

DAM NO. 16 AND 17A  
TX04688 AND TX04689  
EMERGENCY ACTION PLAN

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*May 26, 2011*

Prepared for

City of Denton Parks and Recreation

Prepared by

***KIMLEY-HORN AND ASSOCIATES, INC.***

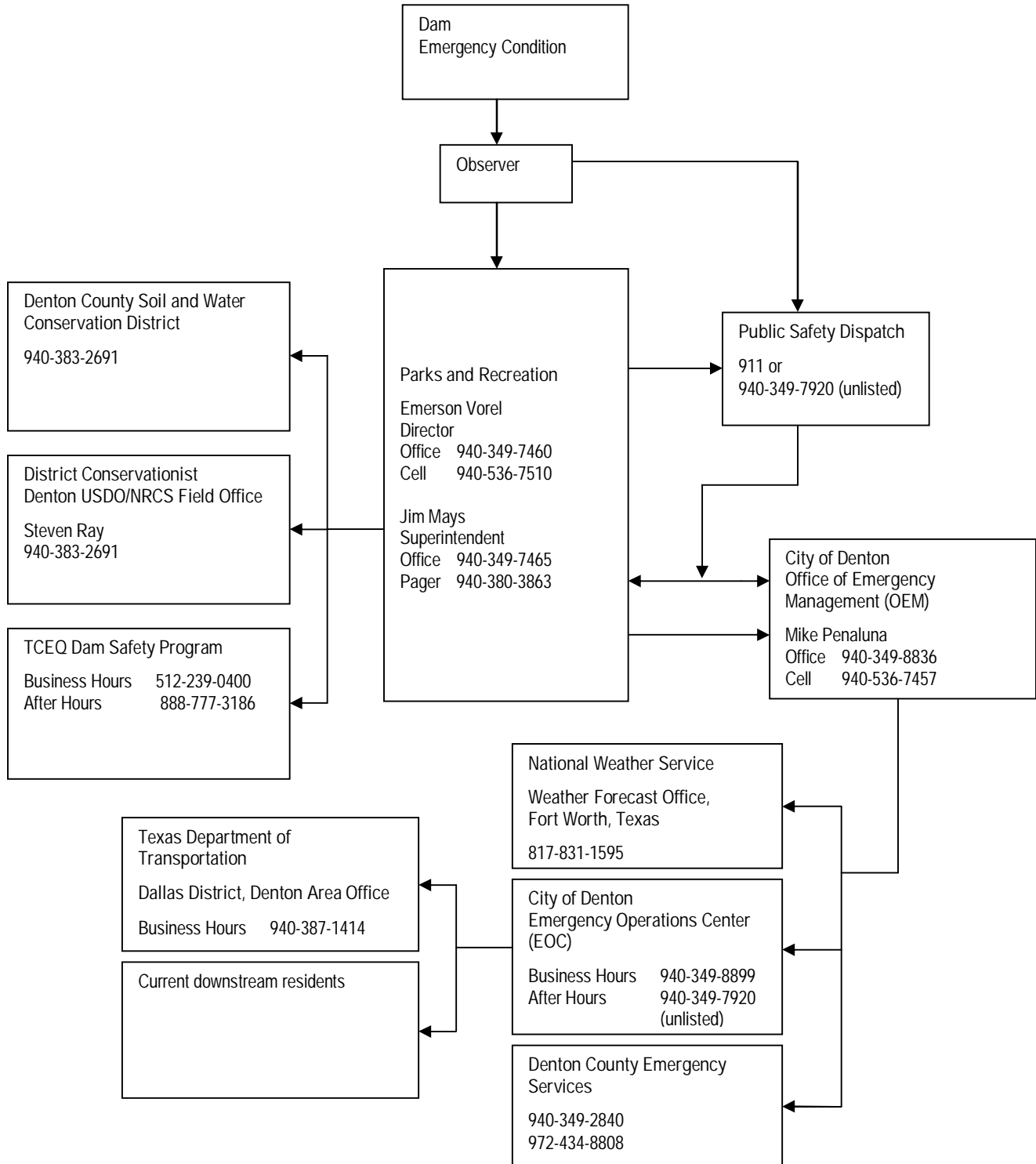


Emergency Action Plan  
Dam No. 16 and 17A  
City of Denton Parks and Recreation

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# NOTIFICATION FLOWCHART





APPROVAL AND IMPLEMENTATION

EMERGENCY ACTION PLAN

DAM No. 16 and Dam No. 17A

This Emergency Action Plan is hereby approved. This plan is effective immediately and supersedes all previous editions.

\_\_\_\_\_  
Mike Penaluna  
Office of Emergency Management

\_\_\_\_\_  
Date

\_\_\_\_\_  
Emerson Vorel  
Director of City of Denton Parks and Recreation

\_\_\_\_\_  
Date

\_\_\_\_\_  
Lewayne Peterson  
Chairman, Denton County Soil and Water Conservation District

\_\_\_\_\_  
Date

# EMERGENCY ACTION PLAN

## DAM NO. 16 AND 17A

### 1. Introduction

Dam No. 16 and Dam No. 17A are owned and operated by the City of Denton Parks and Recreation and the Denton County Soil and Water Conservation District (SWCD). Dam No. 16 is located on Pecan Creek and Dam No. 17A is located on North Pecan Creek in the City of Denton, Texas. North Pecan Creek is a tributary of Pecan Creek, located in the Trinity River Basin. The dams were completed in 1975. The lakes were constructed to serve as flood control structures.

According to the Dam Breach Analysis (Tab 8), if a breach of either dam were to occur, a flood wave would flow downstream through developed areas along Pecan Creek and North Pecan Creek. A breach of either dam has the potential to result in the loss of human life and loss of property.

#### 1.1 Authority

The Texas Commission on Environmental Quality (TCEQ) is the regulatory agency responsible for the dam-safety laws in Texas. The primary goal of the state's dam-safety program is to save lives and reduce property damage that may result from a dam failure. The development and implementation of an Emergency Action Plan (EAP) is a positive step dam owners can take to accomplish dam-safety objectives, to protect their investment, and to reduce the potential liability associated with a dam failure. Title 30, Texas Administrative Code, Chapter 299, gives the state the authority to direct the owner of a dam, pursuant to Texas Water Code 12.052, to take immediate and appropriate action to remedy situations posing serious threat to human life or health, or risk of property damage. In addition, the following authorities formulate organization and operational concepts for emergency planning:

Texas Disaster Act of 1975, Executive Order of the Governor (GWB 95-1a).

*Guidelines for Operation and Maintenance of Dams in Texas*, Texas Commission on Environmental Quality, November 2006. Publication no. GI-357.

#### 1.2 Purpose

The purpose of this Emergency Action Plan is to identify emergency situations that could threaten Dam No. 16 and Dam No. 17A, and to plan for an expedited, effective response to prevent failure of these dams. This plan defines the notification procedures to be followed in the event of a potentially hazardous situation or the potential failure of either dam. The procedures are intended to protect lives and prevent property damage from an uncontrolled release of water from the reservoir.

### 2. Project Description

Dam Owner (both dams):	City of Denton Parks and Recreation
Address:	215 East McKinney Street Denton, Texas 76201
Phone Number:	(940) 349-8836
Fax Number:	(940) 349-8897





### 3. Responsibilities

#### 3.1. Dam Owner's Responsibilities

The owner, City of Denton Parks and Recreation, is responsible for all dam operation and maintenance. The EAP will not designate a specific person for a specific responsibility but instead will designate the person's duties or job description.

The dam operators are Parks and Recreation employees. They should be advised of the necessity of the EAP. The operators are the first line of dam observers and are the persons responsible to initiate implementation of the EAP protocols.

The Parks and Recreation superintendent is in the first line of dam observers and is the person responsible to initiate implementation of the EAP. The superintendent is responsible for conducting routine dam maintenance, such as annual brush control, conducting dam integrity inspections, and notifying the City of Denton Parks and Recreation director of any potential emergency situations. The director is responsible for contacting emergency personnel should a dam failure be imminent.

The Parks and Recreation director is responsible for updating the EAP. An annual EAP review should be conducted to ensure that contact names and numbers are current on the Notification Flowchart.

The superintendent is also responsible for directing specific, incident-appropriate actions that Parks and Recreation employees must take during an emergency, such as opening or closing water intakes and remedial construction activities such as dirt moving, etc. Specific scenarios are not listed in this EAP.

#### 3.2. Responsibilities for Notification

The City of Denton Parks and Recreation superintendent is responsible for inspecting the dam in a potential emergency such as the threat of high waters or a tornado. The superintendent will contact the City of Denton Office of Emergency Management (OEM). Those emergency personnel will determine if an emergency situation is warranted. Sample notifications and news releases appear in Tab 3 and Tab 4.

If warranted, the superintendent will notify the TCEQ Dam Safety Program. The City of Denton OEM will notify the Emergency Operation Center (EOC). The EOC will notify downstream residents under the direction of the OEM. The EOC will implement the notification flowchart for county, regional, and state emergency-management contacts.

#### 3.3. Responsibilities for Evacuation

Local public safety officials shall be responsible for evacuating residents in the event of a dam emergency. After notification by the City of Denton Parks and Recreation superintendent through the City of Denton OEM officials, local public safety officials will be responsible for the warning and evacuation of people in the threatened areas. The potential Inundation Map in Tab 9 should be used for the evacuation.

#### 3.4. Responsibilities for Duration, Security, Termination, and Follow-up

The City of Denton Parks and Recreation superintendent is responsible for monitoring of emergency situations at the dam and for keeping local authorities informed of developing conditions at the dam from the time that an emergency starts until it ends.

The public safety officials are responsible for cordoning off the affected area per the directives of the appropriate emergency personnel.

The City of Denton Parks and Recreation director and the City of Denton OEM coordinator are responsible for declaring that an emergency at the dam is terminated. Applicable authorities will be notified based on the Notification Flowchart.

The appropriate emergency personnel are responsible for the follow-up evaluation after an emergency. Parks and Recreation will be responsible for the written report that should be maintained in this EAP.

### 3.5. Communications

Local officials and downstream residents may be notified by a variety of notification methods, such as CodeRED, cable override, and partnership with radio station KNTU 88.1 FM. The City of Denton uses the CodeRED Emergency Notification System, which is a high-speed telephone communication service for emergency notifications. Additionally, the City of Denton partners with radio station KNTU 88.1 FM, which will interrupt regular broadcasts to provide emergency public information. The City of Denton also has the ability to override the Charter and Grande cable systems to relay messages.

Sample notification messages appear in Tab 3. Verification or authentication of the situation can be made by contacting the City of Denton OEM coordinators. Television and radio can be used as much as possible to notify area residents of the possible dangers. Sample news releases appear in Tab 4. News releases are to be issued by the City public-affairs officer. The following summarizes the notification procedures for different levels of alert:

#### “Abnormal” Condition

1. The City of Denton Parks and Recreation superintendent will be notified.
2. The Parks and Recreation superintendent will notify the Parks and Recreation director and the City of Denton OEM.
3. Parks and Recreation will contact the City Engineer to inspect the situation.

#### “Watch” Condition

1. The City of Denton Parks and Recreation superintendent will notify the Parks and Recreation director and the City of Denton OEM.
2. Parks and Recreation will contact the City Engineer to inspect the situation.
3. A “watch” message will be issued by the EOC to downstream contacts, if so directed by the OEM and Parks and Recreation officials.
4. NRCS and TCEQ will be notified by Parks and Recreation.

#### Possible Dam Failure

1. The City of Denton Parks and Recreation superintendent will notify the Parks and Recreation director and the City of Denton OEM.
2. The OEM will notify the EOC, representatives of the Texas Department of Transportation (Dallas District, Denton Area Office), and Denton County Emergency Services.
3. Parks and Recreation will contact the City Engineer.
4. The EOC will send a “possible dam failure” warning message to downstream residents.
5. Parks and Recreation will notify NRCS and TCEQ.

## Imminent Dam Failure

1. The City of Denton Parks and Recreation superintendent will notify the Parks and Recreation director and the City of Denton OEM.
2. The OEM will notify the EOC, representatives of the Texas Department of Transportation (Dallas District, Denton Area Office), and Denton County Emergency Services.
3. Parks and Recreation will contact the City Engineer.
4. The EOC will issue a "failure" message to downstream residents and evacuation programs shall begin.
5. Parks and Recreation will notify NRCS and TCEQ.

The City of Denton Parks and Recreation director shall ensure notification of personnel in the event of an emergency at the dam, and may delegate contacting some personnel to other Parks and Recreation personnel. The delegation of contacts should be very specific as to which ones are to be made. The Notification Flowchart at the beginning of this report contains contact information for Parks and Recreation staff, as well as the other officials which may be involved in the event of a situation at the dam.

## 4. Possible Emergency Conditions

### 4.1. Situations

Many dam conditions can lead to emergency situations, not all of which will necessitate the implementation of the Emergency Action Plan; however, if any of them occur, the appropriate action must be taken.

- Severe storms: Although generally not in themselves a threat to the dam, severe storms can contribute to an existing problem and hinder any remediation efforts. Severe storms also cause the uncontrolled release of floodwater, and increase flow in already rain-swollen areas.
- Earthquakes: Dam No. 16 and 17A are located in a seismic zone with low activity. An earthquake is, however, a possibility, and appropriate post-earthquake inspections should be performed.
- Tornadoes: Tornadoes do occur in the area, with the potential for structural damage to the dam, possibly resulting in its failure. If a tornado has struck in the area, an inspection of the dam for any signs of damage will be appropriate.
- Sabotage: A threat to damage the dam has been made. Appropriate actions must be taken to protect the dam.

### 4.2. Signs of Failure

The following sections describe some of the different types of failure which could lead to a dam breach. The impacts of a dam breach have been evaluated and the results are included in this report.

- Seepage Failure: Although all earthen embankments allow some minor seepage through the dam or the foundation, excessive, uncontrolled seepage can result in piping (or the movement of embankment material in the seepage flow) and lead to failure. Piping can occur for years at a slow rate. If the piping has progressed to a dangerous level, it will be evident by increased flow or the discharge of muddy water (or both). At that stage,

immediate action to stop the piping is needed. Fully developed piping is difficult to control and is very likely to result in failure. A whirlpool in the reservoir is a sign of uncontrollable piping and necessitates immediate emergency action.

- Embankment or Foundation Sliding: Sliding is usually first apparent when cracks or bulges in the embankment appear. Slides with progressive movement can cause failure of the embankment.
- Structural Failure: The structural failure or collapse of any portion of the service spillway or spillway gates could result in loss of the reservoir. A structural failure of a portion of the spillway could cause piping and possibly embankment failure.
- Overtopping Failure: Overtopping of the embankment results in erosion of the dam crest. Once erosion begins, it is very difficult to stop.

#### 4.3. Emergency Identification

This section lists the conditions and actions which may be used to classify the level of emergency response, as a guide for City of Denton Parks and Recreation personnel.

- Abnormal Condition. Visual evidence of distress at the dam is observed which can be repaired or corrected in the next few months with no immediate action necessary. Contact the City of Denton OEM.
- Watch Condition. A problem is developing; however, the dam is not in danger of failing. Contact the City of Denton OEM.
- Possible Dam Failure. A situation is developing that could cause the dam to fail. Contact the City of Denton OEM.
- Imminent Dam Failure. A dam failure is occurring that may result in flooding that threatens life and property. When the owner determines that no time remains to implement measures to prevent failure, the City of Denton OEM will be notified for implementation of emergency procedures.

In an emergency, the Parks and Recreation superintendent is responsible for the dam's operation, maintenance and inspection. The early identification of potentially dangerous conditions can allow time for the implementation of emergency action plans. It is important to understand how distress can develop into failure. With appropriate action, distress need not lead to a catastrophic failure of the dam. Early identification, close monitoring, planned action and remedial measures will help alleviate a potentially dangerous situation. The following sections describe some of the different levels of distress which could lead to a dam breach.

##### A. Abnormal Condition

Periodic inspections of the dam by City of Denton Parks and Recreation personnel will evaluate its structural safety, stability, and operational adequacy. If Parks and Recreation personnel who visit the dam site notice visual evidence of distress, the structure should be inspected by the City Engineer. In the event of an abnormal occurrence, such as a tornado, earthquake, or unusually heavy rainfall, special inspections by the City Engineer of the embankment and spillway are warranted. An abnormal condition can generally be repaired or corrected in the next few months with no immediate action necessary.

The conditions listed below are not normal occurrences. These conditions are summarized in Tab 2, along with recommended actions. When these conditions are present, they should be noted, and action should be taken to prevent the possible failure of the dam.

- piping or boils in the area of any structure such as the embankment, spillway, or in the vicinity of the toe of the embankment, as evidenced by muddy water
- slides or sloughs in the embankment, discharge channel or abutments
- a significant increase in seepage quantities through or under the embankment, abutments or emergency spillway
- unusual vertical or horizontal movement or cracking of the embankment or abutments
- small sinkholes or subsidence within 500 feet of the embankment or spillway
- excessive displacement of the soil cement on the embankment slope
- an earthquake
- a severe storm
- a tornado
- threat of sabotage

In the event that any of these items are observed, the City Engineer should be contacted to inspect the dam to document the distress and determine whether remedial action is necessary. Notification of local authorities is not necessary for "abnormal" conditions.

#### B. "Watch" Condition

If a problem has been detected at the dam which requires constant monitoring or immediate action to repair and the condition is manageable by City of Denton Parks and Recreation staff, a "Watch" condition exists. A "watch" indicates that a significant problem that may potentially progress to a dangerous situation has been detected, but that a breach is considered unlikely and no flooding is imminent. A "watch" will continue until the problem is corrected or a "possible dam failure" warning is issued.

This situation will require monitoring and repair or correction as soon as possible. Upon detection, the notification procedures must be implemented in accordance with the instructions in Tab 2. The Parks and Recreation superintendent shall institute all practicable measures to mobilize personnel to control the situation. The following is a list of conditions which constitute "watch" conditions:

- small boils if conditions are muddy, on the downstream slope of the embankment or downstream from the toe, or if there is flowing muddy water downstream from the embankment
- large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe
- any slide that degrades the crest of the embankment or that is progressively increasing in size
- significantly increasing seepage or flow
- cracking or movement of any concrete structure
- the engagement of the emergency spillway

### C. Possible Dam Failure

A “watch” condition that is progressively getting worse is considered a possible dam failure. Efforts to correct the situation will continue, and—although there is no imminent danger—if conditions continue to deteriorate, a dam failure could occur. A “possible dam failure” condition generally has already involved extensive efforts by City of Denton Parks and Recreation personnel and potentially other contractors. A “possible dam failure” condition will continue until the problem is corrected, or until an “imminent dam failure” warning is issued.

The Parks and Recreation superintendent will immediately notify the City of Denton OEM officials and others in accordance with the Notification Flowchart. He or she will continue all practicable measures to correct the problem, including lowering the reservoir level if appropriate. The existence of any of the following conditions constitutes possible dam failure:

- large boils, increasing in size and flow rate, especially if there is flowing muddy water
- significantly increasing seepage, especially flowing muddy water
- slides involving a large mass of material that impairs the crest of the dam and is continuing to move
- sinkholes with seepage flowing muddy water
- large cracks, movement or failure of a portion of any major concrete structure that forms an integral part of the dam
- an increase in the reservoir level to near the top of the dam
- overtopping of a concrete dam that is not designed for overtopping

### D. Imminent Dam Failure

“Imminent failure” is the determination that a “warning” condition will most likely progress to a failure of the dam and the reservoir will be uncontrollably released, regardless of the actions taken. When this determination is made, immediate notification and warning of downstream areas becomes the primary concern. The existence of any of the following conditions constitutes imminent failure:

- rapidly increasing boils or the presence of new, significantly flowing boils, particularly muddy ones near previously identified ones
- rapidly increasing seepage, especially flowing muddy water
- slides involving a large mass of material or which have degraded the crest of the embankment to a level that approaches the water surface level, or if significant seepage is observed through the slide area
- settlement that is predicted to degrade to the reservoir level
- cracks that extend to the reservoir level
- significant movement or failure of any major concrete structure that forms an integral part of the dam
- overtopping of an earthen dam

## E. Dam Failure

A dam failure has occurred and a flood wave is moving downstream. Flooding will occur immediately and will continue to move downstream until water levels in the reservoir are stabilized. Considerable destruction can be expected, and evacuation of low-lying areas should continue.

### 4.4. Other Considerations

#### Access

Alternate access routes should be planned in the event of an emergency at the dam. Dam 16 is reachable from Bonnie Brae Street on the west, Windsor Drive on the north and from State Highway 380 (University) on the south. Dam 17A is reachable from State Highway 77 on the north and Windsor Drive to the south. All-weather access to the downstream toe of either dam may be unavailable during adverse weather conditions. For developing situations near the downstream toe of the dam, gravel may need to be brought in to stabilize a road in that area.

#### Darkness

In a nighttime emergency, the City of Denton Parks and Recreation superintendent should arrange for access to generators and lights to adequately monitor the situation.

## 5. Preventive Actions

Preparations are to be taken to prevent, or to help reduce the effects of, a dam failure and facilitate emergency response. The following are some steps that could prevent or delay failure after an emergency is first discovered. These actions should only be performed under the direction of a qualified professional engineer or contractor. In all cases the personnel of the TCEQ Dam Safety Office must be notified.

Due to the seriousness of the items discussed below, it is paramount that the City of Denton OEM be notified should any of these situations occur.

### If the Dam's Integrity Is Threatened

#### Overtopping by flood waters

- (a) Give erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas.

#### A slide on the upstream or downstream slope of the embankment

- (a) Lower the water level in the reservoir at a rate, and to an elevation, considered safe given the slide condition. If the outlet is damaged or blocked, pumping or siphoning may be required.
- (b) Stabilize any slide on the downstream slope by weighting the toe area below the slide with additional soil, rock, or gravel.

#### Erosional seepage or leakage (piping) through the embankment, foundation, or abutments

- (a) Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting, if the entrance to the leak is in the reservoir).
- (b) Lower the water level in the reservoir until the flow decreases to a non-erosive velocity or until it stops.
- (c) Place an inverted filter (a protective sand-and-gravel filter) over the exit area to hold materials in place.

- (d) Continue lowering the water level until a safe elevation is reached; continue operating at a reduced level until repairs are made.

A failure of an appurtenant structure such as an inlet or outlet of the spillway

- (a) Implement temporary measures to protect the damaged structure, such as closing the inlet or putting in place temporary protection for a damaged spillway.
- (b) Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair.
- (c) Lower the water level in the reservoir to a safe elevation. If the inlet is inoperable, pumping or siphoning may be required.

A mass movement of the dam on its foundation (spreading or mass sliding failure)

- (a) Immediately lower the water level until excessive movement stops.
- (b) Continue lowering the water level until a safe level is reached; continue operation at a reduced level until repairs are made.

Auxiliary spillway erosion threatening reservoir evacuation

- (a) Provide temporary protection at the point of erosion by putting in place sandbags, riprap materials, or plastic sheets weighted with sandbags.
- (b) Consider pumps and siphons to help reduce the water level in the reservoir.
- (c) When inflow subsides, lower the water in the reservoir to a safe level; continue operating at a lower water level in order to minimize spillway flow.

Excessive settlement of the embankment

- (a) Lower the water level by releasing it through the outlet or by pumping or siphoning.
- (b) If necessary, restore freeboard, preferably using sandbags.
- (c) Lower the water in the reservoir to a safe level; continue operating at a reduced level until repairs can be made.

Malicious human activity (sabotage, vandalism, or terrorism)

- (a) If malicious human activity that could endanger public safety is suspected, contact law-enforcement personnel for their help in evaluating the situation.
- (b) If the principal spillway has been damaged or plugged, implement temporary measures to protect the damaged structure. Employ experienced, professional divers, if necessary, to assess the problem and possibly implement repair.
- (c) If the embankment or auxiliary spillway has been damaged or partially removed, provide temporary protection in the damaged area by putting in place sandbags, riprap materials, or plastic sheets weighted with sandbags. Use pumps and siphons to help reduce the water level in the reservoir.
- (d) If the water supply has been contaminated, immediately close all inlets to the water supply system and notify appropriate authorities.

## 6. Supplies and Resources

In an emergency, equipment, supplies, and other resources may be needed on short notice, such as sandbags, riprap, fill materials, and heavy equipment. Resources that may be helpful include:



- earth-moving equipment
- riprap
- sand and gravel
- sandbags
- pumps
- pipe
- laborers
- lighting equipment
- ATVs

The City of Denton Parks and Recreation superintendent should coordinate with the Streets and Drainage superintendent to obtain equipment or coordinate with local contractors.

Parks and Recreation will also be in direct consultation with the TCEQ Dam Safety Office, which is able to offer appropriate plans of action and advice.

In any EAP implementation, the Notification Flowchart will apply.

## 7. Inundation Maps

The impacts of a dam breach have been evaluated and the results are included in the Dam Breach Analysis (Tab 8). The complete dam breach evaluations for each dam are provided in *Dam Breach Analysis for SCS Dam Number 16 North Lakes Park Pond* and *Breach Inundation Mapping for NRCS Floodwater Retarding Dam No. 17A*. The inundation mapping resulting from the breach analyses is included in Tab 9. It illustrates the areas subject to flooding for a failure of the dams. Also included on these maps are the times to flood associated with bridge crossings.

After examining the results of the breach analyses of both Dam No. 16 and 17A, it has been determined that there were a significant number of structures that could be affected due to a dam breach. These structures are located along Pecan Creek and North Pecan Creek. The City of Denton can suffer a dramatic impact from a breach of either dam.

The Dam Breach Analysis provided in Tab 8 contains profiles of the peak flood levels expected, as well as an estimation of the time from the beginning of the breach to the peak flood elevations. A comparison of the areas that are likely to be flooded with the plots showing the times from the start of the breach to the flooding shows the areas of evacuation and the time constraints involved. Tables included on the inundation mapping (Tab 9) include information on the estimated impact of flooding on the bridges along Pecan Creek and North Pecan Creek. These structures may suffer such impacts before the peak elevation of the flood wave.

## 8. Implementation

### 8.1. Plan Maintenance

This plan should be reviewed every five years and revised as necessary. A distribution list for this plan is included in Tab 7. The Notification Flowchart should be updated once a year. Approval of the plan is provided at the front of the report. A new approval should be attached to each annual update of the plan, as well as a log of any sheet changes.

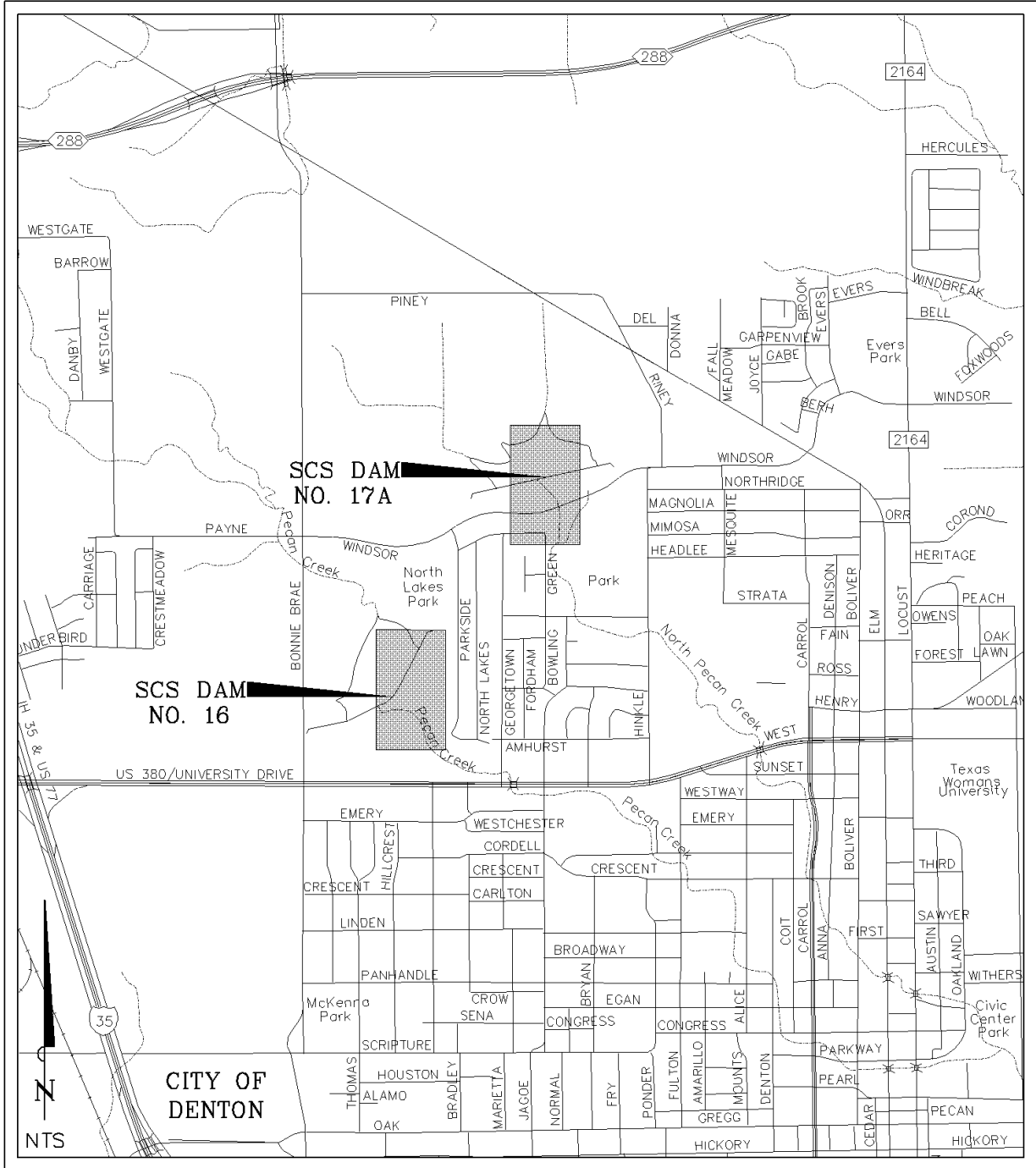
## 8.2. Training

All people involved in the EAP shall be trained to ensure that they are thoroughly familiar with its elements, the availability of equipment, and their responsibilities and duties under the plan. Personnel shall be trained in problem detection, evaluation, and appropriate corrective measures. This training is essential for proper evaluation of developing situations at all levels of responsibility.

## 8.3. Testing

A tabletop exercise shall be conducted at least once every five years. The purpose of this exercise is to review the plan with key personnel. Any revisions to the plan will be implemented after the exercise. The timing and frequency of testing can be adjusted as needed by the Parks and Recreation superintendent. The table top exercise should include emergency scenarios; notification of participants, including verification of all phone numbers and personnel; and notification of local officials. Area residents should not be included. Records of training and exercises should be maintained in Tab 5.

**TAB 1**  
**VICINITY MAP**



TAB 2

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Boils	Small boils, no increase of water flow, flowing clear water	Abnormal	Notify the City Parks and Recreation superintendent during normal work hours. Call the City Engineer for inspection.	Closely check all of downstream toe, especially in the vicinity of boil for additional boils, wet spots, sinkholes, or seepage. Closely monitor entire area for changes or flow-rate increases	None	Site and location, approximate flow
	Large or additional boils near previously identified ones, without increasing flow rate, but carrying small amount of soil particles	Watch	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Monitor as described above. Construct sandbag ring dikes around boils, to cover them with water to retard the movement of soil particles. Filter cloth may be used to retard soil movement, but do not retard the flow of water.	Sandbags, filter cloth	Site and location, approximate flow
	Large or additional boils near previously identified ones, increasing flow rate, carrying soil particles	Possible Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue 24-hour surveillance. Continue monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Issue a warning to downstream residents.	Sandbags, pump	Site and location, approximate flow
	Rapidly increasing size of boils and flow increasing and muddy water	Imminent Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the boil area.	Dozer, shovels, source of earthfill	Site and location, approximate flow

TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Date to Record
Seepage	Minor seepage of clear water at toe, on slope of embankment, or at the abutments	Abnormal	Notify the City Parks and Recreation superintendent, Plant Coordinator and Plant Engineer during normal work hours. Call the City Engineer for inspection.	Closely check entire embankment for other seepage areas. Use wooden stakes or flagging to delineate seepage area. Try to channel and measure flow. Look for upstream whirlpools.	Wooden stakes, flagging	Site, location, approximate flow
	Additional seepage areas observed flowing clear water and/or increasing flow rate.	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Monitor as described above. Construct measuring weir and channel all seepage through weir. Attempt to determine source of seepage.	Dozer, shovels	Site, location, approximate flow
	Seriously or rapidly increasing seepage, underseepage, or drain flow.	Possible Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue 24-hour monitoring and remedial action as described above. Initiate emergency lowering of the reservoir. Construct a large ring dike around the seepage area.	Dozer, shovels, source of earthfill	Site location, approximate flow
	Additional seepage areas with rapid increase in flow and muddy water.	Imminent Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county/city emergency management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Employ all available equipment to attempt to construct a large ring dike around the seepage area.	Dozer, shovels, source of earthfill	Site location, approximate flow

TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Slides or severe erosion	Skin slide or slough on slope of embankment. No further movement of slide and embankment crest not degraded.	Abnormal	Notify the City Parks and Recreation superintendent during normal work hours. Call the City Engineer for inspection.	Examine rest of embankment for other slides. Place stakes in slide material and adjacent to it for determining if further movement is taking place.	Stakes, tape measure	Distance between stakes
	Slide or erosion involving large mass of material, crest of embankment is degraded, no movement or very slow continuing movement.	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Mobilize all available resources and equipment for repair operations to increase freeboard and to protect the exposed embankment material. Start filling sandbags and stockpile near slide area.	Dozer, shovels, sources of earthfill, sandbags.	Distance between stakes
	Slide or erosion involving large mass of material, crest of embankment is degraded, progressively increasing in size.	Possible Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue monitoring and remedial actions as described above. Place additional material at the toe of the slope to stop the slide.	Dozer, shovels, source of earthfill, pump.	Distance between stakes
	Slide or erosion involving large mass of material, crest of embankment is severely degraded, movement of slide is continuing and may reach pool level.	Imminent Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam safety officials, and the City Engineer immediately.	Downstream evacuation. Utilize all available equipment and personnel to sandbag the degraded slide area to prevent it from overtopping.	Dozer, shovels, sandbags, pump.	Distance between stakes

TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Sinkholes	Sinkholes anywhere on the embankment or within 500 feet downstream from the toe.	Abnormal	Notify the City Parks and Recreation superintendent during normal work hours. Call the City Engineer for inspection.	Carefully walk the entire embankment and downstream area looking for additional sinkholes, movement, or seepage.	Stakes, flagging	Size, location
	Sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Monitor as above. Construct sandbag dike around the seepage exit point to reduce the flow rate. Start filling sandbags and stockpile near sinkhole.	Dozer, shovels, pump	Size, location
	Large sinkholes with corresponding seepage anywhere on the embankment or downstream from the toe.	Possible failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue monitoring and remedial action as described above. Utilize sandbags to increase the freeboard on the dam if necessary.	Sandbags, dozer, pump	Size, location
	Sinkholes rapidly getting worse, seepage flowing muddy water and increasing flow.	Imminent failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Utilize all available equipment and personnel to attempt to construct a large ring dike around the area.	Dozer, shovels, pump	Size, location

TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Settlement	Obvious settlement of the crest of the embankment, especially adjacent to concrete structures.	Abnormal	Notify the City Parks and Recreation superintendent during normal work hours. Call the City Engineer for inspection.	Look for bulges on slope or changes in crest alignment.	None	Size, location
	Settlement of crest of embankment that is progressing, especially adjacent to concrete structures or if any corresponding seepage is present.	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Mobilize all available resources for repair operations to increase freeboard. Fill and stockpile sandbags. Identify any boils near settlement points for flowing material and pursue action for boils.	Sandbags, dozer, shovels, source of earthfill.	Size, location
	Settlement of crest of embankment that is rapidly progressing especially adjacent to concrete structures or if any corresponding seepage is flowing muddy water or increasing flow.	Possible failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue monitoring and remedial actions as described above. Use sandbags to increase the freeboard on the dam if necessary.	Sandbags, dozer, shovels, source of earthfill.	Size, location
	Progressing settlement that is expected to degrade the embankment to reservoir level.	Imminent failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Utilize all available equipment and personnel to build up the crest in the area that is settling. Identify any boils near settlement points for flowing material and pursue action for boils.	Dozer, shovels, source of earthfill, sandbags.	Size, location



TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Cracking	Cracks in the embankment crest or on slopes.	Abnormal	Notify the City Parks and Recreation superintendent during normal work hours. Call the City Engineer for inspection.	Walk on entire crest and slope and check for additional cracking.	Stakes, tape measure	Size, location
	Numerous cracks in crest that are enlarging, especially those perpendicular to the centerline of the dam.	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Carefully monitor and measure cracking to determine the speed and extent of the problem. Mobilize to fill cracks. Cracks parallel to the centerline indicate a slide. Follow remedial action for slides.	Stakes, tape measure, dozer, shovels, source of earthfill.	Size, location
	Large cracks in the crest that are rapidly enlarging, especially those perpendicular to the centerline of the dam.	Possible failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue monitoring and remedial action as described above.	Dozer, shovels, source of earthfill.	Size, location
	Cracking that extends to pool elevation.	Imminent failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Continue remedial actions as described above.	Dozer, shovels, source of earthfill.	Size, location

TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Cracking or movement of concrete structure	Minor cracking and/or movement.	Abnormal	Notify the City Parks and Recreation superintendent during normal work hours. Call the City Engineer for inspection.	Immediately install measuring device to monitor movement.	Crack Monitors, stakes, tape measure.	Size, location
	Significant cracking and/or movement.	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Lower burlap on upstream face of crack to reduce flow of soil particles. Dump rockfill downstream of moving concrete structure monolith to resist the movement.	Burlap, rockfill, dozer, shovels.	Size, location, flow rate
	Serious cracking and/or movement	Possible failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Continue monitoring and remedial action as described above.	Dozer, rockfill, burlap, crack monitors	Size, movement, flow rate
	Major cracking and/or movement	Imminent failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Continue monitoring and remedial actions as described above.	Dozer, shovels, rockfill	Size, location, flow rate

TAB 2 (continued)

EVIDENCE OF DISTRESS

General Observation	Specific Observation	Condition	Notification	Emergency Action	Equipment, Material and Supplies	Data to Record
Upstream Whirlpool	Whirlpool in the lake in the vicinity of the embankment	Imminent Failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Attempt to plug the entrance of the whirlpool with riprap from the slope of the embankment. Search downstream for an exit point and construct a ring dike to retard the flow of soil particles	Dozer, source of earthfill, sandbags, filter cloth, straw, rocks	Size, location, flow rate
Broken gate	Structural member of a gate or gate operator broken or severely damaged so as to prevent operation of the gate	Possible failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance. Immediately place stop logs in front of gate and initiate necessary actions to get gate repaired.	Crane and welder	Type of problem, location
Rapidly rising lake	Lake level rising and rain continuing	Watch	Notify the City Parks and Recreation superintendent, Department of Public Safety Regional Liaison office, state dam-safety officials, and the City Engineer immediately.	Initiate 24-hour surveillance of lake level and rainfall.		Lake level, rainfall
Dam being overtopped	Water flowing over the dam and lake continuing to rise	Possible failure	Notify the City Parks and Recreation superintendent, National Weather Service, Department of Public Safety Regional Liaison office, county-city emergency-management coordinators, state dam-safety officials, and the City Engineer immediately.	Downstream evacuation. Continue monitoring.		Lake level, rainfall

## TAB 3

### SAMPLE NOTIFICATION MESSAGES

Note: These notification messages will be coordinated through the City of Denton Parks and Recreation director, the City of Denton Office of Emergency Management (OEM), and the National Weather Service before they are disseminated to downstream organizations. Messages developed with the assistance of the National Weather Service may be used instead.

#### “Watch” Condition Message

This is an emergency message. The City of Denton Parks and Recreation has declared a “watch” condition for Dam (No. 16/ 17A), Texas ID (TX04688/TX04689).

*(Briefly describe the problem or condition.)*

There is no immediate danger of the dam failing; however, the potential does exist. We request that you initiate appropriate emergency-management procedures.

For verification, call the phone numbers listed on the Notification Flowchart of the Emergency Action Plan for Dam No. 16 and 17A. The City of Denton Office of Emergency Management has been notified of this condition and may be contacted for information on emergency procedures. The City of Denton Parks and Recreation will supply additional information regarding the status of the dam as it becomes available.

#### “Possible Dam Failure” Warning

This is an emergency message. The City of Denton Parks and Recreation has declared a “possible failure” condition for Dam (No. 16/17A), Texas ID (TX04688/TX04689).

*(Briefly describe the problem or condition.)*

There is a possibility that the dam could fail. Attempts to save the dam are under way, but their success cannot be determined as yet. Emergency water releases to lower the lake (*are/are not*) being made. We request that you initiate appropriate emergency management procedures and prepare for evacuation of the threatened areas.

If Dam (No. 16/17A) does fail, flooding will occur along (*Pecan Creek/North Pecan Creek*).

For verification, call the phone numbers listed on the Notification Flowchart of the Emergency Action Plan for Dam No. 16 and 17A. The City of Denton Office of Emergency Management has been notified of this condition and may be contacted for information on emergency procedures. The City of Denton Parks and Recreation will supply additional information regarding the status of the dam as it becomes available.

#### “Imminent Dam Failure” Warning

Urgent! This is an emergency message. The City of Denton Parks and Recreation has declared that Dam (No. 16/17A), Texas ID (TX04688/TX04689), is in imminent danger of failing.

Attempts to save the dam will continue, but their success is unlikely. We request that you initiate appropriate emergency management procedures and begin evacuation of threatened areas. It is probable that the dam will fail in \_\_\_ hours. If Dam (No. 16/17A) fails, a flood wave will move down (*Pecan Creek/North Pecan Creek*).

For verification, call the phone numbers listed on the Notification Flowchart of the Emergency Action Plan for Dam No. 16 and 17A. The City of Denton Office of Emergency Management has been notified of this condition and may be contacted for information on emergency procedures.

### “Dam Failure” Message

Emergency! This is an emergency message. The City of Denton Parks and Recreation has declared that Dam (No. 16/17A), Texas ID (TX04688/TX04689), has failed.

A flood wave is moving down (Pecan Creek/North Pecan Creek), in the City of Denton. The flood waters have already reached (Road), (Road), and (Road) on (Pecan Creek/North Pecan Creek). The flood wave will continue down (Pecan Creek/North Pecan Creek) and flood areas along the river.

(Road) will begin flooding at (time—prior to a PMF breach and three hours after a sunny-day breach). SH (##) at (landmark) will begin flooding at (time—give number of hours after a PMF breach).

Evacuate threatened areas immediately.

For verification, call the phone numbers listed on the Notification Flowchart of the Emergency Action Plan for Dam No. 16 and 17A. The City of Denton Office of Emergency Management has been notified of this condition and may be contacted for information on emergency procedures.

## TAB 4

### SAMPLE NEWS RELEASES

Note: Coordinate with the National Weather Service, the City of Denton OEM, and the emergency management directors for Denton County prior to release. Messages developed with the assistance of the National Weather Service may be used instead.

#### Announcement for a Slowly Developing "Watch" Condition

The City of Denton Office of Emergency Management has issued the following advisory for those who live, work, or are visiting in the City of Denton.

The City of Denton Parks and Recreation has declared a "Watch" condition for Dam No. (16/17A) as of *(time and date)*.

*(Briefly describe the problem or condition.)*

There is no immediate danger of the dam failing; however the potential does exist.

*(Describe what actions are being taken to monitor and control the situation.)*

*(State the quantity of any releases.)*

#### Announcement for a Possible Dam Failure

1. The City of Denton Office of Emergency Management has issued the following advisory for those who live, work, or are visiting in the City of Denton.

The City of Denton Parks and Recreation has declared a possible dam failure at Dam No. (16/17A) as of *(time and date)*.

*(Briefly describe the problem or condition.)*

It is possible the dam could fail. Attempts to save the dam are under way, but their success cannot be determined as yet.

*(Describe what actions are being taken to monitor and control the situation.)*

*(State the quantity of any releases.)*

2. Due to the threat of dam failure, it may be necessary for people who live, work or are visiting in the certain local areas to evacuate in the near future. The area(s) that may be at risk include: *(Describe area boundaries)*

3. Evacuation is NOT being recommended at this time. Local officials will advise you if evacuation is necessary. However, you should be prepared to evacuate if needed. To prepare, you should:

A. Assemble the following emergency supplies:

- Clothing for your family for several days
- Bedding, pillows, and towels
- Prescription medicines & spare eyeglasses
- Soap and toiletries
- Baby food and diapers
- Your address book or list of important telephone numbers

- Your checkbook, credit cards, and cash
  - Your drivers license and identification cards
  - A portable radio and flashlight.
- B. You should also:
- Gather suitcases, boxes, or bags to hold your emergency supplies.
  - Be prepared to secure your home or office and your property before you depart.
  - Ensure your car is in good shape and you have adequate fuel.
  - Decide where you will go if you have to evacuate. Make arrangements with relatives or friends or consider making hotel or motel reservations.
4. Potential evacuation routes from the area(s) at risk include:
  5. Potential evacuation routes from the area(s) at risk are described in:
  6. If you know of any neighbors or co-workers with hearing or language problems or special needs, please advise them of this message. And if you have neighbors or co-workers who do not have transportation, offer to assist them if you can.
  7. We want to emphasize that this is a PRECAUTIONARY message about possible evacuation. Evacuation is NOT being recommended at this time.
  8. Keep your radio or TV on and listen for further information about this situation. Please do not call 911 or local emergency officials for information as this ties up telephone lines needed for emergency operations.

#### Announcement for an Imminent Dam Failure

1. The City of Denton Office of Emergency Management has issued the following advisory for those who live, work, or are visiting in City of Denton.  
  
Urgent! The City of Denton Parks and Recreation has announced that Dam No. (16/17A) is in imminent danger of failing.  
  
*(Describe what actions are being taken to monitor and control the situation.)*  
  
It is possible that the dam will fail in (##) hours.
2. Due to the imminent danger of dam failure that threatens a portion of the local area, the City of Denton Mayor has recommended that people in the following area(s) evacuate immediately to protect their health and safety: *(Describe area boundaries)*
3. Recommended evacuation routes from the area(s) at risk include:
4. Be sure to take essential items such as:
  - prescription medicines
  - eyeglasses
  - identification cards
  - checkbook
  - credit cards
  - valuable papers

Do not delay your departure to collect other belongings.

5. Take your pets with you, but make sure you bring a leash, crate, or cage for them. Some shelters will not accept pets.
6. If you have no means of transportation or if you are physically unable to evacuate on your own, ask a neighbor to assist you.
7. If you know of any neighbors or co-workers with hearing or language problems or special needs, please advise them of this message. And if you have neighbors or co-workers who need help or do not have transportation, offer to assist them if you can.
8. Repeating, local officials recommend the people in the following area(s) evacuate now: *(Repeat the area description in paragraph 2 above.)*
9. Please do not use your telephone except to report a true emergency. Stay tuned to this station for more information and instructions from local officials.

#### Announcement of a Dam Failure

1. The City of Denton Office of Emergency Management has issued the following advisory for those who live, work, or are visiting in City of Denton.

Emergency! Dam No. *(16/17A)* failed at *(time and date)*. The flood waters have already reached *(Highway)* and *(Road)*.

2. Due to the dam failure that is affecting a portion of the local area, the City of Denton Mayor has recommended that people in the following area(s) evacuate immediately to protect their health and safety: *(Describe area boundaries)*
3. Recommended evacuation routes from the area(s) at risk include:
4. Be sure to take essential items such as:
  - prescription medicines
  - eyeglasses
  - identification cards
  - checkbook
  - credit cards
  - valuable papers

Do not delay your departure to collect other belongings.

5. Take your pets with you, but make sure you bring a leash, crate, or cage for them. Some shelters will not accept pets.
6. If you have no means of transportation or if you are physically unable to evacuate on your own, ask a neighbor to assist you.
7. If you know of any neighbors or co-workers with hearing or language problems or special needs, please advise them of this message. And if you have neighbors or co-workers who need help or do not have transportation, offer to assist them if you can.
8. Repeating, local officials recommend the people in the following area(s) evacuate now: *(Repeat the area description in paragraph 2 above.)*
9. Please do not use your telephone except to report a true emergency. Stay tuned to this station for more information and instructions from local officials.





TAB 5 (continued)

SIMULATED-EMERGENCY EXERCISE

Date of Exercise:	
Participant Sign-In:	
Type of Simulation Conducted:	<p>Circle Emergency Type:</p> <p>watch condition</p> <p>imminent dam failure</p> <p>actual dam failure</p>
Comments, Results of Exercise:	
Revisions Needed to EAP Based on Results of Exercise?	<p><input type="checkbox"/> Yes   <input type="checkbox"/> No</p> <p>If yes, list revisions required:</p>

TAB 5 (continued)

PLAN REVIEW AND UPDATE

This plan will be reviewed and updated annually and tabletop exercises will be conducted at least once every five years. Document these reviews below.

Date of review: \_\_\_\_\_

Participants:

Date of review: \_\_\_\_\_

Participants:

Date of review: \_\_\_\_\_

Participants:

Date of review: \_\_\_\_\_

Participants:

Date of tabletop exercise: \_\_\_\_\_

Participants:

TAB 6

ANNUAL EAP EVALUATION CHECKLIST

Was the annual dam inspection conducted?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, is the checklist signed and included in the EAP?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Was brush clearing, animal-burrow removal, or other maintenance required?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, describe actions taken and date:	
Was the outlet gate operable?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If no, describe actions taken and date:	
Does the Notification Flowchart require revision?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, date revised Contact Information pages were distributed:  (Note that revision of the Contact Information will not require EAP approval; however, the revised Contact Information pages will need to be redistributed as a replacement pages.)	
Was annual training or an exercise conducted?	<input type="checkbox"/> Yes <input type="checkbox"/> No	Circle: training      exercise  Date conducted:	
Are inspection and training records included in the EAP?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Was the EAP reviewed?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, review date:	
Were changes required to the EAP?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, date of revised EAP approval:	

Signature of superintendent: \_\_\_\_\_ Date completed: \_\_\_\_\_

TAB 7  
DISTRIBUTION LIST

Authority	Name, Title, Phone	Address
City of Denton Parks and Recreation	Emerson Vorel Director (940) 349-7460	City Hall East 601 E. Hickory, Suite B Denton, Texas 76205
City of Denton Parks and Recreation	Jim Mays Superintendent (940) 349-7465	City Hall East 601 E. Hickory, Suite B Denton, Texas 76205
City of Denton Office of Emergency Management (OEM)	Mike Penaluna Emergency Management Coordinator (940)349-8836	Denton Fire Department 332 E. Hickory Street Denton, Texas 76201
Denton County Soil and Water Conservation District	Lewayne Peterson Chairman (940) 383-2691	Denton Service Center 525 S. Loop 288, STE C Denton, Texas 76205-4515
Natural Resources Conservation Service	Steve Ray (940) 383-2691	Denton Service Center 525 S. Loop 288, STE C Denton, Texas 76205-4515
National Weather Service	Weather Forecast Office, Fort Worth, TX (817) 831-1595	
State of Texas Texas Commission on Environmental Quality Dam Safety Program	Warren Samuelson, P.E. Dam Safety Program Coordinator 512-239-5195	Field Operations Support Division, MC 174 P.O. Box 13087 Austin, TX 78711

## TAB 8

### BREACH ANALYSIS

NRCS Floodwater Retarding Dam No. 16 is located on Pecan Creek in the City of Denton, Texas. The structure is designated as an intermediate-sized dam based on the guidelines specified in Chapter 299 of the Texas Administrative Code (TAC).

NRCS Floodwater Retarding Dam No. 17A is located on North Pecan Creek in the City of Denton, Texas. The structure is classified as a small size, high-hazard dam in accordance with TAC Chapter 299. The design event for the structure is approximately 75% of the Probable Maximum Flood (PMF) event.

#### Breach Analysis

The Dam Breach Analysis was performed using methodology detailed in the Texas Commission of Environmental Quality (TCEQ) *Hydrologic and Hydraulic Guidelines for Dams in Texas* (TCEQ, 2007). In accordance with TCEQ guidelines, the Simplified Breach Method was used to calculate breach flow and inundation length of an existing intermediate size dam for both structures.

Geometric parameters for each dam and spillway used in this analysis were determined by record plans provided by the City of Denton. Results of the Simplified Breach Method calculations are summarized in the table below. Detailed calculations are provided in *Dam Breach Analysis for SCS Dam Number 16 North Lakes Park Pond* and *Breach Inundation Mapping for NRCS Floodwater Retarding Dam No. 17A*.

Table 1: Breach Parameters

Parameter	Dam No. 16	Dam No. 17A
<i>Spillway Flow (cfs)</i>	7,700	2,598
<i>Breach Flow (cfs)</i>	18,550	16,636
<i>Total Flow (cfs)</i>	26,250	19,234
<i>Inundation Length (miles)</i>	4.9	4.35

#### Hydraulic Analysis

The inundation length spanned across North Pecan Creek and Pecan Creek. Hydraulic models for each structure were prepared to determine the inundation extents of each dam breach.

Cross sections along the subject reaches were established at 300-foot intervals along the flowline of Pecan Creek and North Pecan Creek. Additional cross sections upstream and downstream of each bridge crossing were added to model each structure.

Cross section geometry was based on aerial topography provided by the City of Denton in November 2010 and aerial topography obtained from North Central Texas Council of Government (NCTCOG) (dated 2001). Manning's "n" values used in the hydraulic analysis of North Pecan Creek and Pecan Creek were based on site observations and engineering judgment. As specified in Chapter 8 of the TCEQ guidelines, these roughness coefficients were increased by 25% to account for increased turbulence and energy losses associated with the dam breach flood waves. The downstream

boundary condition for the hydraulic model was determined using the slope-area method. This method uses the geometry of the downstream-most cross section, the discharge, and the hydraulic slope of the channel to determine the profile elevation at that location.

Discharges calculated through the Simplified Breach Method were used to obtain a water surface profile within the dam breach inundation limits. The total release discharge was assumed to attenuate at a linear rate over the inundation length of the channel downstream of the dam. The flow attenuates from the total release discharge to the peak discharge capacity of the spillway.

Hydraulic modeling of the creeks included 22 roadway crossings. The deck information for each crossing was obtained by either aerial topography, bridge inspection reports obtained from the City of Denton, or site observation.

Between cross sections 53309 and 57467 in the model for Dam No. 16 (under Parkway Street), the main channel is enclosed in a series of box culverts of varying sizes. HEC-RAS is not capable of modeling the existing culvert configuration. Based on the size of the opening at the upstream face of this enclosure (4 – 8'x4' Reinforced Concrete Box culverts) and the tailwater elevation during the PMF event, it is estimated that this underground system conveys approximately 840 cfs. Linear attenuation of the breach flood wave between the affected cross sections is greater than the capacity of the enclosed system, so the geometric data associated with the enclosure has not been included in the HEC-RAS model. The HEC-RAS model prepared in this analysis assumes that the breach flow is conveyed across Parkway Street above the enclosure.

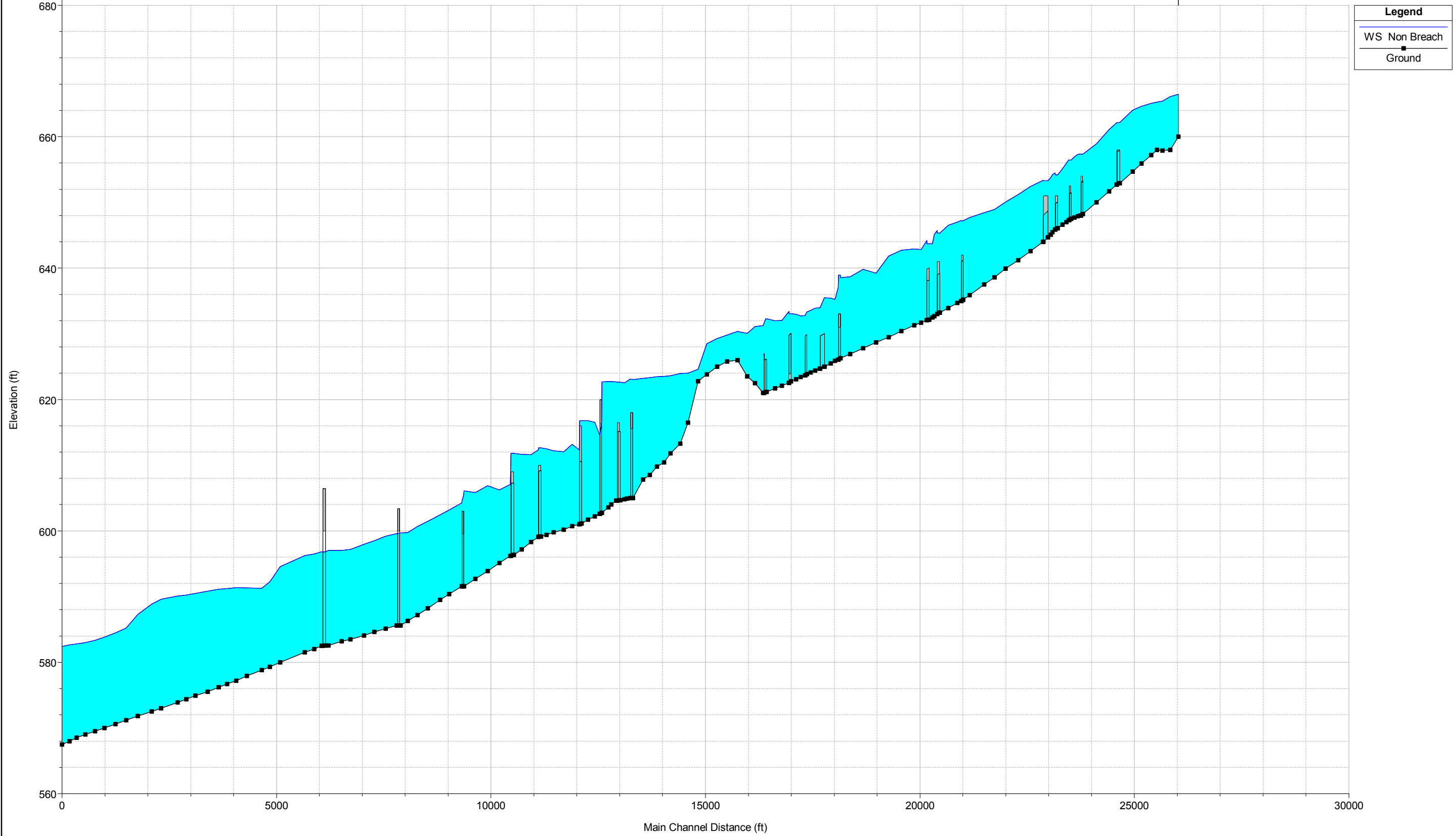
Between cross sections 61025 and 62525 in the model for Dam No. 17A (under commercial developments surrounding University Drive), the main channel is enclosed in a series of box culverts of varying sizes. HEC-RAS is not capable of modeling the existing culvert configuration. Based on the size of the opening at the upstream face of this enclosure (4 – 6' x 4' Reinforced Concrete Box culverts) and the tailwater elevation during the PMF event, it is estimated that this underground system conveys an insignificant amount of flow compared to the breach flood wave. The geometric data associated with the enclosure has not been included in the model, and assumes that the breach flow is conveyed across the commercial area above the enclosure.

### **Breach Inundation Mapping**

Inundation maps for NRCS Floodwater Retarding Dams No. 16 and No. 17A were prepared in accordance with TCEQ guidelines and are based on the results of the hydraulic analysis. The inundation maps are provided in Tab 9.

Profiles of the peak flood levels expected for each dam breach are provided here.

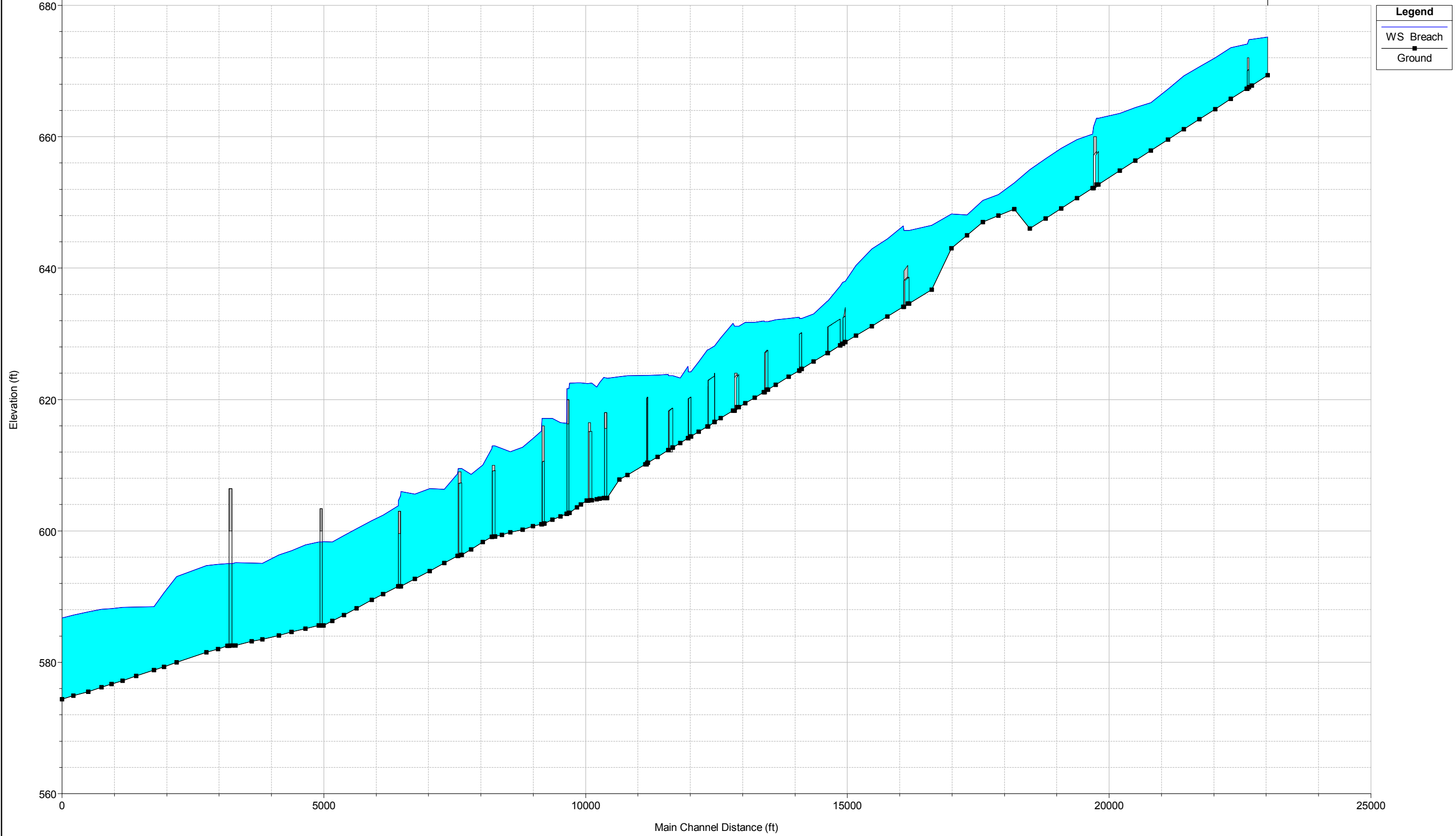
Pecan Creek PC





Denton\_Dam\_17A Plan: Inundation 11/30/2010

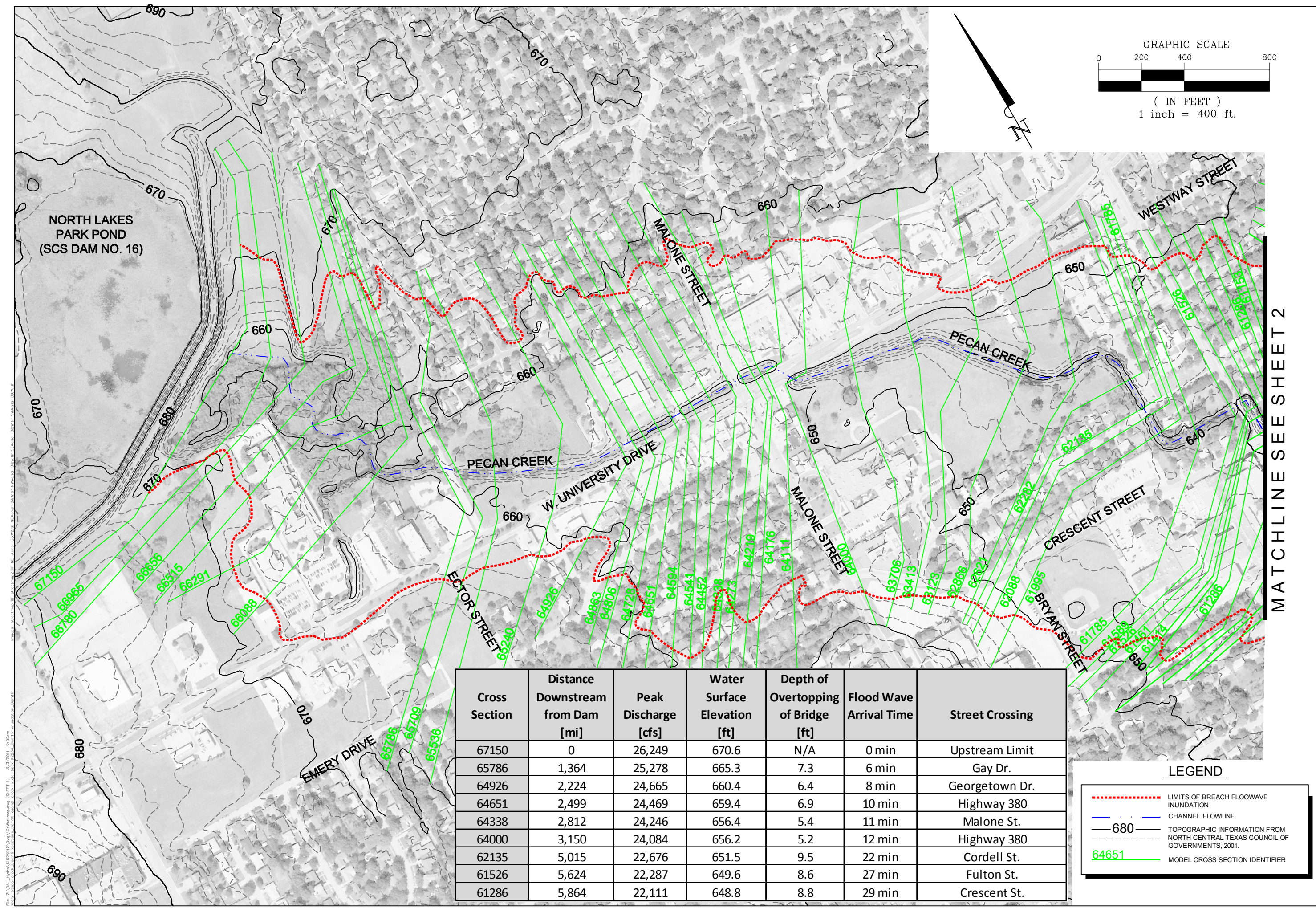
North Pecan Creek



**Legend**

- WS Breach
- Ground

TAB 9  
INUNDATION MAPS



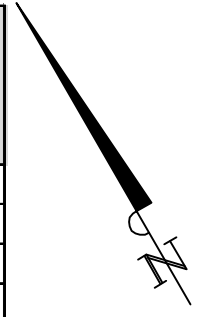
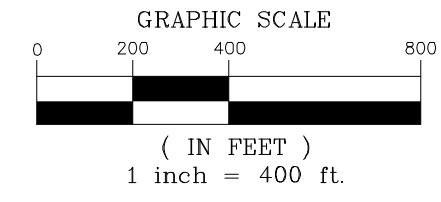
Cross Section	Distance Downstream from Dam [mi]	Peak Discharge [cfs]	Water Surface Elevation [ft]	Depth of Overtopping of Bridge [ft]	Flood Wave Arrival Time	Street Crossing
67150	0	26,249	670.6	N/A	0 min	Upstream Limit
65786	1,364	25,278	665.3	7.3	6 min	Gay Dr.
64926	2,224	24,665	660.4	6.4	8 min	Georgetown Dr.
64651	2,499	24,469	659.4	6.9	10 min	Highway 380
64338	2,812	24,246	656.4	5.4	11 min	Malone St.
64000	3,150	24,084	656.2	5.2	12 min	Highway 380
62135	5,015	22,676	651.5	9.5	22 min	Cordell St.
61526	5,624	22,287	649.6	8.6	27 min	Fulton St.
61286	5,864	22,111	648.8	8.8	29 min	Crescent St.

**LEGEND**

- - - - - LIMITS OF BREACH FLOWWAVE INUNDATION
- — — — — CHANNEL FLOWLINE
- — — — — 680 TOPOGRAPHIC INFORMATION FROM NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, 2001.
- — — — — 64651 MODEL CROSS SECTION IDENTIFIER

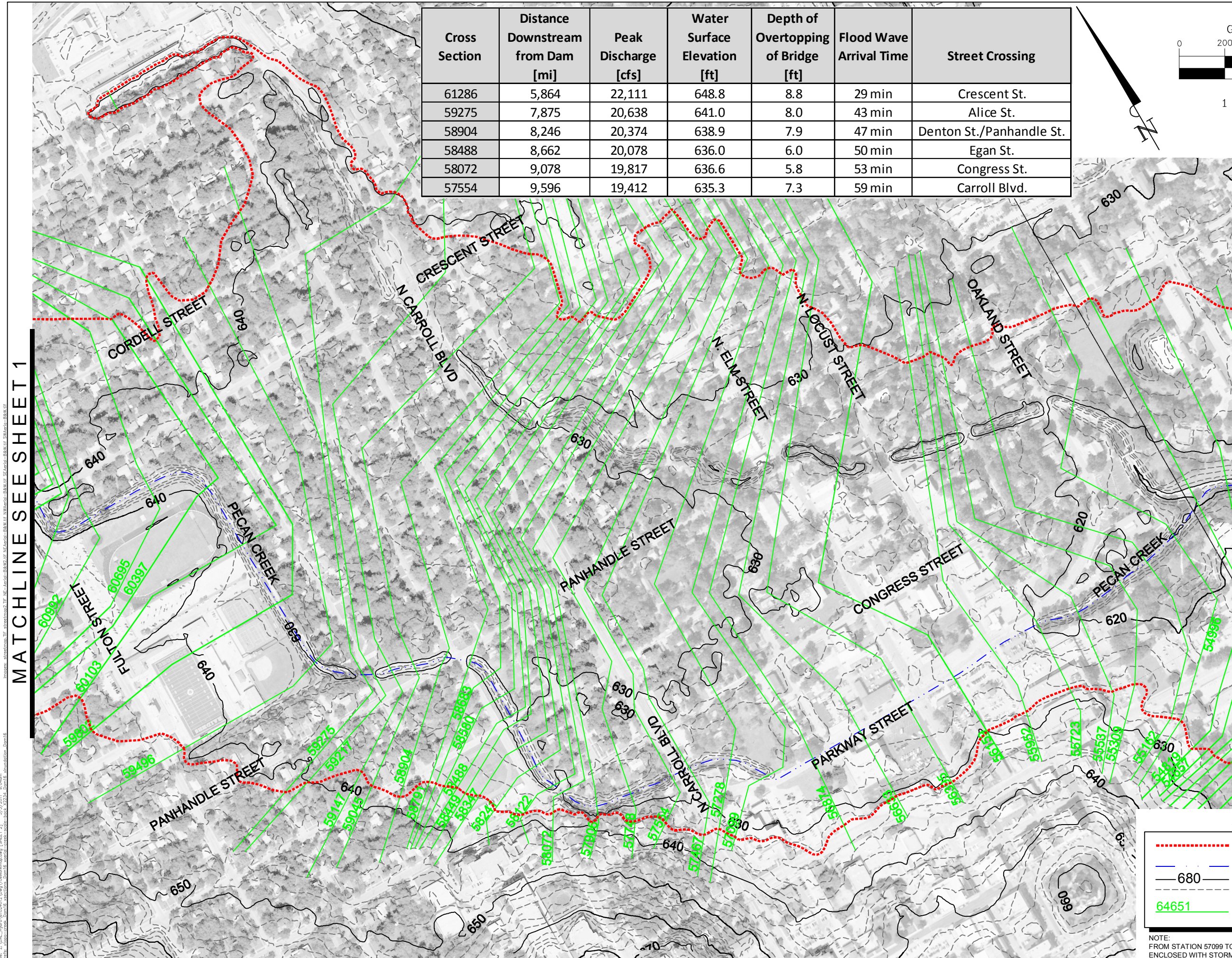
MATCHLINE SEE SHEET 2

Cross Section	Distance Downstream from Dam [mi]	Peak Discharge [cfs]	Water Surface Elevation [ft]	Depth of Overtopping of Bridge [ft]	Flood Wave Arrival Time	Street Crossing
61286	5,864	22,111	648.8	8.8	29 min	Crescent St.
59275	7,875	20,638	641.0	8.0	43 min	Alice St.
58904	8,246	20,374	638.9	7.9	47 min	Denton St./Panhandle St.
58488	8,662	20,078	636.0	6.0	50 min	Egan St.
58072	9,078	19,817	636.6	5.8	53 min	Congress St.
57554	9,596	19,412	635.3	7.3	59 min	Carroll Blvd.



MATCHLINE SEE SHEET 1

MATCHLINE SEE SHEET 3



**LEGEND**

- - - - - LIMITS OF BREACH FLOWWAVE INUNDATION
- - - - - CHANNEL FLOWLINE
- 680 — TOPOGRAPHIC INFORMATION FROM NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, 2001.
- 64651 MODEL CROSS SECTION IDENTIFIER

NOTE:  
FROM STATION 57099 TO 55952, THIS SECTION OF PECAN CREEK IS ENCLOSED WITH STORM DRAINAGE SYSTEM

**Kimley-Horn and Associates, Inc.**  
 Tel. No. (972) 770-1300  
 Fax No. (972) 238-3820  
 12700 Park Central Drive, Suite 1800  
 Dallas, Texas 75251

**NRCS DAM 16 BREACH ANALYSIS**  
 CITY OF DENTON, TEXAS

**DAM BREACH INUNDATION WORKMAP**

Scale:	AS SHOWN
Designed by:	CLS
Drawn by:	AO
Checked by:	SDG
Date:	May 2007
Project No.:	064012001

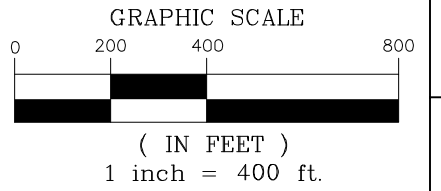
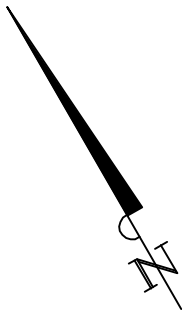
**SHEET**  
**2**

File: Z:\DAL\_Horn\01024920\Draw\Workmap.dwg [SHEET 2] 3/2/2011 9:04am  
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 Plot: Kimley-Horn\cshorn  
 Plot Device: HP DesignJet 5000 Series  
 Plot Style: Kimley-Horn.ctb  
 Plot Range: Extents  
 Plot Scale: 1" = 400'





Cross Section	Distance Downstream from Dam [ft]	Peak Discharge [cfs]	Water Surface Elevation [ft]	Maximum Depth [ft]	Flood Wave Arrival Time	Street Crossing
67067	0	19,234	675.2	N/A	0 min	Upstream Limit
66710	357	18,944	674.8	2.8	2 min	Windsor Dr.
63835	3,232	16,816	662.8	2.8	14 min	Hinckle Dr.



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 Fax No. (972) 239-3820

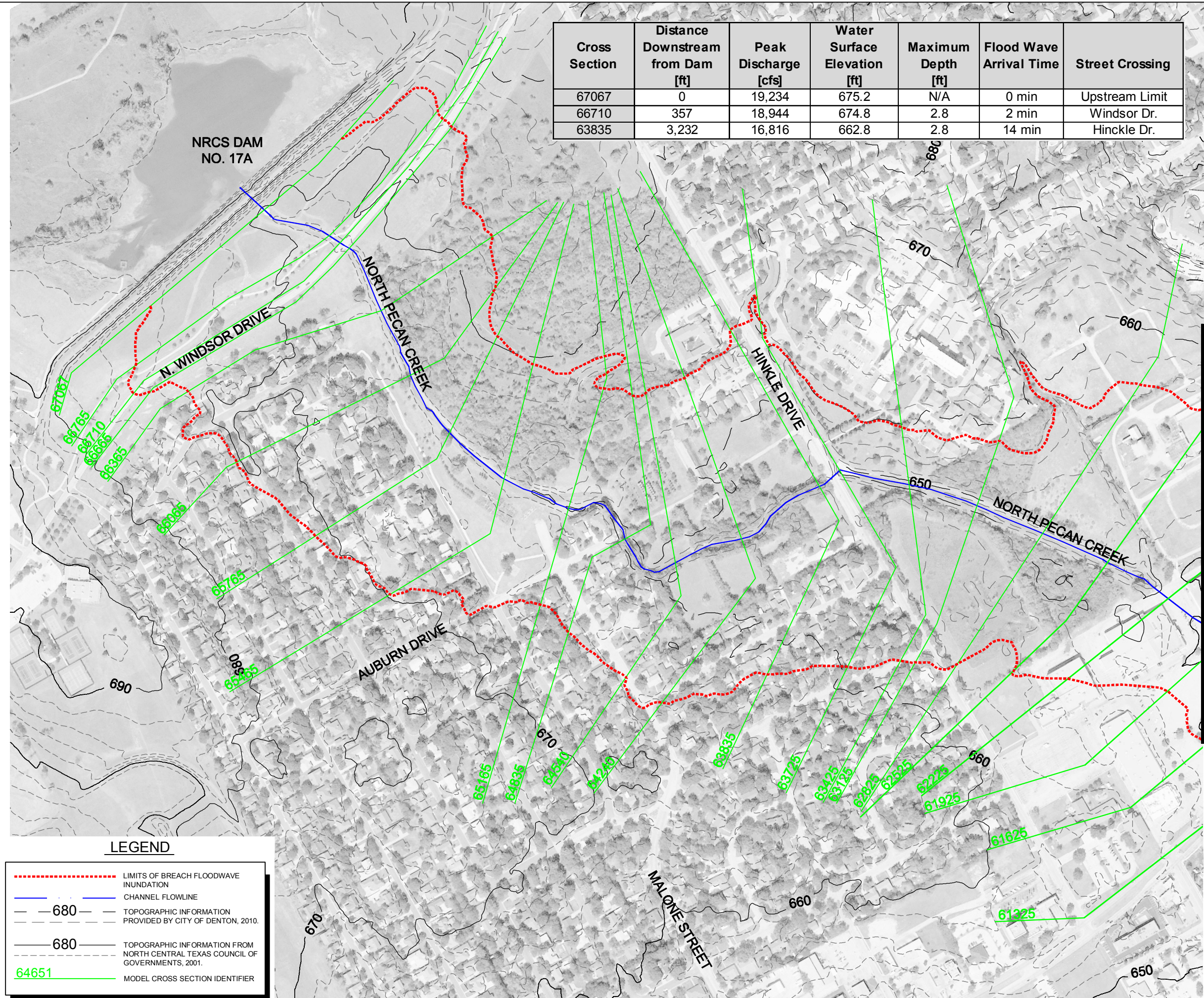
12700 Park Central Drive, Suite 1800  
 Dallas, Texas 75251  
 Firm Registration # F-928

**NRCS DAM 17A BREACH ANALYSIS**  
 CITY OF DENTON, TEXAS

**DAM BREACH**  
**INUNDATION WORKMAP**

Scale:	AS SHOWN
Designed by:	KEH
Drawn by:	KEH
Checked by:	SDG
Date:	December 2010
Project No.:	064012001

MATCHLINE SEE SHEET 2



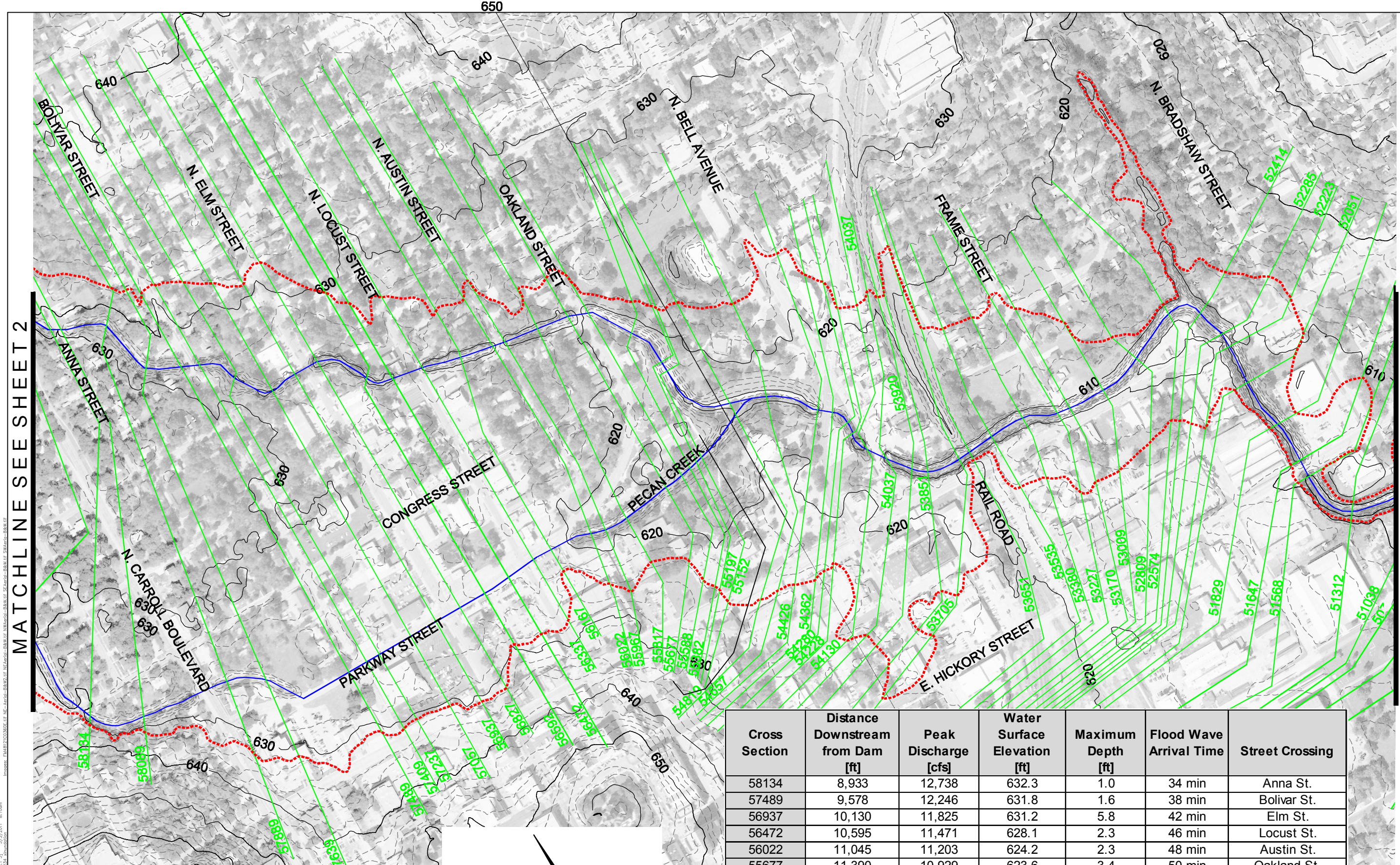
**LEGEND**

- - - - - LIMITS OF BREACH FLOODWAVE INUNDATION
- — — — — CHANNEL FLOWLINE
- - - - - 680 TOPOGRAPHIC INFORMATION PROVIDED BY CITY OF DENTON, 2010.
- - - - - 680 TOPOGRAPHIC INFORMATION FROM NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, 2001.
- — — — — 64651 MODEL CROSS SECTION IDENTIFIER

File: Z:\DAL\_Hydra\81024912\Draw\Inundation.dwg [SHEET 1] 3/2/2011 8:04am  
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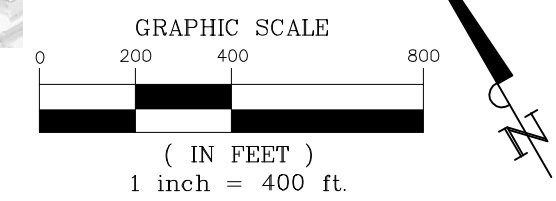


MATCHLINE SEE SHEET 2

MATCHLINE SEE SHEET 4

**LEGEND**

- - - - - LIMITS OF BREACH FLOODWAVE INUNDATION
- CHANNEL FLOWLINE
- 680 TOPOGRAPHIC INFORMATION FROM NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, 2001.
- 64651 MODEL CROSS SECTION IDENTIFIER



Cross Section	Distance Downstream from Dam [ft]	Peak Discharge [cfs]	Water Surface Elevation [ft]	Maximum Depth [ft]	Flood Wave Arrival Time	Street Crossing
58134	8,933	12,738	632.3	1.0	34 min	Anna St.
57489	9,578	12,246	631.8	1.6	38 min	Bolivar St.
56937	10,130	11,825	631.2	5.8	42 min	Elm St.
56472	10,595	11,471	628.1	2.3	46 min	Locust St.
56022	11,045	11,203	624.2	2.3	48 min	Austin St.
55677	11,390	10,929	623.6	3.4	50 min	Oakland St.
55197	11,870	10,613	623.7	2.3	55 min	Pedestrian bridge
54426	12,641	10,042	623.2	5.2	1 hr 1 min	Bell Ave.
54130	12,937	9,806	622.5	6.0	1 hr 3 min	Bell Ave.
53705	13,362	9,527	622.5	2.5	1 hr 7 min	Railroad bridge
53227	13,840	9,179	617.1	1.2	1 hr 9 min	Frame St.
52285	14,782	8,494	612.9	2.9	1 hr 12 min	McKinney St.
51647	15,420	8,020	609.5	0.5	1 hr 13 min	Hickory St.

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 Plot: kimley-horn\kimley-horn\kimley-horn\kimley-horn\kimley-horn\kimley-horn\kimley-horn\kimley-horn\kimley-horn\kimley-horn

