Green Infrastructure for Arid Communities

Webcast Transcript

Tuesday, March 24, 2015

Speakers:

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- **Emily Brott**, Sonoran Institute

Transcript:

Slide: 2015 Green Infrastructure Webcast Series

[Presentation recording begins a few minutes into the webcast.]

Slide: Map of Sustainable City Plan

Neal Shapiro:
We're nestled, surrounded on three sides by the city of Los Angeles, and then the Pacific Ocean is on our western border, eight square miles.

Slide: Urban Runoff – What is it?

So we're all aware of the water pollution problem from stormwater, dry weather runoff. Urban runoff is the single largest source of water pollution, and there's been lots of studies to document that.

Slide: The Watershed Level

And I'm sure we're all aware of that. We're all aware how we've disrupted the water cycle by paving over open spaces, permeable spaces. And just ten percent coverage, you start to get impacts to the water quality. So we're, again, all very familiar with that, and Santa Monica is a highly urbanized built-out city. So we really want to get back to working with nature with the water cycle.

Slide: Runoff Treatment Solutions Staircase

So our city started out, back in the mid, late '80s, in terms of dealing with stormwater pollution, dry weather runoff, at the bottom of this hierarchy. Most common solution was detention, and then we started to work up with other kinds of products that came out on the market and eventually started getting into more of the low impact development kind of strategies, biofiltration, remediation, surface infiltration. And then we really were focusing on harvesting water on site, keeping it on site, through our ordinance which I'll mention momentarily, and keeping that water on site, infiltrating into the ground, although we don't have a lot of groundwater that we can really recharge in our area. So really, we're starting to evolve to harvesting rain, stormwater, keeping it on site in storage tanks, and directly using it for various purposes, which is the height of this hierarchy.

Slide: OBJECTIVES

So our objectives in our city is, again, to treat as much or all the dry weather that we can and as much wet weather that we can, work with the nature's water cycle, try to mimic nature before we paved over the land. And just the highlight in red, we really are focused on converting impermeable areas to permeable areas or directing them to permeable areas and then storing as much of this runoff, whether it's wet weather, dry weather, for passive and direct active uses. And by doing this, we also deal with our pollution, water pollution problems. So again, our solutions are focused on water quality and water quantity solutions.

Slide: Tools of the Trade

And we all have a variety of tools in our toolbox, and I'll be focusing on our ordinances, our treatment schemes, and some of the funding for that.

Slide: ORDINANCES

So in our city, back in the mid-'90s, we passed our urban runoff mitigation ordinance, which is basically our low impact development ordinance, in which, when you do construction, you have to do a BMP, a post-construction BMP, on your property to deal with a certain amount of water. In our city the standard is a three-quarter inch storm, harvest all the runoff falling on impermeable surfaces up to a three-quarter inch storm. And the costs are borne by the property owner, whether it's a private property or it's the city property. We also have two parcel fees. So one was passed before the state passed Prop 218, which sent any fees to the voters. So our first fee was passed by our city council, and then our second fee, we actually went to the voters in 2006 and got a second stormwater fee. There's also an L.A. county stormwater fee, so our property owners are actually paying three fees. So that brings in about $4 million to our city to do our various programs that I'll describe. We also passed the proof recently, our 2020 Sustainable Water Master Plan that the city hopes to be self-reliant on local water by 2020. Right now we're getting about 35 percent of our water from the Metropolitan Water District, so we're looking to get rid of that and close that gap so we have all of our water locally provided. And then we have our new stormwater NPDES Permit, which now the focus is on these EWMPs, enhanced watershed management plans, and that focuses on green infrastructure.

Slide: TREATMENT – Public Projects

Now I'll talk about some of our city projects, and this is the various categories of projects that we have since the late '90s. So this is an interesting product.

Slide: Onsite Natural Infiltration/Filtration

Maybe you've heard about a module wetland or a storm tree back in the late '90s. It's a great product if you are living in a place that gets lots of rain because, obviously, it's kind of a mini-wetland. But when you put that in a dry, arid climate like ours, you have to make sure someone knows to water it when it's not raining, which didn't happen. That's where maintenance comes in. So, unfortunately, ours failed. And I did go back and redo them, and now we have maintenance, and our staff knows they have to go out there and water them on a regular basis. So for wet areas, this is kind of a nice product. But for drier ones, I don't think I would necessarily recommend it because you have to add water to water it.

Slide: Onsite Retention – Drivable Surfaces

We also have various projects where we focus on permeable surfaces where there's hardscape impermeable surfaces. So in this case, we have permeable alleys. We did some pilot projects. The picture on the left here was an alley that flooded the neighbors here, so we put in pervious concrete so that the water could soak into the ground. And we started to do more and more of these types of projects on a regular basis.

Slide: Green Alley Projects – 2011: Before (ongoing)

So we do, as part of our CIP, or capital improvement program, every year we're doing maybe five to ten alleys just as part of our regular resurfacing. These are what our alleys typically look like.

Slide: Green Alley Projects – 2011: Construction

So what we do is we go in, and we remove the asphalt. We repave it with asphalt, and then we remove the center swale. And we pour in – we put in a couple feet of rock and then come back and put the pervious concrete over that. And so, when it rains, the bottom picture here, you can see –

Slide: Green Alley Projects – 2011: After

The impermeable asphalt, you can see the sheen from the water, not percolating, but you can see there's no sheen for the pervious concrete, and that soaks in. So this is an ongoing project we have now in our city when we redo our alleys. We also start to look at intersections where we also have the asphalt swale going across it, let the water flow across the street and move on.

Slide: Permeable Intersection Swales (pervious concrete)

So we're actually starting to replace those areas with pervious concrete. This is a project done a couple years ago. So we can get rid of this nuisance flow, this bottom picture, which is a common thing in Santa Monica and probably much of Southern California from people's sprinklers over spraying.

Slide: Permeable Gutters (pervious concrete)

We also began a project a number of years ago, when we're replacing our curbs, to put in pervious concrete here.

Slide: Permeable Paving - Gutters

So as you can see, we go in there, put in pervious concrete, and then that, when the water, stormwater or dry weather flowing in here, picks it up, and it lets it infiltrate into the ground. Here's an example from a storm event where you can see, again, the impervious area has the sheen of water on it. But in the pervious concrete gutter, the water soaks in and keeps the water on site. This has some maintenance requirements because most of our streets are tree lined, so you have to make sure that you have regular street sweeping or actually street vacuuming to suck out any particles so you don't clog the voids in this material because of all

the trees that are dropping things. You really have to make sure that you have a good maintenance program.

Slide: Use of Parkways for Surface Runoff

Another program we started, you know, you have water flowing down the gutters of your street, and then you have the parkway here, which kind of serves really no purpose other than it has to be irrigated, generally, in our city. So it's really a great place to try and do something in the parkway to get the water out of the street and into the parkway and infiltrate it.

Slide: Parkway Infiltration

So we got a grant from Metropolitan Water District to test out this concept. We added a storm drain in the gutter to collect the runoff coming off of the – whether it's dry weather or wet weather. We put an insert to filter out any debris, and in the parkway, we put in an infiltration zone. I wanted to put out actually a cistern here to store the water and then use it for irrigation, but the grant didn't have enough money for that. So this was a successful project in which we could test out taking water off the gutter and getting it into the parkway and keeping it from going out into the ocean.

Slide: In-Line Stormwater Harvesting (1)

From there, we got another grant from the state, actually, to test, I guess, an evolved example from that previous one. We call it an in-line stormwater harvesting project. And you can't really see the schematics, but we have a couple residential streets where we're actually augering down and putting deep infiltration pits in these areas. And we're actually tapping into the storm drain line, whether it's a catch basin, in this example, or it's the actual storm drain under the street.

Slide: In-Line Stormwater Harvesting (2)

So at this particular location, we have two examples. We have one where we used the parkway for the infiltration zone, the water goes down the gutter into a storm drain, and then it gets filtered out, some initial filtration, goes into the parkway, and it infiltrates into the ground.

Slide: In-Line Stormwater Harvesting (3)

Across the street, we have another catch basin where the water collects – is collected in the catch basin. There's a little diversion here that directs it, actually, to this auger, 30-foot infiltration zone, and then the water seeps into the ground. And then, at a third location, we have another in-line where we actually tap into the storm drain. So the storm drain is running in the alley, makes a 90-degree turn into a street. We have a diversion here which takes the water out of the storm drain and sends it into two augered pits, 30 feet deep, to allow the water to infiltrate into the ground.

Slide: In-Line Stormwater Harvesting (4)

So here's an example of this, of the augered pits. Here's the diversion in the storm drain and then a surface view of the two augered pits. This is the Maxwell system. And then, ultimately, you can see the finished product here. Here's the manhole cover for access, where the original storm drain line is, and then we've tapped into it and we infiltrate the water to come out. So

that was a very successful project and one that could take advantage of using the transportation grid to collect, harvest stormwater, dry weather runoff, and get it back into the ground.

Slide: Virginia Avenue Park

Whenever the city does a project, we want to make sure we have a post-construction BMP. This is Virginia Avenue Park, where we redid the park, and we put infiltration zones around the perimeter of the park, picking up water, any excess water in the landscape. The parking lots have pavers in the parking stalls, so the water comes off the impermeable surface into the permeable surface and soaks into the ground here.

Slide: Airport Park

We've created a new park at our Santa Monica Airport, and we have two parking lots where we've tried out the product, the porous asphalt. So here's an example of the porous asphalt, and this is during a rain event. You can see there's no sheen there. The water is infiltrated into the ground, and so there's no runoff from that. And then we also have perimeter infiltration zones to take any excess water during heavy storm events.

Slide: Big Blue Bus Retention - Phl

Our Big Blue Bus facility, we had a couple of phases of remodeling. So this is the first phase in which we redid a wash area. And so we dug out a big area and put in infiltration zones to collect the water coming off, about the third of this location to infiltrate into the ground.

Slide: Big Blue Bus Retention: Phase II

Phase two was a much larger, to deal with two-thirds of our Big Blue Bus area, and we put in dual systems of this pretty extravagant system. We have pre-treatment, a vortex system. We have a storm filter to filter the water with lots of – a couple dozen cartridges that filter out a variety of pollution. Then it goes into a detention vault, where it sits there and settles until it then goes into the infiltration zone in that area. So this is a very large project. And again, we're getting the water, collecting it and putting it back in the ground. Ideally, it would have been nice to have cisterns here, but we didn't do that because there really was no – not a great use of that water at the bus facility.

Slide: 415 Pacific Coast Highway - Retention

This is one of our beach house facilities where we have public events. And the water, it comes off the beach area, the parking lot and the building, and goes into some infiltration zones in the beach. Obviously, that's a great location. The soil is very sandy, and it can percolate in pretty quickly.

Slide: Green Beach Parking Lot Project

We also got a grant from the state to test out a concept of redoing our parking lots at the beach and using a structural grass material, a base, so that you can park on it, but it also creates a more open space for recreational activities. This is called Netlon. And this -- so we took about one-third of this parking lot, and we installed the Netlon.

Slide: Onsite Storage/Use - Main Library

Then we use this parking lot for overflow parking about five to six times a year. So here's the parking lot with the finished product. This is the opening day event, and there's where we used it for parking. So it's a very educational event. So we can use it for parking, and when it's not used for parking, we can use it for various activities. And lots of groups come here to use it for various meetings and activities.

And getting to the most sustainable solutions, which are the storage tank solutions, so this is our new library we built many years ago, back in 2004. And underneath the building and the underground parking is a 200,000-gallon cistern being laid out here. The concrete was poured, and you're inside, looking up at the access. These are the ports that bring in water from the roof, the decks, and the parking lot for the library, and an access path. So this water is used for landscape irrigation only. We didn't – we weren't able to use it for flushing because this design came in at the end of the design of the project.

Slide: Multi-Family Project

This is a multi-family building that was completed a couple years ago. This is a 13,000-gallon cistern that collects the water from the parking area and the roof, minimal treatment, and it's used for landscape irrigation at this building.

Slide: Virginia Ave. Park Library (1)

And then our most exciting project, which was finished last year, is our new library at our Virginia Avenue Park. A 12,000-gallon cistern takes water off of the roof of a couple buildings in the area, and here it's stored – it's built under a fire lane, and then the cistern water, you can see a picture after it's been raining. And this water is actually used for indoor flushing. So this is the first project of its kind for our city in which we're using it for indoor flushing, and we're very excited about that because we feel that's really the most sustainable use of the water. When it's raining, you don't need the water to use for landscape irrigation. You really should be using it for indoor use to offset the use of potable water.

Slide: Virginia Ave. Park Library (2)

The water goes through initial pretreatment, and then it goes through a sand filter and some microfiltration, ultraviolet radiation treatment, and then it goes into a day tank, a 300-gallon day tank, and then the water is pumped to the bathrooms for use during the day. And then there's additional back-up potable water when this goes dry. Generally, this is sized to offset about 60 percent of the water demand, potable water demand.

Slide: Future Projects – Marine Park

Some other future projects we're working on now that we got some state grants, this is Penmar Park in the city of Los Angeles. This is Marine Park in the city of Santa Monica. This is our borderline between cities. City of L.A. built an almost three million-gallon cistern underneath an athletic field, and we're now building the pipeline to take the water from there, run it around the golf course, and then bring it to our park to use it for irrigation of the park. So that's -- now the completion of the design is almost done, and we'll be building this later this year. Just FYI, Harrison Ford, when his plane crashed, it crashed right here at this particular golf course because our airport that he took off from is right over – up to the upper right.

Slide: Los Amigos Park Project

Another project -- we got a grant from the Metropolitan Water District -- is for Los Amigos. We're actually going to tap into a storm drain underneath this street, and we're going to put in a large cistern storage tank at this Los Amigos Park. And then we'll be using it for irrigation of the athletic fields and actually for indoor flushing of the bathrooms at the park. So that's under design, almost completed the design, and that will go into construction next year, after the school year.

Slide: Ozone Park Project (1)

And then we recently got an EPA Green Infrastructure Technical Grant, and so Tetra Tech was finishing -- or I think they've just completed the study, and this is to, again, tap into a storm drain that is running under Ozone Park, which is also on the border of Los Angeles.

Slide: Ozone Park Project (2)

And it's like a perfect location because you have a large storm drain running right underneath the park, and you have a use of the water for irrigation here. And so that's a great study that's been completed, and now we're just hopefully going to get some funding to actually go in and build it. This is a schematic showing the storm drain running under the park, and then we have different colors for the different cisterns.

Slide: Presentation Outline

And we're also going to test subsurface irrigation.

Slide: TREATMENT – Small Scale Privates

Now to get some of our private projects – excuse me – this is a restaurant called The Lobster at our pier.

Slide: Onsite Retention-private businesses

They have an augered infiltration pit right here to collect the water, and it infiltrates into the ground. This is an automotive. The water from the roof goes underneath this area and into a bio-filter along the perimeter there.

Slide: Drywell BMPs-single/multi- family

For multi-family, single families, the most common solution is an infiltration pit. On the right is an example of one infiltration going in underneath a multi-family. This is actually an augered pit on the left. It's actually raining at this time that I was there, and that's from another multi-family.

Slide: Infiltration Pits BMPs

Typically, our infiltration pits use rock in the beginning, but I felt that wasn't the best solution because rock can plug very easily if you don't have good pretreatment.

Slide: Onsite Retention

So we've gone to these other plastic products that have been out on the market over the years. There's a variety of different types, and these are all used in our city. They're 90 percent void. And this way, you don't have to increase the size of the pit if you use rock. If you use rock, now you have to make the pit two and a half times larger to offset the loss of storage capacity.

Slide: Onsite Retention

And again, just lots of different examples of products that are out there to suit your needs and to fit whatever footprint you're working with.

Slide: Big Projects

Some larger projects, supermarket in the city that was remodeled. They put a large infiltration pit in the parking lot.

Slide: Driveways and Runoff – drains and paving

Top right is part of our Santa Monica College, a big parking lot where they have – there's the bio-filter, very simple solution, where the water just comes off the parking area and into bio-filters. Driveways, there's a variety of different solutions, and parking lots. Driveways, you know, pavers, grass – although we don't like to use Grasscrete. We prefer to fill it with rock because, obviously, if it's grass, you have to water it.

Slide: Driveways, Walkways and Runoff – drains and paving

The pervious concrete that you've seen, again, a lot of variety of different things. If you want to keep your concrete solid and permeable, you can put a trench drain, ribbon drain, and the water gets picked up and takes it to the infiltration pit somewhere in the yard.

Slide: Rain Harvesting Rebate Program

This is, again, more pervious concrete, parking lots, private. Here's a house that has gravel pave. And then, again, getting to the – the more sustainable solution is rainwater harvesting and storage tanks. So if you're not required to do a BMP during construction, we do have a retrofit program, and we pay up to $1,000 for larger cisterns for this.

Slide: Multi-Family building

So again, rain barrels come in all kinds of shapes and sizes to fit your needs. This is actually a 5,000-gallon cistern at a multi-family that was put in many years ago. And you can see it's in the front yard. It collects the water, and they've sized the landscape to deal with the – they sized the cistern to match the water need of the landscape.

Slide: Multi-Family building

This is another multi-family that put in these very large cisterns. They use the water for irrigation. Again, typically, 5,000-gallon cisterns are used for some of the larger homes in Santa Monica to collect the water and use it for irrigation.

Slide: Single-Family buildings

And just different kinds of sizes and shapes -- again, if you don't have a lot of space, you can use a trim line that hugs the wall and doesn't take up a lot of space.

Slide: Green Roof

And we do have, actually, some green roofs in our city. Again, the challenge there is you want to make sure you use plant species that can survive the warm summers without rain, or you may have to use supplemental water. But we do have a couple in our city.

Slide: Presentation Outline

Green streets, we have three of them in our city. We got a grant to do our first one, called Bicknell.

Slide: Green Street – Bicknell Avenue Green Street Project BEFORE – Aerial

It's one block, right near the ocean, doesn't drain a lot. It's a very commercial, multi-family area, a very wide street, very narrow parkway.

Slide: Green Street – Bicknell Avenue Green Street Project BEFORE

So we went in there and actually doubled the size of the parkway. We depressed the parkway.

Slide: Demolition, Parkway Expansion/depressed, Curb cuts

We added catch basins in the gutter to collect water, which go to infiltration zones.

Slide: StormTech Infiltration Chambers

And here's where the infiltration zones are, underneath the parking lane, so these infiltrators here. And then there's access ports for sampling, if you need to do that.

Slide: Permeable Concrete Pour, Curing & Test

We used pervious concrete for the parking shoulder above the infiltration zones.

Slide: Catch Basin Filter *(Pre Treatment) – Sub-surface Chamber*

And the catch basins with inserts that filter out debris, and then the curb cuts so the water can go into the depressed areas to infiltrate, or the water goes through the catch basin and into those infiltration zones in the parking area. So there's a variety of paths the water can take to get into the ground to our infiltration zones.

Slide: Parkway Landscaping & Irrigation

This shows the depressed parkways, with climate appropriate plants, drip irrigation. We did want to make this actually cisterns underneath the parking area, but, again, we didn't get the money for that. So we just had to go on infiltration. So this – it would have been nice to have cisterns so the water could have been used to water the landscapes here.

Slide: Rain Events

And then, during a storm event, all the water from this block actually ends up somewhere underground or in the depressed parkway. It does not leave the site unless it's a huge storm. We also have curb openings, where water is coming off the roof, that go back into the infiltration zones.

Slide: Green Street – Bicknell Avenue Green Street Project AFTER

And these are also good – they pick up trash that's captured here, prevents it from going out to the ocean. And this is what it looks like, when it's not raining, when it's finished.

Slide: Green Street Projects – 2011: Longfellow: During Construction

Our second project, Longfellow, it's a two-block area. And the residents there didn't like it. They wanted some changes because there was really no designated parking areas, no curb areas. So this is what it looks like. And we kind of went in, did the same kind of thing in terms of subsurface infiltration zones. You can see here the access ports, permeable paving products for the parking areas,

Slide: Green Street Projects – 2011: Longfellow: Completion

and this is what it looks like completed, a variety of different pavers. Pervious concrete is also used, curb extensions, bulb-outs where the water comes in the gutter and goes into the parkways to infiltrate into the ground.

Slide: Ocean Park Blvd Green Street Project

And then our last, most recent project is Ocean Park Boulevard, a very long section, about two miles of very interesting terrain.

Slide: Ocean Park Blvd. Green Street - Before

It's very hilly, and you have different views, looking west at the ocean or looking east at our local mountains. So it was a great project to enhance the neighborhood because, before this project, it was just a lot of cars going by. The residents couldn't cross very safely. So they really wanted a variety of improvements.

Slide: Ocean Park Blvd. Green Street – 2012 Construction

So besides the aesthetic improvements, we have infiltration zones at both ends of the project to collect the water and infiltrate into the ground.

Slide: Ocean Park Blvd. Green Street – 2012 Construction

And then there's also curb cuts in between, where the water can get out of the gutter and into the depressed parkways and infiltrate into the ground there.

Slide: SMURRF

And the last part, I'll talk about the SMURRF facility. This is the Santa Monica Urban Runoff Recycling Facility. It's the only one in the world, as far as I know, and it can process up to

500,000 gallons of dry weather only. So we're not talking stormwater, although some stormwater can be dealt with here. But generally, it's dry weather runoff. And we're collecting about 95 percent of the city's dry weather runoff from two areas.

Slide: Recommended Treatment for Reuse with Recycled Water

And just the treatment systems, some initial treatment in a vortex system. And then we have a grid chamber to remove trash, some additional trash and smaller sediments, a DAF unit, dissolved air flotation, to remove oil and grease, a microfiltration to remove even finer material, and then ultraviolet radiation.

Slide: Rotating Drum Screen

So this is the rotating drum screen for trash and debris, one of three waterfalls so the people can see what's going on as they walk around this facility and see how the water starts and gets improved.

Slide: Grit Chamber

This is the grid chamber. Our second waterfall is right here and removes the grit.

Slide: Dissolved Air Floatation

And we have our DAF unit. Oil and grease is removed. There's a skimmer that removes – the oil and grease combines with a coagulant, flows to the surface, and a skimmer, which is right here, is skimming off that top layer of oil and grease and taking it to the sanitary sewer.

Slide: Microfiltration

Microfiltration occurs in this container to remove very fine materials and to reduce the turbidity of the water. We have rectangle area that is reserved -- if we have to do a further treatment, we can put in reverse osmosis. We're actually looking into doing that in the very near future. And this is what the microfiltration looks like, a bunch of plastic perforated tubes.

Slide: UV Radiation Channel

And then ultraviolet radiation, the water bubbles up and goes through the U-shaped channel and comes out our third waterfall. And this is the finished product. And this water is used for indoor flushing at some of our buildings and landscape irrigation.

Slide: SMURRF Educational Panels

And then there's a variety of educational material at the facility, because it is open 24/7 -- although not the interior -- where people can come and see what's going on. And there's some educational pedestals. At the end of the facility, you see the final project, and another further up, where you can see the water mid-stream being treated.

Slide: Artwork

And there's a lot of artistic work. This particular graphic on the right shows -- the color tiles are different pollutants, and as you go to the left, you remove the pollutants and end up with

cleaner water. Here we have an access ramp. If people have any mobility issues getting to the facility or to the beach, we have this ramp so that anybody can get to the beach and to our facility.

Slide: Virtual Tour of SMURRF

There's also a virtual tour you can take of our facility if you need to do that. It's on our website, and it's a 12-minute tour that I give as if you were there.

Slide: Promoting Widespread Implementation

And in conclusion, I just want to also mention that the organization ARCSA, the American Rainwater Catchment Association, a national organization, it's a clearinghouse of information about rainwater harvesting, stormwater harvesting. And they have a lot of great information to help people learn how to do it, get trained and accredited to this. They also have worked on two standards, design standards, with ASPE, the American Association of Plumbing Engineers 63, for rainwater, and 78 is currently being reviewed for stormwater. So there's a lot of good information that we've tapped into here at Santa Monica -- I'm also the secretary on that group -- to be able to get that information, all the expertise around the country, and use that and apply it here in Santa Monica. And again, through all these programs that we're doing, we'd like our city to be an example that you can do sustainable watershed management. You can harvest this water resource and keep it on site, even in arid climates, although, obviously, right now it's kind of a challenge, getting minimal water. But when it does rain, obviously, you can get a lot of water and put it to good use.

Slide: Thank you

And with that, I want to thank the EPA for inviting me to speak, and I'll turn it back to you. Thank you very much.

Emily Ashton:
Thank you, Neal. That was a great presentation, as usual. And we had a lot of great questions that were coming in that we're going to get to at the end of the presentation today.

Slide: Poll

So for now, I'm going to actually send a poll out to the audience before we get to Emily's presentation. I'm going to send that out right now. It's just going to ask you how many people are viewing the webcast today. So we'll just take a second so you can fill that out, and then we'll move on with the presentation.

Speaker:
Hello. Are we starting again?

Emily Ashton:
All right. Sorry. I realized that I was on mute for a second. So we really appreciate you guys filling out the poll, and we're going to go ahead and introduce our next speaker for today. Emily Brott is a development officer with Sonoran Institute, and she is Sonoran Institute's former program manager for the Santa Cruz River Project. Emily has worked for a decade in water conservation and river restoration programs, from the Colorado River Delta in Baja California, Mexico, to the Cienega Creek and Santa Cruz River in Arizona and northern Sonoran Mexico.

In 2011, she was named one of Arizona Daily Star's "Tucson's 40 under 40, Up and Coming Community Leaders." Prior to joining the Sonoran Institute, Emily specialized in US Environmental Protection Agency drinking water policy at the Cadmus Group, Incorporated, in Waltham, Massachusetts. She has an international master's degree in Environmental Sciences from Lund University in Lund, Sweden, and a BA in Biology from Harvard University. Outside of work, Emily is currently pursuing her MBA at Thunderbird School of Global Management. So, Emily, we're going to bring you on the line. Are you there?

Emily Brott:
I'm here.

Slide: *Living River* Series and Conserve 2 Enhance

Emily Ashton:
Okay, great. And we can see your screen, as well. So if you want to go ahead and take it away, it's all yours.

Emily Brott:
Great. Thank you so much, Emily. And thanks for inviting me, and thanks to everyone for your participation. I really enjoyed Neal's presentation, and I think our presentations will complement each other nicely because most of what I'm focusing on is work in the main channel of the river systems down in southern Arizona, as well as some of the dry river washes that we have in the Tucson community. And I'd like to define the word wash before I start and forget to do so. But basically, so many tributaries here are dry most of the time that we don't call them streams. We call them washes or arroyos. And so what I mean is essentially a riparian corridor that's leading to the main channel of the Santa Cruz River.

So before I get started, I want to tell you just a little bit about the Sonoran Institute. We're a nonprofit conservation organization. We're based in Tucson, Arizona, and we focus on helping communities tackle the biggest natural resource challenges of our day, mainly land, water, and energy issues. The Sonoran Institute focuses on the western United States and Mexico. We work from Montana down to Mexicali. And our model is a community-based conservation model. So usually we're invited into communities to help them think through these natural resource issues in a way that respects their own value systems. So along that vein, just about everything Sonoran Institute does is collaborative. So the outcomes that I'm going to share with you today are truly shared amongst diverse partners, and the two green infrastructure projects, the Living River Series and the Conserve to Enhance project, they both reflect this approach. And actually, they were both launched with seed funding from the EPA, so just a shout-out to EPA Region 9.

Okay. I'm trying to advance the slide, but – let's see. Okay. Good.

Slide: *Running water is something for a Southwesterner to get excited about*

So I like to start my presentations with this poem, or it's actually prose. It's written by University of Arizona Regents professor Richard Shelton, and he writes, "Running water is something for a south westerner to get excited about. It's scarce, it's cool, it's wet, and it creates an oasis of shade, a green retreat from the sun and the desiccation of the surrounding country." Mr. Shelton says in poetry what scientists endeavor to articulate with numbers.

Slide: Map

So I'll provide some context here with a map of Arizona. We all know that water is life, and this becomes even more important in arid environments. Riparian areas make up only two percent of the landscape in Arizona, and yet over 90 percent of the wildlife use these areas at some point in their lifecycle. This map shows that many of Arizona's formerly perennial streams and especially the low, large desert rivers, have been damaged by dam related flow alteration. And those are the rivers that you can see in green. Population pressures on the landscape and increasing demand for water has resulted in many stretches of river having dried out, and now they only flow when it rains. That's the dotted river systems, the orange dotted. The Santa Cruz River is an example of that kind of river. Were it not for the discharge of treated wastewater or effluent to the river, the formerly perennial segments of the Santa Cruz would remain dry. So on this map, the areas in purple show where portions of river are now dependent on in-flows of that effluent to run.

So now we'll get to more specifics about the Santa Cruz River. And this is where it's located, right down by the US-Mexico border.

Slide: Context: 12,000 years of Rich History

Few people know that the Santa Cruz River has drawn people to its life giving waters for over 12,000 years. And evidence of agriculture goes back 4,000 years, making this the longest continually inhabited area in the United States. And this is an artistic rendering of one of our ancient peoples, known as the Hohokam.

Slide: Threatened & Endangered Species

The Santa Cruz River watershed boasts over ten threatened and endangered species. And these photographs just show a couple of these. On the left, we have the yellow billed cuckoo. At the top, we have the endangered Gila topminnow. And to the right, the ever elusive jaguar. And this cat, we keep finding photographs of it as other nonprofits and the US Fish and Wildlife Service are documenting this particular individual roaming the mountains just outside of Tucson. So it's pretty exciting.

Slide: Demand Far Exceeds Supply

The Colorado River and the Santa Cruz River and their respective watersheds provide drinking water for over one million people living in southeastern Arizona and northern Sonora, Mexico. Unfortunately, demand on the surface waters of the Santa Cruz River exceeded supply in the 1940s. So our community depended on ancient groundwater reserves to sustain itself from 1940 until the 1990s, when the central Arizona project canal was built and started to bring Colorado River water out here. So now, in Tucson, about 90 percent of our drinking water is actually supplied by the Colorado.

Slide: Picture

The Santa Cruz River nowadays mostly flows only when it rains. So this is a photograph of the river near downtown Tucson after a hard rain.

Slide: Result: Dry Rivers

But most often, it looks like this. And there are some exceptions to that, which I'll get to in the presentation, which is essentially the outflows of the treated wastewater. And so I like to say that challenges always bring opportunities, and in this case, our ever growing population brings with it additional inputs of wastewater from homes.

Slide: Map

So here's a more – a close-up map of the Santa Cruz River watershed itself. I'm just going to walk you through it a little bit. If you look down to the right -- I hope you can see my little arrow, but down to the right-hand bottom portion of the map is the headwaters of the Santa Cruz. It starts in a grassy desert grassland. It goes south down into Mexico about 25 miles, where it takes a U-turn and passes up through the cities of Nogales on the border. At that point, it hits the Nogales International Wastewater Treatment Plant and – excuse me – we see large inflows of treated wastewater into the river channel. And this bright blue line indicates where we see perennial flow because of those wastewater inputs. And then the river continues north, up to Tucson, where, once again, we see inputs of wastewater. And then it flows – continues north and eventually meets the Gila River up by Phoenix. So the total river miles is about 200.

Slide: Modern "Headwaters" of Santa Cruz

With so much dry channel, these wastewater treatment plants that I showed you on the map, the outflows are now often considered the modern headwaters of the Santa Cruz. So this left photograph is the inputs from the Nogales Wastewater Treatment Plant near the border, and up in the right-hand corner, this is the outflows near Tucson. You can see that it's completely dry right before you get that inflow of water from the treatment plant, and then it gets incredibly lush. So I'll talk the opportunity now to underscore the incredible community amenity that these wastewater treatment plants provide in the form of the green infrastructure that results from the flowing water. The river based wetland habitat and riparian vegetation are incredibly lush. They provide a respite from the searing heat of the desert, and they provide flood control, help regulate temperatures, particularly in a time of climate change, and they offer recreation opportunities and places for reflection and spiritual renewal. So I know – I chose the house that I'm in right now in Tucson because it's right next to a wash. And you just can't – you can't do better than being along a shady area in the middle of the 110-degree summers here.

Slide: Map

So I'm going to start this presentation by discussing the Living River green infrastructure project near the US-Mexico border, and so we're going to focus on this stretch right here.

Slide: Nogales International Wastewater Treatment Plant

This is an aerial photograph of the treatment plant. We're receiving about nine – pretty much, actually, ten million gallons per day of wastewater from Mexico, and it's being sent north and combined with five million gallons per day of wastewater generated in Arizona and then released into the river channel.

Slide: Picture

The wastewater inputs feed this incredible river ecosystem that you see here. And I just – I could just look at this photograph for a long time. It really just brings my heart rate down. It's so beautiful. And it's equally wonderful to be out there, wandering around. There's a historic trail called the Anza Trail, which links the Tumacacori mission actually up to the mission in San Francisco. So it's a historic area, as well, this river system. So this is a nice photo, but let's look at the next one, which is taken from a similar area in 2005, right after a massive tree die off that came unexpectedly.

Slide: Picture

People really didn't know why, all the sudden, we lost about eight contiguous river miles of trees. And the community, including Sonoran Institute, we were all kind of up in arms. How could this have happened? What happened? And how can we get ahead of this kind of environmental disaster in the future? So it was this event that actually triggered Sonoran Institute working with a host of partners to put in a large grant to the US EPA to the targeted watershed program. And we proposed to try and develop, essentially, a methodology where we could track and report on river health and its changes over time, with the goal of trying to get ahead of any kind of threshold events that might be coming down the pike that we just didn't know about. And so the idea was to collaborate with many different kinds of partners who might be monitoring different kinds of river health and watershed health parameters and then organize and consolidate and summarize those indicators into a series of reports that would actually create a narrative for the community so we could really understand what was happening here.

Slide: *Living River Report Series (1)*

So that idea was funded by the EPA, and it's called the Living River Report Series. And it's essentially a report card for the river. And the timing on this was very, very serendipitous. It turns out that as soon as we received the funding, EPA and the Nogales International Wastewater Treatment Plant invested many millions of dollars to upgrade that treatment plant and improve the wastewater – basically, the treatment process so it would come out with higher quality water. And so the last most report was created as a baseline before the wastewater treatment plant upgrade. The blue report in the middle was developed during the upgrade process. And the red one on the right was the year afterwards. And so we were able to show some really wonderful changes.

Slide: *Living River Report Series (2)*

So these are the indicators that the technical committee – that's what we call the group of community stakeholders that came together to help brainstorm how we could really characterize the health of the river with just a small set of indicators. We focused on about ten. And so we looked at the different categories, water quality, groundwater, aquatic animals, and landscape changes.

Slide: *Living River Report Series – Upper Basin*

So, over the three-year period, I think the most exciting data point beyond the fact that the water quality improved so markedly was that we saw a massive return of fish to the river system. The first monitoring year that we went out there, we actually only documented two

individual fish. And by the third year, we found over a thousand fish. And although the majority the fish the third year were non-native mosquito fish, we did find quite a number of the native longfin dace. And I think probably the most exciting is that the water quality is now so good that if our endangered topminnow, which lives in the upper tributaries of the watershed, if it gets washed down by any monsoon floods, it's basically just a matter of time before that can reestablish itself, because now the water is clean enough to receive it and nurture it. So we're keeping our fingers crossed every year as we go out and monitor the fish populations.

We have some persistent concerns. One thing that I'll get to a little bit more in the next slide is that we're actually seeing a decrease in the extent of water flow, the quantity of water. And like I said, I'll explain that a little later. And then, we also continue to have E. coli problems. It looks like the E. coli is actually running off from wildlife and cattle and leaky septic systems in the upper part of the watershed. And so it's actually not related to wastewater treatment plant inputs. And heavy metals continue to be a concern. There's a lot of industrial activity happening in northern Sonora, Mexico. And these plants don't always have the pretreatment facilities that are needed to really get the heavy metals out of the water before it's delivered to the municipal treatment plant in the United States. The Nogales International Wastewater Treatment Plant, that I showed you the aerial photo of and everything, that is not designed to deal with industrial wastewater. So that's still an issue that Arizona Department of Environmental Quality is working very closely with the Mexican government on, and they're seeing some improvements with that.

Slide: Healthy Hydrologic Function 1980s & 1990s

So you might wonder what was it that really caused that massive tree die off, and how does it relate to other efforts in other parts of the country so that people can kind of get ahead of the issue? And what we found -- and this was actually not just through the work that Sonoran Institute did, but actually quite a bit of research that was undertaken by the University of Arizona -- we found that there's a – there was a perfect storm of events that occurred in the timeframe of the tree die off. And so what this graphic attempts to illustrate is kind of the key points of what happened. So if you look at the top illustration, you'll see a depiction of how a healthy Santa Cruz River system usually works, where you have certain areas where you have the groundwater tables high enough to be discharging to the stream and essentially creating what we call gaining stream conditions, where the water table feeds the river. And other parts of the river, the water table is a little bit lower, and so the stream – the water from the stream feeds the aquifer. And it kind of goes back and forth, and it's able to be healthy.

But in 2002 to 2005, what we saw was that the nitrogen – actually, the nitrogen levels from the wastewater treatment plant were so high that they were combining with the channel conditions to create excessive microorganisms and algae that essentially blocked off the infiltration capacity of that channel bottom. So you saw this really interesting phenomenon where you have a tremendous amount of water in the channel, so, you know, you think that everything is fine, there's plenty of water. But the water isn't infiltrating, and so the aquifer is suffering and suffering and suffering. And at that same time, we didn't have any massive flood events to scour the bottom of the channel and clear some of the algae and microorganism out. And so it just built up and really created quite a seal. And another thing that was observed was that, because there was so much nitrogen, the plants, the trees, for a short period of time, they actually had this incredible burst of growth, because nitrogen, of course, is a fertilizer. And so it was just unexpected that you'd have all the water in the river, and you'd see these really lush trees, and then, all the sudden, they just all die. And so this is kind of the mechanism that the

university researchers are very convinced is what has happened. And we've seen this clogging layer, which has a fun name in German. It's called the schmutzige Decke, or the dirty blanket. And it's actually, I'm finding, very common in effluent-dependent streams. It's actually an issue near Tucson, as well. It just never got so dire as it did down here.

So, since then, we have had some flooding, and, of course, the water quality has improved quite a bit. So the infiltration rate we've seen really increased, and so the water is – is going into the aquifer now. And one of the side effects of that is actually the flow of the water doesn't go quite as far. So that's kind of the trade-off, you know. If you want to have a healthy riparian area that can sustain itself, you might not get as much flow as when you have these unhealthy conditions that eventually crack and collapse. So just keep that in mind.

Slide: Map

All right. Let's just see where we are. We're getting on to, essentially, the next part of the talk, which is it's still – we're still going to talk about this Living River project, but now it's – we're going to focus on the area near Tucson. And the work up near Tucson resulted from Pima County essentially noticing, wow, look at this information that was gathered for the stretch of the Santa Cruz near the border. We're about to invest $60 million in a wastewater treatment plant upgrade, and this is going to cost our rate payers quite a bit of money. We want to be able to convey to them all of the benefits that this upgrade is going to have and really start to brand the river as an amenity instead of a liability. And I'll get into some of that a little bit later. But they were really excited about the idea of doing a similar series of monitoring reports and the stakeholder process to bring together the indicators and all of that because it's got to be different. It's an urban system. It's not a rural system up by Tucson. And so the indicators are not at all just a mirror image of the river health indicators near the border. So Pima County applied once again for a grant from the EPA and were awarded the grant.

Slide: *Living River Report Series – Lower Basin (1)*

And this is the first baseline report of the Living River ecosystem near Tucson. It was released last year, and we were able to really show kind of what the conditions are pre-upgrade. And the second report hasn't been released yet, but I do have some intel on what the data is showing us. So I can share with you what some of the initial results that have yet to be published.

Slide: *Living River Report Series – Lower Basin (2)*

So first off, this is an aerial view of the Santa Cruz River just north of Tucson. And you can see on the left-hand portion of this schematic, we've got a dry river channel. This – these arrows are just showing where the runoff comes. It's not actually wet water that's actually there. The wet water starts right at this arrow. And you can see this beautiful ribbon of green that continues north through our community. And this has been developed and is continuing to be developed as an urban green way, with bike paths and bird watching areas and walking paths. And further up, you see the Rillito River. This is one of those washes I talked to you about earlier. It is one of the major tributaries to the Santa Cruz, and also, Pima County has developed a trail system along this wash, with really quite lovely, robust vegetation, as well. And so just another shout-out to the benefits of green infrastructure for our community.

Slide: Wetland Health Indicators

So the wetland health indicators that the Technical Committee in Tucson came up with are these. I'll let you read them. I won't read them to you. But what I will say is I've got a couple of results. I'm not going to go through all of the results. I'm going to focus on water quality, fish, the macro invertebrates, and odor and water clarity. Oh, sorry. So that drawing, that's the western mosquito fish, so a non-native fish. But that's the fish that we found, and I'll get to that in the results.

Slide: Water Clarity and Odor

All right. So water quality and odor, I'm really focusing on this because it relates directly to the urban use of our green infrastructure system in Tucson. And the water quality before the upgrade was actually so poor that the river emanated a very palpable smell of human waste, which was obviously really gross and was not a good introduction to our community. Our interstate runs right along the river, and so travelers would be met with this odor. Also, the folks that had homes along the river, their property values suffered. And obviously, as a recreator, you don't necessarily want to go out and enjoy the beautiful shade and the outdoor environment when it's that smelly. So I think this was one of the things that we're really excited to see change. And unlike the Living River Series for the river by the border, this is actually something that we're calling a social indicator because the odor itself doesn't impact necessarily the wildlife or the health of the river, but it really does impact its utility for the local community, and it helps change the perspective on how the river is enhancing our community rather than detracting from it. And you can see in these photos also the difference in water clarity.

Slide: Effluent Quality Comparison

So this graphic just shows some water quality parameters and how, pre-wastewater treatment upgrade, we can see they're high -- and that's the red -- and then, post-upgrade, they're much lower. So that's the blue.

Slide: Photo of annual fish monitoring

This is a photograph of the team doing the annual fish monitoring survey. And you can see, down in the right-hand corner, this is a photograph of the western mosquito fish. We were disappointed this second year – so this is the year that it's kind of been during the upgrade, and the baseline is pre-upgrade. So, in comparison with the first year, we still aren't seeing any native fish species. The first year we did find western mosquito fish, but this year, the mosquito fish are generally more widespread in the river. And so they're distributed more broadly. They're not just in, you know, a certain section, but just throughout the river. So we're hoping that next year we're actually see some longfin dace, some of those native species.

Slide: Before: Scuds, Snails, Leeches and Midges

So I love to talk about bugs. And for some reason, I just get really excited about this. These are the – actually, these are the kinds of bugs that you don't want to see in a river system. They are indicative of low water quality. And so we've got scuds snails, leeches and midges. And what we saw before the treatment plant upgrade was just a very high abundance of all of these. And the reason that they're indicative of low water quality is that they can survive in low water quality conditions, whereas other organisms like – getting to the next slide – mayflies

and damselflies are also – actually, they indicate a higher water quality because they just cannot tolerate polluted water.

Slide: After: Mayflies and Damselflies, Diversity

So the more that you find these kind of species that are so-called pollutant sensitive, the better. And the other indicator for higher water quality here is that diversity of different macro invertebrate species. And so this graph shows that, year one, we found only seven families. And year two, we saw 12. So that's a real improvement, as well.

Slide: Picture along river of people biking

This is just a beautiful photograph of what it's like along the river. And this is what it looks like in channels that don't have water, as well. So the river and its washes, they truly provide this incredible public amenity and allow people who want to get out and recreate, as well as -- maybe they don't want to commute by car anymore, and they want to use this as an alternative mode of transportation. So I, for one, can attest to the river being a good place to learn how to ride a bicycle. I mean, I knew how to do it, but I didn't want to ride with cars. So this is a good place to kind of wean yourself of your fear of getting on a bike.

Slide: *Living River Outreach and Education*

And this is another part of the program. It's called the Living River of Words, and it's our attempt to engage youth and get them involved in this effort. So, particularly young kids that might not be as interested in all these water quality indicators and such, but they might be inspired by the river to create some artwork or think about poetry. So we, including work with Pima County and other partners, we're bringing kids to the river to experience the river and then challenging them to express themselves through some form of art with their teachers. And then we have a judging panel that selects the best pieces of artwork, and then the winners are celebrated in a festival, and the winning art pieces are published in a small book, which is a lot of fun.

Slide: Map

So onto the last part of the presentation, this is where we get to more of the rainwater harvesting that is going to parallel somewhat to what Neal was talking about. I think the efforts that we've made in this arena are, at least in terms of the Conserve to Enhance project that I'll talk to you, they're much lower tech than the ones that he was describing.

But I think it's a really fun project. I'm excited to share it with you. It's quite innovative. So this area is really what we call the urban uplands. It's those washes and tributaries to the Santa Cruz that run through the urban fabric and almost -- pretty much none of them have running water. They're all dry unless it's rained. But they generally have the capacity to support really nice riparian vegetation as long as you're able to establish the vegetation with water up-front and you're planting native trees and shrubs.

Slide: *Tucson Conserve 2 Enhance*

So this mechanism is exciting. It's the first in the country to do this. It's called Conserve to Enhance. And the idea is that we thought -- and this is, once again, seed funded by the EPA. The Tucson Conserve to Enhance is a brain child of the University of Arizona. And they

brought Sonoran Institute and one other nonprofit called Watershed Management Group together in 2008 to start brainstorming this idea. And the concept is to engage the public in saving water at home and work to create a funding mechanism that translates their water savings to essentially water use and enhancement of the local wash system. So you save water at home. You continue to pay the same water bill. So what this graphic shows is that, you know, this is what you're using now. This entire cup of water is what you used to use. So there's a difference here that you've conserved. But you're paying the same water bill. So $2, maybe $1, maybe $3 a month, you choose to donate it to a fund that then pays for water improvements in the local wash systems. And since we don't have an active in-stream flow market, which would obviously be ideal if you could buy or lease water rights to keep water in these tributaries, we don't have that. So most of the funding is going towards urban rainwater harvesting infrastructure to help improve and restore the quality of the habitat along these dry washes and improve their ability to infiltrate water when it does rain and be a community amenity.

Slide: *Tucson C2E Launched 2011*

So a little bit more about Tucson Conserve to Enhance. The goals of it are actually four-fold. We want to obviously provide supplemental water to Tucson's wash restoration projects. There's a lot of interest in restoring these urban washes, and so we want to make sure that they get the water that they need to establish those plants. We also want to change minds about how the environment can be a customer of water, if you will. So we want to ensure that people are thinking about how their water use at home is impacting their local community and specifically impacting their local green infrastructure waterways, where they can go and enjoy the shade and the – essentially, the beautiful environment. And the fourth goal is to raise awareness about water conservation and river restoration needs throughout our community.

Slide: *Track your Water Savings & Donate On-line or Via Water Bill*

So what this shows is just a larger version of that website that we – the group that put this together, we have a partnership with the water utility, Tucson Water. And so, if you sign up for Conserve to Enhance, and you want to track your water, and you want to make your donations depending on how much water you saved, then the utility sends your water data to this database. And it's all automated, and it tells you how much water you saved in a given quarter. And it asks you – you can go ahead and donate just with a click of the button to the fund.

There's another opportunity to donate to the fund, and that's for folks who pay the paper water bill. And in this case, this is actually where we're getting most of our donations. It's very easy. You don't track your water savings. You just decide, hey, I want to add a dollar or two down to my water bill. And if you just write it in there, it gets put into the fund. And we're finding that the majority of people just want to contribute and they're not necessarily interested in going through the water tracking feature, which was actually the piece that we were most excited about because we wanted folks to be thinking about behavior change and not just donating money. But we think it's great that we're getting a lot of input from the broader community through donations, as well.

Slide: *Results*

So the results so far, since 2011, we've seen over six million gallons of water saved by tracking the savings on that website. And the dollars that have come in from the local

community through either the website or the water bill have totaled over $55,000. And a community advisory board has made decisions about which community projects are the most bang for the buck in terms of reinvesting that. And so there's an annual request for proposals, and they have granted just about two or three proposals a year. And so we've had seven river restoration projects go through so far.

Slide: Atturbury Wash Photos

This is some photos of the first one. It's from 2012. It's called the Atturbury Wash project. It was implemented by Tucson Audubon Society. And I'll back up a little bit to just say that Conserve to Enhance projects, they all have to be connected to the wash system, the local wash system. So if you look in the lower photograph down here, in the back of this truck, this robust riparian vegetation is the banks of a wash, a major wash, actually, that comes through the city of Tucson. And so Tucson Audubon Society had received I think two or $300,000 from Arizona Water Protection Fund, which is a state fund for riparian restoration along this wash system. And a lot of what they were doing was soil retention and erosion control and water harvesting and native re-vegetation. But what they felt was lacking was some sort of interpretive area, just in the park, outside of the wash, so that people going to picnic and enjoy a soccer game or play baseball could actually learn more about what was happening right along that beautiful, natural area. And so they proposed, essentially, a five – sorry, a half-acre restoration of this abandoned – this used to be a playground that was vandalized, burned down, and then bladed. So it was totally vacant. So Tucson Audubon worked with Tucson Parks and Rec to put in a proposal to develop, essentially, a demonstration site of water harvesting features that include signage and tell more about the story of the larger river restoration project happening right behind, in the big wash there.

Sorry. I don't think it clicked. I'm going to try it again. Okay. So that first one was in 2012.

Slide: Three projects were implemented in 2013

These three projects were implemented in 2013. The one at the top right is at an elementary school called Henry Elementary, and this photo was actually from while they were developing the project. What ended up happening is they wanted to harvest the rainwater off of this massive school building, which was streaming over the side and degrading this down slope and washing sediment away. And it actually feeds into a street and right into a local wash. And that's a wash that people like to walk their dogs and enjoy, and so it was contributing and degrading that wash system. So they proposed several things. One was a large cistern right here. The other was a series of earth works to slow the flow that might come over past the cistern, the overflow. And then they installed some native vegetation replantings along the wash itself and put some dog poop kind of stations along the wash so that they could further improve the water quality entering that wash system. The second project from 2013 was, once again, really focused on rainwater harvesting. This was just in the middle of urban Tucson but, once again, right next to a wash. And then the last one, you can see this beautiful park. Unfortunately, most of this grass, it's non-native, and it requires irrigation. And so they put in curb cuts and revegetated much of that landscape to include rainwater harvesting and native plants. They did keep -- certainly they kept some of the grass, because the community enjoys that greenery. But they reduced the amount of the park that needed to be regularly watered.

Slide: three projects that were approved in 2014

And these are the three projects that were approved for – in 2014. So they're underway right now. You can see they're kind of a blank slate. All of them are adjacent to washes, and all of them will include – all of the projects will include community signage to interpret what these groups are doing on the ground with the dollars raised through Conserve to Enhance.

Slide: *Acknowledgements*

So just a few acknowledgements. This actually isn't even indicative of all of the groups that have worked on these projects, but these are some of the major ones. And just wanted to give a shout-out to these partners because certainly these outcomes wouldn't be possible without their engagement and support.

Slide: Thank You

So thank you again for your attention, and I'm excited to answer any questions you might have

Emily Ashton:
Thanks, Emily. We really appreciate the presentation. We're just going to switch back to our screen right now to show the speaker contacts. And Neal, I've also unmuted you. Are you there?

Neal Shapiro:
Yes, I am.

Slide: Speaker Contacts

Emily Ashton:
Okay, great. We're just going to bring up our speaker contact here and get to our questions. So, Neal, I'm going to start with you. And one of the questions that a lot of people had, it's a fairly straightforward question, but folks were wondering if you could describe what dry weather flows or dry weather runoff is and what composes dry weather runoff.

Neal Shapiro:
Yeah, sorry about that. So in our part of the country, and might be in other areas, when it's not raining, we do get significant water flowing from wasting water. So that would be from irrigation, sprinklers, over spraying or leaking, people draining their pools, washing their cars, washing equipment. Those are the most – gardeners hosing down after – you know, doing a job at a property, hosing down the sidewalk, driveway, streets. We also call it nuisance water. So, I mean, every day you can drive around our city and see lot of water flowing down various streets from people wasting water, using it inefficiently. But most of it is going to come from spray irrigation systems.

Emily Ashton:
Okay, great. Thanks, Neal. Another question folks had, they were asking a lot about the augered pits. And so a few of the questions were, "How long do the augered pits last? Do they get clogged? And what does vector and mosquito control look like for those?"

Neal Shapiro:
So -- okay. Let's see. So there's pretreatment before the main infiltration zone to remove trash, debris, and sediments. So that generally will remove, you know, hopefully all or most of the materials that could plug it up. The actual structure will last, I mean, you know, decades. I mean, there's no reason for it to fail. The only thing that will fail is that it could plug up if you get debris and sediment in there, and then you would have to clean out the materials, you know, fill it up with water and vacuum out materials. Or depending on what you put in the augered pit, our examples were perforated concrete pipe. So it's just a big open space with rock at the bottom. So they would be pretty easy to maintain. But there's no reason for it to fail. Structurally, it's pretty sound. And that would apply to all the other examples I showed of infiltration pits. They're not going to fail. The thing that's going to go wrong, it's going to get plugged up with perhaps sediment if you don't have proper pretreatment and proper annual maintenance. I think – was there a third part of that?

Emily Ashton:
No, that was it. They just were wondering how long they last and about clogging and do you have any, you know, idea about what mosquito control or –

Neal Shapiro:
Oh, I'm sorry. Yeah, so vector control, generally these things are sealed. I mean, it's just water flowing in pipes underground. If there's any – well, I guess the surface runoff and catch basins, again, the water is going to be diverted out and into the underground system, which is closed. And when the catch basin or storm drain dries up, you know, there's not going to be any standing water. So vector, generally for these kinds of things, are not a problem.

Emily Ashton:
Uh-huh. Another question, Neal, was, "Are there any safety concerns with having water infiltrated close to building foundations?"

Neal Shapiro:
Yes, there are concerns, which is why we do require, during plan check process, that the applicant has to have a soils engineer or some geo-tech person, a professional sign off that infiltrating the water is acceptable and will not cause any problems or weakness to the foundation. You can also vary the distance. Some people have a standard of no closer than ten feet, which is what we used to have. But we decided that we don't need to determine that distance because a lot of properties are small, and you couldn't do an infiltration pit ten feet or more away. So we leave it up to the applicant and their soils professionals to decide the distance that they need for the infiltration pit.

Emily Ashton:
Great. Thanks, Neal. So I'm going to jump to you, Emily, and then I'm going to jump back to both of you. There was a question I wanted to get for both of you. So, Emily, I wondered if you could talk a little bit about how you promoted the Living River Series and what communication strategies did you use with the public, maybe, besides the website. And if you have any sort of suggestions or lessons learned for working with all those partners?

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Emily Brott:
Sure. And I'll go ahead and respond to the first part of that. I'm aware of what we did in the portion near the border, but my colleague Claire Zugmeyer has been the lead on the work in Tucson, and I've actually invited her in here to speak to that question for the Tucson portion. But down by the border, which was, of course, our inaugural effort with the Living River Program, most of the outreach that we did after the reports had been created, it was mail based, direct mail, to people that we were aware were very interested in this issue. And we also did many presentations to community groups. We presented to the Santa Cruz County Board of Supervisors. We essentially tried to make ourselves available to anyone and everyone who had an interest in the issue. And in terms of how the creation of the Technical Committee went, it was really an exciting process. Sonoran Institute, of course, has been working in a community collaborative conservation mode since the '90s, and so we had already developed some pretty strong relationships with the various agencies and citizen scientists and nonprofits who were monitoring different kinds of river health. So we were aware of some of those, and so we started essentially a series of meetings that always began by, who are we missing? And in that way, started to build, essentially, the world of folks that were out there working on the issue and brought them together and started to really have a series of facilitated brainstorming sessions about how we could narrow down the indicator list so that it would be a snapshot of watershed health, and it would actually have meaning to the public, and we could, you know, create a narrative around it that wasn't just one element or another but would provide a complete picture. And in Tucson, I know that we actually have not done a direct mail outreach strategy. We've had a more diverse series of pieces. But I'll go ahead and let Claire Zugmeyer -- she's our ecologist for the Santa Cruz River Project. I'll let her respond to that.

Claire Zugmeyer:
Hi, everyone. Yeah, Emily described everything really well. And we did a similar effort on the lower Santa Cruz. But instead of the direct mail piece, because the Tucson community is so much larger, we didn't have a budget to print and mail that many copies. We've focused more on a variety of different kind of outreach presentations, so really targeting – giving presentations, but also targeting public events where we're tabling and providing copies of the report at these events to approach the general public and working to increase communication through social media, which I don't think we really – we're doing for Santa Cruz, but we haven't done much of that yet. And one novel difference from the upper Santa Cruz is that we just recently had the Living River Series form the education base for a student science and art program called – now called Living River of Words. It was originally called Tucson River of Words, and it was renamed. So they're using the report as the base for science field and class-based exercises, and then the students work with artists and produce artwork based on their experiences. And there's a traveling exhibit. So that has been a really exciting new outreach tool because the field trip, in particular to the river, has been the first time that many of these students go to the river and see a flowing river, which is pretty amazing.

Emily Brott:
Yeah, you'd be surprised how many people live in Tucson and do not realize that there's a section of river – actually quite a large section of river – with year-round flow. And I think part of that is because it's a little bit north of the midtown part of the city, and also because, historically, it smelled so bad. So you didn't ever even want to approach it to look at it to see that there was river, because it smelled bad. So we've got a public perception turnaround that

needs to happen here, and that's a lot of what the investment is about, is building a constituency that cares about and wants to protect this river system, now and into the future. And that will come about through use.

Emily Ashton:
Great. Yeah, thanks for the insight into the communications piece of that. So, Neal and Emily, I wanted to ask kind of a final question if you can provide your thoughts on it. A lot of folks are asking about any obstacles for being able to implement rainwater reuse and, if you're meeting resistance to that, any suggestions for our audience within their communities. So, Neal, why don't – if you have any thoughts on implementing rainwater reuse and suggestions for those that may want to get that started in their communities?

Neal Shapiro:
Okay, sure. And actually, we're dealing with that now. So there's the legal and the water quality standard issues. You want to make sure that you have laws or policies that allow legally to use rainwater. We have a law in California, the Rainwater Capture Act, so it is legal to do that. And also, our California plumbing code, the IAPMO plumbing code and – well, the California Unified Plumbing Code does have a chapter in it for rainwater harvesting and also for stormwater harvesting in the chapters there. So it's legal. It has design standards for that. So, generally, what we find is the water quality is the big challenge because our public health departments get involved, and they're very leery about an alternate water supply on site and using that instead of municipal supply. And they want to make sure the public health is protected, which, obviously, we all want that. So they – it's been difficult sometimes to get through public health to allow these alternate water sources to be used, certainly for exterior irrigation. Subsurface, there's no problem there, because there's no exposure and there's minimal treatment. When you get to spray irrigation, there's a little concern. But generally, they will want you to use spray irrigation during the late night, early morning hours, when people aren't around and have some disinfection. The real challenge is indoor use because, again, you're using it for flushing or for maybe laundry, and there's worry about people being exposed to it and inhaling bacteria, heavy metals, is what I've heard. So that's why our Pico Library project was a real breakthrough for us, to get that done. And now we're actually – I'm actually talking with the city of L.A. and some of our local non-governmental agencies. We developed a matrix in 2011, with our public health organization and our county, to have a matrix, what we call it, a matrix for using these various water resources for outdoor use. Now I've decided – you know, we're starting now, actually yesterday, to start that dialogue for the indoor use. So we're going to expand that matrix for using rainwater, stormwater indoors. And so we're very excited about that. So those are generally the two main categories of problems. What's your water quality standard at the end use? Some people, you know, can use Title 22, which is recycled water, because that's a good standard for non-potable. And then the National Science Foundation NSF 350 is also non-potable water quality for gray water and wastewater, but I'm involved in expanding that to rainwater and stormwater. So there are standards out there. We just want to make sure it's uniform and applied uniformly around the country.

Emily Ashton:
Great, Neal. Thank you very much. Emily, do you guys have any thoughts on obstacles for rainwater reuse there?

Emily Brott:
Yeah. So actually, I had two thoughts. We have a very progressive government here that is very pro-reuse of not only rain water, but also gray water. And back in 2008, 2009, the city

council passed an ordinance. One was a commercial rainwater harvesting ordinance, and the other was a residential gray water harvesting ordinance. And the latter actually met with some obstacles, and the former has been quite a success. So the commercial rainwater harvesting ordinance, what it stipulates is that all new commercial construction must meet at least 50 percent of their landscaping water budget, using rain water harvesting. And so what that does is it incentivizes the use of native plants, obviously, but that's actually quite a paradigm shift for many of these businesses, to start thinking about using our native species here which use less water, of course. And the other nice paradigm shift that that brings about is it kind of – it makes people think and start to use and contour the landscape to capture the rainwater. Previously, in Tucson, you saw quite a number of planting on mounds, if you will, you know, where you've got the elevated landscape, and you put your plants there, and the water essentially drains right off of it. And so what's happening is slowly we're having a paradigm shift as people are required to capture some water with rainwater harvesting. In even the areas where they're starting – where they continue to irrigate non-native plants, well, now they're contouring the landscape in an appropriate way so, even in those areas with non-natives, they don't need quite so much imported municipal water. But the gray water harvesting ordinance, I think, is an interesting example, where we did have a – we did have one problem, and that was that, although the ordinance was progressive -- and what it does is it requires all new homes to be plumbed to bring gray water outside. And so you have to create what's called a stub-out, which brings water from your shower and your laundry system and your bathroom sink, it brings all of those different water sources outside. And then the homeowner, all they have to do is attach a tube to bring that to the plants. And what that was trying to address is that most homes in Tucson had been prior built such that the laundry and the bathroom and the shower were all interior to the building. And so the cost of retrofitting a gray water system on these old houses is just often very prohibitively expensive for people. So the point of the gray water ordinance was to try and incentivize actual construction of homes in a different way such that those rooms would be located on exterior walls, and it would make it easier to harvest gray water. But what we ran into there is that actually the ordinance was written perhaps with too many engineers involved, because it was very, very complicated, and it required that all of those water sources be piped to a single pipe and that they all exit the house in one location. And of course, if any of you have studied gray water harvesting, that's not the most efficient, and it's actually one of the most costly ways to collect your gray water. The best way to do it is to actually create various different outflows from the home and essentially have an outflow from your shower and an outflow from your laundry, you know, so that you can pipe the water to different parts of your yards, and you don't have to create this costly, highly engineered, single tube system. So the city council actually updated the ordinance based on feedback from the development community, where the development community said, hey, this is an untenable ordinance for us. It's too expensive. And so, instead of throwing the baby out with the bath water, luckily the city council just amended the ordinance to make it lower tech so that it would be easy to implement.

Emily Ashton:
That's great, Emily. Thank you for sharing that information. So we are actually out of time today, so we are going to wrap up. I'd like to thank Neal and Emily for joining us as well as all of our participants for listening in and helping us kick off the 2015 webcast series. We brought up a slide here on our next webcast, which will be on May 5, on "Getting More Green from your Stormwater Infrastructure," featuring speakers Chris Kloss, from EPA's Green Infrastructure Program, and Dan Christian, who is a senior water resource engineer from Tetra Tech. And

registration for that webcast will open in late April. That ends our webcast for today. I want to thank everyone for joining us.

Emily Brott:
Thank you.

Neal Shapiro:
Thanks. Take care, everyone.