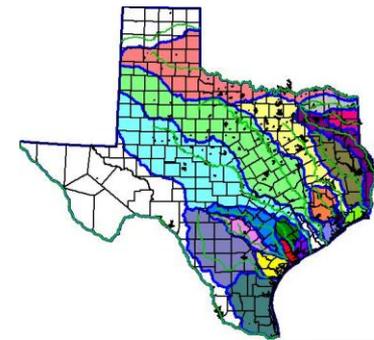


FRAT OVERVIEW BRAZOS BBASC WACO TEXAS

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OUTLINE OF PRESENTATION

- Brief Overview of WAM
- Overview of Past SB3 BBASC Approach
- FRAT
 - Inputs for Study
 - Different Types of Flows Analyzed
 - Discussion of Hydrologic Condition
 - Example Results from Colorado BBASC
- QUESTIONS?

WAM OVERVIEW

WAM = Water Availability Model = WRAP (Water Rights Analysis Package)

- Model Code Developed and Continually Updated by TAMU
- Various Versions Maintained by TCEQ
- Originally Designed for the Purpose of Evaluating New Water Right Applications
- Priority Among Water Rights is Prior Appropriation
- Usually Represents all Water Rights, regardless of whether they have been utilized or not.

All WAM Models :

- Use Naturalized Flows for Hydrologic Flow Input
- Represent a Fixed Level of Man's Use for the Entire Simulation Period.
- Use a Monthly Timestep.
- Simulate a long period of record, typically 50 to 60 years ,which Includes a Broad Range of Hydrologic Conditions (Droughts, Normal Years, Wet Years)
- Do not Encompass Recent Hydrology

VALUE OF WAM MODELS

Impose Fixed Level of Mans Activity on History, which only had Historic Levels of Man's Activity

Allows User to Answer Questions Like:

- How much worse would the 1950's Drought been if all current water rights were in place in the 1950's diverting their:
 - Current Demands (RUN8)
 - Authorized Demands (RUN3)
 - All Authorized Demands PLUS A New Water Right being Considered
- Test Changes in Management Practices and Gain Insights to the Impact of Proposed Changes on Complicated Systems.

OVERVIEW OF SB3 APPROACH

- TCEQ MONTHLY WAM MODEL USED TO DEVELOP INFLOWS
 - RUN3 – Represents Permit Evaluation Condition
 - RUN8 – Represents Current Levels of Use, Returns, Storage
 - RUN? – Can be Made to Reflect Whatever Stakeholders Deem Reasonable
- FUTURE PROJECT TAKEN FROM REGIONAL PLAN OR OTHER INFORMATION
- WAM FLOWS EXTRACTED AT PROJECT LOCATION
 - Total Flow
 - Flow Already Dedicated to Existing Rights
- MONTHLY WAM FLOWS DISTRIBUTED TO DAILY FLOWS USING GAGED (HISTORIC) DAILY FLOW
- RESULTING DAILY FLOWS INPUT INTO DAILY TIME STEP PROCESS (FRAT)
- PROJECT SIMULATED WITH EFLOW RECOMMENDATIONS IMPOSED
- FIRM YIELD OF PROJECT DETERMINED FOR MULTIPLE EFLOW ASSUMPTIONS

FRAT

(FLOW REGIME ANALYSIS TOOL)

- DEVELOPED BY HDR WITH ONGOING REFINEMENTS BY TPWD (DAN OPDYKE)
- COMPLEX EXCEL SPREADSHEET THAT ANALYZES SINGLE WATER SUPPLY PROJECT
- INPUTS
 - DAILY FLOWS
 - HYDROLOGIC CONDITION
 - EFLOW RECOMMENDATIONS
 - Specifically designed to Test SB3 type EFLOW recommendations but does all other common EFLOW recommendations as well
 - PROJECT CONFIGURATION
- OUTPUTS
 - DAILY REPRESENTATION OF PROJECT
 - DAILY FLOWS AFTER PROJECT
 - NUMEROUS CHARTS, FLOW FREQUENCY CURVES, TIME SERIES PLOTS
 - FLOW PROTECTED (RESERVED) BY EFLOW RECOMMENDATIONS

USE OF FRAT RESULTS BY BBASC/BBEST

- FIRM YIELD OF PROJECT DETERMINED FOR MULTIPLE EFLOW SCENARIOS
 - 1- No Environmental Requirements
 - 2- TCEQ Modified Lyons Instream Flow Requirements
 - 3- TWDB Consensus Planning Instream Flow Criteria
 - 4-BBEST/BBASC Recommendations
- EFFECT OF PROJECT ON RIVER FLOWS FOR ALL OF ABOVE

DETAIL OF INPUTS FOR STUDY

- EFLOW Recommendations for Project Location
 - BBEST Typically Based on HEFR
 - Lyons and Consensus Criteria based on Other Methods
- Hydrologic Condition
- Daily Pattern of Flow
- Project Configuration (Regional Plan or Other Source)
 - Area / Capacity Relationship
 - Pump Rate
- WAM Model (TCEQ)
 - Total Flow
 - Flow Required for Downstream Seniors
 - Evaporation Rate, if Applicable

VARIOUS FLOWS COMPARED USING FRAT

- Optional Flow Information Used for Comparison Purposes
 - (1) NATURAL - Input Flow Associated with all WAM Models
 - (2) CURRENT - Simulated Flows from TCEQ RUN8
 - (3) HISTORICAL - Observed Flow from USGS, COE, etc
- Inflow to and Outflow from FRAT
 - (4) BASELINE (flows before project diverts – input to FRAT from WAM3)
 - (5) PROJECT (flows after project diverts – output of FRAT)
 - (6) FLOW PROTECTED BY FLOW REGIME (output of FRAT)

(4) BASELINE (input to FRAT)

Simulated Flows from TCEQ RUN3

- Full Authorized Demands for All Water Rights of Record
- No Assumed Return Flows
- Major Reservoirs Represented with Authorized Capacities
- Represents the Full Utilization of all Existing Water Rights of Record whether they have been used or not
- Assumes Senior Water Rights are Fully Met Before Junior Water Rights are Satisfied
- Output of this WAM model used as Input to all Project Scenarios

(5) PROJECT (output of FRAT)

BASELINE model with Test Project in Place.

- Selected Project Implemented
- Effectively Represented as most Junior Right in Basin
- Diverts Water Subject to Eflow Assumptions
- Success of Project Diversions Quantified for the Various Scenarios
- Depletions by Project can be put back in WAM model to Assess Impacts on Other Locations (such as Bay)
- Results Used to Understand how the various EFLOW Recommendations Impact Project's Ability to Supply Water and How Project Impacts River Flows

(6) FLOW PROTECTED BY EFLOW REGIME

Flow Reserved by EFLOW Recommendation

- Computed by FRAT as the Quantity of Water that is being Reserved or Protected by the EFLOW Regime being Modeled.

Considers:

- Applicable Hydrologic Condition
- All Tiers of Flow Recommendation being Represented
- Has been called “Infinite Infrastructure” line

HYDROLOGIC CONDITION

- ONE OF THE MOST DIFFICULT SUBJECTS
- COLORADO/LAVACA BBASC WAITED UNTIL LATE IN PROCESS TO ADDRESS
 - BBEST RECOMMENDATIONS TYPICALLY INCLUDE MULTIPLE LEVELS OF BASE FLOWS (LOW, MED, HIGH) THUS SOME APPROACH NEEDS TO BE USED TO DETERMINE WHICH LEVEL OF BASEFLOW IS APPROPRIATE
- NEEDS TO BE IMPLEMENTABLE IN ORDER TO BE ACCEPTED BY TCEQ
- RECENT SB3 BBASC EFFORTS HAVE USED:
 - RESERVOIR STORAGE
 - CUMULATIVE FLOW

COLORADO BBASC EXAMPLES

MAIN INFORMATION THAT WILL BE EXAMINED:

- UNAPPROPRIATED WATER FROM TCEQ RUN3 AT ALL BBEST SITES (21)
- FRAT OUTPUT FOR ONE OF THE PROJECTS THE BBASC CONSIDERED

ULTIMATELY LOOKED AT 2 PROJECTS:

- OFF-CHANNEL RESERVOIR ON THE LAVACA RIVER NEAR EDNA (LAVACA BASIN)
 - Project Parameters Taken from River Authority's Recent Analysis (FNI)
 - 25,000 acre-feet Off-Channel Reservoir Capacity, 309.4 cfs River Pump Rate (200 MGD)
- OFF-CHANNEL RESERVOIR / AQUIFER STORAGE AND RECOVERY PROJECT ON THE PEDERNALES RIVER NEAR JOHNSON CITY (COLORADO BASIN)
 - Project Parameters Developed by BBEST and BBASC Members
 - 10,000 acre-feet Off-Channel Reservoir Capacity, 1,000 cfs River Pump Rate
 - 100,000 acre-feet of Aquifer space, 50 cfs aquifer injection rate

HYDROLOGIC CONDITION for LAVACA PROJECT

BBEST DIRECTION SUGGESTED HYDROLOGIC CONDITION BE BASED ON LAKE TEXANA STORAGE

Percent of time condition expected to be applied

- Subsistence: 5
- Dry: 25
- Average: 50
- Wet: 25

LAKE TEXANA SIMULATED STORAGE IN BASELINE WAM MODEL USED TO DETERMINE STORAGE TRIGGERS ACCOMPLISH ABOVE DIRECTION

Corresponding Lake Texana Triggers Used for Lavaca Project FRAT Analysis

Subsistence:	BELOW 93,298 af (54% CAPACITY) <u>[5.3 % OF TIME]</u>
Dry:	BETWEEN 93,298 af (54%) AND 132,460 af (77%) <u>[20.7 % OF TIME]</u>
Average:	BETWEEN 132,460 af (77%) AND 170,300 af (FULL) <u>[45.5% OF TIME]</u>
Wet:	TEXANA FULL (170,300 af) <u>[30.5% OF TIME]</u>

- Note that Lake Texana is nearby Lavaca Project Site, but neither upstream or downstream.
- Hydrologic Condition only applies to BBEST Scenarios.

FIRM YIELD RESULTS FOR LAVACA PROJECT

- (1) No EFLOW: 15,875 af/y.
 - (2) Lyons EFLOW: 10,240 af/y.
 - (3) Consensus EFLOW: 9,900 af/y.
 - (4) FULL BBEST EFLOW: 10,125 af/y.
 - (5) BBEST EFLOW; no Pulses: 10,725 af/y.
- Note number 4 above reflects BBASC change for Subsistence flows from TCEQ Water Quality Standard based to Q95 based (HEFR results).

DESCRIPTION OF CHARTS FROM FRAT COLORADO BBASC – LAVACA RIVER PROJECT

- DAILY FLOW FREQUENCY CHARTS FOR PERIOD OF RECORD
- DAILY TIME SERIES CHART FOR EXAMPLE DRY, AVERAGE AND WET YEAR