AWSA - TIER II APPLICATION

for

WATER HARVESTING

submitted December 12, 2011
by

Van Clothier

Stream Dynamics, Inc.

Executive Summary
Stream Dynamics, Inc. Water Harvesting Proposal

Right as Rain

Stream Dynamics, Inc. is pleased to keep on the table a fantastic and revolutionary concept that will go a long way towards permanently solving our region's water problems. Water harvesting, done in thousands of locations on a regional scale can provide abundant and cost effective water resources to thousands of the residents of the four county area. This is a very far reaching proposal. It is designed to optimize the water resources created per dollar, and locate these resources adjacent to the many critical points of demand.

Each participating property owner will receive water harvesting infrastructure paid for by AWSA funds. Water harvesting will capture roof runoff in cisterns and earth basins. The greywater from washing machines will go directly to a tree basin for free. The runoff previously bypassing the landscaping in the street gutter and causing a giant puddle at the intersection will soon be redirected to basins to grow huge street trees all along our public rights of way.

These practices are elegant in their simplicity, well tested regionally, entirely legal in New Mexico, and supported by the office of the State Engineer. The only exception is that storing water in cisterns is not yet allowed by law in the Gila/San Francisco basin, but causing the water to soak into the ground on your property is legal, moral, ethical, and a very good idea! It benefits you and your neighbors, and harms nobody.

This is a generous idea that is intended to be implemented by many qualified individuals, firms, and agencies, including but certainly not limited to Stream Dynamics, Inc. In fact, scores of sustainable jobs will be created for local contractors implementing this proposal. Within ten years, we could be well on our way to having a secure and reliable source of clean water for every citizen in this arid region.

This proposal will meet a water supply demand for thousands of homes and businesses in the four county area by building thousands of appropriately scaled local rainwater catchments and greywater landscape irrigation systems. It will create the largest overall benefit for the people of our four county region from our water resources and the funds that have been appropriated to properly utilize them. After construction, the water harvesting features will fill up with water every time it rains, every time the snow melts. No one will have to pay for this extra water, and it will not have to be pumped. As a community, we will have access to reliable sources of clean water in an emergency.

Water for commercial and residential use is the next largest demand for water in this region after agriculture and mining. Currently, the supply is mostly met through groundwater pumped from municipal and private wells, which are in decline. Huge electricity bills will be lowered as we learn to let gravity do the work of delivering free rainwater to where it is needed. Harvesting rainwater and greywater on a large scale will dramatically increase the effective supply of water available while decreasing the demand on our precious groundwater resources.

Maintenance of this low tech infrastructure is cheap and easy. In fact, diverting stormwater runoff into basins instead of sending it down the street will save a huge amount of money for road maintenance departments, and greatly improve traffic safety. No more giant puddles, no more chronic icy patches. Converting nuisance stormwater runoff into localized water resources for thousands of homes, thousands of small public

green spaces, and hundreds of business will save society the cost of routing this water "out of town in the Big Ditch," which is very damaging to road infrastructure. Municipalities will also save money on many items such as the cost of street sweeping, the cost of water pumping, and the cost of sewage treatment.

An interesting array of collateral good arises from implementing this proposal. Our cultural attitudes towards water and other resources will change over time. Our society may eventually start to live in balance with the limited precipitation of the southwest arid landscape. Water tables will then start to rise again through natural percolation. This is true sustainability. Our citizens will each have a reliable source of free and unpolluted water to use. Our rainwater resources will be democratized, thus preventing the rain that falls free from the sky from becoming a commodity that requires money to obtain. This is true water security. We will strengthen our democracy, and set a positive example for communities all over the world. This is thinking locally and acting globally. Both people and the environment benefit from this proposal. Both the ecology and the economy make significant gains here. There are no losers. This is a graceful solution to a challenging problem, and it requires you, dear proposal evaluator, to think outside of the box.

In an era of stalled economic recovery, this 66 million dollars may be our best chance, perhaps our only chance, to retrofit our entire region's water infrastructure for sustainability. I welcome you to share my vision of how we can we can work together to transform water waste and the fear of scarcity into water abundance for everyone.

Van Clothier

1. [570] If the proposal would extend the water supply through conservation, or increase the supply through development of new water,

a. Describe the location and verify the ownership of and legal access to lands related to the proposal. [0 to 30 points]

This proposal will do both! Greywater recycling will extend the water supply through conservation. Water harvesting will increase the supply through development of new water, as stormwater runoff will be transformed from an old nuisance into a new resource. It will be implemented in thousands of locations on both private and public lands within the four county area governed by the AWSA. Due to the widespread nature of this proposal, this long list of land ownership and location cannot be known at this time. Access is not an issue, because implementation of this proposal will be entirely voluntary for homeowners and private landowners.

b. Identify the source of the water to be put to use. [0 to 10 points]

There are three sources of the water in this proposal: rainwater from roofs, stormwater runoff from streets and greywater. All three will be "Harvested" as explained below.

Water Harvesting - a fundamental concept

Imagine if you poured a five gallon bucket of rainwater out in the middle of a dirt parking lot on a hot day. It would spread out 10 feet wide and wet the earth ½ inch deep. By the next day, most of the water would be lost to evaporation. The game changes if you dump the same five gallon bucket of water into a ten gallon hole. Most of the water would then soak deeply into the subsoil where it would be available for tree roots to utilize during the entire dry season. This is the basis of water harvesting: mulched basins.

People need food, and food production requires water. Water harvesting employs a suite of techniques that direct concentrated runoff from hardscape surfaces (such as the roofs of houses, driveways, and streets), towards shallow permeable basins where it will soak into the ground. Water harvesting also includes roof catchment cisterns, and greywater recycling (both are legal in New Mexico, see item 4d). Note that storing this water in a cistern (which is legal in all watersheds in the four county area except the Gila/San Francisco basin) is not required to do water harvesting: a simple water harvesting earth basin stores water in the soil where it can be used to deeply irrigate vegetable gardens, and the roots of trees – fruit trees, shade trees, windbreaks, etc. We propose repeat application of these powerful, yet astonishingly simple concepts. Read on.

Earth basin soaks water deeply into the subsoil within 24 hours, where this tree's roots will be able to access it for many months.

For water harvesting to be an significant component of our region's water supply, it must be implemented in thousands of widespread locations, wherever a concentrated flow of water is adjacent to a point of demand. This has been pointed out by some as a weakness of the proposal. Consider it now as a great strength. The population of the four county area is widely spread out in households that number a score of thousands. We are living on remote ranches, widely scattered homes and rural subdivisions, and a smattering of towns, villages and cities. We are distributed thinly over a vast and mountainous geographical area. It would be difficult and expensive to supply us all from one giant

water project. Fortunately this is not necessary, because each of these homes has a roof. The roof can create for each home an individual supply of water located uphill from the point of demand. This is marvelously convenient, wouldn't you say?

Harvesting Stormwater Runoff from Streets

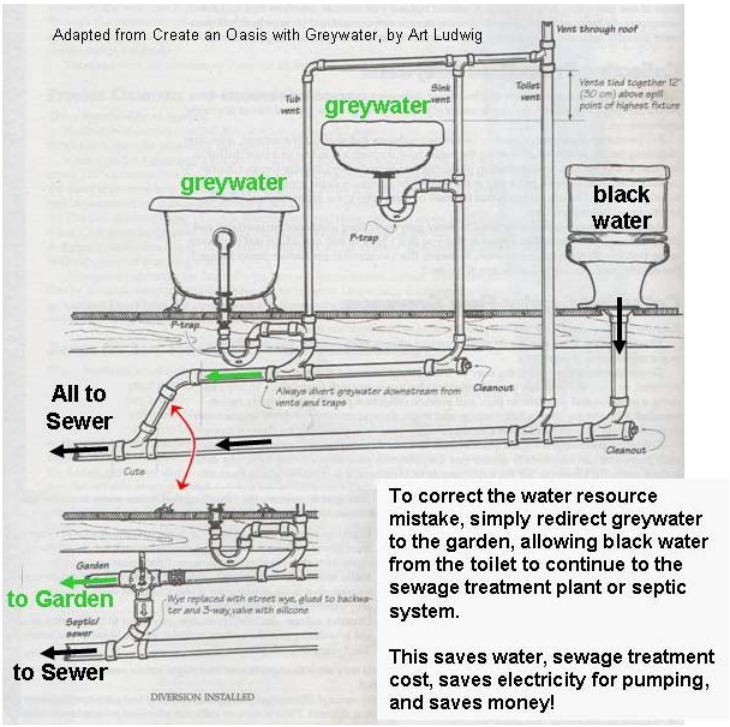
Each dwelling is adjacent to a road or driveway, which is another potential source of water after a precipitation event, one which is advantageously located near landscaping areas that need water. Bingo! Here is a perfect solution for turning nuisance stormwater runoff into a beneficial resource for the people, wherever they live in the four county area.

A bore hole in the curb directs snowmelt runoff into water harvesting basins to deeply irrigate the roots of apple trees and grape vines. This helps keep the streets ice free and safe for cars, bikes, and pedestrians.

These features can and should be built along all the roads in all of the towns to grow trees and create green corridors along the rights of way for everyone to enjoy. They should also be built in parking lots so people can park in the shade on a hot summer day. They should be built at gas stations so polluted water from the pump will not go directly into the creek during rainstorms.

Greywater - A simple way to conserve water and energy.

Our homes are already served by pressurized potable water flowing in a pipe inside the house. The wastewater from sinks, tubs, showers, and washing machines normally gets mixed with the wastewater from toilets before going to the sewer or septic system. An inexpensive modification to this unfortunate plumbing convention is easily made by separating the other drains from the toilet, and directing the relatively clean water to the landscaping. This is called greywater recycling, and creates a reliable supply of irrigation water that can flow directly to the home's landscaping demands.



Approximately 78 percent of the average household's wastewater can be directed for free to irrigate the landscaping instead of having to run the garden hose for this. This is a huge savings! Greywater use vastly decreases our need for water pumping and sewage treatment, saving a bunch of electricity at the same time. This is entirely legal, and so simple, so cost effective. What could be better?

c. Describe and quantify whether and how the proposal would extend the water supply through conservation, or increase the supply through development of new water in the Southwest Planning Region. [4 points for each 10 AF up to 500 points]

This proposal will extend the water supply through conservation, and increase the supply through development of new water in the Southwest Planning Region. There are three sources of domestic water harvesting: Roof Rainwater Harvesting, Greywater Recycling, and Street and Driveway Water Harvesting. This proposal also addresses two sources of municipal water harvesting: Parks, and Problem Spots on Rights of Way. Each will be individually quantified below.

Household Roof Rainwater Harvesting Supply

Below are a few basic calculations to demonstrate that water harvesting represents a significant supply, one located at the point of demand, such as residents' houses. These calculations are written out longhand so that everyone can follow along. Some of the inputs are approximations, yet this serves to illustrate that we are talking about significant water resources.

The four county area has a population close to 63,228 (2010 census). Divide this by approximately 3.5 people per house, multiply by 1700 square feet of roof area per house, multiply by 1.2 feet of rain annually, and finally divide by 43,560 cubic feet per acre foot to arrive at over 800 acre feet of water that falls on the roofs of our homes in the four county area. A calculation of the roof area of all commercial and municipal buildings would significantly add to this.

Let's calculate how much rainwater goes down the downspout of the average house in the four county area. Suppose the average house has approximately 1700 square feet of roof; this times 1.2 feet of rain annually, times 90% runoff coefficient, times 7.48 gallons per cubic foot equals over **13,700 gallons of water per house per year**. For many homes, this water goes past the landscaping (which must therefore be watered with the hose), down the driveway, down the street, and then into the nearest arroyo, contributing to traffic safety hazards and erosion, and flooding problems for downstream landowners.

Water harvesting turns this nuisance runoff directly into a water supply - potentially for the majority of homes in the four county area! This water could grow a vegetable garden or fruit trees instead of creating a public liability for the municipal and county streets departments. The annual water needs of a mulched vegetable garden planted in a sunken bed (ideal for water harvesting roof runoff) is 64 gallons per square foot of vegetable garden per year (This figure is for Tucson, Arizona). This equates to over 200 square feet of vegetable garden for the average home that will be watered for free, without depleting our precious groundwater resources, and without using electricity to pump it. Alternatively, the rainwater could be used to grow shade trees in strategic locations around the house to provide shade in the summer, which would reduce summer temperatures around the building, reducing the need to run the evaporative cooler, thus reducing the demand on our municipal and local water systems, and also reducing the need for electricity, which uses even more water in its generation.

Commercial and municipal establishments could use the water from their roofs and parking areas to irrigate shade trees and windbreaks, while eliminating their contribution to nuisance storm water runoff.

Household Greywater Harvesting Supply

The available supply of greywater is located very close to the point of demand for many houses. Typical household water use, in gallons per week (gpw), for two adults and two kids, is calculated in the table below. (*Create an Oasis with Greywater*, by Art Ludwig):

Washer	5 loads/week x 32 gal/load	160 gpw
Shower	1 shower/day/person x 8 min x 2 gpm x 4 people x 7 days	448 gpw
Bathroom Sink	2 gal/day/person x 4 people x 7 days	56 gpw
Tub	2 baths/wk x 30 gal	60 gpw
	Greywater Total	724 gpw
	Times 52 weeks/year	x 52
	Total gallons per year	**37,648**

According to New Mexico law, kitchen sink water and toilet water are considered blackwater which must go to the sewage treatment plant

Toilet	3 flushes/day/person x 1.6 gal/flush x 4 people x 7 days	126 gpw
Kitchen Sink	3 gal/day/person x 4 people x 7 days	84 gpw
	Blackwater Total	210 gpw
	Times 52 weeks/year	x 52
	Total gallons per year	**10,920**

In this example, 78% of indoor use water is recycled for the landscaping, and previous outdoor water use is drastically cut. As soon as we start to do this simple retrofit in significant numbers, we will be extending the water supply for the whole community.

This is over **37,600 gallons per house per year** that does not have to be treated by the sewage treatment plant, resulting in a cost savings for municipalities, mostly labor and electricity. Since the greywater recycled does double duty by irrigating the landscaping and garden, this also represents 37,600 gallons of water saved at the well. This will save electricity and protect the groundwater resource from depletion. And since water is used for electrical energy generation, by saving electricity, we are saving even more water!

Household Street Water Harvesting Supply

Looking at a typical Silver City neighborhood on Google Earth, I estimated the combined area of street, curb, gutter and sidewalk at approximately 4,000 ft^2 per house. This, times 1.2 feet of rain annually, times 80% runoff coefficient, times 7.48 gallons per cubic foot equals **over 28,700 gallons per house per year.**

Adding up a House's Water Resources

By combining rainwater harvesting with greywater recycling, a home can expect to receive a significant new water resource:

Roof Rainwater Harvesting	13,700 gal/year
Greywater Recycling	37,600 gal/year
Street Water Harvesting	+ 28,700 gal/year
TOTAL PER HOUSE	80,000 gal/year

Wouldn't you like your house to receive this free resource? Why don't you calculate how much money you could save on your water bill?

Municipal Water Harvesting Supply

Parks

All large and small parks in the four county area will be assessed for water harvesting diversions. The purpose is to remove nuisance stormwater from the adjacent streets and use it to irrigate the tree basins at the perimeter of the parks in these green spaces for free during each runoff event.

Problem Spots on Rights of Way

In the photo below, concentrated stormwater from poorly drained dirt lanes in a one acre sub-watershed is transporting a lot of sediment onto the paved street system. This problem could be corrected permanently with about two hours backhoe time, creating a water resource for the trees and eliminating this chronic safety problem. All the problem spots in all of the towns will be analyzed for water harvesting treatments.

A stitch in time would save nine at the top of Kelly Street in Silver City. The multiple benefits of water harvesting include flood protection, free irrigation, improved traffic safety, higher water quality, and lowered street maintenance costs.

Suppose there are 500 places that are either parks, or causing safety or environmental hazards, and each one drains an average of one acre:

500 places x 1 acre x 1.2 ft of rain x .60 runoff coefficient = 360 acre-feet

Water Supply to be Created by this Project

The scope of work will be to build 3625 roof rainwater harvesting projects, 3625 greywater recycling projects, and 3625 street water harvesting projects. Two or three domestic water harvesting methods could be employed at the same house. In addition, we propose to correct 500 street problem spots.

80,000 gal per house per year x acre-foot/325,852 gal x 3625 houses	890 acre-feet
Plus 500 problem spots x 1 acre x 1.2 ft of rain x .60 runoff coefficient	+ 360 acre-feet
TOTAL WATER SUPPLY CREATED	**1250 acre-feet**

d. Demonstrate how the proposal would meet AWSA and CUFA requirements. [up to 30 points] (see www.AWSAplanning.com for AWSA and CUFA documents)

For the Mimbres basin, CUFA doesn't apply. In the Gila/San Francisco basin no cisterns would be used for rainwater harvesting, and the additional runoff created by the roof would be directed into a porous earth basin near the house. Some of this water would be available for trees and landscaping, and the rest would be available to percolate towards the aquifer. The effect of building a house with a roof, and then directing the concentrated roof runoff into a rainwater harvesting basin increases the amount of available water over the pre-development watershed.

2. [40] Describe the proposal and its technical viability.

This proposal employs very basic technology. Water flows downhill. Curb cuts, downspouts, earth berms and subtle landscaping will direct rainwater and stormwater runoff into earth basins, where it will soak deeply into the subsoil.

The reader may question the technical viability of constructing and maintaining thousands of water harvesting basins throughout the four county area, but we already have much more complex systems in place, e.g., telephone, electricity, internet, water, gas, and sewer lines. These systems require a much more sophisticated level of organization than the methods described in this proposal.

Water harvesting basin diverts runoff from a dirt road in Silver City. Water soaks into the ground instead of sending sediment onto the paved street below. This saves the town money for diesel to run the street sweeper after a storm.

a. Include any (or reference publically-available) technical and engineering studies completed and demonstrate how these studies support the proposal. [up to 20 points]

Urban Stormwater Retrofit Practices, by the Center for Watershed Protection, 2007. This is a 240 page manual that provides an integrated framework to restore small urban watersheds, with a detailed description of many urban stormwater retrofit practices, and an assessment method to determine which practices are appropriate for different situations. In addition, there is a 100 page appendix explaining methods of doing calculations to assess stormwater volume and water quality impairment, sizing basins for pollutant load reduction and channel protection. This report confirms that a series of micro-catchments are the most cost effective method of protecting water quality and stream channel stability in the urban watershed, and recommends that a high priority focus should be immediately adjacent to pollution hot spots.

b. Include any (or reference publicly-available) hydrologic, ecologic, or geotechnical studies completed and demonstrate how information included in these studies specifically supports or detracts from the proposal. [up to 20 points]

City of Tucson and Pima County Water Study and recommendations - This report focuses on lot-scale water harvesting practices for most efficient use of rainwater and to benefit infrastructure:http://www.tucsonpimawaterstudy.com/ The Stream Dynamics proposal is based on lot-scale water harvesting practices. Our mountainous area receives 50% more precipitation than Tucson, and we have lower temperatures. This means we have more stormwater runoff, and will receive even more benefits from the water as outlined in this proposal.

A Prototype Analysis for Determining the Stormwater Retention and Water Supply Benefits of Cisterns, by Evan Canfield and Lisa Shipek:
http://www.watershedmg.org/sites/default/files/publications/canfielde_paper.pdf
This paper evaluates how effective cisterns are as flood control measures as well as water supply. It considers a problematic situation that is becoming common in the southwest – residential areas on small lots where over half the lot is impermeable. The cisterns were shown to be capable of reducing runoff in comparison to a site without a cistern, and showed that cisterns will provide most of the water for the trees in an average year. Post-development runoff should be maintained at pre-development levels. Cisterns can reduce runoff to pre-development values for the 2 to 10 year events for soils with high runoff potential. This supports the Stream Dynamics proposal in that stormwater mitigation can be coupled with landscaping irrigation to provide multiple benefits.

3. [40] Quantify estimated costs.

Doing all the work to retrofit our region's infrastructure for water efficiency and self-reliance is a huge task. It would take much time, and the dedicated work of many people. We have many unemployed people in need of meaningful work to not only feed our families, but also make our world a better place. The AWSA funding can be used to transform the four county area into an exemplary model of how people in the drylands can live in balance with our water supply.

Water harvesting from a city street irrigates the Silva Creek Botanical Gardens, Silver City

a. Quantify the proposal's estimated costs, including planning, design, and/or construction, and administration or oversight. [up to 10 points]

Planning and Design

We anticipate that two certified water harvesting designers would be required to work for ten years to plan all of the 4125 projects. At a salary of $100,000 per year per person for ten years, planning and design would cost $2 million.

Construction of domestic water harvesting features

Water harvesting earth basins that capture roof runoff can be built for free with a hand shovel by a knowledgeable homeowner. The cost to hire a water harvesting contractor to design and build roof runoff basins for an average home is in the $500 - $1000 range, If the project involves a cistern, this costs $0.75 - 1.50 per gallon of storage, and the accompanying installation package, (including rain gutters, basic filtration, and downspouts) is in the vicinity of $1000 for a simple roof. There will be fewer cistern installations because of the higher cost. They will be used in situations where earth basins are inappropriate to solve the design problem.

The cost of a complete residential greywater installation varies, depending on existing plumbing arrangement. A simple installation, including all plumbing cost $810. (source: *Create an Oasis with Greywater* by Art Ludwig, 2009).

At a neighborhood scale implementation, water harvesting curb cuts, including a small mulched, stone-lined basin planted with a tree, cost approximately $300. For $600, a high volume curb cut with a large 2500 gallon basin can be installed.

Installing a combination of roof rainwater harvesting (either earth basin systems or cisterns where appropriate), street stormwater harvesting, and greywater recycling can create a water resource of 80,000 gallons per year for a four person household. In the chart below, we use average values for the construction of these features:

Roof Rainwater Harvesting	$ 1400
Greywater Installation	1000
Street Stormwater curb cut and basin	600
TOTAL COST	$3000

For an estimated project cost of $3000, an interested homeowner could receive the free installation of infrastructure that would provide a free lifetime supply of landscape irrigation water!

Note that water harvesting from roofs and greywater is not in conflict with downstream users. The additional runoff created by urban hardscape is a liability which water harvesting responsibly handles. No payments will be demanded from downstream water users if we implement this plan that benefits everyone.

Construction of Municipal water harvesting features

You will recall the discussion about treating 500 sites at parks and problem runoff locations. At the low end of the range, the construction of water harvesting features at these is similarly priced to domestic water harvesting curb cuts. Many areas could probably be treated for $600. Formal parks and high traffic areas may need concrete work, large size plant materials, more formal landscaping and starter irrigation. These could range as high as $10,000. Let us use an average cost of $4000 per site for construction cost here.

Adding It All Up

Domestic Water Harvesting $3000 per house x 3625 houses	$10,875,000
Municipal Water Harvesting $4000 per site x 500 sites	$ 2,000,000
TOTAL CONSTRUCTION COST	$12,875,000

This would all be spent on time and materials for construction. Water harvesting installation contractors, and plumbers, in the case of greywater recycling projects would be hired and trained to complete this work. There should also be a provision for a reimbursement or payment for homeowners who apply to do the work themselves, as long as it meets specifications.

Administration and Oversight

The energy audits being conducted in the Silver City area by the Silver City / Grant County Joint Office of Sustainability serve as an ideal example of how this project could be organized. The Office of Sustainability has secured funding for minor energy efficiency improvements for local area homes of interested individuals. Trained personnel visit the home and perform an energy audit. They also install insulation and weather stripping, sink aerators, low flow shower heads, etc., at no charge to the resident. This simple model could be used to implement widespread water harvesting retrofits for people's homes and businesses. Alternatively, the office could coordinate with licensed water harvesting contractors and greywater-trained plumbing contractors to accomplish this work. The office would provide technical assistance to, and facilitate cooperation with, road maintenance departments, especially on multi-party projects, such as water harvesting curb cuts on municipal infrastructure.

Administration and Oversight would be $50,000 per year for a project administrator and $35,000 per year for an administrative assistant. These employees could use municipal office space as a cost share. (worth $12,000 per year.) Office supplies, phone bill, etc. is estimated at $5,000 per year for this office. Total for this line item would be $90,000 per year x 10 years = $900,000.

b. If applicable, quantify the proposed project's on-going administrative, operational, and maintenance costs. [up to 10 points]

There really aren't any on-going administrative costs once the projects are done. Water harvesting projects do not have any operational costs because these are low tech gravity fed systems.

Maintenance Costs

Maintenance costs would be passed on to the landowners where the infrastructure was installed. This arrangement would be formalized in a contract saying "in return for accepting the free installation of this water harvesting infrastructure I agree to maintain it for a period of 20 years." Monitoring and maintenance of these systems is straightforward, and will be explained to the project recipient upon completion of the project. Maintenance literature, including a hotline to the administrative office for questions, will be part of the package.

Municipalities and streets departments will receive a lot of free water harvesting infrastructure along road rights of way, pocket parks, etc. It will be the responsibility of the municipality to maintain this infrastructure. Bear in mind that maintaining water harvesting earth basins and curb cuts is far cheaper than the extra cost of maintaining roads that become rivers or ice floes. Therefore no maintenance costs will be borne by the project budget.

Rainstorm in Bayard, NM August 1, 2010
Stormwater on road is very dangerous.

c. Describe environmental compliance activities, and quantify the costs for environmental mitigation and restoration related to the proposal. [up to 10 points]

These projects would not require New Mexico State 401 permits or U.S. Army Corps of Engineers 404 permits. There are no environmental compliance activities required by the regulating agencies for these tiny (less than 1/1000th of an acre) water harvesting basins that are located outside of the 100 year floodplain. Therefore, the cost for environmental mitigation and restoration related to this proposal is zero. Instead of causing damage to the fabric of life which would cost money to attempt to mitigate, implementation of this proposal will serve to mitigate and restore ongoing damage to the environment caused by the infrastructure now in place, by transforming the operational hydrology of our impervious surfaces (streets, roofs, etc.) from water disposal to water harvesting.

d. Quantify the AWSA funding sought for the proposal and for the pendency of the proposed activity's or project's duration. [up to 10 points]

The AWSA funding sought during the original Tier I proposal was $66,000,000. This was based on a cost of approximately $1000 per person for water harvesting infrastructure, and an estimated 66,000 population by the time this is implemented.

Implementation of this proposal is very flexible. Construction of any number of these small projects is feasible: the more water harvesting sites, the more benefits for the people and environment of the four county area. The ultimate goal is for each person in the four county area to have access to the benefits created by a free source of harvested rainwater, if not at their home, then at their workplace, along their street, in the local park, or in a store parking lot so they can park in the shade on a hot day.

This proposal could easily have used all the available AWSA funding, and created water resources for every person in the four county area. Yet, since there are a surprising number of worthy proposals that passed the Tier I evaluation process, it makes sense to scale back the scope of work as much as possible without decreasing the point scoring in this evaluation process. Providing domestic water harvesting infrastructure at a saturation level of 20% is quite sufficient to demonstrate to the entire community of our region the significance of our rainwater and greywater resources. Therefore the Tier II proposal in your hands is asking the AWSA committee for:

Planning and Design	$ 2,000,000
Construction Costs	12,875,000
Administration	900,000
TOTAL	$ 15,775,000

It will take ten years to complete this scenario, which will cost $ 1,577,500 per year. For this price, we will be creating a significant water resource with the AWSA money, and will create jobs for 10 people for ten years, including all the installation contractors. We will transform people's attitudes about water and create an abundance of water resources.

4. [40] If proposal impacts, beneficially or adversely, the environment of the Southwest Planning Region, the Gila River, its tributaries or associated riparian corridors, use the best available science to:

a. Describe and quantify how the proposal might impact the project site and environment, particularly state and federally-listed species. [up to 10 points]

The Stream Dynamics Proposal benefits the environment of the Southwest Planning Region, the Gila River, its tributaries and associated riparian corridors because it will create a water resource that will grow in proportion to the population. Water harvesting and the second use created by greywater recycling will increase the water resources available for human beings without the need to take more from the environment. In fact, this practice will increase available water resources for both people and the environment. In the southwest desert ecosystem, greater water resources benefit all species, both endangered and common. Excessive groundwater pumping has dried up many once perennial streams in the desert southwest. By reversing this process, we will see flows return to springs and seeps. The length of surface flow reaches in perennially interrupted streams will increase, with a corresponding increase in riparian habitat.

Our civic leaders will breathe a sigh of relief when they realize that we can have it all. We can have a reliable source of water for every citizen. We can avoid a legal confrontation on the banks of the Gila River. We won't have to cause negative impacts on the river or any of the project sites. Each of the thousands of tiny (1/1000th of an acre) water harvesting sites will create a moist microclimate in our arid region. This will have tremendous localized benefits for all creatures.

b. Describe and quantify the proposal's efforts to mitigate possible adverse impacts on the environment, particularly riparian areas and state and federally-listed species in the Gila Basin and at the specific location of the proposal. [up to 10 points]

Again, there are no adverse impacts on the environment from this proposal. In fact, the entire proposal is a positive impact on both the ecology (nature's economy) and the human economy. Implementing this proposal will mitigate historic and present adverse impacts on the environment by creating more water resources for people by achieving water sustainability in the drylands.

A student at WNMU who came out in the rain to witness the project his class designed and built working perfectly during its first rainstorm, July 11th, 2011

c. Describe and quantify how the proposal may benefit the environment, particularly riparian areas and state and federally-listed species in the Gila Basin and at the specific location of the proposal. [up to 10 points]

The implementation of this proposal will obviate the need to construct a dam or major diversion on the Gila River. The natural hydrograph of this free flowing river will be maintained, and these species will continue to have a safe refuge on the Gila River.

d. List any environmental statutes, rules, or regulations that may apply to the proposal, and demonstrate how the proposal implementation will comply with such laws, rules or regulations. [up to 10 points]

Greywater recycling has been fully legal in New Mexico since 2003. Details of this can be found at http://www.oasisdesign.net/greywater/law/#newmexico. This is a well considered law, which requires the installation of a convenient Y-valve that can direct laundry water to the sewer when required, such as when washing greasy coveralls from an auto repair, or diapers.

Water harvesting is legal in New Mexico. The office of the State Engineer has issued a statement encouraging "the harvesting, collection and use of rainwater from residential and commercial roof surfaces for on-site landscape irrigation and other domestic uses." The office also has how-to water harvesting information on its website: http://www.ose.state.nm.us/wucp_waterwise_building.html

It is against the law to create nuisance runoff that causes property damage to your downstream neighbor. The beast way to avoid this problem is to harvest the water from the impervious surfaces such as your roof and driveways, causing it to soak into the ground harmlessly.

Caveat pertaining to the Gila/San Francisco Basin

Due to a quirky law, the people living in the portions of Grant and Catron Counties within the Gila/San Francisco basin cannot legally store roof runoff in cisterns, and will not, therefore, be able to have individual supplies of drinking water from the roofs of their own houses, (although they can still legally build permeable water harvesting basins, and install greywater recycling systems).

This actually reduces the amount of water going into the aquifer for downstream users. The reason is that a very small amount of precipitation makes it to the groundwater table. Let me explain: These people still need to use the same amount of water to live. It will have to continue to come from depleting the aquifer by pumping groundwater up to the surface with domestic and municipal water wells. Their wastewater is returned to a place near the surface of the earth where very little of it will go back into the aquifer. People using roof runoff catchments for their domestic water supply coupled with greywater recycling systems are temporarily diverting the additional water resource created by their own roof. This water is used within the household, and then returned to the soil where the rain would have gone anyway. This arrangement does not involve disturbing natural rivers or pumping down the groundwater. So using cisterns to store roof runoff for domestic use saves water in the aquifer for other people and the environment.

Because now we all know that preventing domestic roof runoff from being stored in cisterns makes the problem worse, we can start to work together to change this law. Then people in the Gila/San Francisco basin will one day be able to legally drink their rainwater just like everybody else in New Mexico.

New Legislation Could Foster More Water Harvesting

As an example of how a large municipality in our region is dealing with its water resource issues, the City of Tucson has a recently adopted water harvesting ordinance that requires greywater stub outs on all new construction, as well as water harvesting basins to infiltrate any new runoff caused by new construction. The text of the ordinance is in the appendix of the Stream Dynamics TIER I application. It is available at: www.tucsonaz.gov/water/docs/rainwaterord.pdf

5. [70] Describe any economic or cost analysis information and data for the proposal:

a. Quantify estimated economic benefits including environmental, recreation, value of water itself, value of the water to the regional economy, increased economic growth, protection against loss of jobs, agriculture, ranching, local economic sustainability or growth, or other. [up to 10 points]

Environmental Benefits

An intact river is still performing ecosystem services to society free of charge, instead of us having to pay millions of dollars for flood control and environmental mitigation. This is very difficult to quantify.

Recreational Benefits

In an era of increasing human population, the few remaining beautiful natural areas are important attractions for visitors. Thousands of people visit the Gila National Forest and surrounding areas every year to enjoy the scenery. They engage in hiking, swimming, boating, camping, picnicking and bird watching. Fewer people would bother to travel to

this out of the way place if the environment was degraded.

The Value of Water Itself

Deming recently paid $2,200 per acre foot to acquire additional water rights, and this figure is expected to rise rapidly (unless water harvesting is adopted region wide). I will use the more conservative figure of $2,200 per acre foot instead of the higher estimates of $3,000 or $3,500 predicted by some agencies.

1250 acre feet x $2,200 per acre foot = $2,750,000

Note that this is merely the cost to purchase the water, and does not include delivery. Water harvesting creates a supply of water immediately adjacent to the point of demand, so no additional costs are required to use it.

The Value of Water to the Regional Economy Increased Economic Growth and Protection Against Loss of Jobs

Tourists visiting the Gila stay at motels, buy gas, eat at local restaurants, etc. A degraded river ecosystem would decrease the amount of tourist dollars generated by the local economy.

Benefits to Agriculture and Ranching

This proposal indirectly benefits these traditionally high water users. It reduces the competition by towns and developments for limited water resources, because they will be able to create their own water resources instead.

Local Economic Sustainability and Growth

Water harvesting and Greywater recycling are unique in that the water resource is created at the point of demand, so no pumping is required. This is a huge economic benefit that few other proposals can offer. These are gravity powered systems. That's sustainable.

As new houses are constructed, each one will come with its own supply of water from the roof and the street, located at the point of demand. Greywater recycling will greatly extend the supply of City or well water pumped onto the property. Growth will not be limited by water supply, as the more growth, the greater the supply of water will be.

b. Quantify estimated costs including planning, design, and/or construction, environmental compliance, operation, maintenance, repair, and administrative costs or other. [10]

Please refer to the answers for 3a and 3b.

c. Identify the source of local contributions and demonstrate the commitment and ability to pay any local cost-share for project proposal, including any applicable exchange costs [1 point for every % of project cost to be borne by local sponsor up to 50 points]

This proposal will change people's attitudes about stormwater region wide, as road maintenance departments learn a new way to deal with stormwater. By diverting water off the street/curb/gutter system into adjacent landscaping areas at frequent intervals, the streets will be drier, safer, and will require less maintenance. No more deep puddles, flash flooding gutters, or ice accumulation on shaded streets. Water will now flow to water harvesting basins instead of staying on the streets. This will save a lot of money for road maintenance, and result in safer streets. Municipal road maintenance departments

within all towns in the four county area will quickly become major proponents of this concept, and will change their practices. Subsequently, no additional funding will be required from outside sources (such as AWSA) because it will make economic sense to permanently adopt these practices. I submit to the AWSA evaluation committee that after a series of demonstration projects that resolve 5% of the critical stormwater issues region-wide, the remaining 95% of the street runoff issues will then be solved by local road departments.

To further enhance the cost-share budget, there are many current sources of funding for stormwater mitigation projects. For example, the US EPA is encouraging water harvesting nationwide as the ideal solution to stormwater pollution of urban streams. The EPA, water trust boards, and other agencies offer grants for municipalities.

There are no applicable exchange costs because this proposal is transforming a commodity that was previously viewed as a liability (stormwater) as a new source of water.

6. [120] Describe how the proposal addresses the needs of a particular group or groups or interests on the issues of

a. Historic uses, traditions, cultures, and customs. [up to 10 points]

The Desert Southwest has a long tradition of water harvesting. Before the advent of modern irrigation technology, peoples of the American Southwest relied on water harvesting techniques for drinking water and to grow their food. Check dams were built for many hundreds of years across small ephemeral drainages to catch soil and water and to provide irrigation for crops. Terraces and linear borders were built along contour lines to catch soil, nutrients and water. Sunken beds were built to catch and infiltrate water and grow valuable crops. Plantings were often situated advantageously at the base of cliffs and rock outcrops where water would run off and become concentrated. Brush weirs were used to spread water across floodplains.
(from August 1994 article in *Permaculture Drylands Journal* by Joel Glansburg)

Many old homesteads in New Mexico had kitchen gardens that were irrigated in part by greywater. Rain barrels and cisterns were an important water source back in the day. The traditional self-sustaining hacienda was, out of necessity, a study in wise use of resources. It's exciting to see these important traditions being revived with the recent popularity in water harvesting. Growing your own garden and fruit trees with harvested rainwater in an urban or rural setting can again become the norm.

Historically, the Gila River flowed from the mountains in New Mexico, all the way across Arizona and into the Colorado River, which flowed to the Gulf of Mexico. Aldo Leopold described this area as a fantastic and highly productive delta zone. Water supply and demand were balanced naturally. Water manipulation through dams and large-scale irrigation diversion has created a false impression of increased supply, resulting in an unsustainable demand over the long term, e.g., water hungry cotton grown in the desert with diverted river water or pumped groundwater. The balance has been tipped to the degree that the river now goes dry more frequently and rarely, if ever, completes its flow to the Gulf. This is abomination has incalculable costs for the ecology of our desert river from Gila to the Gulf of California.

A thriving agricultural economy has now existed for a very short time frame in the historical sense, but the traditions, cultures and customs established during that 200-year timeframe have become sacred to some, to be preserved at all costs. Agriculture for profit

in the Southwest is now struggling to survive, and is decreasingly cost-effective as the cost to run such operations increases and the profit decreases. The demand for water has surpassed the supply, and competitive uses vie for control.

Implementation of this proposal on a significant scale would honor historic uses, traditions, cultures, and customs and move us toward a more natural balance of water supply and demand..

b. Current and future demands for water in the Southwest Planning Region. [up to 20 points]

To meet future demands, we must do something intelligent to extend our limited supply. In the domestic greywater recycling example above, 78% of indoor water use, or 37,000 gallons a year, was recycled as greywater to the garden and landscaping trees, drastically cutting the need for outside irrigation. In the rainwater harvesting example, 13,000 gallons of water from the roof of the average home can be put to beneficial use by the residents (i.e. meet a "water supply demand"). Harvesting street runoff and improving the safety of the street creates a supply of 28,000 gallons per year for landscape irrigation. These three items add up to an effective supply increase of approximately 78,000 gallons per year per average household. Multiply this by an estimated 18,700 households in the four county area and you get 1,450,000,000 gallons, or 4,300 acre feet of water savings per year. This is water that we don't have to pump out of the ground. It can be stored there free of charge, and without evaporating, to meet future demands. (This is not including water harvesting from roads along public rights of way, which can add thousands of gallons more per household to irrigate street trees. In concert, these practices add up to a significant decrease in the strain on existing water infrastructure and resources.

We must also find a way to carefully address the human population issue. Unless this is done, all increases in supply or efficiency will be quickly overcome by additional demand. Let us not continue to abrogate our responsibility to pay attention to these important matters!

c. Flood control.[up to 20 points]

It is normal for a healthy, stable river to flood its banks every couple of years. This is an important natural process that maintains the health of the riparian area. Flooding, as defined as a problem for people, is entirely a human caused phenomenon. Humans build valuable infrastructure within the flood prone area of a watercourse, and are harmed when the watercourse floods. Overgrazing, urbanization, poorly drained roads, poorly managed wildfires and poorly managed timber harvests exacerbate this problem by increasing runoff. We tend to build within the flood prone area, then manage the landscape to increase the risk of flooding. Water harvesting will lower the flood stage and significantly reduce the magnitude of this very expensive and potentially life-threatening problem.

Water harvesting, by transforming nuisance stormwater into a beneficial resource, is a fantastic low risk approach to flood control in urbanized areas. As Dunne and Leopold, stated in *Water and Environmental Planning* "The best solution to the urban runoff problem is to detain this stormwater in small volumes as near to its source as possible, and then to release it slowly to natural stream channels or to the groundwater system."

Water harvesting from impervious roads and rooftops creates a vegetated filter that protects our water quality, and reduces storm water runoff as well as downstream erosion and sedimentation problems.

Water is wasted as unfiltered street runoff goes directly into a stream.

d. Fire protection, prevention, or suppression. [up to 20 points]

Having thousands of cisterns adjacent to homes throughout our rural area will be an important contribution to fire suppression. Unlike a domestic water well, the water in a cistern requires no electricity to access, making it more reliable than any other water supply in an emergency, such as fire or electricity outage (which often happen at the same time). Cisterns are an important water source for rural fire fighting, and should be built with a hose bib compatible with local fire trucks.

Having thousands of green spaces that store water in the soil will irrigate trees and shrubs so they will be green, and hence more fire resistant, during the dry season.

e. Recreation. [up to 20 points]

Within the AWSA planning area there are scores of small pocket parks and larger parks distributed among the communities. Water harvesting will target these areas so that the park trees receive a generous drink during each runoff event. This will make the trees be green and healthy, and grow fast and tall. The parks will be more beautiful for the people to enjoy. Less irrigation will be needed to maintain the landscaping, so the parks departments will be able to continue to maintain the parks in an era of shrinking budgets.

f. Environmental protection and/or enhancement. [up to 20 points]

By using the AWSA funds to create dispersed water sources at thousands of points of demand, we will be simultaneously enhancing and protecting our environment. Thousands of water harvesting basins will irrigate trees for wind breaks, shade, visual screening to enhance property values, wildlife habitat, and food for people.

g. Any others. [up to 10 points]

This proposal is specifically formulated to derive maximum water resource benefit for all residents of the four county area. All groups and interests will benefit simply and fairly without one group dominating this natural resource that falls on the roofs of rich and poor alike. Implementation of this proposal will provide water harvesting infrastructure for many property owners, and for many public spaces. Those individuals and businesses that do not elect to receive water harvesting infrastructure on their property will benefit from their neighbors who do, because the local environment will improve for everybody. The benefits are safer streets, more green spaces, windbreaks, shady places to park, more wildlife and beauty, flood protection, cleaner water in our watercourses, more groundwater infiltration, less public monies required for the maintenance of infrastructure (read: lower taxes), and a Gila River protected from diversion.

This proposal was also designed to be a graceful solution to a challenging problem. Some people think it makes sense to exploit the Gila River for its water resources. Whether or not the reader agrees with this viewpoint, it is important to keep in mind that there is a well organized opposition to a dam or major diversion on the Gila or San Francisco rivers. This is because of two important factors. First is the fact that several of the other proposals are well thought out and address immediate needs for their communities. Second is the commitment of many individuals and groups dedicated to preventing the waters of the Gila from being directly exploited. If the ISC moves forward with a dam or major diversion, these people will vigorously oppose every step of the process in the media, and in the courtroom. It would be unfortunate to see precious time and money lost to litigation. The practical approach may be to quickly move forward with the proposals that will immediately create multiple benefits for many stakeholders.

The $66,000,000 is a one-shot-deal in an era of shrinking budgets. Let's capitalize on this opportunity to work together toward a graceful resolution to our water resource problems.

7. [40] List those supporting the application, including federal, state, and local government entities; Indian nations, tribes or pueblos; irrigation or conservation districts; non-profit organizations; and other entities. Provide letters or resolutions of support for the application. [up to 40 points]

Please find in the appendix letters of support from:
Gila Resources Information Project, providing information for healthy local communities.

Grant County Trails Group, protecting water quality in San Vicente Creek.

New Mexico Wilderness Alliance, advocating for ecosystem health statewide through the restoration of natural processes.

River Source, supporting people living as good stewards of their watersheds by providing watershed science and policy education, planning, monitoring, and ecological restoration.

San Ysidro Permaculture, creating some of the most beautiful and functional water harvesting gardens in New Mexico.

Sky Island Alliance, Supporting southwest desert ecosystems through education and restoration.

Upper Gila Watershed Alliance, dedicated to protecting the ecological integrity of the Gila River and its tributaries within New Mexico.

Watershed Management Group, the regional leader in water harvesting education and advocacy.

8. [30] Describe whether the proposal would benefit one or more than one of the counties in the Southwest New Mexico Planning Region – Catron, Grant, Hidalgo, and/or Luna Counties. [10 points/county up to 40 points]

This proposal will benefit all four counties. Except for a correctable problem discussed below, Catron, Grant, Hidalgo, and Luna County will all benefit in a fair and balanced way from implementation of this proposal. The people in these four counties almost all live in houses or apartments with roofs that can be used to collect rainwater. They have pressurized potable water flowing in pipes in the house, and can therefore separate and recycle greywater. The people living in all four counties are adjacent to a road or driveway, and have landscaping nearby, and so may benefit from water harvesting from these impervious surfaces. They can receive the benefits of water harvesting from roofs, driveways and roads and greywater recycling.

Catron, Grant, Hidalgo, and Luna Counties will all benefit from water harvesting. This is an elegantly simple solution to the problem of water supply which benefits everyone and harms nobody. Every watershed in every county that participates in this sustainable solution will benefit. The people of all four counties will benefit by having cleaner watercourses, higher groundwater tables, safer roads that are cheaper to maintain, beautiful street trees to park under on a hot day, windbreaks for those terrible spring winds, and free irrigation for fruit trees to provide food for people.

This proposal may be unique in that it simultaneously benefits both people and the environment in all four counties. People living in all municipalities and all remote areas in the four county area stand to gain substantially from water harvesting. Residents, businesses, and public lands in Catron, Grant, Hidalgo, and Luna Counties are all eligible to receive the benefits from water harvesting.

9. [50] Describe whether the proposal would support economic growth or benefit one or more than one of the following interests in the Southwest New Mexico Planning Region – agricultural, ranching, municipal, recreational, or other (specify). [10 points/interest up to 50 points]

Implementation of this proposal will create scores of jobs for ten years. These will be truly green jobs, that will accelerate the growth of our green economy. Our region will reduce expenditures on road drainage that keeps stormwater on the streets (causing them to need premature maintenance), and will instead divert this water to thousands of gardens and fruit trees for the people of the four county area to enjoy. We will be able to better balance our municipal budgets, and save money for other types of projects. The Southwest New Mexico Planning Region will become an example for other regions to follow. We will have water harvesting and stormwater mitigation conferences and draw many people to our area to learn how they too can do this.

Agricultural

Farmers can have water harvesting features installed on their properties just like everybody else. More importantly from their perspective, the more people in each watershed that are water harvesting, the less demand there will be on the water table, and the more water will be available for agriculture.

Ranching

Ranchers can have water harvesting features installed on their properties just like everybody else. More importantly from their perspective, the more people in each watershed that are water harvesting, the less demand there will be on the water table, and the more water will be available for cattle.

Municipal

An astonishing array of economic growth and other benefits are directly and indirectly caused by multiplying our water resources through water harvesting. Each new street built, each new roof, will create a new water resource for the family that will live in this new house. The local supply of water will increase at the same rate as the local demand! Municipalities will spend less money on electric bills for water pumping, less money for electricity for sewage treatment, less money on street maintenance. Tree lined streets will improve property values and the quality of life for everyone.

Recreational

Recreational interests will benefit tremendously. Water harvesting will stop the erosion of our streams and arroyos, decrease flooding, increase base flow, and improve water quality. This will improve the beauty and habitat quality along our watercourses. Hiking, picnicking, and bird watching will all be improved, especially in the vicinity of our population centers, because water harvesting is the cure for the woes of the urban drainages. Avoiding the necessity of diversion on the Gila River will preserve this unique desert stream for future generations to enjoy.

Other

The Stream Dynamics water harvesting proposal will benefit all species equally. Everybody needs a clean, safe supply of water, safe streets, healthy food, lower taxes, and a beautiful and productive environment.

Links

Fabulous article on Stream Dynamics, Inc. Silver City water harvesting projects in the July 2011 edition of Desert Exposure:
http://www.desertexposure.com/201107/201107_van_clothier_water.php

EPA resource links:
http://cfpub.epa.gov/npdes/docs.cfm?program_id=6&view=allprog&sort=name -->
related presentation listed on page: http://www.epa.gov/npdes/pubs/ginm13.pdf

Appendices

1) Letters of Support from:
Gila Resources Information Project, Grant County Trails Group, New Mexico Wilderness Alliance, River Source, San Ysidro Permaculture, Sky Island Alliance, Upper Gila Watershed Alliance, Watershed Management Group

2) Silver City Water Harvesting Projects - this is a report by Van Clothier on recent projects by Stream Dynamics, Inc. within the Town of Silver City.

3) Santa Fe Water Harvesting Projects - report by Van Clothier on water harvesting demonstration projects in Santa Fe designed by Van Clothier and Steve Vrooman of Keystone Restoration Ecology

4) Swale Treatment of Parking Lot Runoff

5) Urban Stormwater Management

6) Tucson Rainwater Ordinance

Van Clothier, Stream Dynamics, Inc.