

An Overview of LCRA Water Supply Operations August 2018



LCRA Water Supply Operations Basic Concepts

Two basic sources of surface water supply

- Run-of-River Water (ROR) - natural flow of the river
- Stored Water - water supplied from lakes Buchanan and Travis

Water supply operations are conducted consistent with all water rights, contracts and legal agreements

LCRA Water Supply Operations Basic Concepts

Water rights generally grant the holder access to the natural flow of the river subject to conditions.

- Location
- Purpose of use
- Maximum Annual Quantity
- Maximum Rate of Diversion
- Priority Date
- Special Conditions

Many water right holders on the Colorado River also contract with LCRA to purchase Stored Water.

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LCRA Water Supply Operations Basic Concepts

Stored Water is supplied from two storage reservoirs in the Highland Lakes system:

- Lake Buchanan – formed by Buchanan Dam
- Lake Travis – formed by Mansfield Dam

Water rights for these two lakes authorize LCRA to impound and divert water, and use the bed and banks of the Colorado River to convey water released from lake storage for use by others.

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LCRA Water Supply Operations Basic Concepts

The Water Management Plan (WMP) is a special condition on the Buchanan and Travis water rights – required by the State. The current version was approved by TCEQ Nov. 2015.

Stored Water is accounted for based on amounts supplied to customers that divert from the lakes or released through Mansfield Dam to meet downstream needs.



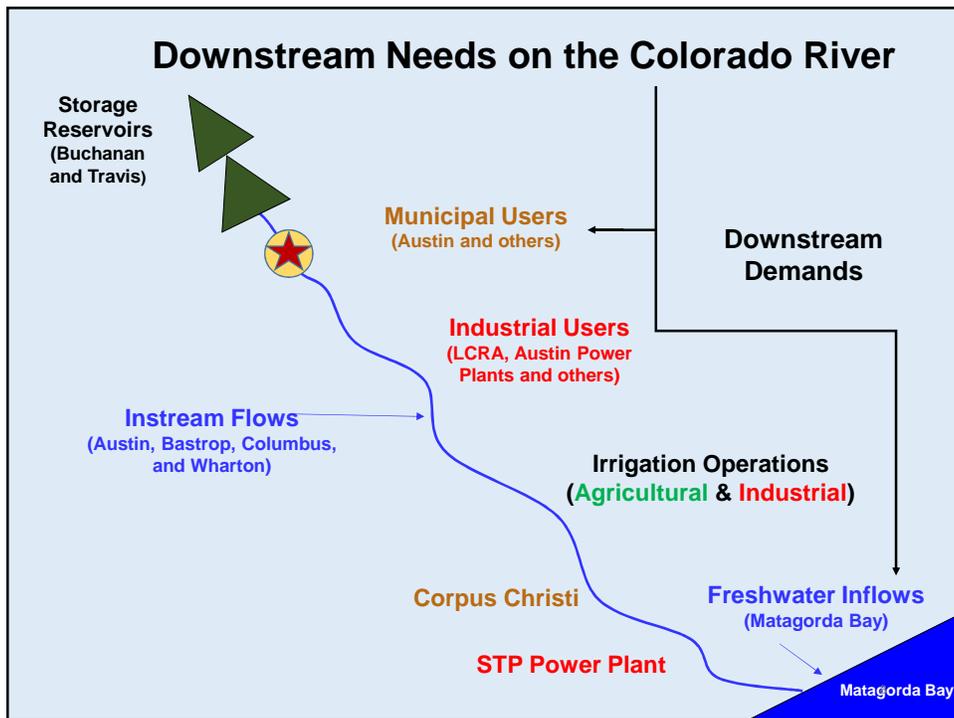
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LCRA Water Supply Operations Objectives

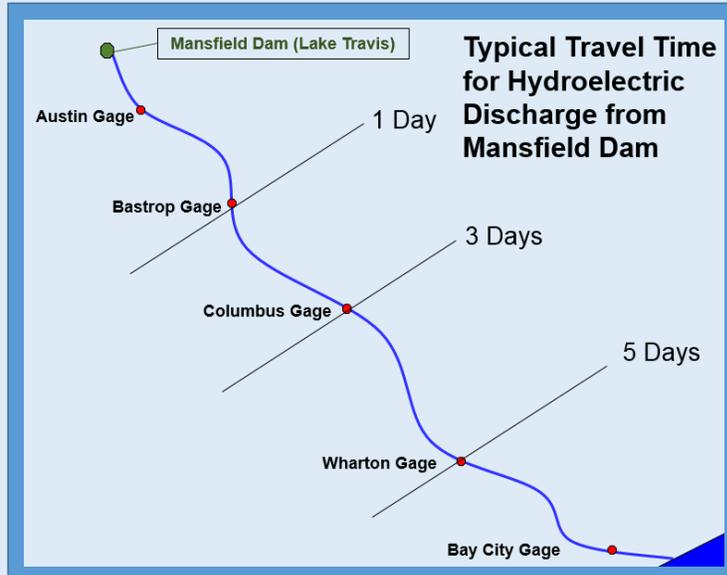
LCRA manages the system according to the following guidelines:

1. All demands for water from the Colorado River downstream of lakes Buchanan and Travis should be satisfied to the extent possible by run-of-river flows of the Colorado River pursuant to run-of-river water rights;
2. Inflows should be passed through lakes Buchanan and Travis to honor downstream senior water rights only when those rights cannot be satisfied by the flow in the Colorado River below the Highland Lakes;
3. Water should be released from lake storage to satisfy downstream contractual demands only to the extent that such contractual demands cannot be satisfied pursuant to run-of-river water rights.

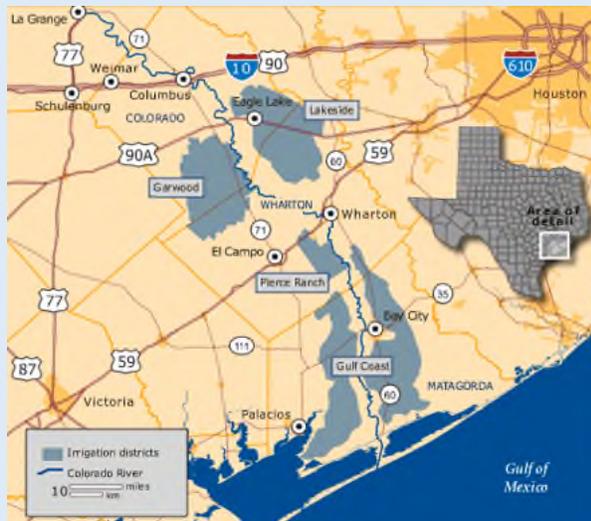
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Typical Flow Times from Mansfield Dam



Detail - Downstream of Columbus



- Columbus Gauge
- Lakeside Irrigation
- Garwood Irrigation
- Pierce Ranch Irrigation
- Wharton Gauge
- Gulf Coast Irrigation & Arbuckle Reservoir (Plant 2 at Lane City)
- City of Corpus Christi
- Gulf Coast Irrigation (Plant 1 at Bay City)
- Gulf Coast Irrigation (Plant 3 at Bay City)
- Bay City Gauge
- South Texas Project

Functional Requirements

Mansfield releases are scheduled two days in advance.

Delivery times vary with conditions, but are typically about 1 to 7 days depending on location.

Scheduling of releases requires - at multiple locations along the lower river for 3 to 9 days in the future – daily forecasts of:

- Location and timing of planned diversions
- Amounts of ROR and Stored Water available to meet needs

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Modeling System

LCRA uses CADSWES RiverWare to make daily forecasts, schedule water releases at Mansfield Dam and track water use.

CADSWES – University of Colorado, Center for Advanced Decision Support for Water and Environmental Systems

RiverWare – software platform funded and used by

- U.S. Bureau of Reclamation
- Tennessee Valley Authority
- U.S. Army Corps of Engineers
- others

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LCRA Daily River Operations Model (DROM)

LCRA DROM includes two RiverWare models that support daily forecasts, daily schedules to release water at Mansfield Dam and water use accounting.

- **Routing Model** - Estimates the run-of-river (ROR) available to satisfy demands of water right holders
- **Release Model** - Determines the amount of ROR and Stored Water that must be released at Mansfield Dam to satisfy all downstream demands, consistent with all water rights and agreements.

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ROUTING MODEL

Considers recent historical data for

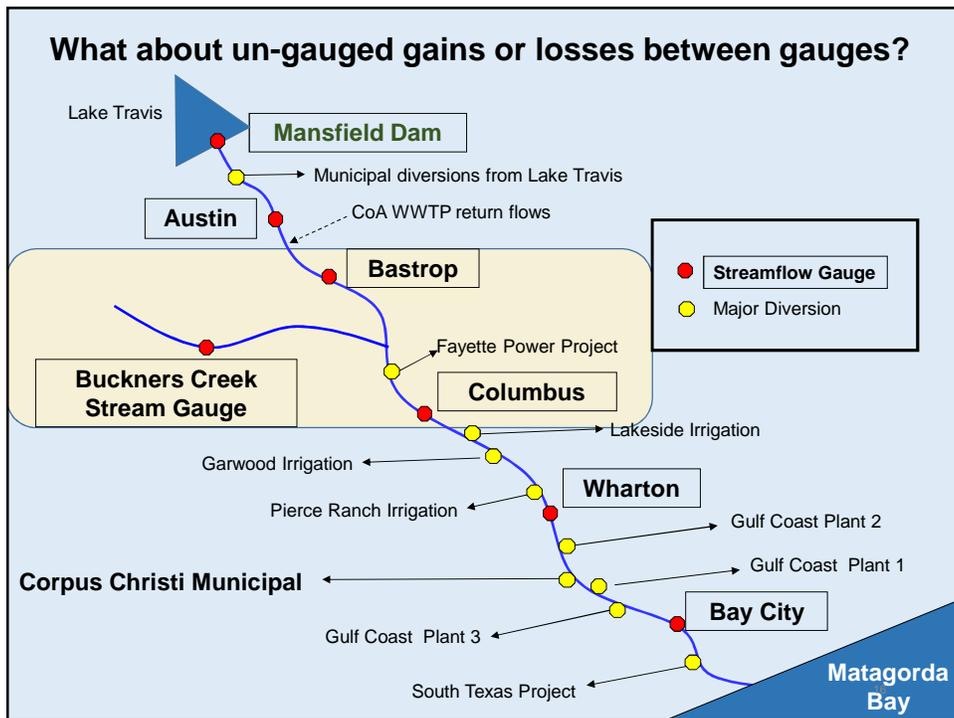
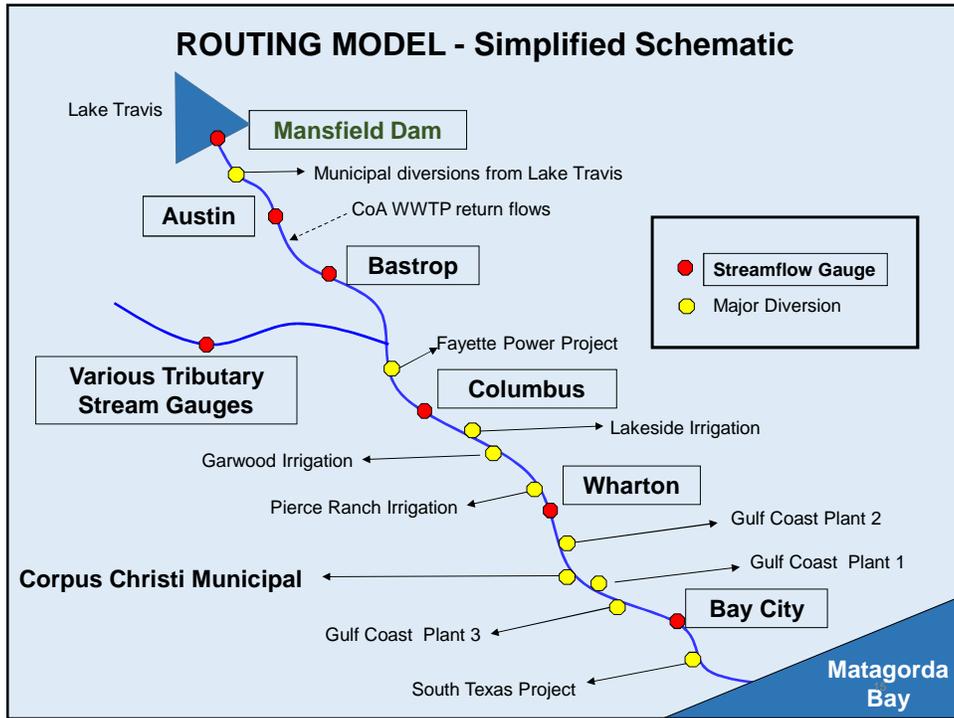
- releases from Mansfield Dam
- diversions and return flows
- gauged inflows from tributaries

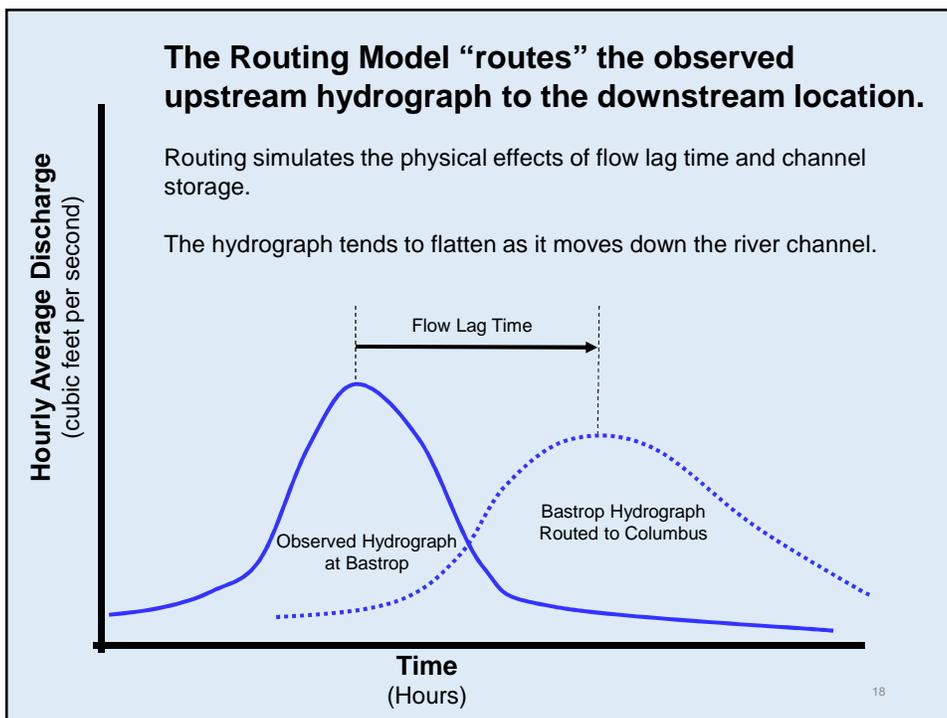
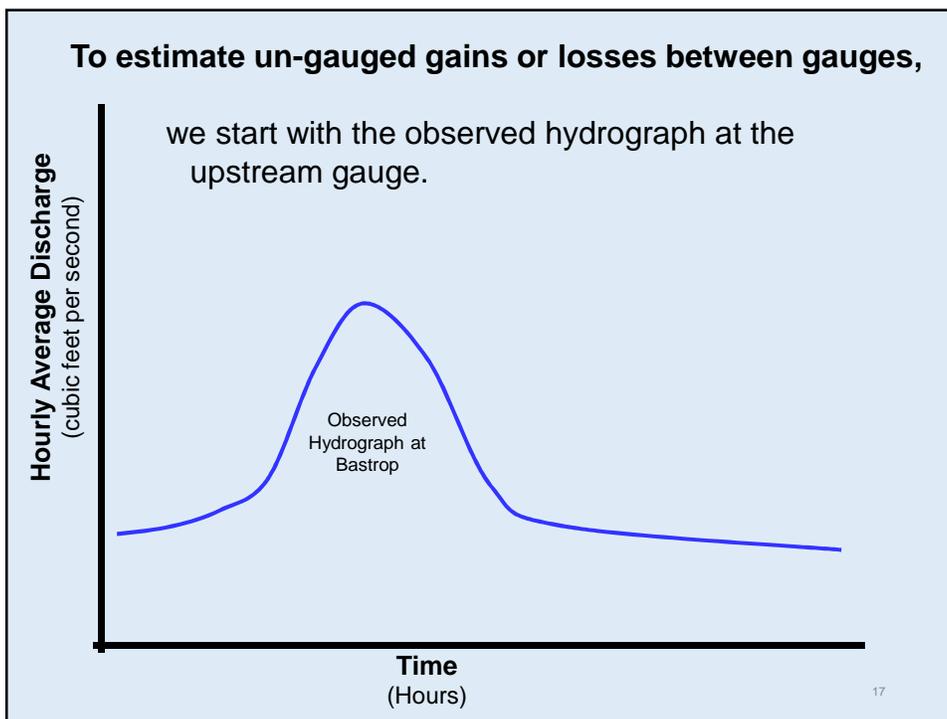
Provides estimates of:

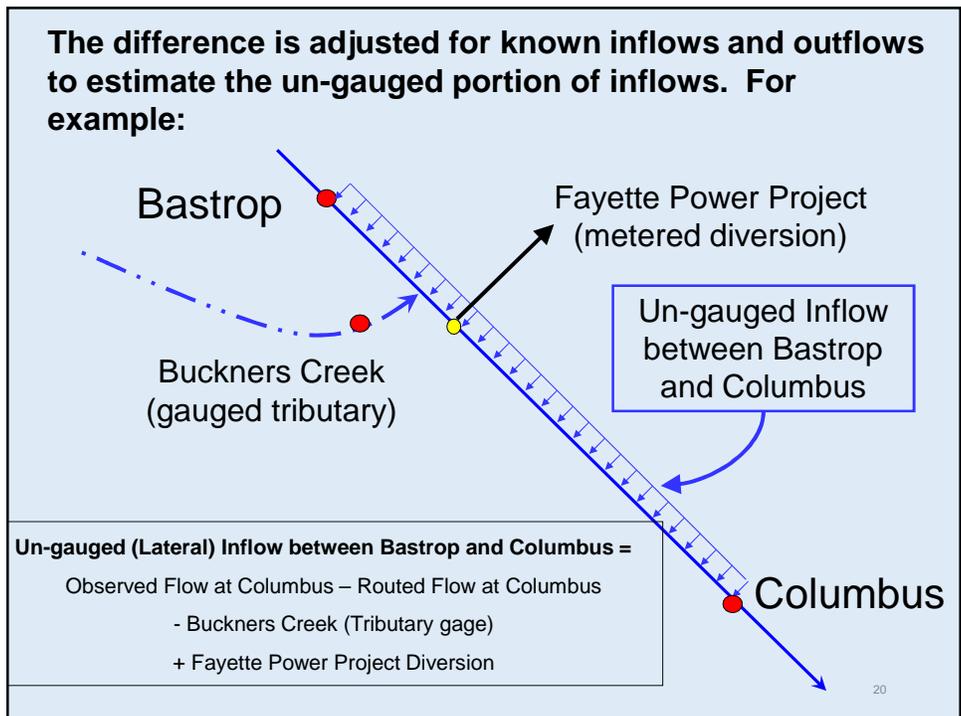
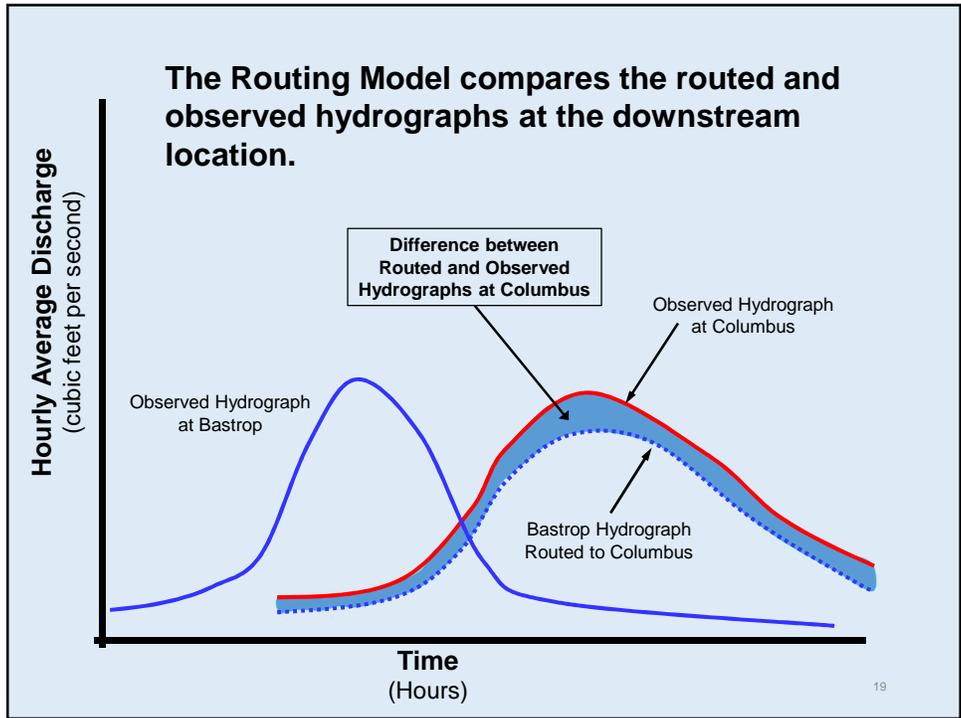
- un-gauged (run-of-river) gains and losses of flow
- flow attributable to run-of-river and stored water

The routing model operates on an hourly time-step.

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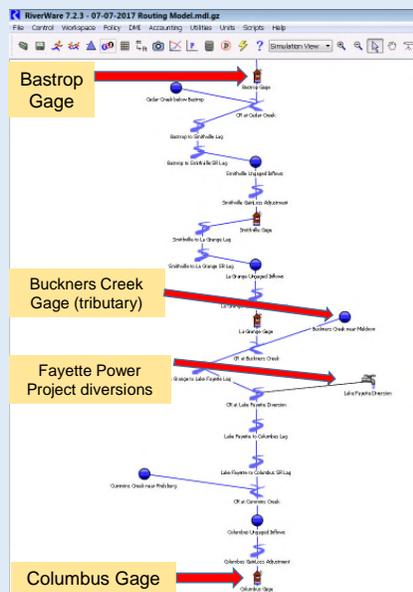






RiverWare Simulation View - Bastrop to Columbus

The RiverWare model is more complex than shown on the simplified schematic map on the previous slide.



ROUTING MODEL – USE OF OUTPUTS

The routing model provides estimates of historic mean daily values, based on recent history, for:

- un-gauged (run-of-river) gains and losses of flow
- allocation of flows to run-of-river and stored water

When weather conditions are expected to remain stable, i.e., consistently wet or consistently dry, recent history provides a good basis for estimating flows in the near future.

When weather conditions are unstable, the modeler must exercise independent judgment to forecast future flows.

RELEASE MODEL

Considers expected demands for senior water right holders, stored water contract customers and environmental flow requirements.

Considers forecasted ROR water entering the river downstream of Mansfield Dam, (downstream ROR), available to meet demands of ROR water right holders.

Considers previous day gauged inflows to the Highland Lakes (upstream ROR) available for pass through to downstream water rights senior to the Highland Lakes.

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RELEASE MODEL

Considers

- legal framework of prior appropriation among water rights
- contractual obligations between LCRA and water users
- environmental criteria

Calculates the minimum discharges from Mansfield Dam for water supply purposes based on priority allocation among all water rights, contracts, and other requirements.

Forecasts expected flows downstream of Mansfield Dam.

The release model operates on a daily time-step.

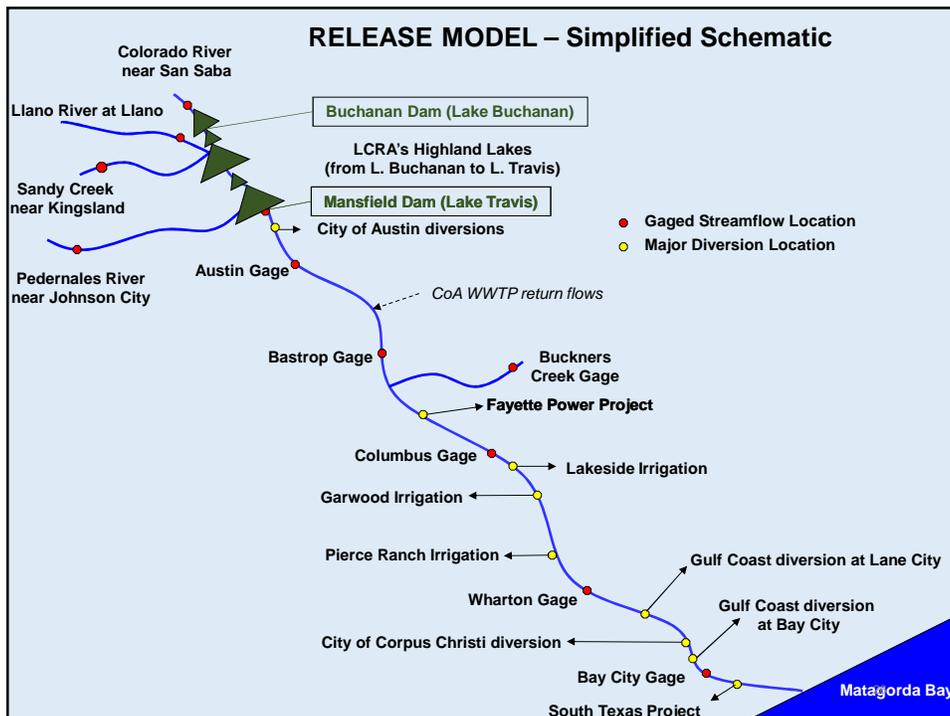
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Priority Dates for Major Water Rights on the lower part of Colorado River

Rank	Effective Priority Date*	Water Right holder
1	November 1, 1900	Garwood Irrigation Division
2	November 2, 1900	City of Corpus Christi (available at Garwood diversion point)
3	June 30, 1913	City of Austin municipal use (from L. Austin for Davis WTP and Ullrich WTP)
4	July 1, 1913	Gulf Coast Irrigation Division (unsubordinated date Dec. 1, 1900)
5	July 2, 1913	Lakeside Irrigation Division (senior portion) (unsubordinated date Jan. 4, 1901)
6	July 3, 1913	Pierce Ranch (unsubordinated date Sept. 1, 1907)
7	July 4, 1913	Lakeside Irrigation Division (junior portion) (unsubordinated date Sept. 2, 1907)
8	November 12, 1913	Bastrop Energy
9	June 27, 1914	Austin Energy at Fayette Power Project (available at Lady Bird Lake)
10	June 27, 1914	City of Austin additional municipal for L. Austin and LBL
11	March 29, 1926	LCRA Highland Lakes (impoundment)
12	March 7, 1938	LCRA Highland Lakes (diversion)
13	August 20, 1945	Austin Energy at Decker Power
14	August 20, 1945	City of Austin additional municipal from Colorado River d/s of LBL
15	June 10, 1974	South Texas Project
16	November 1, 1987	Lakeside Irrigation Division (1987 portion)
17	November 1, 1987	Gulf Coast Irrigation Division (1987 portion)
18	September 23, 1997	City of Corpus Christi (flow d/s of Garwood diversion point)
19	January 28, 1999	Austin Energy at Fayette Power Project (flow d/s of Lady Bird Lake)

*As modeled in DROM. Note, for example, that by separate agreement, some LCRA water rights have been subordinated to the City of Austin municipal water right.

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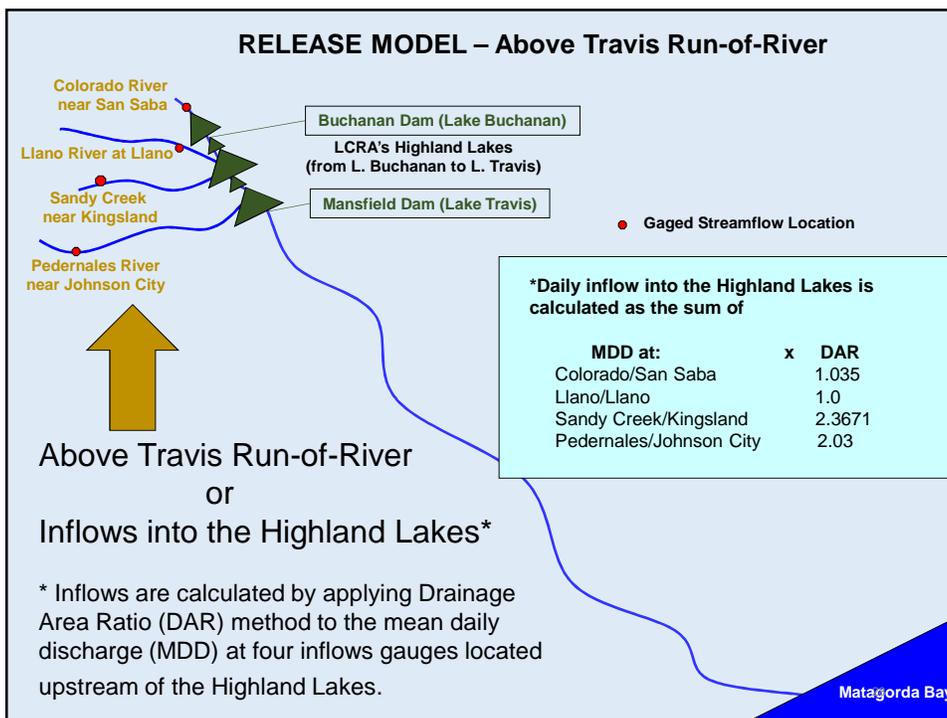
RELEASE MODEL – Allocation of ROR

Uses accounting features of RiverWare to allocate ROR water to meet expected demands for each major diverter that holds a water right that holds a water right

Allocation is performed in two rounds:

- Round 1 - considers the ROR water originating downstream of Mansfield Dam (also called “Below Travis Run-of-River”) to optimize use of this supply source.
- Round 2 - considers the ROR water originating upstream of Mansfield Dam (also called “Above Travis Run-of-River” and “Inflows into the Highland Lakes”).

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RELEASE MODEL – Releases of ROR and Stored Water

- Allocates Above Travis Run-of-River water to any downstream water rights senior to lakes Buchanan and Travis that have not been met with Below Travis Run-of-River water.
- Allocates Stored Water to any remaining portion of orders for diverters with LCRA water supply contracts, that have not been met or cannot be met with ROR water.
- Releases of stored water to meet Water Management Plan environmental flow criteria for freshwater inflows to Matagorda Bay are determined each month and scheduled when required.

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RELEASE MODEL – Instream Flow Releases

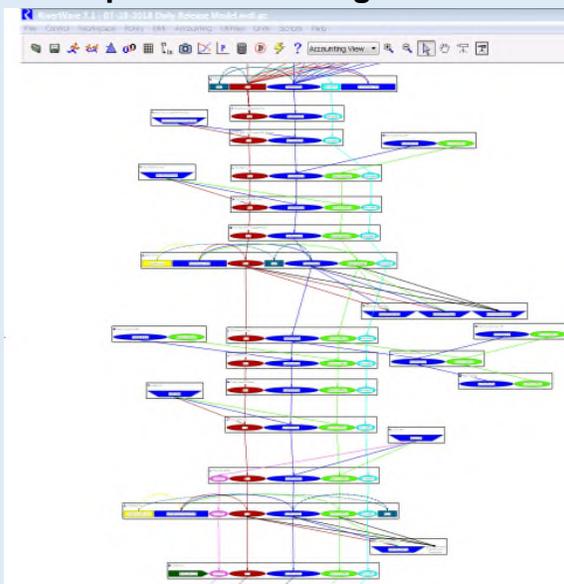
- Releases of the Above Travis Run-of-River and stored water needed to meet downstream needs of senior waters, water supply contracts and freshwater inflow needs are simulated.
- Simulated flows are compared to Water Management Plan criteria for instream flows at Austin, Bastrop, Columbus, and Wharton.
- Additional releases of Above Travis Run-of-River or stored water may be required to meet instream flow criteria, depending on specific conditions of the Water Management Plan.

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RiverWare – Example of Accounting View

The RiverWare model is more complex than shown on the simplified schematic maps.

This is same portion of the river as previous slide, but this shows the accounting features. Each color is a different water supply, such as “Below Travis Run-of-River”.



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