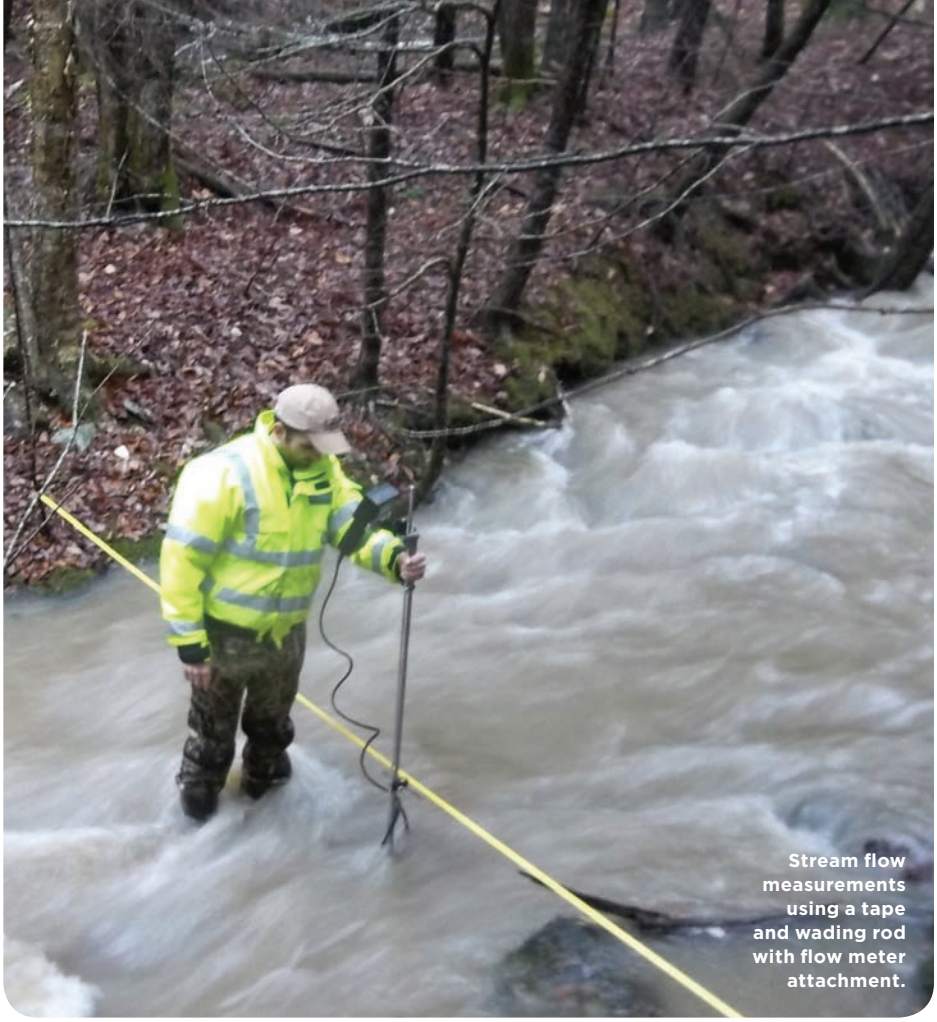
CONSERVATION FRONTIERS

Reports from the California Council of Land Trusts

Volume 5.3 • July 2014



Stream flow measurements using a tape and wading rod with flow meter attachment.

©U.S. GEOLOGICAL SURVEY

This Issue

Wading Deep: The Importance of Hydrological Monitoring

by ANDY ZDON, PRESIDENT, ANDY ZDON & ASSOCIATES

In light of the oft-quoted truism that "Whiskey is for drinking and water is for fighting over", you are far more likely to have to defend or enforce issues related to water resources than vegetation. You may be required to recognize changes, such as instream flows or spring flows, or to recognize things you can't see, like what is happening to the water under the ground. The question inevitably arises, "How can I know if a change is happening if I don't know my starting conditions?" The answer: just as with other natural or agricultural resources—you create a hydrologic baseline and you monitor against it to identify changes.

This edition of "Conservation Frontiers" will provide an understanding of the importance, implementation and key strategic issues associated with developing a baseline hydrologic monitoring program.

Conserving land by acquiring fee simple or a conservation easement is an important accomplishment, and involves great effort. However, it is important to recognize this as the tip of the stewardship iceberg. You must focus on the effort to maintain the conditions that prompted its conservation. You memorialize the conditions in a variety of ways, including baseline documents, surveys, residual dry matter assessments, vegetation maps and photographs. Hopefully, important features are documented in photographs and property maps. All this work enables you to recognize—and prove if necessary—changes that may occur over time.

However, there is one resource that land trusts and agencies have been inadequately memorializing at the time of property protection, as well as failing to provide sufficient attention to during annual monitoring: water resources on the property. Water is an intrinsically valuable natural resource and many other features of the protected values are dependent upon its continuation and quality. Further, the legal defense of the property will sometimes depend upon water resource monitoring.

Baseline Hydrologic Data

Baseline hydrologic data is simply a "starting point" and is foundational to land stewardship. This will be a data set of initial conditions of water resources from which future changes may be identified. The goal will be to develop a long-term data set that will allow you to know what is happening with the property's water resources and to provide defensible data to either defend your water rights, or to understand the changes occurring around your property that could impact your project. These data may include:

- groundwater levels
- stream flow
- spring flow, and
- water quality data.

Once a staff gauge has been calibrated for different flows, it can be a quick, useful means of measuring flow.

Whether you're responsible for narrow riparian habitats in stream corridors, broad regional wetland areas, isolated water sources or groundwater-dependent vegetation in otherwise arid areas, the maintenance of groundwater levels and surface flows is essential to maintain those habitats. As a decision-maker or manager with a conservation organization, the questions to ask yourself are: "Does the property have water resources for which you have some responsibility, rights or interest, such as surface or groundwater resources, agriculture or other water-dependent vegetation?" "Are there water-use pressures, including development, that are decreasing water supply, increasing groundwater or surface water usage, or altering water quality in your conservation area?" A "yes" to any of these questions leads to the following propositions:

- how to "maintain" flows in streams and rivers if current flows are unknown
- how to "maintain" groundwater levels that support groundwater-dependent habitats if current levels are unknown, and
- how to "maintain" water quality if current water quality is unknown.

In some environments, by the time visual changes in flow or biota are recognized, irreversible alterations to vegetation or wildlife habitat from changes in water availability/quality have already occurred. Absent strong baseline data, there is no basis for evaluating the cause and magnitude of the water resource changes and providing a defense of water rights impacted by:

- development
- groundwater pumping, or
- surface water diversions.

Absent real data, you only have a totally hypothetical set of conditions. This can leave your organization in a very weak position to defend your resources and protect water rights.

Other questions should be considered, including "Do we have a baseline hydrologic report that describes water resources with specific flow and water quality data?"; "Do we conduct any regular hydrologic monitoring?" and "Do we have the expertise to design and implement a hydrologic monitoring program?" This kind of documentation may not only be necessary to stage a water rights defense, it may be considered essential for successfully filing an insurance claim for losses or legal expenses.

Why Worry About Your Water?

IMPACTS TO YOUR WATER RESOURCES CAN IMPACT:

- your water rights
- groundwater and surface-water dependent vegetation
- wildlife that frequent your properties
- your ability to maintain existing uses on your properties, and
- your organizational reputation if your projects become noticeably degraded over time.

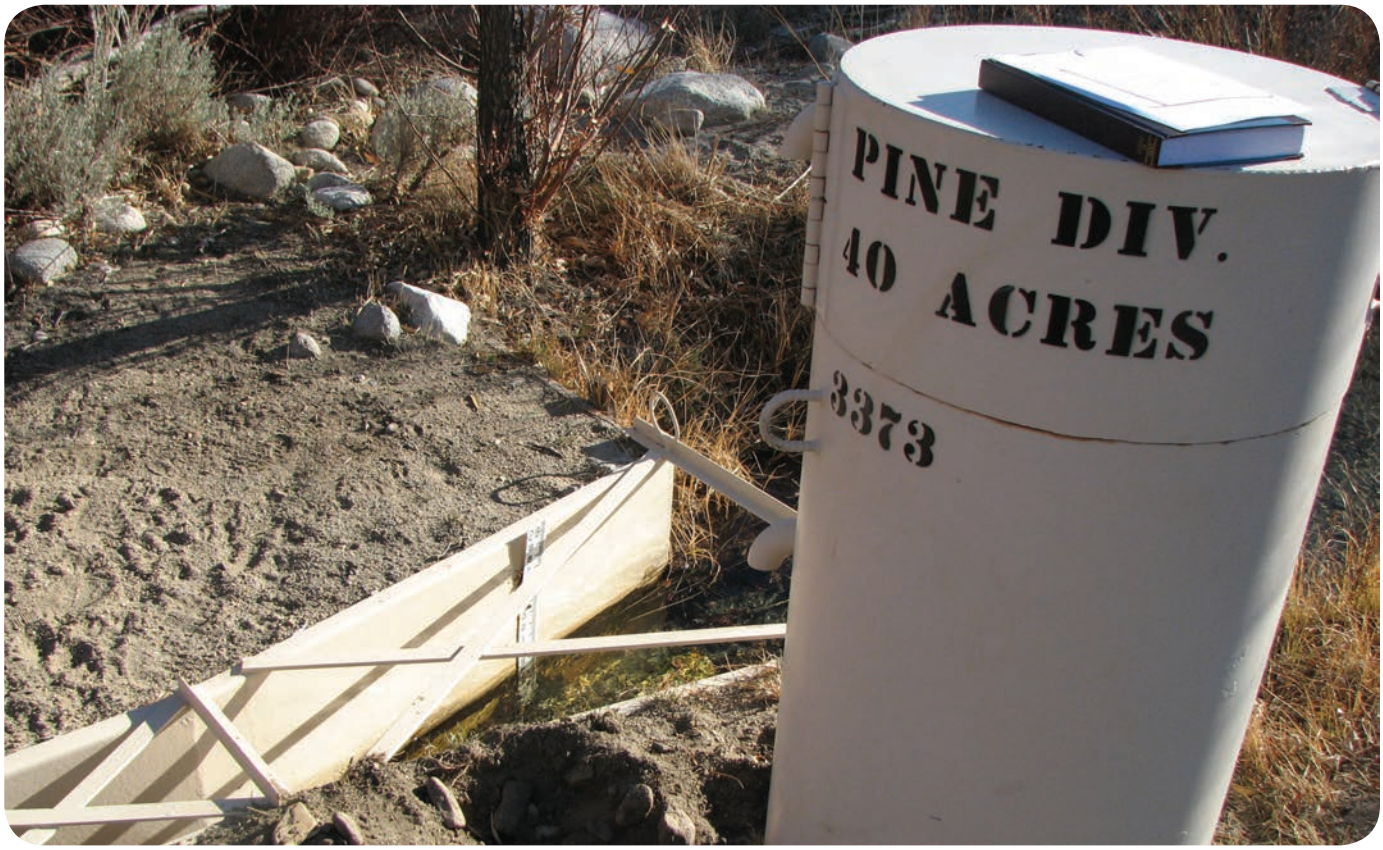
©GRACE SU

"Absent real data, you are in a very weak position to defend your resources and protect water rights."

Monitoring and Data

A landscape characterized by healthy vegetation is a good indicator of adequate water supplies. Or is it? In actuality, vegetative stress is typically the last indicator of a reduction in available groundwater resources. By the time clear indications of vegetative stress are observable, irreversible damage related to the reduction in water supplies may have already occurred. The collection of baseline groundwater resources data is the only way to quantify currently available resources and to detect changes in groundwater availability before irreversible damage has occurred, if it is not already underway. Additionally, having knowledge of current baseline groundwater conditions provides a valuable point of reference for CEQA negotiations related to the implementation of local projects requiring water resources that could impact your property or easement.

Groundwater Levels Precipitation is the source of water for all terrestrial life. Falling as rain or snow, it infiltrates into the subsurface to become groundwater flow. Flowing groundwater is the source of surface seeps, springs, and sometimes streams, rivers and lakes. It is also a primary source of water for plant life, which in turn sustains animal life. The primary metric for monitoring the health of groundwater systems is the measurement of groundwater levels. This is accomplished via the installation of groundwater monitoring wells. Groundwater levels are measured manually with a depth-to-water meter or automatically using a continuous recording device such as a pressure transducer. Fluctuations in groundwater elevation can reveal long-term trends in groundwater conditions, such as overdraft, where more groundwater is being extracted than is being replaced. In addition, the effects of groundwater pumping that occurs at significant distances from the monitoring point may be observed as fluctuating groundwater elevations. The monitoring of strategically placed groundwater wells is the most accurate method of establishing baseline groundwater conditions and detecting changes in groundwater availability. However, the installation of groundwater wells and the deployment of pressure transducers can involve sig-



Data can be gathered from existing flow measurement devices however sometimes obtaining recent data from agencies (for example less than one year) can sometimes be difficult.

©TRUST FOR PUBLIC LAND

nificant costs, which are highly dependent on depth to groundwater and local geologic conditions.

Spring Flow A spring occurs when groundwater intersects the earth's surface and flows onto the land surface. Springs take many different forms, dependent on local geologic conditions, ranging from minor seeps to lakes to cascading waterfalls. Whatever the morphology of the spring, its existence is directly dependent on groundwater conditions. In general, reductions in the availability of groundwater will reduce the amount of water discharging at the spring, potentially to the point that the spring dries up. Thus, spring monitoring is an important tool for determining baseline groundwater conditions. Technically, spring monitoring can mean the measurement of the amount of water being discharged from the spring. However, spring monitoring generally also includes measurements of basic spring water quality, a survey of vegetation local to the spring, and pictures of overall spring conditions. These conditions can be measured over time to paint a picture of changes in groundwater availability.

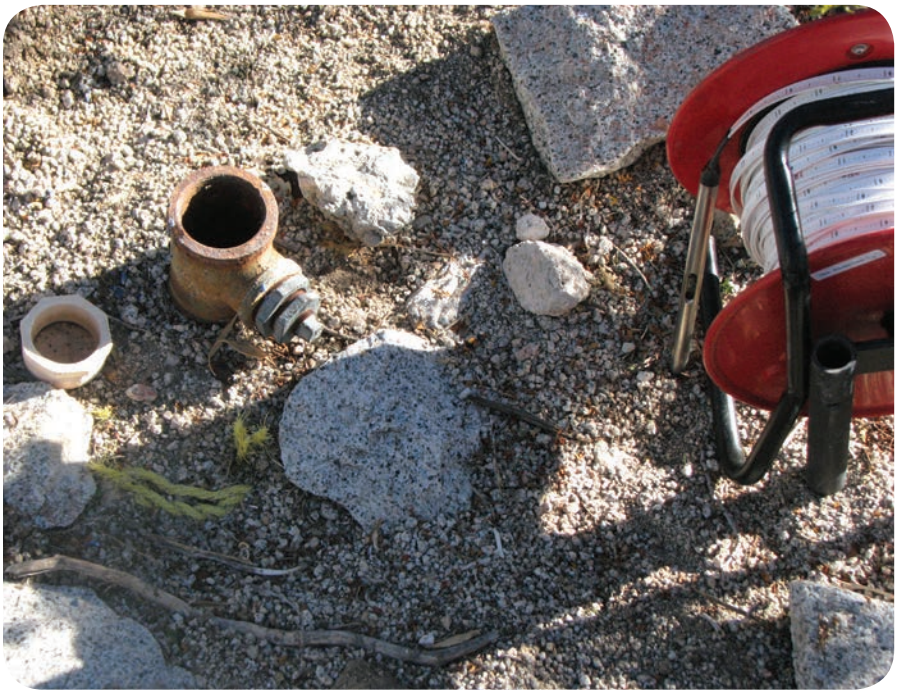
"Whiskey is for drinking; water is for fighting over." —ANONYMOUS

Though generally not as precise as measurements of groundwater elevation, spring flow measurements are simpler to perform and do not require the installation of groundwater monitoring wells.

Stream Flow Rain events and spring runoff resulting from snow melting high in the mountains are responsible for the larger flows observed in streams and rivers. However, the base flows that occur during the dry periods are sustained by the inflow of groundwater. Depending upon the configuration of the stream/river channel and the groundwater surface, groundwater is either contributing to the surface flows (i.e. gaining reach) or receiving water from the surface flow (i.e. losing reach). In general, the higher the groundwater surface, the more apt it is to contribute water to surface flows. A reduction in groundwater elevation (e.g. due to pumping or other groundwater withdrawals) may reduce the amount of water flowing in the stream/river, potentially to the point where it goes dry. River and stream gauging is an excellent baseline monitoring tool, as river flow can be directly related to groundwater availability. Periodic flow measurements can reveal how groundwater interactions are changing over time.

Water Quality Groundwater quality is as important a baseline parameter to monitor as is groundwater availability. There are many levels of detail to which groundwater quality can be monitored. Basic parameters, such as temperature, conductivity, pH and dissolved oxygen, can be easily measured with hand instruments and require little in specialized training. These parameters provide good information on basic water quality and repeated measurements can signal changes in the groundwater environment. More detailed groundwater mineral parameters, such as cations, anions and metals, can be obtained via the collection of water samples that are sent to a laboratory for analysis. While more expensive, the results can be interpreted by a hydrologist to shed light on groundwater flow history and the degree of connectedness between water sample points. Finally, the collection of water samples for isotope analysis can reveal significant details related to flow history including age, depth and other relationships. However, the cost for isotope analysis and specialized expertise needed for interpretation of the results can be significant.

Other Data Sources In general, it is a good idea to be cognizant of groundwater use in your general area. A lot of good information is available online at a variety of different public agencies, including water levels and water quality at nearby monitoring wells, flow in nearby streams and rivers, municipal and agricultural



Groundwater levels are one of the most important types of data to collect. Equipment shown is a Solinst water level indicator.

©ANDY ZDON

pumping locations and rates, and changes in land use potentially signifying new groundwater pumping. Online hydrologic information can generally be obtained either free or for small service fees. Taken in conjunction with your own baseline information, these data can greatly enhance your understanding of local groundwater resources.

AN IMPORTANT POINT—You may be saying to yourself... "Oh but the cost!" However, after an initial assessment by a licensed professional and proper training of land trust staff, much, if not all of the monitoring work may be accomplished by land trust staff or volunteers—saving many dollars. In fact, funding to conduct these activities may be more easily obtained if participation by citizen scientists is included in your plan. In the end though, it won't just be about collecting information, but about collecting defensible information, so a licensed professional will need to be consulted to get your monitoring program up and running.

Building in Defensibility

Building in defensibility is critical to your monitoring program. Should the data collected be used in a legal proceeding, your expert's opinion will be worth no more than the data upon which it is based. It is important to recognize that at some point in the future, those data may have to be of sufficient quality to withstand both scientific and legal challenges.

First, it is important to know what you don't know. That includes recognizing when a trained professional is needed. In California, geologists and hydrogeologists are licensed, as are engineers. With respect to groundwater issues and those surrounding the interactions of groundwater and surface water, data collection efforts should be developed under the supervision or guidance of a California Professional Geologist, preferably a Certified Hydrogeologist. Surface water issues, particularly those issues such as surface flow routing and infrastructure, should be evaluated under the supervision or guidance of a California Professional Engineer. While there are certainly costs associated with obtaining professional services, those data that are gathered on an ad-hoc basis without the guidance of a licensed professional may have limited or no defensibility in any kind of future regulatory or legal proceeding.

The role of citizen scientists or volunteers in collecting data can be considered after training. There is a trade-off between the significant savings that volunteers can provide versus future defensibility of the data. However, with sufficient training, citizen scientists or volunteer support staff can be an integral part of your baseline monitoring program. Depending on the land trust's particular issues, this should be addressed on a case-by-case basis.

A key to defensibility is implementing a standard professional methodology. Groups such as ASTM International (formerly known as the American Society for Testing and Materials) have developed standards for many monitoring procedures including measuring groundwater levels, collecting groundwater samples, and conducting stream flow measurements. Research that uses experimental or non-standard methods may have lesser value: both the data and the method of data collection will have to hold up under very close scrutiny since it deviates from standard professional practice. Resources are available, including any number of hydrologic reference books and materials published by regulatory agencies.

Finally, having a trained professional review the data, be able to recognize data and/or reporting errors, provide an analysis of the meaning of data, recognize the statistical significance of changes in flow, water levels, or water quality, or other aspects of the baseline monitoring program, will be a key component of a defensible program.

There is a trade-off between costs of monitoring and the significant savings that volunteer support can provide versus future defensibilty of the data.

Safety

As with any field-oriented work activities, health and safety considerations should be addressed. There is liability attached to any kind of activity conducted by staff in the field. In technical services firms, employees typically operate under a corporate health and safety program, and frequently under site-specific health and safety plans. Any non-professional or volunteer support should be educated on the health and safety issues associated with their assigned tasks.

Conclusions

Baseline hydrologic data is foundational to land stewardship. While the purchase of land or conservation easements may protect a property from resource extraction and development, changes in water resources can also cause negative impacts to a protected property. Baseline hydrologic monitoring will be the land trust's first line of defense in protecting these valuable resources.

case study

Baseline Monitoring at the Wild & Scenic Amargosa River

Some land trusts also focus on the conservation of significant water resources—perhaps a river, spring system or groundwater basin—that may encompass many properties. An illustrative case study is offered by the Amargosa Conservancy and The Nature Conservancy. They identify and ultimately quantify the surface water and groundwater sources feeding the perennial flow of the recently-designated Wild & Scenic Amargosa River, located within the Middle Amargosa Valley Basin east of Death Valley. It was essential that hydrogeologic characterization of the basin take place in order for river management planning to have a firm basis, and to assure that baseline monitoring was conducted in a meaningful way to identify potential impacts to the river and its feeder springs before potential irreversible impacts from future groundwater development occur. Amargosa Conservancy and The Nature Conservancy worked with Andy Zdon and Associates on this important project.

Stream gaging on the Amargosa River.

The initial task was the reconnaissance and cataloging of all of the known springs in the Middle Amargosa River Basin, an area encompassing well more than 1,000 square miles. Additionally, well canvassing over the same area was conducted to identify potential future groundwater monitoring locations. Geochemical and isotope samples were collected from a range of springs, wells and the river, and analyzed with the goal of identifying groundwater connections and sources. Several groundwater monitoring wells were installed as additional basin monitoring points and more are planned. Spring flow discharge and groundwater elevation measurements are collected on a seasonal basis from a select group of springs and wells within the Middle Amargosa River Basin, including seepage run monitoring along the river from Tecopa to below the Dumont Dunes area.

The results of this work were highly rewarding and valuable. First, an unanticipated outcome of the monitoring has been that the results of both the sampling and monitoring well installation provided new insight into the principal water sources for the river. Second, the data findings were used in the California Energy Commission (CEC) hearings regarding the proposed installation of a solar power project in a basin immediately adjacent to the Amargosa River. The collected data informed expert testimony on the potential impacts to the Amargosa River groundwater resources resulting from groundwater use by the proposed solar project. Consequently, the CEC required additional briefings on the connection between the basins, as opposed to assuming a lack of connection as the project proponent encouraged. Inclusion of the issue in the CEC hearings was only possible because of previous data collection efforts.

©ANDY ZDON

Conservation Frontiers is published by the California Council of Land Trusts.

CCLT provides a unified voice for more than 150 land trusts in California.

CCLT's mission is to build a statewide land trust community that is equal to the challenge and privilege of conserving our extraordinary land and water resources for all Californians.

Copyright ©2014 California Council of Land Trusts. All rights reserved.

ABOUT THE AUTHOR:

Andy Zdon, P.G., C.E.G., C.Hg.
President, Andy Zdon & Associates

Andy Zdon is President of Andy Zdon & Associates, Inc., a water resources and geological consulting firm with a focus on assisting the land trust community. Andy's focus on the land trust community derived from his former experience as a land trust board member and advisor. Andy also provides expert services to clients that have varied from groundwater resources and hydrogeology to mining-related issues. He has also been appointed by the Inyo County Superior Court as Watermaster for a surface water system in the eastern Sierra Nevada. Andy has more than 25 years of experience in geology and hydrogeology and is working on, and has worked on, projects that span California.

CALIFORNIA COUNCIL OF LAND TRUSTS

1029 K Street, Suite 48
Sacramento, CA 95814
916 497 0272 tel
916 218 7373 fax
mail@calandtrusts.org
www.calandtrusts.org