EMERGENCY ACTION PLAN
FOR

TRAILHEAD
DETENTION BASIN
BOULDER CITY, NEVADA

PREPARED FOR

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT
600 S. Grand Central Parkway, Suite 300
Las Vegas, Nevada
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AND

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DISTRIBUTION LIST

This Emergency Action Plan and its updates have been distributed to the following Agencies and parties:

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		Maintenance Management Manager	2	
	Fire Department	Administration	7	8
		Alternate	1	
	School District	Superintendent	1	3
		School Security Division	1	
		Facilities And Transportation Director	1	
	Emergency Management	Emergency Management Coordinator	3	3
	Regional Flood Control District	General Manager	1	9
		Assistant General Manager	1	
		Hydrologist	7	
	Health District	Director	1	1
	Las Vegas Metropolitan Police	Southeast Area Commander	1	4
		Emergency Management Coordinator	1	
		Communications Supervisor	1	
		Public Information Officer	1	
Boulder City Agencies	Department of Public Works	City Engineer: Scott Hansen, P.E.	2	2
	Fire Department	Fire Chief: Dean Molburg	1	1
	Police Department	Police Chief: David Mullin	1	1
State Agencies	Nevada Highway Patrol	Commercial Enforcement Commander- Region 1	2	2
	Nevada Department of Transportation	District Engineer	1	1
	State Engineer's Office	State Engineer	2	2
Federal Agencies	National Weather Service	Meteorologist-In-Charge	1	1
	National Park Service	District Manager	1	1
Consultant	Harding Lawson Associates	Office Manager	1	1
		Total Copies:	45	45

RECORD OF CHANGES

The following table is a record of all changes made to this Emergency Action Plan since its last complete revision. As described in the General Information Section of this Emergency Action Plan, the Clark County Emergency Management Coordinator is responsible for updating and distributing this document.

RECORD OF CHANGES

DATE	SECTION	CHANGE, ADDITION, DELETION	BY

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EMERGENCY ACTION PLANS
Clark County Regional Flood Control District

BLM	Bureau of Land Management
CCFD	Clark County Fire Department
CCPW	Clark County Public Works
CCRFCD	Clark County Regional Flood Control District
CCSanD	Clark County Sanitation District
CCSD	Clark County School District
CEMP	Comprehensive Emergency Management Plan
CEO	Coordinator of Emergency Operations
CEOP	Comprehensive Emergency Operations Plan
COHEMC	City of Henderson Emergency Management Coordinator
COHFD	City of Henderson Fire Department
COHPD	City of Henderson Police Department
COHPW	City of Henderson Public Works
EAP	Emergency Action Plan
EMC	Emergency Management Coordinator
EOC	Emergency Operations Center
LVFD	City of Las Vegas Fire Department
LVPW	City of Las Vegas Public Works
LVVWD	Las Vegas Valley Water District
MDB&M	Mount Diablo Base & Meridian
Metro	City of Las Vegas Metropolitan Police Department
NDOT	Nevada Department of Transportation
NHP	Nevada Highway Patrol
NLVEMD	City of North Las Vegas Emergency Management Director
NLVPD	City of North Las Vegas Police Department
NLVPW	City of North Las Vegas Public Works
NWS	National Weather Service
PMF	Probable Maximum Flood
SNWA	Southern Nevada Water Authority

Trailhead Detention Basin

1.0 GENERAL INFORMATION

This section describes the purpose, organization, planning considerations, supporting assumptions, and updating process formulated in development of this Emergency Action Plan.

1.1 Purpose and Organization of the Emergency Action Plan

This Detention Basin Emergency Action Plan (EAP) presents plans for emergency action required to protect public health and welfare within areas subject to flooding from rare hydrologic events resulting in emergency spillway discharge or embankment failure at the Trailhead Detention Basin in Clark County, Nevada. The Trailhead Detention Basin is a component of the Clark County Flood Control Master Plan, compiled by the Clark County Regional Flood Control District (CCRFCD). This EAP follows the format and content guidelines presented by the U.S. Department of the Interior, Bureau of Land Management (BLM), and is intended to serve as an appendix to and supplement agency responsibilities and actions set forth in the Comprehensive Emergency Management Plan (CEMP) of Boulder City. The CEMP describes the advanced preparations which Boulder City has made for managing major emergencies and the procedures for keeping the preparations up-to-date and effective.

This plan was developed in cooperation with the following local, state and federal agencies.

- Clark County Regional Flood Control District
- Clark County Department of Public Works
- Boulder City Public Works Department
- Boulder City Department of Fire Services
- Las Vegas Metropolitan Police Department
- U.S. Department of the Interior, Bureau of Land Management
- National Weather Service
- Boulder City Police Department

The existence of this EAP does not imply or indicate that a lack of safety or structural integrity exists at the storm water detention basin. The plan is intended to be a proactive measure to support emergency actions which may become necessary at or downstream of the detention basin only under a rare set of circumstances which could cause downstream flooding.

Following this General Information section, the remainder of this document is divided into the following parts:

- **Emergency Identification Subplan:** defines emergency situations that may develop at the detention basin and require immediate action and notification of local officials in charge of emergency operations and evacuation.

- **Emergency Operations and Repair Subplan:** describes the possible actions which might be necessary when an emergency occurs to repair the basin and/or reduce the severity of the emergency.

- **Notification Subplan:** identifies the agencies to be notified in the event of an impending or existing emergency at the detention basin and the individuals responsible for making the notifications.

- **Evacuation Subplan:** describes potential evacuation areas for spillway or dam break storm-water discharge from the detention basin, and general information necessary to aid in conducting evacuation operations.

- **Recovery Subplan:** outlines key considerations in planning and performing recovery operations during and immediately following a detention basin emergency condition.

- **Glossary:** provides definitions of terminology used throughout the plan.

- **Tables, Maps, Appendices:** presents specific information regarding the location and design of the detention basins, maps showing the location and probable extent of inundation and flood wave travel time for conditions of emergency spillway discharge and detention basin embankment failure, criteria used to develop this EAP, and agencies and individuals to be contacted in the event of an impending or existing emergency condition, along with their pertinent telephone numbers.

1.2 Physical Setting

The following subsections describe the physical setting and condition of the upstream watershed, the downstream floodplain and the detention basin area.

1.2.1 Upstream Watershed

Inflow into the Trailhead Detention Basin comes from the Trailhead Basin Channel. The detention basin detains stormwater from approximately 0.71 square mile drainage area. Land use coverage in the watershed 100% undeveloped lands.

1.2.2 Description of the Detention Basin

The detention basin configuration is depicted on Figure 8 in the Appendix of this EAP. The Trailhead Detention Basin System is designed as an above ground, homogeneous earthen embankment with a concrete pipe principal outlet and two reinforced concrete emergency spillways. As shown in Figure 1, the Detention Basin is located in Boulder City. The basin lies in Sections 4 and 5, Township 23 South, Range 64 East of the Mount Diablo Base and Meridian (MDB&M). This basin is situated on land owned by the city of Boulder City.

The basin is accessed via US Highway 93. From the intersection of Highway 93 and Lake Mountain Drive, travel north on Lake Mountain Drive approximately ¼ mile to Valencia Drive. Travel west on Valencia Drive approximately ½ mile. The main entrance to the basin is at the intersection of Valencia Drive and Malaga Drive.

The embankment and hydraulic works for this basin have been conservatively designed to store up to a 6-hour duration, 100-year frequency design storm runoff event, allowing larger flood events, having peak discharges up to the probable maximum flood (PMF) event to pass through the emergency spillway without overtopping the embankment.

The basin, including its embankment, outlet works and emergency spillways, is inspected and maintained periodically by the Boulder City Department of Public Works. During site visits conducted while developing this plan (2000), the embankment and its hydraulic works appeared to be relatively new (less than ten years old), and appeared to be constructed according to plan and current engineering design standards.

As shown in Figures 8 and 9, and summarized in Table 1.1, the basin has an overall depth of approximately 8.5 feet measured from the crest of the emergency spillway to the floor of the basin. The maximum embankment height above natural ground surface is approximately 12 feet. The basin is designed to store approximately 28 acre-feet of water captured during the 100-year, 6-hour duration flood event.

The detention basin system is designed to reduce the design storm peak (100-year, 6-hour duration) flows downstream from 624 to 155 cubic feet per second (cfs). The principal outlet pipeline is designed to slowly discharge captured storm water into the Hemenway Channel over a period of up to 7 hours. The emergency spillways are designed to safely pass design flood water peak discharges through the detention basin and out over the emergency spillways in the event the detention basin is full. The emergency spillways are designed with sufficient capacity to pass the flow resulting from the PMF event without overtopping the sidewalls.

The principal outlet consists of a 36" reinforced concrete pipe with trash rack protection, which discharges into the Hemenway Channel. The channel is concrete lined. The principal outlet has a capacity of approximately 155 cfs at full basin stage elevation. The length of the principal outlet is 215 feet with an invert elevation of 2424.0 feet above mean sea level (MSL).

The emergency spillway is divided between two locations. The southern concrete spillway is located upstream of the Hemenway Channel, is 90' long, and has a spillway crest of 2437.21. The eastern concrete spillway is located upstream of Valencia Drive, is 130' long, and has a spillway crest of 2437.21. The combined maximum capacity is 1,965 cfs, with 3.0 feet of freeboard.

1.2.3 Description of the Downstream Area

Flood flows discharging the Trailhead Detention Basin will generally flow two directions: east down Valencia Drive and southeast, downhill, through the Hemenway Channel. Flood flows eventually flow in an easterly direction, to the Lake Mead National Recreation Area.

Land uses within the projected floodplain include residential development and the recreation area, which consists of a campground and a boat launch. A number of public buildings and facilities, shown on Figures 5 and 6, are located within potential inundation areas downstream of the detention basin. Tables A-1 and A-2 in the Appendix lists the names and addresses of the facilities known to be located within the probable floodplain area.

Table 1.1
Location and Design Information Summary

NAME AND LOCATION INFORMATION		
Name of Detention Basin: TRAILHEAD DETENTION BASIN		
City: Boulder City	**County:** Clark	**State:** Nevada
BLM District, Resource Area: Las Vegas District, Stateline Resource Area		
Basin Location and Access Route: Sections 4 and 5, Township 23 S, Range 64 E of the MDB&M. From the intersection of Highway 93 and Lake Mountain Drive, travel north on Lake Mountain Drive approximately ¼ mile to Valencia Drive. Travel west on Valencia Drive approximately ½ mile. The main entrance to the basin is at the intersection of Valencia Drive and Malaga Drive.		
WATERSHED INFORMATION		
Watershed Names: Unnamed		
Drainage Area: 0.71 sq. mi.	**Design Inflow:** 624 cfs (100-yr, 6-hr storm)	
STRUCTURE DESCRIPTION		
Max. Water Depth (Emergency Spillway to Basin Floor): 8.5 feet	**Maximum Embankment Height:** 12 feet	**Embankment Type:** Homogeneous earthfill
Maximum (Normal) Storage Water Level: 2,437.4 feet MSL	**Normal Storage Pool Surface Area:** 4.5 acres	**Max Normal Storage Volume:** 28 acre-feet
Maximum Storage Drain Time: 7 hours	See Tables in the appendix for Storage Depth vs. Discharge, Drainage Time, and other information.	
EMERGENCY SPILLWAY DESIGN		
Maximum Capacity: 1965 cfs	**Maximum Design Flow Depth:** 3.5 feet	**Spillway Type:** Reinforced Concrete
Spillway Lip Elevation: 2,437.21 feet above MSL	**Maximum Design Flow Elevation:** 2,437.4 above MSL	
PRINCIPAL OUTLET DESIGN		
Design Capacity: 155 cfs at maximum elevation (100-yr, 6-hour storm	**Structure Type:** Reinf. Concrete Pipe	**Size:** 36" RCP
Outlet Invert Elevation: 2,424.0 feet	**Outlet Length (to channel) :** 215 feet	

1.3 Agency Responsibilities

The departments and agencies indicated in Table 1.2 are designated in the Clark County CEOP and the Boulder City Comprehensive Emergency Management Plan as having Primary (P) and Secondary (S) responsibilities during emergency conditions:

Table 1.2
Summary of Emergency Action Responsibilities

AGENCY OR DEPARTMENT	DAM FAILURE, FLOODING	EVACUATION	EOC OPERATION	RECOVERY
CLARK COUNTY				
PUBLIC WORKS	S	S	S	P
REGIONAL FLOOD CONTROL DISTRICT	S	S	S	S
COUNTY MANAGER	S	S	P	P
EMERGENCY MGMT	S	S	S	P
SOCIAL SERVICE	S	S	S	S
SCHOOL DISTRICT	S	S	S	S
FIRE DEPARTMENT	S	S	P	S
BOULDER CITY				
CITY ATTORNEY		S	S	
CITY MANAGER	S	S	S	
FIRE SERVICE	P	P	P	P
POLICE DEPARTMENT	P	P	P	P
PUBLIC WORKS	P	S	P	P

The following agencies may have responsibilities for emergency action or may have additional resources which can be employed during emergency operations. These agencies should be notified as specified in the Clark County CEOP, the Boulder City CEMP and this EAP during a detention basin emergency condition.

- Clark County Regional Flood Control District
- National Weather Service
- Bureau of Land Management
- American Red Cross
- Nevada Highway Patrol
- Nevada Department of Transportation
- Clark County Health District
- Clark County Emergency Management Coordinator
- Clark County School District
- Clark County Regional Transportation Commission
- Boulder City Department of Public Works
- Boulder City Fire Department
- Boulder City Police Department
- Boulder City Emergency Management
- Nevada Power Company
- Southwest Gas Corporation
- Sprint Telephone
- Nevada State Engineer
- Nevada State Office of Emergency Management
- U.S. Bureau of Reclamation
- Nevada National Guard
- National Park Service

1.4 Inundation Area Evaluation

Inundation areas shown in this plan were evaluated using the National Weather Service DAMBRK computer model to estimate the travel time and rate of embankment failure, flood wave travel time, and depth of flood wave action during downstream inundation.

1.4.1 Hydrologic and Hydraulic Criteria

Hydrologic and hydraulic data pertaining to the Trailhead Detention Basin used in the development of this EAP were derived from information developed by others in the design of the structure and its appurtenances. Hydraulic criteria used in determination of the inundation areas followed the guidelines presented in the "Hydrologic Criteria and Drainage Design Manual" of the CCRFCD.

1.4.2 Inundated Areas and Flood Wave Travel Times

Evaluation of the limits of downstream flooding was based on the flood hydrographs created by: 1) the PMF event being passed through the Emergency Spillway, and 2) the discharge of a full pool of water being held within the basin at the time that an embankment breach occurs.

The areas inundated in a composite of the planning scenarios and associated average times required for the leading edge of the flood wave to reach various downstream points are shown on Figure 2. The actual flooded areas within the limits shown will vary depending upon a number of factors including the type of discharge, either emergency spillway discharge or dam break, and the nature of the storm event. It is expected that the majority of flood flow will follow the west to east running street system within the expected inundation area.

In the case of sudden, progressive breaching of the embankment, the flood wave is considered as the increment of flow resulting from the breach, discharging up to approximately 28 acre-feet of volume. Where maximum design flow through the emergency spillway occurs, flood wave travel is based on the rate of release which will begin to cause significant damage in the downstream area. Except to those areas immediately downstream of Trailhead Detention Basin, flood depths are expected to be generally less than 8 feet outside of depression and local channel areas. The inundated areas shown on Figure 2 in the Appendix of this EAP are those areas in which a product of the flooding depth times the average velocity of flow exceeds a value of six. These areas represent the most probable areas in which flooding will create property damage and pose a threat to public safety. Flooding experienced outside of these areas will be at generally lower depths and/or velocities.

1.5 Review and Update of the EAP

To remain a viable guide for responding to emergency conditions, this EAP must be reviewed and updated on a regular basis and as conditions change. The Boulder City Emergency Management Coordinator (EMC) is responsible for coordinating and distributing all updates as follows:

1.5.1 Review

Turnover of personnel, telephone number changes, and other important personnel, procedural or departmental changes that occur over time, will necessitate EAP review and modification. The plan should be reviewed and the subplans and, tables and appendices updated as necessary.

1.5.2 Updates to Reflect Watershed, Detention Basin, and Inundation Area Changes

Physical changes in the watershed, in the urbanization or street pattern within the projected inundation area, or the detention basin design may affect the hydrology or hydraulics upon which the planning of this EAP was based. These changes may require modification to the EAP. Physical modifications in the contributing watershed or inundation areas should be reviewed to determine if these changes modify hydraulic and hydrologic conditions presented in this EAP. Some types of changes may require only minor revisions of the plan, such as modifying the Evacuation Subplan to account for new urban development or new public facility construction. Other changes, such as physical alterations to inflow and outflow drainage courses may require substantial replanning of the EAP. The Boulder City Department of Public Works is responsible for notifying the Boulder City Emergency Management Coordinator (EMC) of the need for EAP revision due to these types of changed conditions, and for providing the EMC with updated hydrologic and hydraulic information for use in revising the EAP.

1.5.3 Comprehensive Emergency Plan Revision

Changes made to the Comprehensive Emergency Plans of agencies responding to potential detention basin emergencies may necessitate modification of the action protocols outlined in this EAP. Upon initiating modifications to Comprehensive Emergency Plans, this EAP should be reviewed and updated as necessary.

Trailhead Detention Basin

2.0 EMERGENCY IDENTIFICATION SUBPLAN

This Emergency Identification Subplan identifies and describes the type of emergency conditions that may develop at the Trailhead Detention Basin which would require notification of public officials and emergency action.

2.1 Potential Emergency Conditions

The construction of the Trailhead Detention Basin was accomplished to meet a flood mitigation need identified in the Clark County Flood Control Master Plan. The following emergency conditions are defined solely for planning purposes and in no way imply the structural integrity of the detention basin is in question.

The Trailhead Detention Basin is designed to remain empty except during times of large volume storm-water runoff. The CCRFCD has worked in conjunction with the National Weather Service to develop advanced systems to predict heavy runoff prior to its occurrence. This allows for early monitoring of flow conditions at the Trailhead Detention Basin.

Due to these circumstances, the development of events which may lead to emergency action are expected, in some cases, to take only a few hours to occur. If prompt action is taken to post a site monitor at the detention basin during large volume storm-water runoff events, only a few hours of time will be available to detect the development of emergency conditions. This should allow sufficient time to initiate emergency operations. Except under the most rare set of conditions, a sudden, instantaneous failure of the detention basin is not expected to occur.

There are two general threatened or actual conditions which will generate emergency response: emergency spillway discharge and dam failure.

2.1.1 Emergency Spillway Discharge

There is not sufficient capacity in the defined outlet channel located downstream of the detention basin to carry flood flows of the volumes involved with emergency spillway discharge away from the Trailhead Detention Basin. Therefore, downstream streets, residential and commercial developments and health care facilities lying adjacent to the main wash channel may be subject to flooding conditions during an emergency spillway discharge event. Due to the physical capacity limitations in the downstream channel and floodplain, a threatened or actual emergency spillway discharge is considered an emergency condition. The extent, depth, and velocity at which flooding takes place will be dependent upon the rate and volume of emergency spillway discharge experienced and downstream physical obstructions in existence at the time of the event. A predicted or actual large storm event or a rapidly rising detention basin water surface will be the first indication that a potential emergency spillway discharge may occur. During the life of the detention basin there is a good chance that runoff conditions will cause an emergency spillway discharge event to occur.

2.1.2 Dam Failure

Once the basin begins to impound water, the potential is present for development of conditions which threaten the stability of the embankment or its outlet works. The presence of water in the detention basin may lead to embankment seepage and piping, embankment surface erosion, downstream slope slides, or embankment crest slumping. These conditions could become serious in a short period of time if not properly controlled.

The worst case of downstream flooding will occur when prolonged rains keep the detention basin full, the embankment soils become saturated, and embankment failure occurs. Up to 28 acre-feet of water, depending upon the location of the release, could be discharged into the downstream channel and urban area during this type of event. The rate at which a dam failure could develop will vary from several hours to a period of days depending upon circumstances.

This instantaneous dam failure develops in water storage facilities which impound water over long periods of time during which the embankment becomes saturated and piping or slumping occurs. The Trailhead Detention Basin is designed to remain unfilled except during heavy runoff events, and the principal outlet is expected to completely drain the full detention basin in approximately 8.5 hours without additional inflow. Owing to these design features, and the fact that the embankment portion of the detention basin will only be subject to the type of hydrostatic pressures which can lead to dam failure for short periods of time, an instantaneous type of embankment failure at the Trailhead Detention Basin is expected to be of low risk.

In many dams, piping or water seepage along the principal outlet pipe can remain undetected for long periods of time, allowing seepage to carry soil to the free water surface below the dam and creating an internal erosion condition. This type of failure often occurs along relatively short outlet pipes placed at elevations above the downstream natural ground surface. Therefore, the potential for embankment failure due to piping at the principal outlet is considered remote.

2.2 Emergency Scenarios

Based upon the design and location of the detention basin, it was assumed for the purposes of this EAP that the following emergency scenarios may occur:

Case 1 - Threatened or Actual Emergency Spillway Discharge

A. **Predicted Major Runoff Event** - information available to the National Weather Service and/or the CCRFCD indicates that a major storm event is likely to generate a high rate of runoff from the watershed above the detention basin.

B. **Plugged Principal Outlet** - storm-water inflow into the basin is occurring, the basin is filling and the outlet is becoming plugged with sediment and debris or is damaged and the normal rate of release of storm water is impeded. This condition results in a relatively rapid rise in the elevation of the detention basin's water surface threatening to cause flow over the emergency spillway.

C. **Emergency Spillway Discharge** - the volume of storm-water runoff inflow is near the maximum probable flood event or at the inlet capacity, and the basin is almost completely full. This will result in discharge over the emergency spillway.

Case 2 - Threatened or Actual Dam Failure

A. **Embankment Seepage and Piping** - beginning with a small flow through the soil at or near the base of the detention basin embankment or around its principal outlet or emergency spillway, piping and seepage are removing increasing volumes of soil materials. If not treated, the embankment may be breached within several hours or less; thus releasing stored water into the floodplain below the structure.

B. **Emergency Spillway Structural Damage** - embankment slumping, discharge of floodwater over the emergency spillway, downstream erosion adjacent to the spillway, or piping under or around the roller-compacted concrete spillway cover have compromised the structural competency of the emergency spillway and may lead to embankment failure.

C. **Embankment Slumping and Overtopping** - beginning after a significant amount of local rainfall has occurred and the detention basin is filled, saturated soils in the embankment have lost structural strength causing the crest of the embankment to slump increasing the chance that stored water will overtop or seep through the embankment and possibly cause a breach to occur within the next hour.

D. **Sudden Embankment Failure** - Seepage and piping, embankment slumping, or other conditions have gone undetected or have developed very rapidly causing the embankment to completely fail within a period of one hour or less and releasing stored water into the downstream channel.

2.3 Emergency Condition Considerations

An emergency condition could occur any time that a significant amount of rainfall is anticipated within the upper watershed, or storm water is flowing into and being impounded in the detention basin. Special considerations should be taken into account in implementing emergency response:

- **Advance Warning** - Significant inflow into the basin may be known to the CCRFCD in advance of the event from hydrometeorological information transmitted to the CCRFCD. The detention basin will be monitored by one or more persons from the Boulder City Department of Public Works assigned to the site commencing at the time the department is notified by the CCRFCD or when it is known that a significant amount of water is being impounded. However, quickly developing, highly localized thunderstorm events may develop over the watershed with little or no advance warning, necessitating an accelerated emergency response.

- **Time of Day** - The emergency could arise at any time of the day, with night time and/or heavy traffic times being the most serious periods in which a flooding event could occur. Under these circumstances, evacuation routing and public notification procedures must be accelerated or modified to meet specific conditions

- **Department Staffing** - Night time, weekends, or holidays, when agency staffing is minimal, are the most logistically critical time in which an emergency condition could develop. During these periods response times will usually be longer.

- **Environmental Conditions** - Conditions will most likely be poor, including heavy rainfall and high wind, making travel and visibility poor and making it difficult to hear warning sirens or public address systems.

Trailhead Detention Basin

3.0 EMERGENCY OPERATIONS AND REPAIR SUBPLAN

3.1 Emergency Conditions

As described in the Emergency Identification Subplan of this EAP, any of the following conditions indicate an emergency condition exists or may develop if prompt remedial action in the form of emergency mobilization and/or repair is not undertaken:

3.1.1 Emergency Spillway Discharge

- Predicted Major Runoff Event
- Plugged Principal Outlet
- Emergency Spillway Discharge

3.1.2 Dam Failure

- Embankment Seepage and Piping
- Emergency Spillway Structural Damage
- Embankment Slumping and Overtopping
- Sudden Embankment Failure

3.2 Emergency Condition Indicators and Control Actions

The following Tables describe investigations and actions which should be undertaken to identify emergency conditions, and steps to be taken to eliminate or reduce potential damages created by downstream flooding created by each of the conditions outlined above.

3.3 Sources of Assistance

Principal sources of material, equipment and personnel for dealing with emergency conditions that arise at the detention basin are listed in the Clark County CEOP. Some of these sources and additional resources are listed in the appendix of this EAP. Those listed do not necessarily represent all of the available sources of assistance in the area.

3.4 Site Monitor and Public Works Department Early Actions

In all cases in which there is an indication of a possible emergency, the Boulder City Department of Public Works will assign a site monitor to observe conditions at the detention basin. The assigned site monitor shall follow the notification procedures set forth in this EAP and shall:

- Alert his/her immediate supervisor to the nature of conditions and problems observed.
- Prepare notes using the checklist attached to this EAP which describes the status of the reservoir and indicated problems (if any), to assist in determining the rate of progress of problem development.
- Initiate action necessary to reduce or control the potential problem as described in the Emergency

Operations and Repair Action Tables of this section.

- In all cases, the Boulder City Department of Public Works, when advised of the existence of a potential emergency, shall dispatch appropriate technical staff to the site to evaluate the situation, determine if emergency action is needed and commence appropriate action.

Table 3.1
Emergency Operations and Repair Action
Predicted Major Runoff Event

Emergency Condition	Due to a predicted large volume of storm-water runoff, the detention basin is expected to begin filling rapidly and may discharge storm water over the emergency spillway. This condition will necessitate on-site surveillance to evaluate and report status of basin condition and emergency spillway discharge potential.
Condition Description	Information has been received from the National Weather Service or the CCRFCD that a major storm event is likely to produce substantial storm-water runoff in the watershed above the detention basin. The predicted large volume of runoff will cause the basin to begin filling rapidly and may be sufficient to cause it to discharge flow over the emergency spillway.
Mitigation and Control Actions	• Contact Boulder City Dispatch (911) and post a site monitor at the Trailhead Detention Basin to observe filling conditions and check dam safety. • The Site Monitor inspects the condition of the detention basin as needed, following the checklist entitled "Detention Basin Inspection Form", attached to this EAP. • Site monitor describes storm-water inflow and detention basin conditions to Boulder City Department of Public Works on an hourly basis once the basin fills to half full or more. Communications are increased as conditions change or if potential problems are observed. • If emergency conditions appear to be developing, site monitor contacts Boulder City Department of Public Works to request technical assistance to evaluate problems and to implement emergency operations plans where required. • Implement notification procedures outlined in this EAP. • Follow Emergency Operations and Repair Actions for the emergency condition observed as described in this EAP.

Table 3.2
Emergency Operations and Repair Action
Plugged Principal Outlet

Emergency Condition	Sediment and debris buildup over the outlet trash rack will reduce the basin's drainage rate. With severe blockage of the outlet, the detention basin may not drain until filled to the top of the principal outlet weir spillway elevation. If the rate of drainage is slowed, the basin will take longer to drain, increasing the chance the next storm will cause the basin to fill and discharge storm water over the emergency spillway embankment.
Condition Description	• During filling, visual inspection of the trash rack indicates trash and debris are building up on the grate. • Changes in expected vortex action on the water surface over the trash rack may indicate debris is restricting the capacity of the outlet headworks. • After the outlet trash rack has become submerged, visual inspection of the depth of flow through the outlet pipeline indicates that the pipeline is not discharging at capacity.
Mitigation and Control Actions	• Notify the Boulder City Police Department of the condition and commence trash rack cleaning operations, if practical and safe and evaluate potential downstream impacts.

Table 3.3
Emergency Operations and Repair Action
Emergency Spillway Discharge

Emergency Condition	Storm water is being stored in the detention basin. Water has found a seepage path through the embankment or around the outlet works. If this path becomes efficient enough to let water flow out at rapid rates and/or in large volumes, additional soil particles will be eroded away from the embankment until the growing seepage channel causes the embankment to collapse, releasing stored water into the floodplain below the detention basin.
Condition Description	The water surface reaches an elevation of 2 to 3 feet below the crest of the emergency spillway, and meteorological projections indicate continued large volumes of runoff are expected to flow into the basin.
Mitigation and Control Actions	• Notify the Boulder City Police Department that emergency spillway flow is expected to commence and downstream water flow control, traffic control, and evacuation may be necessary. • Inspect spillway surfaces and sidewalls for structural integrity to ensure the ability of the spillway to safely pass flood flows without major damage. Use sandbags or other means to divert anticipated flows around damaged areas if necessary. • Inspect and clear debris from the anticipated downstream flood areas and culverts under the streets that cross the channel prior to spillway discharge. • Prior to spillway discharge, begin action to place sandbags, concrete barriers, earthen dikes or other protection devices to control flow in the street system adjacent to the channel, divert flow around private property or from areas which must be protected from inundation. • Prior to spillway discharge, place traffic control devices to barricade entry into anticipated flood areas. As spillway flow commences post monitors at strategic points adjacent to the predicted areas of inundation to monitor flow, debris buildup and damage conditions. • Prior to spillway discharge, coordinate with agencies responsible for evacuation to warn residents to evacuate from areas where inundation is expected to occur. • Follow the notification procedures outlined in this EAP.

Table 3.4
Emergency Operations and Repair Action
Embankment Seepage and Piping

Emergency Condition	Storm water is being stored in the detention basin. Water has found a seepage path through the embankment or around the outlet works. If this path becomes efficient enough to let water flow out at rapid rates and/or in large volumes, additional soil particles will be eroded away from the embankment until the growing seepage channel causes the embankment to collapse, releasing stored water into the floodplain below the detention basin.
Condition Description	The basin is storing storm water. The ground surface below the basin is becoming increasingly soggy, and seepage or springs on the surface or downstream of the embankment is evident.
Mitigation and Control Actions	There are two general types of actions that may be taken to combat potential piping: 1) reduce the quantity of flow through the seepage path by reducing the difference in water level between the reservoir and the point of outflow, or 2) allow seepage flow to continue but reduce or eliminate the removal of soils from the interior of the embankment. • Contact Boulder City Police Department • If seepage or piping conditions are observed, it is essential to inspect the turbidity of the flow at the point of seepage discharge. If possible, catch the water in a clean jar and inspect it. Anything other than clear water may indicate that soil is being carried away from the interior of the embankment and immediate action is needed to prevent an embankment failure condition from developing. • If piping or seepage is identified, begin emergency repair and follow the notification procedures outlined in this EAP. • Inspect the embankment on the upstream side of the basin, if vortex action is noted opposite the suspected area of piping, or if a seepage path can be seen, follow procedures below for plugging the seepage path inlet. 1) To reduce the quantity of flow through the seepage path, reduce the difference water level between the reservoir and the point of outflow by pumping or 2) To allow seepage flow to continue while reducing or eliminating the removal materials from the interior of the embankment, cover the point of inflow with filtering materials including weighted plywood, filter blankets, gravel, and rock materials. Cover the point of outflow with filtering materials to slow down the migration of soil from the seepage path. • Begin advanced preparations to institute emergency evacuation of the downstream floodplain area.

Table 3.5
Emergency Operations and Repair Action
Emergency Spillway Structural Damage

Emergency Condition	Foundation settlement, floodwater discharge, embankment erosion adjacent to the emergency spillway sidewalls, and/or other conditions have caused damage to the structural components of the emergency spillway. Should the spillway loose ability to protect the underlying soil fill and the embankment from being eroded by storm-water flow, a potential breach in the dam is likely to develop which will release stored storm water into the downstream flood plain.
Condition Description	• There are open cracks in the concrete surface of the spillway through which relatively large volumes of water is being discharged. • Flow is discharging from under the downstream lip of the emergency spillway at basin surface level. The flow is laden with soil materials. The above conditions indicate that subsurface flow or foundation settlement may be creating channels in which water is passing or may pass under or around the spillway surface thus reducing the structural integrity of the spillway.
Mitigation and Control Actions	• Contact Boulder City Police Department • If flow depths are low, attempt to divert flow around damaged spillway surfaces. Divert flow away from problem areas using sandbags or other diversion measures. If damaged areas are not easily accessible from the spillway abutments, proceed with caution, flow depths greater than several inches deep will create a safety hazard to anyone attempting to wade in the current. Use motorized equipment to access problem areas if necessary. • If flow depths are low, where structural damage is occurring, place filters or rock materials upstream of and over the problem area. • Use dumped rock and filtering materials to protect the downstream toe of the spillway where erosion or damage is occurring. • If spillway flow is eroding the downstream embankment in the vicinity of the spillway abutments, use dumped rock or sand bag diversions to direct overflow back onto the roller-compacted spillway surface. • If embankment or foundation erosion appears to be uncontrollable, accelerate emergency response by following the notification procedures outlined in this EAP.

Table 3.6
Emergency Operations and Repair Action
Embankment Slumping

Emergency Condition	Beginning after significant rainfall has occurred and the detention basin is partially or completely filled, saturated embankment soils have lost structural strength and/or piping through the embankment is causing the embankment to slump, increasing the potential for stored water to overtop the embankment. This condition may lead to the rapid release of storm water into the floodplain below.
Condition Description	Slumping of the embankment is indicated by a change in the level of the top of the embankment, by cracks in the top or face of the embankment, by bulging of the embankment, and/or by sliding of the downstream face of the embankment. The top of the embankment in the trouble area has been reduced to an elevation which may allow water to flow over the dam creating severe erosion and potentially a breach in the embankment.
Mitigation and Control Actions	• Contact Boulder City Police Department • The site monitor should make an accurate report to the Boulder City Department of Public Works as soon as any indication of slumping is noticed. The report should include information on the indicator(s) observed, location, extent of slumping, and rate of progress of slumping. • Where embankment slumping and structural failure pose a potential threat of dam breaching, accelerate emergency response following the notification procedures outlined in this EAP. • Dealing with slumping of an embankment requires heavy equipment and considerable time. There are two general approaches to dealing with the situation caused by a slump in the embankment. The appropriate approach depends on the reservoir water level and expected inflow: 1) If the water inflow is expected to be sizable enough to make repair difficult in the time available, it may be preferable to breach the embankment entirely and let all inflow pass through the basin as it occurs rather than run the risk of a sudden or rapidly progressing uncontrolled failure. In order to prevent major expenses of repairing damage to the outlet works and emergency spillway, the breach should be well away from those features, if possible. 2) If the embankment crest does not immediately slump to an elevation below the level of water in the reservoir and time is available for remedial action, it may be possible to contain rising water in the reservoir by dumping appropriate sand and gravel fill materials in the slumped area. This approach should only be used in cases where the structural capacity of the embankment indicated by downstream embankment slumping or sliding is not the source of the problem. Where the structural capacity of the embankment has been lost, increased weight of additional fill over the top of the slumped area may only serve to accelerate the rate of embankment failure and lead to uncontrolled dam breaching.

Table 3.7
Emergency Operations and Repair Action
Sudden Embankment Failure

Emergency Condition	The embankment fails without warning over a period of less than one hour. Runoff stored above the elevation of the surrounding ground surface is released into the downstream floodplain. Downstream areas are flooded or in the process of being flooded as released storm water moves downhill.
Condition Description	A breach in the dam has occurred. Stored water is flowing from the Trailhead Detention Basin. The flood wave is moving downstream.
Mitigation and Control Actions	• Contact Boulder City Police Department • Immediately proceed with notification procedures outlined in this EAP. • Commence public notification using public address systems. • Inspect and clear evacuation routes, route traffic around expected areas of flooding. • Commence emergency evacuation in downstream and potentially isolated areas beginning downstream of the detention basin. • Set up sandbag and concrete barriers to channelize flows into street sections where flood water channelization is practical and if time is available. • Dump rock materials into the breach to help reduce the rate of at which the breach opening is developing.

Trailhead Detention Basin

4.0 NOTIFICATION SUBPLAN

Responsible agency and personnel telephone numbers are listed in the appendix of this EAP. This Notification Subplan lists the general conditions and key notifications to be made during potential detention basin emergencies. However, not every possible situation can be anticipated and the conditions listed and persons and agencies to be notified are not necessarily all that may be required. Following the list of key notifications is a general flow chart for notification as emergency conditions develop and become more severe over the duration of the event. Additionally, a general list of agency responsibilities is included in this subplan below. Consult the Boulder City Comprehensive Emergency Management Plan for a more complete description of agency responsibilities and protocol.

Table 4.1
Key Notifications

CONDITION	NOTIFYING PARTY	NOTIFICATION OR ACTION	NOTIFIED PARTIES
Significant rainfall or runoff is expected.	CCRFCD	Advise appropriate agencies and monitor rainfall/runoff conditions.	Boulder City Police Department
Significant rainfall or runoff conditions exist.	Boulder City Department of Public Works	Post a site monitor with a radio at the Trailhead Detention Basin.	Boulder City Police Department, Boulder City Department of Public Works Site Monitor
Emergency conditions are indicated or expected at the site.	Boulder City Department of Public Works Site Monitor	Dispatch technical staff to the site to assess conditions. Mobilize resources to the site, begin remedial action, following the Emergency Operations and Repair Subplan of this EAP.	Boulder City Department of Public Works Technical Staff and other Manpower and Equipment resources, and CCRFCD
Commencement of emergency operation and repair action.	Boulder City Department of Public Works	Notify that emergency actions are underway and that evacuation actions may be required.	Boulder City Police Department, CCRFCD and National Park Service
Notified by Boulder City Department of Public Works that emergency conditions exist and that emergency operations and repair are underway.	Boulder City Department of Public Works	Implement notification procedures in the Boulder City CEMP as supplemented by this EAP.	County Manager, Lead Agencies, U.S. Bureau of Reclamation and National Weather Service
Downstream inundation appears likely to occur at a sufficient depth to threaten public safety.	Boulder City Department of Public Works	Advise that downstream inundation appears likely and evacuation is required.	Boulder City Police Department and National Park Service

Table 4.1
Key Notifications
(Continued)

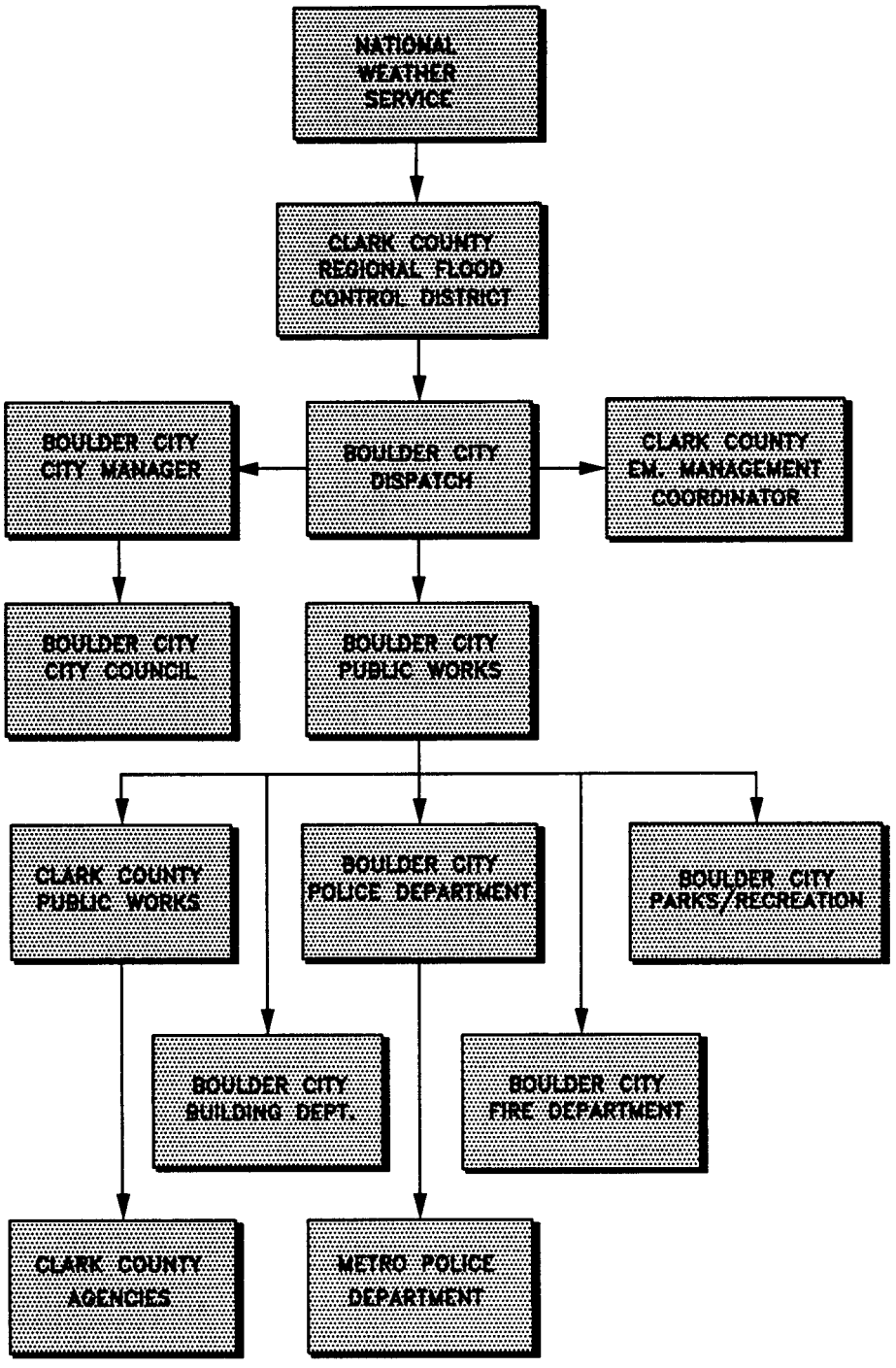
CONDITION	NOTIFYING PARTY	NOTIFICATION OR ACTION	NOTIFIED PARTIES
Boulder City Department of Public Works advises evacuation of downstream areas is necessary.	Boulder City Public Works	Initiate evacuation of the endangered area following the protocol outlined in the CEMP.	Evacuation Action Lead Agencies, U.S. Bureau of Reclamation, National Weather Service, CCRFCD and National Park Service
Evacuation order has been given.	Boulder City Police Department and other agencies responsible for evacuation operations	Commence evacuation operations following the protocol outlined in the CEMP and the Evacuation Subplan of this EAP.	Evacuation Action Lead Agencies, CCRFCD and National Park Service
Threat of inundation has passed and/or floodwaters have subsided.	Boulder City Department of Public Works	Notify of the cessation of emergency conditions.	Boulder City Police Department, CCRFCD, Boulder City Manager and National Park Service
Consultation with Clark County Department of Public Works indicates emergency conditions no longer exist.	Boulder City Department of Public Works	Lift the evacuation order and commence recovery operations following the action protocols of the Recovery Subplan of this EAP.	Boulder City Police Department, Lead Agencies, U.S. Bureau of Reclamation, and National Weather Service and the Public

NOTIFY

NOTIFICATION FLOW CHART

PENDING OR ACTUAL EMERGENCY CONDITION

TRAILHEAD DETENTION BASIN



Harding Lawson Associates
Harding Lawson Associates
Environmental Services

NOTIFICATION FLOW CHART
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control
Boulder City, Nevada

FIGURE
4.1

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		5/00	

Table 4.2
Agency Responsibilities
Pending or Actual Flood Event Which Impacts Detention Basin

AGENCY	RESPONSIBILITIES
National Weather Service	1) Broadcasts weather conditions on public access news networks. 2) Alerts CCRFCD of impending weather event.
CCRFCD	Issues storm alerts to: 1) Local area Public Works Departments 2) Las Vegas Metropolitan Police Department
Boulder City Department of Public Works	1) Serves as Lead Agency for detention basin and flood events. 2) Mitigation of flood damage. 3) Tracks storm events through CCRFCD and National Weather Service. 4) Posts site monitor at Detention Basin. 5) Dispatches technical site evaluation team to basin site. 6) Alerts Boulder City Police Department and Clark County Department of Public Works of emergency action. 7) Traffic warning, sign posting, diversion. 8) Roadway clearance and restoration. 9) Debris removal. 10) Coordinates public utility restoration. 11) Assists with public property damage assessment.
Boulder City Police Department	1) Notifies and coordinates with Fire Department of pending event through central 911 communications system. 2) Notifies police field patrol, reports flooding problems to Boulder City Department of Public Works. 3) Advises Boulder City Department of Public Works on traffic diversion needs.
Boulder City Fire Department	1) Increases alertness to respond to emergencies. 2) Maintains contact with Boulder City Police and Boulder City Department of Public Works. 3) Provides operational Emergency Operations Center.
Boulder City Fire Department	1) Assembles analysis team. 2) Coordinates environmental monitoring activities. 3) Coordinates with Boulder City Department of Public Works. 4) Notifies Boulder City Manager of pending or actual flood event.
Boulder City Department of Parks & Leisure	1) Provides supplemental manpower and equipment to Boulder City Department of Public Works. 2) Public shelter, food coordination if evacuation required.
Consult the Boulder City CEMP for responsibilities of other agencies not listed.	

Table 4.3
Agency Responsibilities
Detention Basin Emergency Condition or Pending Emergency Spillway Discharge

AGENCY	RESPONSIBILITIES
National Weather Service	1) Broadcasts weather conditions on public access news networks. 2) Alerts CCRFCD of pending weather event.
CCRFCD	Issues storm alerts to: 1) Local City and County Public Works Departments. 2) Boulder City Police Department.
Boulder City Department of Public Works	1) Lead Agency for detention basin mitigation and repair operations. 2) Conducts emergency detention basin repair and flood mitigation operations. 3) Tracks storm events through CCRFCD. 4) Notifies Boulder City EMC and Boulder City Department of Public Works of detention basin emergency operations conditions. 5) Acquires resources as needed to meet emergency operations requirements. 6) Coordinates with Boulder City Police Department to identify available emergency evacuation routes from the map shown in this EAP. 7) Assists Boulder City Police Dept. barricading access to inundation areas. 8) Communicates with site assessment team on condition of detention basin and structure.
Boulder City Fire Department	1) Communicates with Boulder City Department of Public Works and Boulder City Police Dept. on status of emergency operations. 2) Assembles analysis team. 3) Coordinates environmental monitoring activities. 4) Notifies Clark County Health District of pending evacuation. 5) Notifies Clark County School District and Nevada National Guard of potential need for evacuation buses. 6) Notifies US Bureau of Reclamation, National Park Service 7) Issues public alert.
Boulder City Police Department	1) Notifies and coordinates with Boulder City Department of Public Works and Fire Department pending evacuation event. 2) Notifies field patrol of changing detention basin conditions. 3) Patrols possible evacuation routes and evacuation areas. 4) Participates in public warning to residents in expected evacuation area.
Boulder City Fire Department	1) Increases alertness to respond to potential evacuation order. 2) Maintains contact with Boulder City Police Department and Boulder City Department of Public Works. 3) Provides operational & staffed Emergency Operations Center.

Table 4.3
Agency Responsibilities
Detention Basin Emergency Condition or Pending Emergency Spillway Discharge
(Continued)

AGENCY	RESPONSIBILITIES
Boulder City Department of Public Works	1) Obtains full information on evacuation operations. 2) Communicates with Boulder City Department of Public Works on characteristics of inundation area and/or dam failure. 3) Obtains meteorological data and other information. 4) Prepares recommendations on the area to be evacuated based upon actual flood event.
Boulder City Department of Parks & Recreation	1) Provides supplemental manpower, equipment to Boulder City Department of Public Works. 2) Prepares for public shelter, food coordination should evacuation order be given.
Boulder City Department of Public Works	1) Documents costs and expenditures.
Clark County Health District	1) Coordinates with medical facilities in inundation area for potential evacuation. 2) Assists in evacuation of institutionalized, living at home sick, or those needing assistance.
Consult the Boulder City CEMP for responsibilities of other agencies not listed.	

Table 4.4
Agency Responsibilities
Pending or Actual Dam Failure and Inundation Area Evacuation

AGENCY	RESPONSIBILITIES
National Weather Service	1) Maintains contact on weather conditions with CCRFCD and EMC.
CCRFCD	Issues storm alerts to: 1) Local City and County Public Works Departments. 2) Las Vegas Metropolitan Police Department.
Boulder City Department of Public Works	1) Lead Agency for detention basin mitigation and repair operations. 2) Conducts emergency detention basin repair and flood mitigation operations. 3) Tracks storm events through CCRFCD. 4) Notifies Boulder City EMC and Boulder City Department of Public Works of detention basin emergency operations conditions. 5) Acquires resources as needed to meet emergency operations requirements. 6) Assists Boulder City Police Dept. barricading access to inundation areas. 7) Communicates with site assessment team on condition of detention basin and structure.
Boulder City Fire Department	1) Communicates with Boulder City Department of Public Works on status of emergency evacuation requirements. 2) Assembles emergency condition analysis team. 3) Coordinates environmental monitoring activities. 4) Notifies Clark County Health District of pending evacuation. 5) Procures public evacuation transportation. 6) Notifies US Bureau of Reclamation and National Park Service. 6) Issues public alert.
Boulder City Police Department	1) A designated lead agency during evacuation. 2) Conducts evacuation. 3) Provides security for evacuated area. 4) Participates in public warning to residents in evacuation area. 5) Provides traffic control to facilitate evacuation.

Table 4.4
Agency Responsibilities
Pending or Actual Dam Failure and Inundation Area Evacuation
(Continued)

AGENCY	RESPONSIBILITIES
Boulder City Fire Department	1) Responds to emergencies in evacuation area or along evacuation routes. 2) Maintains contact with Boulder City Police Dept. and Boulder City Department of Public Works. 3) Provides operational & staffed Emergency Operations Center.
Boulder City Department of Public Works	1) Obtains full information on evacuation operations. 2) Communicates with Boulder City Department of Public Works on characteristics of inundation area and/or dam failure. 3) Obtains meteorological data and other information. 4) Prepares recommendations on the area to be evacuated based upon actual flood event.
Boulder City Department of Parks & Recreation	1) Provides supplemental manpower, equipment to Boulder City Department of Public Works. 2) Prepares for public shelter, food coordination for evacuees.
Boulder City Department of Public Works	1) Documents costs and expenditures.
Clark County Health District	1) Assists in evacuation of the institutionalized, living at home sick, or those needing assistance. 2) Coordinates with medical facilities for treatment of injured.
Consult the Boulder City CEMP for responsibilities of other agencies not listed.	

Table 4.5
Agency Responsibilities
Damage Recovery

AGENCY	RESPONSIBILITIES
National Weather Service	1) Maintains contact on weather conditions with CCRFCD and Boulder City EMC.
CCRFCD	1) Issues storm and runoff information to local area Public Works Departments. 2) Provides hydrologic data to post-event critique.
Boulder City Department of Public Works	1) Coordinates with local utility companies for repairs. 2) Coordinates with other agencies for damage assessment. 3) Provides street repair and cleanup. 4) Develops post-event critique. 5) Provides public infrastructure damage assessment.
Boulder City Manager	1) Schedules post-event critique meeting.
Boulder City Fire Department	1) Assists with post-event critique.
Boulder City Department of Finance	1) Coordinates recovery procedures for public property damage.
Boulder City Police Department	1) Provides security for evacuated area. 2) Supplies security during post-event repairs.
Nevada State Engineer	1) Provides technical assistance in event of damage to the dam. 2) Coordinates permits for any dam repairs.
Consult the Boulder City CEMP for responsibilities of other agencies not listed. Other County Departments and local utility companies may also offer post-event critiques and have damage recovery responsibilities.	

Trailhead Detention Basin

5.0 EVACUATION SUBPLAN

Evacuation may become necessary in the event of a flood condition producing outflows from the site due to either spillway flow or failure of the detention basin structure. This subplan provides:

- Description of the general procedures for implementing evacuation
- Identification of evacuation areas
- Estimates of the number of evacuees
- Agency responsibilities

5.1 General Procedure

The need to request evacuation and the size of the area to be evacuated will be determined by the Boulder City Department of Public Works based on:

- assessment of the nature and seriousness of the emergency;
- potential for more or increased runoff into the basin;
- likelihood of controlling the emergency; and
- potential flow rate of water that could be discharged downstream.

Once the determination to request evacuation is made, the Boulder City Department of Public Works will make an evacuation recommendation to the Boulder City Fire Department. The Boulder City Fire Department will notify the Boulder City Manager, Boulder City Police Department, and the US Bureau of Reclamation. The Boulder City Fire Department will coordinate notification of evacuation order once issued by the Boulder City Manager following the protocol actions defined in the Boulder City CEMP.

5.2 Evacuation Area Mapping Limits

A map identifying the expected limits of inundation by the described conditions is shown in the appendix. The actual areas within the limits shown requiring evacuation will vary depending upon a number of factors including the type of discharge, either emergency spillway discharge or dam break, the nature of the storm event, time of day, and location of expected or experienced flood flow. It is expected that the majority of flood flow will follow the west to east running street system within the expected inundation area. Field evaluation will be necessary at the time of the actual event to determine the location and limits of necessary evacuation.

5.3 Public Facilities in Evacuation Areas

Public facilities identified as being located in potential flood prone areas are listed in Table A-1 and are shown on Figures 5 and 6 in the Appendix.

5.4 Evacuation Area Population

The estimated number of persons residing within the limits of the inundation area shown on the map attached to this EAP is approximately 2,386 persons at the time of initial plan development.

5.5 Evacuation Responsibility and Assistance

Evacuation responsibility and assistance protocols are detailed in the Boulder City CEMP, under the "Specific Contingencies" section.

Lead Agencies include:

1) Boulder City Police Department
2) Boulder City Fire Department
3) Boulder City Department of Public Works

Support will be provided by the following:

1) Boulder City City Manager
2) Boulder City City Attorney

Refer to the Boulder City CEMP for more information.

5.6 Reception and Care Operations

Lead Agencies for evacuee reception and care are identified in the Comprehensive Emergency Management Plans of the respective Cities and the County. Refer to that document for more information.

Trailhead Detention Basin

6.0 RECOVERY SUBPLAN

6.1 Re-Entry of Evacuated Area

It is important to prevent premature entry into an evacuated area that has been flooded due to dangers stemming from damaged roadways, downed power lines, structural hazards, broken or leaking gas lines and other dangers.

Prior to allowing evacuees to return to the evacuated area, it is essential that:

- Public Works Department and utility company personnel check the area for downed power lines and broken or leaking gas and water lines and make repairs necessary to ensure safety.
- Major streets be cleared of sediment and debris.
- If and where sewage spills have taken place, contaminated areas should be cordoned off and cleaned up immediately.
- Building inspectors survey the area and inspect structures to identify damaged buildings that may pose a threat to public safety. Such structures should be tagged and otherwise identified for limited or no entry after the evacuation area is opened to the general population.

In the event that properties in the evacuation area sustain significant damage, entry into the area should be limited to those persons with a direct reason to enter. This process will limit traffic congestion and other problems associated with sightseeing and looting.

6.2 Damage Assessment

Damage assessment team formation and operational protocol are outlined in the CEMP. Damage assessment teams should be formed during the event and be available for entry into the inundation area immediately following the emergency as public re-entry is being allowed.

6.3 Debris Removal and Cleanup

Depending upon jurisdiction, debris removal and cleanup on public rights-of-ways is the responsibility of the Boulder City Department of Public Works.

6.4 Incident Critique

A post-event critique will be held for any incident in which emergency spillway discharge occurs, detention basin damage is sustained, the EOC is opened during a detention basin emergency event, and/or a public warning is issued regarding potential downstream flooding. The critique will be scheduled by the City Manager and include participation from representatives of the following agencies and organizations:

- Boulder City Fire Department
- Boulder City Police Department
- Clark County Health District
- Nevada Department of Transportation
- Nevada Highway Patrol
- Nevada Power Company
- Southwest Gas Company
- Sprint Telephone
- Bureau of Reclamation
- National Park Service
- Nevada State Engineer
- Nevada State Office of Emergency Management

6.5 Incident Report

Following the incident critique, the Boulder City Public Works Department will issue an Incident Report. The report will describe the event and its effects, evaluate the performance of all parties, and present appropriate recommendations for future emergency action events or emergency action plan modification. The incident report should be forwarded to the Nevada Department of Conservation and Natural Resources and to the National Performance of Dams Program.

Trailhead Detention Basin

7.0 GLOSSARY

BREACH - An uncontrolled opening or break in the embankment or spillway section of a dam which encloses a reservoir. Breaches may be caused by piping through or under the embankment, erosion of the embankment crest, or by cracking of a spillway by earthquake shock, soils shrinkage, or other means.

DAM FAILURE - The partial or total collapse of a dam or embankment serving as a dam. In emergency planning, a dam failure is usually considered to be any incident that results in the uncontrolled release of a large volume of water.

DECLARATION - A public statement by the City Council, the Governor, or the President of the United States, setting forth a finding of conditions requiring state or federal assistance to relieve the effects of an emergency or disaster.

DETENTION BASIN - A reservoir which is normally dry and is designed to temporarily hold storm water to prevent or reduce downstream flooding. Detention basins generally include an embankment enclosing the reservoir, a principal spillway through which inflow is released at a limited rate, and an emergency spillway over which excess inflow into the detention basin can be safely discharged past the detention basin embankment.

DISASTER - An occurrence of a severity and magnitude that normally results in deaths, injuries, and/or property damage, and that cannot be managed through the routine procedures and resources of the City. It usually develops suddenly and unexpectedly and requires immediate, coordinated and effective response by multiple government and private sector organizations to meet human needs, to minimize damage, and to speed recovery.

DISASTER FIELD OFFICE (DFO) - The administrative center from which federal and state agencies coordinate disaster recovery efforts.

DISCHARGE - The volume of storm water flow over a set period of time, usually measured in cubic feet per second (c.f.s.).

EMBANKMENT - An earthen barrier or wall used to trap and impound storm water.

EMBANKMENT SLUMPING - The more or less sudden downward movement of a portion of an earthen embankment. The movement may result from loss of strength in the embankment due to water saturation, shaking due to an earthquake or other causes. The effect of the slumping may be either to lower the elevation of the top of the embankment or to reduce the thickness of the embankment, rendering it more susceptible to failure.

EMERGENCY - A situation which seriously threatens loss of life and damage to property. It usually develops suddenly and unexpectedly and demands immediate, coordinated, and effective response by public and private sector organizations to protect lives and limit damage to property. Examples of emergency situations which could result in a disaster include failure of an embankment enclosing a detention basin or large flows over the detention basin's emergency spillway.

EMERGENCY ACTION - Extraordinary action(s) taken to prevent, reduce or otherwise deal with impending or existing emergency conditions.

EMERGENCY ACTION PLAN - A plan including provisions for detection and evaluation of a threat, arrangements for warning, and an emergency action for reducing the risk to life and property.

EMERGENCY ALERT SYSTEM - A radio communications system consisting of broadcast stations and interconnecting facilities. The system enables a warning to be given to the lead radio and television stations in the system to be repeated over all participating radio and television networks.

EMERGENCY MANAGEMENT COORDINATOR - Refers to the individual appointed by the Clark County Manager who has the primary day-to-day responsibility for emergency management programs and activities. The role is one of coordinating all aspects of a jurisdiction's mitigation, preparedness, response, and recovery capabilities. He/she is the local connection to a nationwide direction, control, and warning system available for use in all types of emergencies.

EMERGENCY OPERATIONS CENTER (EOC) - A protected facility with necessary communications from which emergency functions are directed during an emergency or major disaster.

EMERGENCY SPILLWAY - A portion of an embankment or dam designed to safely pass all inflow to a full reservoir or detention basin. Emergency spillways are generally rock or concrete to resist erosion.

EMERGENCY SUPPORT SERVICES - The agencies of the County that have the capability to respond to emergencies 24 hours a day. They include law enforcement, fire/rescue, and public works. They may also be referred to as emergency response agencies or emergency operating forces.

EMERGENCY WARNING - A warning given of a possible or impending emergency. Warnings may be disseminated in a number of ways including radio, television, sirens, public address systems on police and fire vehicles, and door to door contact.

EVACUATION AREA - The area to be evacuated due to a safety hazard. In the case of flooding, the evacuation area is sometimes larger and/or different than the area flooded as it is sometimes necessary to evacuate areas that are likely to be isolated from medical and other emergency assistance, lose utility services, or be subject to secondary hazards stemming from the flooding.

INUNDATION AREA - The area potentially flooded by a dam breach or emergency spillway discharge from the subject detention basin.

MITIGATION - Measures taken to eliminate or reduce the detrimental effects of various hazards.

MOBILIZATION - The process of marshalling appropriate resources to manage emergencies.

100-YEAR FLOOD - Also known as the one percent chance flood. It is the size of flood that, over a very long period of time, has the chance of being exceeded, on the average, only once every one hundred years. It has a one percent chance of occurring in any year.

PIPING - The movement of water through an earthen embankment or dam of sufficient velocity and volume to carry soil away, eroding a passageway through which additional flow can pass which further erodes the soil until embankment failure occurs.

PRINCIPAL OUTLET - A drainage structure, usually of concrete or metal pipe, through which water in a reservoir is released. Primary spillways usually consist of an entrance structure protected by a trash rack, which is connected to a horizontal tube or pipe passing through or under the embankment. Primary spillways may have multiple openings or pipes, at various levels to control the rate of outflow according to the level of water in the reservoir.

PROBABLE MAXIMUM FLOOD (PMF) - The greatest storm-water runoff flood considered possible at a location due to a very rare set of meteorological and hydrological conditions in which the maximum amount of moisture an air mass can hold is precipitated over a given period of time.

PUBLIC FACILITY - Includes publicly owned flood control, navigation, irrigation, reclamation, public works, utility, sewage treatment and collection, water supply and distribution, watershed development, or airport facility; any nonfederal aid street, road, or highway and any other public building, structure, or system, including those used for office, public hearings, maintenance, storage, educational or recreational purposes, or any park. Also includes public gathering facilities (hospitals, nursing homes, schools, day care centers, hotels/motels/casinos, theaters).

RUNOFF - The portion of rainfall or snowmelt that does not infiltrate into the ground and runs off, usually to a nearby stream.

SHELTER (Reception and Care) - A facility that provides temporary communal care for individuals and families that have been forced from their homes by an emergency or disaster.

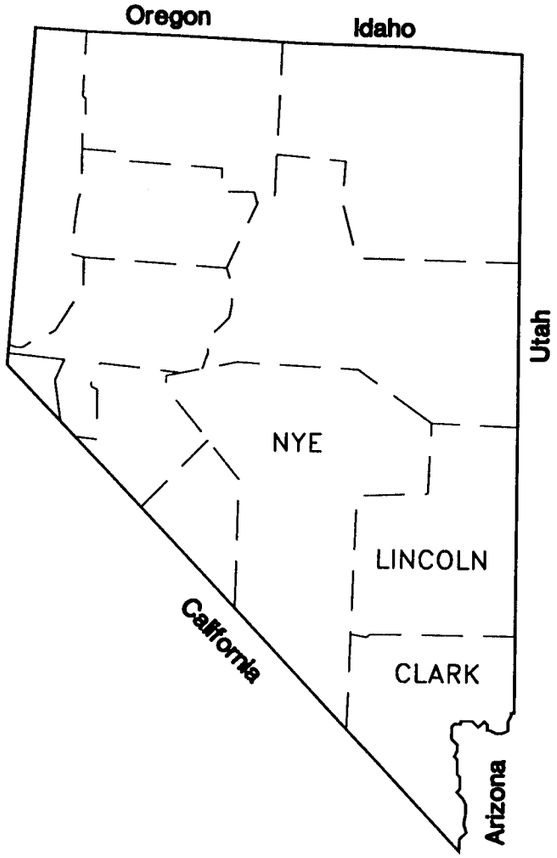
SHELTER MANAGEMENT - The internal organization, administration and operation of a shelter facility by either pre-trained or emergent leadership.

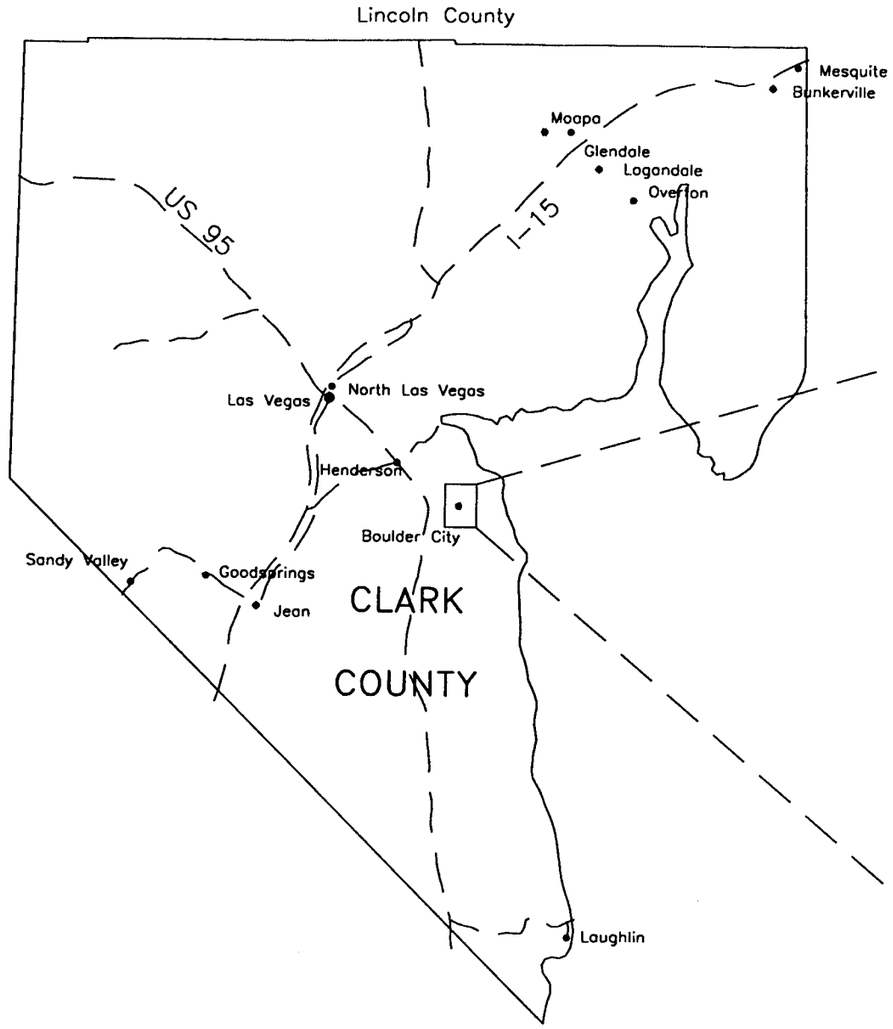
SITE MONITOR - A person detailed to a detention site to observe and report on conditions and initiate remedial work in the event problems occur.

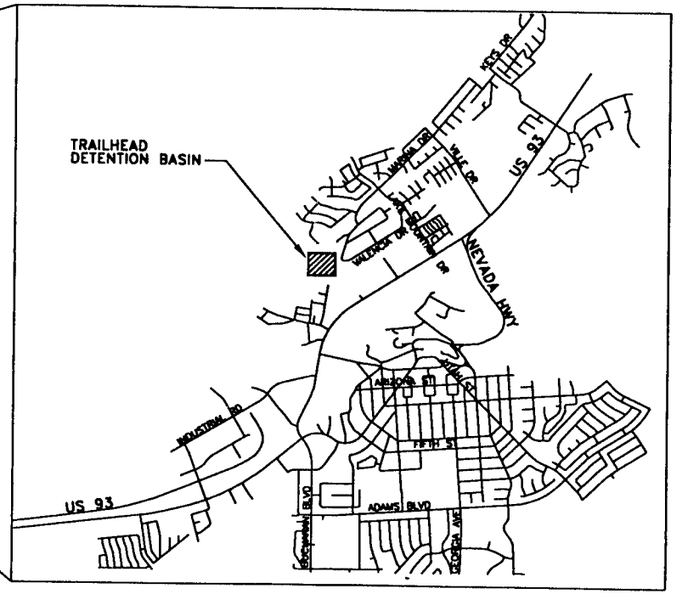
SPILLWAY CREST ELEVATION - The elevation of the spillway surface or control weir at which water in a reservoir begins to flow through or over a principal or emergency spillway.

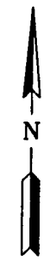
STORM WATER - Surface water runoff resulting from rainfall or snowmelt.

TRASH RACKS - Provisions made at the upstream end of a principal outlet to prevent large size debris from entering and plugging the outlet. Trash racks are usually formed of a grid of metal bars or pipes with appropriate spacing to allow water to pass.









Not to Scale

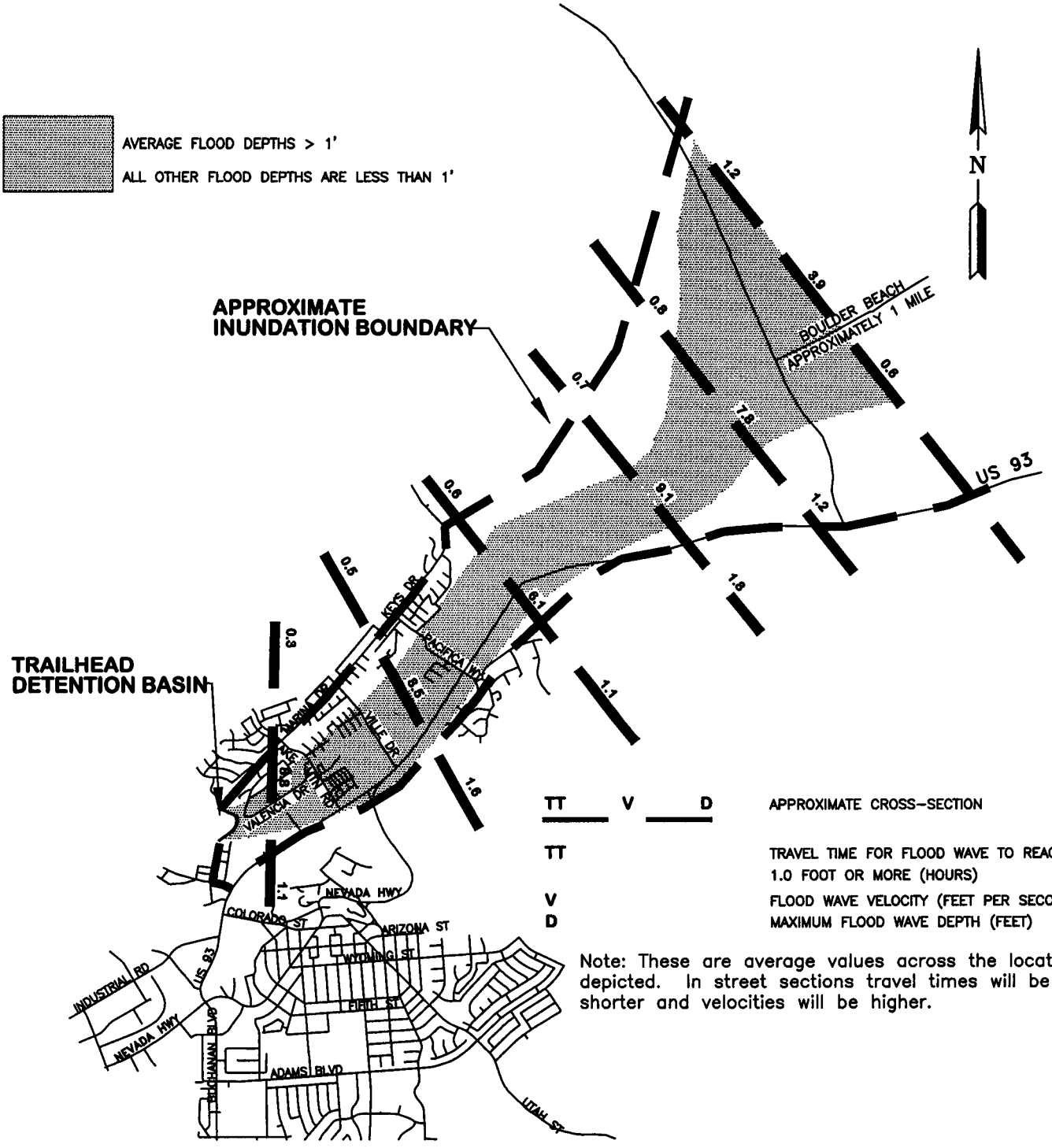
Harding Lawson Associates
Engineering and
Environmental Services

VICINITY MAP
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

FIGURE
1

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		8/00	

INUNDATE



The inundated areas shown on this map reflect an extremely rare event. Publication of this map is not intended to reflect in any way upon the integrity of the structure.

Harding Lawson Associates
Engineering and Environmental Services

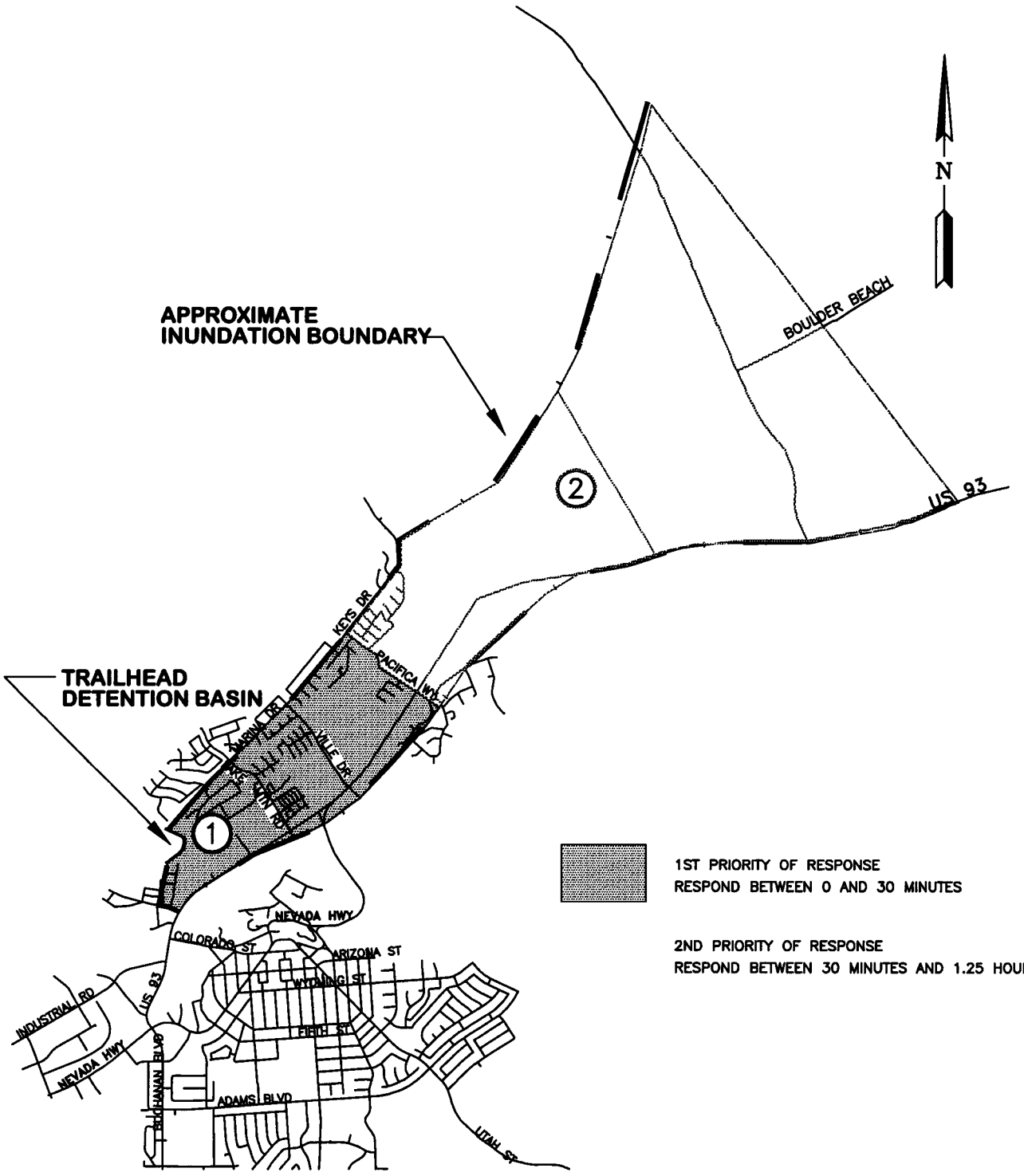
INUNDATION AREA
TRAILHEAD DETENTION BASIN

CLark County Regional Flood Control District
Boulder City, Nevada

FIGURE
2

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		7/00	

RESPONSE



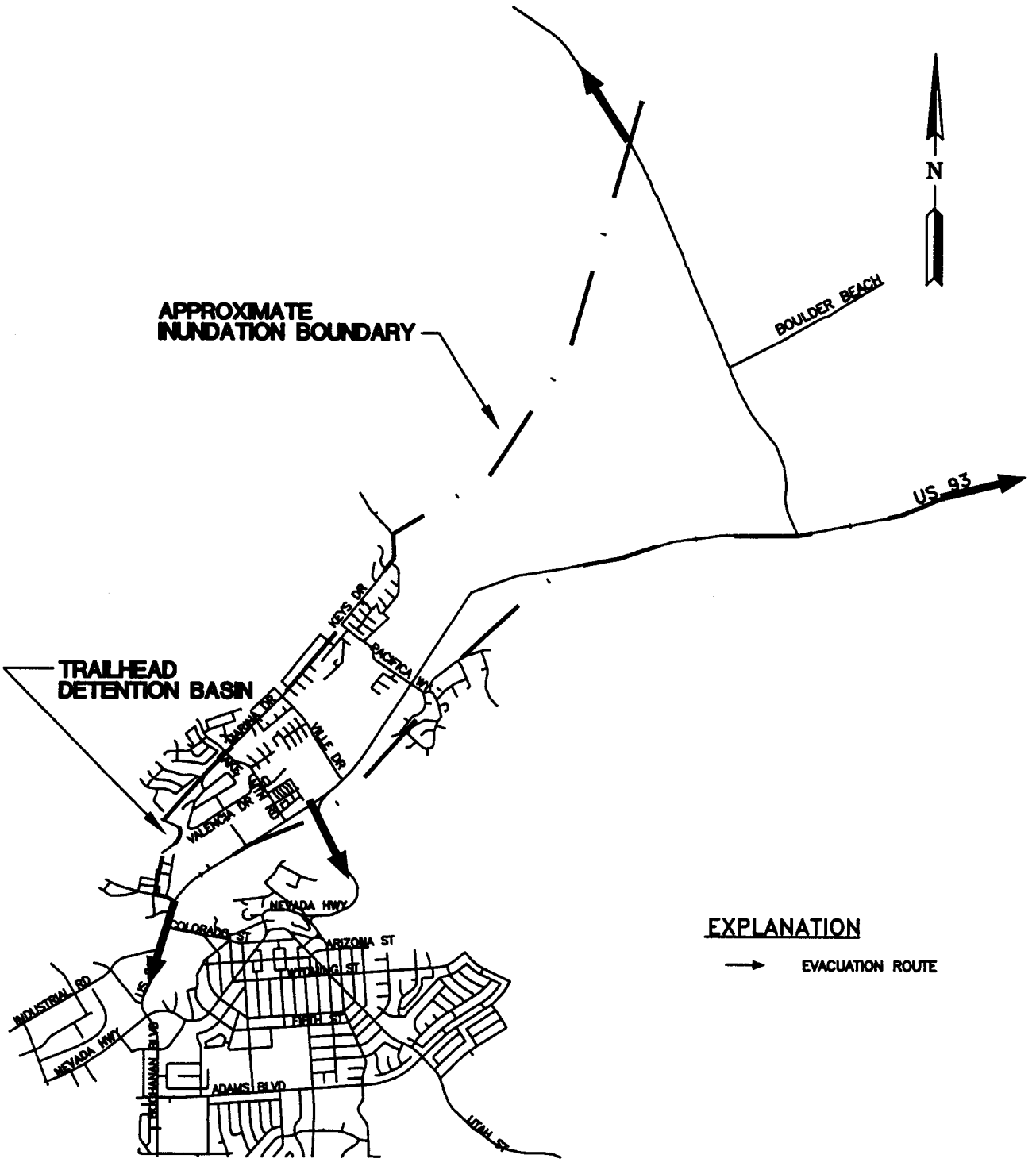
The inundated areas shown on this map reflect an extremely rare event. Publication of this map is not intended to reflect in any way upon the integrity of the structure.

Harding Lawson Associates
Engineering and
Environmental Services

PRIORITY RESPONSE MAP
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

FIGURE
3

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		7/00	



The inundated areas shown on this map reflect an extremely rare event. Publication of this map is not intended to reflect in any way upon the integrity of the structure.

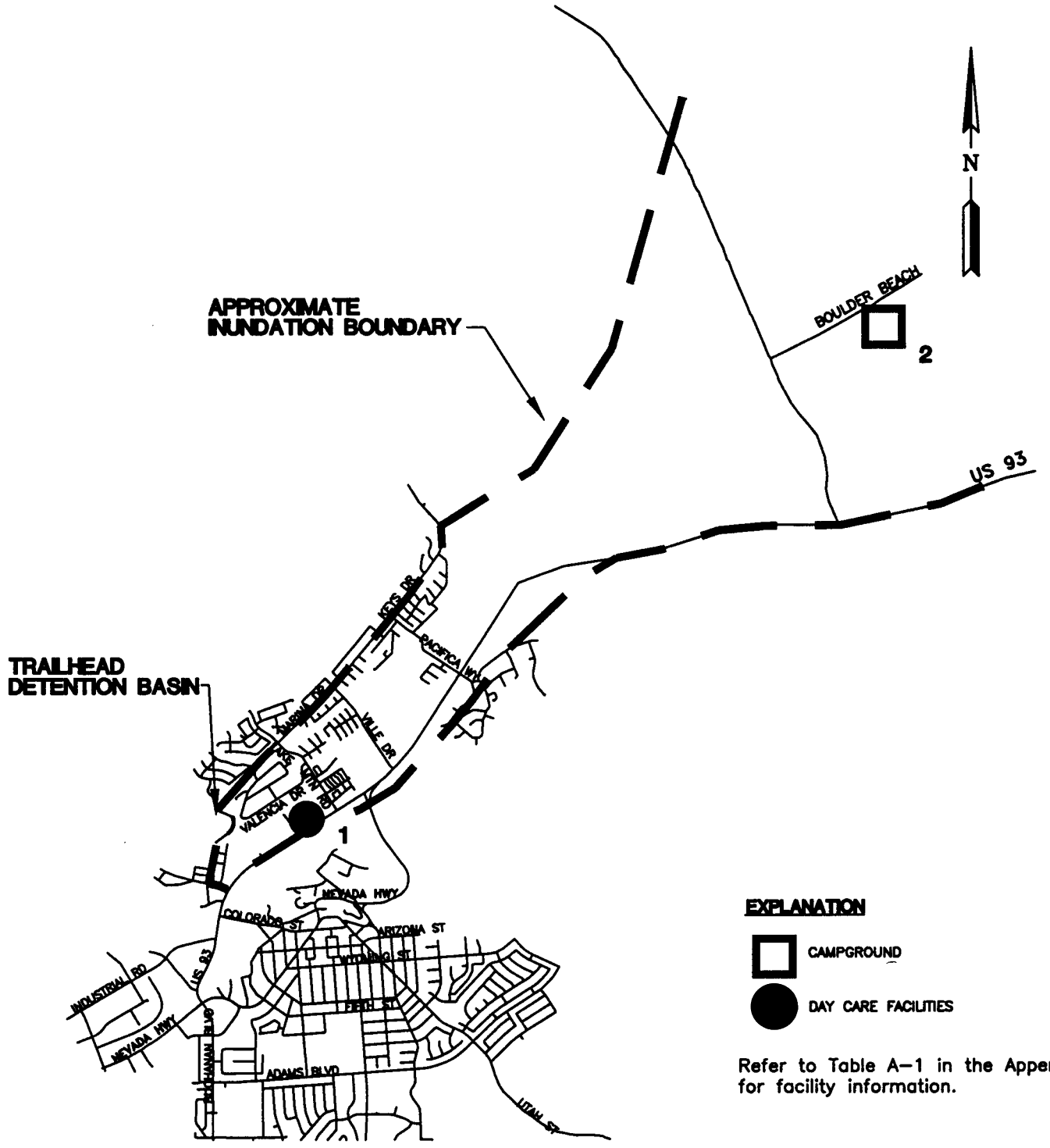
Harding Lawson Associates
Engineering and
Environmental Services

EVACUATION ROUTES
TRAILHEAD DETENTION BASIN

Clark County Regional Flood Control District
Boulder City, Nevada

FIGURE
4

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		7/00	

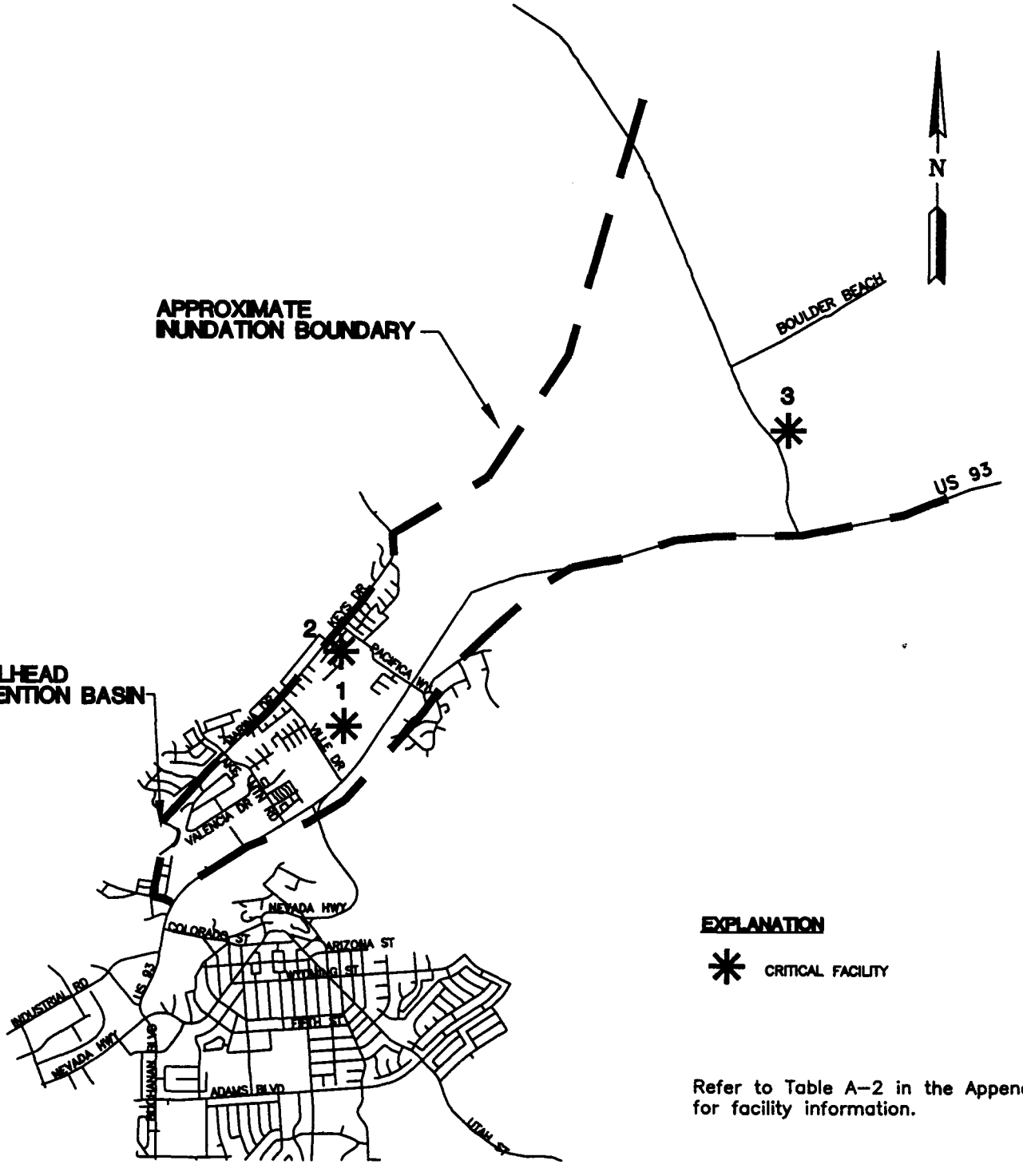


Harding Lawson Associates
Engineering and Environmental Services

PUBLIC FACILITIES
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

FIGURE
5

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		7/00	



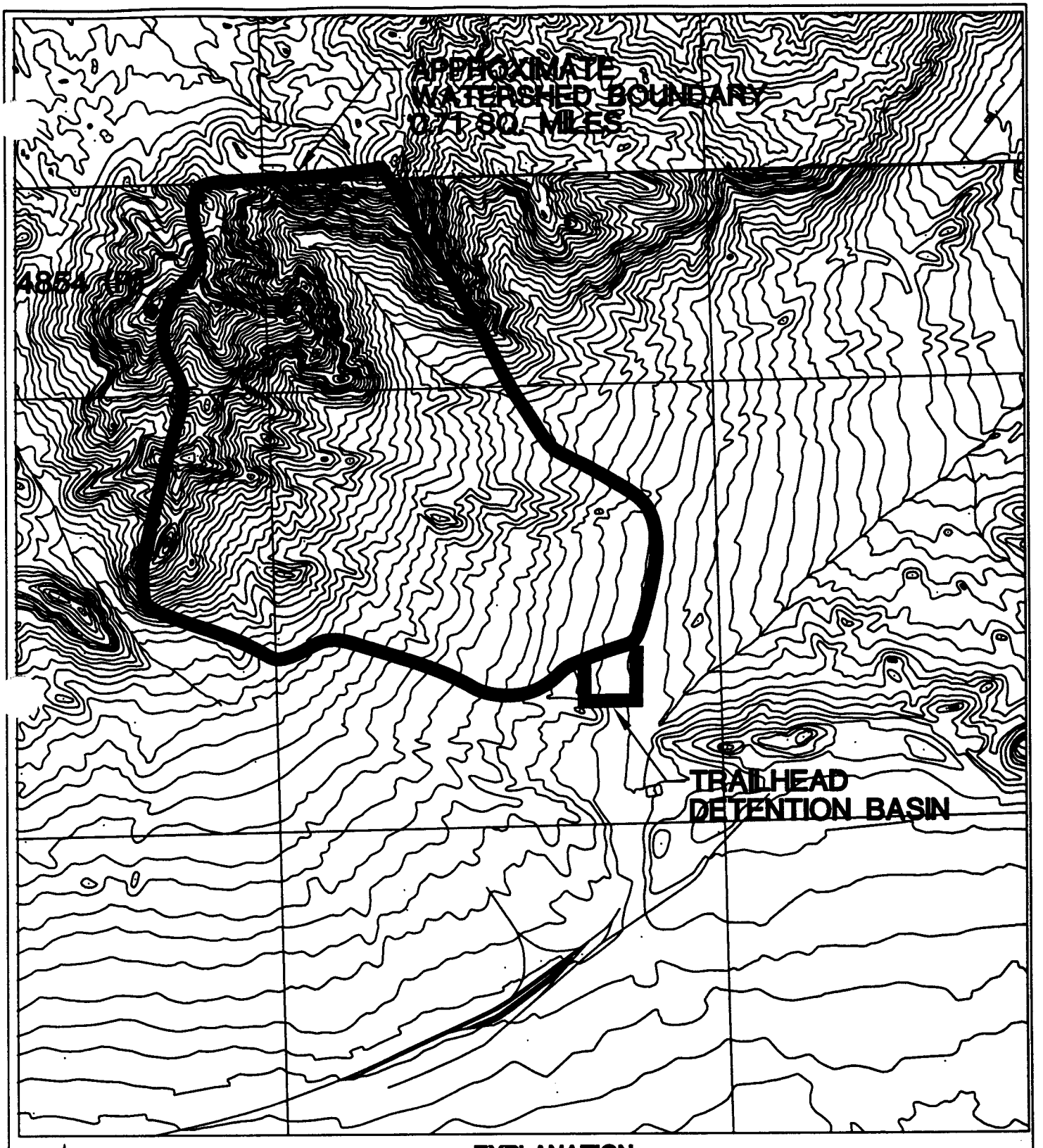
Harding Lawson Associates
Engineering and Environmental Services

CRITICAL FACILITIES
TRAILHEAD DETENTION BASIN

Clark County Regional Flood Control District
Boulder City, Nevada

FIGURE
6

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		7/00	



N

0 500

APPROXIMATE SCALE IN METERS

EXPLANATION

4854 (R) ● GAUGE LOCATION AND IDENTIFICATION NUMBER

R RAIN GAUGE

Harding Lawson Associates
Harding Lawson Associates
Environmental Services

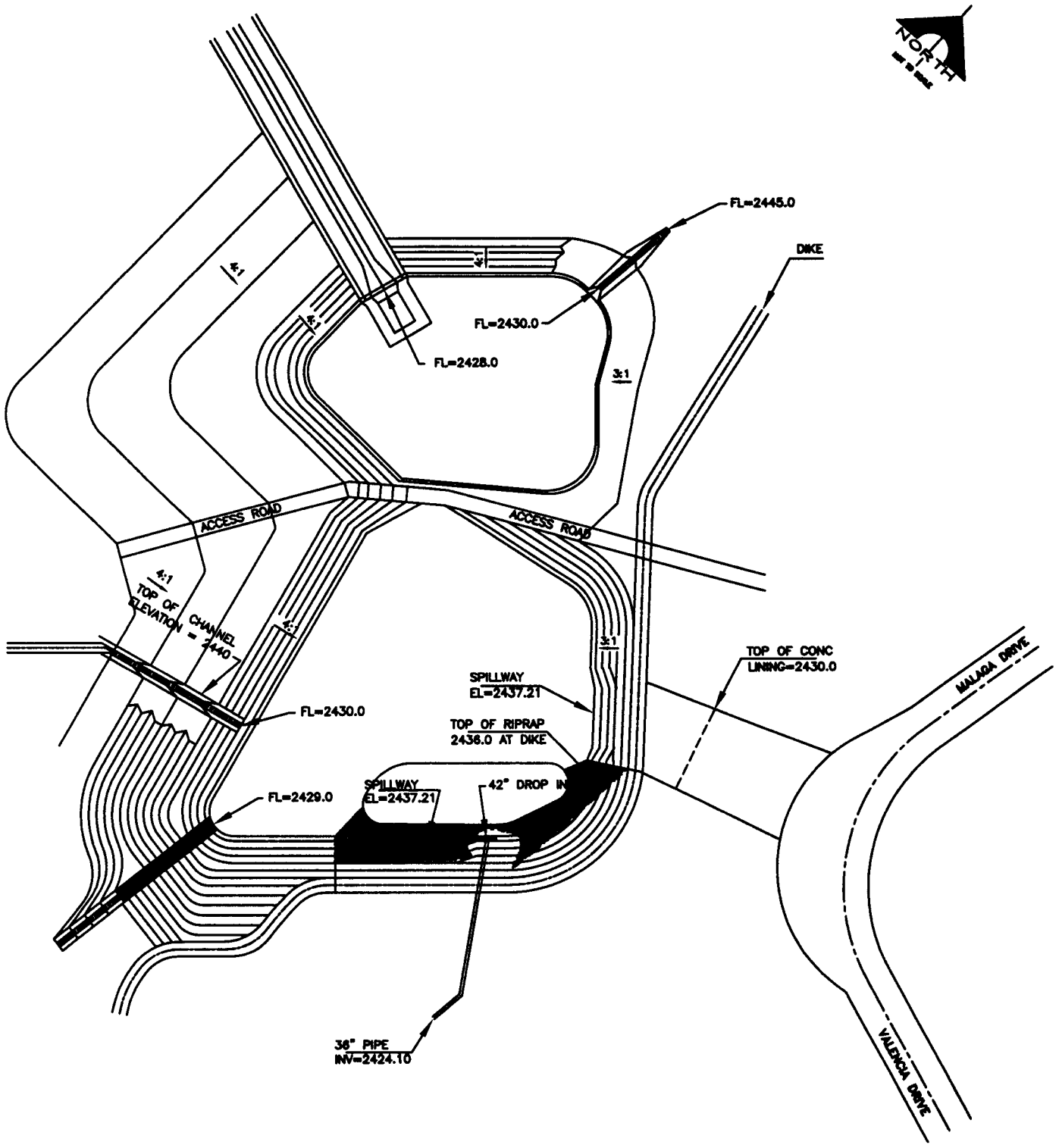
UPSTREAM WATERSHED

TRAILHEAD DETENTION BASIN
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BOULDER CITY, NEVADA

FIGURE 7

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
EBW	50131	EBW	8/00	

PLANVIEW



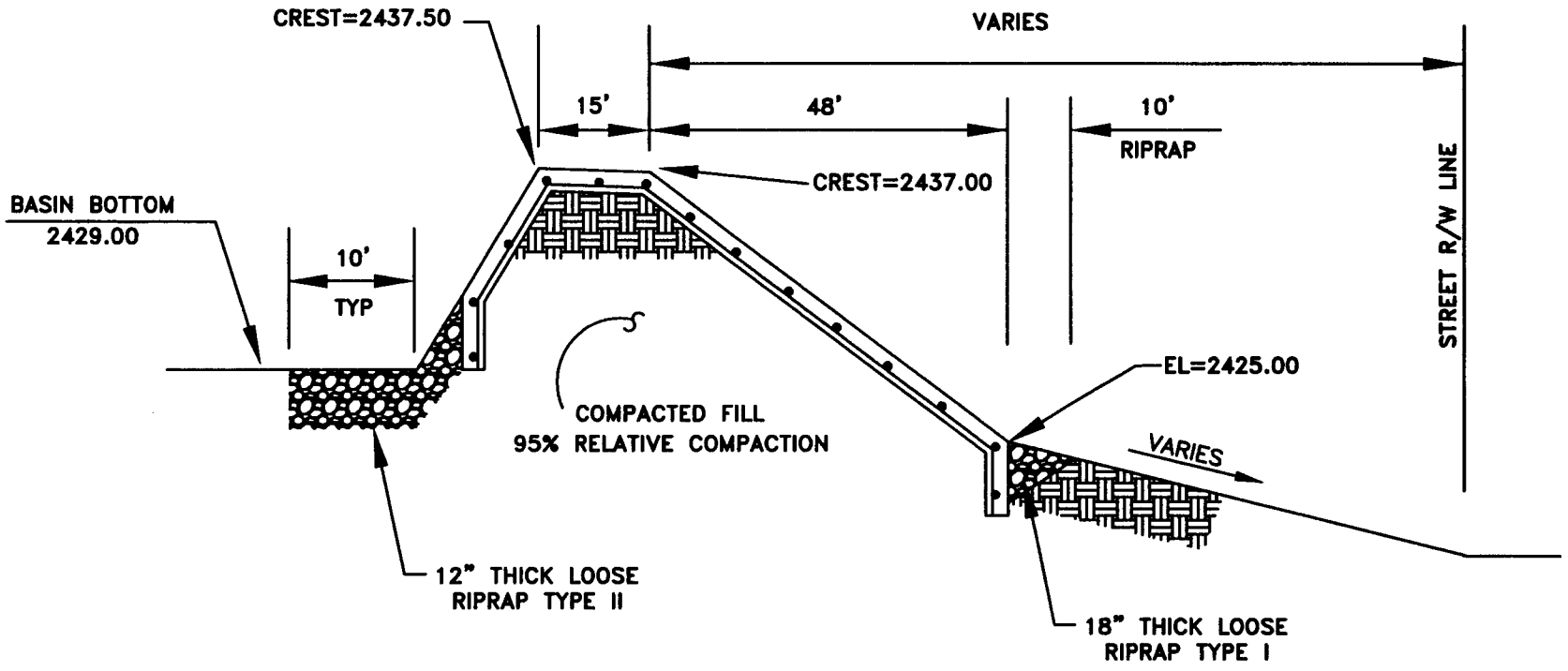
Harding Lawson Associates
Harding Lawson Associates
Environmental Services

PLAN VIEW

TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

FIGURE
8

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
DT	50131		8/00	



CROSS SECTION

FIGURE 6

Harding Lawson Associates
Engineering and Environmental Services

CROSS SECTION
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
DT	50131		8/00	

STAGE VS STORAGE CURVE

TRAILHEAD DETENTION BASIN

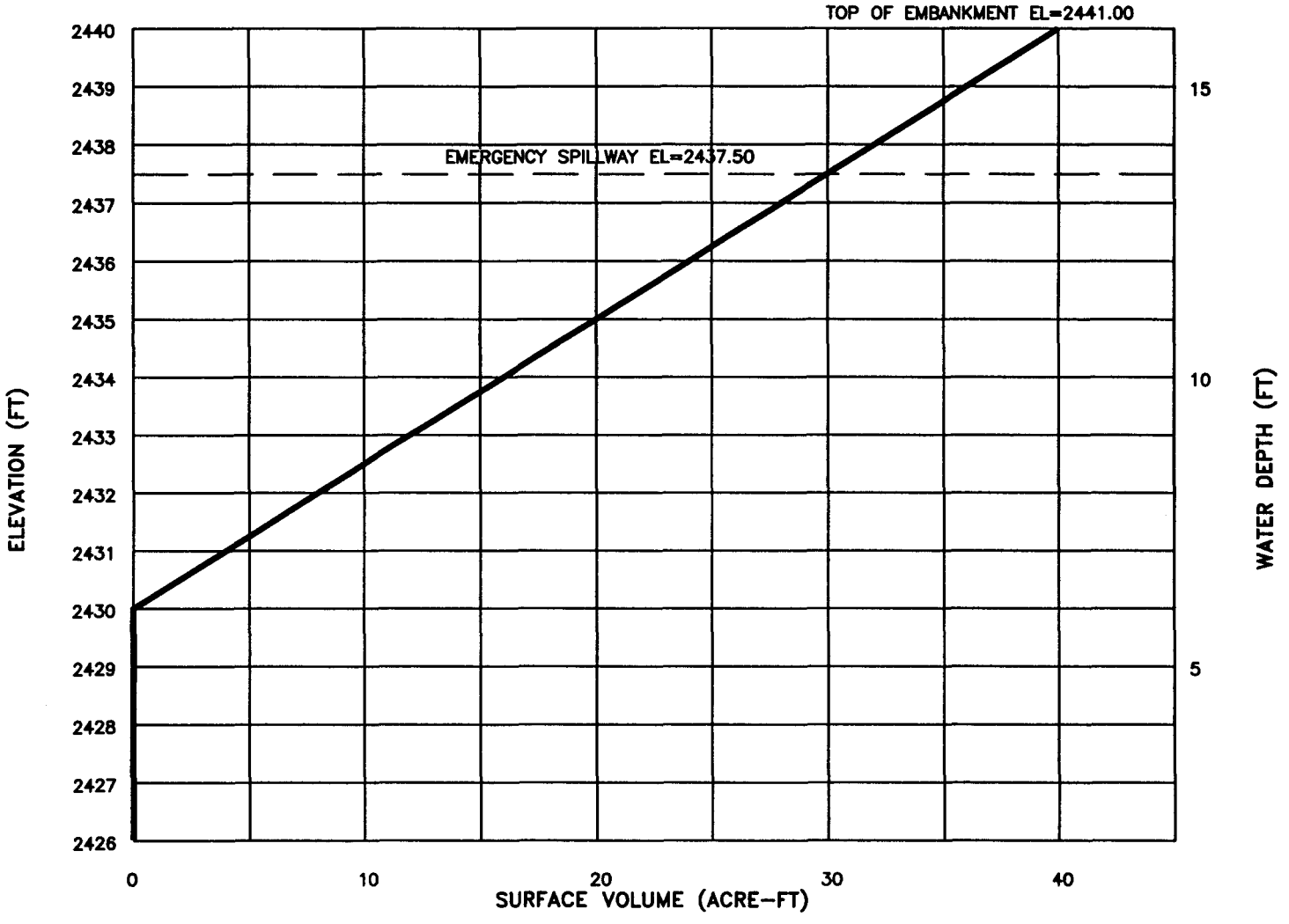


FIGURE 10

Harding Lawson Associates
Engineering and
Environmental Services

STAGE VS STORAGE CURVE
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		8/00	

INFLOW/OUTFLOW HYDROGRAPH

TRAILHEAD DETENTION BASIN

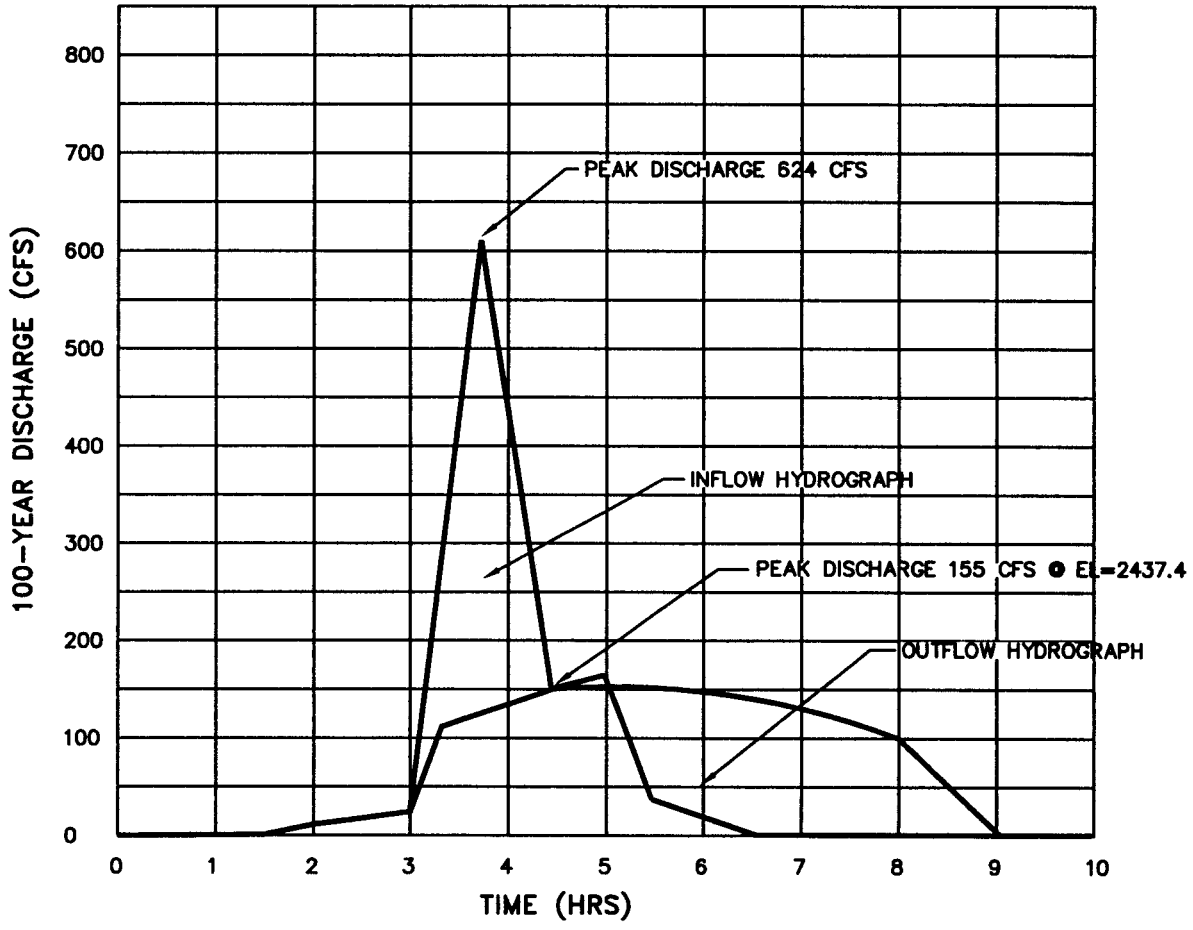


FIGURE 1

Harding Lawson Associates
Engineering and
Environmental Services

INFLOW/OUTFLOW HYDROGRAPH
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		8/00	

STAGE VS SURFACE AREA

TRAILHEAD DETENTION BASIN

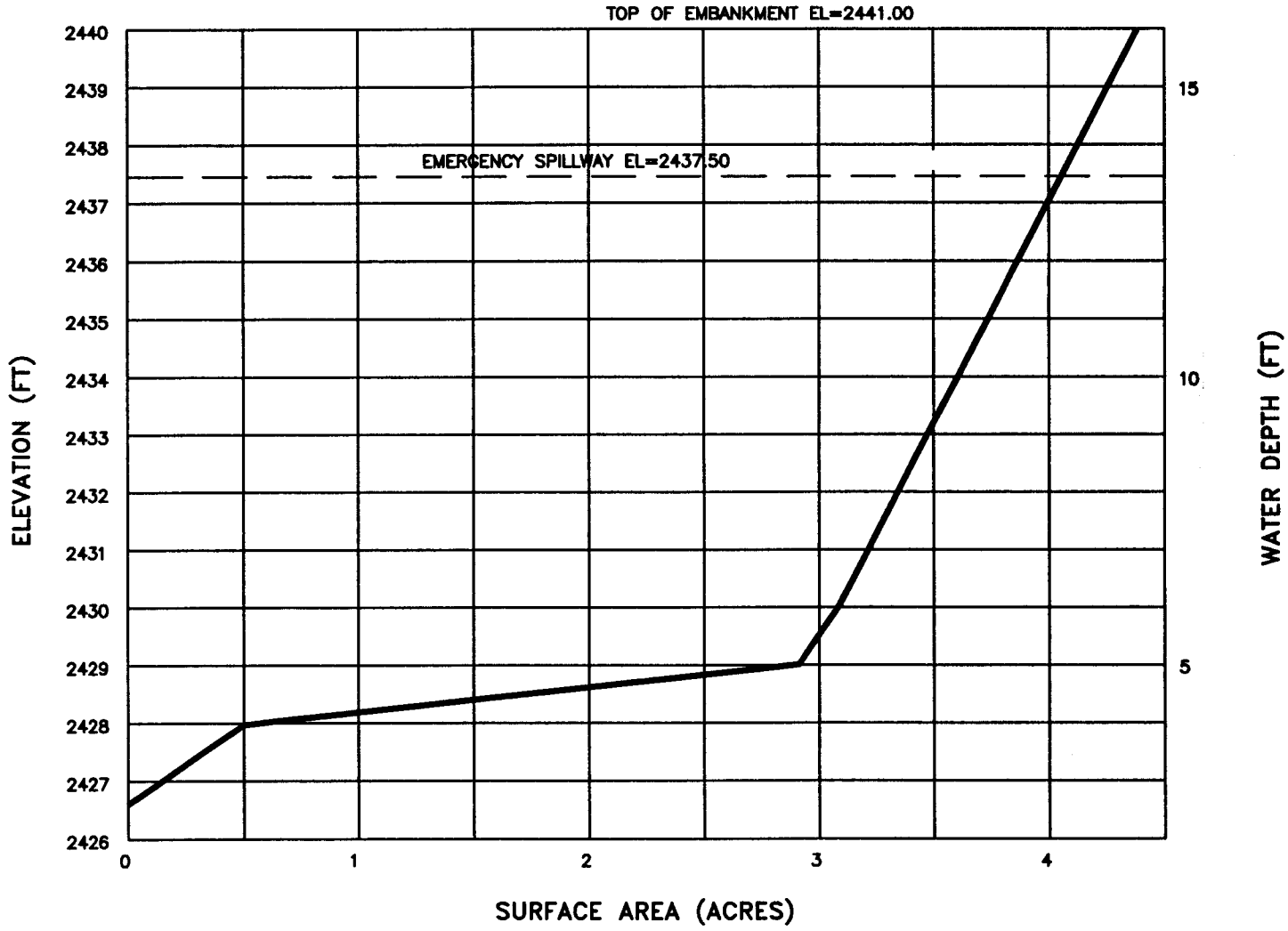


FIGURE 12

Harding Lawson Associates
Engineering and
Environmental Services

STAGE VS SURFACE AREA CURVE
TRAILHEAD DETENTION BASIN
Clark County Regional Flood Control District
Boulder City, Nevada

DRAWN	PROJECT NUMBER	APPROVED	DATE	REVISED DATE
AER	50131		8/00	

Table A-1
TRAILHEAD WASH DETENTION BASIN

HEALTH CARE FACILITIES, SCHOOLS AND PUBLIC FACILITIES IN EVACUATION AREAS

The following agencies will contact Child/Day Care Centers within the respective jurisdictions:

Agency	Contact Name	Phone No.
STATE OF NEVADA BUREAU OF SERVICES FOR CHILD CARE	Natalie	455-3894

PRESCHOOL AND DAY CARE CENTERS			
Name	**Address**	**Contact Name**	**Phone No.**
1. ST. JUDES RANCH FOR CHILDREN	100 St. Jude St.		294-7100

CAMPGROUNDS			
Name	**Address**	**Contact Name**	**Phone No.**
2. BOULDER BEACH CAMPGROUND	Boulder Beach Road	24-Hour Dispatch	293-8932

Table A-2
TRAILHEAD DETENTION BASIN

CRITICAL FACILITIES

FACILITY	ADDRESS	CONTACT NAME	TELEPHONE NUMBER
1. Boulder City Substation	105 Ville Dr.	Dispatch	293-9224
2. SNWA Pumping Station #5	900 Judi Lane	Dispatch	564-7697
3. NPC Boulder Beach Substation		Dispatch	375-1569

Table A-3
Trailhead Detention Basin

EMERGENCY TELEPHONE NUMBERS

Agency	Department/Division	Name	Telephone Number
Boulder City	Emergency	Dispatch	Office: 911
	Public Works Department	General Office: City Hall	Office: 293-9200
		Director: Philip T. Heary, P.E.	Office: 293-9200
		Alternate: Scott Hansen, P.E.	Office: 293-9200
	Department of Fire Services	Director: Dean Molburg	Office: 293-9228
	Department of Planning and Development	Director: John Hoole	Office: 293-9282
	Department of Parks and Leisure Activities	Director: Roger Hall	Office: 293-9256
	Traffic/Electrical Field Operations	Division Manager: Ned Shamo	Office: 293-9200
	City Attorney's Office	Director: Dave Olsen	Office: 293-9238
	City Manager's Office	City Manager: John Sullard	Office: 293-9202
Clark County/ Regional Agencies	Department of Public Works	Administration	Office: 455-6000
		Maintenance Management: John Murdoch	Office: 455-7540 Cellular: 378-6103
		Flood Control: Gil Suckow	Office: 455-7540
	Office of Emergency Management	Manager: Robert Andrews	Office: 455-5710 Cellular: 271-4490 Pager: 253-4860
		Plants & Operations Officer: Jim O'Brien	Office: 455-5710
	Regional Flood Control District	Office Reception:	Office: 455-3139
		General Manager: Gale Fraser, II	Cellular: 379-7651
		Alternate: Kevin Eubanks	Cellular: 379-1632
		Alternate: Stephen Roberts	Cellular: 379-5702
		Alternate: Tim Sutko	Cellular: 378-9536
	Las Vegas Metropolitan Police Department	Emergency Management Coordinator:	Office: 229-2922
		Public Information Officer:	Office: 229-3394 Cellular: 229-5746
		Northeast Area Commander	Office: 229-3151
		Communications Supervisor	Office: 229-3810
	Clark County Fire Department	Administration	Office: 455-7311
	Clark County School District	Emergency Management Coordinator: Dr. Patrick Herron	Office: 799-8712
		Superintendent: Brian Cram	Office: 799-5310
		Emergency Management: Dave Broxterman	Office: 799-8714
		Security: (Emergency Number)	Office: 799-7830 x204
	Clark County Health District	Administration	Office: 385-1291
State Agencies	Division of Emergency Mgmt.	Carson City	Office: (775) 687-4240
	Nevada Highway Patrol	Major Ron Levine	Office: 486-4101
	Nevada Department of Transportation	District Engineer	Office: 385-6500
	State Engineer's Office	State Engineer (Carson City): Michael Turnipseed	Office: (775) 687-4037
		State Engineer (Carson City): Jason King	Office: (775) 687-3861
		State Engineer (SNBO): Robert Coache	Office: 486-2770
Federal Agencies	National Weather Service	Larry Jensen	Direct: 263-9746 x222 24-Hour: 263-9750
	Bureau of Land Management	District Manager	Office: 647-5000
	National Park Service	24-hour Dispatch	Office: 293-8932

TRAIHEAD WASH DETENTION BASIN

SOURCES OF MATERIALS

SAND AND GRAVEL

NAME	ADDRESS	PHONE NUMBER
Canyon Sand, Inc.	500 Parkson Road	565-2225
Hanson Aggregates	1401 American Pacific Drive	565-1313
Wells Cargo	7770 Spring Mountain Road	876-5090
Gornowich Sand and Gravel	3450 South Procyon Avenue	876-2777
Clark Sand and Gravel	3990 Dewey Drive	736-7331
Rock City	1721 West Bonanza Road	648-2400
Frehner Construction Company	124 West Brooks Avenue	649-6250
Nevada Ready Mix	6610 E. Vegas Valley Drive	457-1115
Quality Sand and Gravel	4985 N. Lincoln	644-3668
Allstate Sand and Gravel	6977 E. Charleston Blvd.	871-1510
Stoneworld Company	7200 North Rancho Drive	645-4743

BARRICADES

NAME	ADDRESS	PHONE NUMBER
Traffic Master Company	4845 West Reno Avenue	364-2600
Highway Rentals Traffic Safety	5005 East Carey Avenue	453-2038
Construction Safety	3521 South Valley View Blvd.	367-1972
Nevada Road Control	4205 West Tompkins Avenue	251-5755

DEPARTMENT OF PUBLIC WORKS RESOURCES
SANDBAGS, SAND AND GRAVEL

NAME	ADDRESS	PHONE NUMBER
CLV Public Works East Service Center	3100 E. Bonanza (@ Mojave)	229-6227
CLV Public Works West Service Center	2900 Ronemus (Buffalo/Cheyenne)	229-6227
Fire Station #1	500 N. Casino Center Blvd. (@ Bonanza)	383-2888
Fire Station #2	900 S. Durango (@ Charleston)	383-2888
Fire Station #3	2645 W. Washington Ave. (@ Rancho)	383-2888
Fire Station #4	421 S. 15th St. (@ Charleston)	383-2888
Fire Station #5	1020 Hinson St. (Charleston/Valley View)	383-2888
Fire Station #6	190 Upland Blvd. (Jones/US 95)	383-2888
Fire Station #7	10101 Banburry Cross Dr.	383-2888
Fire Station #8	633 N. Mojave Rd. (@ Bonanza)	383-2888
Fire Station #9	4747 N. Rainblow (@ Lone Mountain)	383-2888
Fire Station #42	7331 W. Cheyenne (@ Tenaya)	383-2888
Clark County Public Works Maintenance Yd.	5825 E. Flamingo (@ Stephanie)	455-7540

Las Vegas Public Works also has a contract with Jensen Precast for concrete barricades.

DETENTION BASIN INSPECTION FORM

DETENTION BASIN NAME: Trailhead Detention Basin	**DATE:**	**TIME:**
LOCATION:	**OBSERVER:**	
EMERGENCY CONDITION:	**DEPT:**	**TELE:**
RESERVOIR WATER LEVEL:	**WEATHER CONDITIONS:**	

INSPECTION NOTES

	LOCATION	OBSERVATIONS/NOTES	ACTION NEEDED
INLETS			
1	Inlet Floors		
2	Sidewalls		
3	Erosion		
4			
5			
EMERGENCY SPILLWAY			
7	Spillway Surface		
8	Approach Slope		
9	Sidewalls		
10	Downstream Roadways		
11	Fencing		
12	Debris Buildup		
13			
OUTLET STRUCTURE			
14	Trash Rack Debris		
15	Vortex Action		
16	Discharge		
17	Structure Condition		
18	Flow in Principal Spillway		
19			

DETENTION BASIN INSPECTION FORM

DETENTION BASIN NAME: Trailhead Detention Basin	DATE:	TIME:
LOCATION:	OBSERVER:	

INSPECTION NOTES:

	LOCATION	OBSERVATIONS/NOTES	ACTION NEEDED
EMBANKMENT CREST			
20	Surface Cracking		
21	Cave Ins		
22	Horizontal Alignment		
23	Vertical Alignment		
24	Ruts and Holes		
25			
UPSTREAM EMBANKMENT SLOPE			
26	Slides and Sloughing		
27	Erosion		
28	Sinkholes		
29	Slope Protection		
30	Observation Wells		
31			
32			
DOWNSTREAM EMBANKMENT SLOPE			
33	Wet or Saturated Areas		
34	Seepage		
35	Slides, Sloughing		
36	Cave Ins, Holes		
37	Slope or Toe Erosion		
38	Slope Protection		
39			

DETENTION BASIN INSPECTION FORM

DETENTION BASIN NAME: Trailhead Detention Basin	**DATE:**	**TIME:**
LOCATION:	**OBSERVER:**	

INSPECTION NOTES:

	LOCATION	OBSERVATIONS/NOTES	ACTION NEEDED
OVERALL SITE CONDITION			
40	**Access Roadways**		
41	**Fencing**		
42	**Security Gates**		
42	**Upstream Erosion**		
44	**Sediment Buildup**		
45			
46			
47			
48			
49			
50			

Additional Notes:

Request For Assistance and Action Follow-up:

TECHNICAL APPENDIX

Trailhead Detention Basin
Inundation Analysis
Boulder City, Nevada

INTRODUCTION

This technical appendix describes the inundation analysis used to model dam-breach flow from the Trailhead Detention Basin. The purposes of the analysis were to model the catastrophic failure of the dam, and to delineate the downstream areas that would be inundated by the modeled flood wave.

The analysis was conducted using the National Weather Service (NWS) DAMBRK flood forecasting computer program (Fread, 1988). This appendix describes the detention basin, the DAMBRK program, the model input, and the results of the inundation analysis. The computer output is not included in this appendix but can be made available upon request.

The analysis was prepared for the limited purpose of presenting the hydraulic calculations and assumptions for the evaluation of inundation due to a dam failure discharge under existing conditions. Harding Lawson Associates is not making any statements or assurances regarding the hydrology, topography, and detention basin plans used in the analysis.

DETENTION BASIN DESCRIPTION

The Trailhead Detention Basin is in Boulder City in sections 4 and 5 of Township 23 South, Range 64 East, and is part of a series of improvements designed to reduce flooding within Clark County. The basin detains storm-water runoff behind an earthen dam constructed to an elevation of approximately 2441 feet above mean sea level (msl). The detention basin has two spillways with both inverts at an elevation of 2437.5 feet, msl. Storage volumes within the detention basin are approximately 30 acre feet at the spillway elevation and 43.5 acre feet at the top of the dam. Flow from the spillway discharges Northeast along Hemenway Valley Wash toward Boulder Beach at Lake Mead.

DAMBRK MODEL DESCRIPTION

The DAMBRK model requires the input of temporal and geometric characteristics of the formation of the breach, topographic cross sections downstream of the detention basin, and an inflow hydrograph to the basin (Fread, 1988). The formation of the breach can be removed from the model and a storm event can be routed through an intact reservoir and the outlet structures. An outflow hydrograph is computed for the discharge through the breach or emergency spillway considering such variables as the breach formation characteristics, the spillway rating curve, reservoir storage volume depletion, and the inflow hydrograph upstream of the basin. A dynamic routing technique is used by the model to compute changes to the flood hydrograph, generated by

the catastrophic breach failure or the emergency spillway discharge, as it advances downstream. Attenuation of the flood hydrograph peak resulting from off-channel storage and frictional resistance is calculated, and travel times, water-surface elevations, and other flow characteristics are computed for each topographic cross section downstream of the basin. In the present analysis, emergency spillway discharge was not modeled.

DAMBRK MODEL INPUT

The DAMBRK program was used to model a hydrograph generated by a catastrophic breach failure from the Trailhead Detention Basin. The modeling of the dam failure, calculations of the breach characteristics, and dynamic routing of the flood hydrograph through the downstream topography were completed in conformance with methods acceptable to the Bureau of Land Management (BLM, 1984).

The catastrophic breach failure DAMBRK analysis utilized the 100-year design storm hydrograph. The 100-year peak discharge used in the analysis was 624 cubic feet per second (cfs). This discharge was based upon a HEC-1 hydrologic model developed for the Trailhead Detention Basin. The detention basin was modeled with the starting water surface at 0.4 feet above the reservoir bottom. The DAMBRK program requires a starting water-surface elevation above the bottom of the reservoir. This initial volume of water does not affect breach discharge. Breach formation was initiated after the inflow volume from the 100-year storm elevated the basin water-surface elevation to 2436.5 feet msl, at approximately 1 foot below the inverts of the emergency spillways. The model began the formation of the breach as a piping breach at elevation 2432 feet msl with a bottom breach width of 50 feet and vertical slopes. No storm-water hydrographs (other than the 100-year design storm hydrograph) were added to the upstream or downstream areas of the model during the breach failure analysis.

CROSS SECTIONS

Eleven cross sections were used in the DAMBRK analysis to model catastrophic breach failure. Topographic cross sections were measured on U.S. Geological Survey (USGS) 7.5 minute quadrangle maps along the stream channel downstream of the Trailhead Detention Basin. The cross-sections were input into the models as a series of elevations and top widths with associated Manning "n" roughness factors, contraction or expansion coefficients, flooding depths, and travel distances (in miles) along the main channel. The farthest downstream cross section was located 4.3 miles downstream of the dam Figure 2.

To maintain numerical stability in the models, it was necessary to begin the analysis with a flow of 150 cfs in the channel. This artificial baseflow did not affect the maximum water-surface elevation in the channel.

A flooding depth of 1 foot above the minimum elevation at each cross section was used in the breach analysis. Flooding depths are not used in the model computations, but only function to tell the model when "flooding" commences. Flooding elevations are input into the model by the user and the model outputs the time in hours when the flood elevation is first exceeded at each

cross section. Additionally, the model calculates the time at which peak flow occurs at each cross section.

BREACH CHARACTERISTICS

The shape of the catastrophic breach was assumed to be rectangular. The breach was assumed to start as a piping failure of the dam. The failure formed a rectangular breach with vertical sides and an ultimate breach bottom elevation of 2426.6 feet msl. The time of formation for the breach to reach maximum size was assumed to be 1 hour. The maximum breach base width was 50 feet. The final breach characteristics used in the DAMBRK model and maximum outflow peak discharge generated by the breach immediately downstream of the dam (at cross section 0.00) are presented in Table 1.

MODEL APPROACH

Once the input was developed, the following approach was employed to generate reasonable results. Reducing the distances between cross sections and reducing the computational time steps improves the DAMBRK model's ability to solve the required equations. In those instances where the program could not generate results, adjustments to the base flow, roughness, and expansion and contraction coefficients were made. Efforts were made to minimize the adjustments as much as possible.

In addition, some sensitivity analysis was conducted on breach characteristics to evaluate the failure scenario. The sensitivity analysis indicated that lower breach piping elevations, wider side slopes, and shorter times to failure, resulted in increased peak discharges.

MODEL OUTPUT SUMMARY

The maximum inundation area downstream of the Trailhead Detention Basin resulting from a dam breach is shown on Figure 2. The figure also illustrates location of the detention basin, stream channel cross-section locations (in miles downstream of the basin), and the locations of roads within the computed area of inundation. Also shown on Figure 2 are the times to flooding, flow velocities, and flow depths for the dam-breach discharge.

References:

Bureau of Land Management, 1984, Preparing Emergency Action Plans, BLM Manual Handbook 9177-2.

Fread, D.L., 1988, The NWS DAMBRK Model: Theoretical Background/User Documentation.

Table 1
Trailhead Detention Basin

BASIN CHARACTERISTICS

Top of Dam (ft. above msl)	Minimum Elevation (ft. above msl)	Spillway Invert (ft. above msl)	Depth at Spillway (ft.)	Volume at Spillway (ac. ft.)
2441	2426.6	2437.5	10.9	30

BREACH CHARACTERISTICS

Initial Breach Piping Elevation (ft. msl)	Final Breach Base Elevation (ft. msl)	Maximum Breach Base Width (ft)	Breach Side Slopes (H:V)	Time to Max. Breach Size (hrs.)
2432	2426.6	50	0	1.0

FLOW CHARACTERISTICS

Peak 100-year Inflow (cfs)	DAMBRK Breach Outflow (cfs)
624	1045

Clark County Regional Flood Control District

and

City of Boulder City

Trailhead Detention Basin

Information References

TITLE	AUTHOR	JURISDICTION	SOURCE	DESCRIPTION
Hemenway Valley Wash Improvement Plans	Coe & Van Loo	Boulder City Public Works	CCRFCD	Addendum #1 Revisions, 1991
Hemenway Valley Wash Improvement Plans	Coe & Van Loo	Boulder City Public Works	CCRFCD	Construction Plans, 1991
Geotechnical Investigation Hemenway Valley Wash Improvements	Converse Consultants Southwest, Inc.	City of Boulder City	CCRFCD	Geotech. Investigation, 1991
Hemenway Valley Wash Improvements (DRAFT)	Coe & Van Loo	Boulder City Public Works	Boulder City	Contract Documents & Special Provisions, 1991
Hemenway Valley Wash Improvements	Coe & Van Loo	Boulder City Public Works	Boulder City	Contract Documents & Special Provisions, 1991
Geotechnical Site AssessmentTrail Head Detention Basin Hemenway Wash	Converse Consultants Southwest, Inc.	Boulder City Public Works	Boulder City	Geotechnical Site Assessment, 1991