Healthy Rivers, Healthy Communities

A Balanced Proposal for the Cache la Poudre River in Colorado

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Taking the Long View

A Proposal to Protect and Partially Restore the Cache la Poudre River

The Cache la Poudre River, often touted as a "working river," has in fact been worked nearly to death. Though we have used the river to grow local crops and bathe our children, we have abused it, often drying it up completely.

But a century and a half of water development has taught us some key lessons about rivers and the way we use water. There are reasons why the water diversion system and water law developed in the way they did — some historical, some financial, some political, but all arising from the semi-arid environment of Northeastern Colorado. On the other hand, the new energy economy combined with technological advances in water use and regional commitments to protect natural resources and improve the environment create new opportunities for managing rivers that meet water needs while protecting the environment.

Some might say that our only goal should be to restore flows on the Poudre to historic levels. But such a goal ignores the reality that the legal framework of Colorado water law protects diversions and existing water users, and that the Poudre drives a thriving economy, meeting multiple needs in many different economic sectors. Instead, we sought to create a ***long-term proposal*** that balances both the minimum needs for river health and the needs of those depending on existing diversions.

In our proposal we first describe existing conditions on the Poudre River, highlighting three key issues we feel must be addressed to improve river health. We follow with a description of a scientifically based instream flow recommendation.

Existing Conditions on the Poudre

Figure 1 through Figure 3 show the existing flows on the Cache la Poudre River at two points below the canyon mouth: the Lincoln Street Gage in Fort Collins and the gage near Greeley, Colorado, located near the confluence with the South Platte River.

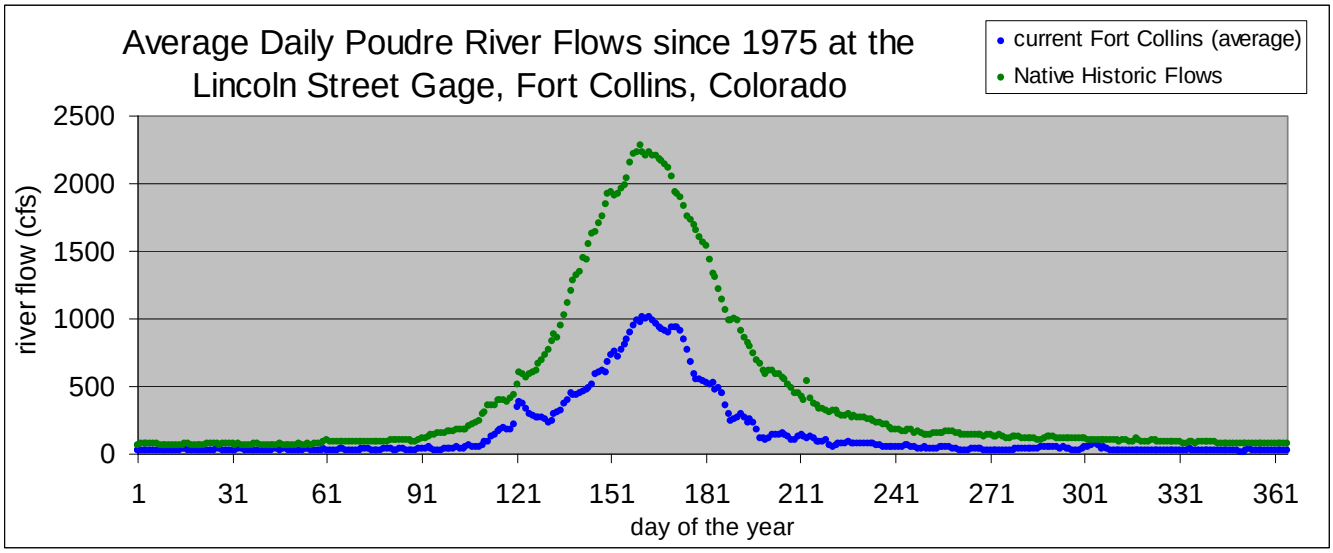

Figure 1. Reconstructed native compared with average current river flows (1975-2007) on the Cache la Poudre River at the Lincoln Street Gage in Fort Collins, Colorado. Source: Reconstructed flows provided by the City of Fort

Collins Utility Department. Average current flows calculated from the USGS Stream Gage # 06752260, http://waterdata.usgs.gov/co/nwis/uv/?site_no=06752260&PARAmeter_cd=00065,00060.

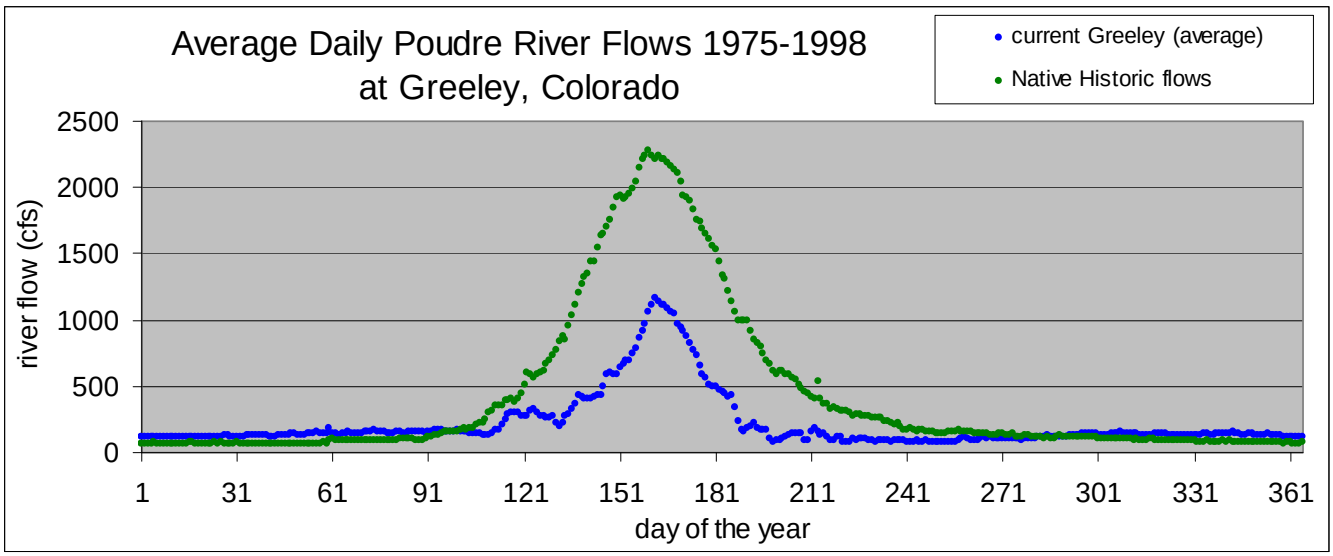

Figure 2. Reconstructed native compared with average current river flows (1975-1998) on the Cache la Poudre River at Greeley, Colorado. Source: Reconstructed flows provided by the City of Fort Collins Utility Department. Average current flows calculated from the USGS Stream Gage # 06752500, http://waterdata.usgs.gov/co/nwis/uv/?site_no=06752260&PARAmeter_cd=00065,00060. Note that the USGS record for this gage ended on Sept 30, 1998. No stream gage data from October 1, 1998 to present is available.

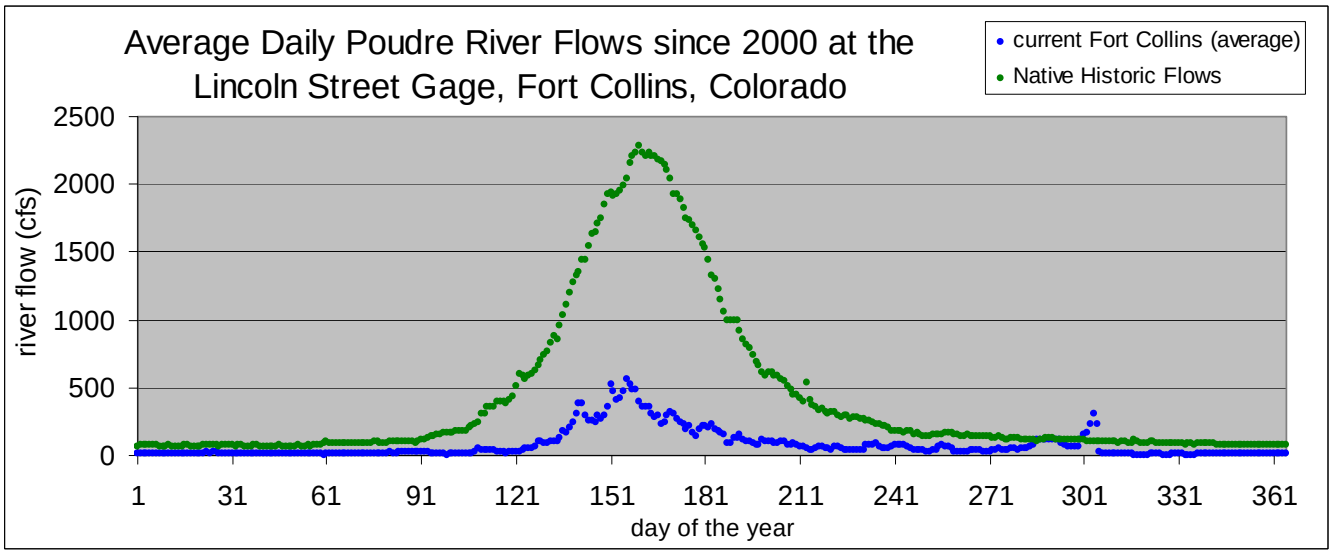

Figure 3. Average daily flows on the Poudre River in Fort Collins since 2000. Note the near absence of base winter flows and the severely reduced peak flows after the water year ends October 31 (day 304), through the end of April. Also note the unusual, unnatural pulse of water during late October, when water users make exchanges between storage reservoirs in order to "balance the books" before the end of the water year.

Peak Flows Degraded, Threatened

The above record shows that peak flows on the Poudre River are highly degraded. Monthly mean flows during the historic "June Rise" running from mid-May to mid-July (corresponding to peak snowmelt runoff) are less than half of the native flows through the river during this period.

Peak flows are fundamental to the health and viability of the ecosystem.[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13] They clear silt and algae from the riverbed, create seedbeds for riparian vegetation, build habitat for fish, recharge riparian-associated wetlands, and greatly improve water quality. Reduced peak flows lead to the "homogenization" of river systems, higher water temperatures, algae infestations, loss of biodiversity, and ecosystem shifts that benefit introduced species over native species assemblages.

Note that the river flow conditions since 1998 on the lower Poudre below Windsor are currently undocumented, as no stream gage data have been collected since that time. Anecdotal reports indicate that peak flows in that stretch have been reduced as much or more than those through Fort Collins since that time.[14]

Loss of Base Winter Flows

Since 2000, the Poudre River in Fort Collins routinely runs dry or nearly dry in the stretch from the canyon mouth to Windsor during the winter months from late October through mid April. Mean flows can frequently be one-fiftieth of native flows, and the river can consist largely of disconnected pools through this reach. The stream flow data from 1975-2007 shows winter flows typically one-third to one quarter of native flows.

This stands in marked contrast to river flows in the stretch from Windsor to Greeley. Besides peak runoff, the river flows near Greeley consist largely of return flows from three sources:

- Upstream sewage treatment plant discharge.
- Return flows from alluvial aquifers, consisting largely of irrigation water over-applied to crops during the irrigation season. This water seeps into the alluvial groundwater and eventually returns to the river weeks or months later.

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[1] N. LeRoy Poff, J. David Allan, Mark B. Bain, James R. Karr, Karen L. Prestegaard, Brian D. Richter, Richard E. Sparks, and Julie C. Stromberg. 1997. *The Natural Flow Regime: A paradigm for river conservation and restoration.* BioScience Vol. 47 No. 11.

[2] David A. Lytle And David M. Merritt. *Hydrologic Regimes and Riparian Forests: A Structured Population Model for Cottonwood.* Ecology, 85(9), 2004, pp. 2493-2503.

[3] Wohl, Ellen. 2001. *Virtual Rivers: Lessons from the Mountain Rivers of the Colorado Front Range.* Yale University Press.

[4] Wohl, Ellen. 2004. *Disconnected Rivers: Linking Rivers to Landscapes.* Yale University Press.

[5] Stewart B. Rood, Jeffrey H. Braatne, And Francine M. R. Hughes. 2003. Ecophysiology of riparian cottonwoods: stream flow dependency, water relations and restoration. Tree Physiology 23, 1113-1124.

[6] Scott, M.L., P.B. Shafroth, and G.T. Auble. 1999. Responses of riparian cottonwoods to alluvial water table declines. Environmental Management 23(3): 347-3.

[7] Auble, G.T., and M.L. Scott. 1998. Fluvial disturbance patches and cottonwood recruitment along the upper Missouri River, Montana. Wetlands 18(4): 546-5.

[8] Friedman, J.M., M.L. Scott, and G.T. Auble. 1997. Water management and cottonwood forest dynamics along prairie streams. In: Knopf, F.L., and F.B. Samson. Ecology and Conservation of the Great Plains Vertebrates. New York, NY: Springer-Verlag. p. 49-71.

[9] Scott, M.L., J.M. Friedman, and G.T. Auble. 1996. Fluvial process and the establishment of bottomland trees. Geomorphology 14(4): 327-3.

[10] Poff, N.L., J.D. Olden, D. Merritt, and D. Pepin. 2007. *Homogenization of regional river dynamics by dams and global biodiversity implications.* Proceedings of the National Academy of Sciences 104:5732-5737.

[11] Wohl, E.E., P.L. Angermeier, B. Bledsoe, G.M. Kondolf, L. MacDonnell, D.M. Merritt, M.A. Palmer, N.L. Poff, and D. Tarboton. 2005. River restoration. Water Resources Research 41, W10301, doi:10l.1028/2005WR003985.

[12] John M. Bartholow. 1991. A modeling assessment of the thermal regime for an urban sport fishery. Journal of Environmental Management, Issue Volume 15, Number 6 / November, 1991.

[13] PTJ Johnson, JD Olden, and MJ Vander Zanden. 2008. *Dam invaders: impoundments facilitate biological invasions into freshwaters.* Frontiers in Ecology 6(7) 357-363.

[14] Personal Communication with residents of Windsor and Greeley. 20008.

- Riparian-associated wetlands seeping water into the alluvial aquifer and then into the river.

Note that the flows at this gage are consistently near or even above historic winter base flows, except for river reaches immediately below winter diversion points such as the Fossil Creek Reservoir inlet diversion and the Greeley Ditch diversion. The river is almost completely dry for several miles during the winter below these and other diversion points until return flows from the alluvial aquifer recharge it.

Highly Variable Hour-to-Hour Flows

In additional to these issues, current flows frequently change drastically over the course of a few days or

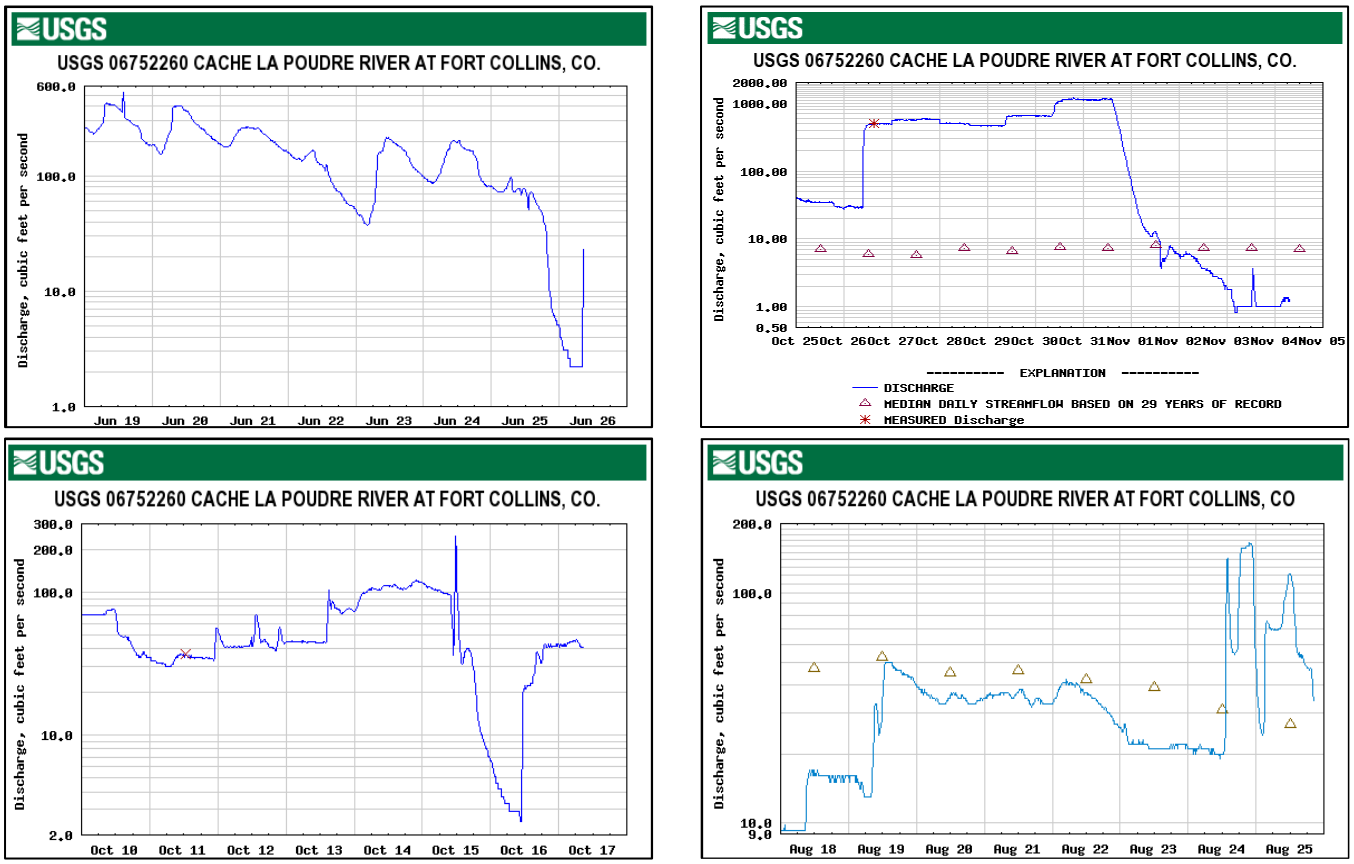

Figure 4. River flows in June, August, and October at the Lincoln Street Gage in Fort Collins, where flows routinely fluctuate from less than five cubic feet per second (cfs) to hundreds of cfs (occasionally over a thousand cfs) in a just a few hours to a few days.

hours (Figure 10 and Figure 5).

This extreme variation is largely due to uncoordinated reservoir releases and diversions at multiple locations along the river and has no natural analog in the Poudre River[3]. Such rapidly fluctuating flows lead to siltation, poor water quality, damaged habitat, and stressed aquatic communities.

The Cache la Poudre River needs a new river management paradigm, one that leads to well-synchronized water management executed over longer periods to achieve far less drastic changes in flow, but in a way that meets water rights owners' needs. We believe that it is feasible to better time diversions to achieve biological as well as economic objectives.

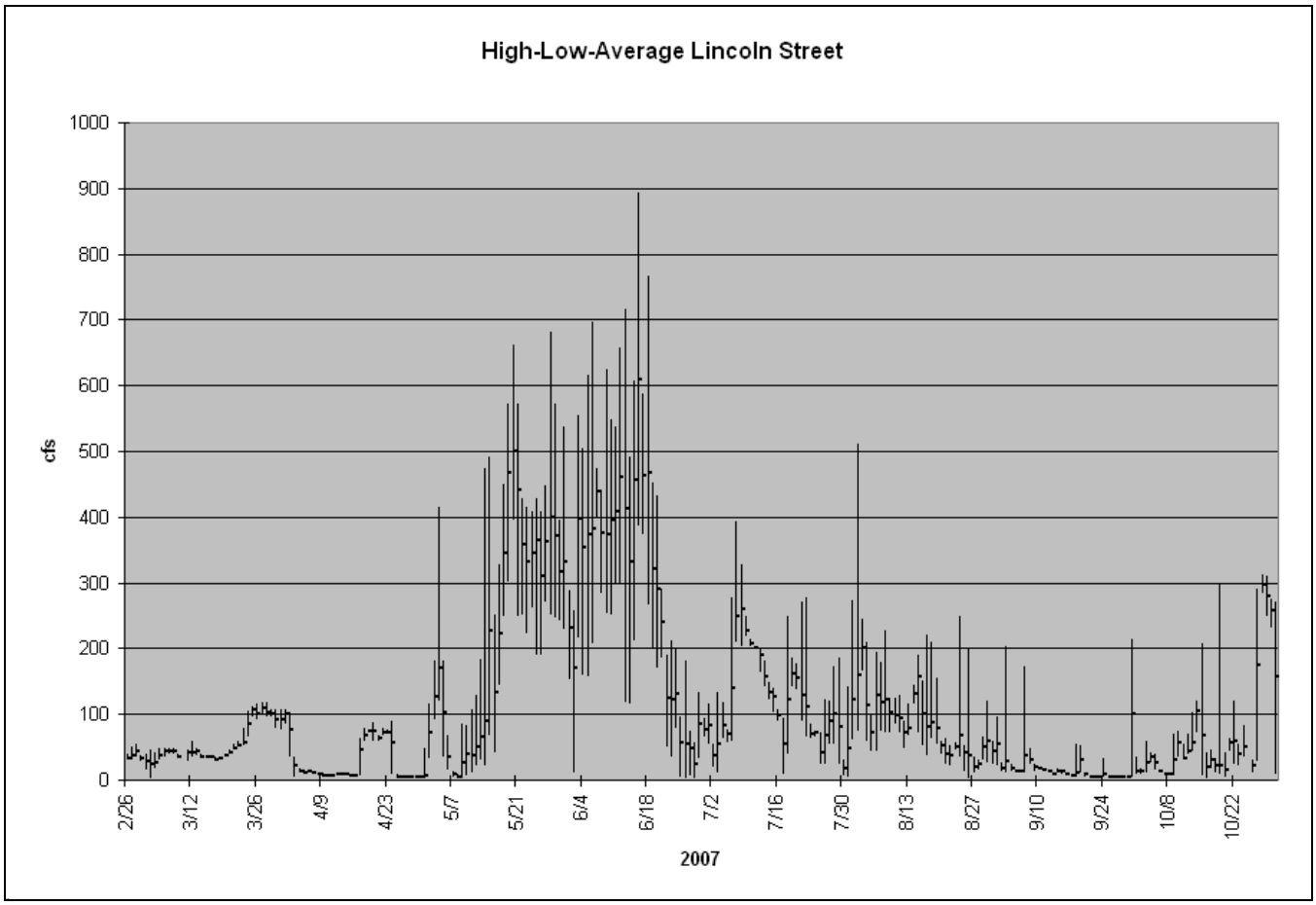

Figure 5. The daily range of flows at the Fort Collins Lincoln Street Gage on the Cache la Poudre River, for the year 2007. This graph shows the range of flows that occurred in each single day during the irrigation season, showing that flows routinely vary by hundreds of cfs in a single day.

Dry-Ups are Common and Extensive on the Poudre

Figure 6 documents a number of known existing dry-ups on the Poudre River. These and other known dry-ups stretch for miles of river and persist for weeks to months of the year.

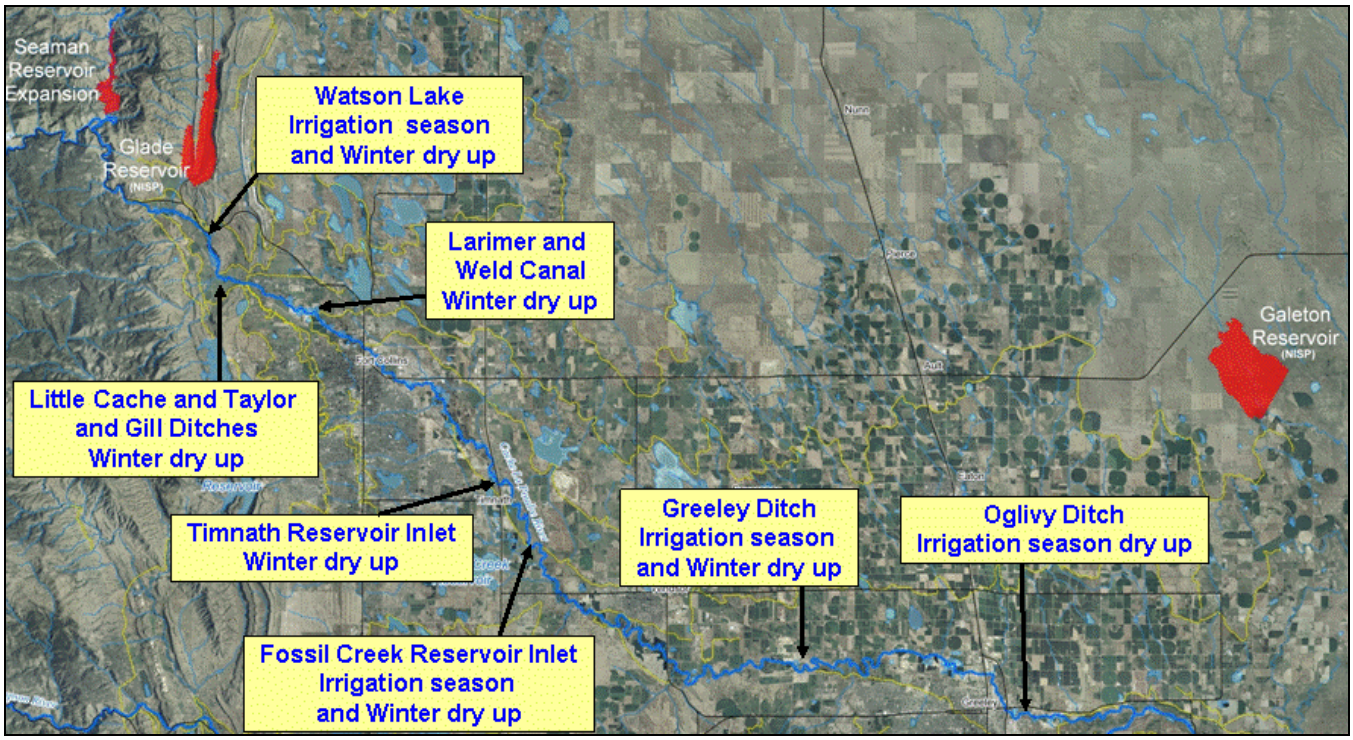

Figure 6. Documented dry-ups on the Cache la Poudre River. Source: Northern Colorado Water Conservancy District.

A Balanced Proposal to Protect and Restore the Poudre River

In response to these adverse and unnatural flow conditions on the Cache la Poudre River, we propose a long-term goal for an instream flow regime that balances the needs for a healthy river ecosystem with the needs of irrigators and water utilities.

Our instream flow regime is based on a recent scientific analysis of the instream flows required to maintain river health and ecosystem function on the Poudre River in its transition from the canyon mouth through Fort Collins.[15]

Benefits of Instream Flows

The Colorado Legislature established the state's instream flow program (ISF) in 1973 in response to the recognized need to provide minimum river flows in its rivers and protect river ecosystems from dry-ups and water quality degradation from water diversions. Instream flows are legally decreed water rights designated to remain within the states waterways (including streams, rivers, and lakes) "…to preserve or improve the natural environment to a reasonable degree."[16]

Instream flows within our rivers provide a number of exceptional public benefits:

[15] Bartholow, John. 2008. Recommended Flow Regime for the Cache la Poudre River Through Fort Collins, Colorado. http://fossilcreeksoft.googlepages.com/poudreriverflowrecommendation, viewed 8/11/2008.
[16] Colorado Water Conservation Board Stream and Lake Protection Program. http://cwcb.state.co.us/StreamAndLake/, viewed on 8/31/2008.

- **Water quality and public safety**: River flows that mimic native flow regimes improve water quality and meet public safety goals, reducing the likelihood that waterways will become public health risks as is the Poudre in its current condition.[17]
- **Improved recreation**: An instream flow on the Poudre would improve recreational opportunities for a broad range of river users including but not limited to whitewater sports enthusiasts, anglers, birders, cyclists, hikers, walkers, and families on river outings.
- **Improved river health**: Instream flows maintain ecosystem services linked to a healthy river ecosystem, such as recharging wetlands, building and maintaining riparian vegetation, building and maintaining aquatic habitat, reducing algal infestations, and a host of other benefits.[18, 19] Maintaining instream flows in the Poudre River means that other efforts linked to maintaining the river ecosystem and improving river healthy will likely become unnecessary.
- **Improved regional economy**: The economy of the communities along the Poudre River is directly linked to the health of the river and the ecosystem functions it performs. Improving water quality and maintaining the ecosystem services linked to water quality and the riparian and aquatic ecosystems of the river mean that communities won't have to spend as much to provide safe water supplies to water utilities, industry, and irrigators. Recent studies and reports in Fort Collins as well as other communities and regions indicate that instream flows show myriad economic benefits to the communities that support them.[20, 21, 22, 23, 24, 25, 26, 27, 28, 29] Communities around Colorado are finding that healthy rivers are intricately linked to healthy economies, supporting vital downtowns and property values.

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[17] U.S. Environmental Protection Agency water quality samples at the U.S. Geological Survey stream gages below the Poudre River Canyon mouth indicate that the river does not meet water quality standards for at least five major pollutants. Source: EPA water quality samples.

[18] Janet Ranganathan, Ciara R Audsepp-Hearne, Nicolas Lucas, Frances Irwin, Monika Zurek, Karen Bennett, Neville Ash, Paul West. 2008. *Ecosystem Services: A Guide for Decision Makers.* World Resources Institute. http://pdf.wri.org/ecosystem_services_guide_for_decisionmakers.pdf, viewed in 8/31/2008.

[19] National Research Council of the National Academies, Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making.* The National Academies Press. http://www.nap.edu/openbook.php?record_id=11139&page=R1, Viewed on 8/31/2008.

[20] Loomis, John. *Estimating the Economic Benefits of Maintaining Peak Instream Flows in the Poudre River through Fort Collins, Colorado*. Prepared for the City of Fort Collins, Colorado. http://fcgov.com/news/index.php?id=2369, Viewed on 5/2/2008.

[21] University Connections

[22] Poudre Technical Advisory Group. *Characterizing the Cache La Poudre River: Past, Present, and Future: A summary of key findings.* Prepared for the City of Fort Collins. http://fcgov.com/nispreview/pdf/white_paper.pdf, viewed on 5/2/2008.

[23] UniverCity Connections. http://www.univercityconnections.org/15/River%20Protection/Development/, viewed on 7/16/2008.

[24] Jennifer Brown (editor). 2002. *Who's Running this Ecosystem?* Proceedings of the 13th Annual South Platte Forum, October 23-24, 2002. http://www.southplatteforum.org/SPF%202002%20Proceedings.pdf, viewed on 8/31/2008.

[25] Steamboat Pilot and Today. August 13, 2006. *Playing for keeps: Top-notch boating and fishing spur flood of recreation on Yampa River*.

[26] Martha G. Roberts and Dan Grossman. 2008. *Healthy Rivers, Healthy Economy: Enhancing Instream Flows will Benefit Colorado's Environment and Economy.* http://www.edf.org/documents/7676_Healthy%20Rivers%20Healthy%20Economy.pdf, viewed on 8/1/2008.

[27] Frank A. Ward James F. Booker. 2007. *Economic Costs and Benefits of Instream Flow Protection for Endangered Species in an International Basin.* Paper No. 01216 of the Journal of the American Water Resources Association. Volume 39 Issue 2, Pages 427 - 440.

[28] Loomis, J.B. 1998. *Estimating the public's values for instream flow : Economic techniques and dollar values.* Water resources bulletin, vol. 34, no5, pp. 1007-1014.

[29] National Park Service River, Trails, and Conservation Assistance Program. 2001. *Economic Benefits of Conserved Rivers: An Annotated Bibliography.* http://www.nps.gov/ncrc/portals/rivers/fulabib.pdf, viewed on 8/31/2008.

Scientific Basis

This instream flow proposal sets ecologically relevant instream flow objectives based on the best available science (Identified as *Restorative* flows in Figure 7).[30, 31, 32, 33] These flow objectives essentially call for monthly flow standards equal to the lowest 25th percentile of the *Native* flow regime, a technique called the "Range of Variability Approach" recommended by Richter and other highly regarded stream scientists. Though the flow objectives call for more water than is usually in the Poudre today, they set the standard for how to partially restore the ecological integrity of the working Poudre River.

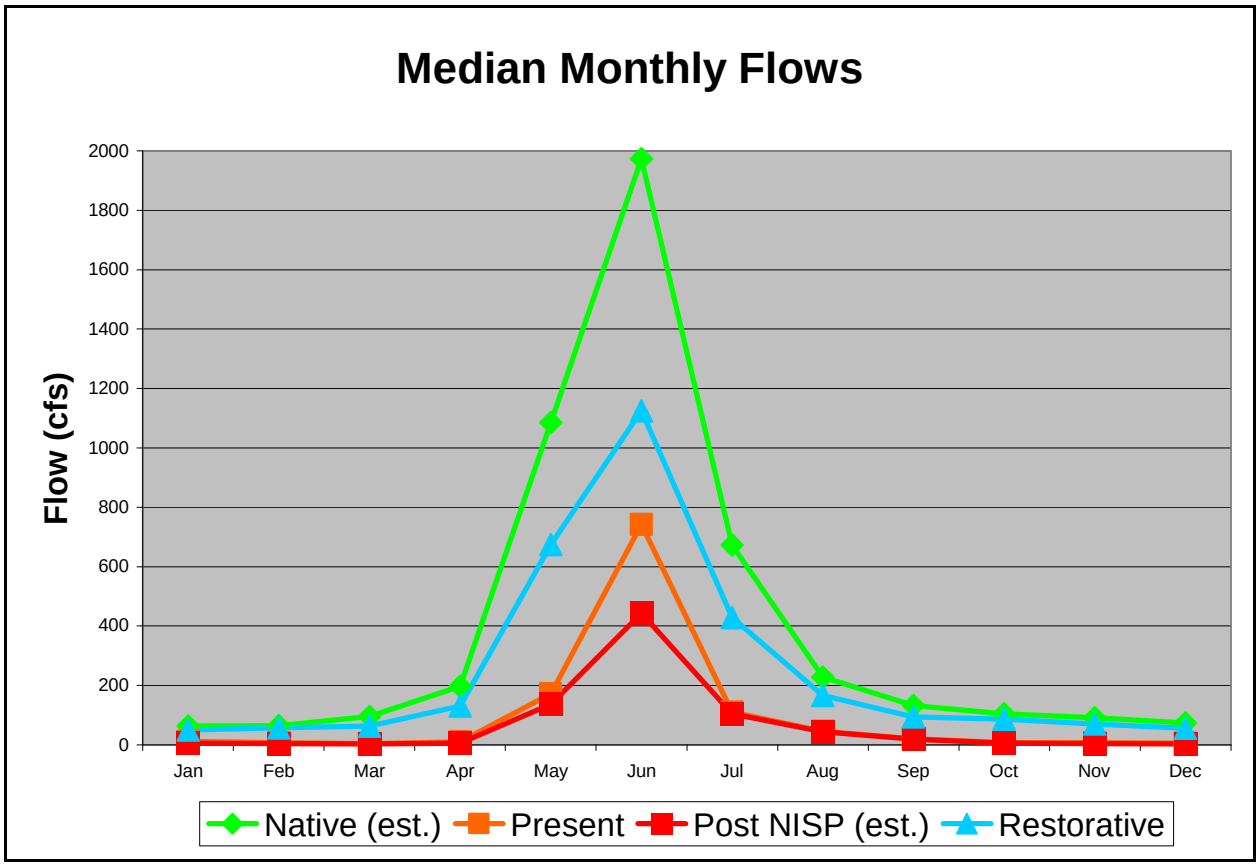

Figure 7. Approximate monthly flows (cubic feet per second) on the Cache la Poudre River through Fort Collins, Colorado, for four different scenarios. The Healthy River Proposal is shown in blue.

Very Few of Colorado's Plains Rivers Currently Have Protected Instream Flows

As of 2008, there are only two short instream flows on Colorado's Eastern Plains. Designated flows on the Arikaree River (in Northeast Colorado) protect endangered amphibians, and flows on Gageby Creek protect waterfowl. There are no instream flows in the Poudre River watershed below the headwaters regions (Figure 8).

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[30] Poff *et al.* 1996.

[31] Richter, B.D., Baumgartner, J.V., Powell, J., and Braun, D.P. 1996. A method for assessing hydrologic alteration within ecosystems. Conservation Biology 10:1163-1174.

[32] Richter, B.D., Baumgartner, J.V., Wigington, R., and Braun, D.P. 1997. How much water does a river need? Freshwater Biology 37:231-249.

[33] Richter B.D., R. Mathews, D.L. Harrison, and R. Wigington. 2003. Ecologically sustainable water management: managing river flows for ecological integrity. Ecological Applications 13(1):206–224.

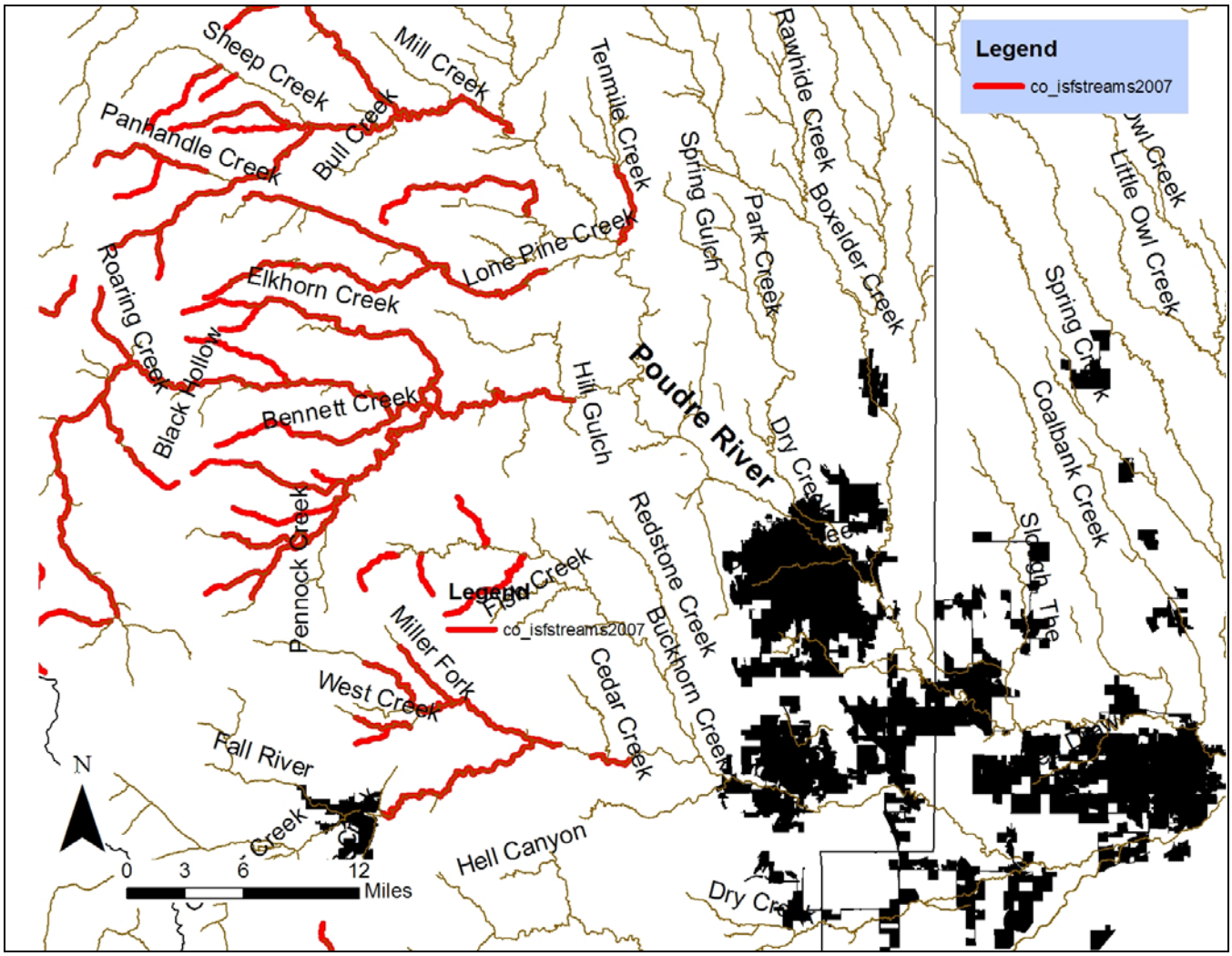

Figure 8. Designated minimum instream flows in the Cache la Poudre watershed. There are no instream flows designated below the headwaters regions, and those that do exist in the headwaters require only bare minimum flows.[34]

This reality denies the benefits that instream flows bring to communities with major rivers like the Poudre running through them. We seem to have made the collective decision to pay little attention to the health of our Plains rivers while focusing only on high elevation rivers and waterways where federal legal intervention would be likely if protections were not established.

Developing a Long-Term Vision to Protect and Restore the Poudre

We don't deny that this is an ambitious proposal. We don't expect that its goals will be achieved immediately. In fact, we expect it may take decades to establish the instream flows necessary to protect major reaches of the Poudre River between the canyon mouth and its confluence with the South Platte. There is clearly much work to be done, and it will take creative cooperation and collaboration between a variety of government entities at all levels and citizen interest groups to build an instream flow regime that protects and partially restores the Poudre River.

We see a number of opportunities to achieve this goal:

[34] Colorado Water Conservation Board. Instream Flow Rules and Definitions. http://cwcb.state.co.us/NR/rdonlyres/4AAE02C8-1A0E-47B5-860C-BAA96970DD21/0/3792103.pdf, viewed in 8/31/2008.

- **Develop a community-based river management paradigm based on cooperation and collaboration**: A great deal may be done relatively quickly through cooperative actions by interest groups on the river. An early priority must be to build relationships between interest groups so that common goals are understood and river protection and restoration goals are realized through collaborative ventures.

- **Link conservation and efficiency to river restoration:** At the present time, conservation and efficiency improvements in all water use sectors are done on behalf of reducing water demand or expanding service opportunities within existing firm supplies by dedicating conserved water to new development or agriculture. We must shift this paradigm so that conserved water may be dedicated to river restoration, and we must explore opportunities to enable ISFs to satisfy downstream water rights.

- **Develop programs so that water donations, loans, and acquisitions from willing sellers may be used to meet river protection and restoration**: It is exceptionally difficult for small acquisitions or donations to be designated for instream flow purposes. Yet, the cumulative power of many small acquisitions and donations in a single watershed may yield major results if legal and financial hurdles are reduced or removed.

- **Link improved flows upstream to downstream water users**: Downstream water diverters can benefit substantially from instream flows when their downstream use is linked to an instream flow further up the watershed, in the form of greatly improved water quality and a more regular, predictable supply. ISFs may be creatively applied to protect and restore rivers when they lead directly to a downstream beneficial use.

- **Establish collaborative efforts to renovate or replace existing diversion structures** to allow for fish passage and ecosystem function while meeting water diversion needs: Most existing water diversion structures create barriers to fish passage through much of the year, while degrading aquatic and riparian habitat. New designs for diversion structures can meet water diversion objectives while improving habitat and allowing fish passage. Abandoned diversion structures and headgates should be removed. Collaborative funding and renovation efforts between interest groups can lead to positive renovations that meet common interests.

- **Shift current water diversions to points downstream where possible:** Carbon-neutral pumpback options are emerging that could support moving existing diversion points downstream. This would allow water to flow down the longest possible stretch before being diverted and returned to upstream users.