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Keeping Streams Flowing

In-Stream Flow Issues Involve Water Development, the Environment, and Even Snakes and Dinosaur Tracks

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In Texas and many other Western states, water has always been thought of as something to be developed or diverted. Texas water law, after all, is based on the concept of beneficial use: the idea that water should be diverted from a river or stream and used for irrigation, industry, domestic use, or other consumptive purposes. The idea that leaving water in a stream or river has merit has been only a recent development.

A new line of reasoning is emerging that says in-stream flows are valuable to protect and maintain fishery habitats, recreation, commerce, navigation, water quality and hydroelectricity generation.

The worth of in-stream flows is becoming apparent. Scientists are using methods like contingent valuation to measure the public's willingness to pay to preserve instream flows. More traditional economy analyses are showing that in-stream uses such as fishing, tourism and recreation are important to Texas' economy.

Most in-stream flow conflicts center around the construction or repermitting of reservoirs. Providing in-stream flows may decrease reservoir yields, because water is released that could otherwise be stored (reservoir yield is defined as the amount of water a reservoir can dependably produce). This makes projects more expensive because potential water sales are lost.

Supplying in-stream flows may also cause a water rights problem. Many reservoir developers have said that much of the water in their projects is already committed, and that there simply is not additional water available for in-stream uses. Water developers also contend that reservoir development has enhanced in-stream flows in some parts of

Texas by providing at least a minimum flow year-round. Without reservoirs, they argue, some rivers would be dry during parts of a year.

Conversely, in-stream flows are needed to protect fish and wildlife habitats. In some cases, free- flowing rivers have been reduced to a mere fraction of their original flow because of dams and reservoirs. Providing optimal amounts of in-stream flows often restores fish populations.

Solutions to in-stream flow conflicts are difficult to develop because of the complexity of the problem. For example, when determining the amount of in-stream flows to be released, should the goal be to maintain or enhance the existing habitat? Should in-stream flows be based on fish that will inhabit the new reservoir or on the fishery in the stream to be flooded? How much mitigation (replacing flooded tracts of land and providing in-stream flows) is adequate? How do you compensate for changing a river into a totally different ecosystem?

Examples of protracted conflicts over in-stream flows include Stacy Dam which focused on the in-stream flow needs of the Concho water snake; the repermitting of the hydropower facility at Possum Kingdom Lake, a regulatory skirmish between the Brazos River Authority and the Federal Energy Regulatory Commission (FERC); the Little Cypress Creek project which centered around the impact of reduced flows on both fish habitat and bottomland hardwoods; and Paluxy Reservoir, where in-stream flow releases are needed to preserve dinosaur tracks.
There are some promising signs that compromises can be reached. The U.S. Army Corps of Engineers has been one of the lead federal agencies to begin using alternative dispute resolution (ADR) strategies that urge cooperation, not litigation. The U.S. Fish and Wildlife Service (USFWS) has developed a simulation model which predicts how organizations may react in conflicts involving in-stream flows. The model pinpoints potential areas of conflict that may be avoidable.

An example of a recent compromise involved the installation of a hydropower facility on Canyon Dam, where flows will be protected without diminishing reservoir yield.

The Legal and Regulatory Environment

To understand the in-stream flow issue, a basic analysis of Texas water law is required. Texas surface water law is based on the appropriation doctrine which established water rights based on the date the water was first put to a beneficial use and the nature of that use. In-stream flows are not recognized as an official beneficial use by Texas law. Official beneficial uses include (in priority order): 1) Municipal and Domestic; 2) Industrial; 3) Irrigation; 4) Mining; 5) Hydropower; 6) Navigation; 7) Recreation and pleasure; and 8) Other uses. Because in-stream flows are not an official beneficial use, it is unclear if water rights can be assigned to them.

The conflicting missions of various state and federal agencies also contribute to the problem. Agencies with a mission to protect fish and wildlife resources such as the Texas

Parks and Wildlife Department (TPWD) and USFWS often find themselves at odds with regulators such as the Texas Water Commission (TWC) and the Texas Water Development Board (TWDB) which are responsible for developing new water supplies and protecting the interests of water rights holders. This situation is accentuated in Texas where it is unclear if in-stream flow uses have a legal water right. Although the system does a good job of providing checks and balances, it often leads to lengthy hearings and lawsuits.

Even though they may not be granted legal water rights, in-stream flow uses do have some protection under Texas water law. In 1985, the Texas Legislature amended the water code to include fish and wildlife considerations as part of the water rights permitting process. The amendments require reservoir developers to take reasonable actions to mitigate the adverse effects of a project on fish and wildlife habitats. Net benefits to the habitat produced by the project can be considered in the mitigation process. The effect of this change has been to involve TPWD, TWC and TWDB in evaluating in-stream flow needs on a case-by-case basis (McKinney, 1988).

At the federal level, the agencies most often involved in in-stream flow cases are USFWS, FERC, and the U.S. Army Corps of Engineers. USFWS is the federal agency primarily responsible for managing the nation's fishery resources, and has broad responsibilities to protect and enhance fish and wildlife habitat. The USFWS National Ecology Research Center in Colorado provides expertise on these issues and develops many of the new technologies used in resolving in- stream flow disputes.

Some of the most controversial in-stream flow issues involve the FERC permitting process. Under the Federal Power Act, FERC licenses the construction and repermitting of hydropower facilities. Recent amendments to that act require FERC to give "equal consideration" to fish and wildlife resources as part of the licensing process, and may require conditions to protect, enhance, and/or mitigate losses to fish and wildlife resources. Although that sounds well and good, FERC is not bound by state law or policy regarding a state's water rights statutes. State officials and water agencies have intervened to object to FERC recommendations in the Possum Kingdom case and others.

Other federal agencies and laws are also important in in-stream flow issues. The Corps of Engineers is involved in many reservoir development and channel modification projects that alter in-stream flows and performs in-stream flow analysis in cooperation with USFWS. National forests, parks, wildlife refuges, and other federal lands such as military bases may also have a right to unappropriated water for in-stream flow needs. Numerous federal laws impact in-stream flows including the Endangered Species Act, which protects in-stream flows that support such species; the Clean Water Act; the Fish and Wildlife Coordination Act; and the Wild and Scenic Rivers Act.

Determining In-Stream Flows

In general, the method used to predict in-stream flow needs may depend on whether the situation is a part of long-range planning or project bargaining (Lamb, 1988).

In long-range planning, analysts are usually called on to recommend an in-stream flow level that may guide low-intensity preliminary planning. Techniques used to determine in-stream flow needs in these situations may include methods which utilize historic streamflow data and field investigations to predict in-stream flow needs.

Mid-range techniques may be utilized when the controversy is not intense, but time is still a constraint. These methodologies involve observing key habitats, studying the impact of different levels of streamflow, and selecting critical areas such as riffles (rocky or gravelly areas in shallow
water) for intense study. Many mid-range techniques are limited because they produce only a single streamflow value; negotiating in-streamflows is usually easier when the impacts of a wide range of flows can be depicted. Other mid-range methods such as the Physical Habitat Simulation System (PHABSIM) link stream channel characteristics with information on fish habitat preferences. PHABSIM requires field data collection of stream cross-section and habitat features, simulation of streamflows, and data on species and habitat suitability.

Project bargaining is characterized by high intensity negotiations involving specific projects. In these cases, studies may require extensive habitat and biological sampling, sediment and water quality analyses, and physical habitat assessments.

One of the most comprehensive techniques for developing in-stream flow recommendations is the in-stream Flow Incremental Methodology (IFIM). IFIM (Bovee, 1982) predicts changes in the relationships between different levels of in-stream flows and fish habitat. IFIM is most useful in comparing the relative effects of various in-stream flow release schedules. Some experts feel IFIM has serious limitations and may not be the best method to estimate relationships between in-stream flows and fish populations (Craig and Kemper, 1987). Summaries of various in-stream flow methodologies are contained in Morhardt (1986).

Despite their sophistication, in-stream flow methodologies don't always produce consistent results. In many Texas situations, different methodologies have produced widely varying in- stream flow recommendations. In some cases, the same methodology produced significantly different recommendations for the same project when analyzed in a different manner.

Predicting in-stream flows can be very complicated. Various fish species inhabiting a stream may require different flows at various times of the year; in other words, a flow schedule that may be excellent for one species may not be appropriate for others. Researchers usually solve this problem by selecting target species. A problem particular to Texas and other southern states is that there is a lack of data on the needs of warm-water species; much of the original data has focused on salmon, trout and other cold-water species in mountain streams. More information on warm-water species needs to be developed to provide reliable predictions of Texas conditions.

Although most of the methods described here predict in-stream flow needs of fish and wildlife, other related research is also underway. Losses and gains in aquatic habitat as a result of reservoir development can be assessed utilizing habitat evaluation procedures (Killgore, 1986). Methods have been developed to assess in-stream flow needs for recreation (Hyra, 1978). Other studies have used contingent valuation to measure the public's willingness to pay to maintain certain levels of streamflow. One study (Clonts, 1988) indicated that Alabama residents were willing to pay $56 per household ($64 million statewide) to preserve free-flowing rivers in that state.

Stacy Dam: The Concho Water Snake

In 1980, the Colorado River Municipal Water District (CRMWD) applied to build Stacy Dam at the confluence of the Concho and Colorado rivers between San Angelo and Abilene. The project would have flooded

32 miles of the Colorado River and 14 miles of the Concho River, creating a 103,000 acre-foot (AF) reservoir. CRMWD also operates 484,000 AF Spence Reservoir on the Colorado River in Coke County, upstream from the Stacy project.

The major environmental issue was whether the project would adversely impact the habitat of the Concho water snake, a threatened species whose habitat had declined by 28% since 1980 (U.S. Army Corps of Engineers, 1987). Concerns were that riffles (areas that provide excellent habitat for juvenile snakes) would be permanently flooded by the dam, or might be covered by silt if occasional high flows were not provided, and that the project might further separate snake populations, limiting the species' survivability. Not everyone agreed that the snake was actually threatened; CRMWD suggested the snake could thrive in the newly created reservoir habitat and theorized that a similar species was flourishing in Possum Kingdom Reservoir and Lake Granbury in the Brazos River basin.

TWC, USFWS and the Corps of Engineers conducted studies utilizing IFIM, PHABSIM and other methodologies that examined the relationship between streamflow and habitat area. TWC suggested flows ranging from 2.5 to 8 cubic feet per second (cfs); USFWS proposed flows of 30 to 90 cfs; and the Corps of Engineers recommended flows of 15 to 100 cfs. CRMWD argued that such in-stream flow releases would amount to giving up as much as 39,000 AF of water per year.

The final negotiated solution included coordinated releases from both Stacy Dam and Spence Reservoir. Recommendations include: 1) In-stream flow releases of 10 cfs from Spence Reservoir, and 2.5 to 11 cfs from Stacy Dam; 2) Scouring flows of 600 cfs for three consecutive days once every 2 years from Spence Reservoir, and 2500 cfs for 2 consecutive days once every 2 years from Stacy Dam; 3) Monitoring the snake and its habitat; 4) Vegetation and silt removal; 5) Addition of rocks to create riffle areas; 6) Employing a biologist to study the snake; and 7) Purchase of mitigation lands to provide habitat for areas flooded by the reservoir. The dam is now being built.

Little Cypress Creek: A Test Case

In this case, the Little Cypress Utility District (LCUD) wanted to develop a 193,485 AF reservoir on Little Cypress Creek in northeast Texas to provide municipal and industrial water supplies for Harrison, Gregg and Rusk counties (Texas Water Commission, 1988). This project, which was recently voted down for the second time by voters, was a milestone, because it was one of the first cases where the new amendments to the state water code were tested.

In-stream flow issues involved: 1) The amount of flows needed for fishery maintenance and enhancement; 2) Impacts of altered flows on Caddo Lake; 3) Trade-offs between the development of a new reservoir fishery and the inundation of a stream ecosystem; and 4) Selecting target species in-stream flow needs should be based upon.

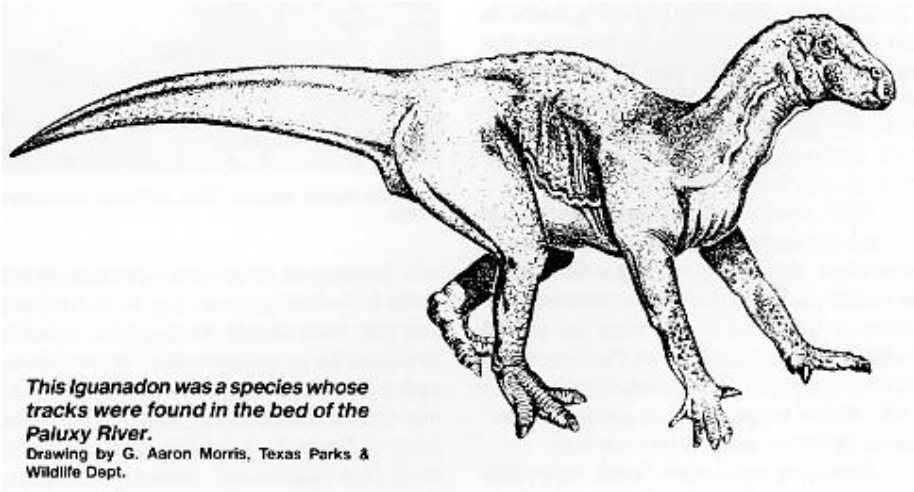
Another issue involved mitigation of 13,760 acres of land that would be permanently flooded by the project, including more than 7,000 acres of bottomland hardwoods. bottomland hardwoods are especially important because they are very productive and support a great diversity of plant and animal species. They also contribute to flood control and water quality. Recommendations for the amount of land that needed to be purchased and set aside to mitigate these losses were as much as 17,400 acres, including 12,227 acres of bottomland hardwoods.

IFIM studies and others were conducted and proposed in-stream flow releases varied significantly (see Figure 1). TPWD recommended flows ranging from 9 to 150 cfs (TWDB estimated this would reduce the reservoir's firm yield by 33%); TWDB proposed flows of 5 to 30 cfs; and TWC suggested flows of 5 to 40 cfs.

Paluxy Dam: Preserving Dinosaur Tracks

Unlike most in-stream flow cases that involve fish and wildlife habitat, this project focused on assessing the impact of the Paluxy Reservoir on streamflows needed to preserve dinosaur tracks and recreation activities (Texas Water Commission, 1987).

The project involved construction of a 99,000 AF reservoir on the Paluxy River a few miles upstream from Dinosaur Valley State Park. The main feature of the park is a series of 2,000 dinosaur tracks made by brontosaurs, pterodactyls and other species that are preserved in the



This Iguanadon was a species whose tracks were found in the bed of the Paluxy River.
Drawing by G. Aaron Morris, Texas Parks & Wildlife Dept.

limestone beds in and around the Paluxy River.

In-stream flows affect the tracks in two ways: 1) In cold weather, riverflow provides insulation and prevents cracking and freezing; and 2) Occasional high flows scour the riverbed and expose new tracks. Another issue concerned the amount of fish in the Paluxy River and if additional in-stream flow would benefit the fishery.

IFIM studies and others were initiated by TPWD, USFWS, TWC, and other agencies. In-stream flow recommendations varied significantly (see Figure 2). The reservoir developers (Somervell County and the cities of Glen Rose and Stephenville) suggested an average flow of 2 cfs and contended that if the reservoir were not constructed the river could be without any flow 60% of the time. They also testified that in-stream flow releases of 3 cfs would cost them $103,500 per year because of a loss in reservoir yield and potential losses of water sales. TPWD recommended average in-stream flow releases of 14 cfs; TWC suggested average flows of 7.3 cfs.

TWC approved construction of the reservoir in 1987 and specified an in-stream flow release schedule that can be adjusted as water demands increase As long as water demands are less than 13,600 AF annually an average in-stream flow of 7.3 cfs will be provided; when demands are greater than 13,600AFbut less than 15,000 AF in-stream flows will average 5 cfs; and when water demands are greater than 15,000 AF in-stream flows will be reduced to 2 cfs. The in- stream flow release schedule was appealed by TPWD and local landowners and is now in court.

Working with FERC: Possum Kingdom Lake & Canyon Dam

Three recent Texas cases have involved in-stream flow disputes with FERC, which has the authority to amend operating licenses for hydropower facilities granted by it or its predecessor agency, the Federal Power Commission.

Possum Kingdom Lake is a 569,000 AF reservoir on the Brazos River near Mineral Wells. The project is operated by the Brazos River Authority (BRA). In 1976, BRA applied to FERC to amend its operating license to reclassify some lands associated with the project. Since that time, USFWS and TPWD have been urging FERC to amend the operating license to require BRAto provide added in-stream flows to enhance downstream fished, habitats.

A jurisdictional dispute as to which agencies can decide in-stream flow issues is a major point in this case. TPWD and USFWS requested FERC intervention in determining in- stream flow releases. Various state officials including the Texas Attorney General's office contend that TWC, the agency that writes water permits in Texas, should be the agency that resolves this dispute. They have stated that FERC involvement is federal intrusion into a matter that ought to be decided at the state level. BRA and the state also argued that FERC actions would interfere with state water rights and would violate Texas water law. FERC's perspective is much different. The agency said that allowing states to prescribe minimum flows would essentially give the states veto power over FERC

projects, and that the in-stream flows recommended by USFWS and TPWD are necessary to enhance sport fishery production in the Brazos River basin. Negotiations are on-going.

FERC worked with USFWS to develop an in-stream flow release schedule that includes minimum releases of 100 cfs from March through June; 75 cfs from July through September; and 50 cfs from October through February. The releases could reduce the yield of the reservoir by as much as 33,700 AF annually. BRA officials have estimated that the releases would diminish the amount of water the reservoir could supply and would result in: 1) A loss in water sales of $3.8 million; 2) A decline of 805,000 kilowatt hours of hydropower production; and 3) Lake levels that would be an average of 1.5 feet lower during normal flows and as much as 10 feet lower during droughts. In-stream flows are still being negotiated.

While the Possum Kingdom repermitting can be described as a conflict situation, some state officials are touting the recent agreement between FERC and the Guadalupe Blanco River Authority (GBRA) on Canyon Dam as a positive example of a negotiated agreement that protects fishery habitats without damaging existing water rights holders.

In 1983, GBRA applied to FERC for a permit to install a 25 megawatt hour hydropower facility on Canyon Lake and Dam, a 40,000 AF facility located on the Guadalupe River north of New Braunfels. The project is a conservation storage reservoir that releases water for downstream users on demand; in other words, its in-stream flow release schedule is determined by the needs of downstream users.

In this case, TPWD and USFWS initially recommended in-stream flow releases of 80 to 200 cfs during operation of the project with provisions for a minimum flow of 75 cfs during droughts. GBRA objected to these in-stream flows as being excessive and maintained that the releases would impair its water rights. GBRA also contended that the proposed in-stream f low release schedule would require the release of more water than normally flowed in the river. Satisfying FERC's recommendations would have required releasing water stored and committed for use during droughts for the purpose of enhancing fish resources.

Negotiations resulted in an agreement that provides additional in-stream flows for the fishery while protecting GBRA during droughts. Minimum in-stream flows of 90 cfs will be continuously released. When the inflow to the reservoir is greater than 90 cfs, as much as 120 cfs may be released. During droughts, releases will be limited to the amount of water flowing into the reservoir.

There is also an instance of a hydropower project that was abandoned because the developer did not want to deal with FERC regulations. The Trinity River Authority (TRA) submitted an application to FERC in 1983 to build a 50 megawatt hydropower facility on Lake Livingston north of Houston. TRA decided against going ahead with the project. It said that, if the license were granted, FERC could dictate the operation of the lake regarding water releases, impacting water rights and increasing the cost of water from the project.

Protecting In-Stream Flows

There are a number of creative legal and institutional solutions that could be employed to preserve in-stream flows. Examples include prohibitions against additional diversions, conditions imposed on new water rights, the creation of in-stream flow rights, and transferring existing water rights to in-stream flow uses (Shupe, 1988).

Examples of efforts by Western states to protect in-stream flows include an Oregon law that placed a moratorium on new withdrawals from streams with important fisheries; programs in California that protect wild and scenic rivers; an Idaho statute that allows the governor to "hold. an appropriated in-stream water right in trust for the people of the state; and recent laws in Utah, Wyoming and Colorado that allow transfer of existing water rights to in-stream flow purposes by purchase or gift. One law that may be especially applicable in Texas is a 1987 Oregon statute that allows irrigators who conserve water to market 75% of that water; the remaining 25% is dedicated to the state to maintain in-stream flows.

Other alternatives involve persuading reservoir operators to alter their operations in order to enhance in-stream flows during critical periods of the year. In New Mexico, recreational users negotiated with a reservoir manager to maximize releases of stored water on summer weekends. This enhanced opportunities for river recreation at no cost to the reservoir owner.

The "public trust" doctrine has been viewed as a potential source of legal protection for in- stream flows, based on findings from the Mono Lake case in California. In that case, the public trust doctrine was used to limit the city of Los Angeles from diverting waters that would have otherwise flowed into the lake to prevent environmental damage. The pubic trust doctrine has not yet been tested in Texas.

Alternative Dispute Resolution

Because so many situations involving in-stream flow releases and other environmental disputes result in protracted lawsuits and administrative hearings, various groups are working on methods that encourage problem solving and cooperation.

A federal agency taking the lead in employing alternative dispute resolution (ADR) strategies is the Corps of Engineers (Priscolli, 1988). Some of the Corps' solutions involve bringing parties together that would probably conflict over individual permit applications and allowing them to write the technical specifications for new permits. The trade-off is that the Corps of Engineers accepts the permit as being valid if the groups compromise.

Other ADR strategies include mediated meetings and mini-trials, where each party makes an abbreviated presentation of its position to an impartial group. A way to target potential trouble spots before problems begin has been developed by USFWS. The Legal Institutional Analysis Model or LIAM (Wilds, 1986) predicts organizational behavior of

parties likely to become involved in in-stream flow disputes. Using the model, one can project the form of negotiation most likely to be successful.

Summary

In-stream flow issues will continue to be an important issue in Texas as the needs for developing water supplies and protecting the environment increase. There are opportunities to reach compromise solutions that protect both interests. Certainly, working together seems more appropriate than needless, expensive legal delays and administrative hearings.

From a research perspective, techniques for determining in-stream flows must be further refined so that the agencies and scientists developing in-stream flow needs arrive at more comparable results. The idea that vastly different results can be obtained from professionals using similar techniques and databases is disturbing.

Finally, consideration should be given to more clearly defining in-stream water rights in Texas. There now exists a situation where various agencies have conflicting agendas on this issue. Some focus on preserving existing water rights, but do not consider in-stream flow needs. Others focus on in-stream flow needs, but do not take into account the concerns of water rights holders. A middle ground needs to be reached.

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