

WATER

Indigenous communities, groundwater opportunities

A U.S. court decision unlocks vast potential to improve sustainable freshwater management

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Instead of managing fresh water as one integrated resource, laws frequently treat groundwater separately from more visible, monitored, and managed surface waters. One under-recognized consequence of such legal fragmentation has been uncertainty about whether water rights for indigenous communities, which have been addressed in many countries to varying degrees for surface waters, apply to groundwater. In late 2017, the U.S. Supreme Court left standing a lower court ruling endorsing priority groundwater rights for Native American tribes by denying an appeal in *Agua Caliente Band v. Coachella Valley Water District* (1). This ruling establishes a new standard throughout nine western states within the lower court's jurisdiction and establishes persuasive, although nonbinding, legal precedent for the rest of the United States (1). To evaluate the ruling's broader potential impacts, we present new data cataloging existing Native American water rights and mapping unresolved tribal groundwater claims across the western United States. No court considered such a regional or national quantitative catalog or map. Drawing lessons from past U.S. experience, we then discuss how tribal rights may offer new opportunities to achieve sustainable ground-

water management for society at large, with implications beyond the United States.

As the U.S. National Water Commission concluded in 1973, "[i]n the history of the United States Government's treatment of Indian tribes, its failure to protect Indian water rights for use on the Reservations it set aside for them is one of the sorrier chapters" (2). In 1908, the U.S. Supreme Court ruled that Native American reservations include high-priority rights to surface water (i.e., federal reserved rights; here, for simplicity, "tribal rights") (2). Since then, however, uncertainty surrounding whether these rights include groundwater has produced a patchwork of tribal groundwater rights. For example, Wyoming's Supreme Court held that tribal rights on the Wind River Indian Reservation did not include groundwater, Arizona's Supreme Court held that tribal rights include groundwater when other water sources do not suffice, and Montana's Supreme Court ruled that tribes may have groundwater rights (2). The *Agua Caliente* ruling by the U.S. Ninth Circuit Court of Appeals held that tribal rights "do not distinguish between surface water and groundwater" and provide tribes with "superior" access to groundwater "appurtenant" to tribal reservations (1).

Ten states asked the U.S. Supreme Court to overturn the ruling, arguing that it undermined authority that states have traditionally exercised (3). Similar concerns led both houses of the U.S. Congress to

consider the Water Rights Protection Act of 2017, which could limit tribal groundwater rights by directing federal agencies to ignore hydrologic connectivity between surface water and groundwater when state law does not recognize such connectivity (4). Nevertheless, unless the U.S. Supreme Court revisits tribal groundwater rights, they are now settled law across much of the western United States (1).

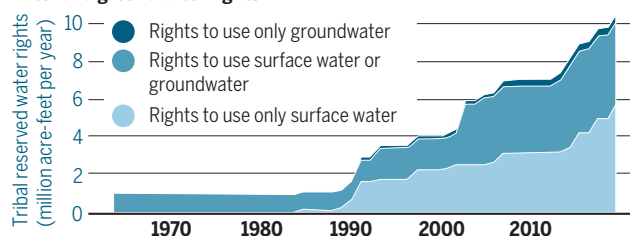
Tribal rights to groundwater exist alongside increasingly strained western United States water supplies. By 2030, projected consumptive water use is expected to exceed legally available surface water and groundwater in most western United States watersheds (5). As surface water becomes fully allocated and climate change modifies river flows, groundwater withdrawals will likely increase to meet water demands. Much of the western United States has been slow to regulate groundwater pumping (6), and increased groundwater extractions can lead to land subsidence, drying springs and groundwater wells, streamflow depletion, ecosystem impacts, seawater intrusion, and reduced groundwater storage (7).

WATER RIGHTS GO UNDERGROUND

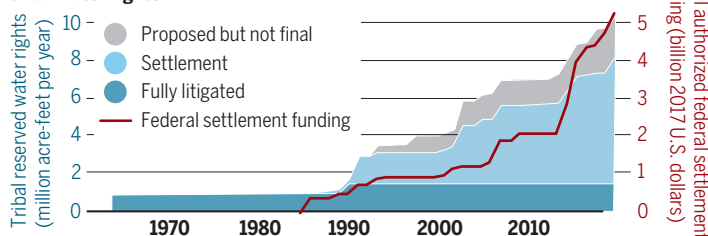
To provide perspective on the potential volume of tribal groundwater claims, we cataloged resolved and proposed tribal surface water and groundwater rights in the 17 western states where most Native American lands are located (8), most national groundwater withdrawals occur (9), and U.S. water scarcity is most acute. To date, tribal water rights have largely involved surface water but not groundwater (see the first figure). Collectively, 59 federally recognized tribes in the western United States have resolved and proposed surface water and groundwater rights to >10.5 million acre-feet annually (see the first figure and table S1). This volume exceeds 13 of 17 western U.S. states' individual annual freshwater withdrawals (see the first figure) (9). Of the 59 tribes, 53 have resolved rights, six have proposed rights, and two have both. Before *Agua Caliente*, just 4% of resolved and proposed

Trends in legal resolution of tribal water rights

Annual volume of resolved and proposed tribal surface water and groundwater rights

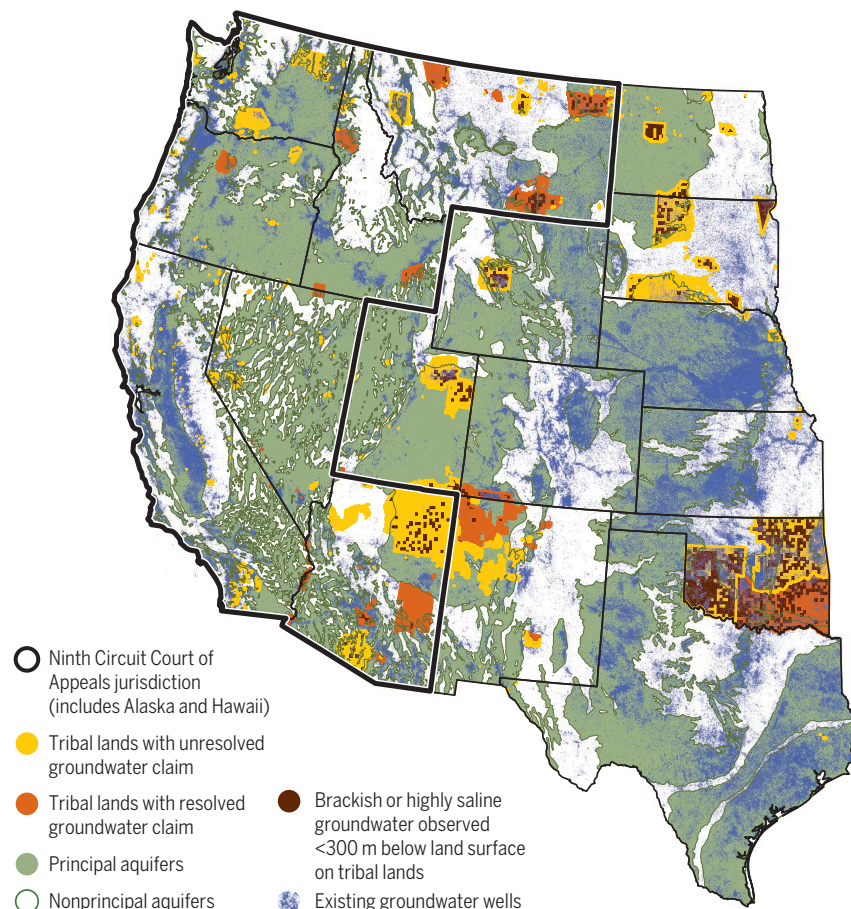


Status and type of resolution for resolved and proposed tribal water rights



Groundwater resources and Native American groundwater claims in the western United States

Principal aquifers are defined by the U.S. Geological Survey as the uppermost regional aquifers or aquifer systems with potential to provide potable water. Observed brackish or highly saline groundwater on tribal lands is >1000 mg/liter total dissolved solids <300 m below land surface. Groundwater well construction data vary by state with various limitations across space, time, and water-use categories (7). Not all state databases collect well information on tribal lands (e.g., Arizona). For map data sources and methods, see supplementary materials.



rights were exclusively for groundwater (see the first figure). We expect that future tribal rights will place greater emphasis on groundwater.

We separated resolved tribal rights into two categories—court decisions in lawsuits and legal settlements—because tribal water access can depend on which mechanism quantifies tribal rights. As opposed to settlements, court decisions have sometimes left tribes with “paper water”; although a tribe may gain legally enforceable rights to use water, the tribe may lack infrastructure and finance to access it. Settlements have been the dominant mechanism for resolving tribal water rights in the western United States (43 of 53 tribes and >80% of resolved tribal rights). Settlements allow tribes to

negotiate water infrastructure funding or other concessions from governments and private water users but often depend on continued congressional funding (2). Settlements have authorized U.S. federal funding of ~\$5.2 billion, largely for water infrastructure (see the first figure), though the U.S. government estimated in 2016 that \$1 billion in settlement funding remains “authorized but unfunded” (10).

To identify where tribal groundwater claims may offer new opportunities for groundwater access and management, we mapped tribal lands with unresolved groundwater claims alongside groundwater resources of potentially viable quantity and quality across the western United States (see the second figure). We estimate that up

to 236 tribes in the western United States have lands with unresolved groundwater claims. The second figure illustrates three important features. First, most but not all tribal lands with unresolved groundwater claims exist in areas where major aquifers occur and can potentially produce appreciable quantities of groundwater. Second, some tribal lands with unresolved groundwater claims exist in regions with lower-quality groundwater. In locations where groundwater quality concerns exist, tribal groundwater claims may offer fewer opportunities for water access without sizable investments in treatment infrastructure. Because ongoing phases of the Agua Caliente lawsuit confront whether tribal rights require water of a certain quality (1), unresolved tribal claims may also offer new legal tools to compel groundwater quality remediation and treatment in such locations.

Third, the second figure reveals areas where unresolved tribal groundwater claims may or may not compete with nontribal groundwater use. In the 2017 appeal to the U.S. Supreme Court, state and local governments argued that tribal groundwater rights would displace existing nontribal groundwater uses (3). Such conflict might occur in locations where tribal lands with unresolved groundwater claims are near many existing groundwater wells on nontribal lands. However, the second figure shows that tribal lands with unresolved groundwater claims exist near relatively few existing groundwater wells on nontribal lands. Some of these tribal lands, meanwhile, exist near many nontribal groundwater wells. The absence of comprehensive and consistent data on groundwater use, rights, quality, and supply for much of the United States precluded definitive identification of areas where tribal groundwater claims conflict with nontribal groundwater use (7).

APPLYING PAST LESSONS

Lessons from past U.S. experience with tribal rights, which predominantly allocated surface water, suggest possible avenues by which tribal rights might promote more sustainable groundwater management for tribal and nontribal water users. Because tribal rights hold higher priority than most other water uses, deferring the recognition of tribal rights has added uncertainty and conflict to water management; legal settlements of tribal rights have thus helped to reduce water conflict. Some U.S. states have actively resolved tribal claims through

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dedicated settlement commissions. For instance, Montana's Water Right Compact Commission has reached tentative or final settlements with all seven tribes in the state (table S1). Proactive settlement of tribal groundwater claims can provide certainty and diminish conflict.

Forty-eight percent of homes on Native American land in the United States suffer from inadequate access to drinking water or waste disposal facilities, compared to <1% of all U.S. homes (11). To date, many legal settlements for tribal water rights have emphasized investment in expensive surface water infrastructure (2, 10, 11). Yet groundwater infrastructure tends to be both less costly and resource-intensive than surface water infrastructure. Where tribal claims overlie viable groundwater and insufficient financial resources for infrastructure have limited tribal drinking water access, legal settlements financing tribal groundwater access may improve water security.

Because tribes frequently own the most valuable water rights due to their priority, tribal participation in water markets may, in some cases, reduce conflict and offer economic incentives. In 2016, 14 tribes leased ~260,000 acre-feet, consisting almost entirely of surface water, to other users for \$19 million (12). This suggests that, where tribes wish to lease their groundwater rights, these leases can promote tribal economic development while avoiding or minimizing disruptions to existing groundwater uses. Markets can also add economic incentives for efficient groundwater use, though without accompanying extraction limits for all groundwater users, little evidence suggests that markets alone ensure sustainable use. Meanwhile, legal uncertainties have made marketing tribal water off-reservation difficult without federal legislation authorizing it (2).

Historically, western U.S. law did not recognize water rights for instream environmental use, leaving many rivers fully allocated with little or no water reserved for the environment. Some tribal surface water rights have restored reliable water supplies for aquatic and riparian ecosystems where a reservation's purpose incorporated fishing, hunting, or gathering (2). In one example, tribes in the Klamath River basin in southern Oregon and northern California maintained large surface water rights to protect fish and riparian habitat. Although ecologically beneficial, the recognition of tribal rights has curtailed nontribal irrigation water having lower legal priority, with >100,000 acres curtailed during the 2013 summer (13).

Tribal groundwater rights may afford similar opportunities to protect groundwater-dependent ecosystems. High-quality

groundwater discharge to rivers and streams often sustains aquatic and riparian ecosystems. Few laws explicitly regulate impacts of groundwater pumping on groundwater-dependent ecosystems (6). Modern groundwater law also often incorrectly assumes that sustainable groundwater extraction equals an aquifer's recharge rate. This ignores that recharge often supplies groundwater discharge for surface water, springs, and dependent ecosystems. Indeed, the cultural and spiritual values that some tribes ascribe to water emphasize aquatic ecosystem health more than western law does. Some tribes also consider water to be sacred and retain traditional ecological knowledge that can inform ecosystem protection. Tribal rights can facilitate including these missing viewpoints in U.S. groundwater management.

GLOBAL IMPLICATIONS

After Agua Caliente, indigenous community groundwater claims are probably more prominent in the United States than any other nation. Yet many nations face the prospect of incorporating water claims for indigenous communities into contemporary water governance. For example, similar challenges and opportunities exist in Australia, Canada, Chile, and New Zealand,

"...tribal rights might promote more sustainable groundwater management for tribal and nontribal water users."

though no two nations legally recognize these claims in the same manner (14, 15).

As in the United States, surface water claims for indigenous communities have received more attention than groundwater claims in these nations (14, 15). The Agua Caliente ruling offers an opportunity to increase awareness of groundwater claims in these nations. By bridging surface water and groundwater, the ruling may also offer persuasive, though nonbinding, legal precedent for courts outside the United States, particularly in Canada and Chile, where courts have previously adopted terminology or approaches in U.S. indigenous water law (14, 15).

The U.S. response to the Agua Caliente ruling may also develop transferable lessons for improving water access. As in the United States, opportunities for major legal settlements to improve water access for indigenous communities exist in Canada and New Zealand, where treaties establish water claims (14). These opportunities

may be more limited in nations without treaties (e.g., Australia and Chile) (14, 15). Additionally, U.S. experience with water markets may be relevant to Australia and Chile, where markets also exist. In Chile, because markets historically transferred water out of indigenous communities, a national Indigenous Land and Water Fund now finances reacquisition of water rights for these communities (15). In Australia, although indigenous land accounts for >30% of all land, indigenous water entitlements constitute <0.01% of diversions (15), and similar to the United States, disputes persist regarding whether indigenous groups should be able to market water.

In the United States, meanwhile, the response to the Agua Caliente ruling holds potential to improve Native American water security. It also holds potential to demonstrate to the United States and other nations the importance, feasibility, and opportunities of recognizing groundwater claims for indigenous communities. ■

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