a living river

CHARTING WETLAND CONDITIONS OF THE LOWER SANTA CRUZ RIVER 2014 Water Year



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remoti Cottonwood (Populus fremonti)

This is a sister series to the Living River reports completed for the Upper Santa Cruz River (learn more at www.tiny.cc/uscr).

THE LOWER SANTA CRUZ RIVER ALIVING ECOSYSTEM

Since it began attracting people to the region more than 12,000 years ago, the Santa Cruz River has undergone a series of dramatic changes. Initially a flowing life force teeming with fish, frogs, and other wildlife, the river all but dried up over the last century as groundwater pumping increased along with the human population and its ever-growing demand for water.

To gauge conditions of this valuable ecosystem and track the Today, however, thanks to the release of effluent-highly impacts of our community investment, Pima County and the treated wastewater-into the river, certain sections of the Sonoran Institute have developed a Living River series for the Santa Cruz River again flow year-round. This practice is not only Lower Santa Cruz River. Modeled on the Sonoran Institute's re-creating our flowing-river heritage, but is also supporting Living River report for the Upper Santa Cruz River, this report important wildlife habitat and building a valued community documents annual change along the Lower Santa Cruz River amenity. The Lower Santa Cruz River offers a great example. in order to gain insight into the river's health. Beginning with a For decades, much of this stretch of river was hidden from view baseline in 2013, the Living River series is an assessment of behind industrial neighborhoods along the freeway. As effluent the wetland conditions created and affected by the effluent. helped create a thriving river ecosystem along this corridor, the This second report examines changes in indicators of river community responded by building numerous river parks and health along a 23-mile stretch of the river during the 2014 The Loop recreational trail to provide easier access to this river water year (October 1, 2013-September 30, 2014). The final bounty. The river in this area now attracts walkers and bikers facility upgrades were completed in December 2013. This and is a popular birding destination from the Sweetwater report includes an assessment of conditions before, and any Wetlands to the Marana Flats. changes observed just after, the upgrade process.

Effluent in the Lower Santa Cruz River is not new; two
wastewater treatment plants, or "water reclamation facilities,"
have been operating on this section of the river since the
1970s. What has changed is the quality of the effluentAll Living River reports and associated documents for the
Lower Santa Cruz River are available for download on the
Sonoran Institute website at www.tiny.cc/lscr.

2014 NOTABLE FINDINGS FOLLOWING UPGRADES

Water clarity and quality improved Nutrient pollution declined Flow extent declined with higher infiltration rates Aquatic wildlife showed signs of improvement

WATER SOURCES

Most of the water flowing in the Lower Santa Cruz River comes from effluent (treated wastewater) released by the Agua Nueva and Tres Rios water reclamation facilities. Effluent is water that has been pumped or diverted from one location, used by people, treated in a reclamation facility, and released in a new location—often into rivers and desert washes.

Additional water in the Lower Santa Cruz River comes from precipitation in the surrounding watershed. When it rains or snows, water that doesn't evaporate, percolate into the soil, or get absorbed by plant roots, becomes stormwater that eventually flows into a wash and down to the river. Stormwater from Tucson, Marana, Oro Valley, and Green Valley, along with irrigation runoff from farmland in Marana, flows toward the river and provides additional streamflow.

AGUA NUEVA OUTFALL

ANTA CRUZ RIVER

COLUMBUS PARK

SWEETWATER WETLANDS

The Ribbon of Green

Sections of the Santa Cruz that are dependent entirely on stormwater tend to have vegetation that is adapted to drier conditions. Add effluent to the river and suddenly we see a vivid ribbon of green snaking its way downstream (notice the green start near the Agua Nueva outfall). This green ribbon includes native willows and other riparian plants that need more water and are becoming very rare in the desert Southwest. The enhanced vegetation provides important wildlife habitat as well as a vibrant, cooling corridor for people to enjoy as they visit river parks and travel The Loop recreation path.



Sweetwater Wetlands

A portion of effluent from Agua Nueva is reused to create the Sweetwater Wetlands. While flowing through the wetlands and into adjacent recharge ponds where it percolates down through soil, effluent gets additional cleaning while replenishing the local aquifer. This water is then pumped and distributed by the reclaimed water system for reuse in Tucson's golf courses, parks, schools, ball fields, and other large turf-irrigation areas. In addition, this water-rich environment provides urban wildlife habitat for many native species that make the wetlands their fullor part-time home.

ASSESSING CONDITIONS

The Living River report evaluates conditions of the Lower Santa Cruz River using indicators (see diagram) organized into six categories that represent a breadth of biological, chemical, physical, and social properties of the river. The

indicators relate to conditions in the river channel and in the adjacent riparian areas, the areas next to and affected by the river. Other characteristics tracked informally and discussed throughout the report include birds, amphibians and reptiles, and recreation.

The purpose of the *Living River* series is to monitor and report on wetland and riparian conditions at various intervals

downstream of the effluent discharge points. As effluent flows downstream, it impacts and is impacted by the natural conditions of soils, vegetation, and the surrounding ecosystem. For the purposes of this study, the 23-mile stretch of river is divided into three sections, or reaches: Three Rivers, Cortaro Narrows, and Marana Flats. Reaches were delineated because they differ in hydrology, geology, and adjacent land use.

 CATEGORY	 PURPOSE	INDICATORS
FLOW EXTENT	General measure of water flowing in and out of the system, recharge, and available aquatic habitat.	 Miles of flow in each reach Number of "dry days" at Trico Road
WATER Clarity	Measure of solid particles in the water and on the channel bottom, which can impact habitat and conditions for aquatic life.	 Total suspended solids Turbidity Percent fines
WATER QUALITY	Measure of chemical conditions necessary for sustaining the river's animal and plant communities.	 Total dissolved solids Ammonia Dissolved oxygen Biochemical oxygen demand Metals
AQUATIC WILDLIFE	Direct measure of river's wildlife, which integrate many factors of the surrounding environment.	FishAquatic invertebrates
 RIPARIAN VEGETATION	Direct measure of river's plant communities, which reflect changes in water quantity and quality.	 Wetland indicator status Nitrogen affinity score Riparian tree cover
SOCIAL Impacts	Measure of aesthetic factors that directly impact people living or recreating along the river.	Odor at reclamation facilities





- 1. Looking southwest at floodwaters at the Agua Nueva outfall, September 2014
- 2. Flowing conditions near Sanders Road, October 2014
- 3. Dry conditions near Sanders Road, October 2014

The following pages present the data collected in the 2014 water year (October 1, 2013-September 30, 2014). Facility upgrades at Tres Rios began in phases between fall 2012 and fall 2013. The Agua Nueva upgrades were completed in December 2013. To review all the data in more detail and see additional charts from the 2014 water year, please visit the Sonoran Institute website at www.tiny.cc/lscr14.







- 4. The Santa Cruz River in 1902 (courtesy of Arizona Historical Society, Main Photo Collection)
- 5. Fish survey in the Santa Cruz River, fall 2013

STREAMFLOW, RAINFALL, AND WATER BUDGET

The amount of water flowing in the river provides an important context for the indicator results. Reclamation facilities continuously release water into the river, which accounts for the majority of streamflow. However, streamflow also includes stormwater from the watershed. The Santa Cruz River Watershed includes all of the land whose stormwater flows toward the river. Seasonal floods are important for scouring the riverbed, recharging aquifers, dispersing seeds, inducing seed germination, and clearing natural debris.

A water budget for the Lower Santa Cruz River estimates the water inputs and outputs. Inputs are effluent and stormwater, while outputs include water that does one of the following: flows past Trico Road (see map on page 2), evaporates or is used by wetland vegetation (a process called evapotranspiration), is diverted for agricultural use, or sinks into the riverbed to recharge local groundwater. Input and output volumes are totaled in acre-feet (AF), the number of acres that would be covered with water one foot deep.

2014 WATER BUDGET

In comparison to 2013, total inputs were about 27% greater in 2014 from higher volumes of stormwater. In 2014 about 28% of the inputs came from stormwater, primarily from the summer monsoon season. In 2013, only 8% came from stormwater. Even with greater inputs, there was 12,000 AF more recharge in 2014 than in 2013, likely from increased infiltration rates in the riverbed after improved water quality



(see page 15). Although the total effluent released into the river remained similar to 2014, effluent releases from Agua Nueva have decreased, for two reasons. First, the facility upgrade resulted in some wastewater being redirected to Tres Rios and thus released further downstream. Second, more water was diverted to the reclaimed water system to irrigate Tucson's large turf areas. Compared to 2013, the volume of water diverted for irrigation increased by an average of 223 AF per month from March through September.

and the water budget online at www.tiny.cc/stream14.

SUMMARY OF WETLAND CONDITIONS

This assessment of the 2014 water year identified initial changes to 2013 baseline conditions of the Lower Santa Cruz River following upgrades to the Agua Nueva and Tres Rios water reclamation facilities.

As anticipated, water quality improved following the completion of the upgrade, and all measures were better or remained similar to the 2013 baseline. Most notably,

ammonia levels were significantly reduced, which improved conditions for fish. Reductions in ammonia likely allowed fish to expand into Three Rivers, where fish were absent in 2013. However, flow in this reach was shallow and one of the survey sites was dry. Therefore, fish habitat may be best downstream of the Tres Rios facility where there is more water.

Reduced nutrient pollution likely diminished any "clogging" layer in the riverbed and increased infiltration, the ability of water to percolate through the sediments in the riverbed. This effect likely contributed to the contraction of the extent of flow in both Three Rivers and Marana Flats. Although shorter flow extent suggests decreased availability of habitat for aquatic wildlife, increased infiltration of water possibly benefited local aquifers along the river.

Materials suspended in the water decreased, and water was clear on normal non-flooding days. The percentage of the fine materials or "muck" covering the riverbed was reduced compared to the 2013 baseline. Fine materials can smother habitat and life on the riverbed if too abundant. Therefore, in addition to improved water quality, this decrease in fine materials likely contributed to improvements in the aquatic invertebrate community.

While Three Rivers was still dominated by pollution-tolerant invertebrates, overall community diversity and abundance of species sensitive to pollution increased. However, the invertebrate community still reflects impaired river conditions compared to warm-water streams in Arizona that are not

CATEGORY			2013 CONDITIONS	2014 CONDITIONS			
	FLOW Extent		Water was always flowing through all three reaches.	Flow extent decreased in both Three Rivers and Marana Flats (p. 12).			
	WATER Clarity	\bigcirc	High amount of particles moving through all three reaches during normal, non- flooding conditions. Materials in the water increased as the river flowed downstream.	Water clarity improved with reduced number of particles in the water column during normal, non-flooding conditions (p. 13).			
	WATER QUALITY		High levels of ammonia posed a health risk to aquatic life. Other measures met standards or provided a baseline for comparison in future assessments.	All water quality measures improved or remained similar to 2013. Most important were significant reductions in ammonia, improving conditions for aquatic wildlife (pp. 14–15).			
	AQUATIC WILDLIFE		No fish in Three Rivers, but Western Mosquitofish in Cortaro Narrows and Marana Flats. Aquatic invertebrate commu- nities in all three reaches suggest the river is impaired or under environmental stress.	Western Mosquitofish now found in all three reaches, but Three Rivers had less habitat with one site dry. Aquatic invertebrate communities showed some signs of improvement (pp. 16–17).	1. Cloudy water, May 2013		
	RIPARIAN VEGETATION		Wetland and nitrogen-tolerant plants increased immediately downstream of the reclamation facilities. With the exception of Marana Flats, riparian trees generally declined as the river flowed downstream.	No change in wetland and nitrogen-tolerant plants (trees were not measured). Continued monitoring will determine if improved water quality and reduced flow extent will lead to changes in streamside plants (p. 18).			
	SOCIAL Impacts		Odor data unavailable at press; past efforts to reduce odor impact have resulted in significant reductions in odor levels.	Reduced odor complaints and anecdotal observations of little or no odor near the boundaries of the reclamation facilities (p. 19).	3. Watercress and wetland vegetation		

dominated by effluent. More time may be needed for the invertebrate community to attain the diversity and abundance found in other streams.

Wetland and nitrogen-tolerant plants were most abundant immediately downstream of the reclamation facilities and were similar to plants found in 2013. Continued monitoring will determine if reductions in flow extent or improvements in water quality will lead to changes in the riparian vegetation community.

As demonstrated in the 2013 baseline report, both the extent and intensity of odor emanating from the reclamation facilities has diminished significantly with the upgrade process. This is further supported by the reduction in odor complaints in the 2013-2014 period and observations from people recreating in the area that odors are either gone or barely noticeable compared to past conditions.



2. Clear water, June 2014



INDICATOR RESULTS



Measuring flow extent, or the distance the river has visible water flowing, provides a general measure of water flowing in and out of the system and the length of available aquatic habitat. Abundant flow extent may indicate high availability of habitat for aquatic life or low infiltration of water into the riverbed. Decreased flow extent could result from reduced water inputs or greater infiltration of water into the riverbed.

2014 RESULTS: Flowing stretch of river is shorter

Flow extent decreased compared to 2013. When measuring miles of flow in June prior to the start of the monsoon season, only Cortaro Narrows had flow through the entire reach. In addition, there were 94 days when the river was dry at Trico Road, thus fewer days when the flow extended to the end of the study area. Although total effluent volume released into the river was similar to 2013, increased infiltration is likely one of the factors responsible for the decreases in flow extent and the dry days at Trico Rd. Decreased release of effluent from Agua Nueva may be another factor responsible for the decrease in flow extent in Three Rivers (see water budget page 8). More monitoring will be needed to determine if increased infiltration will influence any long-term changes in flow extent. Learn more about flow extent and view all the data online at www.tiny.cc/fe14.



Rivers naturally move sediments and other particles downstream. As these materials are swept away, others are conveyed from upstream, bringing an influx of nutrients, organic matter, and sediments to the river ecosystem. Measuring the concentration of the materials in the water provides an estimate of the suspended particles or "cloudy" conditions in the water. Murky water and the associated materials that settle on the riverbed can negatively impact habitat and conditions for aquatic life.



2014 RESULTS: Water clarity increased

Water clarity was measured throughout the year at several locations during normal times when the river was not flooding (murky conditions are normal during high flows). The count of suspended particles in the water, as measured by total suspended solids, declined in 2014 relative to 2013. Turbidity describes the ease of seeing through the water, with higher scores representing cloudier water. All turbidity scores were lower in 2014, indicating improved water clarity. The percent fines, or "muck," that settles out of the water was reduced at all four sites in the spring of 2014, suggesting improved conditions for aquatic life on the riverbed. Learn more about water clarity and view all the data online at **www.tiny.cc/WC14**.



WATER QUALITY

Aquatic ecosystems, such as streams, depend on particular waterquality conditions (chemical, physical, and biological properties) to sustain plant and animal communities. There are many typical measures that help track changes in water quality in the river, including the amounts of total dissolved solids, ammonia, dissolved oxygen, biochemical oxygen demand, and metals.

Nitrogen and other nutrients enter the river from air pollution, fertilizer, surface runoff, and release of effluent. While elevated nutrient levels can benefit growth of riparian plants, they can also lead to poor conditions for aquatic wildlife. High nutrient levels also can encourage an overabundance of organisms that live in the spaces between the sand and gravel in the streambed. These organisms can become so numerous that they "clog" the streambed and reduce the ability for water to soak into the riverbed and recharge aquifers.





Riparian areas are critical habitat for numerous amphibian and reptile species. Historically, the Santa Cruz River was home to a community of species commonly found along rivers and desert washes in southeastern Arizona. Now the effluent stretch of the Lower Santa Cruz River provides some of the only flowing water habitat for these species in the Tucson area. Though no formal surveys were conducted, Sonora mud turtles were observed along the river in Cortaro Narrows. One observation may have been of a very young turtle, but more data is needed to determine if the mud turtles are breeding along the river. American bullfrogs and spiny softshell turtles are two nonnative species that are present and breeding in the river.



2014 RESULTS: Improved water quality from reductions in nitrogen

Measures of water quality were taken at several locations throughout the year. Measuring total dissolved solids is a common way to test for salts in the water. Total dissolved solids have been higher with the community's rising use of water from the Colorado River since 1993. However, these levels did not change between 2013 and 2014.

Ammonia (NH₂) is one form of nitrogen that can be toxic to fish and is more common in rivers dominated by effluent. In 2014, average concentrations of ammonia significantly declined. Since the upgrade at Agua Nueva was only complete in December in 2013, levels of ammonia are expected to further decline in Three Rivers in the future. These lower concentrations of ammonia and other nutrients may be a factor in the reduced clogging effect in the riverbed, which in turn resulted in increased recharge (page 8) and reduced flow extent (page 12).

Fish and other aquatic animals need dissolved oxygen to survive. Levels of dissolved oxygen remained high enough for fish and tended to be higher in Cortaro Narrows and Marana Flats in comparison to 2013. Biochemical oxygen demand estimates pollutant levels by measuring how much dissolved oxygen is being used. For example, microorganisms breaking down organic materials use a lot of oxygen and deprive other animals of their supply. Compared to the 2013 baseline, biochemical oxygen demand declined along the river. This may be due to several factors such as reduced ammonia levels from improved water treatment.

Metals in high concentrations can endanger wildlife in aquatic ecosystems. As in 2013, all the samples tested for arsenic, cadmium, chromium, copper, lead, mercury, selenium, and zinc were low enough to protect conditions for aquatic wildlife in the river.

Learn more about water quality and view all the data online at www.tiny.cc/wg14.



Water is essential for aquatic wildlife to survive in our arid landscape. With natural waters becoming increasingly rare throughout the Southwest, releases of effluent into the Lower Santa Cruz River are providing critical habitat for aquatic wildlife in the Tucson region. Furthermore, wildlife can be good indicators of river health because they integrate and reflect conditions of multiple factors in the surrounding environment, such as water quality and availability of habitat.

2014 RESULTS: Aquatic wildlife show some improvement

A spring 2014 survey of the aquatic invertebrate community was conducted at four locations along the river. In Three Rivers, the invertebrate community was still dominated by pollution-tolerant midges from the family Chironomidae. This lack of diversity, with more than 50% of a community dominated by a single group, suggests the river is impaired. However, the dominant groups in Cortaro Narrows and Marana Flats were pollution-sensitive mayflies from the Ephemeroptera family, and both comprised less than 50% of the community. Overall, pollution-sensitive Ephemeroptera increased in all reaches. While this increased diversity is supported by an increase in the biological index scores, the scores remain below 39 and suggest that river life is impaired. Increased community diversity and presence of mayflies likely results from improved water quality conditions and possibly from the reduction in percent fines on the riverbed. As the survey occurred only four months after the completion of the water reclamation facility upgrades, continued monitoring is needed to confirm improvements.

Aquatic Invertebrates

For many invertebrates life starts in the river with a larval stage. After the required development time, they emerge and live out of the water as adults. Emerging adults like this adult mayfly become an important food source for birds.

Aquatic

(midges)

(mayflies)

Birds

The birds of the Santa Cruz Valley support the local economy by attracting thousands of visitors each year. In the 2014 water year, 434 volunteers collected more than 44,000 bird observations along the Lower Santa Cruz River as part of a citizen-science program managed by Cornell Lab of Ornithology, www.ebird.org. Though bird watchers made observations all along the three reaches, more than 38.000 of the observations were from the Sweetwater Wetlands and Columbus Park. Overall, there were 215 unique species observed along the Lower Santa Cruz, including several migrating warbler species who stop and rest on their journey.

Data source: eBird Basic Dataset. Version: EBD_ relNov-2014. Cornell Lab of Ornithology, Ithaca, New York. November 2014.





Data source: Arizona Game and Fish Department, Pima County, Sonoran Institute, U.S. Fish and Wildlife Service





A fall 2014 fish survey was conducted at the same four locations to detect species and general fish numbers. As in 2013, surveys found only non-native Western Mosquitofish. While several large nonnative fish, including catfish, were observed during the spring invertebrate survey, these were not seen in the fall. Many fish may have succumbed or been washed past Trico Road in the large floods of September 2014. This is one possible explanation why general fish numbers were lower than in 2013. However, Three Rivers had more fish than last year, suggesting a possible expansion of fish upstream. Flows were very shallow during the survey and one site was dry. Thus, continued monitoring will help us understand if Three Rivers can provide habitat for fish.

Learn more about aquatic wildlife and view all the data online at **www.tiny.cc/aw14**.



RIPARIAN VEGETATION

Just as water is essential for aquatic wildlife, many plants grow only in areas with more water, such as wetlands and riparian areas next to rivers and desert washes. Thus, effluent released into the river is also supporting numerous plants that add to the ecosystem diversity along the Lower Santa Cruz River. Although riparian vegetation represents only a small percentage of the land cover in the Santa Cruz River Watershed, it provides important benefits to the region, such as slowing flood flows, increasing groundwater recharge, reducing erosion potential along stream banks, maintaining habitat for wildlife, and providing recreational and spiritual enjoyment.

and the second se				AND ST.			
	2013	2014		2013	2014		
Trico Rd	ste	W 2.8	W 2.4		H 6.8	H 6.8	
	Marana Fl	W 2.4	W 2.0		H 6.1	H	
Avra Valley Rd	SM	W 2.6	W 3.1		H 6.2	H 5.4	
	aro Narro	W 2.7	W 2.3		H 6.4	H 6.9	
TRES RIOS	J	W 2.2	W 1.9		H 6.7	H 7.4	
	Rivers	W 2.5	W 1.9		H 6.3	H 6.9	
AGUA NUEVA	Three	W 3.3	W 3.7		H 5.4	H 5.2	
The A		U 4.9	U 4.9		L 3.2	L 3.4	

2014 RESULTS: Effluent supports wetland species; little change in streamside vegetation

Measures of riparian vegetation were taken in the spring at one site in the dry part of the river upstream of Agua Nueva and at seven sites along the river. Only streamside plants, no trees, were surveyed this year.

Riparian vegetation varied among sites, but was similar to the 2013 baseline. Overall, the abundance of wetland plants increased immediately downstream of the reclamation facilities, as compared to the site upstream of Agua Nueva where upland species of plants were more common. Streamside plants that grow well in high-nitrogen environments were most common immediately downstream of the reclamation facilities. The survey occurred only four months after the upgrades were completed and prior to the reduced flow extent in both Three Rivers and Marana Flats. Therefore, monitoring in subsequent years will determine if changes in water availability and nitrogen levels will reduce abundance of wetland or nitrogen-tolerant plants.

Learn more about riparian vegetation and view all the data online at **www.tiny.cc/rv14**.

Several plant species were misclassified in 2013, resulting in incorrect wetland and nitrogen affinity scores. The corrected values are shown here. Data source: Pima County, Harris Environmental Group, Inc.

SOCIAL IMPACTS

With the release of effluent into the river, reclamation facilities are supporting important wetland habitats and heightening the recreation experience for those enjoying our river parks or walking and biking along The Loop trail adjacent to the river. Even so, unpleasant odors often associated with the reclamation process can lead to negative perceptions of the river. The most common offender is hydrogen sulfide, or the "rotten egg" smell. Minimizing both the extent and intensity of disagreeable odors coming from the facilities was one of the goals of the reclamation facility upgrades.

2014 RESULTS: Significant reductions in odor

As demonstrated in the 2013 baseline report, both the extent and intensity of odor emanating from the reclamation facilities have diminished significantly since the completion of upgrades. Recent anecdotal data from people recreating in the area indicate that odors are either gone or barely noticeable compared to past conditions. Odor complaints received and investigated by Pima County Regional Wastewater **Reclamation Department (RWRD) have** decreased in the 2013-2014 period, reflecting a system-wide effort by the department to reduce odor incidents. Pima County RWRD continues to vigilantly investigate and solve transitory odor problems.

Recreation

The Lower Santa Cruz River is a popular destination for both birding and other recreation. There are seven parks along this reach with access to the river and numerous bridge crossings where you can get a bird'seye view of this rare wetland amenity. Find your favorite spot by traveling The Loop, the recreational path along the river. Over several traffic counts during the month of October 2014, volunteers working with Pima Association of Governments counted more than 860 bicyclists and pedestrians at different locations along the path from the Sweetwater Wetlands to the junction of the river with the Cañada del Oro.

Go to **www.pima.gov/TheLoop** to find a detailed map and plan your visit.

LIVING RIVER OF

In 2015 Sonoran Institute and Pima County expanded the Living River Project goals to include sponsorship of a unique youth education program run by Pima County Natural Resources, Parks and Recreation. The Living River of Words, formerly known as Tucson's River of Words, offers local schools the opportunity to participate in a program that encourages young people to explore how water moves through the landscape and the connections that plants, animals, and people have to water.

The Living River reports help guide the science-based classroom activities and field trips to the river. These field trips are a key element of the program as they often represent the first opportunity students have to experience and visit a flowing river. In the second half of the program, students work with local artists to take what they have learned and create poetry or art entries for the contest. The contest is open to all youth who are 5 to 19 years old.

The 2015 Living River of Words Youth Poetry and Art contest received more than 900 submissions from 21 schools and included several independent entries. Included here, and on other pages, are some of the final poetry, art, and photography selections featured in the traveling exhibit. Learn more about the program at: www.pima.gov/nrpr.





age 10 er School, Mrs. Dudas Aidan Frye, a Satori Charte

I Am The River I am the river wise and old. I have heard stories that are rarely told, I am the river young and new, I see even now as I talk to you, I am the river not a water sprite, I write and write very long into the night, I am the river massaged by leaves and rocks, I do not care about watches or clocks, I am the river flowing to the ocean, Where animals live and play in me as waves keep me in motion, I am the river home of the animals around me, One is a little fish who could not survive without me, I am the river I do feel pain and sadness, When animals hunt from me I don't feel gladness, I am the river replenished with re-used water, Still I am clean enough to house an otter.

GET INVOLVED

• Have your child enter the 2016 Living River of Words Youth Poetry and Art Contest. www.pima.gov/nrpr

• Take a water harvesting class sponsored by Tucson Water. Water harvesting is a great way to improve the resilience of our community by using water more efficiently. Find out how to harvest water and get a rebate on your water harvesting system. www.tucsonaz.gov/water/rwh-rebate

Double your water harvesting efforts and join Tucson's Conserve 2 Enhance (C2E). C2E connects conservation with community action. Your donations, based on water savings, provide funding to enhance Tucson's rivers and urban washes which ultimately flow into the Lower Santa Cruz River. www.conserve2enhance.org/Tucson

• Count birds for the Tucson Bird Count and help document which birds are found along the Lower Santa Cruz River. www.tucsonbirds.org

• Visit the river for yourself! There are many places to see the river. One easy spot is from the Crossroads and Silverbell District Park. You can walk out to The Loop which passes behind the Wheeler Taft Abbett Library and easily watch the river flow by. If you're lucky you might even see a native Sonora mud turtle!

School, Mrs. Hollman ater High Amphithea 16 age Mario Reynoso,

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The Sonoran Institute convened a Living River Technical Committee of ecology, hydrology, and wildlife experts to bring the best available science to bear on the development of the Living River health assessments. The Technical Committee provided guidance by selecting and aggregating indicators of river health, identifying reference values or standards for evaluating and tracking changes in river conditions, and reviewing this report. The information presented in this report grew out of discussions involving these experts and represents the product of a collective effort; it does not reflect the opinions or viewpoints of any individual member of the technical team. The viewpoints and opinions expressed in the discussions of the group and captured in this report also do not reflect the opinions or viewpoints of the agencies, institutions, or organizations with whom the technical team members and external reviewers are associated or employed. Any errors or omissions contained herein are solely those of the Sonoran Institute.

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