance to the leak can be found in the reservoir (whirlpool), On the embankment or abutments (sinkhole), try to plug it with whatever materials are available, such as plastic sheeting, hay bales, mattresses, etc.

3. Construct a reverse filter (large rock to finer material) over the exit area to trap fine materials from washing out of the embankment.

4. Monitor the leakage/piping conditions. Measure the rate of leakage and the clarity of the water (muddy looking). Document the observations.

SATURATION OF THE EMBANKMENT/ABUTMENTS

1. Lower the reservoir with the outlet works to a level determined by your engineer and approved by the SEO.

2. Monitor the conditions frequently for leakage, piping, cracking, and slides. Document the observations.

SETTLEMENT OF EMBANKMENT

1. Determine whether the settlement is related to piping. If it is, see PIPING.

2. Survey the existing monuments to determine the amount and rate of settlement. Install measurement points if necessary. Document the observations.

3. If the settlement is greater than one-foot, lower the reservoir with the outlet works to a level determined by your engineer and approved by the SEO.

TABLE 2. POTENTIAL PROBLEMS AND EMERGENCY ACTIONS

SINKHOLE

1. A sinkhole is an indication of piping. See PIPING.

SLIDES

1. Lower the reservoir with the outlet works to a level determined by your engineer and approved by the SEO. If the slide is on the upstream slope, consult with your engineer on the safe rate of drawdown.

2. If the outlet works is blocked/damaged by the slide, lower the reservoir using pumps, siphons, or construct temporary spillways at the abutments. See OUTLET FAILURE.

3. Stabilize the toe of the slide(downstream slope) by constructing a berm with additional soil and rock. If there is significant leakage(muddy), construct a reverse filter. See PIPING.

4. Monitor settlement, rate of movement, extent of slide. See SETTLEMENT OF EMBANKMENT. Document observations.

WAVE EROSION OF EMBANKMENT

1. Lower the reservoir at a safe rate with the outlet works to a level below the damaged area.

2. Restore any freeboard that may be lost using sandbags.

3. Place suitable sized riprap on the damaged area in emergency by whatever means necessary (dumping) to stop erosion.

4. Mark the damaged areas with stakes and monitor the situation. Document the observations.

APPENDIX

Training/Testing of Plan

The _____ will train new personnel about the operation and inspection of the dam, and the Emergency Preparedness Plan(EPP), within one month of beginning work. In addition, the _____ will review the EPP each January and revise the plan as needed, and distribute the revisions to all holders of the plan no later than the end of February.

The _____ shall periodically test the plan by conducting drills with the dam owner's personnel. In addition, the Emergency Manager shall periodically conduct a Tabletop Exercise of the plan as part of their Local Emergency Operations Plan.

Analysis of Inundation Maps

The inundation maps are based upon a failure of the dam during the Inflow Design Flood with the reservoir full to the crest of the dam and the emergency spillway operating. This is the worst possible condition expected. The potential flood plain boundary should be considered as a minimum for evacuation planning purposes. No critical public facilities are in the dam failure floodplain.

The dambreak and routing were determined using the dambreak model as distributed by BOSS known as DAMBRK.

DIRECTORY

Owners Personnel — No. of copies of plan.

Name:_____ _____
Title:_____
Address:_____
City:_____ State:__ Zip:___
Primary Telephone:(___)_____
Alternate Communication:_____

Name:_____ _____
Title:_____
Address:_____
City:_____State:__ Zip:___
Primary Telephone:(___)_____
Alternate Communication:_____

Name:_____ _____
Title:_____
Address:_____
City:_____State:__ Zip:___
Primary Telephone:(___)_____
Alternate Communication:_____

Emergency Management (LEM, COEM)

Name:_____ _____
Agency:_____
Title:_____
Address:_____
City:_____State:__ Zip:___
Primary Telephone:(___)_____
Alternate Communication:_____

Name:_____ _____
Agency:_____
Title:_____
Address:_____
City:_____State:__ Zip:___
Primary Telephone:(___)_____
Alternate Communication:_____

DIRECTORY

Other Parties/Entities | No. of copies of plan.

Name:______________________________ ____________
Association:_________________________
Title:____________________________
Address:____________________________
City:_________________State:__ Zip:___
Primary Telephone:(___)_______________
Alternate Communication:__________________

Name:______________________________ ____________
Association:_________________________
Title:____________________________
Address:____________________________
City:_________________State:__ Zip:___
Primary Telephone:(___)_______________
Alternate Communication:__________________

Name:______________________________ ____________
Association:_________________________
Title:____________________________
Address:____________________________
City:_________________State:__ Zip:___
Primary Telephone:(___)_______________
Alternate Communication:__________________

Name:______________________________ ____________
Association:_________________________
Title:____________________________
Address:____________________________
City:_________________State:__ Zip:___
Primary Telephone:(___)_______________
Alternate Communication:__________________

Name:______________________________ ____________
Association:_________________________
Title:____________________________
Address:____________________________
City:_________________State:__ Zip:___
Primary Telephone:(___)_______________
Alternate Communication:__________________

DIRECTORY

Division of Water Resources/Dam Safety — No. of copies of plan.

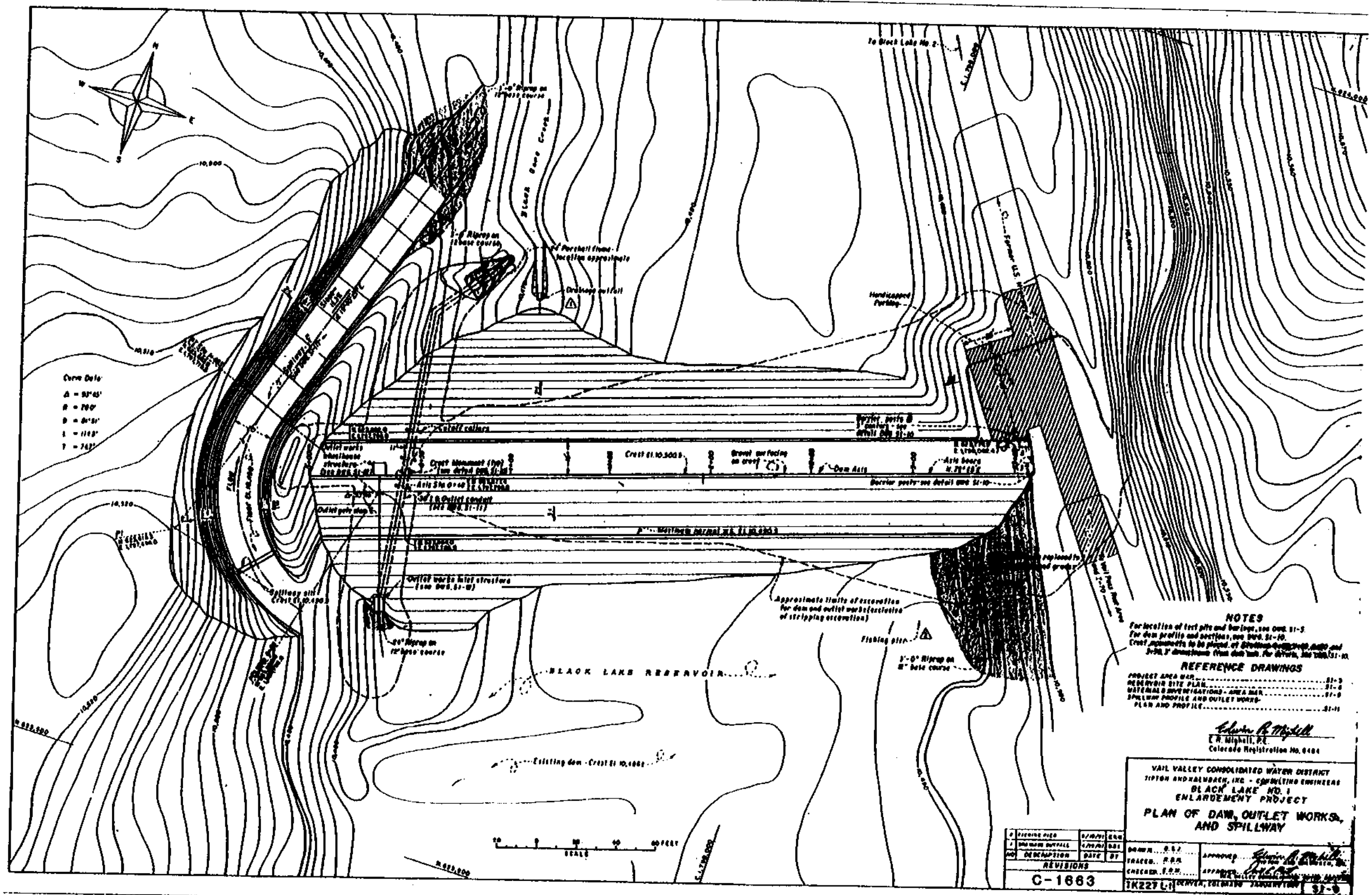
Dam Safety Engineer:_____ _____
Division:__ Location:_____
Office Telephone: (__)_____
Alternate Communication:_____

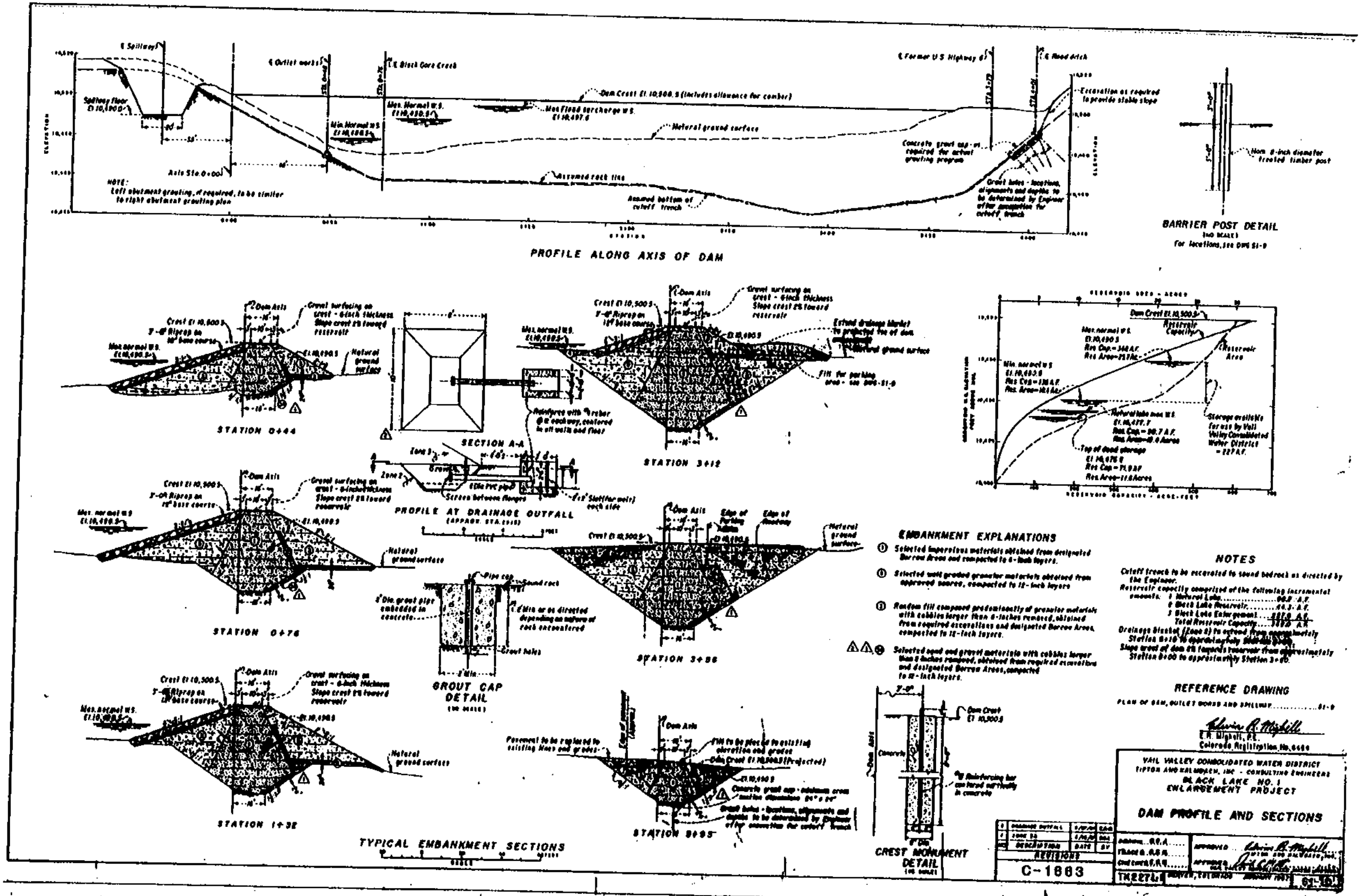
Division Engineer:_____
Office Telephone: (__)_____
Alternate Communication:_____

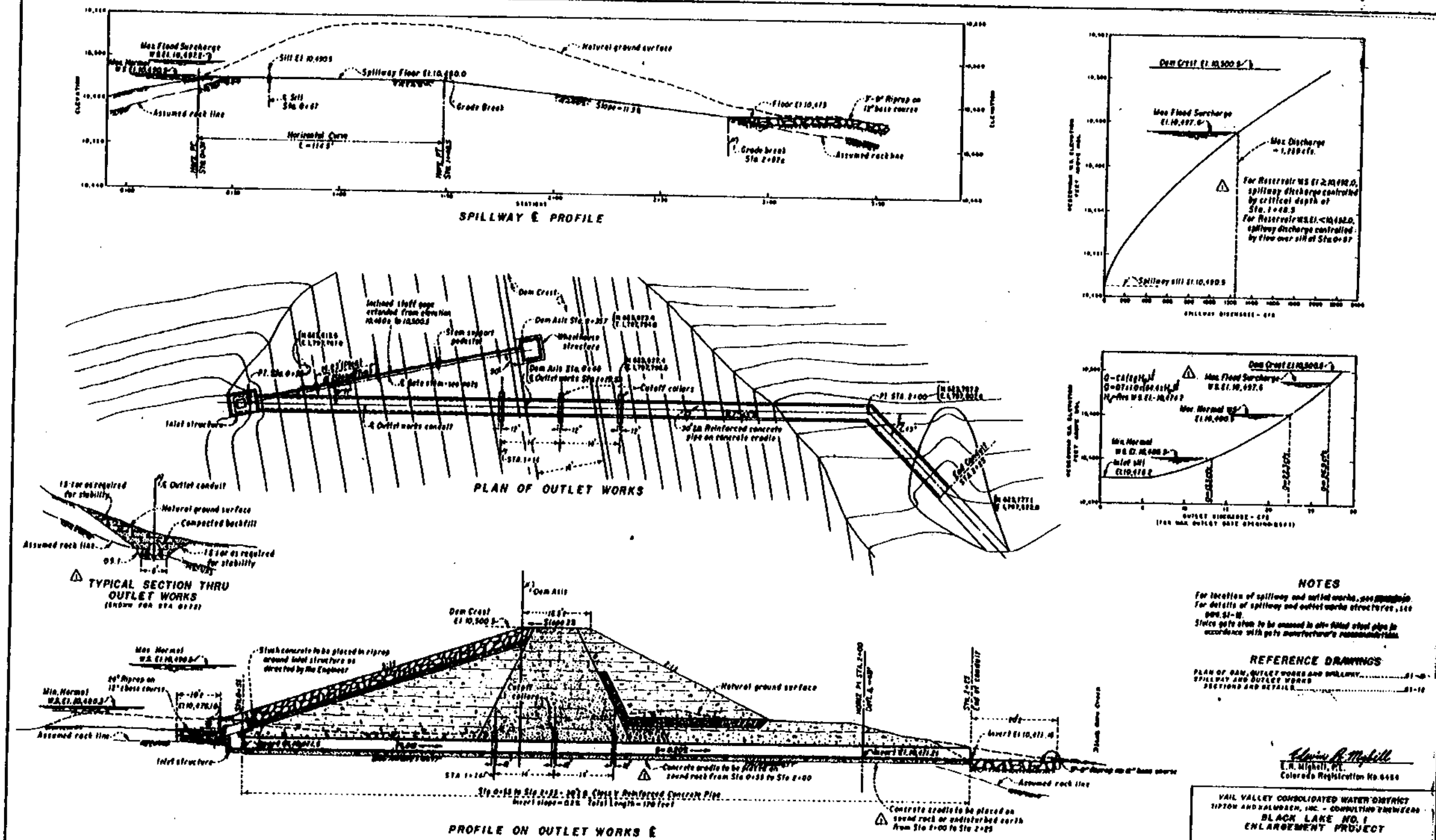
Agency: Division of Water Resources
Division Address:_____
City:_____State:__ Zip:___

Water Commissioner:_____ _____
District:_____
Address:_____
City:_____State:__ Zip:___
Office Telephone: (__)_____
Alternate Communication:_____

Principal Engineer:_____ _____
Location: Denver
Agency: Division of Water Resources
Address: 1313 Sherman Street., Room 818
City: Denver, CO, 80203
Office Telephone: (303) 866-3581
Alternate Communication: (__)_____(H)


NOTES
REFERENCE DRAWINGS
PROJECT AREA MAP
RESERVOIR SITE PLAN
SPILLWAY PROFILE AND OUTLET WORKS-
PLAN AND PROFILE
E. R. Mighell, P.E.
VAIL VALLEY CONSOLIDATED WATER DISTRICT
BLACK LAKE NO. 1
ENLARGEMENT PROJECT
PLAN OF DAM, OUTLET WORKS, AND SPILLWAY
REVISIONS
C-1663
1K227 L-1
BLACK LAKE RESERVOIR
Existing dam
Black Gore Creek
Former U.S.
To Black Lake No. 2
Handicapped Parking
Drainage outfall
Curve Data
SCALE
Fishing pier
Dam Axis


PROFILE ALONG AXIS OF DAM
Dam Crest El 10,500.5 (includes allowance for camber)
Natural ground surface
Assumed rock line
Assumed bottom of cutoff trench
BARRIER POST DETAIL
STATION 0+44
STATION 0+76
STATION 1+32
STATION 3+12
STATION 3+56
STATION 8+95
SECTION A-A
PROFILE AT DRAINAGE OUTFALL
GROUT CAP DETAIL
CREST MONUMENT DETAIL
TYPICAL EMBANKMENT SECTIONS
EMBANKMENT EXPLANATIONS
Selected impervious materials obtained from designated Borrow Areas and compacted to 6-inch layers.
Selected well graded granular materials obtained from approved source, compacted to 12-inch layers
Random fill composed predominantly of granular materials with cobbles larger than 6-inches removed, obtained from required excavations and designated Borrow Areas, compacted to 12-inch layers.
Selected sand and gravel materials with cobbles larger than 6 inches removed, obtained from required excavations and designated Borrow Areas, compacted to 12-inch layers.
NOTES
Cutoff trench to be excavated to sound bedrock as directed by the Engineer.
Reservoir capacity comprised of the following incremental amounts:
REFERENCE DRAWING
PLAN OF DAM, OUTLET WORKS AND SPILLWAY
Colorado Registration No. 6484
VAIL VALLEY CONSOLIDATED WATER DISTRICT
TIPTON AND KALMBACH, INC. - CONSULTING ENGINEERS
BLACK LAKE NO. 1
ENLARGEMENT PROJECT
DAM PROFILE AND SECTIONS
REVISIONS
C-1663



NOTES

For location of spillway and outlet works, see ...
For details of spillway and outlet works structures, see dwg. 51-18.
Sluice gate stem to be encased in oil-filled steel pipe in accordance with gate manufacturer's recommendations.

REFERENCE DRAWINGS

PLAN OF DAM, OUTLET WORKS AND SPILLWAY 51-8
SPILLWAY AND OUTLET WORKS SECTIONS AND DETAILS 51-10

E.R. Mighell, P.E.
Colorado Registration No. 6454

VAIL VALLEY CONSOLIDATED WATER DISTRICT
TIPTON AND KALMBACH, INC. – CONSULTING ENGINEERS
BLACK LAKE NO. 1
ENLARGEMENT PROJECT

SPILLWAY PROFILE AND OUTLET WORKS PLAN AND PROFILE

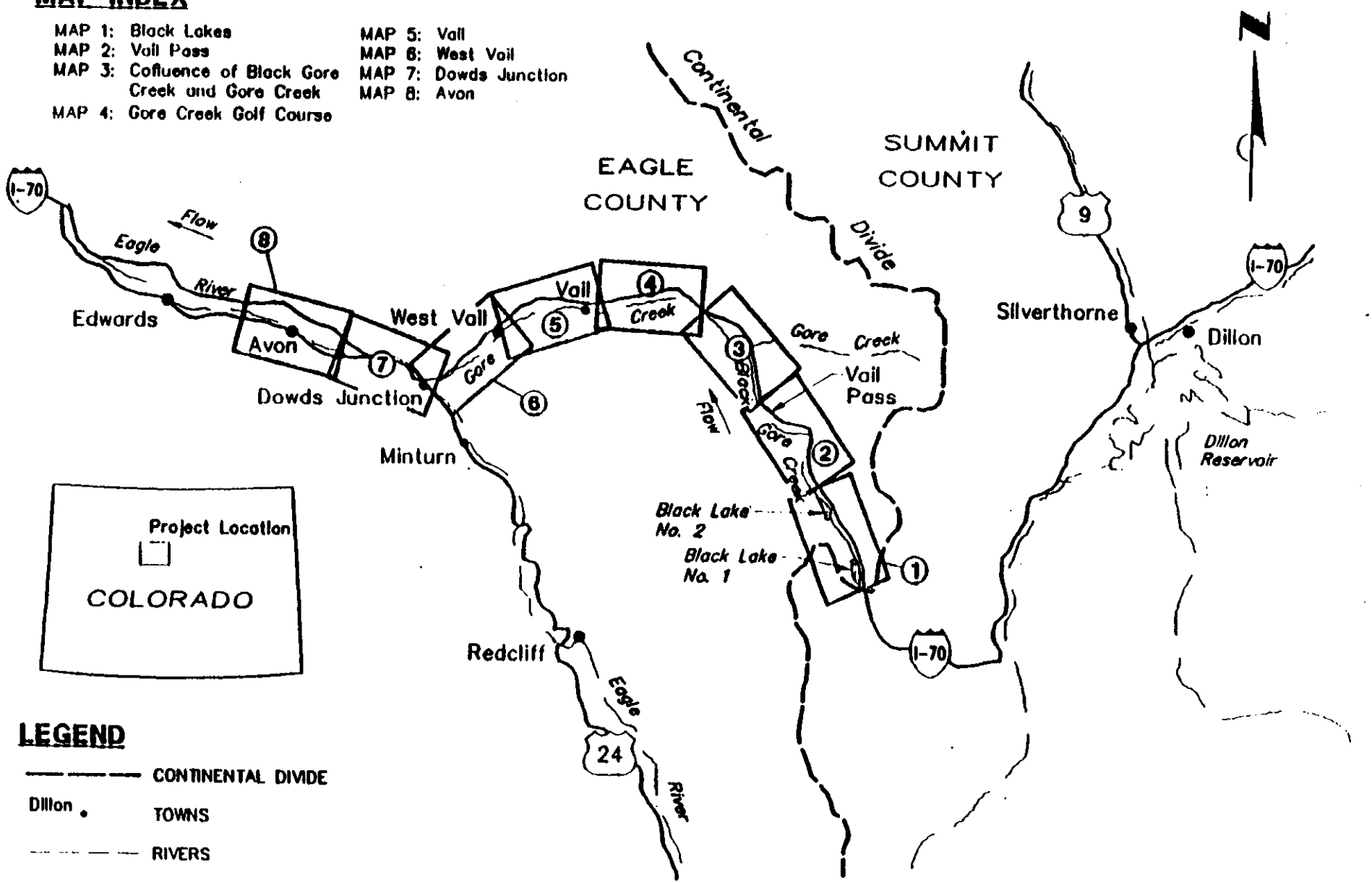
REVISIONS

C-1663

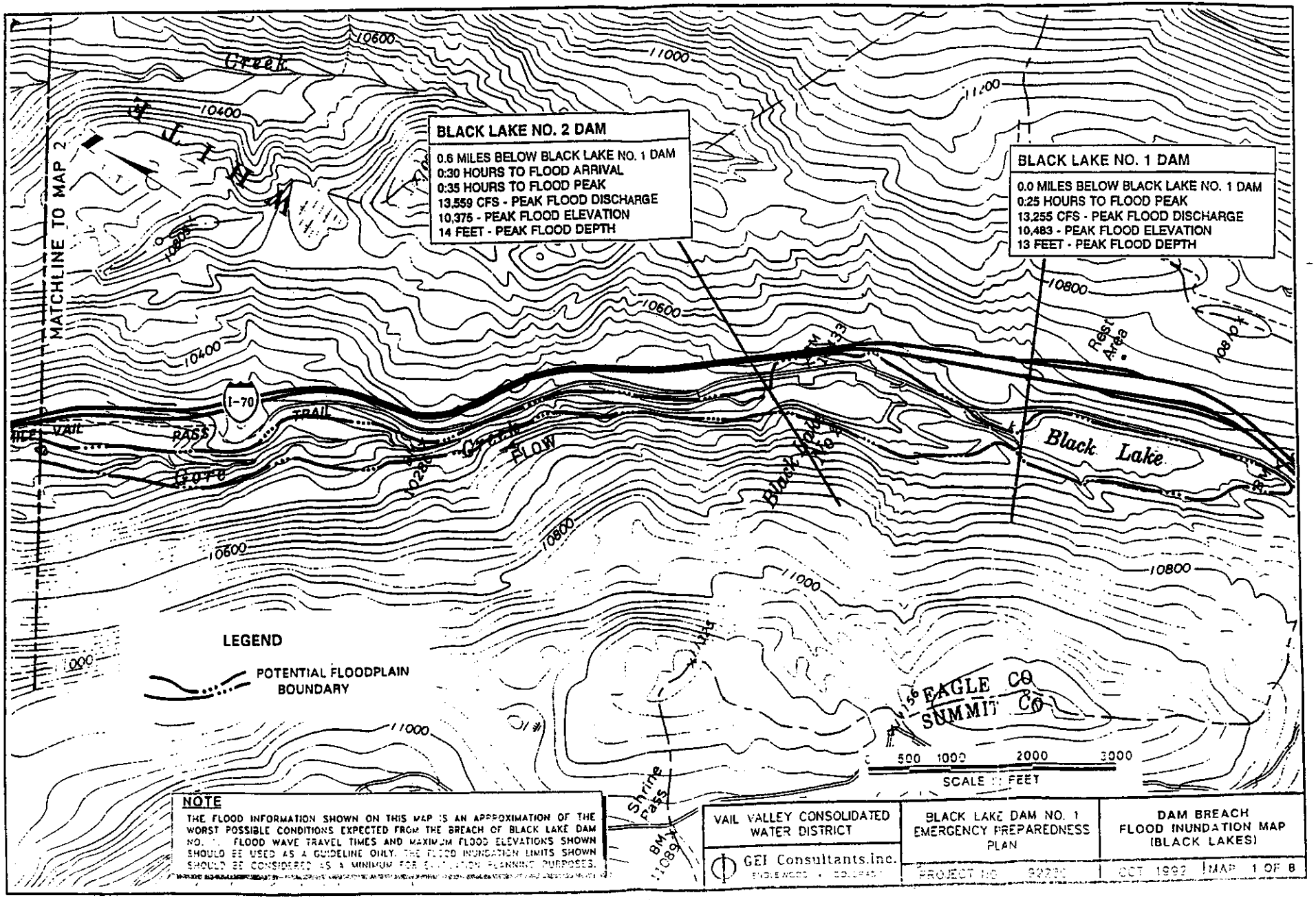
TK227 L-E DENVER, COLORADO

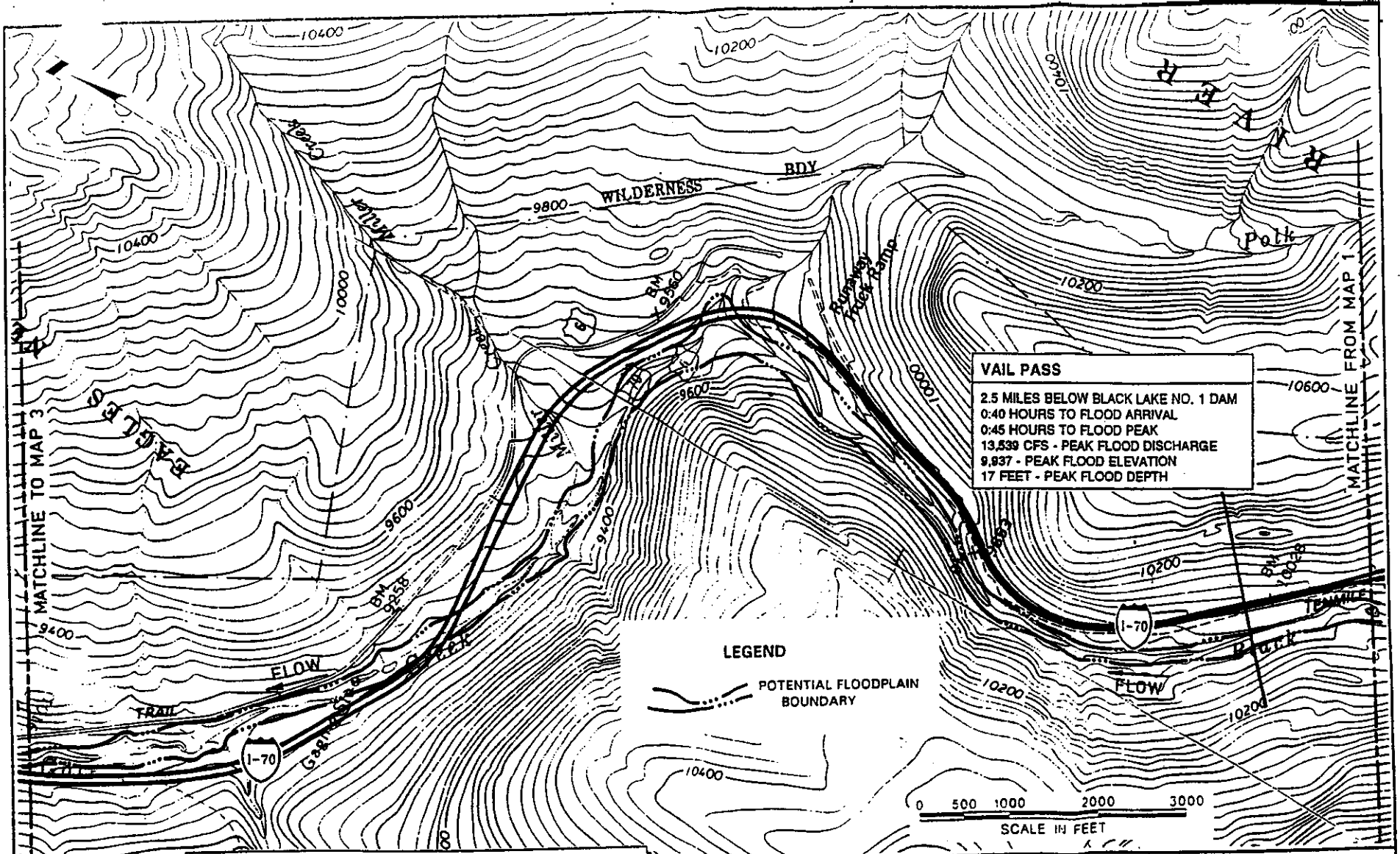
MAP INDEX

MAP 1: Black Lakes
MAP 2: Vail Pass
MAP 3: Confluence of Black Gore Creek and Gore Creek
MAP 4: Gore Creek Golf Course
MAP 5: Vail
MAP 6: West Vail
MAP 7: Dowds Junction
MAP 8: Avon



PROJECT LOCATION MAP

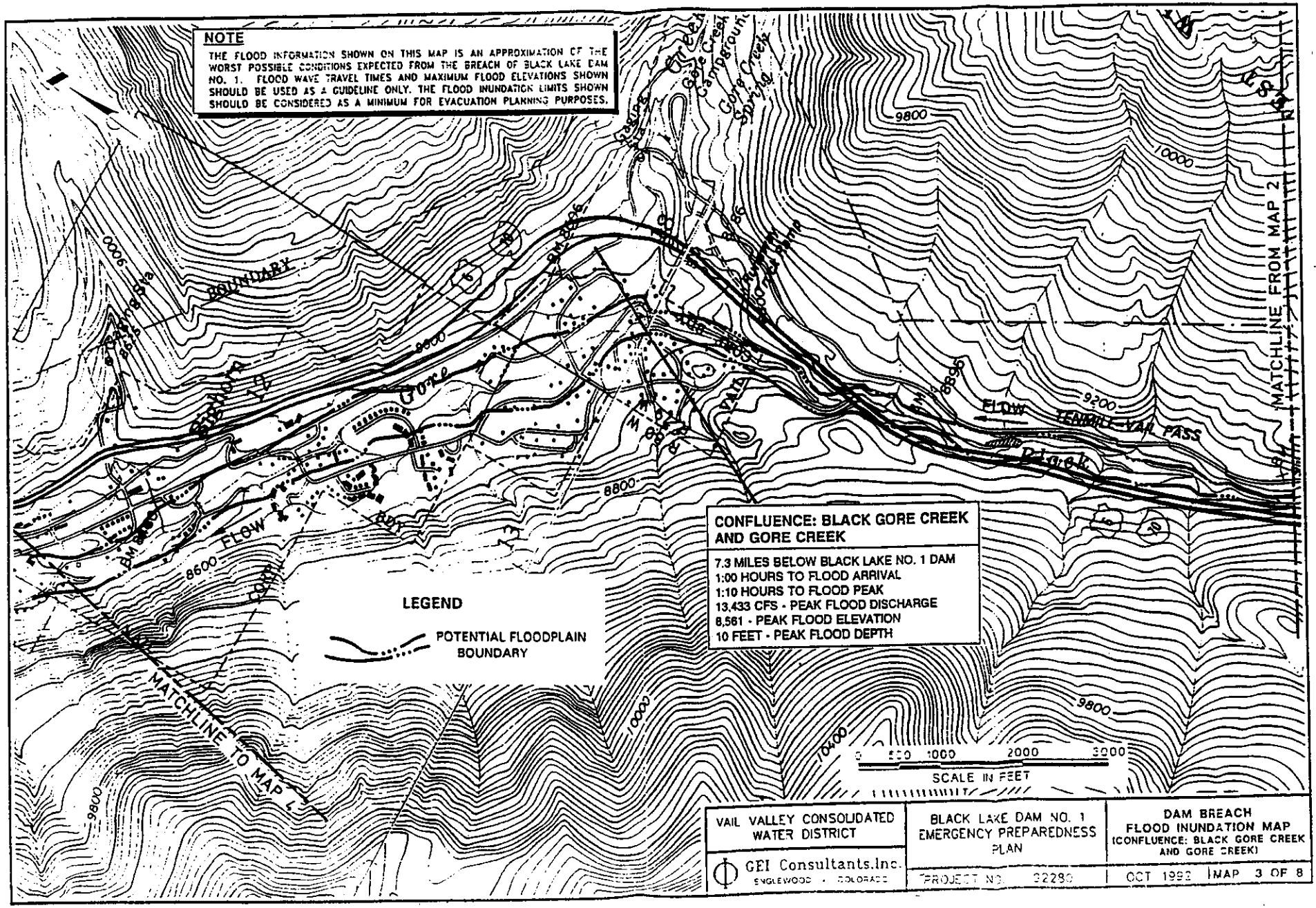

BLACK LAKE NO. 2 DAM
0.6 MILES BELOW BLACK LAKE NO. 1 DAM
0:30 HOURS TO FLOOD ARRIVAL
0:35 HOURS TO FLOOD PEAK
13,559 CFS - PEAK FLOOD DISCHARGE
10,375 - PEAK FLOOD ELEVATION
14 FEET - PEAK FLOOD DEPTH
BLACK LAKE NO. 1 DAM
0.0 MILES BELOW BLACK LAKE NO. 1 DAM
0:25 HOURS TO FLOOD PEAK
13,255 CFS - PEAK FLOOD DISCHARGE
10,483 - PEAK FLOOD ELEVATION
13 FEET - PEAK FLOOD DEPTH
MATCHLINE TO MAP 2
I-70
Black Lake
Rest Area
Shrine Pass
EAGLE CO
SUMMIT CO
LEGEND
POTENTIAL FLOODPLAIN BOUNDARY
0 500 1000 2000 3000
SCALE IN FEET
NOTE
THE FLOOD INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF THE WORST POSSIBLE CONDITIONS EXPECTED FROM THE BREACH OF BLACK LAKE DAM NO. 1. FLOOD WAVE TRAVEL TIMES AND MAXIMUM FLOOD ELEVATIONS SHOWN SHOULD BE USED AS A GUIDELINE ONLY. THE FLOOD INUNDATION LIMITS SHOWN SHOULD BE CONSIDERED AS A MINIMUM FOR EVACUATION PLANNING PURPOSES.
VAIL VALLEY CONSOLIDATED WATER DISTRICT
GEI Consultants, Inc.
BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN
DAM BREACH FLOOD INUNDATION MAP (BLACK LAKES)
PROJECT NO. 92220
OCT 1992
MAP 1 OF 8



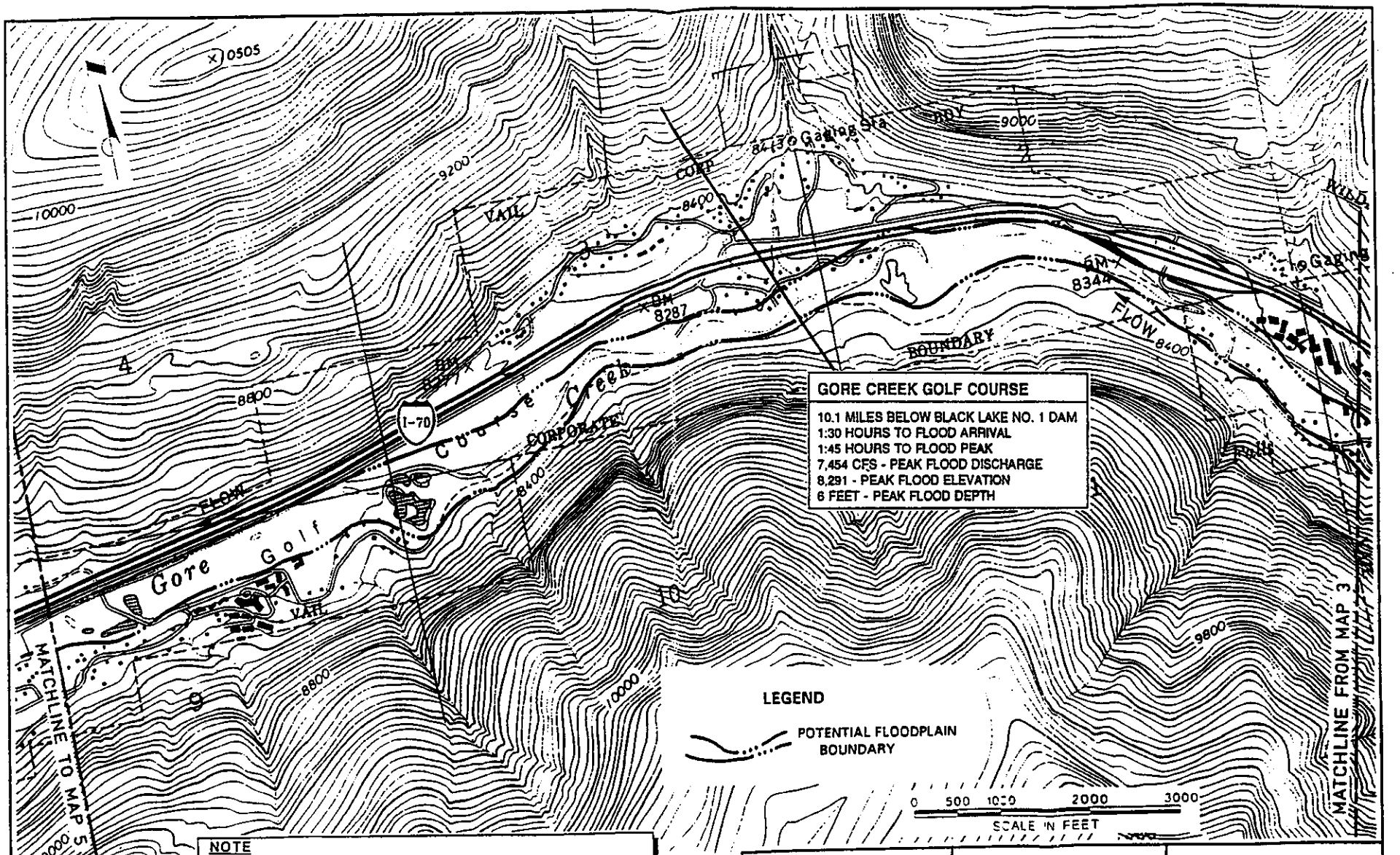
NOTE

THE FLOOD INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF THE WORST POSSIBLE CONDITIONS EXPECTED FROM THE BREACH OF BLACK LAKE DAM NO. 1. FLOOD WAVE TRAVEL TIMES AND MAXIMUM FLOOD ELEVATIONS SHOWN SHOULD BE USED AS A GUIDELINE ONLY. THE FLOOD INUNDATION LIMITS SHOWN SHOULD BE CONSIDERED AS A MINIMUM FOR EVACUATION PLANNING PURPOSES.

VAIL VALLEY CONSOLIDATED WATER DISTRICT	BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN	DAM BREACH FLOOD INUNDATION MAP (VAIL PASS)
GEI Consultants, Inc. ENGLEWOOD • COLORADO	PROJECT NO. 92280	OCT. 1992 | MAP 2 OF 8



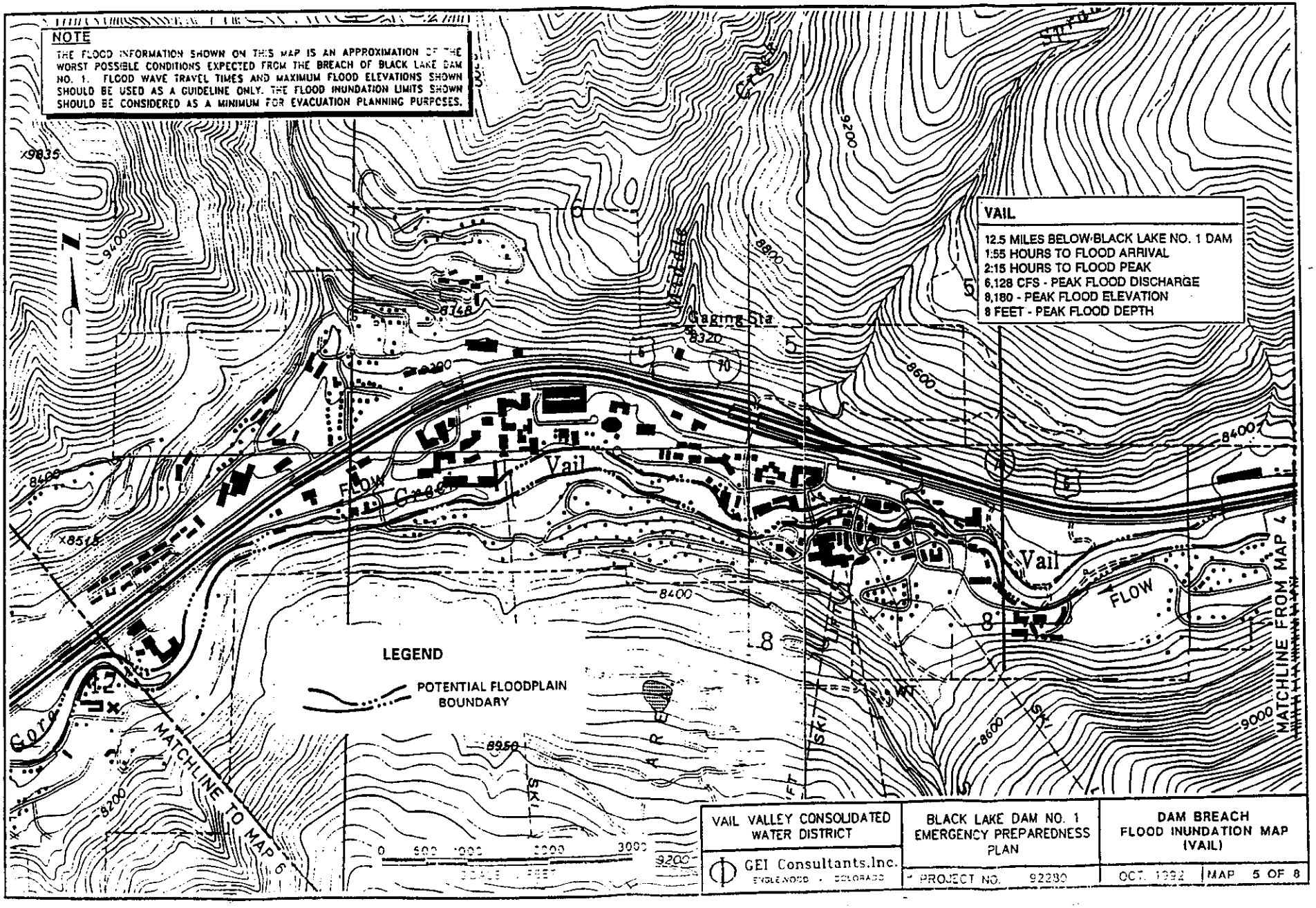
VAIL VALLEY CONSOLIDATED WATER DISTRICT	BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN	DAM BREACH FLOOD INUNDATION MAP (CONFLUENCE: BLACK GORE CREEK AND GORE CREEK)
GEI Consultants, Inc. ENGLEWOOD · COLORADO	PROJECT NO. 92280	OCT 1992 MAP 3 OF 8



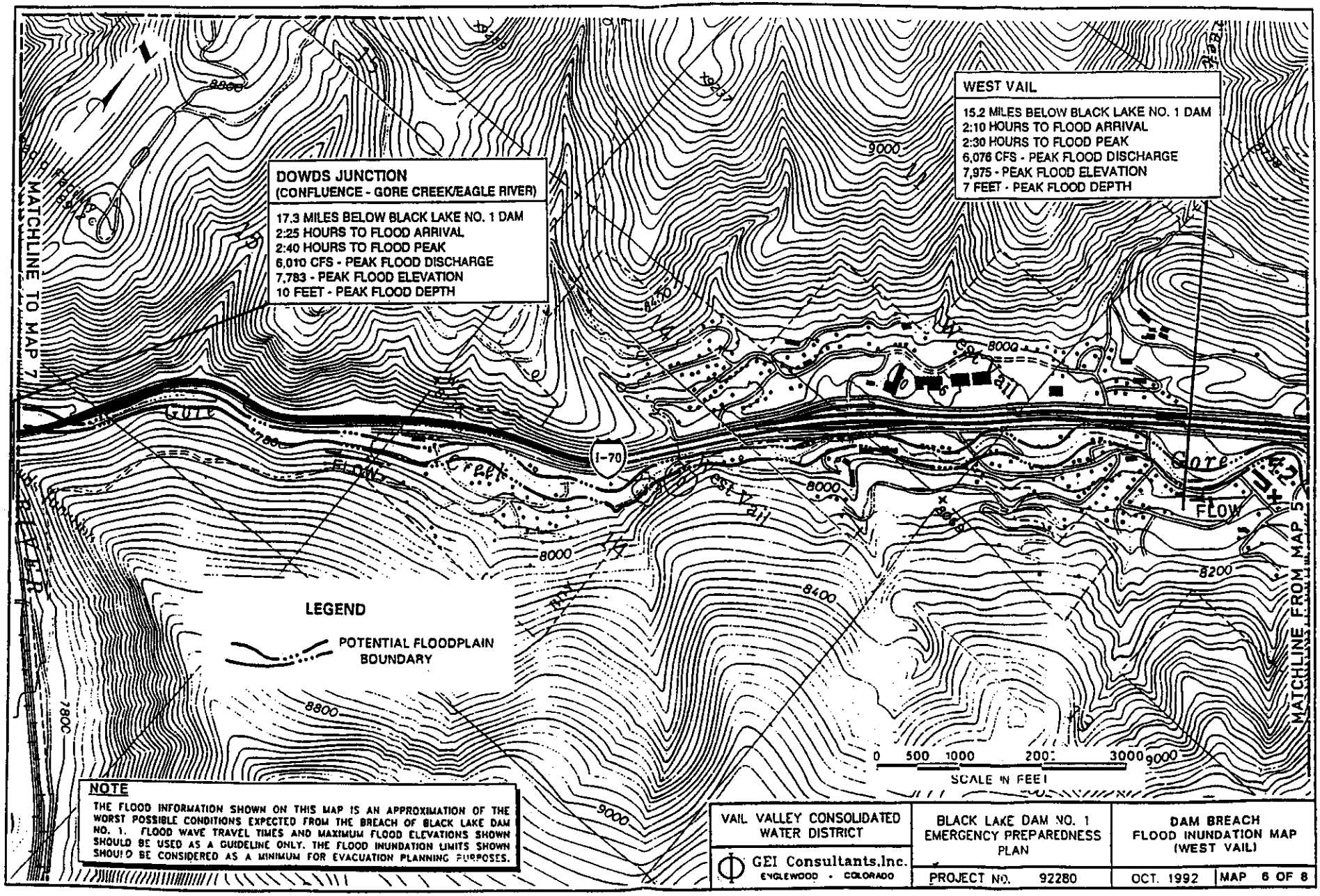
NOTE

THE FLOOD INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF THE WORST POSSIBLE CONDITIONS EXPECTED FROM THE BREACH OF BLACK LAKE DAM NO. 1. FLOOD WAVE TRAVEL TIMES AND MAXIMUM FLOOD ELEVATIONS SHOWN SHOULD BE USED AS A GUIDELINE ONLY. THE FLOOD INUNDATION LIMITS SHOWN SHOULD BE CONSIDERED AS A MINIMUM FOR EVACUATION PLANNING PURPOSES.

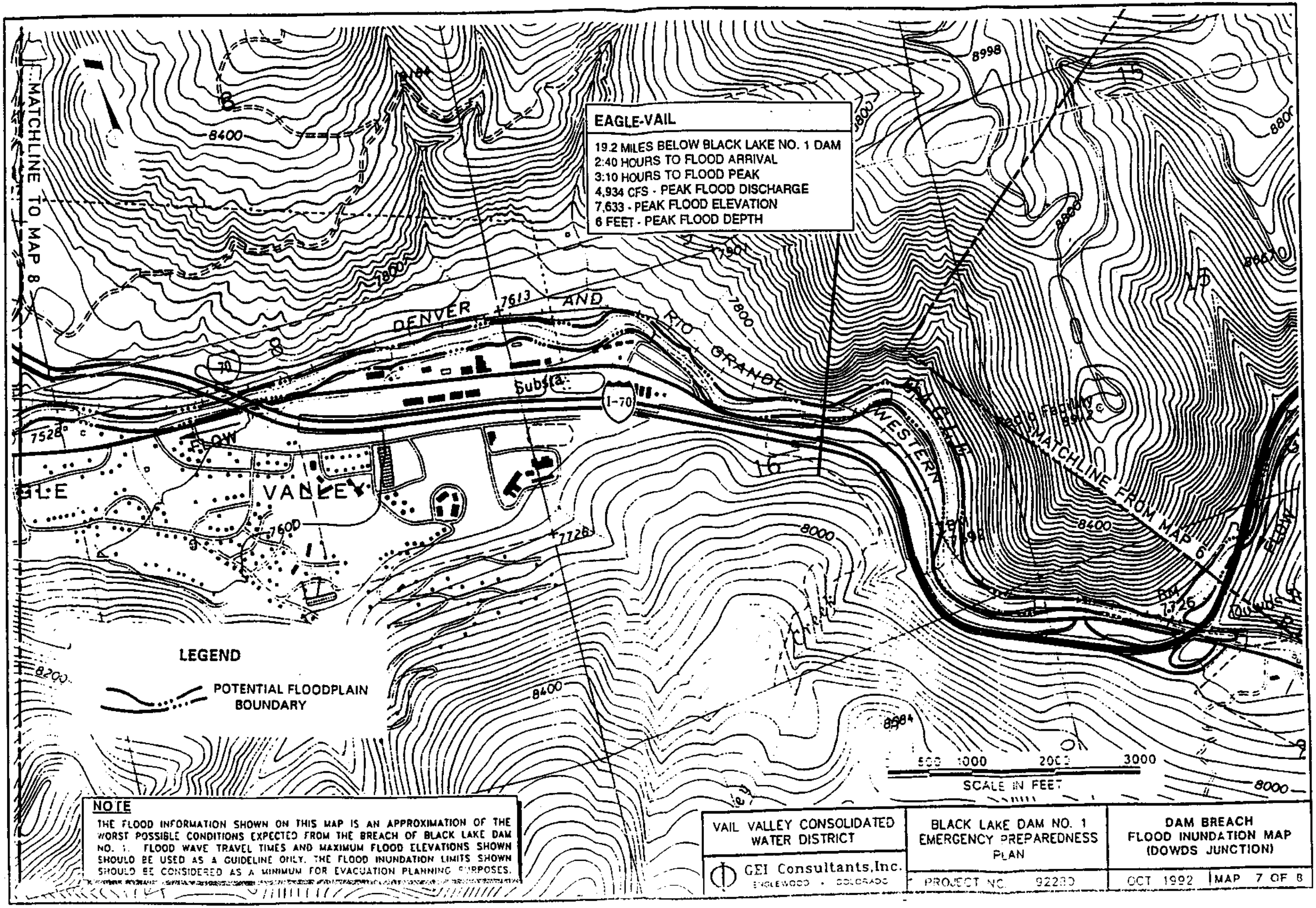
VAIL VALLEY CONSOLIDATED WATER DISTRICT	BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN	DAM BREACH FLOOD INUNDATION MAP (GORE CREEK GOLF COURSE)
GEI Consultants, Inc. ENGLEWOOD • COLORADO	PROJECT NO. 92280	OCT 1992 MAP 4 OF 8



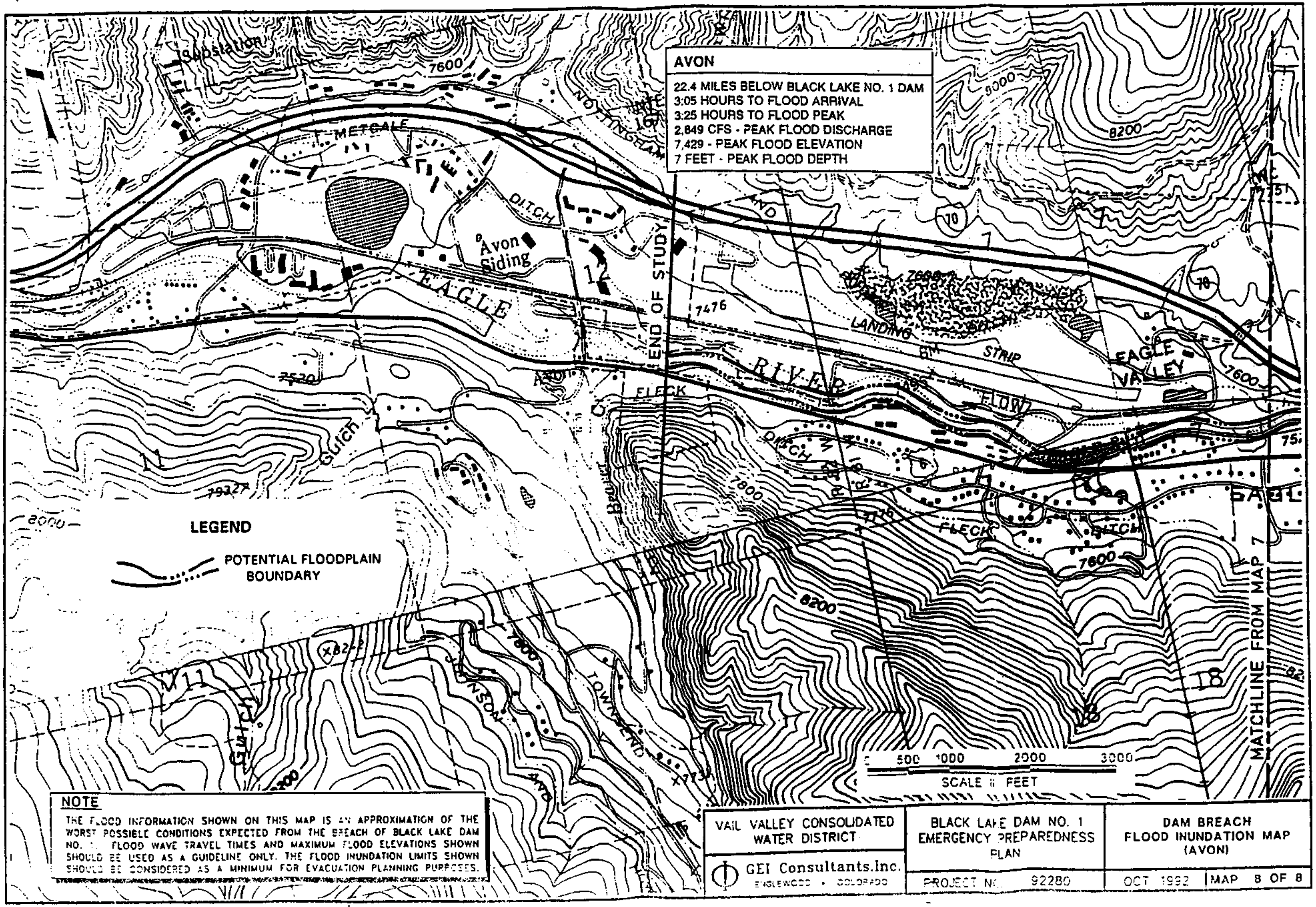
VAIL VALLEY CONSOLIDATED WATER DISTRICT	BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN	DAM BREACH FLOOD INUNDATION MAP (VAIL)
GEI Consultants, Inc. ENGLEWOOD · COLORADO	PROJECT NO. 92280	OCT. 1992 | MAP 5 OF 8



VAIL VALLEY CONSOLIDATED WATER DISTRICT	BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN	DAM BREACH FLOOD INUNDATION MAP (WEST VAIL)
GEI Consultants, Inc. ENGLEWOOD · COLORADO	PROJECT NO. 92280	OCT. 1992 | MAP 6 OF 8



EAGLE-VAIL
19.2 MILES BELOW BLACK LAKE NO. 1 DAM
2:40 HOURS TO FLOOD ARRIVAL
3:10 HOURS TO FLOOD PEAK
4,934 CFS - PEAK FLOOD DISCHARGE
7,633 - PEAK FLOOD ELEVATION
6 FEET - PEAK FLOOD DEPTH
MATCHLINE TO MAP 8
MATCHLINE FROM MAP 6
DENVER AND RIO GRANDE WESTERN
I-70
Substa.
FLOW
VALLEY
LEGEND
POTENTIAL FLOODPLAIN BOUNDARY
NOTE
THE FLOOD INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF THE WORST POSSIBLE CONDITIONS EXPECTED FROM THE BREACH OF BLACK LAKE DAM NO. 1. FLOOD WAVE TRAVEL TIMES AND MAXIMUM FLOOD ELEVATIONS SHOWN SHOULD BE USED AS A GUIDELINE ONLY. THE FLOOD INUNDATION LIMITS SHOWN SHOULD BE CONSIDERED AS A MINIMUM FOR EVACUATION PLANNING PURPOSES.
SCALE IN FEET
VAIL VALLEY CONSOLIDATED WATER DISTRICT
GEI Consultants, Inc.
ENGLEWOOD • COLORADO
BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN
PROJECT NO. 92230
DAM BREACH FLOOD INUNDATION MAP (DOWDS JUNCTION)
OCT 1992
MAP 7 OF 8



NOTE

THE FLOOD INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF THE WORST POSSIBLE CONDITIONS EXPECTED FROM THE BREACH OF BLACK LAKE DAM NO. 1. FLOOD WAVE TRAVEL TIMES AND MAXIMUM FLOOD ELEVATIONS SHOWN SHOULD BE USED AS A GUIDELINE ONLY. THE FLOOD INUNDATION LIMITS SHOWN SHOULD BE CONSIDERED AS A MINIMUM FOR EVACUATION PLANNING PURPOSES.

VAIL VALLEY CONSOLIDATED WATER DISTRICT	BLACK LAKE DAM NO. 1 EMERGENCY PREPAREDNESS PLAN	DAM BREACH FLOOD INUNDATION MAP (AVON)
GEI Consultants, Inc. ENGLEWOOD • COLORADO	PROJECT NO. 92280	OCT 1992 / MAP 8 OF 8