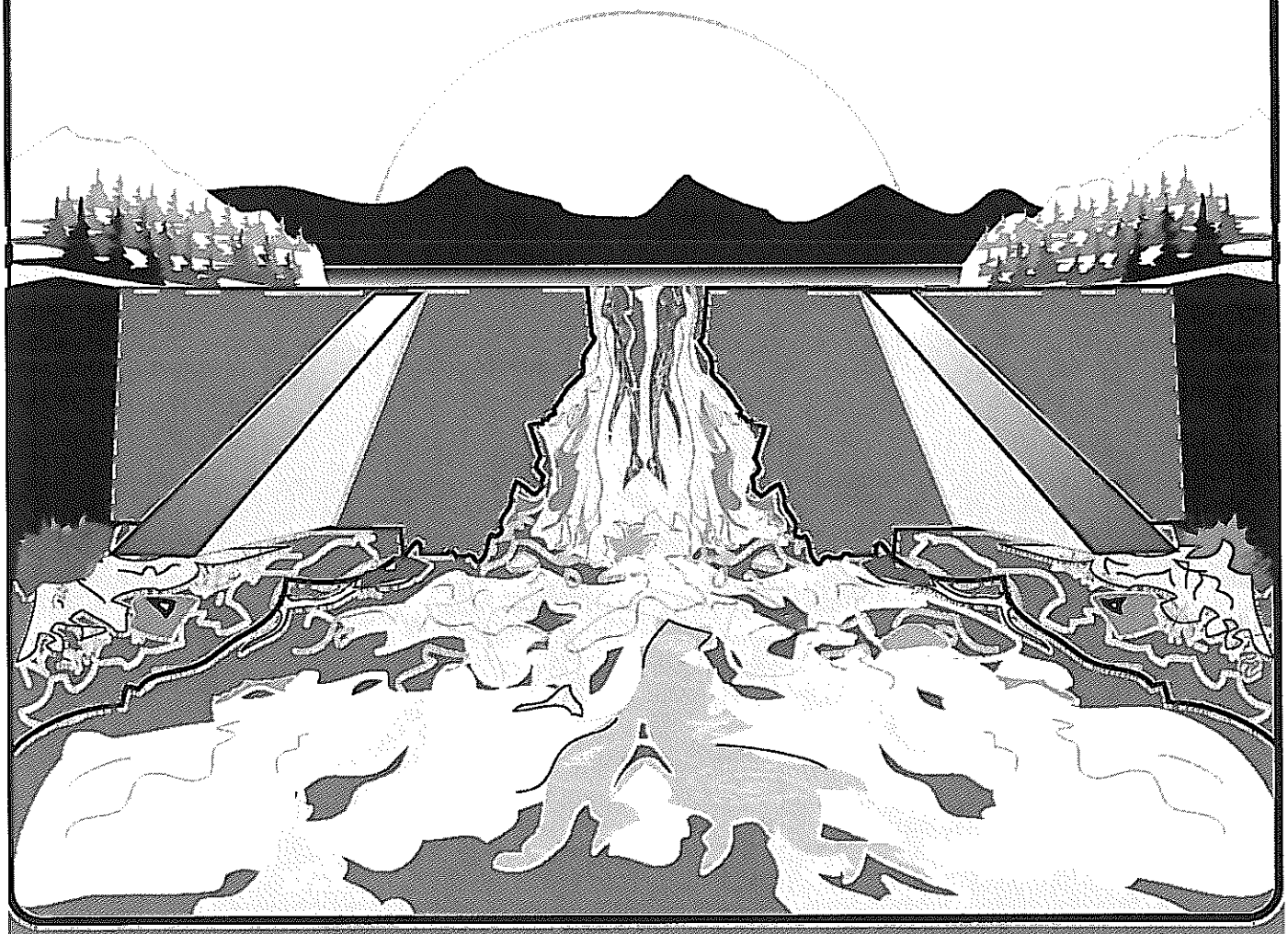
WILLOW CREEK DAM

EMERGENCY ACTION PLAN



DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

WATER RESOURCES DIVISION • STATE WATER PROJECTS BUREAU

2008

REDACTED

RED PAGES – EMERGENCIES

YELLOW PAGES – UNUSUAL OCCURRENCES

BLUE PAGES – TELEPHONE DIRECTORY

WHITE PAGES – GENERAL INFORMATION

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WILLOW CREEK DAM EMERGENCY ACTION PLAN

A Guide to Emergency Procedures at Willow Creek Dam

State Water Projects Bureau
Water Resources Division
Montana Department of Natural Resources
and Conservation
P. O. Box 201601
Helena, MT 59620-1601

Originally Published August 1993
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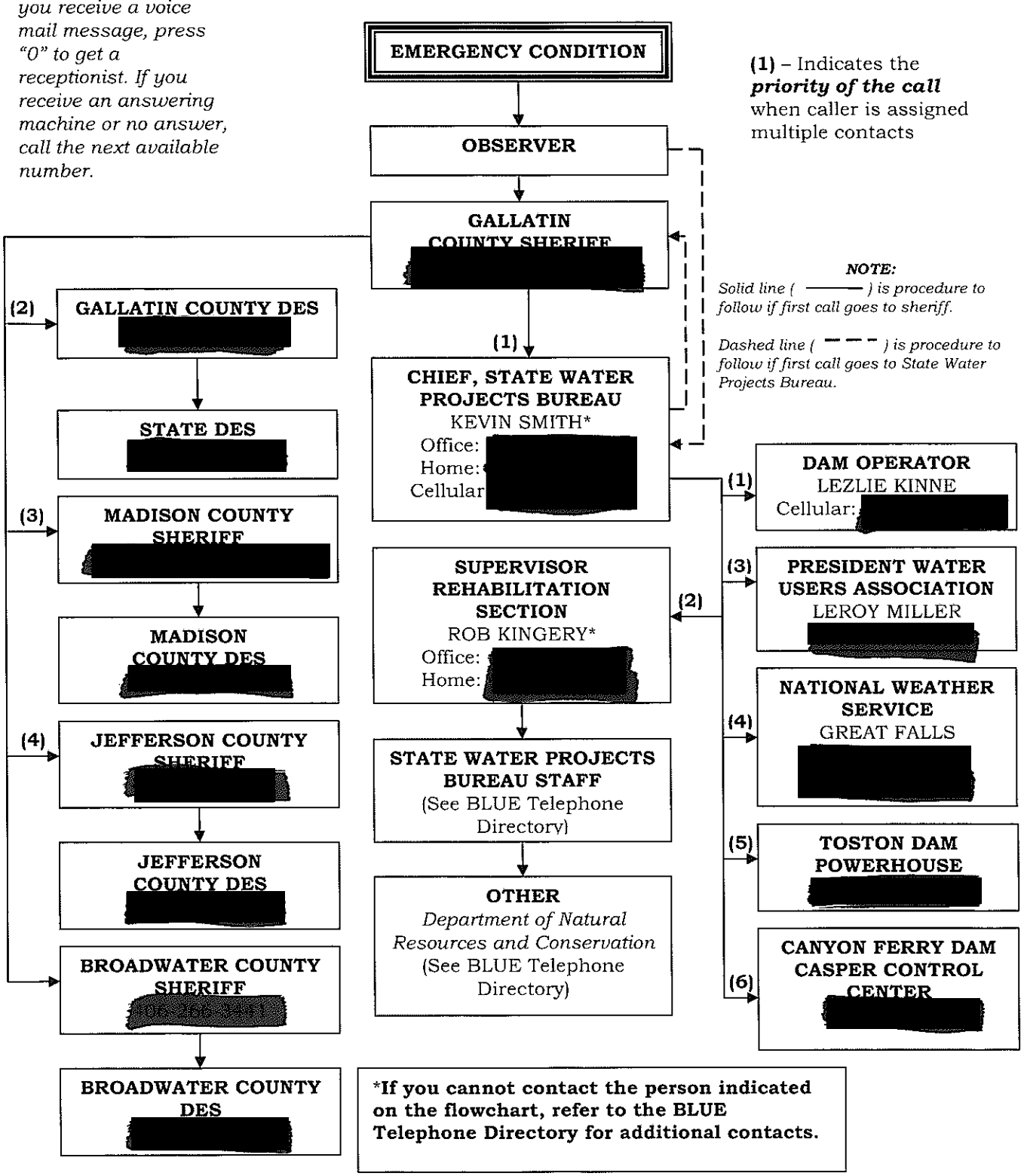
FAILURE IS IMMINENT OR HAS OCCURRED
NOTIFICATION FLOWCHART
WILLOW CREEK DAM

DO NOT *leave recorded messages!!! If you receive a voice mail message, press "0" to get a receptionist. If you receive an answering machine or no answer, call the next available number.*



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POTENTIALLY HAZARDOUS SITUATION ID DEVELOPING
NOTIFICATION FLOWCHART
WILLOW CREEK DAM

NOTE: *State Water Projects Bureau personnel will investigate the unusual occurrence and decide on further action.*

UNUSUAL OCCURRENCE

OBSERVER

CHIEF, STATE WATER PROJECTS BUREAU
KEVIN SMITH*
Office:
Home:
Cellular:

(1) – Indicates the ***priority of the call*** when caller is assigned multiple contacts

(3) **MADISON COUNTY SHERIFF**

(1) **MADISON COUNTY DES**

STATE DES

(2) **GALLATIN COUNTY SHERIFF**

GALLATIN COUNTY DES

(3) **JEFFERSON COUNTY SHERIFF**

JEFFERSON COUNTY DES

(4) **BROADWATER COUNTY SHERIFF**

BROADWATER COUNTY DES

(1)

SUPERVISOR REHABILITATION SECTION
ROB KINGERY*
Office:
Home:

STATE WATER PROJECTS BUREAU STAFF
(See BLUE Telephone Directory)

OTHER
Department of Natural Resources and Conservation
(See BLUE Telephone Directory)

(2)

DAM OPERATOR
LEZLIE KINNE
Cellular:

PRESIDENT WATER USERS ASSOCIATION
LEROY MILLER

(4)

NATIONAL WEATHER SERVICE
(For Flood Events)
GREAT FALLS

If you cannot contact the person indicated on the flowchart, refer to the BLUE Telephone Directory for additional contacts.

DO NOT *leave recorded messages!!! If you receive a voice mail message, press "0" to get a receptionist. If you receive an answering machine or no answer, call the next available number.*

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INTRODUCTION

This emergency plan has been prepared in compliance with the Montana Dam Safety Act and the resultant administrative rules. The purpose of the plan is to provide maximum early warning to affected persons in the unlikely event of failure of either the Willow Creek Dam (dam). Besides providing this early warning, an additional objective is to minimize or eliminate danger to people or property downstream.

This plan should be invoked under either one of two possible emergency situations. Those two potential emergency situations are:

1. Failure of the dam has occurred or seems imminent (**red pages**)

2. A potentially hazardous situation is developing (**yellow pages**)

The plan is intended to provide instructions for notifying the proper authorities of a problem at the dam and is not intended to be an evacuation plan for notifying and evacuating downstream residents. Notifying and evacuating downstream residents are responsibilities of the local authorities.

It is emphasized that the probability of an emergency of the magnitude considered in this plan is extremely remote, and issuing this plan does not imply that any concerns exist concerning the project's integrity. To help ensure the integrity of state-owned dams, the Department of Natural Resources and Conservation (DNRC) inspects the dams regularly.

FAILURE OR IMMINENT FAILURE

(This procedure assumes the dam operator is the observer.)

If the Willow Creek Dam is failing or about to fail, two actions must be undertaken immediately: (1) the floodplain downstream from the dam must be evacuated, and (2) any steps that might save the dam or reduce damage to the dam or floodplain should be taken. (Refer to the maps in **Appendix C** to determine the areas that are likely to be inundated if the dam fails.) The Gallatin County sheriff will handle the evacuation. The State Water Projects Bureau (SWPB) of the Department of Natural Resources and Conservation will manage the dam with your assistance. As dam operator, you are responsible for contacting the Gallatin County Sheriff [redacted]) as soon as you are aware of any danger. All of your responsibilities are listed in **Table 1**.

It is extremely important that you accurately judge whether the dam is about to fail. If you are not sure whether the dam is threatened, call the SWPB ([redacted] for a decision on whether to begin the emergency procedures listed in **Table 1**.

NOTE: DO NOT leave recorded messages! If you receive a Voice Mail message, press "0" to get a receptionist. If you receive an answering machine or no answer, call the next available number (see phone numbers in the Telephone Directory - blue pages.)

If you are unable to contact the SWPB during an emergency, however, you must decide for yourself what type of action the emergency demands, and then take that action.

TABLE 1. DAM OPERATOR'S RESPONSIBILITIES

1. Call the Gallatin County Sheriff's Dispatch Center ([redacted]

   Be sure to say, "**This is an emergency,**" and ask the sheriff's dispatcher to repeat the message to you to avoid confusion. The sheriff's dispatcher will call the Gallatin County Disaster and Emergency Services (DES), the Madison, Jefferson and Broadwater County Sheriffs and the SWPB. The DES will initiate its own emergency warning procedures. The four county sheriffs will begin the evacuation.

2. Do whatever is necessary to bring anyone in immediate danger (someone on the dam, directly below the dam, or boating on the reservoir, for instance) to safety.

3. Keep in frequent touch with the SWPB. The engineers there will tell you how to handle the emergency.

4. If all means of communication are lost, you should (1) try to find out why, (2) try to locate another radio or telephone that works, or (3) find someone else to try to reestablish communications. If all of these means fail, handle the immediate problems as well as you can, and try periodically to reestablish contact with the SWPB.

TABLE 2. SWPB'S RESPONSIBILITIES

The engineer who receives the call that Willow Creek Dam is either failing or about to fail is responsible for (1) finding out how serious the danger is, (2) notifying the many people within DNRC who will be needed to handle the emergency.

1. Get as much information as possible from the initial caller, and decide whether the dam is either failing or about to fail. If it is about to fail, continue with the following steps. If not, then one of the procedures listed in the **Reporting Unusual Occurrences** section **(yellow pages)** probably would be more appropriate.

What to Ask the Caller

- *Is the dam about to fail? If so, how can you tell?*
- *What is the rate of failure? How big is the failure site, and where is it? How good is the access to the site? Are there any alternative access routes?*
- *Who else have you notified? The Gallatin County Sheriff's Dispatch Center?* **(Notifying the sheriff so that he can begin the evacuation is the number one priority if the project is failing.)**
- *If the dam is not failing, what is the problem? What caused it? Where is it? When did you first notice the problem, and when did it start?*
- *What is the weather like now? What has it been like for the past couple of days? What is the forecast for the near future?*
- *If there is a discharge of water, where is it? How much water is seeping through, and what color is it?*
- *Where are you calling from? How can we get in touch with you? When will you call again?*

Table 2 *continued*

2. If the person phoning in the warning is not the dam operator, call the dam operator Lezlie Kinne ([redacted]) at once. Attempt to verify the authenticity of the report if you question it.

3. Refer to the maps in **Appendix C** to determine the areas that are likely to be inundated if the dam fails. If evacuation of downstream residents is necessary, call the Gallatin County Sheriff at [redacted] who will direct the evacuation. You should call Gallatin County DES at [redacted] frequently during the emergency to keep county officials informed of the condition of the dam and of the amount of flooding.

4. Notify the Gallatin County DES [redacted] that the Irish Slough (ditch) should be breached just before it reaches the town of Willow Creek. This will keep flood waters from breaching the ditch naturally and causing flooding in Willow Creek. Call Leroy Miller, President of the Water Users (**406-285-6657**) to implement the ditch breach.

5. Notify the Gallatin County DES [redacted] and the City of Three Forks [redacted], **or see other telephone numbers on page 20 under "Three Forks, City Of"**) that water flowing through railroad culverts and bridges would cause scattered flooding east of the railroad tracks. Steps may be taken to restrict the flow through the culverts and bridges.

6. Notify the operators at Toston Dam ([redacted], **or see operator's numbers on page 19 "Hydropower Section"**) so they can adjust the reservoir level and spillway gates to pass the flood flows.

7. Notify the Bureau of Reclamation:
   (1) Casper Control Center ([redacted])
   (2) Montana Area Office in Billings ([redacted]), and
   (3) Canyon Ferry Dam Operators ([redacted])
   Convey to them the details of the breach at Willow Dam so they can plan the operation of Canyon Ferry Dam to pass the flood flows.

Table 2 *continued*

8. Call the following persons or agencies to advise them of the situation. See **Failure Is Imminent Or Has Occurred** flow chart for names and telephone numbers.
   (1) President Water Users Association
   (2) National Weather Service (Great Falls)

9. Call as many SWPB and DNRC employees to help handle the emergency as you think you need (phone numbers in the **Telephone Directory - blue pages**).

10. Arrange for SWPB representatives to inspect the dam immediately. Call the State Disaster and Emergency Services office ([redacted]) to obtain state resources for communication, transportation, and maintenance equipment. Providers of aircraft are listed in the **Telephone Directory (blue pages)**. Also, keep the DES office in Madison, Jefferson, and Broadwater Counties informed of the situation.

11. Ask the appropriate agencies if they want SWPB representatives to be stationed at the following locations:
    (1) Madison County Emergency Operations Center (EOC)
    (2) Jefferson County Emergency Operations Center (EOC)
    (3) Broadwater County Emergency Operations Center (EOC)
    (4) State Disaster and Emergency Services Office
    (5) SWPB Office

REDACTED

REPORTING UNUSUAL OCCURRENCES

An unusual occurrence is an event or condition not normally encountered during the routine operation of the dam and reservoir. These occurrences may endanger the dam, the public, or the downstream valley and may necessitate a temporary or permanent revision of the dams' operating procedures. Among the unusual occurrences that may affect the dam are dam embankment problems, failure of the outlet works or spillway, heavy precipitation or rapid spring snowmelt, landslides, earthquakes, theft, vandalism, acts of sabotage, and serious accidents or fatalities.

This section of the *emergency plan* tells you how to notify the SWPB - and, in some cases, whom else to notify - if an unusual occurrence takes place. Notify the SWPB by the fastest means available - usually by phone.

> ***NOTE: DO NOT leave recorded messages! If you receive a Voice Mail message, press "0" to get a receptionist. If you receive an answering machine or no answer, call the next available number (see phone numbers in the Telephone Directory - blue pages.)***

If you are unable to contact the SWPB during an emergency, however, you must decide what action the emergency demands, and then take that action. The emergency measures described in **Appendix G: Dam Safety Problems** may help you.

Dam Embankment Problems

If you discover an unusual condition of the dam embankment that could threaten the structure:

You should telephone the SWPB at [redacted] immediately - call the engineers at home if there's no answer at the SWPB office. (See phone numbers in the **Telephone Directory - blue pages**.) Among the conditions you should watch for are sloughing, cracking, or settling of the embankment; slides; development of sinkholes or scarps; appearance of seepage on the embankment; damage to riprap; whirlpools in the reservoir; boils downstream; changes in seepage discharge or color; bulges in the embankment; misalignment of the dam structure; damage to the embankment from rodents; vegetation changes; and movement of

material along concrete structures.

When you call the SWPB to report a slide, slough, or sinkhole, be prepared to report:

1. Its location
2. Its size
3. Its rate of growth
4. Its effects on adjoining structures
5. Reservoir water surface elevation
6. Weather conditions
7. Amount of damage
8. Any seepage or wetting - if any, estimate its flow rate
9. Any other pertinent information

When you call the SWPB to report the development of a new spring, seep, boggy area, or boil, be prepared to report:

1. Its location
2. Its size
3. Its estimated flow rate (does it appear to be increasing?)
4. Nature of its discharge (clear or cloudy?)
5. Reservoir water surface elevation
6. Any other pertinent information

After notifying the SWPB, prepare a map showing the extent of the seep or spring, and record the date and the reservoir water surface elevation at the time of each observation. Revise the map periodically if the seep or spring develops further.

Check all riprapped areas periodically (but particularly after high winds and after the reservoir water level has been high) for slippage, sloughs, deterioration, or failure of bedding material. If you find any damage, call the SWPB immediately.

The SWPB also should be notified of any abnormal requirements for maintenance of the dam embankment.

Failure Of Outlet Works

If the outlet works stop working:

First, try to find out why the outlet works aren't working. It may be because of one of these malfunctions:

1. Blocking of the inlet by debris, sediment, dam embankment failure, or riprap failure
2. Collapse of conduit
3. Damage to gates
4. Broken or damaged gears
5. Blocking of outlet
6. Binding of gates

Second, call the SWPB at [redacted] immediately. If you were able to find out the reason that the outlet is not working, give the SWPB this information.

Failure of the Spillway

If you discover damage to the spillway:

Immediately call the SWPB at [redacted] the engineers will tell you what to do.

Check the spillway whenever water is flowing over it - particularly when that water is 2 or more feet deep at the spillway crest (see **page 12** for emergency flooding procedures). As the depth of water over the spillway crest increases, check the spillway more frequently, and notify the SWPB. A 24-hour-a-day watch may become necessary; if so, the SWPB will let you know. Also, inform Madison and Gallatin county DES personnel that you are on a 24-hour-a-day watch, and tell them how you can be reached.

When checking the spillway, watch for:

1. Movement of walls, footing, and floor slabs
2. Settling of backfill
3. Loss of Riprap
4. Undermining of spillway at stilling basin
5. Loss of backfill around spillway walls
6. Separation of water from spillway floor at changes of slope
7. Clogging of entrance

8. Rolling rocks or debris in stilling basin
9. The effect of the water jet exiting the spillway on the surrounding channel, the stilling basin, and any nearby structures.

Flood

If it appears likely that the dam embankment will be overtopped:

You should immediately call the SWPB at [redacted]. *Be prepared to give the engineers the following information:*

1. Current reservoir water surface elevation
2. Observed rate at which the water surface is rising
3. Weather conditions (current and predicted)

The SWPB will tell you how to operate the reservoir and when to make further reports.

If, because of heavy rain or heavy runoff from snowmelt, it appears that an unusually large outflow from the reservoir will occur, you should immediately notify the SWPB. Also, notify the Gallatin County DES [redacted] that downstream flooding may occur so that its office can take any necessary action. The SWPB will contact the National Weather Service to advise them of the potential flooding conditions.

Landslide

If you discover a sizable land movement toward or into the reservoir:

Call the SWPB at [redacted] immediately. *Be prepared to report:*

1. The land movement's size
2. Its location
3. Weather conditions
4. How the reservoir was being operated before the movement was discovered
5. Any effect the slide has had on the dam or reservoir
6. How the project currently is being operated

Be alert for possible danger to any people near the slide or in the area around or below the reservoir.

From the time you first detect movement in an area, keep careful records of any further slides. Check those areas frequently, and note any changes. The SWPB will help you decide how frequently the areas should be checked.

Earthquake

If you feel an earthquake or hear that one has occurred in your area:

1. Inspect the dam immediately.

2. **If the dam is so badly damaged that it may fail, immediately begin the Failure or Imminent Failure procedures that start on page 3.**

3. If the dam has been damaged, but not badly enough to cause it to fail, take the following actions at once.

   a. Inspect the damage more closely; note its location, extent, and nature.

   b. Even if it still appears that the dam is in no imminent danger of failing, call the SWPB at [redacted], and make a complete report. ***Make sure that the person receiving your report understands your evaluation of the potential hazard at the dam***. Stay in frequent contact with the SWPB; SWPB staff may tell you to contact local officials or take other emergency steps.

4. Inspect the dam embankment and abutments more closely for possible sloughs, displacement, cracks, or seeps. Observe the flow of water in drains, noting turbidity and flow rate.

5. Inspect the outlet works, control house, and gate chamber. If you discover any damage, stop releasing water, and notify the SWPB ([redacted]) at once.

6. Regardless of whether you discover any damage, call the SWPB, and make a report.

The National Earthquake Information Service of the U.S. Geological Survey (USGS) in Denver ([redacted]) notifies the SWPB of earthquakes occurring in Montana or Wyoming according to this schedule:

Magnitude (Richter)	Regional Office Notification Schedule
3.5 to 4.5	**The next working day**
4.6 and above	**Immediately**

The SWPB will notify you of any earthquake that occurs within a 200-mile radius of Willow Creek Dam.

Theft

If any state property at the dam is stolen:

Call the Madison County Sheriff ([redacted]) first, and then the SWPB ([redacted]). If the loss is serious enough to threaten the dam or necessitate changes in its operation, follow the steps listed below for vandalism.

Vandalism

If any state property at the dam is vandalized:

Investigate the damage first, and then take any action necessary to protect the dam or any people in the immediate area who may be endangered. Then call the Madison County Sheriff ([redacted]) and the SWPB ([redacted]). When you call the SWPB, give the following information:

1. When the incident happened
2. When it first was discovered
3. What changes in dam operation will be necessary until repairs are made
4. How much you estimate repairs will cost
5. What actions you already have taken or plan to take

Sabotage

One small bomb, strategically placed, could cause a great deal of damage and inconvenience in the area surrounding the dam, even though it might not endanger the dam itself. Therefore, be alert for any suspicious behavior near the dam or any associated structures, and be on the lookout for any suspicious objects. Lock all buildings and mechanisms, and check the locks frequently to make sure they are in good condition.

If you receive a bomb threat by telephone:

1. Keep the caller on the line as long as possible. Ask the caller to repeat the message.

2. If the caller doesn't say where the bomb is or when it will go off, ask for this information.

3. Tell the caller that the explosion of a bomb at the Willow Creek Dam could kill or injure innocent people.

4. Listen for any background noises - motors running, background music (what type?) - that might give even a slight clue as to where the call is being made.

5. Listen closely to the caller's voice. Is it male or female? What can you tell about its quality, accent, or any impediments such as stutter, lisp, etc.?

As soon as the caller hangs up, call the Madison County Sheriff [redacted] first, and then call the SWPB [redacted]. Handling bombs is best left to professionals trained in the disposal of explosives. Any recreationists in the area should be told to move immediately; if it is necessary to evacuate residences, the evacuation will be carried out by the Gallatin County sheriff.

If you receive a bomb threat in the mail:

Call the Madison County Sheriff [redacted] first, and then call the SWPB [redacted]. Remain near the dam (on high ground) to assist the sheriff if necessary.

If a bomb explodes near the dam, reservoir, or any associated facility:

Immediately call the Madison County Sheriff ([redacted] and then call the SWPB ([redacted]). The SWPB staff will tell you what to do next. Keep the Gallatin County Disaster and Emergency Services office ([redacted]) informed at all times.

Fatality Or Serious Accident

If you learn of any drowning or other fatality or any accident causing personal injury:

If you are among the first on the scene, see that any necessary first aid is administered, and then send for help - the Madison County Sheriff should be notified immediately at [redacted]. Then call the SWPB [redacted]

TELEPHONE

DIRECTORY

WHOM TO CALL IF THE DAM FAILS

(Listed in Order of Priority)

PRIORITY ONE

1. Sheriff

Gallatin County.....

Madison County .....

Jefferson County

Boulder Office .....

Broadwater County.....

2. Disaster and Emergency Services

Gallatin County (24 hr) .....

Coordinator,Chuck Winn.....

Deputy, Jason Shrauger.....

Madison County (24 hr) .....

Coordinator, Frank Ford..... Office

Deputy, Natalie Robison ..... Office

Jefferson County (24 hr) .....

Coordinator, Sally Buckles ..... Office

Deputy, Patrick McKelvey ..... Office

Broadwater County (24 hr).....

Coordinator, Bill Fleiner ..... Office

Deputy, Richard Thompson ..... Office

Montana Disaster and Emergency Services Division (Helena) (24 hr) .....

3. Montana Department of Natural Resources and Conservation (DNRC

Bureau Chief, Kevin Smith .....

Home

Cellular

Project Rehabilitation Section .....

Supervisor, Rob Kingery..... Home

Dam Safety Engineer, (Vacant).....

Civil Engineer, Brian Grant .....Cellular

REDACTED

*Hydropower Section: (**TOSTON DAM**)*

Toston Dam Powerhouse .....
Supervisor, Walt Anderson .....
Home
Cellular
Plant Superintendent, Mike Sims .....
Home
Cellular
Plant Operator, Brian Carroll .....
Home
Cellular
Plant Operator, Jim Beck.....
Home
Pager

Water Operations Bureau .....
Bureau Chief, Laurence Siroky..... Home
Cellular

Dam Safety Section
Supervisor, Michele Lemieux .....
Home

Water Resources Regional Office

Bozeman .....
Manager, Scott Compton ..... Home

Helena .....
Manager, Jan Langel ..... Home
Civil Engineering Specialist, Jim Beck . Home

Water Resources Division .....
Administrator, John Tubbs ..... Home
Cellular

Assistant Administrator,
Lorene Thorson ..... Home

Department Director .....
Director, Mary Sexton ..... Home
Cellular

Information Specialist, Dan Bushnell.....
Home
Cellular

4. **Dam Operator**
Lezlie Kinne..... Cellular

5. **National Weather Service**
Great Falls .....

PRIORITY TWO

6. **Willow Creek Water Users Association**
President, LeRoy Miller.....
Vice President, Robert Sitz.....
Secretary, Mary Miller .....
Directors:
Bill Buttleman.....
Bryan Dyk.....
Jack Cooper .....

7. **Three Forks, City** of .....
Emergency Services, Wendall Ewan ..... Office
Cellular
Marshall, Troy Burdick .....

8. **Canyon Ferry Dam (U.S. Bureau of Reclamation)**
Casper Control Center (24 hr) .....
Montana Area Office, Billings .....
Canyon Ferry Dam Operators .....

9. **Governor's Office** .....
Citizen's Advocate .....

REDACTED

PRIORITY THREE

10. Sources of Aircraft

GOVERNMENT AGENCIES

Department of Natural Resources & Conservation ..... Office [redacted]

Fixed-wing, helicopters

Chuck Brenton ..... Office [redacted]
Cellular
Home

Randy Yeager ..... Office
Cellular
Home

Hanger .....
Helena Fire Dispatch .....
Statewide Fire Dispatch .....

PRIVATE FLYING SERVICES

Helena

Exec Air ..... [redacted]

Fixed-wing/single and twin engine

John Maxness ..... [redacted]
Dan Horhton .....

Bozeman

Central Helicopters Inc ..... [redacted]
Paragon Air Adventures (Belgrade) .....
Sunbird Aviation .....

Butte

Butte Aviation ..... [redacted]

Fixed-wing/ single & twin engine

Dillon

Dillon Flying Service ..... [redacted]

Single engine

11. Sources of Construction Equipment

Heavy construction equipment--backhoes, trucks, crawler tractors, dozers, and draglines--may be needed during an emergency. Contractors and equipment suppliers are listed below.

Bozeman

ABC Rental .....
Barnard Construction Co., Inc .....
Bozeman Sand and Gravel .....
Cat Rental Store .....
Mahurin Excavating .....
Montana Ready-Mix .....
Portable Inc .....
Sime Construction .....
Thompson's Rental Shop .....

[redacted]

Dillon

R E Miller and Sons .....
Rowe Excavation .....

[redacted]

Ennis

Matson Excavation .....
V.F. LTD .....

[redacted]

Norris

AM Wells Inc .....

[redacted]

Shop

Three Forks

Roadarmel Construction .....
Pierce Construction .....

[redacted]

Whitehall

Joseph Davis .....

[redacted]

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LOCAL NOTIFICATION

The Town of Willow Creek is likely to begin flooding approximately 1.5 hours after a breach of the Willow Creek dam.

The City of Three Forks will begin flooding approximately five hours after a breach of the dam.

Local authorities are responsible for notifying and evacuating persons in danger of being flooded.

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GENERAL INSTRUCTIONS

Surveillance at Unattended Dam (not manned on a 24-hour-per-day basis)

Surveillance of the dam will be performed by the dam operator; water users association directors; recreationists; Department of Fish, Wildlife and Parks personnel; and county law enforcement personnel. The dam operator will check the dam during regularly scheduled visits. The dam operator will be the primary observer and most likely will be the person who sounds a warning. Other persons will view the dam when they are in the area.

Response During Hours of Darkness or Adverse Weather

The response during the night or adverse weather conditions should be the same as that made during the day or clear weather. Responsibilities are the same regardless of the time of day or type of weather conditions.

However, the response time will likely be longer because of additional time involved in notification, verification, and response to an emergency during off hours or inclement weather. Until reports can be either verified or proven false, a warning shall be given to the Gallatin County Sheriff [redacted] in the interest of public safety.

Responsibility for Evaluation of Potential Emergency and Warning

The first person to determine that a potential emergency exists at the dam will call the Gallatin County Sheriff [redacted] to inform him of the potential problem. The sheriff then will notify the SWPB. The sheriff will implement the county disaster plan. SWPB personnel will visit the site to determine the nature of the potential problem and assess its seriousness. These people, the sheriff, and the DES will determine whether downstream evacuation is necessary. Local citizens and other personnel will be trained to handle such potential emergencies, as discussed in **Appendix D**.

Local Access and Evacuation Routes

Access roads to Willow Creek Dam and the surrounding area are shown in **Appendix F**. Should the main roads become impassable, another route possibly may be found on the map. Persons evacuating the area should remain on high ground and not return to potentially flooded areas or attempt to drive through low areas that are flooding.

APPENDICES

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APPENDIX A

PROJECT DESCRIPTION

Willow Creek Dam is located in Madison County, 3 stream miles southwest of the line separating Madison and Gallatin Counties. The project is located approximately 10 miles upstream of the Town of Willow Creek, and 17 miles upstream from the City of Three Forks. The reservoir is fed by Willow Creek from the west and Norwegian Creek from the south. The dam is operated by the Willow Creek Water Users Association; names and numbers of the current officers and the dam operator are listed in the **Telephone Directory -- blue pages**.

The earth fill dam was constructed in 1938. Willow Creek Dam is 105 feet high and 453 feet long. The dam's outlet works consist of an 8-foot-diameter dry well containing a 54-inch emergency gate and a 54-inch butterfly operating valve. The operating valve is controlled from the top of the tower, while the emergency valve is controlled from the bottom.

Water from the reservoir is used for irrigation water supply. The reservoir is also used for water-based recreation.

APPENDIX B

DAM BREACH ANALYSIS

Two breach scenarios were evaluated to determine the extent of the downstream area that would be flooded should Willow Creek Dam breach. The first scenario was the clear weather breach (CWB), or a sudden breach that would occur as the result of an earthquake or a piping failure of the dam. The second scenario was that the dam would breach during the probable maximum flood (PMF), when the flood waters were 3 feet above the crest of the dam.

The hydrology/hydraulics study of Willow Creek Dam involved determining the PMF for the area. This work was done by Gary Fischer, DNRC dam safety engineer. A PMF of about 147,000 acre-feet was computed. The PMF would have a calculated peak inflow of 59,400 cubic feet per second (cfs) in the 56th hour of the 150-hour flood event. The full PMF event was used to calculate the dam breach and flood.

The flood hydrographs resulting from the two breach scenarios were routed downstream using the National Weather Service DAMBRK Model. The backwater curves at the Interstate 90 highway bridge over the Jefferson River below Three Forks and at the Toston Dam were calculated using the dam backwater features of the model. The CWB flood was routed downstream for 43 miles to the Toston Dam (south of Toston, Montana). The DAMBRK model estimates that the CWB flood for the dam would attenuate to approximately 22,710 cfs at the Toston Dam. This is less than the 100-year flood calculated for the USGS gage just downstream from Toston Dam.

The probable maximum flood breach (PMFB) flood was routed 65 miles downstream to the inlet of Canyon Ferry Lake (near Townsend, Montana). The model estimates that the PMFB flood would discharge a peak flow of more than 57,000 cfs into Canyon Ferry Reservoir. The PMFB flow is in excess of the maximum flow of record at the USGS Missouri River gage at Toston (approximately 32,000 cfs). The predicted time of arrival of the flood peak at Townsend is approximately 20 hours after the breach starts to develop. By then, disaster officials would have had time to make real time estimates of flood characteristics and to update warnings to people likely to be affected by the flood.

The CWB was begun with the reservoir's normal operating pool elevation of 4,736.0 feet. The PMFB was begun when the water was flowing 3-feet deep

over the crest of the dam (4,747.5 feet), approximately 50.5 hours after the flood first reached Willow Creek Reservoir. The flood inflow was 38,300 cfs at the time of the PMFB. The model used a breach development time of 1.3 hours, breach bottom width of 272 feet, and breach side slopes of 1.0 horizontal to 1.0 vertical. The bottom of the breach at the dam was assumed to reach an elevation of 4,665.0 feet (bottom of the dam fill).

The computer model used to estimate the flow, stage, and timing of the breach floods provides a mathematical tool to model and approximate a flood's real-life characteristics. The model has been used to recreate the results of real floods from breached dams with some degree of confidence. However, the results of the model

TABLE 3. WILLOW CREEK DAM BREACH ANALYSIS

Based on 1993 DAMBRK Runs

CLEAR WEATHER BREACH (CWB) SCENARIO

CROSS SECTION ID	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hours)	TRAVEL TIME PEAK (hours)	WAVE HEIGHT (feet)
A	0.56	218,190	24.8	0.13	0.22	55.5
B	2.64	213,120	18.8	0.38	0.64	54.6
C	4.37	183,480	9.1	0.63	1.25	31.5
D	6.15	158,720	11.1	0.90	1.64	24.1
E	7.13	155,680	11.2	1.14	1.89	22.4
F	9.36	135,500	8.1	1.89	2.64	19.9
G	11.16	98,230	5.2	2.39	5.22	16.8
H	14.75	43,180	4.1	4.64	8.14	12.0
I	16.04	37,360	3.8	5.64	10.14	12.0
J	21.21	26,390	1.7	9.25	14.75	10.0
K	24.49	24,810	3.8	10.50	15.75	12.2
L	29.18	24,580	3.9	12.50	17.00	11.0
M	33.14	23,820	2.5	15.00	19.75	9.9
N	38.00	23,210	3.6	17.00	21.25	10.8

PROBABLE MAXIMUM FLOOD BREACH (PMFB) SCENARIO

CROSS SECTION (ID)	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hours)	TRAVEL TIME PEAK (hours)	WAVE HEIGHT (feet)
A	0.56	393,290	25.2	0.04	0.06	60.6
B	2.64	369,650	18.7	0.18	0.25	60.1
C	4.37	360,830	11.4	0.35	0.50	31.6
D	6.15	346,470	14.5	0.55	0.75	33.9
E	7.13	327,820	14.3	0.65	1.00	31.1
F	9.36	300,230	11.7	0.90	1.50	23.4
G	11.16	237,120	7.2	1.20	2.50	22.5
H	14.75	122,890	5.6	2.30	5.25	17.2
I	16.04	101,530	5.5	4.00	7.25	17.0
J	21.21	64,780	1.6	7.00	16.50	15.1
K	24.49	60,520	4.9	8.00	17.00	18.5
L	29.18	60,310	5.8	10.00	18.50	15.0
M	33.14	59,030	3.3	12.50	21.50	15.1
N	38.00	58,610	4.8	14.00	23.00	16.5
O	45.71	58,320	6.3	16.50	25.00	18.7
P	50.18	58,180	3.7	18.50	26.00	21.1
Q	57.90	57,900	3.7	21.00	29.50	14.2
R	62.52	57,560	3.8	23.00	32.00	14.2
S	64.98	57,460	2.5	25.00	33.00	8.4

REDACTED

TABLE 3. WILLOW CREEK DAM BREACH ANALYSIS (cont.)

Based on 1993 DAMBRK Runs

CROSS SECTIONS OF PARTICULAR INTEREST

CROSS SECTION NUMBER	LOCATION
A	Just downstream from dam
B	Near Madison/Gallatin County line
C	Near dam operator's home
D	At opening of the canyon
E	Above Irish Slough diversion
F	Above Town of Willow Creek
G	At Town of Willow Creek
H	Between Town of Willow Creek and Three Forks
I	At Three Forks
J	At Headwaters State Park
K	At Trident
L	Opening of Missouri River valley below Trident
M	At Clarkston
N	Near Lombard
O	Below Toston Dam (Johnson house)
P	Near town of Toston
Q	Near Holker (just above Montana Ditch diversion)
R	At Townsend
S	Above Canyon Ferry Lake (game management area)

NOTES: Wave velocity and height figures reported are those in the channel, not the floodplain.

All figures reported are the result of a computer model used to model the actions of a breaching dam and the resultant flood. Therefore, real-life values may vary from those reported, and the numbers should be used only as best-guess approximations in planning for such a flood event.

References

CH2M Hill. June 1980. *Phase I Inspection Report, National Dam Safety Program, Willow Creek Dam, Madison County, Montana, MT-22.* Prepared for the State of Montana (DNRC) under the U.S. Army Corps of Engineers National Dam Safety Program.

Fread, D. L. 1984. *DAMBRK: The National Weather Service Dam Break Flood Forecasting Model.* Washington, D.C.: National Weather Service.

MacDonald, T. C. and J. Langridge-Monopolis. May 1984. "Breach Characteristics of Dam Failures." *Journal of Hydraulic Engineering* 110(5):567-86.

U.S. Department of the Interior, Bureau of Reclamation. 1973. *Design of Small Dams.* 2d ed. Denver, Colo.

APPENDIX C

INUNDATION MAPS

This section of the *Willow Creek Dam Emergency Plan* includes maps of the approximate areas that would be inundated by the flood resulting from the breach of Willow Creek Dam. The floodplain calculated for the CWB is shown with a dashed line on the inundation maps. Flooded areas for the PMFB are shown as solid lines on the inundation maps. It is important to understand that the maps were developed from a computer model that can produce only an approximation of the area that would be flooded by any breach situation. Officials should caution people neither to cross low-lying areas that may become flooded nor to return to areas that have been evacuated. The main flood wave would arrive with such speed and force that it likely would smash bridges and wash vehicles away.

FIGURE C-1

WILLOW CREEK DAM FLOOD INUNDATION MAPS

Cross Section	Distance from Dam (miles)	Peak Discharge (cfs)	Wave Velocity (fps)	Travel Time Initial (hrs)	Travel Time Peak (hrs)	Wave Height (ft)
PMFB						
CWB						

Flood Routing Cross Section

Probable Maximum Flood Breach (PMFB)

Clear Weather Breach (CWB)

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 FEET

C	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	4.37	360,830	11.4	0.35	0.50	31.6
CWB	4.37	183,480	9.1	0.63	1.25	31.5

B	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	2.64	369,650	18.7	0.18	0.25	60.1
CWB	2.64	213,120	18.8	0.38	0.64	54.6

A	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	0.56	393,290	25.2	0.04	0.05	60.6
CWB	0.56	218,190	24.8	0.13	0.22	55.5

DAM

WILLOW CREEK RESERVOIR

GALLATIN CO

MADISON CO

T.1S.

T.2S.

R.1W.

R.1E.

REDACTED

REDACTED

FIGURE C-2

WILLOW CREEK DAM FLOOD INUNDATION MAPS

Cross Section	Distance from Dam (miles)	Peak Discharge (cfs)	Wave Velocity (fps)	Travel Time		Wave Height (ft)
				Initial (hrs)	Peak (hrs)	
PMFB						
CWB						

Flood Routing Cross Section

Probable Maximum Flood Breach (PMFB)

Clear Weather Breach (CWB)

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

SCALE 1:24,000

C	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	4.37	360,830	11.4	0.35	0.50	31.6
CWB	4.37	183,480	9.1	0.63	1.25	31.5

F	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	9.36	300,230	11.7	0.90	1.50	23.4
CWB	9.36	135,500	8.1	1.89	2.64	19.9

E	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	7.13	327,820	14.3	0.65	1.00	31.1
CWB	7.13	155,680	11.2	1.14	1.89	22.4

D	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	6.15	366,470	14.3	0.55	0.75	33.9
CWB	6.15	158,720	11.1	0.90	1.64	24.1

GALLATIN CO

JEFFERSON CO

JEFFERSON

R.1W.

R.1E.

T.1N.

T.1S.

Willow Creek

Willow Creek

Willow Slough

REDACTED

REDACTED

FIGURE C-3

WILLOW CREEK DAM FLOOD INUNDATION MAPS

Cross Section	Distance from Dam (miles)	Peak Discharge (cfs)	Wave Velocity (fps)	Travel Time Initial (hrs)	Travel Time Peak (hrs)	Wave Height (ft)
PMFB						
CWB						

Flood Routing Cross Section

Probable Maximum Flood Breach (PMFB)

Clear Weather Breach (CWB)

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 FEET

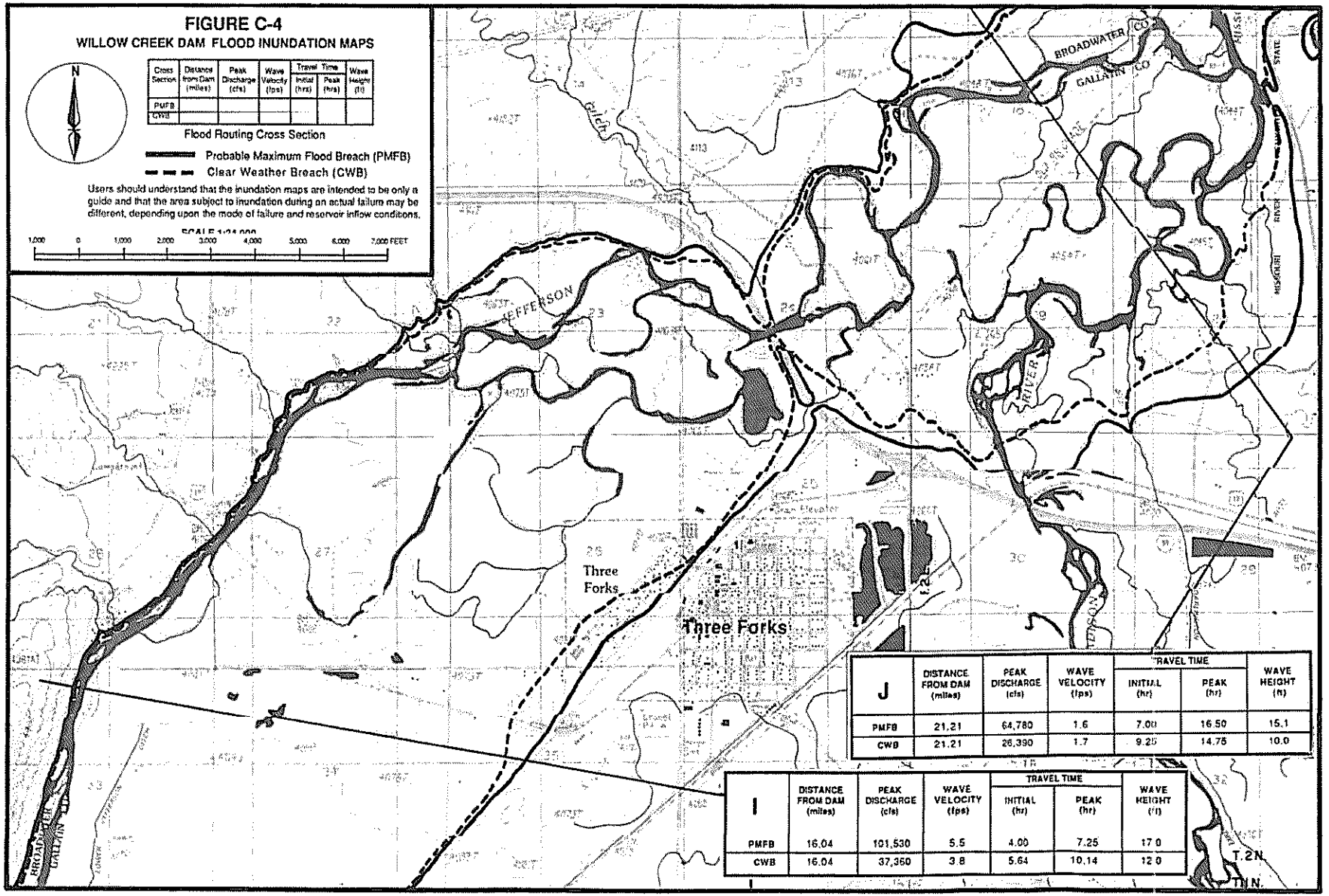
H	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	14.75	122,890	5.6	2.30	5.25	17.2
CWB	14.75	43,180	4.1	4.64	8.14	12.0

G	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	11.16	237,120	7.2	1.20	2.30	22.5
CWB	11.16	98,230	5.2	2.39	5.02	16.8

REDACTED

FIGURE C-4

WILLOW CREEK DAM FLOOD INUNDATION MAPS



J	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	21.21	64,780	1.6	7.00	16.50	15.1
CWB	21.21	26,390	1.7	9.25	14.75	10.0

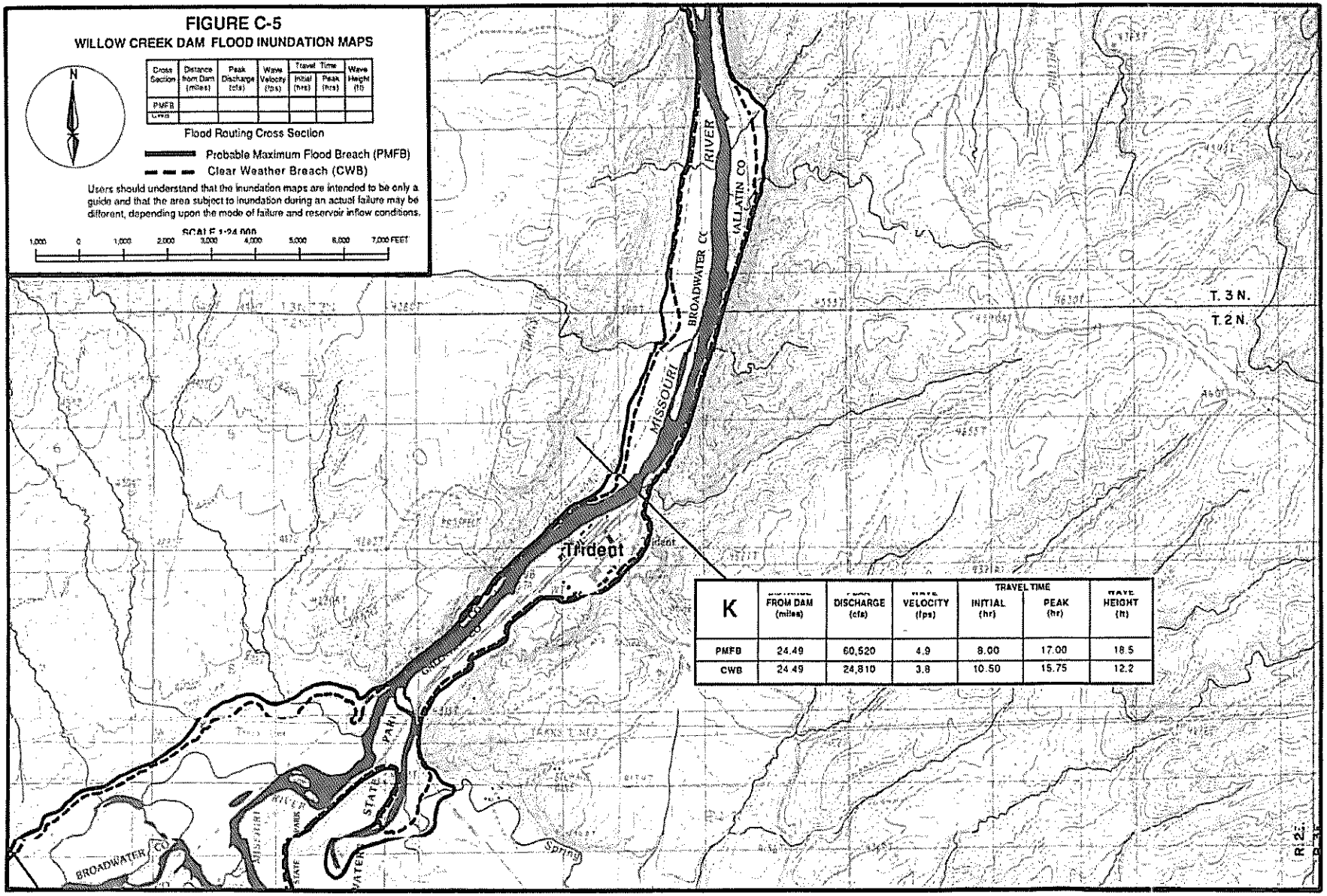
I	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	16.04	101,530	5.5	4.00	7.25	17.0
CWB	16.04	37,360	3.8	5.64	10.14	12.0

REDACTED

REDACTED

FIGURE C-5

WILLOW CREEK DAM FLOOD INUNDATION MAPS



K	FROM DAM (miles)	DISCHARGE (cfs)	VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	HEIGHT (ft)
PMFB	24.49	60,520	4.9	8.00	17.00	18.5
CWB	24.49	24,810	3.8	10.50	15.75	12.2

REDACTED

REDACTED

FIGURE C-6
WILLOW CREEK DAM FLOOD INUNDATION MAPS

Cross Section	Distance from Dam (miles)	Peak Discharge (cfs)	Wave Velocity (fps)	Travel Time Initial (hrs)	Travel Time Peak (hrs)	Wave Height (ft)
PMFB						
CWB						

Flood Routing Cross Section

Probable Maximum Flood Breach (PMFB)

Clear Weather Breach (CWB)

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 FEET

M	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	33.14	59,030	3.3	12.50	21.50	15.1
CWB	33.14	23,820	2.5	15.00	19.75	9.9

L	DISTANCE (miles)	PEAK (cfs)	WAVE (fps)	TRAVEL TIME (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	29.18	50,310	5.8	10.00	18.50	15.0
CWB	29.18	24,580	3.9	12.50	17.00	11.0

Clarkston

MISSOURI

GALLATIN C. BROADWATER CO.

Davis Gulch

Ellis

R2E-T2N

R3E-T2N

REDACTED

FIGURE C-7

WILLOW CREEK DAM FLOOD INUNDATION MAPS

Cross Section	Distance from Dam (miles)	Peak Discharge (cfs)	Wave Velocity (fps)	Travel Time Initial (hrs)	Travel Time Peak (hrs)	Wave Height (ft)
PMFB CWB						

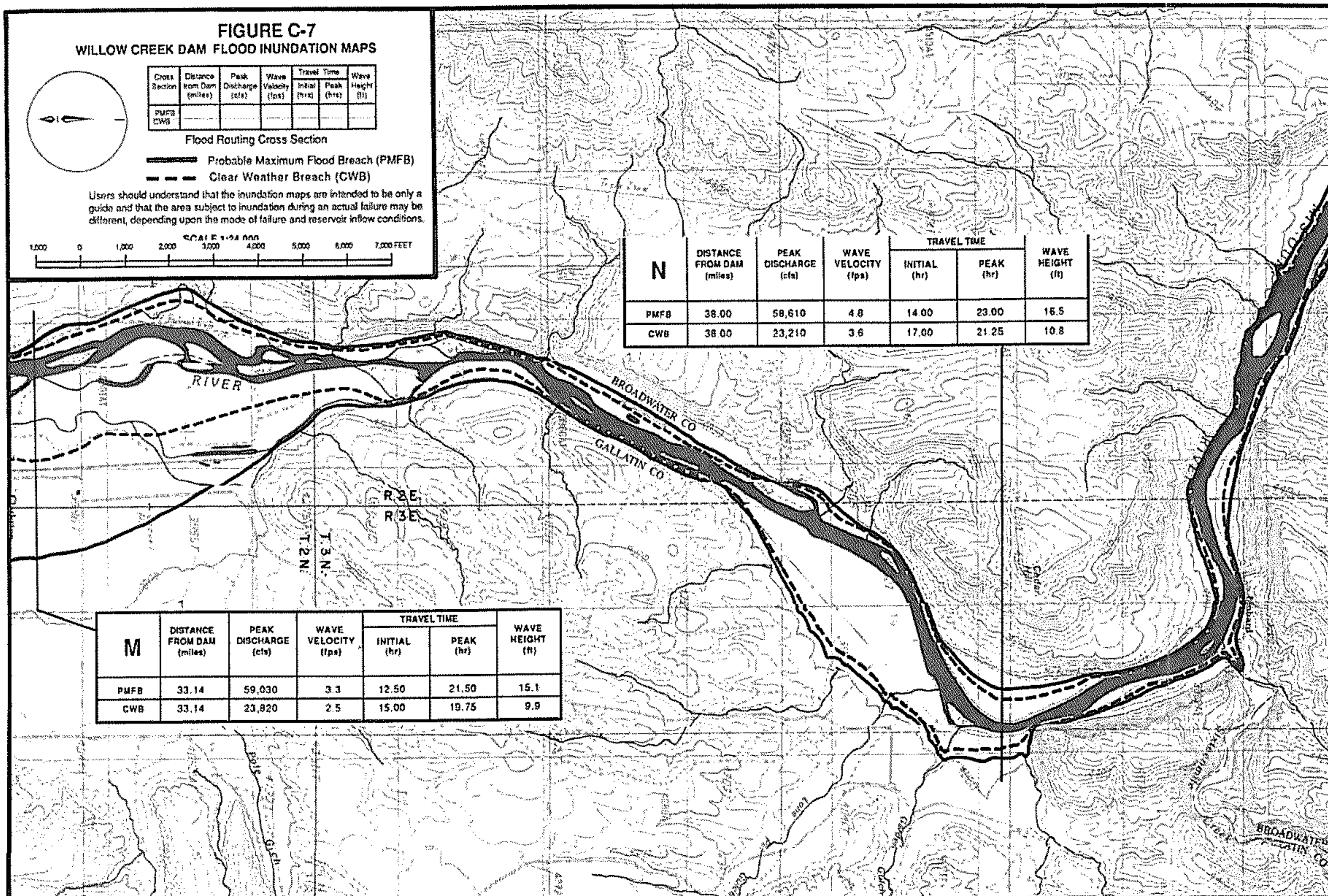
Flood Routing Cross Section

Probable Maximum Flood Breach (PMFB)

Clear Weather Breach (CWB)

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

SCALE 1:24,000

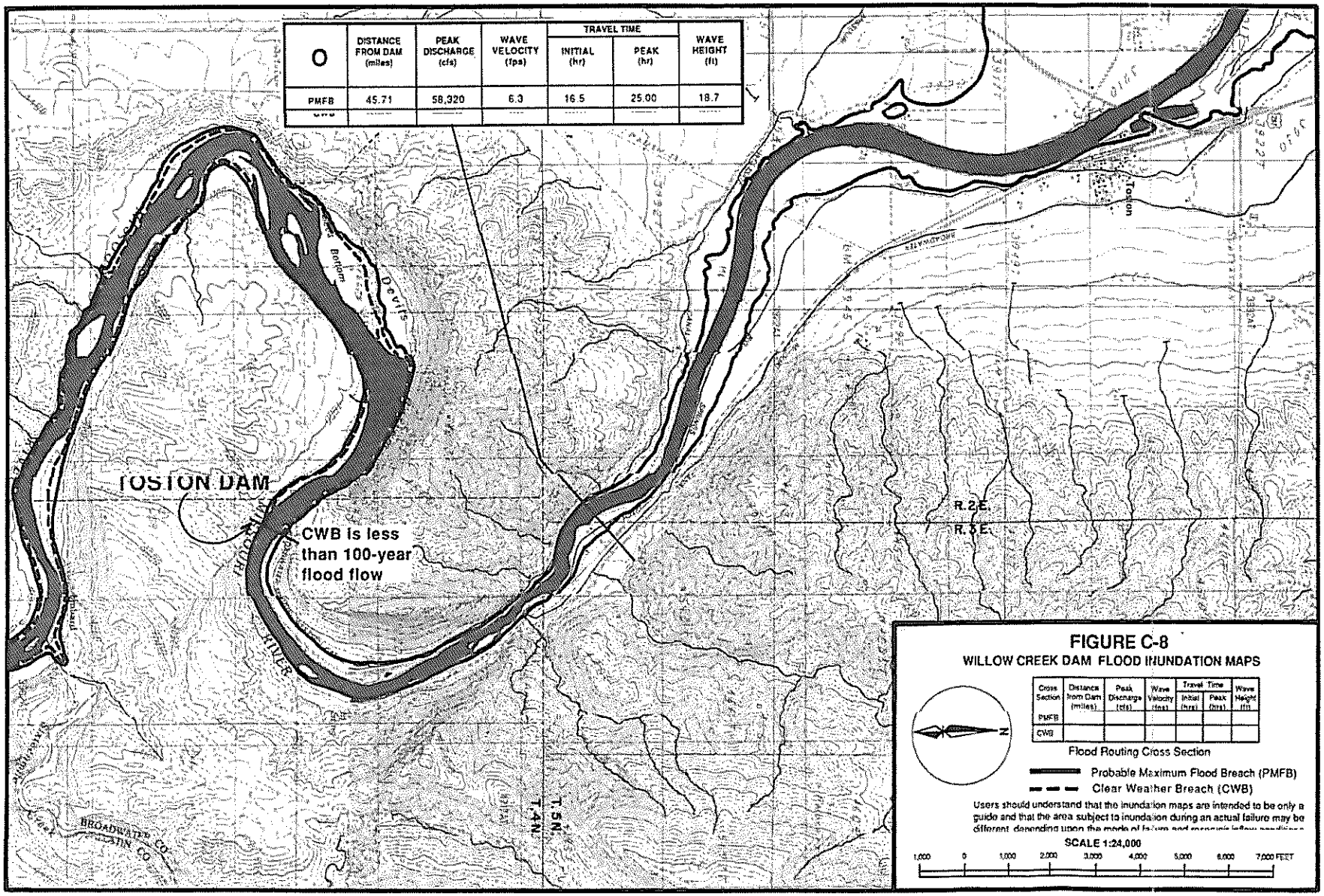


N	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	38.00	58,610	4.8	14.00	23.00	16.5
CWB	38.00	23,210	3.6	17.00	21.25	10.8

M	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	33.14	59,030	3.3	12.50	21.50	15.1
CWB	33.14	23,820	2.5	15.00	19.75	9.9

REDACTED

REDACTED

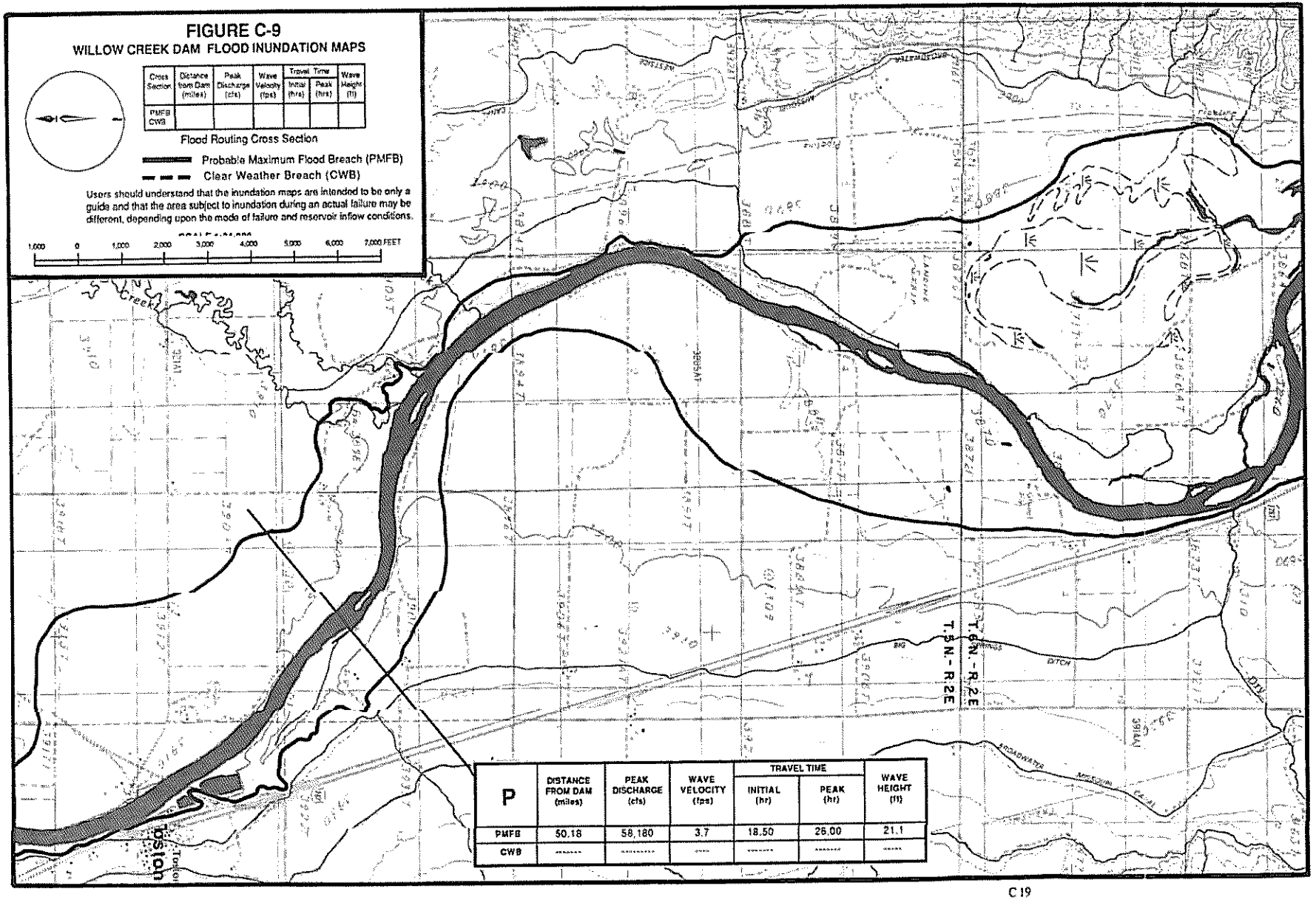

0
DISTANCE FROM DAM (miles)
PEAK DISCHARGE (cfs)
WAVE VELOCITY (fps)
TRAVEL TIME
INITIAL (hr)
PEAK (hr)
WAVE HEIGHT (ft)
PMFB
45.71
58,320
6.3
16.5
25.00
18.7
TOSTON DAM
CWB is less than 100-year flood flow
Devils Bottom
Toston
R.2E.
R.3E.
T.5N.
T.4N.
BROADWATER CO.
JEFFERSON CO.
FIGURE C-8
WILLOW CREEK DAM FLOOD INUNDATION MAPS
Cross Section
Distance from Dam (miles)
Peak Discharge (cfs)
Wave Velocity (fps)
Travel Time
Initial (hrs)
Peak (hrs)
Wave Height (ft)
PMFB
CWB
Flood Routing Cross Section
Probable Maximum Flood Breach (PMFB)
Clear Weather Breach (CWB)
Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be
SCALE 1:24,000
1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 FEET

REDACTED

REDACTED

FIGURE C-9

WILLOW CREEK DAM FLOOD INUNDATION MAPS



P	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	50.18	58,180	3.7	18.50	26.00	21.1
CWB	-------	----------	----	-------	-------	-----

REDACTED

REDACTED

FIGURE C-10
WILLOW CREEK DAM FLOOD INUNDATION MAPS

Cross Section	Distance from Dam (miles)	Peak Discharge (cfs)	Wave Velocity (fps)	Travel Time Initial (hrs)	Travel Time Peak (hrs)	Wave Height (ft)
PMFB						
CWB						

Flood Routing Cross Section

Probable Maximum Flood Breach (PMFB)

Clear Weather Breach (CWB)

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 FEET

R.1E.
R.2E.
T.7N.
T6N.
MISSOURI
RIVER
Deep Creek
Townsend

R	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	52.52	57,560	3.6	23.00	32.00	14.2
CWB	-------	-------	---	-------	-------	------

Q	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME INITIAL (hr)	TRAVEL TIME PEAK (hr)	WAVE HEIGHT (ft)
PMFB	52.00	57,000	3.7	21.00	30.50	14.2
CWB	-------	-------	---	-------	-------	------

REDACTED

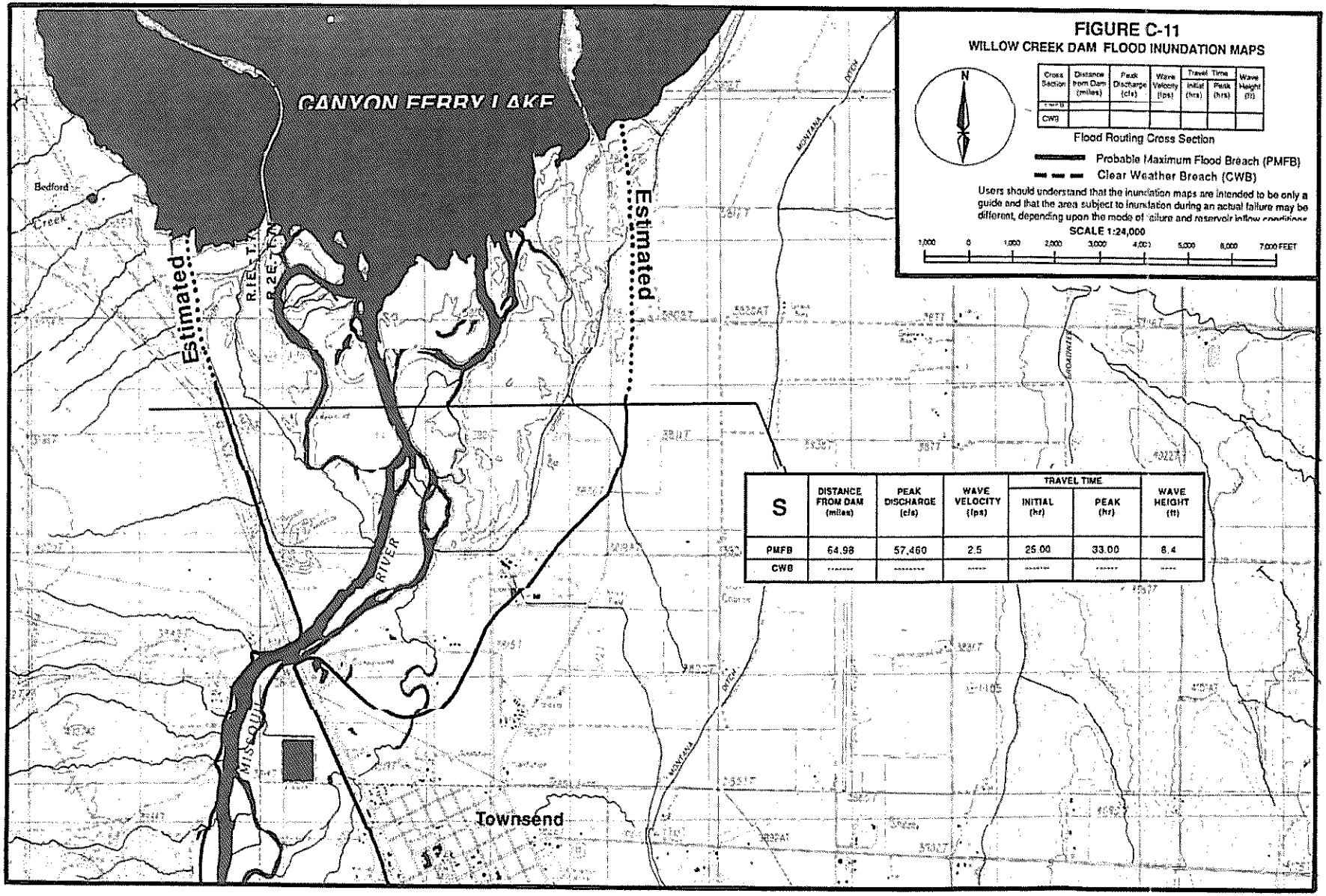


FIGURE C-11
WILLOW CREEK DAM FLOOD INUNDATION MAPS

Users should understand that the inundation maps are intended to be only a guide and that the area subject to inundation during an actual failure may be different, depending upon the mode of failure and reservoir inflow conditions.

S	DISTANCE FROM DAM (miles)	PEAK DISCHARGE (cfs)	WAVE VELOCITY (fps)	TRAVEL TIME		WAVE HEIGHT (ft)
				INITIAL (hr)	PEAK (hr)	
PMFB	64.98	57,460	2.5	25.00	33.00	8.4
CWB	------	------	-----	------	------	----

REDACTED

REDACTED

APPENDIX D

TRAINING

DNRC, in cooperation with the local Disaster and Emergency Services coordinator, will conduct a training session upon request. The training session will be held to instruct the dam operator, state and local DES personnel, the Gallatin, Madison, Jefferson and Broadwater County sheriffs and their deputies, and the local officials in what to look for and whom to call in case of an emergency.

APPENDIX E

PLAN DOCUMENTATION

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

GALLATIN COUNTY SHERIFF'S DEPARTMENT

_____

Signature Date

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

GALLATIN COUNTY DISASTER AND EMERGENCY SERVICES

_____

Signature Date

REDACTED

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

MADISON COUNTY SHERIFF'S DEPARTMENT

Signature _____ Date 4/9/07

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

MADISON COUNTY DISASTER AND EMERGENCY SERVICES

Signature _____ Date 4-9-07

REDACTED

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

BROADWATER COUNTY SHERIFF'S DEPARTMENT

_____

Signature Date

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

BROADWATER COUNTY DISASTER AND EMERGENCY SERVICES

_____

Signature Date

REDACTED

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

JEFFERSON COUNTY SHERIFF'S DEPARTMENT

[redacted] 4-12-07

Signature Date

ACKNOWLEDGMENT

By my signature, I acknowledge that I, or my representative, have reviewed the *Willow Creek Dam Emergency Plan* and agree that it provides sufficient information to accomplish the tasks and responsibilities of my department and/or agency.

JEFFERSON COUNTY DISASTER AND EMERGENCY SERVICES

[redacted] 4-12-07

Signature Date

REDACTED

APPENDIX F

PROJECT AREA MAPS

Figure 1. Willow Creek Dam Location Map

REDACTED

Figure 2. Willow Creek Project

Figure 3. Willow Creek Dam Access Routes

REDACTED

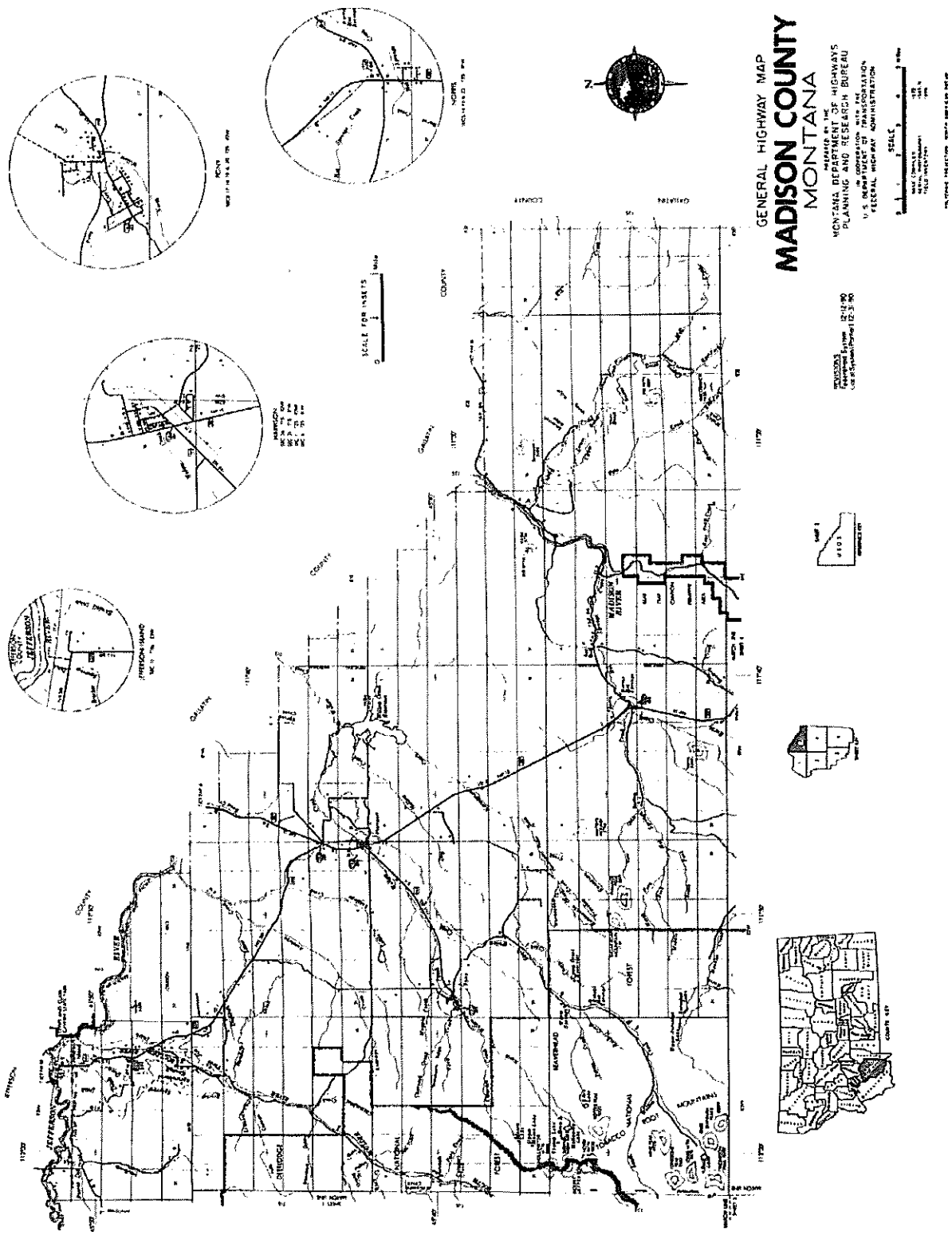


Figure 4. Willow Creek Dam Access Routes

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APPENDIX G

DAM SAFETY PROBLEMS

CONTENTS

DAM SAFETY PROBLEMS

PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
1. SEEPAGE a. Water. Uncontrolled leak without the removal of fines.	Not serious. Rate of flow not increasing.	Place a preliminary ring of sandbags around the area, and leave a free opening at the top toward the natural drainage.	Size and location of seepage area or areas and approximate flow rate. NOTIFY State Water Projects Bureau, DNRC.	
	Could lead to failure.	Same as above.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	
b. Boils. Soil particles deposited around water exit forming a cone. (Boils can vary from several inches in diameter, spaced 2 to 3 feet apart, to isolated boils several feet in diameter).	Not serious. Emerging water in developed cone is clear, and rate of flow is not increasing.	None required.	Size and location of boils or boils and approximate rate of flow. NOTIFY as above.	Artesian condition—water level in the embankment or foundation existing at a higher elevation than the ground surface. Boil most likely at downstream toe of main embankment.
	Could lead to failure.	Temporarily control the seepage by ringing the area with a sandbag dike. The dike should be constructed to sufficient height to provide enough back pressure on the area to prevent loss of material at the surface. A low place must be left in the dike for a spillway, on the side toward natural drainage. Where possible, pump relief wells nearest boil or boils. If boils become so large that it is not practical to dike around them, place an inverted filter over the area. (Inverted filter—3- to 5-ft. thick blanket of material graded from course sand and pea gravel at the bottom to 3-inch at the top.)	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	

DAM SAFETY PROBLEMS

PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
b. Boils. (con'd.)	Failure imminent. If emerging water is muddy, the rate of flow is increasing, and there is an upstream swirl (whirlpool) caused by water entering at the abutments or through the embankments.	Handle "boils" as described above. For the "whirlpool" area or areas, an attempt should be made to plug the entrance with large rock or anything else that is available. Use riprap from the face of the dam, or any large rock. Also consider placing old cars, construction equipment, etc., in the hole if nothing else is available or is working. If the large material placed in the hole appears to have reduced the flow, follow with progressively smaller material (see below).	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	
c. Piping (internal erosion). Uncontrolled with the removal of fines from foundation or embankment (muddy water).	Could lead to failure.	Control using an "inverted filter" (3- to 5-ft. thick blanket of material graded from course sand and pea gravel at the bottom to 3-inch at the top).	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	Caused by internal erosion. Piping most likely at downstream toe of main embankment.
	Failure imminent. If, along with piping, there is an upstream swirl (whirlpool) caused by water entering at the abutments or through the embankments.	Control piping using an "inverted filter" (see above). For whirlpool area or areas, an attempt should be made to plug the entrance with large rock or anything else that is available. Use riprap from the face of the dam, or any large rock. Also consider placing old cars, construction equipment, etc., in the hole if nothing else is available or is working. If the large material placed in the hole appears to have reduced the flow, follow with progressively smaller material.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau	
2. SINK HOLES/CAVE IN Depressions on crest, either embankment slope, abutments, or nearby areas, upstream or downstream.	Could lead to failure.	Coordinate with State Water Projects Bureau. Search abutments and downstream area for seepage, sink holes, or boils.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	Piping, in either the embankment or foundation, has eroded a cavity, causing the earth material above the collapse.

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DAM SAFETY PROBLEMS

	PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
2.	SINK HOLES/CAVE IN (continued.)	Failure imminent. If the sink hole is very large or rapidly enlarging and accompanied by muddy discharge or whirlpool.	Coordinate with State Water Projects Bureau.	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	
3.	RESERVOIR WHIRLPOOLS	Failure imminent.	Search abutments and downstream area for seepage, sink holes, or boils; there has to be discharge of water somewhere downstream.	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	Piping (internal erosion) has eroded a substantial cavity through which a large volume of water is escaping through either embankment or foundation.
4.	SLIDES	Not serious. If slide does not pass through the crest and does not extend into the embankment more than 5 feet (measured perpendicular to slope).	Coordinate any necessary repair work with State Water Projects Bureau.	Location; time first noticed; whether any movement can be visually detected; pool elevation. NOTIFY State Water Projects Bureau.	Check for small slides in the abutments.
		Could lead to failure. If slide passes through the crest, and the water surface is more than 10 feet below the lowered crest.	Coordinate with State Water Projects Bureau for proper remedial action.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	
		Failure imminent. If slide passes through the crest, and the water surface is at or near (less than 10 feet below) the top of the lowered crest.	Use every means possible to armor the crest and to restore lost freeboard. (Adjacent in-place riprap, stockpiled riprap, or sandbagging).	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	
5.	CRACKS a. Embankment cracking. Openings in the embankment or at embankment / structure contact that are parallel, across, or at a diagonal to the dam axis.	Not serious. If crack does not extend completely through the dam structure and pool water is more than 10 feet below the base of the crack.	Excavate test pit or test trench to determine full extent of crack. Coordinate final repair work with State Water Projects Bureau.	Location, width, length, and pattern (horizontal, vertical, or in some intermediate direction). NOTIFY State Water Projects Bureau.	

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DAM SAFETY PROBLEMS

PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
5. CRACKS a. Embankment cracking. (continued)	Could cause failure. If crack extends completely through the dam or structure, and reservoir water is at or near (less than 10 feet below) the base of the crack.	Coordinate with State Water Projects Bureau. Trenching and backfilling will be required after the extent of the crack is determined.	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	
	Failure imminent. If crack extends completely through the dam or structure, and water is entering the crack and emerging on the downstream side.	Plug the crack to the extent possible using spalls and gravel before adding bentonite or other impervious material. This procedure will help prevent the washing out of the filler materials through the crack. The work should be started nearest the water surface on the upstream side.	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	
b. Concrete structure cracking. Expanded openings at conduit joints or intermediate cracks within outlet works or power tunnels; could also be accompanied by mechanical failures such as misalignment of gates.	Not serious. If joints and cracks show no sign of continued expansion or if clear water carried is not increasing in flow rate; operation of mechanical features unrestricted.	Coordinate any necessary repair work with State Water Projects Bureau.	Location, width, length, and pattern of cracks; quantity of seepage; extent of damage, misalignment, etc., of mechanical features. NOTIFY State Water Projects Bureau.	
	Could cause failure. If joints and cracks show signs of gross expansion and / or seepage is carrying fines; operation of mechanical features becomes structurally limited.	Oakum, rags, fibrous material of any description should be placed in small areas as a temporary measure to reduce seepage. State Water Projects Bureau should direct any temporary measure to reestablish operation of mechanical features.	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	
	Failure imminent. Physical motion of concrete or seepage surges to uncontrolled quantities observed; mechanical functions totally lost during precarious circumstances.	Do not reenter structures. Should conditions such as those described under 1.c. Piping visibly emerge on the embankment, handle as indicated.	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	

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DAM SAFETY PROBLEMS

PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
6. FAILURE OF RIPRAP OR OTHER SLOPE PROTECTION	Not serious. If erosion is minor, and pool is at a low level.	Repair work to be coordinated with State Water Projects Bureau.	Elevation of damage; length of damage, in feet; pool elevation when damage occurred. NOTIFY State Water Projects Bureau.	
	Could lead to failure. If riprap damage is severe at low or high pool levels.	Repair using stockpiled riprap. Riprap may be dumped directly into the erosion scarp. The smaller stones will tend to settle to the lower portion of the stone mass, essentially creating a protective filter over the embankment soil. The readjustment of stones in this method requires that the dumped stone section be constructed thicker than the original riprap section. Use of in-place riprap. If stockpiled riprap is used up, and if the pool level is not expected to rise, in-place riprap from higher slope elevations may be used in an emergency. Temporary repair using sand-bags. If stockpiled riprap is depleted, sandbags may be placed in the scarped area. Each bag should be filled with sand and tied. Placement should be by hand, sling, or other methods that would prevent tearing of the bags. Bags filled with clay and silts should be used only if sand is not readily available and other methods of repair cannot be implemented.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	

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DAM SAFETY PROBLEMS

	PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
7.	EROSION FROM RUNOFF	Not serious. If surface runoff does not enter existing cracks or is not concentrated at abutments.	None required.	Location of erosion and approximate depth of gully. NOTIFY State Water Projects Bureau.	
		Could lead to failure. If surface runoff enters existing cracks during high pool levels or is concentrated at the abutments.	Coordinate necessary repair work with State Water Projects Bureau.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	
8.	BURROW HOLES	Not serious. If holes do not penetrate completely through the embankment.	Backfill as deeply as possible with impervious material. If the dam becomes infested with burrowing animals, trapping or poisoning will be necessary.	Location and total number, if above or below water, and approximate depths, NOTIFY State Water Projects.	If holes penetrate through embankment, problem should be considered serious. Embankment should be checked frequently.
9.	GATE FAILURE a. Control gate.	Not serious. Additional gate shutdown available.	Lower emergency gate. Check for superstructure deformations (see paragraph 10).	Report data as directed. NOTIFY State Water Projects Bureau.	Mechanical malfunctioning.
	b. Control gate & emergency gate.	Could lead to failure. Additional gate shutdown available. However, consider problem serious if superstructure deformation is noted (see paragraph 10).	Check throughout outlet works for structural deformation. Check all dam safety problems.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	Substructural deformations due to settlement, slides, or earth tremors.
		Failure Imminent. No additional gate shutdown available. Consider problem extremely serious if superstructure deformation is noted (see paragraph 10). A rapid piping condition could exit.	Immediate downstream notification should begin. Check all dam safety problems, especially slides and seepage in the area of the abutments.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	Same as above.
10.	STRUCTURAL DEFORMATIONS a. Control tower. Settlement, tilt, etc.	Not serious. Minor movement noted with instrumentation or other stationary guide reference.	Observe at more frequent intervals to determine if motion is progressing.	NOTIFY State Water Projects Bureau.	Superstructure deformation as well as Substructural motion possible.

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DAM SAFETY PROBLEMS

PROBLEM	HOW TO EVALUATE PROBLEM	EMERGENCY ACTION	DATA TO BE REPORTED AND NOTIFICATION	PROBLEM CAUSE/REMARKS
10. STRUCTURAL DEFORMATIONS (continued) b. Spillway motion.	Could lead to failure. If misalignments result in gate failure (paragraph 9b), extreme subsurface motion could lead to additional problems of piping etc., along the conduit exterior.	Check all dam safety problems in vicinity of abutments. Begin lowering pool.	IMMEDIATELY NOTIFY County Sheriff and State Water Projects Bureau.	Substructural motion.
	Serious. At elevated reservoir states and spillway structure at imminent failure.	Begin emergency notification	IMMEDIATELY NOTIFY County Sheriff, local DES, and State Water Projects Bureau.	

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APPENDIX H

EAP DISTRIBUTION LIST

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WILLOW CREEK DAM

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