Appendix F-1

BRA Operations Procedure for Controlled Releases

ADMINISTRATIVE PROCEDURES		NO.
OFFICE OF PRIMARY RESPONSIBITY: **WATER SERVICES &** **PROJECT OPERATIONS**	EFFECTIVE DATE: December 1, 2010	PAGE 1 OF 18
SUBJECT: **OPERATIONS PROCEDURE FOR CONTROLLED RELEASES**	AUTHORIZATION:	DATE: 11-30-2010

BRAZOS RIVER AUTHORITY

OPERATIONS PROCEDURE FOR CONTROLLED RELEASES

1. PURPOSE:

This document establishes procedures and guidelines to be followed for controlled releases from Brazos River Authority (Authority) reservoirs, which include Possum Kingdom Lake, Lake Granbury, and Lake Limestone. Also see separate procedural document dated July 01, 2010 pertaining to Morris Sheppard Dam Spillway Gate Interim Operating Protocols for Low Lake Levels Releases from Possum Kingdom Lake.

Under normal conditions, controlled releases are routinely made to pass minor inflows through the reservoirs and for meeting downstream water needs. For this procedure, normal conditions are defined as follows:

Possum Kingdom Lake – When none of the nine spillway gates are open
Lake Granbury – When release is less than 5,000 cubic feet per second (cfs)
Lake Limestone – When release is less than 2,000 cfs

During periods of excessive rainfall, controlled high flow releases are required to pass runoff through the reservoirs. For this procedure, high flow releases are defined as follows:

Possum Kingdom Lake – When one or more of the nine spillway gates are open
Lake Granbury – When release is greater than 5,000 cfs
Lake Limestone – When release is greater than 2,000 cfs

While high flow releases typically occur only when a reservoir is at or near full, releases during normal conditions may be made at any reservoir elevation in order to meet downstream water needs.

Information specific to operations procedures for Possum Kingdom Lake, ,Lake Granbury, and Lake Limestone is contained in Attachments A, B, and C, respectively. Attachment D is the Notification Procedure for Project personnel to contact Water Services during non-duty hours.

2. SCOPE:

This document is intended for use by the operating personnel at the Authority reservoir sites and by Central Office staff involved in controlled release operations. All personnel

involved should exercise reasonable and prudent judgment in the conduct of duties keeping safety as the top priority.

3. RESPONSIBILITIES:

a. WATER SERVICES MANAGER. The Water Services Manager, or designated alternate, is responsible for the safe passage of waters through the Authority's reservoirs. Water Services personnel direct release operations including decisions on the rate and timing of releases. Water Services has established an emergency notification system for Project personnel to initiate communications with trained engineers and hydrologists in the Central Office on a 24 hour/day, seven day/week basis (see Attachment D). Upon initiation of high flow releases, Water Services personnel will keep other Central Office and Project personnel informed of impending operations and consult with them as appropriate. Water Services personnel will also coordinate high flow release information as necessary with the National Weather Service West Gulf River Forecast Cent (WGRFC), the United States Geological Survey (USGS), the United States Army Corps of Engineers (USACE), and the Federal Energy Regulatory Commission (FERC).

b. PROJECT ENGINEER - DAMS. The Project Engineer, or designated alternate, is responsible for construction and major dam maintenance at the Authority's reservoirs. The Project Engineer should keep Water Services informed of dam construction and maintenance activities that could potentially affect release operations.

c. PROJECT MANAGER. The Project Manager, or designated alternate, is responsible for supervision of the activities at each Project including making the physical adjustments to the release settings as directed by Water Services. The Project Manager will keep the Water Services Manager, or designated alternate, informed of circumstances that may necessitate or affect controlled release operations and will coordinate with Water Services as necessary during a high flow release event. In the event that communications are lost with Water Services and until such time that communications are restored, the Project Manager should direct release operations following the guidelines outlined in this document. Restoring communications with Water Services is a high priority.

ATTACHMENT A TO OPERATIONS PROCEDURE
FOR CONTROLLED RELEASES
POSSUM KINGDOM LAKE

1. CONSIDERATIONS:

At some time in the past, the dam experienced foundation problems, which allowed certain buttresses to move slightly. Substantial improvements have been made to correct previous problems and to prevent future problems, including the construction of a stilling basin extension below gates 6, 7, 8 and 9. In order for this stilling basin extension to properly protect the foundation, it is desirable that certain minimum tailwater elevations be met, if possible, prior to lowering certain spillway gates and that undesirable flow patterns near the extension be avoided. Model tests were used to develop the spillway gate operating sequences and minimum tailwater elevations provided below. Observation of actual release operations may, in time, produce data, which differs from model test data, and some adjustment of the table may be needed. If undesirable flow patterns develop or it appears that damage is occurring to the stilling basin extension or other areas during release operations, Project personnel will immediately notify the Water Services Manager and/or the Project Engineer.

2. TAILWATER ELEVATIONS AND PREFERRED SPILLWAY GATE OPERATING SEQUENCE:

Gates 1 through 4 may be raised or lowered regardless of the tailwater elevation. Typically, gates 5 through 9 should be operated only if the tailwater elevation measured at the Powerhouse equals or exceeds the minimum tailwater elevation listed in the following table (Table 1). The preferred tailwater elevation will be used as a guide for operating gates whenever possible. Gates are listed in the preferred operating sequence in this table. However, this sequence may vary due to construction, maintenance, gate malfunctions, or other operational issues at the dam. Water Services will coordinate with the Project Manager or designee prior to initiation and during release operations as to the status of gate availability, including positioning of the crane barge, which is used for construction and maintenance activities. The Project Manager or designee, in coordination with the Project Engineer, will provide alternative sequences as appropriate. When closing gates, the sequence will be reversed. Minimum tailwater elevations should also be maintained when closing gates. Project personnel will monitor flow patterns and report any unusual scour or undesirable flow patterns to the Water Services Manager or designee. For perspective, with no gates open and no hydropower generation, the tailwater elevation is typically about 871 feet above mean sea level.

Spillway Gate No.	Minimum Tailwater Elevation at Powerhouse Needed to Operate Gate (ft msl)	Preferred Tailwater Elevation To Operate Gate (ft msl)
1	None	none
2	None	none
3	None	none
4	None	none
9	881.1	886.0
8	881.1	886.0
7	885.5	888.0
5	888.5	891.0
6	891.7	895.3

Table 1: Preferred Gate Operating Sequence and Tailwater Elevations to Operate Gates.

3. ANNUAL EQUIPMENT TESTING DURING RELEASE OPERATIONS:

The Code of Federal Regulations requires that spillway gates be exercised annually. By letter dated November 17, 1995, the Federal Energy Regulatory Commission (FERC) granted the Authority a deviation for those gates where the tailwater does not meet the requirements described in Section 2 above. If circumstances allow, the preferred gate sequence may be temporarily altered in order to complete testing on any gate(s) that may be safely operated. Complete testing requires that the gate spill water. In the absence of adequate tailwater for complete testing of any or all gates 5 – 9, annual testing of each gate must still be conducted and include floatation, unlocking, and relocking. Gates 1 – 4 are required to release water every five years. All gates are required to be floated, unlocked, and locked annually. The Project Manager will conduct and submit all required gate testing documentation to FERC.

4. GENERAL PREPARATION GUIDELINES AND INFORMATION:

a. It could require up to three hours to prepare gates for operation. This includes among other things preparing instruments, closing valves or removing equipment in preparation of a spillway gates release. When possible this preparation should be scheduled sufficiently in advance and during regular duty hours. Detailed preparation procedures are maintained at the Project Site.

b. It requires approximately one hour to prepare each gate for operation. When possible, the preparations should be scheduled in advance to occur during regular duty daylight hours. Two individuals will check gate settings to ensure that all the hatches and fasteners are in place. Operators on top of the piers will be locked when not in use. When the reservoir elevation is above 997 and gate(s) are floated with water in anticipation of a potential high flow release event, the locking bars on the floated gate(s) will be in the unlocked position.

c. The crane barge is periodically secured in front of a single gate during construction and maintenance activities. Gates on either side of the barge may be safely used to pass water in such instances; however, there may be times when it is desirable to remove the barge from the upstream side of service spillway. The barge is typically not moved while any gates are open and releasing water. It takes a minimum of two hours to move the barge under favorable weather conditions during normal working hours. It can take significantly longer under bad weather conditions. The Project Manager or the designated alternate will coordinate with Water Services regarding the positioning of the crane barge prior to and during high flow release operations.

d. The interior of each gate should be inspected for any abnormality after each use during a high flow release event.

5. SPECIFIC RESPONSIBILITIES:

a. The Water Services Manager, or designated alternate, should:

i. Monitor river, reservoir, and weather conditions.

ii. Notify the Upper Basin Regional Manager and the Project Manager when release operations are anticipated to be needed to pass runoff or move stored water downstream.

iii. Direct release operations through the Project Manager or designee. This includes the floating, opening, and closing of the spillway gates and the opening and closing of low flow gates.

iv. Keep the Project Manager or his designee informed of anticipated release operations and inflow predictions.

v. Keep the Project Engineer informed of anticipated release operations that may affect maintenance or other activities at the dam.

vi. Arrange for the pass-through of water through Lake Granbury.

vii. Coordinate as necessary with Authority Management and the Authority Public Information Officer to keep them adequately informed.

viii. Coordinate operations with external agencies such as the National Weather Service West Gulf River Forecast Center, USACE, FERC, and USGS (Note: Coordination with USGS should include the potential need to remove equipment from the Graford gage at the Highway 16 bridge when five (5) or more gates may be necessary).

ix. Produce after-action reports for high flow release events.

b. The Project Manager, or designated alternate, should:

i. Supervise the physical preparation and operation of gates. Typically, the Water Services Manager, or designated alternate, is responsible for determining the timing for floating the spillway gates. The Project Manager may float the spillway gates at any time with just cause, but advance consultation with Water Services is desired.

ii. Notify the Water Services Manager, or designated alternate, at the initiation of release operations of any restriction in gate availability or maintenance activities that may affect such operations.

iii. Consult and coordinate with the Water Services Manager, or designated alternate, throughout a high flow release event with regard to anticipated operations and changing conditions.

iv. Ensure adequate Project personnel are available to accomplish all necessary tasks for high flow release operations. Project personnel will be placed in "on-call" status anytime spillway gate(s) are in the floating position after regular duty hours, including weekends and holidays. In addition to physical operations at the dam, such tasks may include upstream visual observations of gages and flow conditions to verify gage readings, or in the event that electronic gage data transmissions are lost, to report stage levels at the upstream gage.

v. Ensure that appropriate downstream notifications are made. The Project Manager will also ensure that the areas between the dam and the Highway 16 bridge are cleared prior to lowering a gate.

When gate releases are initiated the Connect-CTY™ service is used by Project personnel to create a new message which includes an event title, the amount being released and the date, to rapidly disseminate messages to every telephone number, teletypewriter (TTY) and email stored in the notification database. A voice message is recorded that is then delivered quickly to individuals in the notification database. The automated downstream call list is again activated each time there is an increase in the amount of discharge through the gates. This list and instructions for operating the Connect-CTY™ system are maintained at the Project and are updated as needed and reviewed annually.

vi. Evacuate Powerhouse prior to a release with five or more gates open.

vii. Coordinate evacuation of River Park Trail as necessary.

viii. Coordinate evacuation of Reservoir System Maintenance Unit (RSMU) as necessary.

ix. In the event that communications with Water Services personnel are lost during high flow release operations and until they are restored, the Project Manager should direct release operations according to the following schedule. This schedule may be altered when, in the judgment of the Project Manager, local conditions so require. Upstream flow measured at the South Bend gage may be considered in conducting

release operations; however, consideration should be given to the fact that flows at this gage take approximately one day to reach the reservoir. Safety of Project personnel and the safety of the structure are of overriding concern. All other guidelines and considerations contained within this document, including gate opening sequence and minimum required tailwater elevations in Section 2 above, should be observed.

1. Attempt to reestablish communications with Water Services personnel as soon as possible.

2. If the lake level is above 998.0, heavy rain has occurred around the lake or immediately upstream, and the lake is rising at the rate of 0.1 feet per hour or more, float the first three (3) gates to be used.

3. With three (3) gates floated and the lake elevation above 998.50 and rising at the rate of 0.1 feet per hour or more due to heavy rain around the lake or immediately upstream, open one (1) gate.

4. With one (1) gate open and the lake elevation above 998.50, heavy rain has occurred around the lake or immediately upstream, and the lake is rising at the rate of 0.05 feet per hour or more measured over at least a two-hour period after the first gate is opened, open a second gate.

5. With two (2) gates open, the lake elevation above 998.50 and continuing to rise at the rate of 0.05 feet per hour or more, float three additional gates and open a third gate.

6. With three (3) gates open, the lake elevation above 999.00 and continuing to rise, open a fourth and fifth gate as necessary with one hour between openings, if possible. Upon opening of a fifth gate, float the remaining three gates. Open remaining gates as needed with a minimum of one hour between openings, if possible, to stabilize and maintain the elevation below 1000.00.

x. Upon the opening of a second gate or earlier in anticipation of the potential for opening a third gate, notify The Texas Department of Transportation (TxDOT) that releases may inundate Highway 16 (three (3) gates open or about 30,000 cfs), and coordinate with Central Office staff to discuss the following check list:

1. Possum Kingdom (PK) management receives notification from Water Services to lower third gate
2. PK maintenance personnel respond to prepare for lowering gate
3. PK office personnel (regular duty hours) and Lake Rangers (weekends and after duty hours) make downstream notification
4. Lake Rangers respond below dam at Highway 16 bridge to notify citizens of high flow release operation
5. Lake Rangers notify TXDOT who will close the road and post their personnel on both sides of the road 24 hours daily during high flow release operation

6. Lake Rangers notify Mineral Wells Department of Public Safety and Palo Pinto Sheriff Office of the high flow release operation
7. PK maintenance personnel lower the third gate

xi. Conduct the Extraordinary Event Inspection as described in the Possum Kingdom Emergency Action Plan and forward results to the Project Engineer. Particular attention will be focused on evaluating any possible movement of the stilling basin extension or surrounding materials below gates 6 through 9.

xii. During and/or immediately after a significant runoff event, coordinate with Water Services to monitor and mark high water elevations along major streams that experience any significant backwater or inundation. As soon as practicable after the runoff event, have a survey of all high water marks accomplished and produce a memorandum report for the record, including a summary map displaying elevations in the surveyed areas.

6. GATE OPERATION DURING LOSS OF ELECTRICAL POWER

The sluice gates, which must be opened prior to lowering a spillway gate, are typically operated by fixed electric motors; however, there is an alternate manual crank system that can be used in the event that electrical power is lost. In this event, the crank system will be operated by hand or by devices powered by portable generators. The spillway gates do not require electrical power for operation.

7. OPENING AND CLOSING GATES

When a possibility exists for release operations, Water Services will coordinate with the Project Manager or designee prior to non-duty hours (nights, weekends, and holidays) so that appropriate planning and arrangements can be made should release operations be necessary. For potential high flow releases, these discussions and arrangements should include at a minimum weather forecasts, whether or not gates should be floated, the anticipated time required for Project personnel to respond should a gate operation be required, SCADA alarm trigger level settings, communication procedures, and any other factors that could be relevant.

The Project Manager and/or the Project Engineer will inform the Water Service Manager of any restriction in gate availability or maintenance activities that will impact or be impacted by release operations.

RISING STAGE:

When possible, the first gate should be opened early enough to provide a minimum time period of 2 1/2 hours before opening the second gate in order to allow the tailwater to stabilize in the spillway section of the dam. After the second gate is opened, a minimum one-hour time delay should be observed between each successive gate opening.

Elevation	Action
995.50 – 999.00+	Depending on inflow predictions and rainfall forecasts, float one or more of the first three (3) gates to be used. Open gate(s) as necessary based on analysis of inflows. Opening a gate(s) at elevations below 998.00 may help to reduce the peak discharge ultimately required to pass the event.
998.00 – 999.25+	Float the next three (3) gates to be used if it is anticipated that the lake elevation may not be controlled below 1000.00 with two (2) gates operating. Open gate(s) as necessary based on analysis of inflows.
998.50 – 999.50+	Float the final three (3) gates to be used if it is anticipated that that the lake elevation may not be controlled below 1000.00 with five (5) gates operating. Open gate(s) as necessary to maintain the reservoir elevation below 1000.00.
1000.00	Maximum operating level and level of emergency spillway. Uncontrolled releases over the emergency spillway begin at this elevation.

FALLING STAGE:

Gates should be closed in reverse order based on the evaluation of upstream river flow data and calculated reservoir inflow. Gates should be closed with a minimum of two hours between each closing when possible. In order to protect the area below the stilling basin extension, the same minimum tailwater elevations should be used for closing a gate that are used for opening the gate. It is desirable to close gates only when best available data indicate that the gate being considered for closing will not need to be reopened. This is not always possible due to additional rainfall that may occur or unknown/inaccurate upstream gage data. Upon conclusion of high flow release operations, the reservoir elevation should be between 998.5 and 999.5. Water Services in coordination with Project personnel will give consideration to the time of year, upstream hydrologic conditions, and near-term meteorological forecasts in determining the desired ending elevation for a high flow release operation event. Having some freeboard below elevation 1000 provides time for responding to future runoff events.

Due to the numerous variables involved, professional judgment must be used in all aspects of release operations as it is not practical for a procedural document to define with specificity all actions to be taken in every possible situation. These guidelines are subject to future revision.

ATTACHMENT B TO OPERATIONS PROCEDURE
FOR CONTROLLED RELEASES
LAKE GRANBURY

1. GENERAL OPERATING GUIDELINES:

a. High flow releases (greater than 5,000 cubic feet per second (cfs)) should not exceed inflows during the initial hours of a local runoff event when the inflows are increasing (i.e., during the rising limb of the inflow hydrograph) unless the integrity of the dam is threatened, or the spillway gates are in jeopardy of being overtopped.

b. Release rates may be based on actual reservoir inflow, measured runoff at upstream gages, releases from Possum Kingdom Lake, or demand for downstream water supply. Releases should not be made in anticipation of rainfall-runoff.

c. During periods of excessive rainfall originating upstream, releases may be made in advance of actual inflow to the reservoir in order to draw the water surface elevation down prior to arrival of the peak flood wave. Up to a 5 foot drawdown is acceptable depending upon the magnitude and travel time of upstream flows. These advance release rates should not exceed the greater of upstream gaged flow discharge rates or release rates from Possum Kingdom Lake. The drawdown of the reservoir in advance of the peak flood wave provides additional freeboard during high flow events that makes operation of the reservoir safer and less labor intensive. Secondary benefits include slightly reduced peak water surface elevations upstream along the reservoir, and potentially a slightly lower peak release rate from the reservoir.

d. In order to provide advance warning of impending downstream flows, releases should not increase more than 5,000 cfs per hour when total release rates are less than channel capacity (approximately 35,000 cfs) unless inflow to the reservoir is resulting in a rising water surface elevation at the dam approaching elevation 693.0 ft msl (BRA datum) or the top of the tainter gates. It is desirable to keep all increases in the release rate at or below 5,000 cfs per hour, following the general pattern of inflow.

e. The minimum desirable time period for inflow computations is two hours. This time period may be reduced when heavy local rainfall is creating a rapid rise in the reservoir.

f. Once opened, gates will typically be closed only after reasonable assurance that the peak inflow has been received, and the inflows are receding.

g. Decreases in release rates should generally follow the pattern of decreases in inflow rates. To minimize downstream bank sloughing, it is desirable to keep decreases in the release rates to less than 5,000 cfs per hour, especially when the total release is less than 35,000 cfs.

h. At the conclusion of high flow release operations resulting from a period of excessive rainfall, the desired reservoir level is between elevations 692.40 and 692.60 ft msl (BRA datum).

2. SPECIFIC RESPONSIBILITIES:

a. Water Services personnel monitor reservoir and weather conditions daily. They are also in contact with the WGRFC, the USGS, and the USACE as necessary. Nonetheless, most high flow release operations are initiated when the Project Manager or designee notifies Water Services personnel of local rainfall and/or a rising reservoir level. This notification is made by calling Water Services or the Upper Basin Manager and the Water Services 24-hour hotline (see Attachment D), or by other contact means previously arranged.

b. Once aware of runoff and a rising reservoir, Water Services personnel are responsible for gathering weather and inflow data, determining necessary release rates, making inflow projections and coordinating with Project personnel regarding release operations. Project personnel will adjust gate settings based on instruction from Water Services. Project personnel will monitor lake elevation and will report to Water Services personnel at the time intervals as directed by Water Services personnel. Water Services personnel may also provide upper and lower reservoir elevations at which Project personnel should report. Project personnel will notify Water Services personnel of any unusual circumstances that may affect or result from high flow release operations and, as time is available, inspect the structure and surrounding grounds for signs of distress. Coordination between the Project personnel and Water Services prior to and during high flow release events will also include the status of high elevation alarm settings in the on-site residences occupied by Project personnel and high/low SCADA cell phone call-out alarm settings.

c. In the event that communications are lost with Water Services, and until such time that communications are restored, the Project Manager or his designee will direct release operations to keep the reservoir below a target elevation of 692.70 ft msl (BRA datum) following these guidelines. Restoring communications with Water Services is a high priority.

d. At the appropriate release rates, Project personnel should perform downstream notifications according to the notification list kept and maintained by Project personnel. When releases exceed 5,000 cfs the Connect-CTY™ service is used by Project personnel to create a new message which includes an event title, the amount being released and the date, to rapidly disseminate messages to every telephone number, TTY and email stored in the notification database. A voice message is recorded that is then delivered quickly to individuals in the notification database. The automated downstream call list is again activated each time there is an increase in the amount of discharge through the gates. This list and instructions for operating the Connect-CTY™ system are maintained at the Project and are updated as needed and reviewed annually.

e. New Monticello Drive is the bridge approximately 2.3 miles downstream of the dam that accesses Pecan Plantation. Modeling indicates that this bridge

would be overtopped at a flow rate of approximately 124,000 cfs; however, this is a rough estimate. Historically, releases from Lake Granbury have not exceeded 80,000 cfs. In the event releases are anticipated to reach 100,000 cfs, Project staff should initiate contact with the Pecan Plantation for contingencies to close the bridge.

f. Siren instructions: The siren is activated by Project personnel with each increase of water flow. The siren button is on the SCADA computer and it sounds for 60 seconds.

g. Water Services personnel are responsible for keeping Authority Management, the Authority Public Information Officer, and other agencies including the WGRFC and the USACE advised of changes in release rates.

h. At the conclusion of high flow release operations, Water Services personnel are responsible for compiling data to document the event. This data should include inflow and release hydrographs, reservoir elevations, upstream and downstream gage hydrographs, rainfall data, communication information, and other pertinent data.

i. At the conclusion of high flow release operations, Project personnel are responsible for inspecting the Project to identify any damage and issuing a Special Inspection Report, if necessary. Project personnel will coordinate inspection activities and results with the Authority's Project Engineer – Dams.

j. If inflow is significant and/or unusual, Water Services and/or Project personnel may mark and survey high water marks upstream and/or downstream of the dam.

3. GATE OPERATION DURING LOSS OF ELECTRICAL POWER:

There are two emergency generators located at the Project. One of these is for operation of the tainter gates during a power failure and the other is for operation of office power supply. In the event of a power loss, these two generators are automatically activated.

4. GATE OPERATING SEQUENCE AND SPECIFIC GUIDELINES:

a. Gates should typically be opened in one-half (1/2) foot increments until all 16 gates or all available gates are open. Once all available gates are open, one foot opening increments are acceptable. The minimum gate opening is one-half (1/2) foot.

b. It is undesirable for water to overtop the gates due to resulting stresses that could lead to damage during subsequent opening or closing. The top of the gates when closed is elevation 693.0 ft msl (BRA datum). As the gates are opened, the elevation of the top of the gates increases providing additional freeboard against overtopping. If a rapid rise in the reservoir is occurring in which the water surface is nearing the top of gates, open gates in jeopardy of being overtopped an additional six inches to prevent overtopping.

c. The difference in openings between adjacent tainter gates should not exceed two feet unless a mechanical malfunction, such as a loss of power, requires a variation from these guidelines that is necessary to pass inflow.

d. Gates should be opened to provide an evenly distributed flow pattern downstream of the dam. The initial opening sequence below is desirable when all 16 gates are operational. Once all gates are open, the sequence may be reversed for additional openings. When gate(s) are unavailable or out of service, attempt to maintain an evenly distributed flow pattern while abiding by the maximum two feet opening differential between adjacent gates. Deviation from the sequence below may be necessary or desirable to exercise gates that have not been used for an extended period of time.

Operating Sequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gate Number	1	16	2	15	3	14	4	13	5	12	6	11	7	10	8	9

e. Close the tainter gates in reverse order, abiding by the two feet differential criteria for adjacent gates.

f. Though the sluice gates are generally used for making water supply releases and passing lower inflows, they may be used during larger release events as necessary.

ATTACHMENT C TO OPERATIONS PROCEDURE
FOR CONTROLLED RELEASES
LAKE LIMESTONE

1. GENERAL OPERATING GUIDELINES:

a. During and/or immediately after an excessive rainfall runoff event when the inflows are increasing (i.e., during the rising limb of the inflow hydrograph), releases should not exceed inflows.

b. Release operations should be determined based on actual reservoir inflow, measured runoff at upstream gages, or demand for downstream water supply. Releases in excess of channel capacity (~2,000 cfs) should not be made in anticipation of rainfall-runoff.

c. In order to provide advance warning of impending downstream flows, whenever possible, releases should not increase more than 1,000 cfs per hour for the first two hours of a release. After channel capacity (~2,000 cfs) has been reached, it is desirable to keep increases in the release rate at or below 5,000 cfs per hour, following the general pattern of inflow.

d. The minimum desirable time-step for inflow computations is two hours. This may be reduced in the event that heavy local rainfall is creating a rapid rise in the reservoir. A rising rate of 0.3 feet per hour or greater has been used in the past as a guideline for using a reduced time step. Release rates in excess of approximately 30,000 cfs have been found to influence the headwater elevation as measured at the USGS gage located at the dam in an erratic manner. As a result, computation of inflows using elevation data from this gage should be avoided when releases are above 30,000 cfs. When possible in these situations, elevation data from the USGS gage at the Lake Limestone Marina near Farrar should be used for calculating inflow.

e. The top of the conservation pool is at elevation 363.0. The space between elevations 363.0 and 365.0 provides additional volume that may be used to store excessive rainfall runoff temporarily. The space between elevation 363.0 and 363.5 will routinely be used so release rates can be kept at or below inflow rates. In unusual situations, such as temporary equipment malfunction or severe runoff, the space between elevations 363.5 and 365.0 may be used to temporarily store runoff. The Water Services Manager should be notified by the Water Services staff member that is controlling releases during the event when this storage is being used. Uncontrolled releases over the emergency spillway begin at approximately elevation 370 feet msl.

f. Gates should typically be operated in six inch or one foot increments. The minimum gate opening is six inches. The differential in gate openings between adjacent gates should not exceed two (2) feet.

g. Once opened, gates should typically be closed only after reasonable assurance that the peak inflow has been received and the inflows are receding.

h. Decreases in release rates should generally follow the pattern of decreases in the inflow rate. To minimize downstream bank sloughing, it is desirable to keep decreases in release rates below 5,000 cfs per hour until channel capacity (~2,000 cfs) is reached. Once the flow is contained in the channel, releases should not decrease at a rate greater than 500 cfs per hour. In some cases near the conclusion of an event, a release of 500 cfs or less may need to continue for several days to allow fish that have congregated below the dam to move and disperse downstream. The ball valves may be used for this purpose.

i. At the conclusion of high flow release operations due to a period of excessive rainfall, the desired reservoir level is between elevations 362.8 and 363.0.

2. SPECIFIC RESPONSIBILITIES:

a. Water Services personnel monitor reservoir and weather conditions daily. They are also in contact with the WGRFC, the USGS, and the USACE, as necessary. Nonetheless, most gate release operations are initiated when the Project Manager or designee notifies Water Services personnel of local rainfall and/or a rising reservoir level. This notification is made by calling Water Services, the Lower Basin Manager or the Water Services 24-hour hotline (see Attachment D), or by other contact means previously arranged.

b. Once aware of runoff and a rising reservoir, Water Services personnel are responsible for gathering weather and inflow data, determining necessary release rates, making inflow projections and coordinating with Project personnel regarding release operations. Project personnel will adjust gate settings based on instruction from Water Services. Project personnel will monitor lake elevation and will report to Water Services personnel at the time intervals as directed by Water Services personnel. Water Services personnel may also provide upper and lower reservoir elevations at which Project personnel should report. Project personnel will notify Water Services of any unusual circumstances that may affect or result from high flow release operations and, as time is available, inspect the structure and surrounding grounds for signs of distress.

c. In the event that communications are lost with Water Services, and until such time that communications are restored, the Project Manager or designee will direct release operations to keep the reservoir below a target elevation of 363.5 following these guidelines. Restoring communications with Water Services is a high priority.

d. At the appropriate release rates, Project personnel should perform downstream notifications according to the notification list kept and maintained by Project personnel.

When releases exceed 2,000 cfs the Connect-CTY™ service is used by Project personnel to create a new message which includes an event title, the amount being released and the date, to rapidly disseminate messages to every telephone number, TTY and email stored in the notification database. A voice message is recorded that is then delivered quickly to individuals in the notification database. The automated downstream call list is again

activated each time there is an increase in the amount of discharge through the gates. This list and instructions for operating the Connect-CTY™ system are maintained at the Project and are updated as needed and reviewed annually.

e. Water Services personnel are responsible for keeping Authority Management, the Authority Public Information Officer, and other agencies including the WGRFC and the USACE advised of changes in release rates.

f. At the conclusion of high flow release operations, Water Services personnel are responsible for compiling data to document the event. This data should include inflow and release hydrographs, reservoir elevations, upstream and downstream gage hydrographs, rainfall data, communication information, and other pertinent data.

g. At the conclusion of high flow release operations, Project personnel are responsible for inspecting the Project to identify any damage and issuing a Special Inspection Report, if necessary. Project personnel will coordinate inspection activities and results with the Authority's Project Engineer – Dams.

h. If inflow is significant and/or unusual, Water Services and/or Project personnel may mark and survey high water marks upstream and/or downstream of the dam.

3. GATE OPERATION DURING LOSS OF ELECTRICAL POWER:

a. Emergency power generators provide backup power during loss of power to the administration building and the dam. The system is automated and does not require staff to activate the emergency power supply.

4. GATE OPERATING SEQUENCE AND SPECIFIC GUIDELINES:

a. There is not a specific tainter gate opening sequence. However, gates should be opened to provide an evenly distributed flow pattern downstream of the dam. The minimum allowable gate opening is six (6) inches. Once all gates are opened six (6) inches, successive openings should be made in either six (6) inch or one foot increments. During periods of extreme inflow when more than a 5,000 cfs increase in the release rate is necessary, up to two (2) feet opening increments may be used.

b. The difference in openings between adjacent tainter gates should not exceed two feet unless a mechanical malfunction, such as a loss of power, requires a variation from these guidelines that is necessary to pass inflow.

c. Close the tainter gates in reverse order, abiding by the two feet criteria for adjacent gates.

d. Though the ball valves are generally used for making water supply releases and passing lower inflows, they may be used or exercised at the conclusion of larger release events for fish/wildlife purposes and/or to minimize downstream bank sloughing.

ATTACHMENT D TO OPERATIONS PROCEDURE

NOTIFICATION HOTLINE

254-761-3140

All Water Service staff will receive notification that a voice mail has been left on the Water Services Notification Hotline.

Responsibilities of Area Project(s):

To notify Water Services personnel of a situation requiring attention, such as high flow release operations, or potential or imminent emergency:

Step 1. Call the Water Services Notification Hotline at (254) 761-3140 to connect to a voice mailbox at the Central Office.

Step 2. Leave your name, telephone number, and a brief voice message describing the situation that requires attention.

Step 3. Allow 10 minutes for the person(s) "on-duty" to return your call.

Step 4. If no response is received within a ten-minute period, use the table of individual contact information in this section to call Water Services personnel by cell or home phone.

Responsibilities of Water Services Personnel:

When you are "on-duty" and receive notification that a message has been left on the Water Services Notification Hotline:

Step 1. Send a short email message to the Water Service group indicating that you are responding.

Step 2. Call 254-761-3250 to connect to the voice mail and enter the mailbox number (3140) and password (00003140). Retrieve the name, telephone number, and brief description of the situation that requires attention. Clear the message from the voice mail system by pressing 76 on the telephone touchpad.

Step 3. Return the call and handle the situation accordingly.

Step 4. Provide a courtesy email message to the Water Services group providing more detail of the situation and the actions and follow-up required.

Step 5. If an email is not received within five minutes indicating the situation has been responded to, the designated "on-duty" backup person should respond as instructed above.

Table: Individual Contact Information

Name	Pager	Home	Cell	Ext.
Phil Price, P.E.		254-754-7788	254-640-1171	3189
Brad Brunett		254-694-7239	254-707-0968	3171
Chris Higgins			254-644-2225	3152
Aaron Abel			254-644-1972	3175
Don Naylor			254-717-4384	3138
Daryl Spiewak		254-776-7117	254-640-1076	3136
Judi Pierce	254-398-2746	254-857-9504	254-855-8228	3103
Wayne Mooney			254-640-1068	3196
David Whiteside			254-855-9822	3286
David Williams			254-223-4147	3288
Nathan Holle		254-498-4538	254-292-9737	3289
Robert Flanary			254-723-3425	3188