DRAFT Work Plan for Rillito River Ecosystem Restoration and Environmental Project—Area 1, Tucson, Arizona

Prepared for

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For submittal to

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Tucson Resident Office
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RECON Number 4252B
March 15, 2006

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Rillito River Ecosystem Restoration and Environmental Project—Area 1: Project Description

1.0 Background

The Rillito River Ecosystem Restoration and Environmental Project—Area 1 (hereafter called Rillito Riparian—Area 1) project will provide restored xeroriparian habitat on an 8.6-acre parcel of land on the southern bank of the Rillito River west of Craycroft Road in Tucson, Arizona. This project is the first phase of the larger Rillito River Ecosystem Restoration and Environmental Project, which covers over 60 acres along the southern bank of the river between Alvernon Way and Craycroft Road. This Work Plan has been developed in accordance with the November 2003 Draft of the Ecosystem Restoration Report and Environmental Assessment for the larger project that was prepared by the U.S. Army Corps of Engineers.

Draft

2.0 Project Summary

This Work Plan includes a grading plan, details, and notes; a planting plan, details, and notes; an irrigation plan, details, and notes; an invasive species management plan; a stormwater pollution prevention plan; and a maintenance and monitoring plan. A Habitat Restoration Specialist will monitor all aspects of this project to ensure that they are implemented in the most prudent and efficient way to protect the integrity of the restoration effort. This person will have a minimum of a Bachelor's degree in a natural resources-related field and 5 years of experience in similar efforts.

The restoration plan will have three main planting elements: basin and wash areas, upland areas, and enhancement areas. These different elements will work together to create a diverse mosaic of native vegetation that will be available as wildlife habitat and for the recreational enjoyment of adjoining residents and users of the Rillito River Park Multi-use Path.

The restoration plan has been developed to become a self-sustaining (non-irrigated) ecosystem upon completion of the 5-year establishment period. Emphasis has been placed upon the use of site-appropriate native vegetation, leaving existing stands of native vegetation intact, removal of invasive species, and working with the existing site contours for minimal ground disturbance. Water harvesting principles are integral to the grading design in order to conserve water and increase the long-term sustainability of the site. Nineteen small basins, with a cumulative total size of just under one acre

(41,075 square feet), are located in areas where existing vegetation is sparse to minimal. These basins will capture on-site surface run-off during rainstorms and will greatly increase soil moisture and vegetative growth. Higher densities of plant and wildlife species are expected in these basin pockets.

The passive stormwater harvesting basins, the western wash, and some existing areas will support mesquite and paloverde bosque vegetation. Enhancement areas include intact stands of mesquite and blue paloverde, which will be enhanced with understory plantings of shrubs, vines, and grasses. Upland areas will include more widely distributed tree plantings and more xeric understory species. An underground irrigation system will support these planting areas through their establishment period (2–5 years, depending on rain and other weather conditions). In addition to the grading, planting, and irrigation components, the extension of Pima County's asphalt path and decomposed granite trail will be installed. Locations and details for these elements are shown on the drawings.

Draft

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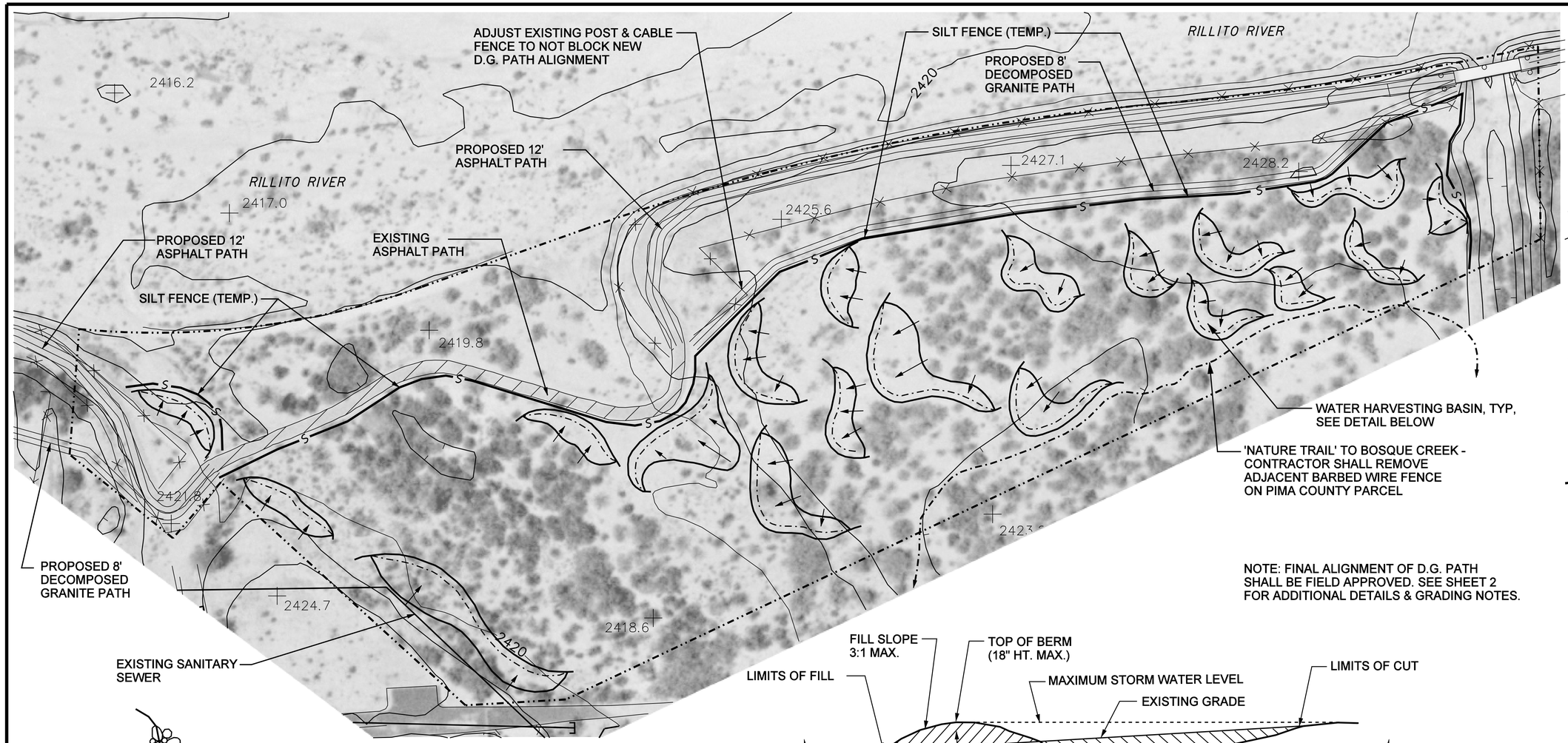
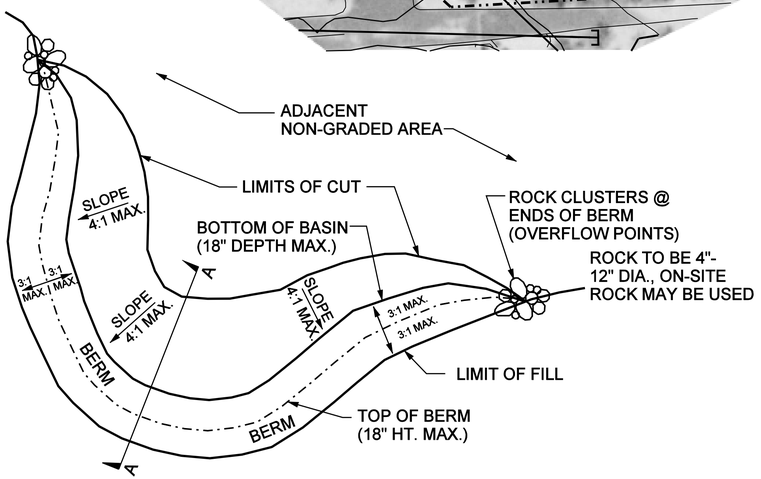
Work Plan Drawings

Draft



NOTE: FINAL ALIGNMENT OF D.G. PATH SHALL BE FIELD APPROVED. SEE SHEET 2 FOR ADDITIONAL DETAILS & GRADING NOTES.



REPRESENTATIVE BASIN CONFIGURATION DETAIL

PLAN N.T.S.

REPRESENTATIVE BASIN CONFIGURATION DETAIL

CROSS-SECTION (HEIGHT & DEPTH MEASURED FROM EXISTING GRADE) N.T.S.

REGISTERED LANDSCAPE ARCHITECT CERTIFICATE NO. 15970 LORI JONES WOODS Signed ARIZONA U.S.A.

PREPARED BY:

RECON

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DESIGNED BY:
DRAWN BY:
CHECKED BY:

RILLITO RIVER TUCSON, ARIZONA
T13S/R14E, PORTION OF SECTION 26

RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

BASIN GRADING PLAN & DETAILS

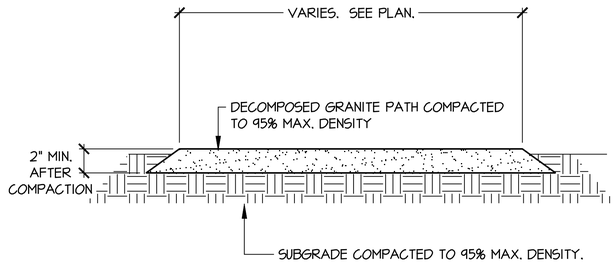
SUBMITTED BY:
CHIEF. DESIGN BRANCH

DATE APPROVED:

SPEC. NO. DACW09-

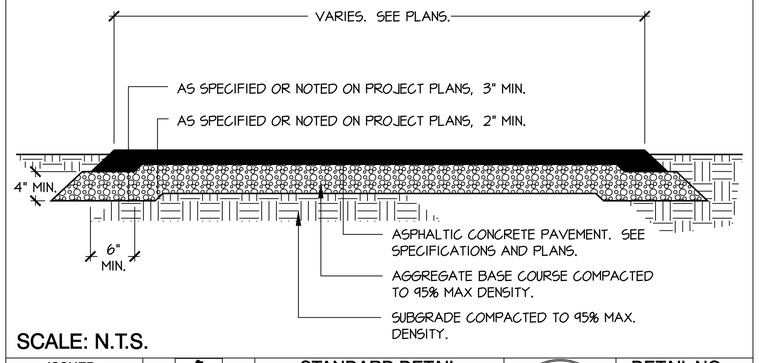
DISTRICT FILE NO. XXX-XXX

SHEET 1 OF 8 SHEETS



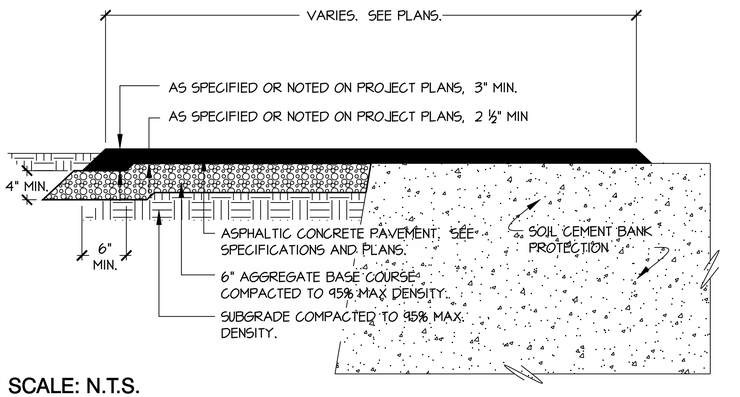
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PATHWAY & TRAIL PAVING:	P-1100
REVISED:	DECOMPOSED GRANITE PATH	
MO/YR		SHEET 1 OF 1



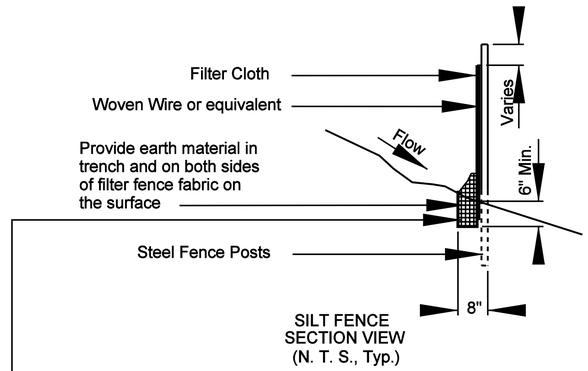
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PATHWAY & TRAIL PAVING:	P-1101
REVISED:	ASPHALTIC CONCRETE PATH	
MO/YR		SHEET 1 OF 1



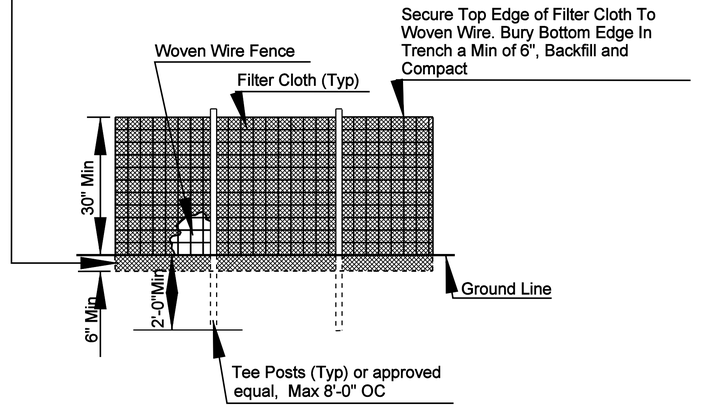
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PATHWAY & TRAIL PAVING:	P-1102
REVISED:	ASPHALTIC CONCRETE PATH AT BANK PROTECTION	
MO/YR		SHEET 1 OF 1



SILT FENCE
SECTION VIEW
(N. T. S., Typ.)

Silt fence filter fabric in the installation trench shall be buried a minimum of twenty inches. The section of the trench shall be a minimum of 6" (deep) X 8" (wide). Filter fabric is to be buried along the side and bottom of the trench and back up to the upstream slope grade. Silt fence filter fabric section shall be a "J" form to prevent under cuts and carry stress from upstream sediment loading.



SILT FENCE
ELEVATION VIEW
(N. T. S., Typ.)

Silt Fencing Notes:

1. Silt fencing shall be installed where shown on Grading Plan and as may be required to meet the objectives of the Stormwater Pollution Prevention Plan (SWPPP). (See SWPPP Section in Work Plan.) The quantity of temporary silt fence to be installed will be affected by actual conditions that occur during the construction of the project.
2. Silt fences are for temporary erosion control only and function to remove suspended particles from water passing through. They shall be installed prior to any grading, and maintained throughout the project installation, in accordance with the SWPPP. Contractor shall remove silt fencing upon receipt of project completion and acceptance from USACE. Upon removal of fencing, remove and dispose of any excess silt accumulations, and fine grade the area to leave a natural and smooth appearance.
3. Fencing shall be supported by steel Tee posts @ 8' O.C. max.
4. Wire mesh hardware cloth shall be standard woven wire fence fabric 4" mesh, 7/64" wire size, 30" ht. min.
5. Filter cloth shall be 3' ht. min., secured with wire ties to woven wire fence at top and midpoint every 3' O.C. and at posts, with bottom edge buried in trench. Woven polypropylene fabric and shall conform to the following specifications:
   Opening Size: 20-50 US Std. Sieve
   Mullen burst: 200-275 PSI
   Trapezoidal Tear: 50-60 lbs.
   Grab Elongation: 15-25%
   Grab Tensile: 100 lbs. min.
   UV Resistance: 70-90%

Grading Notes for Rainwater Harvesting Basins:

1. The Arizona Department of Agriculture (AZDA), Tucson Office, shall be notified in writing of plans to clear, grade and/or conduct surface disturbing activities associated with the project at least 30 days in advance of clearing and grading activities. Notification shall be in conformance with the Arizona Native Plant Law, Arizona Revised Statutes, Chapter 7, as administered by the AZDA.

2. The Contractor shall cause the project site to be Blue-Staked prior to the start of any excavation or trenching work, and shall be familiar with plans showing utility locations. Engineering Plans shall be reviewed to identify the locations of known underground utility and telephone lines. Blue-Staking shall be kept current during the course of the project.

3. Rainwater Harvesting Basin Grading Drawings are diagrammatic and are based on topography provided, at 2' contour intervals. Drawings are intended to show the approximate locations and grading limits for basins. All basins shall be located within the project limits. Minor adjustments in the location and layout may be necessary.

4. Basin staking: Locations and outlines of all rainwater harvesting basins shall be field staked, and evaluated by USACE, Pima County and Landscape Architect prior to any surface disturbance. Minor adjustments in layout may be made in order to best capture rainwater runoff. Contractor shall receive written authorization to initiate surface area preparation and basin construction after basin locations and layout are approved.

5. Surface Area Preparation: Surface area within the final approved basin locations shall be raked and the raked surface materials (i.e., rock, woody debris, and vegetative materials) shall be set aside prior to basin excavation. This material shall be distributed over the new soil surface of the basin after all excavation, planting, and irrigation installation is complete. Fine rake the surface to blend with adjacent undisturbed soil surface.

6. Basin excavation: In order to best capture and temporarily hold rainwater and surface runoff during storm events, the basins shall be built such that excavated material is removed (Cut) from the higher elevation area of the basin (upslope) and placed (Filled) along the lower elevation area (downslope) in a low berm, according to the following parameters:
   - Basins shall be built starting with those at the eastern project limits and working west, completing those at the western project limits last.
   - Basins shall be dug using hand tools and small motorized equipment ('bobcat' or similar size) with rubber wheels, to minimize soil compaction and disturbance of adjacent non-graded areas.
   - Cut and fill material shall balanced within each basin. Exceptions may be made only if approved on-site by Landscape Architect or Habitat Restoration Specialist. No fill material shall be taken off-site.
   - Cut slopes of basins shall not exceed 4:1 (i.e., 25% slope) and in most cases will be less steep.
   - Fill slopes of low berms forming the basin containment shall not exceed 3:1 (i.e., 33% slope) without authorization by Landscape Architect or Habitat Restoration Specialist. Where authorized, fill slopes over 3:1 shall receive erosion control blanket per Landscape Restoration Note #7.
   - Maximum depth of any basin shall not exceed 18" (below existing grade).
   - Maximum height of berms shall not exceed 18" (above existing grade).
   - Rock and boulders that are excavated shall be utilized to stabilize the side slopes of the low berms and shall be clustered at the ends to prevent erosion at times of overflow.
   - Excavated soil shall be place in 6" maximum layers (lifts) to form low berms. Firmly tamp down soil in each lift before adding the next 6" lift. Use mechanical tamper.

7. Final Shaping and Draining: Once excavation and fill work is complete at each basin, and the containment berm is firmly tamped down, apply water in a gentle spray to wet the surface area without eroding the berm slopes. Let dry. Re-tamp fill areas and use hand tools and rock as-needed to repair and reshape surface as-needed and as-directed by Landscape Architect or Habitat Restoration Specialist. Fill basin with water using a small spray sprinkler. Let drain completely. Contact Landscape Architect or Habitat Restoration Specialist if a basin does not completely drain within 24 hours. Fine rake the surface to incorporate surface materials set aside (per Note 4, above) and blend with adjacent undisturbed soil surface.

8. Contractor shall initiate no further site work until basins are built and Contractor has received basin acceptance and authorization to proceed by USACE, Pima County and Landscape Architect. Exception may be given to installation and trenching for irrigation mainline, trenching and system control valves, per Irrigation Note #1.

REGISTERED LANDSCAPE ARCHITECT CERTIFICATE NO. 15970 LORI JONES WOODS ARIZONA U.S.A.

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RILLITO RIVER TUCSON, ARIZONA
T13S/R14E, PORTION OF SECTION 26

RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

GRADING NOTES & DETAILS

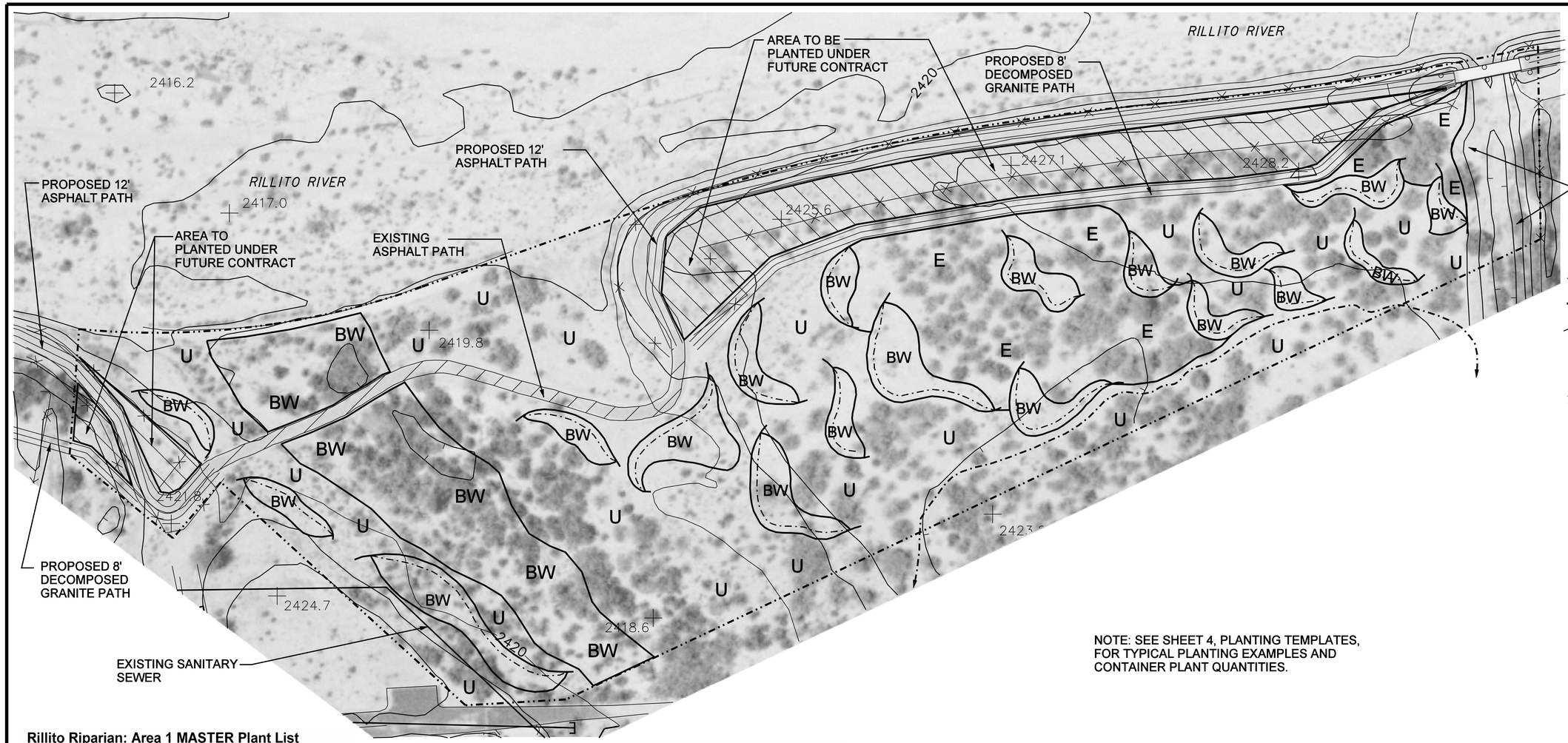
SUBMITTED BY: DATE APPROVED:

CHIEF, DESIGN BRANCH

SPEC. NO. DACW09-

DISTRICT FILE NO. XXX-XXX

SHEET 2 OF 8 SHEETS



KEY:

- PROJECT LIMITS
- 2420 2' CONTOURS
- EXISTING ASPHALT PATH
- PROPOSED 12' ASPHALT PATH
- PROPOSED 8' DECOMPOSED GRANITE PATH
- PROPOSED RAINWATER HARVESTING BASIN
- DIRECTION OF SLOPE
- AREAS TO BE PLANTED UNDER FUTURE CONTRACT
- BW AREAS OF BASIN & WASH PLANTINGS (+/- 2 ACRES)
- E AREAS OF ENHANCEMENT PLANTINGS (+/- 1 ACRE)
- U AREAS OF UPLAND PLANTINGS (+/- 3.5 ACRES)

NOTE: SEE SHEET 4, PLANTING TEMPLATES, FOR TYPICAL PLANTING EXAMPLES AND CONTAINER PLANT QUANTITIES.

Rillito Riparian: Area 1 MASTER Plant List

		24" box	15-gallon	5-gallon	1-gallon
TREES					
Chilopsis linearis	desert willow		44		
Parkinsonia florida	blue paloverde	63			
Prosopis velutina	velvet mesquite		72		
Sambucus mexicana	elderberry		8		
SHRUBS					
Acacia constricta	white-thorn acacia			70	
Acacia greggii	catclaw acacia			36	
Atriplex canescens	four-wing saltbush			70	
Celtis pallida	desert hackberry			36	
Condalia warnockii	condalia			36	
Larrea tridentata	creosote			70	
Lycium berlandieri	wolfberry			36	
Opuntia fulgida	chain-fruit cholla			35	
Opuntia leptocaulis	Christmas cholla			35	
Opuntia spinosior	cane cholla			35	
Zizyphus obtusifolia	greythorn			36	
GRASSES, FORBS, and SUB-SHRUBS					
Ambrosia ambrosioides	canyon ragweed				15
Ambrosia deltoidea	triangle leaf bursage				140
Datura wrightii	sacred datura				15
Muhlenbergia rigens	deer grass				45
Ruellia nudiflora	ruellia				15
Sporobolis wrightii	sacaton				30
VINES					
Clematis drummondii	virgin's bower				24
Cucurbita digitata	coyote melon				17
Marah gilensis	wild cucumber				24
Sarcostemma cynanchoides	desert milkweed				18
Vitis arizonica	Arizona grape				24
TOTAL FOR ALL PLANTING AREAS (approx. 6.5 acres)		63	124	495	367

Seed Mix		
shrubs		**Lbs./acre**
Celtis pallida	desert hackberry	1
Acacia constricta	white-thorn acacia	1
Atriplex canescens	four-wing saltbush	2
Larrea tridentata	creosote	1
subshrubs/grasses/forbs		
Ambrosia deltoidea	triangle leaf bursage	3
Aristida purpurea	three awn	1
Aristida ternipes	spidergrass	1
Baileya multiradiata	desert marigold	1
Bouteloua curtipendula	sideoats grama	1
Bouteloua repens	slender grama	1
Digitaria californica	Arizona cottontop	1
Encelia farinosa	brittlebush	2
Eragrostis intermedia	plains lovegrass	1
Erioneuron pulchellum	fulffgrass	1
Kallstoemia grandiflora	Arizona poppy	1
Muhlenbergia porteri	bush muhly	1
Proboscidea parviflora	devil's claw	1
Senna covesii	desert senna	1
Sphaeralcea sp.	globemallow	1
Vulpia octoflora	sixweeks fescue	1
Zinnia pumila	desert zinnia	1
TOTAL POUNDS per ACRE		**24**
POUNDS FOR TOTAL SEEDED AREA (approx. 6.5 acres)		**156**

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RILLITO RIVER TUCSON, ARIZONA
T13S/R14E, PORTION OF SECTION 26

RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

PLANTING PLAN

SUBMITTED BY:
CHIEF. DESIGN BRANCH

DATE APPROVED:

SPEC. NO. DACW09-

DISTRICT FILE NO. XXX-XXX

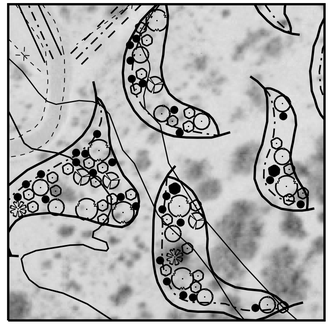
SHEET 3 OF 8 SHEETS

REVEGETATION & PLANTING NOTES:

1. All planting and Landscape Restoration work shall be performed in accordance with these Work Plan Drawings and Specification Notes.
2. Drawings are diagrammatic and intended to show the approximate location of plantings. Minor adjustments in the layout will be necessary. Significant adjustment to the layout, including all changes that affect the basic configuration, shall be subject to the prior review and approval by the Landscape Architect or Habitat Restoration Specialist. Final plant locations are to be approved in field by Landscape Architect or Habitat Restoration Specialist prior to actual planting and irrigation work.
3. Revegetation and planting work shall be coordinated with grading and irrigation work. Planting shall not be initiated until basin grading is complete and approved, and irrigation system is installed sufficient to provide immediate water upon planting. Work that is completed or in-progress shall be protected during the planting process. Contractor shall notify the USACE Construction Manager of any field conditions, which prevent the installation of the irrigation system as shown. Contractor shall complete notification of USACE and Blue-staking prior to the start of any excavation work.
4. The Contractor shall protect and preserve in place all existing vegetation except those species that are identified by the Invasive Species Management Plan or Habitat Restoration Specialist for removal (e.g., desert broom and Mexican palo verde). Any vegetation that is not identified for removal by the Invasive Species Management Plan, and that is damaged or removed by the Contractor, shall be replace at the Contractor's expense with container stock of same species and size as damaged or removed material.
5. Invasive Species Removal: Invasive species shall be identified for removal in coordination with the Habitat Restoration Specialist. Removal shall be consistent with the directives included in the Invasive Species Management Plan.
6. If herbicide application is necessary, it shall be applied directly to individual plants and not broadcast on the soil.
7. Surface Area Preparation: Surface area at planting locations shall be raked and the raked surface materials (i.e., rock, woody debris, and vegetative materials) shall be set aside nearby prior to planting. This material shall be distributed over the new soil surface around the plantings after planting is complete. Fine rake the surface to blend with adjacent undisturbed soil surface. All plantings shall be planted such that they have a shallow basin surrounding them, per the planting details, to facilitate the capture of rainwater.
8. Planting, Staking and Fertilizing: Shall be in accordance with planting details of this Work Plan. Fertilizer tabs shall be applied to plantings as shown, at these quantities: (1) per 1-gallon plant; (2) per 5-gallon plant; (4) per 15-gallon plant; (6) per 24" box plant.
9. Seeding: With the exception of pathway and soil-cement areas, all unpaved, non-concrete, graded or otherwise disturbed areas within the project boundaries shall be hydroseeded with the seed mix once all planting and irrigation installation is complete. Only locally native seed will be used that are appropriate for the local habitat. Whenever possible, seed will be collected from a 20-mile radius of the Rillito Riparian Area 1 site. If seed of a particular species is not available at the time of seed application, the Habitat Restoration Specialist may make substitutions. Seed shall be applied to prepared areas between October 1 and January 31. Prior to mixing hydroseed ingredients, the tank and hose used to apply the hydroseed mix will be thoroughly rinsed with water at least three times to ensure any previous seed mix is removed. After the initial cleaning the tank does not require washing between batches, providing the same hydroseed mix is being applied. The hydroseed mix will contain M-binder, which does not prolong seed germination. The organic binder should be applied at a rate of 200 pounds/acre with 2,000 pounds/acre of wood fiber. The seed/slurry will be mixed thoroughly before, and continuously during, application. The hydroseed mix will be applied in an even and consistent manner.
10. Irrigation: All plantings shall be served by an automatic irrigation system.
11. Erosion Control Blanket: Contractor shall install erosion control blanket on areas where otherwise unprotected slopes are steeper than 3:1. Material shall be 100% biodegradable, double net straw-coconut fiber matrix with jute netting top and bottom. ('North American Green BioNet, #SC150BN'.) Apply material per manufacturer's specifications after hydroseeding is complete. Unroll blanket material down the slope (perpendicular to contours) without stretching, allowing it to fully contact the soil. Secure with 6" wire staples @ 3" on-center max. (1staple/sq. yd. min.) All staples should be driven flush to the ground. Staple all edges and providE 3"-5" material overlaps at parallel edges. The beginning and end of each roll should be secured by anchoring the matting into 6"X6" trenches and providing a 12" overlap, secured with staples @ 12" o.c.
12. Maintenance:All required planting and irrigation shown here shall be maintained as shown here during the life of the project. Maintenance during installation, and during a one year Landscape Establishment period of the plant materials and the irrigation system is the responsibility of the Contractor and shall consist of regular watering, pruning, fertilizing, clearing landscape areas of debris and weeds, the removal and replacement of dead plant materials with like types and sizes, and keeping the irrigation system in working order.
13. Guarantee: Contractor shall guarantee all plantings for one year from the date of written final job acceptance by USACE and Pima County, including replacement of dead or dying plants, and repair of any backfill settlement. All plants shall be alive and thriving before final job acceptance is granted.

TEMPLATE FOR BASIN & WASH AREA PLANTING

SCALE: 1"=50'
(ONE ACRE AREA SHOWN)



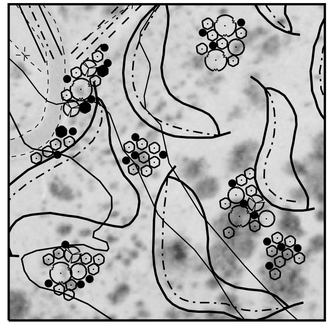
KEY:

- - 24" BOX BLUE PALOVERDE
- - 15-GAL. DESERT WILLOW
- - 15-GAL MESQUITE
- - 15-GAL ELDERBERRY
- - 5-GAL SHRUB
- - 1-GAL SHRUB, VINE OR GRASS

BASIN AND WASH PLANTINGS (Mesquite Bosque Plant Community)		24" box/acre	15-gallon/acre	5-gallon/acre	1-gallon/acre
trees					
Chilopsis linearis	desert willow		8		
Parkinsonia florida	blue paloverde	14			
Prosopis velutina	velvet mesquite		22		
Sambucus mexicana	elderberry		4		
shrubs					
Acacia greggii	catclaw acacia			12	
Celtis pallida	desert hackberry			12	
Condalia warnockii	condalia			12	
Lycium berlandieri	wolfberry			12	
Zizyphus obtusifolia	greythorn			12	
grasses/forbs					
Ambrosia ambrosioides	canyon ragweed				5
Datura wrightii	sacred datura				5
Muhlenbergia rigens	deer grass				15
Ruellia nudiflora	ruellia				5
Sporobolis wrightii	sacaton				10
vines					
Vitis arizonica	Arizona grape				8
Clematis drummondii	virgin's bower				8
Marah gilensis	wild cucumber				8
AVERAGE PER ACRE		**14**	**34**	**60**	**64**
TOTAL IN BASIN & WASH PLANTING AREAS (approx. 2 acres)		**28**	**68**	**120**	**128**

TEMPLATE FOR UPLAND AREA PLANTING

SCALE: 1"=50'
(ONE ACRE AREA SHOWN)



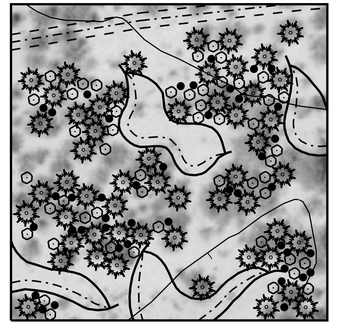
KEY:

- - 24" BOX BLUE PALOVERDE
- - 15-GAL. DESERT WILLOW
- - 15-GAL MESQUITE
- - 5-GAL SHRUB
- - 1-GAL SHRUB, VINE OR GRASS

UPLAND PLANTINGS (Xeroriparian Plant Community)		24" box/acre	15-gallon/acre	5 gallon/acre	1-gallon/acre
trees					
Chilopsis linearis	desert willow		8		
Parkinsonia florida	blue paloverde	10			
Prosopis velutina	velvet mesquite		8		
shrubs - cacti					
Acacia constricta	white-thorn acacia			20	
Atriplex canescens	four-wing saltbush			20	
Larrea tridentata	creosote			20	
Opuntia fulgida	chain-fruit cholla			10	
Opuntia leptocaulis	Christmas cholla			10	
Opuntia spinosior	cane cholla			10	
subshrubs/grasses/forbs					
Ambrosia deltoidea	triangle leaf bursage				40
vines					
Cucurbita digitata	coyote melon				5
Sarcostemma cynanchoides	desert milkweed				5
AVERAGE PER ACRE		**10**	**16**	**90**	**50**
TOTAL IN UPLAND PLANTING AREAS (approx. 3.5 acres)		**35**	**56**	**315**	**175**

TEMPLATE FOR ENHANCEMENT AREA PLANTING

SCALE: 1"=50'
(ONE ACRE AREA SHOWN)



KEY:

- - EXISTING TREE
- - 5-GAL SHRUB
- - 1-GAL SHRUB, VINE OR GRASS

ENHANCEMENT AREAS (Mesquite Bosque Plant Community)		5 gallon/acre	1-gallon/acre
shrubs			
Acacia greggii	catclaw acacia	12	
Celtis pallida	desert hackberry	12	
Condalia warnockii	condalia	12	
Lycium berlandieri	wolfberry	12	
Zizyphus obtusifolia	greythorn	12	
grasses/forbs			
Ambrosia ambrosioides	canyon ragweed		5
Datura wrightii	sacred datura		5
Muhlenbergia rigens	deer grass		15
Ruellia nudiflora	ruellia		5
Sporobolis wrightii	sacaton		10
vines			
Vitis arizonica	Arizona grape		8
Clematis drummondii	virgin's bower		8
Marah gilensis	wild cucumber		8
AVERAGE PER ACRE		**60**	**64**
TOTAL IN ENHANCEMENT PLANTING AREAS (approx. 1 acre)		**60**	**64**

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SYMBOL	DESCRIPTIONS	DATE	APPROVAL

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DRAWN BY:
CHECKED BY:

RILLITO RIVER TUCSON, ARIZONA
T13S/R14E, PORTION OF SECTION 26

RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

PLANTING NOTES & TEMPLATES

SUBMITTED BY:
CHIEF, DESIGN BRANCH

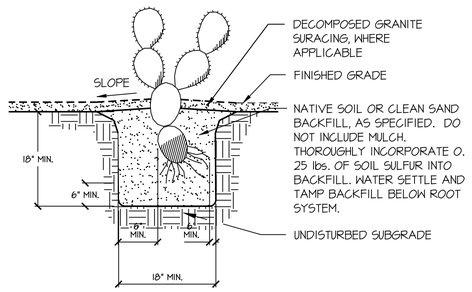
DATE APPROVED:

SPEC. NO. DACW09-

DISTRICT FILE NO. XXX-XXX

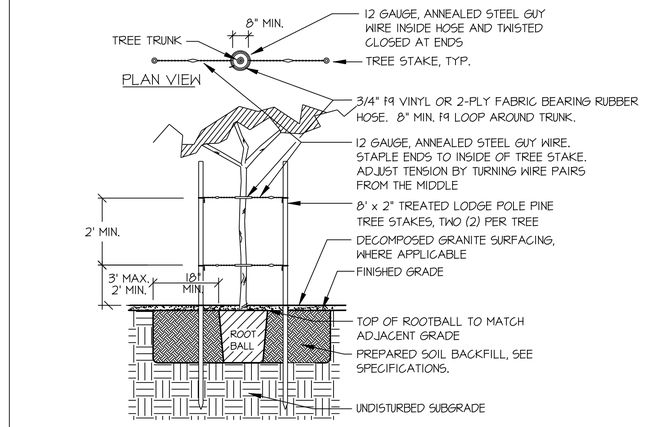
SHEET 4 OF 8 SHEETS

NOTES:
1. DO NOT CREATE BASIN AT BASE OF CACTUS. SLOPE BACKFILL AWAY FROM PLANT.
2. BURY ONE FULL PAD, MINIMUM.
3. THIS DETAIL APPLIES TO SALVAGED STOCK OF THE GENUS OPUNTIA.



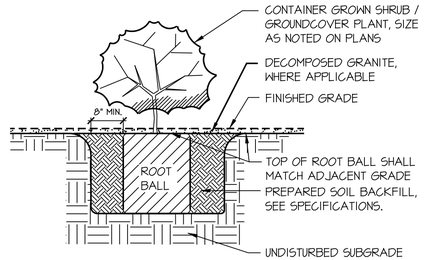
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PLANTING / SALVAGED NATIVE PLANTS:	P-107
REVISED:	PRICKLY PEAR AND CHOLLA CACTUS PLANTING - SALVAGED CUTTING	
MO/YR		SHEET 1 OF 1



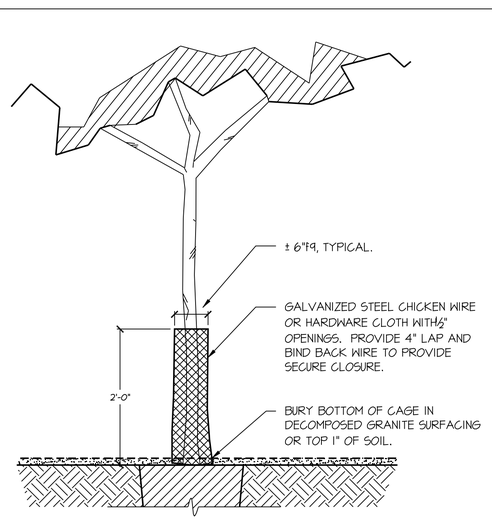
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PLANTING / NURSERY STOCK:	P-201
REVISED:	TREE PLANTING - 24" BOX & 15 GAL. SIZE	
MO/YR		SHEET 1 OF 1



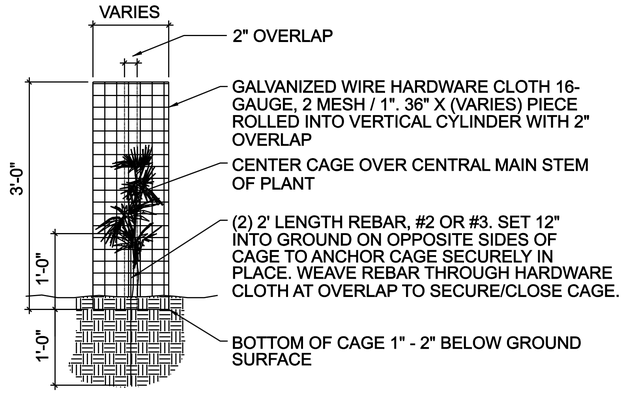
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PLANTING / NURSERY STOCK:	P-203
REVISED:	SHRUB / GROUND COVER PLANTING - 1, 5 & 15 GAL. SIZE	
MO/YR		SHEET 1 OF 1



SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	PLANTING / NURSERY STOCK:	P-208
REVISED:	RODENT PROTECTION CAGE FOR TREES	
MO/YR		SHEET 1 OF 1



PROTECTIVE PLANT CAGE DETAIL

Note: Each planting of 1 gallon size and larger shall receive a metal wire cage to protect against wildlife damage. Cages shall be assembled on-site from 36" wide pieces of hardware-cloth, ½" mesh, formed into vertical cylinders and anchored in place with 2' lengths of #3 rebar (or #2, if available). Rebar shall be woven through a 2" overlap of the hardware cloth to secure closure, and driven 1' into the ground. Larger cages may need an additional rebar stake to stabilize. Cages shall be centered over the central main stem of plant, with a minimum of 1"-2" set below grade. Size of cages shall be as follows:

Plant Size:	Diameter of Cage	Length of Hardware Cloth Required (approx.)
1 gallon	12"	3'
5 gallon	16"	4'
15 gallon	24"	6'
24" box	36"	9'

Soil Specification for Plantings:

Prepared Soil Backfill Mix for planting holes shall consist of 4 parts native soil thoroughly mixed with 1 part soil conditioner/mulch. Remove non-soil materials (e.g., rocks, sticks, brush, roots, plastic, refuse) of 1" size or larger from native soil before mixing soil with mulch. Soil conditioner/mulch shall be premixed with sulfur (4 pounds per cubic yard) and ammonium phosphate 16-20-0 (2 pounds per cubic yard). Soil conditioner/mulch shall be composted, pass a 1 inch sieve, and shall not contain poultry, animal or human waste, pathogenic viruses, fly larvae, insecticides, herbicides, fungicides or poisonous chemicals that would inhibit plant growth. Add fertilizer tabs to each planting hold per Note 8 on Planting Plan, Sheet 4.

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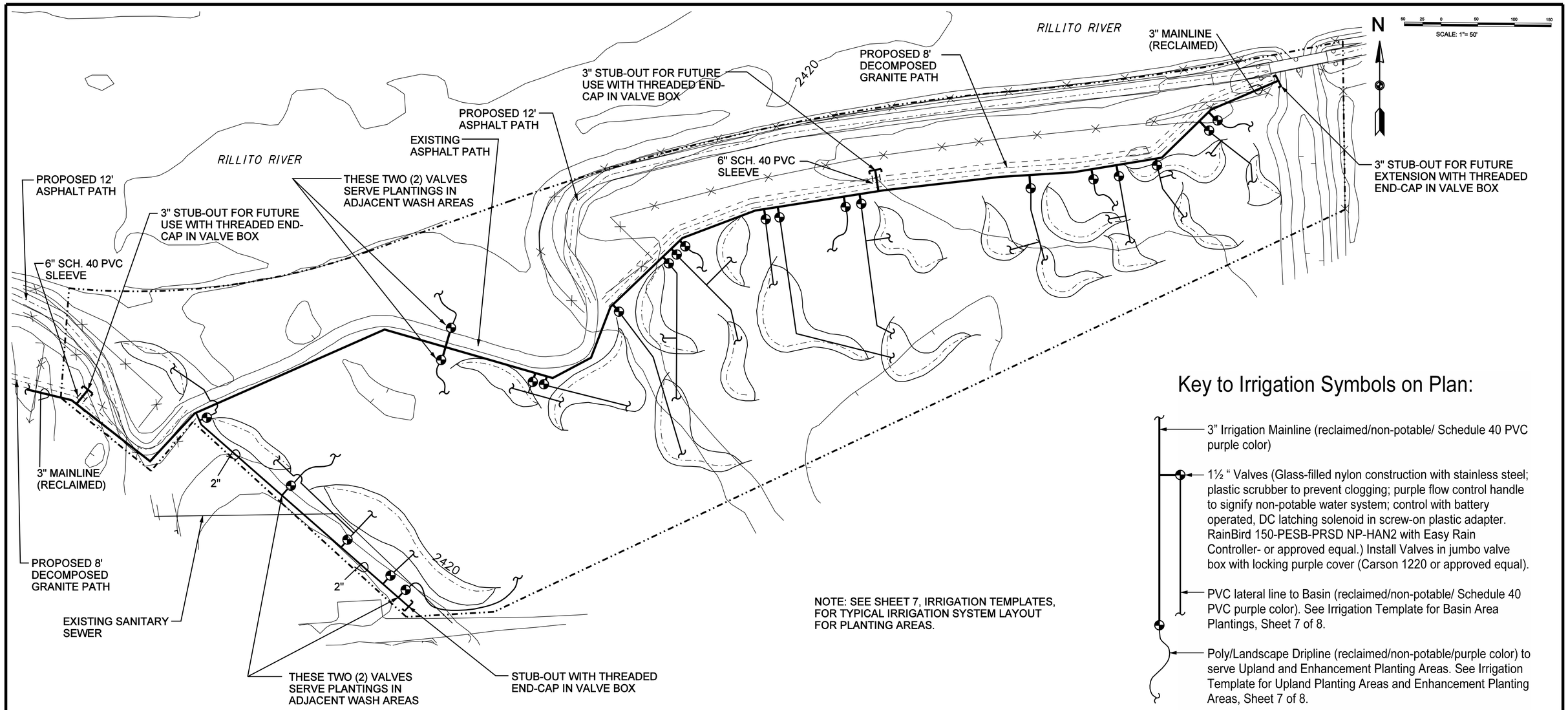
T13S/R14E, PORTION OF SECTION 26

RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

PLANTING DETAILS

SUBMITTED BY: CHIEF, DESIGN BRANCH
DATE APPROVED:
SPEC. NO. DACW09-
DISTRICT FILE NO. XXX-XXX
SHEET 5 OF 8 SHEETS



Key to Irrigation Symbols on Plan:

- 3" Irrigation Mainline (reclaimed/non-potable/ Schedule 40 PVC purple color)
- 1½ " Valves (Glass-filled nylon construction with stainless steel; plastic scrubber to prevent clogging; purple flow control handle to signify non-potable water system; control with battery operated, DC latching solenoid in screw-on plastic adapter. RainBird 150-PESB-PRSD NP-HAN2 with Easy Rain Controller- or approved equal.) Install Valves in jumbo valve box with locking purple cover (Carson 1220 or approved equal).
- PVC lateral line to Basin (reclaimed/non-potable/ Schedule 40 PVC purple color). See Irrigation Template for Basin Area Plantings, Sheet 7 of 8.
- Poly/Landscape Dripline (reclaimed/non-potable/purple color) to serve Upland and Enhancement Planting Areas. See Irrigation Template for Upland Planting Areas and Enhancement Planting Areas, Sheet 7 of 8.

NOTE: SEE SHEET 7, IRRIGATION TEMPLATES, FOR TYPICAL IRRIGATION SYSTEM LAYOUT FOR PLANTING AREAS.

KEY:

- PROJECT LIMITS
- 2420 — 2' CONTOURS
- EXISTING ASPHALT PATH
- PROPOSED 12' ASPHALT PATH
- PROPOSED 8' DECOMPOSED GRANITE PATH
- PROPOSED RAINWATER HARVESTING BASIN

REGISTERED LANDSCAPE ARCHITECT CERTIFICATE NO. 16970 LORI JONES WOODS Signed ARIZONA U.S.A.

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RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

IRRIGATION PLAN

SUBMITTED BY:
CHIEF, DESIGN BRANCH

DATE APPROVED:

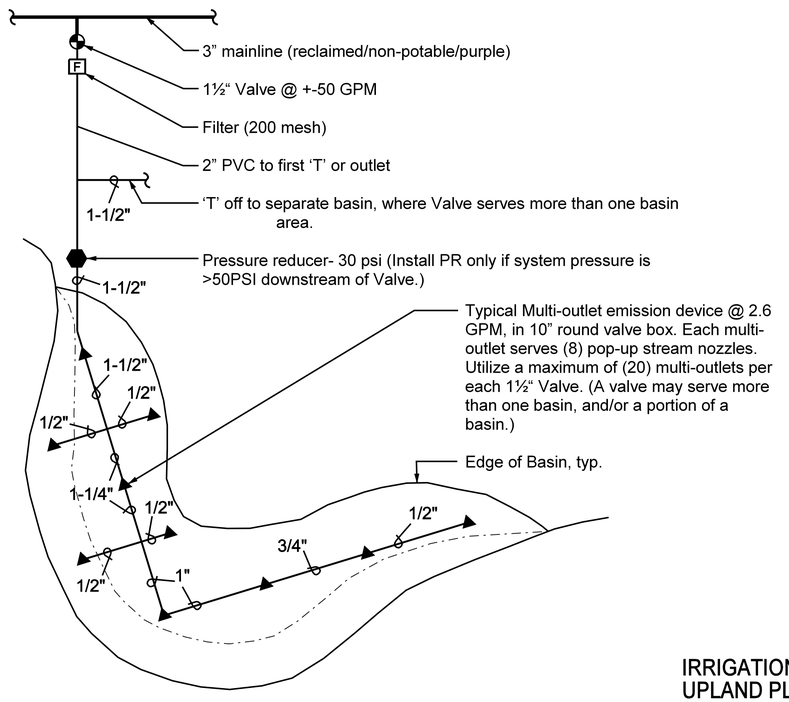
SPEC. NO. DACW09-

DISTRICT FILE NO. XXX-XXX

SHEET 6 OF 8 SHEETS

IRRIGATION TEMPLATE FOR BASIN PLANTING AREAS

SCALE: 1"=10'



Key to Irrigation Template Materials

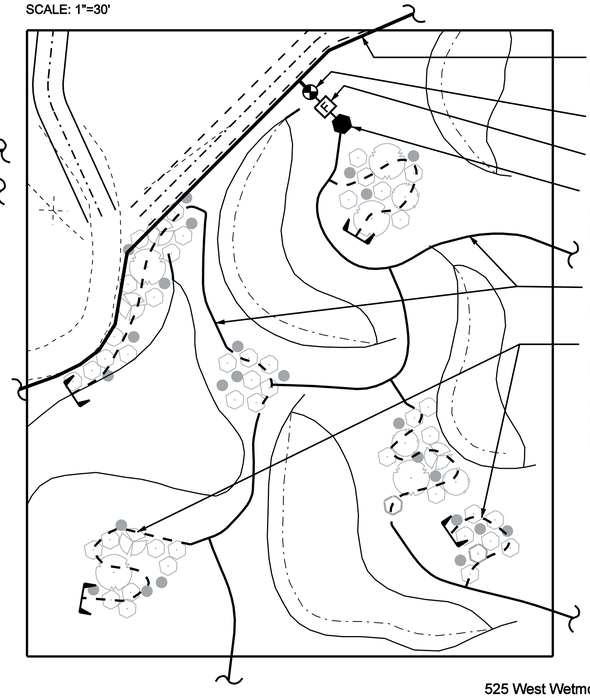
- 3" Irrigation Mainline (reclaimed/non-potable/ Schedule 40 PVC purple color)
- 1½ " Battery Operated Valves (See specification on Sheet 6).
- F 1½" Filter (200 mesh Drip Filter. RainBird RBY 150C-SC 150 200 SS or approved equal.) Install in standard valve box with purple cover or in jumbo box with Valve.
- 1½" Pressure Regulator (Wilkins 600 or approved equal.)
- PVC lateral line to Basin, size as shown (reclaimed/non-potable/ Schedule 40 PVC purple color).
- Multi-Outlet Emission Device with (8) bottom-mounted barbed outlets for independent flows from .5 to 24 GPH, and integral 200-mesh filter. (RainBird XBD-80 or approved equal.) Install each multi-outlet in 10" round valve box with purple cover (Rainbird VB-10RNDP-H or equal.) Each multi-outlet serves up to (8) 6" pop-up micro-sprays with 2' radius full-circle, multi-port stream nozzles @ .33 GPM (RainBird XP-600X/MP2QSS or approved equal. Pop-up micro-sprays not shown on drawing.)
- ¾" Poly lateral line. Use in areas between plantings to connect runs of Landscape Dripline.
- ½" Landscape Dripline (reclaimed/non-potable/purple color, pressure-compensating inline emitter tubing, with emitters spaced 12" on-center, flow rate of .92 GPM. RainBird LD-P-09-12 or approved equal).
- Flush Cap (purple). Install @ end of all poly or Landscape Dripline runs in 10" round valve box with purple lid. (Compression fitting with threaded cap. (RainBird MDCFPCAP or equal.)

Reclaimed Water Irrigation System Notes:

1. Irrigation system will utilize reclaimed water. Piping, valve flow control handles, and valve box covers shall be purple color to designate non-potable water.
2. Irrigation mainline, trenching and valves may be installed prior to completion of basins, as described above. However, NO components of irrigation system downstream of control valves shall be installed, nor associated trenches dug, prior to completion of grading and excavation for rainwater harvesting basins. Trenching and piping shall be extended to basins only after final acceptance of basins.
3. All Irrigation work shall be performed in accordance with these Work Plan Drawings and Specification Notes.
4. Drawings are diagrammatic and intended to show the approximate location piping and equipment. Certain runs of piping may be shown distorted for clarity. All piping and irrigation components shall be located within the boundaries of properties owned by Pima County. Adjustments in the layout of the system may be necessary to best serve basins and plantings. Significant adjustment to the layout, including all changes that effect the basic configuration of piping runs, shall be subject to the prior review and approval by the Landscape Architect or Habitat Restoration Specialist.
5. Surface Area Preparation: Surface area along the trench and valve box locations shall be raked and the raked surface materials (i.e., rock, woody debris, and vegetative materials) shall be set aside prior to trenching. This material shall be distributed over the new soil surface of the trench alignment after all excavation, pipe and valve box installation, and backfilling of trenches is complete. Fine rake the surface to blend with adjacent undisturbed soil surface.
6. The main pressure line shall be pressure tested at 100 PSI and approved by USACE/PM, Landscape Architect or Habitat Restoration Specialist prior to burial. Sustain pressure for 2 hours minimum. Contractor to furnish necessary force pump and gauges.
7. Irrigation work shall be coordinated with that of other trades. Work that is completed or in-progress shall be protected during the installation of the irrigation system and during the planting process. Contractor shall notify the USACE/PM of any field conditions, which prevent the installation of the irrigation system as shown. Notification of USACE and Blue-staking shall be completed by Contractor prior to the start of any excavation work.
8. The Contractor shall cause the project site to be Blue-Staked prior to the start of any excavation or trenching work, and shall be familiar with plans showing utility locations. Engineering Plans shall be reviewed to identify the locations of known underground utility and telephone lines. Blue-Staking shall be kept current during the course of the project.
9. Sleeving shall be installed for all piping under path/trail. Sleeves for piping shall be PVC Schedule 40, sized as noted on plan. Contractor shall insure the timely placement of sleeves.
10. A valve box shall be provided for all valves, filters, pressure reducers, and multi-outlet emission devices. Valve box covers to be purple color, high strength plastic, lockable, and of a size and configuration as shown on details. Contractor to provide USACE/PM with 2 sets of valve box bolts/keys for locking/unlocking valve covers. Valve boxes shall have bottom and side penetrations/openings sealed with geotextile fabric. Top of all boxes shall be flush with adjacent grade. Filter may be installed in same box as remote control valve if a jumbo box is used, and both fit well with ample room for access, maintenance and operation.
11. Irrigation system maintenance during installation, and during a one-year Landscape Establishment period of the plant materials and the irrigation system is the responsibility of the Contractor and shall consist of regular watering, and keeping the irrigation system in working order. Repair any leaks and replace any defective components. Adjust controllers and install new batteries every 3 months or more often if needed. Replace batteries at the end of the one-year period.
12. Guarantee: Contractor shall guarantee the irrigation system and all components for one year from the date of written final job acceptance by USACE/PM, including repair and replacement of defective materials, system adjustments, workmanship, and repair of any backfill settlement and/or erosion caused by operation of the irrigation system.

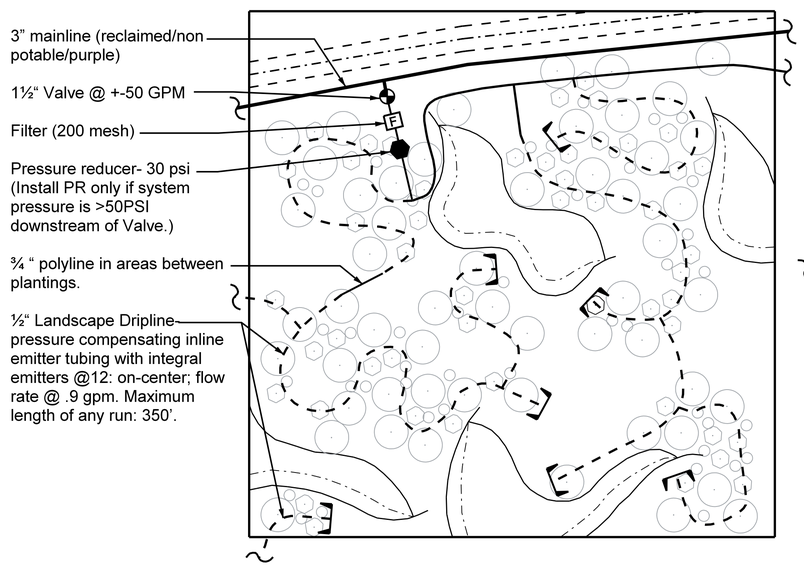
IRRIGATION TEMPLATE FOR UPLAND PLANTING AREAS

SCALE: 1"=30'



IRRIGATION TEMPLATE FOR ENHANCEMENT PLANTING AREAS

SCALE: 1"=30'



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T13S/R14E, PORTION OF SECTION 26

RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

IRRIGATION NOTES & TEMPLATES

SUBMITTED BY:
CHIEF. DESIGN BRANCH

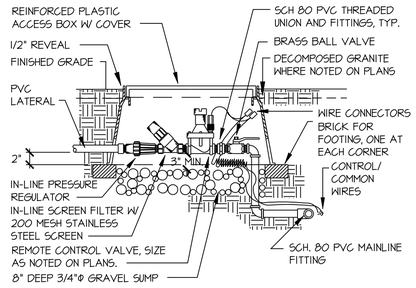
DATE APPROVED:

SPEC. NO. DACW09-

DISTRICT FILE NO. XXX-XXX

SHEET 7 OF 8 SHEETS

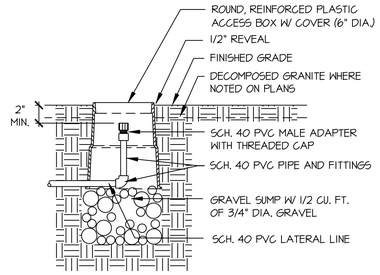
NOTES:
1. ALL WIRES TO BE INSTALLED PER LOCAL CODE. TAPE AND BUNDLE WIRES EVERY 20'. PROVIDE EXPANSION COIL AT EACH WIRE CONNECTION IN VALVE BOX (WRAP AROUND 1/2" Ø PIPE 15 TIMES).
2. COMPACT SOIL AROUND VALVE BOX TO SAME DENSITY AS ADJACENT UNDISTURBED SOIL.
3. ALL THREADED PVC JOINTS SHALL BE WRAPPED WITH TEFLON TAPE.



SCALE: N.T.S.

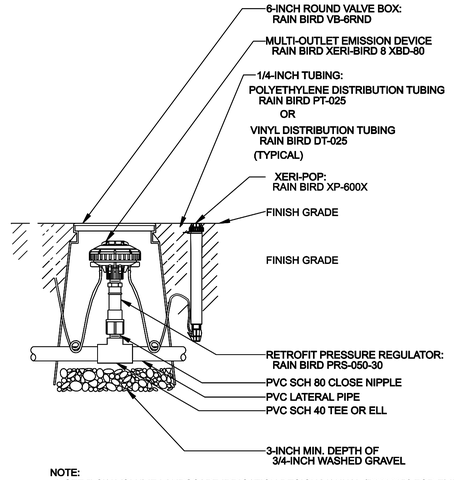
ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	IRRIGATION: REMOTE CONTROL VALVE ASSEMBLY - DRIP ZONES	P-310
REVISED: MO/YR		SHEET 1 OF 1

NOTE: SEPARATE VALVE BOX MAY BE REQUIRED FOR PRESSURE REGULATOR WHEN LOCATED AWAY FROM VALVE AND FILTER, IN BASIN OR OTHER PLANTING AREA.



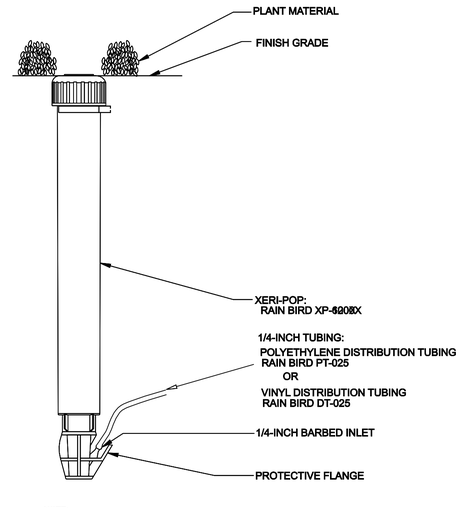
SCALE: N.T.S.

ISSUED:	STANDARD DETAIL	DETAIL NO.
11/05	IRRIGATION: EMITTER LINE FLUSH CAP IN ACCESS BOX	P-320
REVISED: MO/YR		SHEET 1 OF 1



NOTE:
1. SEE "LOW-VOLUME LANDSCAPE IRRIGATION DESIGN MANUAL (D39030D) FOR EMITTER PLACEMENT.
2. COIL ADDITIONAL 9-INCHES OF TUBING IN VALVE BOX TO FACILITATE MAINTENANCE.

D XERI-BIRD 8 WITH XERI-POPS IN VALVE BOX
N.T.S.



NOTE:
USE XERIMAN TOOL XM-TOOL TO INSERT BARB CONNECTOR DIRECTLY INTO 1/2-INCH POLYETHYLENE TUBING.

D XERI-POP 6"
N.T.S.

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RILLITO RIPARIAN RESTORATION PROJECT WORK PLAN FOR AREA 1

IRRIGATION DETAILS

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Invasive Species Management Plan

Table

Draft

Invasive Species Management Plan for the Rillito River Ecosystem Restoration and Environmental Project—Area 1

1.0 Introduction

Invasive plant species are present within the Rillito Riparian—Area 1 project area. These species can be expected to increase in number and distribution with ground-disturbing activities associated with restoration without the implementation of appropriate control measures. The ultimate success of the restoration project will largely depend upon the control of invasive species, which can outcompete the native species that the project is designed to promote.

Invasive species often produce enormous quantities of viable seed and can be very difficult to control once established; therefore, early detection is key to management success. This Invasive Species Management Plan is designed to be implemented over five years in conjunction with the Maintenance and Monitoring Plan (Section 5 of this document). If the program is successful in controlling problem species, a reduced level of effort (i.e., periodic spot control and identification–eradication of new populations) will be required for long-term control after the initial five years.

The management program will be based on the concepts of eradication, prevention, and monitoring:

- Eradication of existing problem species within the project area;
- Preventative actions to keep the project area free of species that are not yet established but that may be expected to colonize the area; and,
- Ongoing monitoring to ensure success and identify adaptive management needs as new infestations arise.

The natural open space of the project area is not isolated, but exists within a matrix of neighboring open space areas, a recreational multi-use path, and residential development. For many plants, the mechanism for dispersal may include travel by wind, water, or transport by animals and humans. For this reason, any adjacent areas occupied by invasive plants may pose a threat to neighboring lands, as these modes of seed transport may carry unwanted species into the open spaces. Reconnaissance surveys for invasive species and potential sources of seed production should be conducted on neighboring lands with landowner approvals. If populations of invasive

species are discovered on parcels immediately adjacent to the restoration site, the project proponent should work with the respective landowner to eradicate or manage the off-site problem.

2.0 Management Tools

The species, location, and extent of invasive species infestation will largely determine the management tools used to control populations. Consideration will also be given to the difficulty of controlling a particular invasive species.

All options of control will be considered before action is taken. These methods may include removal by hand, machine, passive management (allowing native species to become established and out-compete invasives), and/or application(s) of herbicides. Each of these management tools has advantages and disadvantages, and often the best approach is a combination of methods (Bossard *et al*. 2000). In addition, optimum timing of invasive species management strategies can vary by the type of plant in question. For example, for many perennial species timing of control may not be as critical as for annual species. Annual invasive species are best controlled before they set seed in order to limit costly repeat efforts.

A number of operational considerations should be taken into account when considering any invasive species management tool. The first consideration a land manager faces is the varying cost of available management tools. Hand removal operations consist of the expense of the removal equipment as well as significant labor costs. If ground in the removal site is disturbed, reseeding or container planting and costs associated with these tasks should be considered. Revegetation of disturbed areas will be an important preventative strategy for suppressing future invasive species infestations.

2.1 Prevention

The most effective and efficient invasive species control strategies prevent invasions from occurring and quickly detect invasions that do occur so that invasive species can be eradicated or contained before they spread (Bossard *et al*. 2000). Management tools to prevent the establishment of invasive species within a given area include regular monitoring for invasive species, eradicating species immediately upon detection, removing exotic seed sources from neighboring areas, and prompt revegetation of eradicated areas.

2.2 Eradication

Eradication is the complete elimination of an invasive species from a given area. Early detection and removal of a new invasive species infestation is critical, if eradication is

the management goal of a particular species. However, invasive species are likely to reinvade from adjacent properties, if there are no barriers to prevent dispersal.

2.3 Physical Control

2.3.1 Material Removal

Physical control often involves hand dethatching, pulling, cutting, or removal by mechanical means. These methods are labor intensive, but may be the most appropriate for the relatively small project area size and limited infestation present within the Rillito Riparian—Area 1. Physical methods of invasive species control may provide an advantage in situations where desirable species may be left in place, while surrounding invasive species are removed.

2.3.2 Mulching

Applying mulch, black paper, or black plastic excludes light from reaching invasive species and prevents them from photosynthesizing. Commonly used mulch includes grass clippings, hay, manure, straw, sawdust, wood chips, or rice hulls. Mulches can be a very effective form of invasive species control in small areas and can aid in soil stabilization, moisture retention, and soil insulation. If mulch is used as a form of invasive species control, it is imperative that invasive species-free material is used to prevent the introduction of other invasive species.

2.3.3 Chemical Control

The chemical means of controlling invasive species is the application of herbicides. Herbicides kill or inhibit plant growth and can be very effective in controlling many invasive species. Each invasive species may have different requirements regarding effective herbicides, application rates, and timing of application.

Using herbicides to control invasive species requires careful planning and a professional staff familiar with the application areas and herbicides they are using. The use of herbicides should be under the direction of a professional pesticide applicator with a Qualified Applicators License (QAL) and a Pesticide Applicators License (PAL). Before applying any herbicides, the applicators should be aware of all safety regulations, applicable environmental regulations, and be familiar with target versus native plants. The Habitat Restoration Specialist is responsible for meeting these requirements and approving any trained staff or certified pesticide applicators that will handle herbicides. The Habitat Restoration Specialist should be consulted before actions are taken.

The method of application varies from one species to the next and with the degree of infestation. The application method ultimately chosen should minimize risks of harming

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non-target plants. The environmental risks of some herbicides may include drift, volatilization, or persistence in the environment, groundwater contamination, and harmful effects on animals.

The presence of high levels of free lime in the soils of the project area may affect the solvability of herbicides in the soil. Therefore, herbicides should only be applied directly to individual plants as opposed to be broadcast on areas of soil.

2.3.4 Competition and Restoration

Competition and restoration involve the planting and rearing of native species so they may out-compete invasive species. By increasing the density and distribution of native trees, shrubs, and forbs, there is less space available for invasive species to occupy. Planting will often involve a maintenance period when watering and weeding will be necessary, until the plants have become established. This method of invasive species management must be implemented in conjunction with another form of invasive species control, such as dethatching, mulching, and/or herbicide use.

3.0 Target Species

The Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG) has ranked 71 plant species known to be invasive into Arizona's natural ecosystems through the application of a regionally developed objective assessment protocol (AZ-WIPWG 2005a). Although this list is non-regulatory, it is endorsed by several state and federal agencies (including the U.S. Army Corps of Engineers) as a guide for invasive species management. Several invasive species that are either present within the project area or that can be reasonably expected to become established are presented in Table 1 with their respective AZ-WIPWG ratings.

The target species identified in this Invasive Species Management Plan are not all-inclusive of the species that may become problems within the Rillito Riparian—Area 1 project area. Changing site conditions may work in concert with unpredictable climatic patterns to encourage invasion of species that are not explicitly identified in this plan. A strategy of on-going monitoring and adaptive management will be necessary to identify additional target species as the project schedule progresses in coordination with the Habitat Restoration Specialist.

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TABLE 1
AZ-WIPWG RATINGS OF INVASIVE PLANT SPECIES PRESENT OR EXPECTED TO BECOME ESTABLISHED WITHIN RILLITO RIPARIAN—AREA 1 PROJECT AREA

Species	AZ-WIPWG Rating
Currently Present	
Desert broom (*Baccharis sarothroides*)	Not ranked (native)
Burrow brush (*Hymenoclea monogyra*)	Not ranked (native)
Mexican paloverde (*Parkinsonia aculeata*)	Not ranked
Russian thistle (*Salsola* sp.)	MEDIUM
Likely to Become Established	
Giant reed (*Arundo donax*)	HIGH
Bermuda grass (*Cynodon dactylon*)	MEDIUM
Fountain grass (*Pennisetum setaceum*)	HIGH
Buffelgrass (*Pennisetum ciliare*)	HIGH
Salt cedar (*Tamarix* spp.)	HIGH

HIGH: These species have severe ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal and establishment; and species are usually widely distributed, both among and within ecosystems/communities.

MEDIUM: These species have substantial and apparent ecological impacts on ecosystems, plant and animal communities, and vegetational structure; invasiveness attributes are conducive to moderate to high rates of dispersal, often enhanced by disturbance; and ecological amplitude and distribution range from limited to widespread.

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3.1 Invasive Species Known to be Present within the Project Area

The Rillito Riparian—Area 1 project area was surveyed for the presence of invasive species during January and February 2006 by RECON Environmental. The observations made were integral to the development of this document. It is important to note that this survey occurred during a time of extreme drought; there had been effectively no winter precipitation. Therefore, many invasive species (especially annuals) that are likely to be present within the seed bank of the project area were not evident above the soil surface due to the dry conditions. The perennial species listed below have been observed within the project area. The descriptions below include treatment options and schedules.

3.1.1 Desert Broom (*Baccharis sarothroides*) and Burrow Brush (*Hymenoclea monogyra*)

Desert broom and burrow brush are native shrubs that colonize disturbed environments. These plants will be removed from areas that are identified for wash or basin plantings

(see Planting Plan in Section 2 of this document) at the discretion of the Habitat Restoration Specialist.

Control: It is likely that not all individuals of these species will be removed, but that areas of extensive desert broom and burrow brush cover (e.g., within the wash on the western portion of the project area) will be thinned to provide areas suitable for planting the basin and wash planting palette (see Planting Plan in Section 2). The Habitat Restoration Specialist shall be onsite to identify areas appropriate for removal.

Mechanical control: Desert broom and burrow brush should be removed by bulldozer or pulling with a tractor to effectively remove all roots. The smallest machinery possible shall be used to complete removal so that ground compaction is minimized on site. Follow-up removal may be necessary, as ground disturbance will encourage additional seedling germination and establishment.

Treatment schedule: Removal should occur in conjunction with site preparation and grading activities. Follow-up control should occur as necessary, at the discretion of the Habitat Restoration Specialist.

3.1.2 Mexican Paloverde (*Parkinsonia acuelata*)

Mexican paloverde is a tree that grows 15–30 feet tall. It is distinguished from the abundant blue paloverde (*Parkinsonia florida*) within the project area by its long leaf rachises and generally weeping appearance. This species is native to Mexico and tropical America. Mexican paloverde is common throughout the project area, in open areas and within groves of mesquite, blue paloverde, and desert willow. Although this species is not addressed in the AZ-WIPWG assessment, the restoration project presents a unique opportunity to eradicate it from the site to encourage a completely native tree flora.

Control: The Habitat Restoration Specialist will locate and flag all specimens within Area 1. A two-pronged treatment approach will be followed for this species, based on location of the individual tree. Very small trees and those in close proximity to the river trail should be removed, whereas larger trees in areas of desirable vegetation should be killed with herbicide, but remain in place to avoid unnecessary soil disturbance and provide snags for wildlife benefit. The Habitat Restoration Specialist will work with the grading crew to identify which individual trees should be removed.

Mechanical control: Small individuals of Mexican paloverde trees that are identified for removal by the Habitat Restoration Specialist should be removed by bulldozer or by pulling with a tractor to effectively remove all roots. Larger trees that are to be removed due to proximity to the river path should be cut down, and the stumps immediately treated with herbicide as described below. Seedlings should be pulled by hand or

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machine, as appropriate. Follow up removal will be necessary, as ground disturbance will encourage additional seedling germination and establishment.

Chemical control for trees that are to be removed due to close proximity to the river path: Immediately (within 15 seconds) after Mexican paloverde trees are cut as close to the ground as possible, the stumps should be treated with herbicide (picloram or triclopyr, trade name Access®, has been successfully used) to prevent resprouting. **Chemical control for trees that are to remain in place:** Holes are to be drilled near the base of the trunk, and picloram or triclopyr should be injected into the holes to kill the tree. Trees should be monitored to ensure that the herbicide is effective.

Treatment Schedule: Mexican paloverde trees can be removed and/or treated with herbicide during any season. Treatment should occur in conjunction with site preparation and grading activities. Follow-up control should occur at least twice per year.

3.1.3 Russian Thistle (*Salsola* sp.)

Russian thistle, which is also known as tumbleweed, is an annual that grows one to four feet tall. This common inhabitant of disturbed areas blooms from July to October. In the fall, the plant often breaks off at the ground and tumbles around dropping its seeds along the way. Russian thistle is a native to Eurasia. Russian thistle is prevalent throughout the disturbed portions of the project area, especially near the multi-use path.

Control: The Habitat Restoration Specialist shall locate and mark all specimens within Area 1. All Russian thistle individuals shall be removed by mechanical (preferred) or chemical control as described below prior to planting and seeding of the project area. Monitoring of the project area during the establishment period will be important to identify any infestations that may arise with initial soil disturbance. Russian thistle is shade intolerant (DeLoach *et al.* 1986) and will likely be shaded out as native vegetation becomes established and matures. In addition, its seeds do not have high viability or longevity (Parker 1972); seed germination from soil seed bank drops off sharply after the first year and was not found to occur after the third year in a four-year study conducted in Canada (Crompton and Bassett 1985).

Mechanical control: Russian thistle should be pulled by hand to remove the plant before the seed heads have formed. This species may need to be removed more than once in a growing season.

Chemical control: Russian thistle should be sprayed with the herbicide glyphosate when the plant is actively growing but prior to flowering. Herbicide applications should wet the plant thoroughly. Chemical control may be preferred in some situations to limit ground disturbance.

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Treatment Schedule: Control methods should be applied before the plants set seed and are actively growing. Seeds are produced during the summer; by fall the plant dries out, breaks off, and rolls away. Therefore, the optimal time to control Russian thistle is in the spring during active growth. Follow-up control should occur at least twice per year.

3.2 Invasive Species Likely to Invade the Project Area

The species described below are either present in areas adjacent to the project area; likely to be present within the seedbank, but not observed during the survey due to extremely dry conditions; or likely to invade the area with soil disturbance.

3.2.1 Giant Reed (*Arundo donax*)

Giant reed is a robust perennial grass nine to thirty feet tall, growing in many-stemmed, cane-like clumps, spreading from horizontal rootstocks below the soil, and often forming large colonies many meters across. The species reproduces vegetatively, either from underground rhizome extension or from plant fragments carried downstream, primarily during floods, to become rooted and form new clones. Large colonies of this species typically occur in low-gradient riparian areas and floodplains of medium-sized to large streams, and scattered colonies occur in moist areas or springs and on steeper slopes of dry riverbanks.

Giant reed displaces native plants and associated wildlife species because of the massive stands it forms (Bell 1994) and is also suspected of altering hydrological regimes and reducing groundwater availability by transpiring large amounts of water from semi-arid aquifers. As giant reed replaces riparian vegetation, it reduces habitat and food supply—particularly insect populations—for avian species (Frandsen and Jackson 1994) and reduces shade cover to the in-stream habitat leading to increased water temperatures and reduced habitat quality for aquatic wildlife (Franklin 1996). In addition, giant reed is highly flammable throughout most of the year and appears to be highly adapted to extreme fire events (Bell 1996; Scott 1994).

Control: Giant reed is not currently established in Area 1; however, it is common both upstream and downstream.

Prevention: Pima County should work with adjacent landowners to remove source populations in the area.

Mechanical control: Giant reed is likely to invade Area 1 in the future and should be immediately removed by the most appropriate of the following methods: hand pulling, chainsaw, machete, shovel, or backhoe. Early detection will enable removal of giant reed with the least amount of ground disturbance possible. Complete removal is

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necessary to prevent vegetative re-sprouting. Mechanical removal may need to be followed up with chemical control.

Chemical control: If giant reed becomes well-established before control is possible, it may be necessary to use herbicide. Glyphosate should be applied to clumps of giant reed after flowering (late summer) either as a cut stump treatment or as a foliar spray (Benton *et al.* 1998).

Treatment Schedule: Giant reed should be removed as soon as it is detected; seasonality is not important for mechanical removal, but herbicide application should occur once flowering is complete (late summer). Follow-up control should occur at least twice per year.

3.2.2 Bermuda Grass (*Cynodon dactylon*)

Bermuda grass is a turf-forming grass that spreads by seeds, stolons, and rhizomes. It is an early successional species that can become established more quickly than other species and it forms a dense turf that can preclude the growth of other species (AZ-WIPWG 2005b). This species is commonly found in mesquite bosque areas and should be anticipated as a target species for the Rillito River—Area 1 project area.

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Control: Bermuda grass is not currently established in Area 1; however, it is commonly used as a lawn grass both in the adjacent residential development and at St. Gregory's School. The following information on control of Bermuda grass is summarized from the University of California's Integrated Pest Management Pest Management Guidelines (Elmore and Cudney 2006).

Prevention: Bermuda grass can be shaded out with dense or complete canopy cover, although this will probably not be possible in the first stages of this project. Shaded growth will be fine and spindly; plants are easier to remove than those growing in full sun. Shade from short shrubs or ground covers will not be effective; Bermuda grass will simply grow up through these plants.

Mechanical control: Bermuda grass may be controlled with mulches of black polyethylene plastic or geotextile landscape fabric that block out all light if occurring in monotypic stands. The grass should be mowed and irrigated; plastic placed over the plants; and plastic left intact (without any holes) for at least 6 to 8 weeks in summer. It is important that the plastic remains intact without holes, or Bermuda grass will grow through the holes and survive. Placing plastic over Bermuda grass in winter will not control it.

Clear plastic mulching (solarization) is effective for eradication of Bermuda grass plants and seed, if it is applied during periods of high solar radiation. Before applying the plastic, closely mow the Bermuda grass, remove the clippings and water the area well. It

is not necessary to cultivate before solarization, but a shallow cultivation may improve control. Place clear, ultraviolet (UV) -protected polyethylene over the area. The plastic should extend roughly 2 feet beyond the Bermuda grass stolons to make sure that the infested area is covered; it must be maintained intact for 4 to 6 weeks. Shade will reduce the effectiveness of solarization, because it limits the amount of radiation. After solarization, do not cultivate the area deeper than 3 inches to avoid bringing invasive species' seed into the upper soil layer. Solarization is the only effective way to kill seeds in the soil.

Chemical control: Post-emergent herbicides can be used when Bermuda grass is actively growing (late spring—summer). Selective herbicides should be applied in early spring, when new Bermuda grass growth is less than 6 inches in length, then herbicides should be reapplied before the regrowth reaches 6 inches in length. Additional applications may be needed as new growth occurs. Label directions must be followed to ensure that any annual limits of application are not exceeded. Control is increased, if Bermuda grass is growing well with plenty of leaf area. Plants that are drought stressed, insect damaged, or with dust on the leaves will not be controlled.

Glyphosate (Rodeo®/Aquamaster® and other formulations) is a nonselective herbicide that kills both the tops of the plant and the roots. For it to be most effective, it must be applied to vigorously growing Bermuda grass that is not water stressed. Do not mow the Bermuda grass for 2 to 3 weeks before applying glyphosate and withhold water for 2 to 3 days after an application. For even more effective control, spray the area with glyphosate, leave it for up to 7 days, then cultivate the area to cut surface stolons and bring rhizomes to the surface to dry out. If the area isn't cultivated, another application of glyphosate may be necessary, when the invasive species begin to grow again.

Treatment Schedule: If using mulching methods to control Bermuda grass, application must occur during the hot summer months. Herbicide application should occur during vigorous, active growth (late spring—summer). Follow-up control should occur at least twice per year.

3.2.3 Fountain Grass (*Pennisetum setaceum*) and Buffelgrass (*P. ciliare*)

Fountain grass and buffelgrass are closely related bunchgrasses native to Africa that have spread extensively through the wildlands of the Sonoran Desert. Fountain grass is a commonly planted landscape ornamental in residential neighborhoods adjacent to the project area. Fountain grass spreads primarily along roads and washes where it can form solid stands. Fountain grass is a highly aggressive, fire-adapted colonizer that readily outcompetes native plants and rapidly reestablishes after burning (Benton 1997). Fountain grass reaches maturity in its first year of growth and has high reproductive

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potential. Seeds are produced every year in great quantity and remain viable in the soil for more than six years (Benton 1997).

Buffelgrass was introduced for livestock forage and reclamation applications in the 1930s and has since become an extensive problem in many different kinds of areas including roadsides, uplands, and within the urban core.

Control: Neither grass is currently established in Area 1; however, fountain grass is common in landscaped areas of the adjacent residential neighborhoods, and buffelgrass can be expected to invade with disturbance.

Prevention: Pima County should work with adjacent landowners to remove potential source populations in the area.

Mechanical control: Fountain grass and buffelgrass are likely to invade Area 1 in the future and if detected, individual plants should be immediately removed by shovel or digging bar. Inflorescences should be clipped and securely bagged prior to digging out the plant to reduce the number of seeds that escape.

Chemical control: Chemical control should not be necessary, because the project area is relatively small and easily accessible, and these species are not yet present. Early detection and mechanical eradication should control any infestations. If a serious problem develops before this is possible, application of glyphosate may be necessary.

Treatment Schedule: Follow-up control should occur at least twice per year.

3.2.4 Salt Cedar (*Tamarix spp.*)

Salt cedar (*Tamarix* spp.) is a rhizomatous rooted shrub that may occur as spotty to heavy infestations along drainages and shores of water bodies. The scale-like leaves have salt glands; flowers are small, white to deep pink, and densely packed on racemes. The bark is reddish-brown with smooth stems less than one inch in diameter. Salt cedar is native to Eurasia and Africa, and was used in the 1800s as erosion control, windbreaks, shade, and as an ornamental. It spreads by seed and vegetative growth. An individual plant can produce 500,000 seeds per year.

Presence of salt cedar can have devastating effects on native habitats and has been a pervasive problem across the American southwest for several decades. Some of the more profound effects include dramatic narrowing of stream channels and sediment trapping, lowering water tables, increases in soil salinity, fire frequency, plant community composition, and native wildlife diversity.

Control: Like many other invasive species, salt cedar spreads easily, but is difficult to eradicate. Therefore, early detection and control are critical to the successful control of

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this species. Post treatment monitoring is also essential, since salt cedar is capable of resprouting following treatment.

Mechanical Control: Removal by mechanical methods is not an effective means of controlling salt cedar, since it tends to resprout vigorously following cutting. Seedlings and small plants may be successfully uprooted by hand, if the entire root system can be removed.

Chemical Control: The most frequently used and effective method is to cut the salt cedar shrub near to the ground and immediately (in less than 30 seconds) apply a triclopyr or glyphosate herbicide to the cut stump. This technique usually results in a 90 percent kill rate.

Treatment Schedule: Salt cedar should be immediately eradicated upon detection. All cut vegetative material should be bagged and carried off-site. Follow-up control should occur at least twice per year.

4.0 Invasive Species Monitoring

The restoration site will be monitored both qualitatively and quantitatively for five years following the construction year, according to the directives outlined in the Maintenance and Monitoring Plan (Section 5 of this document). Areas that have been treated for invasive species should be closely monitored for resprouting and/or seedling germination; appropriate control methods should be promptly applied. The restoration area's cover of invasive plant species should not exceed an absolute value of 10 percent, and its cover of perennial invasive species should not exceed an absolute value of 0 percent.

5.0 Literature Cited

Arizona Wildlands Invasive Plant Working Group

2005a Invasive Non-Native Plants that Threaten Wildlands in Arizona. 23 pp.

2005b Plant Assessment Form for Cynodon dactylon. Accessed at http://www.usgs.nau.edu/swepic/swvma/plantpdf/Cynodon_dactylon_AZ_PAF.pdf on 1 March 2006.

Bell, G.

1996 Ecology and management of *Arundo donax*, and approaches to riparian habitat restoration in southern California. Pages104-114 in J.M. Randall and J. Marinelli (eds.), Invasive Plants: Weeds of the Global Garden. Brooklyn Botanic Garden Handbook. 149 pp.

Benton, N.
1997 Fountain grass (*Pennisetum setaceum* (Forsk.) Chiov.) Plant Conservation Alliance—Alien Plant Working Group (PCA-APWG) Alient Plant Datasheets. Available online at: http://www.nature.nps.gov/npci/epwg/pese1.htm (accessed 1 February 2006).

Benton, N., G. Bell, and J.M. Swearingen
1998 Giant Reed (*Arundo donax* L.). Plant Conservation Alliance—Alien Plant Working Group (PCA-APWG) Alient Plant Datasheet. Accessed at: http://www.nps.gov/plants/alien/fact/ardo1.htm on 1 February 2006.

Bossard, C. C., J. M. Randall, and M. C. Hoshovsky
2000 Invasive Plants of California's Wildlands. University of California Press.

Crompton, C.W. and L.G. Bassett
1985 The biology of Canadian Weeds 65. *Salsola pestifer* A. Nels. *Canadian Journal of Plant Science* 65:379-388.

DeLoach, C.J., P.E. Boldt, H.A. Cjordo [and others]
1986 Weeds common to Mexican and U.S. rangelands: proposals for biological control and ecological studies. Pages 49-68 in D.R. Patton, V. Gonzales, C.E. Medina, L. Alvin [and others] (technical coordinators), Management and Utilization of Arid Land Plants: Symposium Proceedings. February 18-22, 1985, Saltillo, Mexico. Gen. Tech. Rep. RM-135. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Elmore, C. L. and D. W. Cudney.
2006 University of California Integrated Pest Management Guidelines: Turfgrass. Pest Notes: Bermudagrass. UC ANR Publication 3365-T. Accessed at www.ipm.ucdavis.edu/ PMG/PESTNOTES/pn7453.html on 1 March 2006.

Frandsen, P., and N. Jackson
1994 The impact of *Arundo donax* on flood control and endangered species. Pages 13-16 in N. Jackson *et al*. *Arundo donax* workshop, California Exotic Pest Plant Council, San Diego, CA.

Franklin, B.B.
1996 Eradication/control of the exotic pest plants tamarisk and *Arundo* in the Santa Ynez River drainage. USDA-FS-PSW, Washington, DC.

Draft

Parker, K.F.
1972 An Illustrated Guide to Arizona Weeds. The University of Arizona Press, Tucson, Arizona. 338 pp.

Scott, G.D.
1994 Fire threat from *Arundo donax*. Pages 17-18 in N. Jackson *et al*. *Arundo donax* workshop, California Exotic Pest Plant Council, San Diego, California.

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Stormwater Pollution Prevention Plan for the Rillito River Ecosystem Restoration and Environmental Project—Area 1

1.0 Introduction

A Stormwater Pollution Prevention Plan (SWPPP) defines the measures to be employed to prevent the release of pollution from a specific construction site into waterways. The SWPPP identifies the techniques that will be used to reduce site erosion and sediment loss, as well as manage construction-related wastes. It identifies the maintenance procedures that will be performed to preserve the efficiency of the techniques used.

The SWPPP supports compliance with the Arizona Pollutant Discharge Elimination System General Permit for Discharge from Construction Activities to Waters of the United States, administered by the Arizona Department of Environmental Quality (ADEQ) pursuant to the Clean Water Act (ADEQ 2003).

This SWPPP will not be submitted to ADEQ, however it must be available on-site or nearby for inspection by the regulatory agency personnel, local jurisdiction staff, and the public upon request. The SWPPP is a "living document" that must be updated as conditions on the construction site change. Compliance checks by the permitting authority are normally based on completeness and accuracy of the record keeping in the SWPPP. SWPPP records must be maintained a minimum of 3 years after the permit coverage ends.

2.0 Background

Development, implementation, and maintenance of this SWPPP will provide NAC Construction with the framework for reducing soil erosion and minimizing pollutants in stormwater during construction of the Rillito River Ecosystem Restoration and Environmental Project – Area 1 (hereafter referred to as "Rillito Riparian – Area 1"). The SWPPP will:

- Describe the existing site conditions including existing land use for the site, soil types at the site, as well as the location of surface waters which are located on or next to the site;
- Identify the body of water(s) which will receive runoff from the construction site, including the ultimate body of water that receives the stormwater;

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- Describe the site plan for the facility to be constructed;
- Identify drainage areas and potential stormwater contaminants;
- Describe stormwater management controls and various Best Management Practices (BMPs) necessary to reduce erosion, sediments, and pollutants in stormwater discharge;
- Describe the implementation schedule and provide amendments for the plan.
- Identify the SWPPP coordinator with a description of this person's duties; and
- Identify the SWPPP support team that will assist the coordinator in implementation of the SWPPP during construction.

3.0 Project Description

3.1 Site Location

The Rillito Riparian – Area 1 site is located on the southern bank of the Rillito River in Tucson, Arizona (Figure 1). The project area consists of an 8.6-acre parcel located in Section 26 of Township 13 South, Range 14 East, Gila & Salt River Meridian. The triangular-shaped parcel is bound on the north by the Rillito River, on the west by a vacant parcel, on the east by St. Gregory's High School, and on the south by residential neighborhoods.

3.2 Construction Type

NAC Construction has been contracted to construct a habitat restoration project on the site. The project will consist of the removal of invasive shrub and tree species, minor grading activities to create small rainwater catchment basins, and the installation of plant materials and associated irrigation system components. Installation of an asphalt path and decomposed granite trail is also included. NAC Construction and its various subcontractors will be on site from approximately 7 A.M. until 5 P.M., five days per week. Construction activities are expected to be complete within 180 days following groundbreaking.

3.3 Existing Site Conditions

The 8.6-acre parcel currently consists of pockets of mesquite/blue paloverde bosque with interspersed areas of disturbed strand vegetation. A portion of the Rillito River multi-use path transects the project area at its northern end. The western portion of the

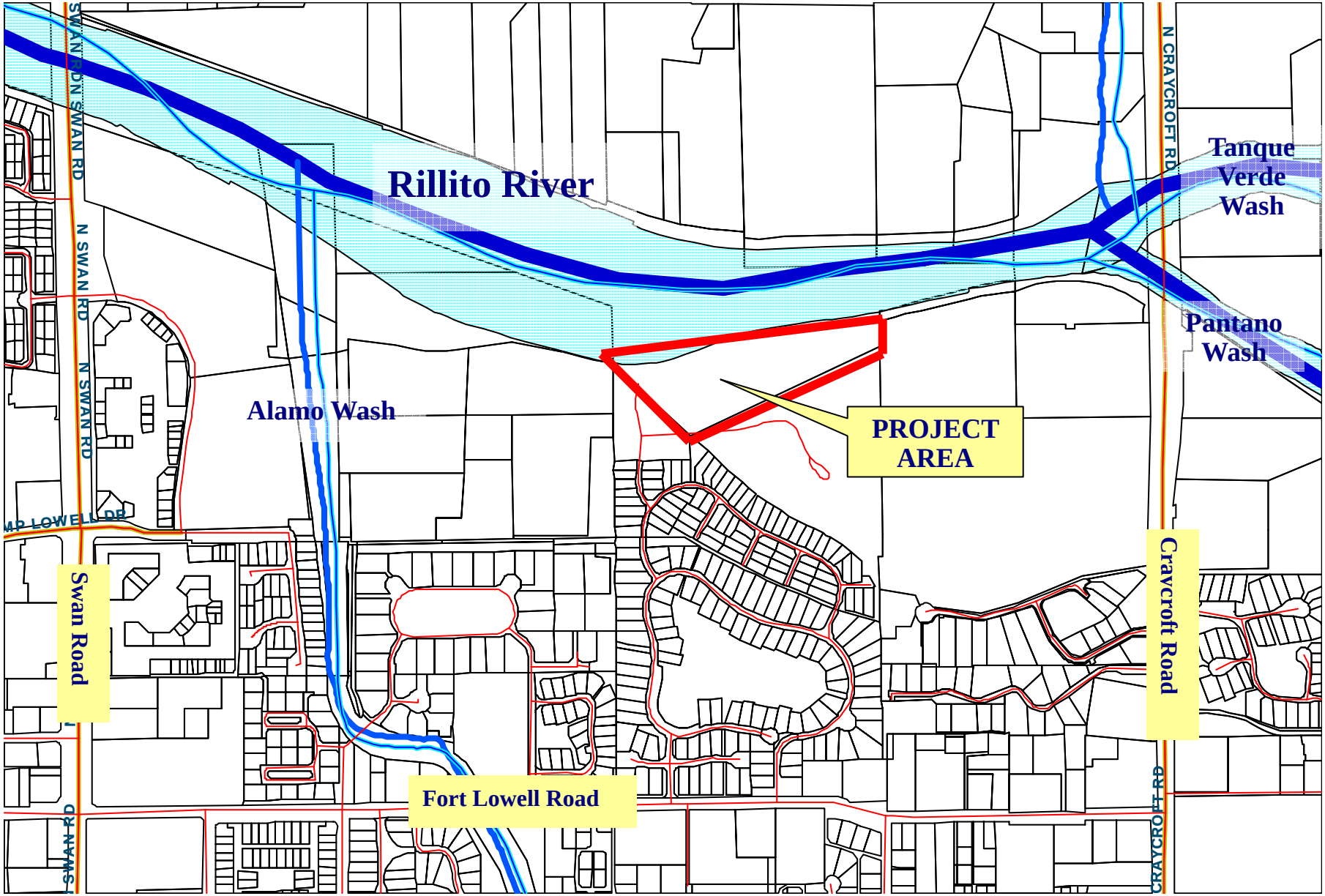

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Figure 1
Location Map

existing path is paved and the eastern portion is composed of decomposed granite. Currently, area residents use the project area for passive recreation and open space activities. The undeveloped parcel creates an aesthetically pleasing natural buffer between the residential areas and the Rillito River.

The parcel slopes gently from the east to the west, at 0 to 3 percent. A relatively steep channelized wash occurs at the eastern boundary. This drains only the extreme eastern portion of the project area. An unchannelized wash near the western boundary drains the majority of the surface flow from the project area. Both washes empty directly into the Rillito River, adjacent to the project area.

Currently, the paved portion of the Rillito River multi-use path occupies approximately 4,000 square feet (500 feet long X 8 feet wide). The proposed new asphalt path will be installed on top of the existing soil cement bank and will therefore not result in a net gain of paved or hard-surface area. The new decomposed granite path will be of material permeable to stormwater.

A site's run-off coefficient takes into consideration the imperviousness/permeability of a site based on slope, surface characteristics, and soil type. The closer the run-off coefficient is to 1.0 the more impervious the condition, and hence, a higher rate of run-off. The run-off coefficient for the project area is estimated to be between 0.1 and 0.2, based upon coefficients calculated for other sites with moderately well-drained soils on relatively flat slopes in rural and suburban areas (Strom *et al*. 2004).

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One soil type is found within the site: Glendale Silt Loam, 0 to 3 percent slopes (USDA NRCS 1993):

Glendale Silt Loam, 0 to 3 percent slopes—This series consists of very deep, well-drained soils formed in stratified alluvium. Glendale soils are found on alluvial fans, flood plains, and stream terraces. Run-off is medium, and permeability is moderately slow. The soil moisture regime is typically aridic and is driest during May and June.

3.4 Site Plan

The Rillito Riparian—Area 1 project will enhance the current site values of recreation, wildlife habitat, groundwater recharge, aesthetics/open space. Passive stormwater harvesting micro-basins are designed to support a xeroriparian vegetation community's greater biodiversity than is supported by the currently degraded conditions.

Figure 2 is a site map showing property boundaries, the proposed limits of clearing and grading, and areas of additional trail pavement. A total of approximately 1 acre of area will be graded during construction activities. All exposed soils will be reseeded and new vegetation will be planted immediately following grading activities. Figure 2 also shows

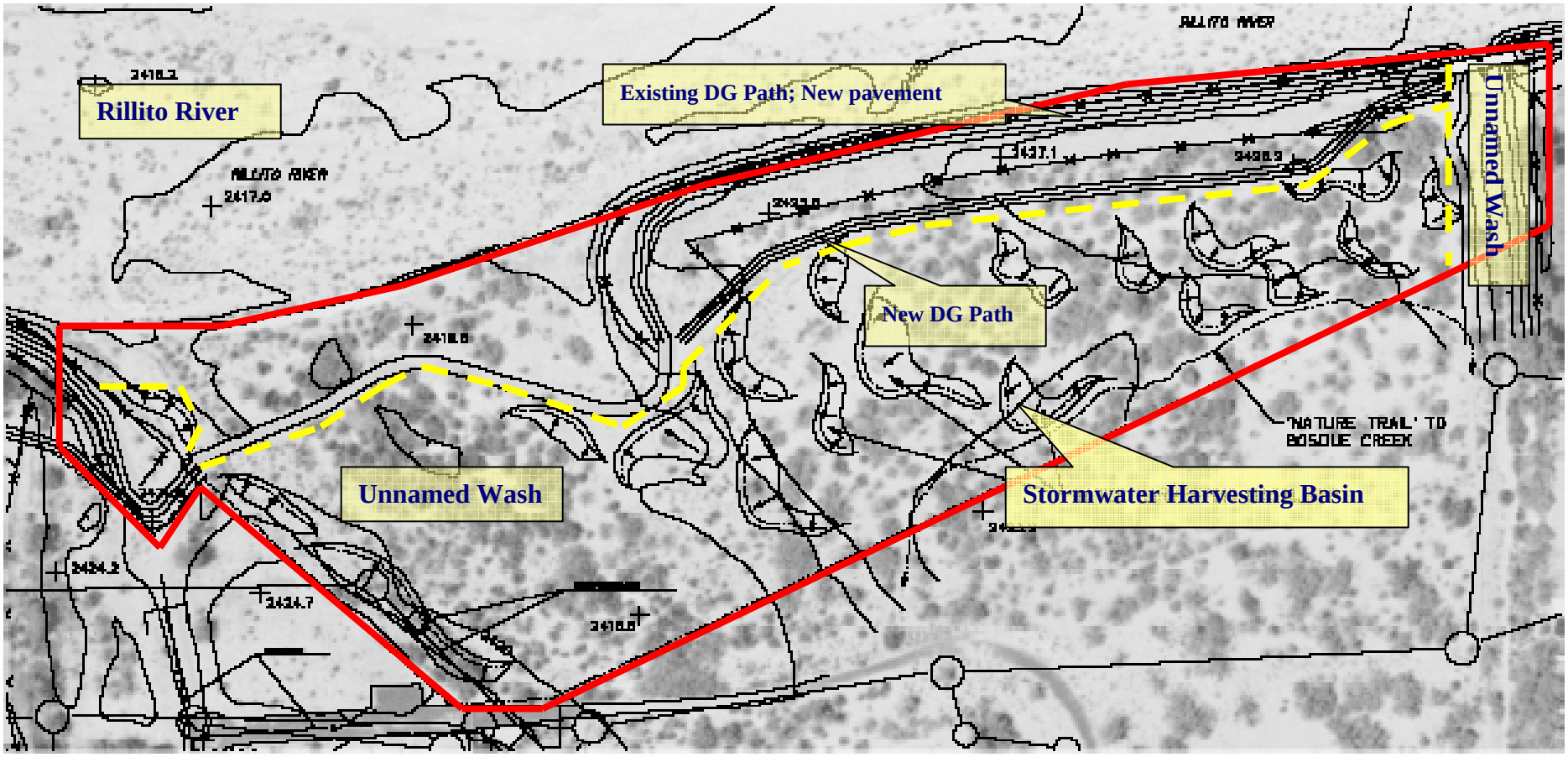

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Figure 2
Site Features

the locations of the various drainage areas and the apparent stormwater drainage patterns.

The water supply for the restoration project will be non-potable, secondary-treated wastewater from the reclaimed water distribution system. The point of connection will be near an existing line near Fort Lowell Road and Columbus Boulevard. An irrigation mainline will be installed from this point of connection to the south bank of the Rillito River and east to this project, Area 1. This water will be applied to the soil surface around all new plantings. No off-site runoff of irrigation water is anticipated. On-site stormwater runoff will be directed to the restoration areas via passive stormwater harvesting micro-basins.

3.5 Sequence of Soil-disturbing Activities

The Rillito Riparian—Area 1 project would entail three straightforward phases of activity that would require soil disturbance as outlined in the grading, planting, and irrigation plans (Section 2) of this document:

1. Removal of invasive vegetation;
2. Grading to create water harvesting basins;
3. Minor trenching to install the underground irrigation lines; and digging holes for plantings.

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4.0 Identification of Potential Stormwater Contaminants

The purpose of this section is to identify pollutants that could impact stormwater during construction of the facility.

4.1 Significant Material Inventory

No toxic materials are known by Pima County Regional Flood Control District to have been treated, stored, disposed of, spilled, or leaked on the site in significant quantities. Pollutants that may result from clearing, grading, excavation, and restoration landscape installation that could have the potential to be present in stormwater runoff are listed in Table 4.1. This table includes information regarding material type, chemical and physical description, and the specific regulated stormwater pollutants associated with each material.

TABLE 1
POLLUTANTS POTENTIALLY PRESENT IN STORMWATER DISCHARGES

Pollutant	Source
Petroleum Products	
Diesel, oil, and grease	Daily operation of machinery and heavy equipment
Asphalt and tar	Paving operations (multi-use path)
Other Organic Compounds	
Fertilizers	Landscaping installation and maintenance
Herbicides	Landscaping installation and maintenance
Sedimentation	
Sediments	Grading, land clearing, daily operation of site, and erosion from stormwater runoff
Trash	
Debris, Trash, Litter, etc.	All construction activities and phases, including off-site construction

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4.2 Potential Areas for Stormwater Contamination

The following potential source areas of stormwater contamination were identified:

- Cleared and graded areas;
- Daily operation of machinery and equipment;
- Paving operations; and
- Areas to be treated with herbicides and fertilizers.

5.0 Best Management Practices

Best Management Practices (BMPs) are operational activities (non-structural BMPs) or physical controls (structural BMPs) that reduce the discharge of pollutants and minimize potential impacts upon receiving waters when properly implemented, operated, and maintained. Many of the BMPs for the Rillito Riparian—Area 1 project are implicit to the site design features as the goals of the project (i.e., habitat restoration and stormwater infiltration) are compatible with erosion, sediment, and pollutant control.

The BMPs included in this SWPPP include temporary and permanent erosion and sediment controls that will be used during project design and implementation. The controls will provide soil stabilization for disturbed areas and structural controls to divert runoff and remove sediment. The BMPs also address control of other potential

stormwater pollutant sources such as waste disposal, control of vehicle traffic, and sanitary waste disposal.

A list of BMPs has been developed and the locations of these BMPs are shown in Figure 2. A number of the BMPs included in this SWPPP have been developed to serve as post-construction stormwater controls.

5.1 Non-structural BMPs

5.1.1 Construction Practices to Minimize Stormwater Contamination

Indications of contaminated soils include discoloration, odor, or unusual soil properties, which may be observed during site operation. The discovery of buried debris or trash also would be an indication of potential contamination.

If contamination is suspected, test for pollutants, and call Pima County Regional Flood Control District (520.740.6350) and the Arizona Department of Environmental Quality (800.243.5677) immediately.

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Contractor will use the following specific BMPs to prevent and control pollution from toxic materials:

5.1.1.1 Vehicle and Equipment Service

In order to prevent and control leaks from equipment and vehicles, and to minimize the possibility of toxic pollutant discharge, the following practices will be implemented:

- No vehicle or equipment staging areas will be allowed on-site.
- No maintenance or repair of equipment/vehicles will be allowed on-site. Equipment/vehicles needing maintenance or repair will be transported off-site.
- No asphalt or petroleum products will be stored on-site. During asphalt path construction, only the material being immediately applied to the new alignment will be allowed on-site. Any excess material will be immediately removed.
- No refueling of equipment will occur on-site.
- Vehicles and equipment used for grading and planting will be the minimum size necessary to complete the task. No vegetation removal, other than of specifically designated invasive species (in accordance with the Invasive Species Management Plan, Section 3 of this work plan), will be allowed.

5.1.1.2 Material Delivery, Handling, and Storage

Good housekeeping and spill control practices will be followed during construction to minimize stormwater contamination from petroleum products, fertilizers, and any other contaminant sources. In order to minimize the potential of polluting runoff, the following procedures will be implemented:

- All employees will be trained in proper material delivery, handling, and storage practices, during the weekly safety meetings.
- No hazardous materials or fertilizers will be stored on-site.
- No storage of irrigation components, pipes and materials, other than what can be installed that workday will be allowed on-site at any given time.
- No storage of plant materials other than what can be installed that workday will be allowed on-site at any given time.
- Fertilizers will be applied sub-grade at the time of plant installation, only in the minimum amounts recommended by the manufacturer.

5.1.1.3 Accident Response

- Materials and equipment necessary for spill cleanup will be kept on-site during working hours. Equipment will include but will not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, saw dust, and plastic and metal trash containers.
- All spills will be cleaned up immediately upon discovery. Spills large enough to reach the Rillito River or storm sewers will be reported to the National Response Center at 800.424.8802.

5.1.1.4 Sanitary/Septic Waste Management

- Portable toilets will be supplied from a licensed company that has a waste disposal permit. Toilets will be sited away from storm drains and areas draining to the Rillito River. All sanitary waste will be collected from the portable units a minimum of two times per week by a licensed sanitary waste management contractor. Units will be serviced regularly as needed. Facilities will be inspected weekly for leaks.
- No construction materials will be buried on-site.
- All waste materials will be collected and stored in a securely lidded metal dumpster rented from a licensed local solid waste management company. The

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dumpster will be emptied a minimum of twice per week, and the trash will be hauled to an off-site landfill.

- Dump trucks hauling material from the construction site will be covered with a tarpaulin.

- The paved street adjacent to the site entrance will be swept daily to remove excess mud, dirt, or rock tracked from the site.

5.1.1.5 Employee Training

An employee training program will be developed and implemented to educate employees about the requirements of this SWPPP. This education program will include background on the components and goals of the SWPPP and hands-on training in erosion controls, spill prevention and response, good housekeeping, proper material handling, disposal and control of waste, equipment fueling, and proper storage, washing, and inspection procedures. All employees will be trained prior to their first day on the site.

5.1.2 Site Design

Several aspects of the site design incorporate permanent stormwater pollution prevention controls:

- Stormwater harvesting microbasins will be excavated such that material is cut from the higher elevation of the basin and filled along the lower elevation area in a low berm, according to the parameters set forth in the grading plan. Cut and fill will be balanced on-site and within each basin, and no fill/spoil material will be generated.

- Preservation of existing areas of desirable native vegetation will slow and disperse stormwater run-off while the project is implemented.

- Once all planting and irrigation installation is complete, all unpaved, non-concrete, graded, or otherwise disturbed areas within the project boundaries shall be hydroseeded according to the specifications of the landscape plan.

5.2 Structural BMPs

Measures to control temporary impacts possible during project implementation will be necessary. To prevent soil from washing into the Rillito River, undisturbed areas of the site, or to adjacent properties, the following structural BMPs will be implemented:

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- Silt fencing will be placed along the perimeter of the area to be cleared and graded before any clearing or grading takes place.
- Contractor shall install erosion control blanket on areas where otherwise unprotected slopes are steeper than 4:1. Material shall be applied according to the specifications in the grading plan (see Section 2.1).
- Surface area within the final approved stormwater harvesting microbasins will be raked, and the surface materials (i.e., rock, woody debris, and vegetative materials) will be set aside priori to basin excavation. Upon completion of excavation and installation of the plant materials and irrigation, the salvaged material will be distributed over the new soil surface.
- All cleared and graded soils will be sloped toward water-harvesting micro-basins.
- Areas of the site which are to be paved (new multi-use path alignment) will be temporarily stabilized by applying geotextile and stone sub-base, until asphalt is applied.

5.3 SWPPP Coordinator and Duties

The construction site SWPPP coordinator for the facility is Mr. Allen Sheppard (phone number: 520.682.2855) with NAC Construction, Inc. Mr. Sheppard will have operational control over construction plans and specifications, and will have the authority to make modifications to them as necessary. His duties as SWPPP coordinator include the following:

- Implement the SWPPP plan with the aid of the SWPPP team;
- Oversee maintenance practices identified as BMPs in the SWPPP;
- Implement and oversee employee training;
- Conduct or provide for inspection and monitoring activities;
- Identify other potential pollutant sources and make sure they are added to the plan;
- Identify any deficiencies in the SWPPP and make sure they are corrected; and
- Ensure that any changes in construction plans are addressed in the SWPPP.

To aid in the implementation of the SWPPP plan, members of the SWPPP team will also include other NAC personnel and a representative from RECON Environmental. Team

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members will ensure that all housekeeping and monitoring procedures are implemented and the integrity of the structural BMPs continued.

5.4 Coordination of BMPs with Construction Activities

Structural BMPs will be coordinated with construction activities so they are in place before construction begins. The following BMPs will be coordinated with construction activities:

- Temporary perimeter controls consisting of silt fencing will be installed before any clearing or grading begins.
- No vegetation removal or grading will occur, until authorization is given for construction to proceed.
- Basin grading areas will be revegetated with container plantings and seed (according to the planting plan [Section 2 of this document]) following approval of basin grading.
- The temporary perimeter controls (silt fencing) will not be removed until all construction activities at the site are complete and soils have been stabilized.

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5.5 Certification of Compliance with Federal, State, and Local Regulations

This SWPPP reflects Pima County requirements for stormwater management and erosion and sediment control, as established in the Floodplain and Erosion Hazard Management Ordinance (Title 16 of the Pima County Code). The project area is not within a regulatory floodway or sheet flood zone; however it is within an identified Important Riparian Area.

5.6 Maintenance, Inspection, and Amendment Procedures

Visual inspections of all cleared and graded areas of the construction site will be performed daily and within 24 hours of the end of a storm with rainfall amounts greater than 0.5 inch. The inspection will be conducted by the SWPPP coordinator and/or by his designated SWPPP team members. The inspection will verify that the structural BMPs described in this SWPPP are in good condition and minimizing erosion. The following inspection and maintenance practices will be used to maintain erosion and sediment controls:

- Built up sediment will be removed from silt fencing, when it has reached one-third the height of the fence.

- Silt fences will be inspected for depth of sediment, for tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.

- The stabilized construction entrance will be inspected for sediment tracked on the road and that all traffic uses the stabilized entrance when leaving the site.

A maintenance inspection report will be made weekly. A copy of the report form to be completed by the SWPPP coordinator is provided as Attachment 2 of this SWPPP. Completed forms will be maintained on-site during the entire construction project. Following construction, the completed forms will be retained at the office of NAC Construction for a minimum of 1 year. If construction activities or design modifications, which could impact stormwater, are made to the site plan, this SWPPP will be amended appropriately within 15 days. The amended SWPPP will have a description of the new activities that contribute to the increased pollutant loading and the planned source control activities.

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6.0 Literature Cited

Arizona Department of Environmental Quality
2003 Arizona Pollutant Discharge Elimination System General Permit for Discharge from Construction Activities to Waters of the US. Permit # AZG2003-001.

Strom, S., K. Nathan, and J. Woland.
2004 Site Engineering for Landscape Architects. John Wiley & Sons. 338 pp.

USDA NRCS
1993 Soil Survey of Pima County, Arizona, Eastern Part. Accessed on the web at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx (February 6, 2006).

ATTACHMENTS

ATTACHMENT 1
CERTIFICATION

Certification

Preparer Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature:

Name: Lori Jones Woods

Title: Principal, RECON Environmental

Date:

Contractor Certification (NAC Construction - General Contractor)

I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the stormwater discharges associated with industrial activity from the construction site identified as part of this certification.

Signature:

Name: Allen Sheppard

Title: Vice President, NAC Construction

Date:

ATTACHMENT 2
AMENDMENTS TO SWPPP

ATTACHMENT 2
AMENDMENTS TO SWPPP

Amendment No.	Location	Description	Reason	Sections Amended	Amended by	Amendment Date

ATTACHMENT 3
INSPECTION REPORT FORM

Construction Storm Water Inspection Report

Construction Site Information

AZPDES Permit No. TNR _____ Notice of Coverage (NOC) Date _____ County _____

Name of Project _____

Developer and/or Contractor Name _____

Outfall Point _____ (or station number or other identifier of drainage area represented)

Month/Year	Week 1	Week 2	Week 3	Week 4	Week 5
	Yes or ***No*** / Initials	***Yes*** or ***No*** / Initials	***Yes*** or ***No*** / Initials	***Yes*** or ***No*** / Initials	***Yes*** or ***No*** / Initials
January, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
February, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
March, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
April, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
May, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
June, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
July, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
August, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
September, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
October, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /

Construction Storm Water Inspection Report

Construction Site Information

Month/Year	Week 1	Week 2	Week 3	Week 4	Week 5
	Yes or ***No*** / Initials	***Yes*** or ***No*** / Initials	***Yes*** or ***No*** / Initials	***Yes*** or ***No*** / Initials	***Yes*** or ***No*** / Initials
November, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
December, _____	Date:	Date:	Date:	Date:	Date:
Inspections Performed	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /
E&S Controls in Order	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /	***Yes*** or ***No*** /

Provide the following information for the person(s) who have performed and initialed the above inspections. If more than two persons have performed these inspections, give information for the two persons who performed the most numbers of inspections.

Initials _____	Name _____	Phone No. (____)
Initials _____	Name _____	Phone No. (____) _____

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated information presented. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, I certify that inspections of storm water discharge points (outfalls) and of erosion and sediment controls have been performed as recorded in the table above. I certify that erosion and sediment controls in the drainage area of the identified outfall were installed as planned and designed and in working order as recorded in the table above. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name_____Title_____Signature _____
Company_____ Date _____

Information and Instructions

1. The purpose of this form is to report inspections of storm water discharge points and the condition of erosion and sediment controls (E&S Controls) at the construction site. You can determine whether you are discharging to a listed stream by looking at the Notice of Coverage (NOC) returned to you after you applied for the construction runoff permit.

2. You are required to inspect outfall points (where discharges from the site enter streams or wet weather conveyances) to ascertain whether your erosion control measures are effective in preventing soil from leaving the construction site and entering nearby streams. You are also required to inspect the erosion and sediment control measures being used at the site, whether these controls have been installed according to the storm water pollution prevention plan and whether these controls are in working order. These inspections are required at least once per week.

3. For each month, spaces are given for every week of the month. To record the inspections and observations for a given week, write the date on which the inspections were performed in the box labeled "Date:". In the two boxes immediately below the Date: box, circle *Yes* or *No* to indicate if the inspections of outfall points and of the erosion and sediment control measures were performed, and circle *Yes* or *No* to indicate if erosion and sediment controls were in place and in working order. Sign your initials beside the yes or no answers that you give.

4. The inspection results shall be submitted (postmarked) by the 15th day of the month following the end of the quarter, to the Environmental Assistance Center responsible for the area of the state where the construction project is located. Quarters are January – March, April – June, July – September, and October - December. Continue to use the same form, submitting it with original signatures each quarter, until the end of the year or until the Notice of Termination is filed.

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Monitoring and Maintenance Plan for the Rillito River Ecosystem Restoration and Environmental Project—Area 1

1.0 Performance Standards for the Target Dates and Success Criteria

The restoration site will be monitored by the Habitat Restoration Specialist both qualitatively and quantitatively for five years following the construction year. This person will have a minimum of a Bachelor's degree in a natural resources-related field, and five years of experience in similar efforts.

The performance goals will evaluate plant species diversity and density relative to the design parameters. The habitat restoration will be considered successful, if the restoration site achieves values of at least 75 percent of the design parameters and at least 60 percent total cover by Year 5. In addition, the restoration area's cover of exotic plant species will not exceed an absolute value of 10 percent, and its cover of perennial invasive species should not exceed an absolute value of 0 percent. Table 1 presents the specific performance criteria.

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TABLE 1
DESIGN PARAMETERS PER PLANTING PLAN

Post-Restoration Vegetation Community	Density			Diversity
	Trees/Acre (24" box and 15-gal)	Shrubs/Acre (5-gal)	Grasses, Forbs, and Vines/Acre (1-gal)	Number of Species in Planting Palette and Seed Mix
Basin and Wash Area (Mesquite—Paloverde Bosque)	48	60	64	17
Enhancement Area (Mesquite—Paloverde Bosque)	-	60	64	17
Upland (Xeroriparian)	26	90	50	24

2.0 Target Functions and Values

By satisfying the performance standards, the restoration site indicates that it is establishing itself as self-sustaining habitat that is equivalent in form, function, and value of a natural, undisturbed xeroriparian site. Moreover, the restoration site must sustain itself for a minimum of one year (meeting Year 5 performance standards of 75 percent of performance design parameters) in the absence of significant maintenance measures.

The performance standards described in Table 2 for achieving species diversity and density will be based on a relative percentage of design parameters outlined in the grading, planting, and irrigation plan (Section 2 of this document). For example, if the design parameters included 50 trees per acre, after five years of monitoring the mitigation site must reach 75 percent of that value (i.e., 37.5 trees per acre). Each restored vegetation community will be considered to meet the diversity criteria, if it contains at least 75 percent of the species included in the design parameters after five years. The values presented for Years 2 through 4 in Table 6 are recommended goals to be used in obtaining the performance standard for Year 5. Within each habitat, cover of exotic plant species will not exceed an absolute value of 10 percent of annual invasive species and 0 percent cover of perennial invasive species.

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TABLE 2
PERFORMANCE GOALS AND STANDARDS

	Relative Percentage of Design Parameters		Absolute Value		
Year	Density	Diversity	Total Cover	Cover of Annual Invasives	Cover of Perennial Invasives
1*	–	–	–	<10%	0%
2	50%	60%	30%	<10%	0%
3	60%	70%	40%	<10%	0%
4	70%	75%	50%	<10%	0%
5	75%	75%	60%	<10%	0%

*Quantitative measurements are not recommended during Year 1 as the area is newly planted.

3.0 Monitoring Methods

Specific management and monitoring activities will track changes over time and measure conditions against the success standards. Parameters for monitoring activities are grouped into two levels, qualitative and quantitative, based on the level of effort and type/intensity of data collection.

3.1 Quantitative Monitoring

Unlike qualitative monitoring, which provides rapid assessments that can be repeated regularly, quantitative monitoring is a more intensive approach that measures specific attributes via sampling methodologies to produce quantifiable data. Quantitative monitoring will occur regularly to provide an unbiased assessment of vegetation conditions.

3.1.1 Transects

Cover, density, and diversity are parameters that will reflect the habitat value of the restored vegetation communities within the Rillito Riparian—Area 1 project area. Monitoring of these parameters will track how the restoration effort performs over time.

Five permanent monitoring transects have been established in the project area. Transect locations were chosen to capture the range of pre- and post-restoration vegetation communities. The start and end points of each transect are marked in the field with rebar stakes including labeled orange plastic safety caps as well as UTM coordinates (Table 3 and Figure 1).

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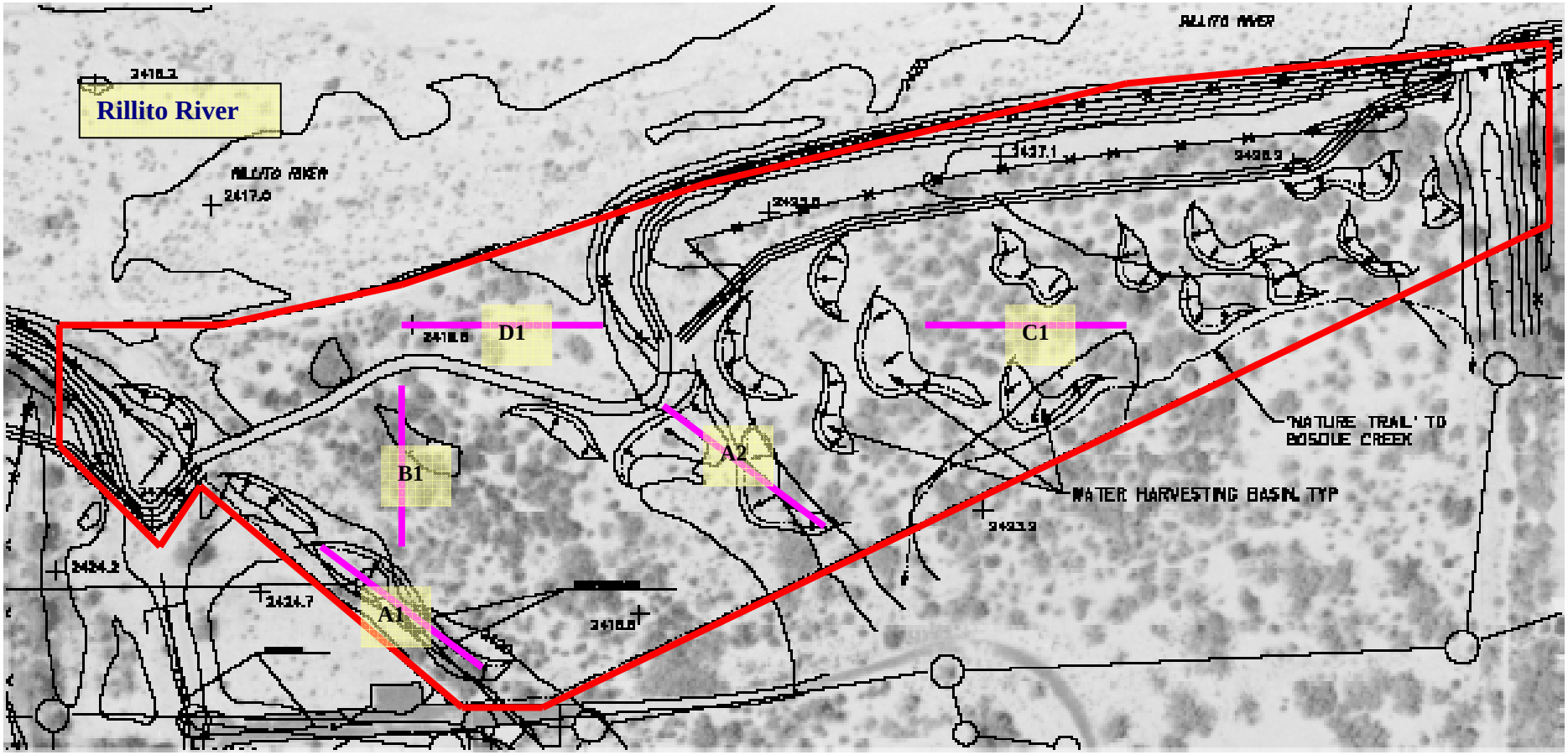
Monitoring transects will be evaluated according to the point-intercept method. This method is easily repeatable (any two people should get similar results), easy to learn, and efficient. Measuring cover by this method is also considered to be the least biased of typical methods (Bonham 1989; Barbour *et al*. 1987). The method is based on a 50-meter point-transect centered on a 2×50-meter plot. Using this method, vegetation is sampled by points at 0.5-meter intervals along the 50-meter transect to determine cover. The surveyor will note the species encountered at each interval. In addition, individuals of each perennial species rooted within the 2×50-meter plot will be counted to determine shrub density and diversity. All annuals present in the 2×50-meter plot will also be noted.

TABLE 3
TRANSECT DESCRIPTIONS

Tran-sect	Pre-Restoration Vegetation Community	Post-Restoration Vegetation Community	Transect Start UTM (NAD 1983)	Transect End UTM (NAD 1983)
A1	Desert Broom–Burrowbrush	Mesquite–Paloverde Bosque	0511052 E 3570005 N	0511014 E 3570034 N
A2	Desert Broom–Burrowbrush	Mesquite–Paloverde Bosque	0511105 E 3570060 N	0511131 E 3570013 N
B1	Wash–Mixed Broom and Bosque	Mesquite–Paloverde Bosque	0511031 E 3570070 N	0511038 E 3570022 N
C1	Mesquite–Paloverde Bosque	Enhanced Mesquite–Paloverde Bosque	0511212 E 3570113 N	0511257 E 357012 N
D1	Desert Broom–Burrowbrush	Upland	0511023 E 3570093 N	0511075 E 3570092 N



Project Area

Transect

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Figure 1
Approximate Transect Locations

Vegetation sampling will be repeated annually during the months of February or March beginning in the second year of project implementation. The purpose of sampling during this time period is to record maximum species diversity and to consistently conduct sampling during the same of the year to allow comparison of findings between years. Also baseline data were collected in February and March of 2006 and are presented in Attachment 2.

3.1.2 Mosquito Monitoring

Pima County Regional Flood Control District conducted baseline mosquito monitoring during the summer of 2005 to collect data on mosquito diversity and abundance prior to the implementation of the habitat restoration project. Although the project has been designed to minimize standing water availability for mosquito breeding, it will involve the manipulation of drainage patterns, and therefore, mosquito monitoring is an appropriate public health component to the quantitative monitoring plan.

Adult mosquito trapping will be conducted on a bi-weekly basis during the active mosquito season for at least 12 trapping sessions between May and October for the first five years after implementation. Trapping protocols will follow those established in the 2005 Mosquito Monitoring Report (RECON 2005).

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3.2 Qualitative Monitoring

Qualitative monitoring is subjective and/or general and provides information such as presence or absence of specific plant species, hydrology indicators, or a general assessment of site conditions. Qualitative monitoring will initially be performed to evaluate transplant health, non-native species presence, and to identify (and correct) problems as they arise to ensure successful habitat restoration. Qualitative monitoring tracks the quality of the newly established resources as well as identifies maintenance needs.

Qualitative monitoring will be used to inform site maintenance needs for items including, but not limited to:

- Proper irrigation system function;
- Stormwater harvesting basin function and removal of sediment if necessary;
- Removal of litter and debris;
- Invasive species management needs; and
- Replacement of container plants and reseeding to compensate for mortality, monitoring areas damaged by large storm flows and/or for vandalism.

Following the completion of the implementation period, qualitative monitoring will continue as part of the adaptive management for the restoration site. Monitoring will include photographing the site from precisely documented locations at specific (regular) times of the year in conjunction with the quantitative vegetation monitoring that is described above. The purpose of this form of monitoring is to visually document the changes in a landscape over a period of time. The Habitat Restoration Specialist will keep a site journal to document changes and adaptive measures taken to address problems. Any negative changes, such as large-scale non-native plant invasions or high native plant mortality, will be immediately addressed through consultation with field staff and the Habitat Restoration Specialist, and followed by actions to repair the system. Negative changes that may directly affect state or federally listed species (such as the identification of non-native wildlife) will be immediately reported to the appropriate agency (U.S. Fish and Wildlife Service and/or Arizona Game and Fish Department).

Human impacts, which include trampling, trash dumping, frightening wildlife, and introducing unwanted pets, should also be monitored. If humans are having a negative impact, solutions such as planting of defensive vegetation such as cacti or mesquite, changing fence type, and increasing the active presence of law enforcement may be necessary. It may also be useful to monitor positive aspects of human use for purposes of adaptive management and publicity (University of Washington Restoration Ecology Network 2002).

Qualitative monitoring will occur daily during the implementation period, bi-weekly for the first six months following implementation, monthly for the next two years, and quarterly (every three months) thereafter until the completion of habitat restoration.

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3.2.1 Photographic Monitoring

Each sampling site will be photographed during the February—March transect monitoring period, as well as during September—October. This photographic monitoring schedule will capture seasonal changes in the flora. At each transect start point, photos will be taken at due north and south directions. At each transect the end points, photos will be taken due east and west (Table 4). This will result in 40 photos per year.

TABLE 4
PHOTOGRAPHIC MONITORING SCHEDULE

Years 1–5	Transect Start	Transect End
February–March	Photos Due North and South	Photos Due East and West
September–October	Photos Due North and South	Photos Due East and West

Baseline photos were taken in March of 2006 and are archived on a CD (Attachment 3).

4.0 Monitoring Schedule

The monitoring period will begin with implementation of the restoration work and will continue for five years or until the restored vegetation has met performance standards. The monitoring program will be conducted by the Habitat Restoration Specialist as outlined in Table 5.

TABLE 5
MONITORING SCHEDULE

Type/Task	Qualitative Monitoring	Vegetation Monitoring Transects	Photo-monitoring	Mosquito Monitoring
Preimplementation	-	February–March 2006	March 2006	Bi-weekly May–October 2005
Implementation	Daily	-	-	-
Year 1 (2007)	Bi-weekly/Monthly	-	-	Bi-weekly May–October
Year 2 (2008)	Monthly	February–March	February–March and September–October	Bi-weekly May–October
Year 3 (2009)	Quarterly	February–March	February–March and September–October	Bi-weekly May–October
Year 4 (2010)	Quarterly	February–March	February–March and September–October	Bi-weekly May–October
Year 5 (2011)	Quarterly	February–March	February–March and September–October	Bi-weekly May–October

5.0 Annual Monitoring Reports

Annual reports summarizing monitoring results of the habitat restoration will be submitted to the USACE, Arizona Game and Fish Department (AGFD), USFWS, and the Pima County Regional Flood Control District within two months of the end of the monitoring year. The quantitative monitoring section will include survey methods, data summary analyses, comparison to performance standards, discussions, reporting remedial actions, recommendations, and photodocumentation. Each annual report will compare findings of the current year with those in previous years.

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6.0 Literature Cited

Barbour, M. G., J. H. Burk, and W. D. Pitts
1987 Terrestrial Plant Ecology. Second ed. Benjamin/Cummings, Menlo Park, California.

Bonham, C. D.
1989 Measurements for Terrestrial Vegetation. John Wiley and Sons, New York, New York.

RECON
2005 Mosquito Monitoring Report for the Rillito Riparian Restoration Project, Tucson, Arizona.

University of Washington Restoration Ecology Network
2002 Monitoring and maintenance guidebook. <http://depts.washington.edu/uwren/capstone_courses/EHUF_464/guidebook2002.htm>.

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ATTACHMENTS

ATTACHMENT 1
QUANTITATIVE MONITORING TRANSECT DATA SHEETS

Rillito River Ecosystem Restoration and Environmental Project—Area 1

Quantitative Monitoring: Transect Data Sheet

Transect #:_____ Date:_____Recorder(s):_____

UTM (NAD 1983)
START: _____ /_____ END: _____ /_____

Photos taken? **START** (due north and south) **Y or N**
END (due east and west) **Y or N**

Notes:_____
_____
_____
_____

I. POINT-INTERCEPT DATA

Point Intercept (meters)	**Species Encountered**
0.5	
1	
1.5	
2	
2.5	
3	
3.5	
4	
4.5	
5	
5.5	
6	
6.5	
7	
7.5	
8	
8.5	
9	
9.5	
10	
10.5	
11	
11.5	

I. POINT-INTERCEPT DATA (CONT.)

Point Intercept (meters)	Species Encountered
12	
12.5	
13	
13.5	
14	
14.5	
15	
15.5	
16	
16.5	
17	
17.5	
18	
18.5	
19	
19.5	
20	
20.5	
21	
21.5	
22	
22.5	
23	
23.5	
24	
24.5	
25	
25.5	
26	
26.5	
27	
27.5	
28	
28.5	
29	
29.5	
30	
30.5	
31	
31.5	
32	
32.5	
33	
33.5	

I. POINT-INTERCEPT DATA (CONT.)

Point Intercept (meters)	Species Encountered
34	
34.5	
35	
35.5	
36	
36.5	
37	
37.5	
38	
38.5	
39	
39.5	
40	
40.5	
41	
41.5	
42	
42.5	
43	
43.5	
44	
44.5	
45	
45.5	
46	
46.5	
47	
47.5	
48	
48.5	
49	
49.5	
50	

II. BELT DATA

PERENNIALS: (list species and count individuals rooted within the 2 X 50 meter plot)

ANNUALS: (list all species present)

ATTACHMENT 2
BASELINE MONITORING DATA

Note: these data will be included in the Final Draft of this document.

ATTACHMENT 3
BASELINE MONITORING PHOTOGRAPHS (CD)

Note: these data will be included in the Final Draft of this document.