

Proposed Remedial Objectives Report

**SFPP Silvercroft Wash Release
VRP Site Code: 506251-00
Tucson, Arizona**



July 2016

Prepared by
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007
602-771-2300 • <http://www.azdeq.gov>

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APPENDIX

Appendix A Land and Water Use Study

ACRONYMS

A.A.C.	Arizona Administrative Code
A.R.S.	Arizona Revised Statutes
ADEQ	Arizona Department of Environmental Quality
AMSL	above mean sea level
COC	Chemicals of Concern
FS	Feasibility Study
KMEP	Kinder Morgan Energy Partners, L.P.
MNA	monitored natural attenuation
PAH	polynuclear aromatic hydrocarbons
RI	Remedial Investigation
RO	Remedial Objective
SFPP	Santa Fe Pacific Pipeline, L.P.
SVE	soil vapor extraction
VOC	volatile organic compound
VRP	Voluntary Remediation Program
WQARF	Water Quality Assurance Revolving Fund

1.0 INTRODUCTION

The Arizona Department of Environmental Quality (ADEQ) Voluntary Remediation Program (VRP) has prepared this *Proposed Remedial Objectives Report* (Proposed RO Report) for the Santa Fe Pacific Pipeline, L.P. (SFPP) Silvercroft Wash Release Voluntary Remediation Program (VRP) site (the Site), to meet the requirements established under Arizona Administrative Code (A.A.C.) R18-16-406. Although this site is overseen by the VRP, due to the presence of contaminants beyond the boundary of the facility, site activities are being conducted under the Water Quality Assurance Revolving Fund (WQARF) process under Arizona Revised Statutes § 49-282.06.

The Remedial Objectives (ROs) were developed by R18-16-406 of the remedy selection rules of the Arizona Administration Code (A.A.C.). The ROs are established for the current and reasonably foreseeable uses of land and waters of the state that have been or are threatened to be affected by a release of a hazardous substance. Pursuant to A.A.C. R18-16-406(D), it is specified that reasonably foreseeable uses of land are those likely to occur at the site, and the reasonably foreseeable uses of water are those likely to occur within one hundred years unless site-specific information suggests a longer time period is more appropriate. Reasonably foreseeable uses are those likely to occur, based on information provided by water providers, well owners, land owners, government agencies, and others.

The ROs for the Site are based on the Land and Water Use Study (Appendix A). Not every use identified in the Land and Water Use Study will have a corresponding RO. Uses identified in the Land and Water Use Study may or may not be addressed based on information gathered during the public involvement process, the WQARF statutory authority, and whether the use is reasonably foreseeable. The Land and Water Use Study was available for public comment (as an appendix to the Draft Remedial Investigation [RI] Report) from February 9 to April 9, 2016.

A.A.C. R18-16-407 requires the ROs chosen for a given site be evaluated in the feasibility study (FS) phase of the investigative process, when investigative activities are conducted under the oversight of WQARF. The FS will evaluate specific remedial measures and strategies required to meet the ROs and propose a reference remedy and at least two alternative remedies, all capable of meeting the ROs. The proposed remedies will also be generally compatible with the future land use specified by land owners.

1.1 Solicitation Period for Remedial Objectives

The solicitation period for Proposed Remedial Objectives for the Site was held from February 9, 2016 through April 9, 2016. The solicitation period was initiated with a “Notice of 60-Day Public Comment Period”, which was published in the Arizona Daily Star on February 9, 2016. A public meeting to receive comments and solicit Remedial Objectives was held on March 24, 2016 at 6:00 pm at Rusty’s Family Restaurant & Grille, located at 2075 West Grant Road, in Tucson. ADEQ did not receive any proposed ROs from the public during the solicitation period.

Written comments on this Proposed RO Report will be accepted for a period of 30 days following release of the report. If significant public interest exists, or if significant issues or information have been brought to the attention of ADEQ, a public meeting may be held and the comment period may be extended. The final RO Report will be prepared by ADEQ following the comment period and the public meeting, if held. The final RO Report will include a responsiveness summary to

written comments received from the public during the comment period and will become an appendix to the Final RI Report.

1.2 Site Background

The Site is located west of the I-10 Freeway, north of Grant Road, along Silvercroft Wash, in the City of Tucson, Pima County, Arizona. The Site lies at an elevation of approximately 2,290 feet above mean sea level (amsl), and is physically located on the western side of the Silver Creek II Subdivision.

The Site is bounded on the west by Silvercroft Wash, which was impacted by the release. The pipeline release location was in the utility easement on the western side of the Silver Creek II Subdivision. The surface and near-surface area impacted by the release included portions of the Silver Creek II Subdivision (lots 321, 328, 352, 353, 354, 355, and 356), portions of the utility easement west of these lots, the storm drain channel between lots 352 and 353, limited areas of soil beneath Silver Island Way and Silverbell Tree Drive, and portions of Silvercroft Wash. The remaining lots and streets in the Silver Creek II Subdivision were not impacted by the release based on visual observations during emergency response activities, analysis results for surface and near-surface soil samples collected at the margins of the impacted area and on nearby lots, and analysis results of soil samples collected from groundwater monitoring well borings located in streets.

1.3 Release Background

On July 30, 2003, a rupture occurred in a portion of the SFPP pipeline that was transporting gasoline between Tucson and Phoenix. This rupture was detected by a series of pressure monitoring sensors within the pipeline system. Upon detection, the pumps at the SFPP Tucson Terminal were shut down.

Immediately following the discovery of the pipeline rupture, SFPP dispatched emergency response crews to the Site, contacted the City of Tucson Fire Department, and shut off valves along the pipeline to cease flow of gasoline through the pipeline. SFPP conducted emergency response activities to contain and minimize further impact of the release.

SFPP initially used vacuum trucks to recover released gasoline from the Silvercroft Wash, from the excavation at the release point, and from various other areas at the Site where gasoline had ponded on the ground surface. This recovery included water that was ponded in the Silvercroft Wash and water and fire-retardant foam applied to the area by the fire department during their response. Approximately seven truckloads of waste water and foam were routed under appropriate manifest to the Tucson terminal and offloaded into an isolated storage tank to allow the gasoline/water mixture to separate.

Immediately following the pipeline release, SFPP completed various soil excavation activities in impacted areas identified in locations including the Silvercroft Wash, the pipeline release area, the Southwest Gas pipeline right-of-way, the access road on the eastern side of Silvercroft Wash, the curbs at the intersection directly east of the storm-water channel, and the water line junction valve. For more information on these and additional excavation activities, as well as other remedial actions including free product removal, ongoing soil vapor extraction (SVE), and ongoing monitored natural attenuation (MNA) in groundwater, please refer to the October 2, 2015 *Draft Remedial Investigation Report*, prepared by ARCADIS on behalf of Kinder Morgan Energy Partners, L.P. (KMEP).

1.4 Contaminants of Concern

The contaminants of concern (COCs) for the Site are the petroleum-related volatile organic compounds (VOCs) known as benzene, toluene, ethylbenzene, total xylenes (collectively referred to as BTEX), methyl tertiary butyl ether (MTBE), and may also include polynuclear aromatic hydrocarbons (PAHs) if evidence shows PAHs originated from the release at the Site.

2.0 REMEDIAL OBJECTIVES

In accordance with A.A.C. R18-16-406(I)(4), the ROs must be stated in the following terms: 1) protecting against the loss or impairment of each use; 2) restoring, replacing, or otherwise providing for each use; 3) when action is needed to protect against or provide for the use; and 4) how long an action is needed to protect or provide for the use.

2.1 Remedial Objectives for Land Use

The fuel pipeline at the Silvercroft Wash Release Site is located within a utility easement adjacent to the east of the Silvercroft Wash. The land area impacted by the release included portions of the Silver Creek II Subdivision, (including lots 321, 328, 352, 353, 354, 355, and 356, portions of the utility easement west of these lots, the storm drain channel between lots 352 and 353, and limited areas of soil beneath Silver Island Way and Silverbell Tree Drive), and portions of the Silvercroft Wash. Five houses under construction on lots 352 through 356 were impacted and required demolition. Currently, SFPP owns lots 352 through 356 in the Silver Creek II subdivision. A treatment system with building structures occupies the area of these lots. The Silver Creek II Subdivision is zoned for low- to medium-density mobile homes (MH-1).

Typically, ROs for land use are established for those properties known to be contaminated with hazardous substances above a Soil Remediation Level (SRL) or a risk-based level. Soil characterization efforts for impacts related to the fuel release have included over 50 soil borings to date. Over 445 samples have been collected to evaluate surface and subsurface impacts, and to evaluate the effectiveness of remedial excavations. Remedial actions for soil have included extraction of liquid hydrocarbons from the surface using vacuum trucks immediately following the release, excavation of surface and near-surface impacted soil, and soil vapor extraction. Concentrations of fuel constituents in soil at surface are below the residential SRLs in all areas of impact. Subsurface soils will be evaluated as part of the post-remedial characterization when the soil vapor extraction system is shut down.

The current and future use of the land at the Site will likely remain zoned MH-1 for residential use. As such, the Remedial Objectives for land use are:

- ***To restore soil conditions in the Silver Creek II housing community to the remediation standards for residential use specified in A.A.C. R18-7-203 (specifically background remediation standards prescribed in R18-204, pre-determined remediation standards prescribed in R18-7-205, or site-specific remediation standards prescribed in R18-7-206) that are applicable to petroleum-related substances identified as contaminants of concern for the Site. This action will be needed for as long as the need for the land exists, the resource remains available, and the contamination associated with the Site impacts, prohibits, or limits land use.***

- *To restore soil conditions in the Silvercroft Wash to the remediation standards for residential use specified in A.A.C. R18-7-203 that are applicable to petroleum-related substances identified as contaminants of concern for the Site. This action will be needed for as long as the Silvercroft Wash exists and contamination associated with the Site impacts, prohibits, or otherwise effects the wash.*

2.2 Remedial Objectives for Groundwater Use

The Silvercroft Wash Release Site lies within the Tucson Active Management Area. Water rights within the vicinity of the pipeline release belong to the City of Tucson. Based on a telephone water use survey conducted on November 2, 2011, between ARCADIS and the City of Tucson Water Quality and Operations Division, there are no potable water well within 2 miles of the Site. There is no current or foreseeable plan for the installation of any municipal water wells within 1 mile of the Site.

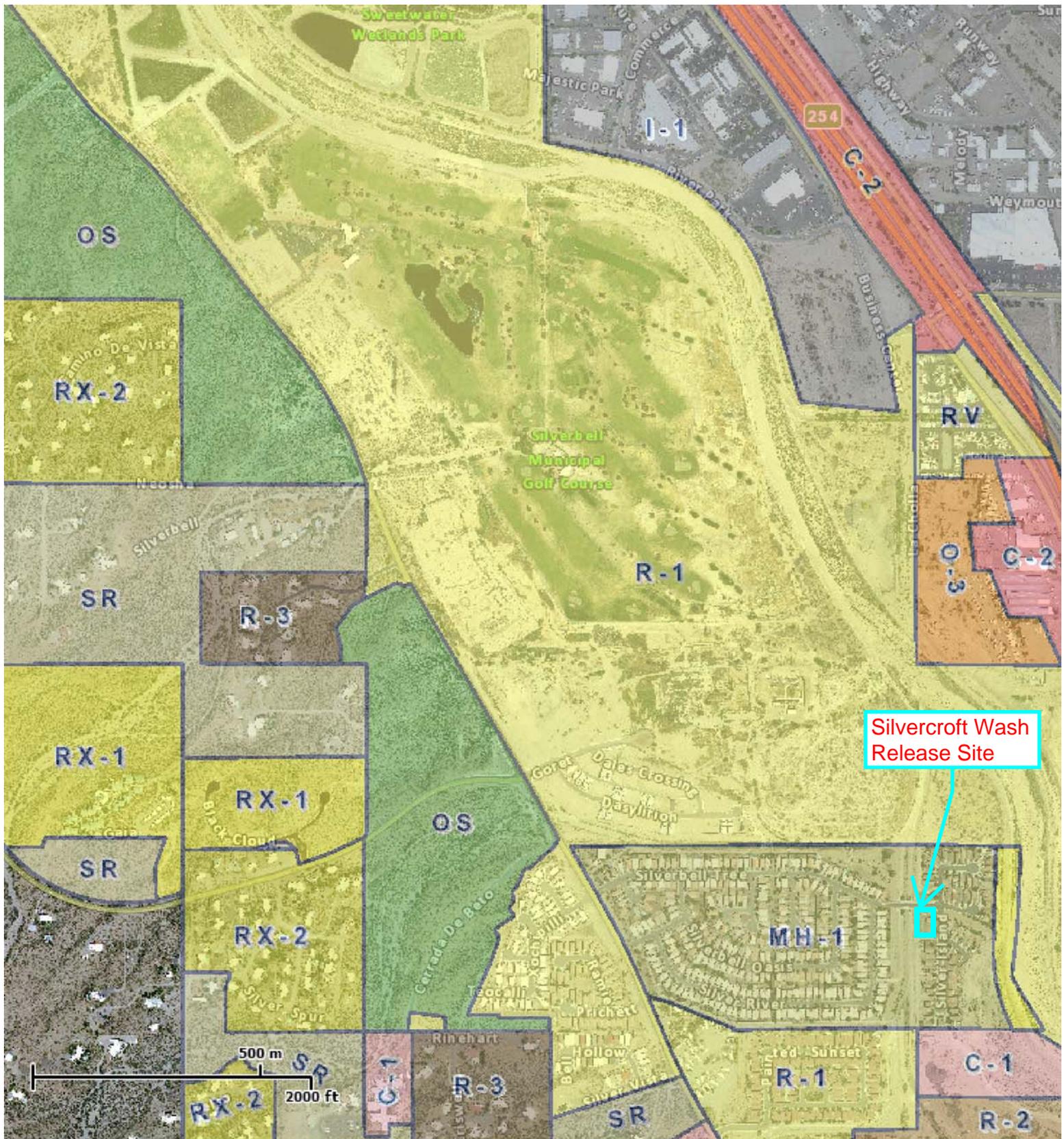
The City of Tucson's Sweetwater Recharge Facility and Pima County's Roger Road Wastewater Treatment Plant are both located approximately 2 miles downgradient to the northwest of the Site. Tertiary-treated water from the Roger Road Wastewater Treatment Plant is pumped to 28 acres of recharge basins and constructed wetlands at the Sweetwater Recharge Facility to be recharged to groundwater. During periods of low water demand, the water storage increases. Storage decreases during conditions of high water demand when the water is extracted. The effluent water is for non-potable use by the City of Tucson's Reclaimed Water System. The City of Tucson has operated the reclaimed water system since 1984. The reclaimed system takes secondary effluent from the Roger Road Wastewater Treatment Plant, further treats it through filtration and chlorination, and delivers it for turf irrigation and other non-potable uses. The reclaimed water is used at many facilities, including the City of Tucson's Silverbell Golf Course, located approximately 1 mile northwest of the Site, as well as over 25 parks and 30 schools.

The Sweetwater Recharge Facility is expanding by adding three new recharge basins on the north side of the Roger Road Wastewater Treatment Plan. Currently, the SRF recharge capacity is approximately 10,000 acre-ft per year, and is expected to increase to 13,000 acre-ft per year.

The current and future regional aquifer groundwater uses are reasonably foreseeable. As such, the Remedial Objectives for the current and future use of the groundwater supply are:

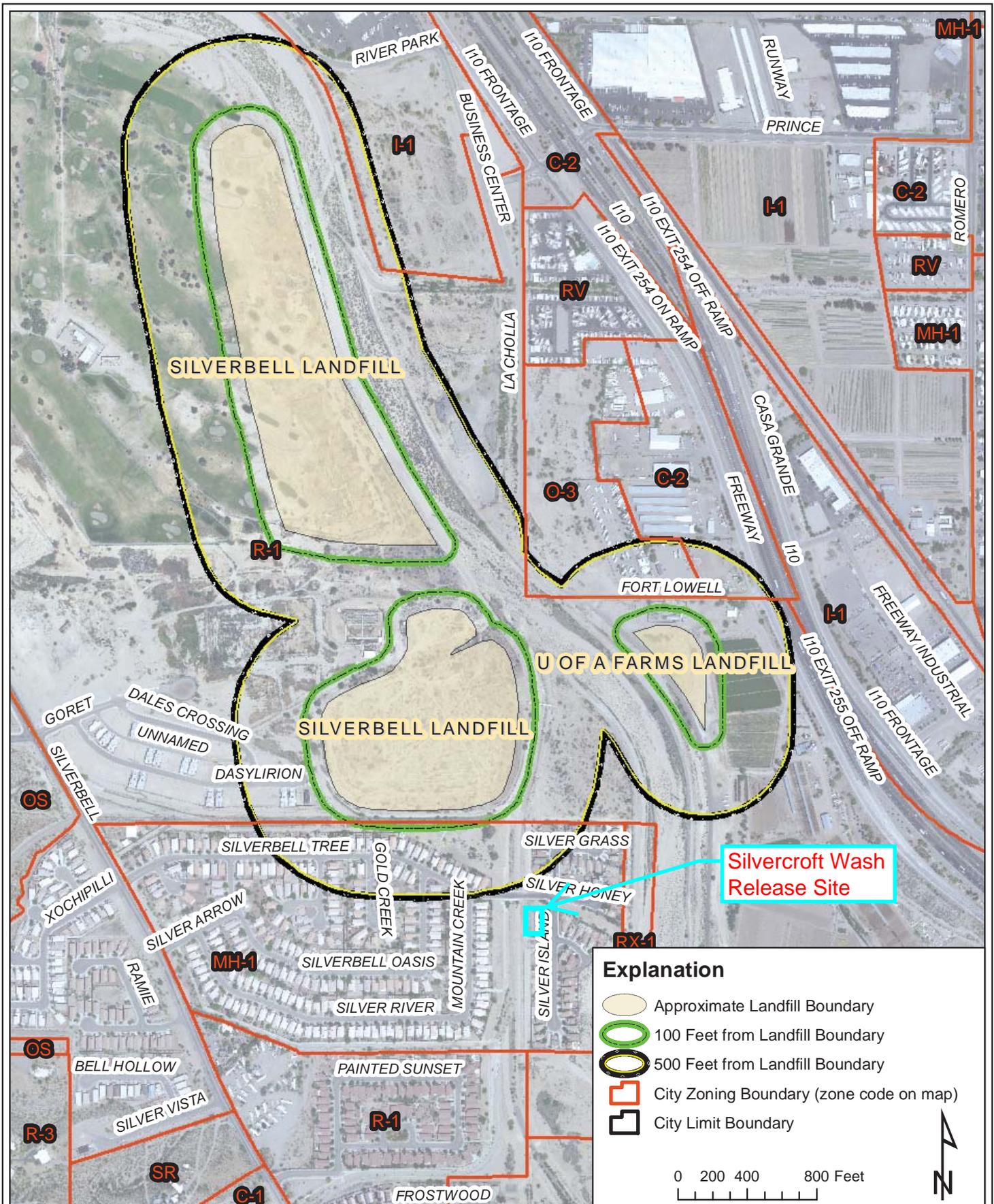
- *To protect, restore, or otherwise provide for the Sweetwater Recharge Facility water supply for surface water recharge if the current use of groundwater is impaired or lost such that it cannot be used for recharge to surface water ponds due to dissolved petroleum-related contaminants of concern emanating from the Site. This action will be needed for as long as the need for the water exists, the resource remains available and the contamination associated with the Site impacts, prohibits, or limits groundwater use.*

Appendix A



Zoning





Explanation

- Approximate Landfill Boundary
- 100 Feet from Landfill Boundary
- 500 Feet from Landfill Boundary
- City Zoning Boundary (zone code on map)
- City Limit Boundary

0 200 400 800 Feet

N



**Silverbell and UofA Farm Landfills
100 & 500 Foot Buffer Boundaries
Tucson, Arizona**

Drawn By:	LE
Checked:	JD
Approved:	NP
Date:	3/28/2011
File:	See Below

J:\GIS\ClosedLandfills\2011\silver.mxd

CITY OF TUCSON
SUMMARY OF ZONING CLASSIFICATIONS AND DEVELOPMENT DESIGNATORS

The *Land Use Code (LUC)* applies development criteria on individual uses within each zone, and the criteria do not necessarily apply to all uses permitted in the zone. The development criteria listed in the table below are provided for only the most common use allowed in each zone. The *LUC* should be consulted to verify the applicable Development Designator for a specific use.

Zone (Code Section)	Development Designator ¹	Minimum Lot or Site Area (Sq. Ft.) ¹	Units Per Lot ²	Density Per Acre ²	Maximum Lot Coverage (Percent) ³	Floor Area Ratio ⁴	Maximum Building Height (Ft.) ⁵	Perimeter Yard (Same Zone) ⁶
OS (2.9.1)	4	4,000			10	0.03	12	25'
IR (2.2.1)	21	1,568,160	1				30	25'
RH (2.2.2)	25	180,000	1				30	25'
SR (2.2.4)	C	144,000	1				30	25'
SH (2.2.6)	E	36,000	2				30	20'
RX-1 (2.3.2)	D	36,000	1				30	20'
RX-2 (2.3.3)	F	16,000	1				25	20'
R-1 (2.3.4)	G	7,000	1		70		25	6' or 2/3(H)
R-1 (2.3.4)	H	10,000	2		70		25	6' or 2/3(H)
R-2 (2.3.5)	I	5,000	1		70		25	6' or 2/3(H)
R-2 (2.3.5)	K	5,000		15	75		25	10' or 3/4(H)
R-3 (2.3.6)	P			36	70		40	10' or 3/4(H)
MH-1 (2.3.7)	G	7,000	1				25	6' or 2/3(H)
MH-1 (2.3.7)	M	7,000		8	70		16	10' or 3/4(H)
MH-2 (2.3.8)	I	5,000	1		70		25	6' or 2/3(H)
MH-2 (2.3.8)	K	5,000		15	75		25	10' or 3/4(H)
O-1 (2.4.1)	26	10,000				0.25	16	10' or 3/4(H)
O-2 (2.4.2)	27					0.50	26	(H)
O-3 (2.4.3)	30					0.75	40	0
RVC (2.5.1)	29					0.50	30	0
NC (2.5.2)	26	10,000				0.25	16	(H)
C-1 (2.5.3)	28					0.35	30	0
C-2 (2.5.4)	30					0.75	40	0
C-2 (2.5.4)	31					0.90	40	0
C-3 (2.5.5)	33					1.50	50	0
C-3 (2.5.5)	34					2.00	75	0
P (2.5.6)	40	5,000				0.90	16	(H)
RV (2.5.7)	M	7,000		8	70		16	(H)
OCR-1 (2.6.1)	35					6.00	140	0
OCR-2 (2.6.2)	36					10.50	300	0
MU (2.6.4)	G	7,000	1		70		25	6' or 2/3(H)
MU (2.6.4)	K	5,000		15	75		25	10' or 3/4(H)
MU (2.6.4)	29					0.50	30	1 1/2(H)
P-1 (2.7.1)	33					1.50	50	0
I-1 (2.7.2)	34					2.00	75	0
I-2 (2.7.3)	35					6.00	140	0

¹Section [3.2.3](#)

²Section [3.2.10](#)

³Section [3.2.9](#)

⁴Section [3.2.11](#)

⁵Section [3.2.7](#)

⁶Refer to the specific use and zone, then Section [3.2.6](#) to determine the Perimeter Yard applicable. The Perimeter Yards shown on the table are the interior yard setback requirements which are based on the adjacent property having the same zoning as the property in question. Perimeter yards are based on the height of the proposed building and the zoning of adjacent property. **If the zoning is not the same, the perimeter yard shown on the table may not be applicable.** Street Perimeter Yards, which are setbacks from the streets, are not shown on the table but are applied as two types, established area and developing area. See definition of established area setback in Sec. [6.2.5](#). Established area--greater of 20' or 1 1/2 (H) for front yard and 10' for street side yard. Developing area (includes all streets on *MS&R*)--Section [3.2.6.5](#).

Mailing Address: Development Services Department
Zoning Administration
P. O. Box 27210
Tucson, Arizona 85726-7210

Location: Public Works Building
201 North Stone
Second Floor
Phone: 520-791-5550
FAX: 520-791-4475

ZONING DISTRICT NARRATIVE SUMMARIES

(For a complete description refer to *Land Use Code*, Chapter 23, *Tucson Code*)

OS	OPEN SPACE – Used for protection of permanent open space.
IR*	INSTITUTIONAL RESERVE – Federal, State, City, County, and other properties under public ownership which are natural reserves or wildlife refuge reserves.
RH*	RURAL HOMESTEAD – Primarily low density residential property, with limited commercial and industrial uses to service residential development.
SR, RX-1, RX-2	LOW DENSITY RESIDENTIAL – Primarily low density residential property, with recreational/tourist related enterprises permitted subject to lot size.
SH*	SUBURBAN HOMESITE – Primarily low density (2 units per lot) residential property, with uses as permitted in the SR zone.
R-1	RESIDENTIAL - SINGLE-FAMILY – Primarily for the use of single-family residences. Schools, churches, and public buildings permitted.
R-2	MEDIUM DENSITY RESIDENTIAL – Multifamily and single-family residences permitted.
R-3	HIGH DENSITY RESIDENTIAL – Primarily for apartment houses; single-family development permitted.
MH-1	MOBILE HOME – Mobile homes permitted, along with site-built structures. Medium density mobile home parks permitted.
MH-2	MOBILE HOME PARK – Mobile home parks or mobile home subdivisions, along with social, commercial, and recreation facilities permitted as secondary uses.
O-1, O-2	LOW INTENSITY OFFICE – Allows for conversion of residential to office use, primarily for properties located on arterial and/or collector streets.
O-3	OFFICE – Professional and semiprofessional office, high density residential developments, and limited research and development uses permitted.
RVC*	RURAL VILLAGE CENTER – Retail shopping facilities, planned and designed for the convenience and necessity of a suburban or rural neighborhood.
NC	NEIGHBORHOOD COMMERCIAL – Low-intensity, small-scale commercial and office uses that are compatible in size and design with adjacent residential uses.
C-1	LOCAL COMMERCIAL – A restrictive commercial zone, limited to retail sales with no outside display/storage. Office and residential development permitted. Restaurants permitted.
C-2, C-3	GENERAL AND INTENSIVE COMMERCIAL – Retail commercial with wholesale; nightclubs, bars, amusement enterprises permitted. Full range of automotive activities; sales, repair, leasing, etc. Limited manufacturing permitted. Residential uses permitted.
P	PARKING – Off-street parking at or below grade.
RV	RECREATIONAL VEHICLE PARK – Travel trailer park only permitted use. Residences and social and recreational secondary uses allowed.
OCR-1, OCR-2	OFFICE/COMMERCIAL/RESIDENTIAL – High-rise mixed office, commercial, and residential uses located in major activity centers.
PAD	PLANNED AREA DEVELOPMENT (PAD) ZONE – A zoning classification which provides for the establishment of zoning districts with distinct regulations as adopted by Mayor and Council.
MU*	MULTIPLE USE – A mixed use zone permitting low to medium density residential development and various commercial activities commonly from the O-3 to C-2 zones.
P-I	PARK INDUSTRIAL – The most restrictive of industrial zones. Administrative, manufacturing, and wholesale activities carried on entirely within an enclosed structure. Limited retail sales permitted when incidental to an industrial use.
I-1, I-2	LIGHT AND HEAVY INDUSTRIAL – Commercial, industrial, and manufacturing uses; residential restricted to caretakers residence, except for Resident Artisans in the Downtown Warehouse District.

The following table lists the overlay zones, as provided in the *LUC*, which may have requirements which supersede requirements of the zone.

OVERLAY ZONES		
HDZ	Hillside Development Zone	2.8.1
SCZ	Scenic Corridor Zone	2.8.2
MS&R	Major Streets and Routes Setback Zone	2.8.3
	Gateway Corridor Zone	2.8.4
AEZ	Airport Environs Zone	2.8.5
ERZ	Environmental Resource Zone	2.8.6
	Reserved	2.8.7
HPZ	Historic Preservation Zone	2.8.8
DSO	Drachman School Overlay Zone	2.8.9
RND	Rio Nuevo and Downtown (RND) Zone	2.8.10

See also Chapter 25 (Floodplain) and Chapter 29 (WASH) of the *Tucson Code*.

GENERAL NOTES

*Zoning for newly annexed areas only.

For a complete description of all zones, refer to the *Land Use Code*, Chapter 23 of the *Tucson Code*.

Home Occupations are permitted as secondary uses to all residential uses.

For specific off-street parking requirements by land use, refer to Section 3.3.4.

Screening and landscaping requirements are found in Section 3.7 and *Development Standards* 2-06 and 2-07.

For additional information on rezoning requirements, call (520) 791-4541.

From: [Molly Collins](#)
To: [Vespalec, Thomas](#)
Subject: Re: Silverbell Landfill - future land use
Date: Tuesday, January 31, 2012 11:19:20 AM

For the landfill itself, I believe the only development planned would be a solar farm. It is only in the possibly someday planning stages though. For the parcels to the west of both the north and south cells of the landfill (and west of the golf course), they have already been sold to private developers for housing developments. I have heard talk of bringing Ft. Lowell Rd across the river and between the two landfill cells to service the houses, but that was a long time ago.

>>> "Vespalec, Thomas" <Thomas.Vespalec@arcadis-us.com> 1/31/2012 8:12 AM >>>

Good Morning Molly,

I have been referred to you by Mr. John Kmiec in regards to my question about the future development plans for the Silverbell Landfill. I am currently working on the Remedial Investigation Report for the Silvercroft Wash Release Site (for KMEP) and need to include a section for land use. Is there any future development plans for the landfill? It is zoned as R-1 (low density Residential). Any assistance with this is greatly appreciated. Thank you.

Sincerely,

Thomas J. Vespalec, P.G. | Project Geologist | Thomas.vespalec@arcadis-us.com

ARCADIS U.S., Inc. | 14201 North 87th Street, Suite 135 | Scottsdale, Arizona 85260
T: 480.905.9311 | M: 562.833.2477 | F: 480.905.9353
www.arcadis-us.com

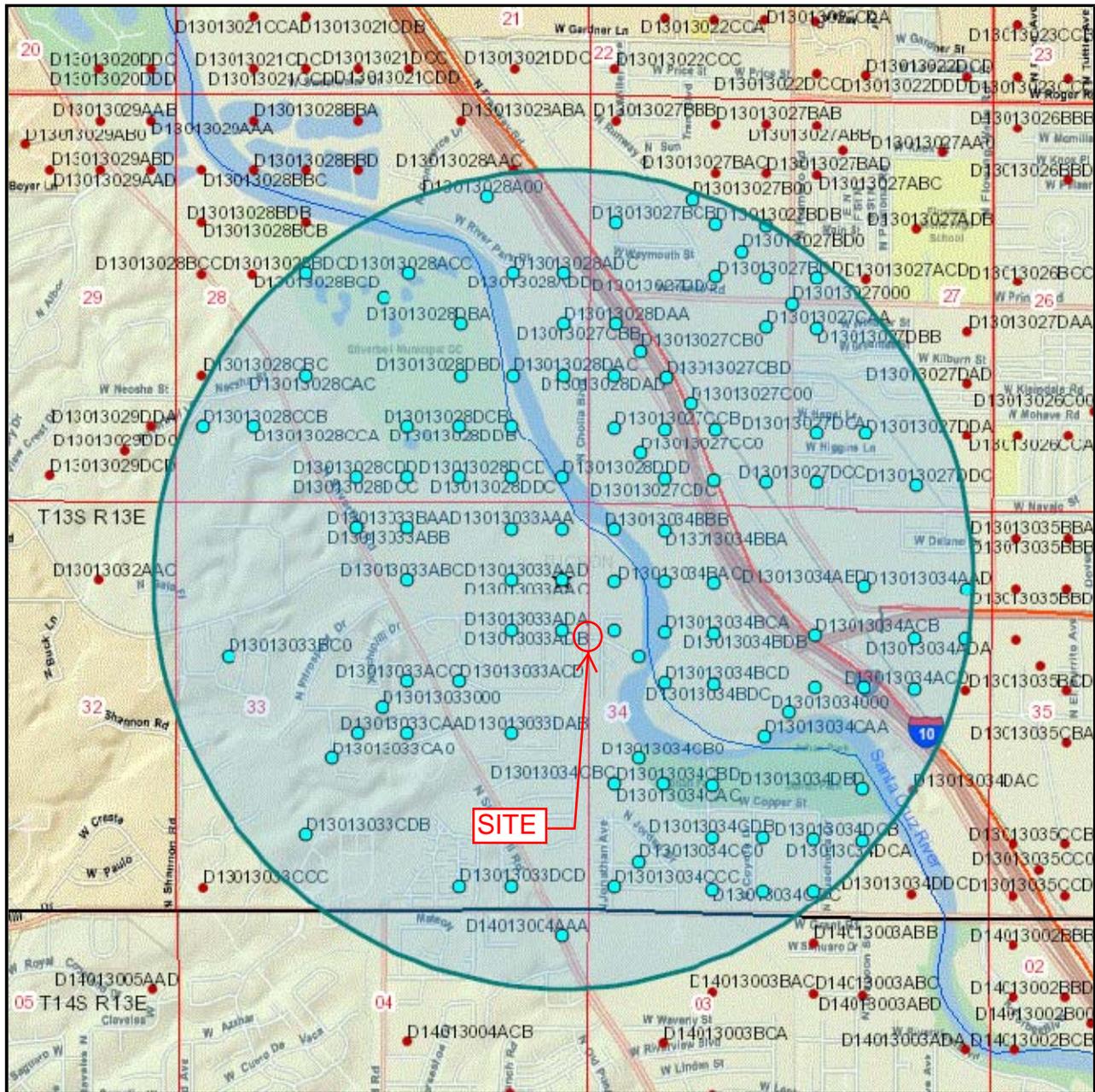
ARCADIS, Imagine the result

Professional Registration/P.G.-CA, #8801

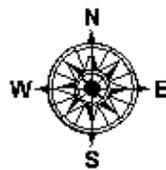
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Wells within 1 Mile Radius of Silvercroft Wash Release Site



- Registered Well(s)*
- Selected Well
- Selection Area
- CAP Aqueduct
- River
- Interstate
- State Route
- US Route



0.150780 0.18 Miles



For more information about this map contact:
 Arizona Department of Water Resources
 3550 N Central Avenue
 Phoenix, AZ 85012
 Phone: (602)771-8500 or 1-800-352-8488

Map created on 1/30/2012

*Locations are approximate and based on the well's legal description

Upper Santa Cruz & Avra Basin

Sole Source Aquifer Designated Area

Notes and Explanation:

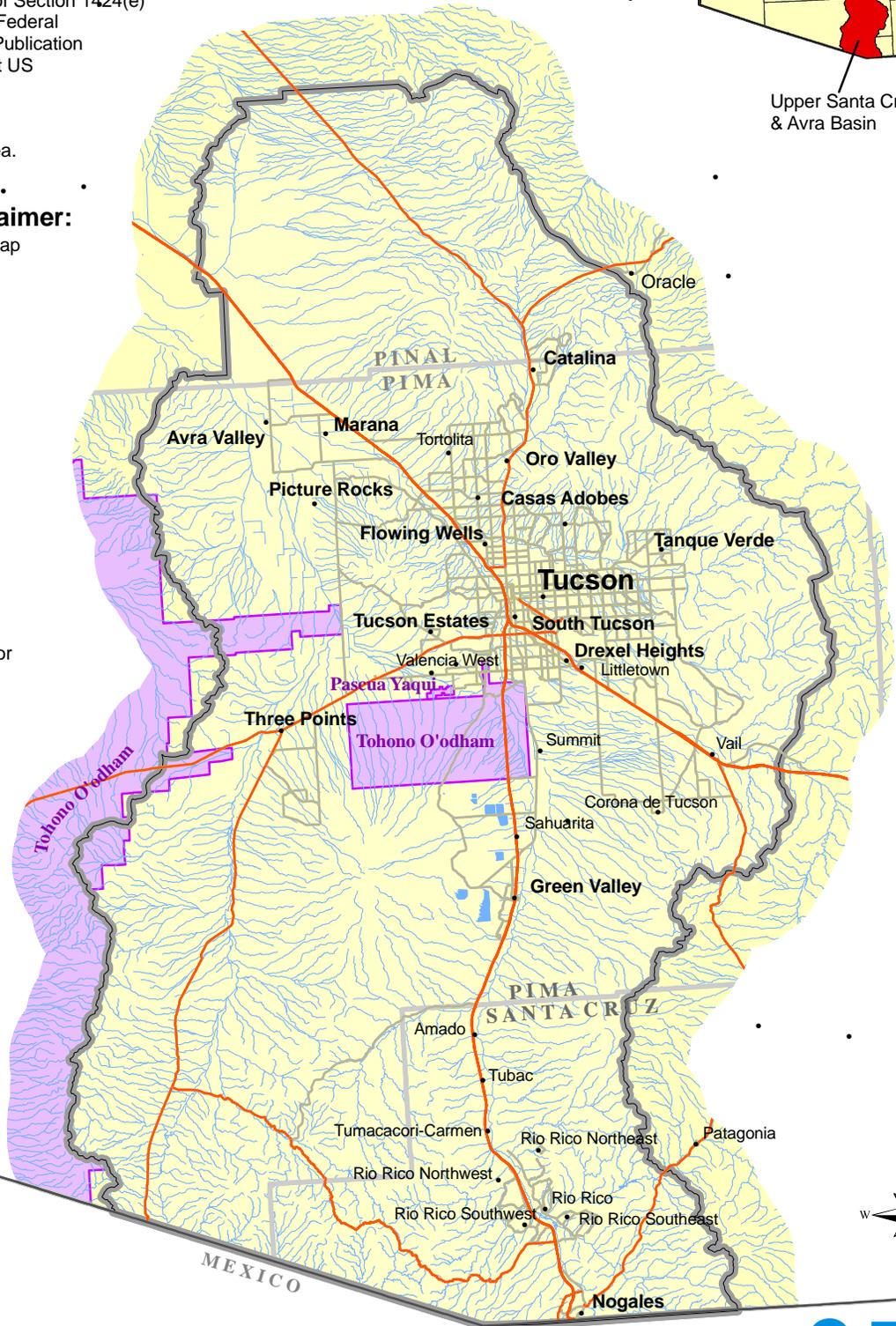
The Upper Santa Cruz & Avra Basin Sole Source Aquifer was designated under the authority of Section 1424(e) of the Safe Drinking Water Act, Federal Register Citation-49 FR 2948, Publication Date - 01/24/84. Please contact US EPA Region 9 (Jamelya Curtis, 415-972-3529) for assistance in determining place locations with respect to the project review area.



Upper Santa Cruz & Avra Basin

Map Status and Disclaimer:

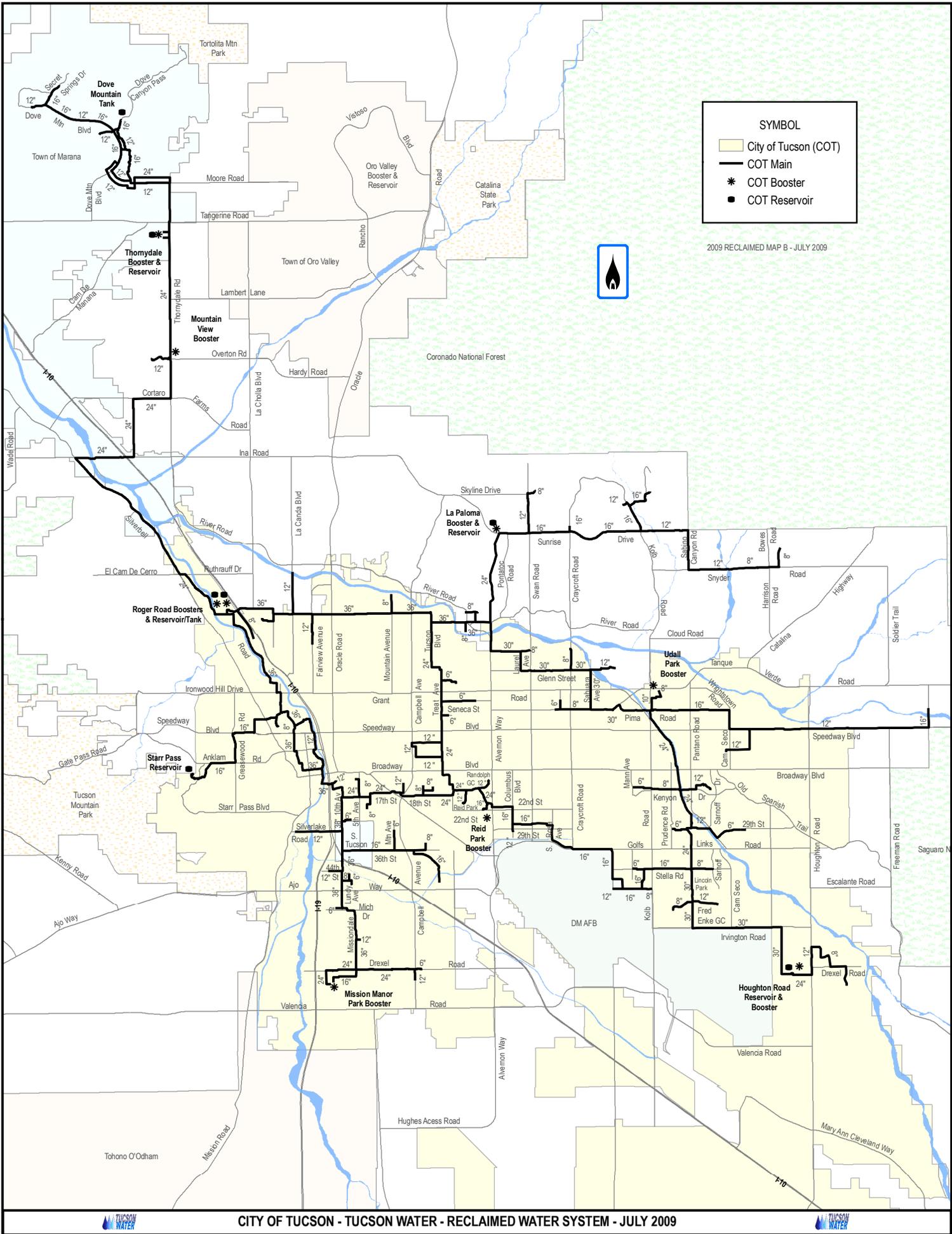
Please note that this working map is a computer representation compiled by the Environmental Protection Agency (EPA) from sources which have supplied data or information that may not have been verified by the EPA. This data is offered here as a general representation only, and is not to be used for commercial purposes without verification by an independent professional qualified to verify such data or information. The EPA does not guarantee the accuracy, completeness, or timeliness of the information shown, and shall not be liable for any loss or injury resulting from reliance upon the information shown.



Legend

- Designation Boundary
- Highways
- Major Roads
- Streams
- Tribal Lands
- Cities, Towns





Groundwater Wells Located within One Mile Radius of Silvercroft Wash Release Site

ADWR 55 ID Number	Cadastral	UTM easting (meters)	UTM northing (meters)	Well Type	Application Date	Drill Date	Well Depth (feet)	Casing Depth (feet)	Casing Diameter (inches)	Water Level (feet bgs)	Pump Capacity (gpm)	Owner Name
ADWR = Arizona Department of Water Resources UTM = Universal Transverse Mercator bgs = below ground surface gpm = gallons per minute												
609750	D13013034DCB	499765.20	3568509.00	EXEMPT	5/24/1982	5/30/1951	310.00	310.00	13.00	0.00	1400.00	INDUSTRIAL RESOURCES,
700178	D13013027DCC	499776.50	3569912.00	EXEMPT	7/17/2001							
640253	D13013033ACC	498173.60	3569129.00	EXEMPT	6/30/1982	7/12/1952	183.00	183.00	6.00	128.00	0.00	TERRAMAR PROPERTIES
602620	D13013027CDC	499380.20	3569920.00	EXEMPT	2/11/1982		250.00	250.00	8.00	115.00	23.00	ARIZONA DEPARTMENT OF TRANSPORTATION
700066	D13013034ABD	499970.60	3569505.00	EXEMPT	7/17/2001							EL MOLINO MOBILE HOME PARK
700154	D13013034BCD	499178.10	3569123.00	EXEMPT	7/17/2001							
633609	D13013034CB0	499079.20	3568825.00	EXEMPT	5/10/1982		200.00	136.00	0.00	0.00	0.00	JDP GRANT SILVER LLC
544699	D13013033DAB	498579.00	3568929.00	EXEMPT	7/15/1994	11/20/1994	250.00	250.00	8.00	137.00	0.00	JONATHAN ZAGORSKY
700182	D13013034ADB	500166.20	3569300.00	EXEMPT	7/17/2001							
640314	D13013027DDC	500172.60	3569899.00	EXEMPT	7/14/1982		0.00	0.00	0.00	0.00	0.00	ERICKSON,A R
482272	D13013033DBB	498173.60	3568929.00	EXEMPT	3/20/2009							JOHN NICHOLAS
700150	D13013034DCA	499961.40	3568504.00	EXEMPT	7/17/2001							
700086	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
700002	D13013027CDC	499380.20	3569920.00	EXEMPT	7/17/2001							
700158	D13013033ACC	498173.60	3569129.00	EXEMPT	7/17/2001							
803940	D13013033CA0	497869.60	3568828.00	EXEMPT	9/2/1986	12/31/1948	225.00	200.00	6.00	200.00	0.00	LEVITZ, CONCHITA,O
700081	D13013034ACC	499769.70	3569109.00	EXEMPT	7/17/2001							
700049	D13013034DCC	499763.70	3568303.00	EXEMPT	7/17/2001							
700064	D13013027C00	499282.20	3570224.00	EXEMPT	7/17/2001							
700123	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
700084	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
700022	D13013027DCB	499777.30	3570112.00	EXEMPT	7/17/2001							VINCENT N CAMPOLONGO
700175	D13013033ACD	498376.30	3569130.00	EXEMPT	7/17/2001							
700056	D13013034000	499671.30	3569010.00	EXEMPT	7/17/2001							
700051	D13013027DCC	499776.50	3569912.00	EXEMPT	7/17/2001							UNIVERSITY OF ARIZONA PLANT MATERIAL CENTER
700092	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
700065	D13013034BC0	499080.10	3569226.00	EXEMPT	7/17/2001							
700159	D13013028DCC	498172.60	3569932.00	EXEMPT	7/17/2001							
805174	D13013033BC0	497463.60	3569229.00	EXEMPT	3/23/1988		90.00	0.00	42.00	0.00	0.00	WETZEL, RALPH,J
618727	D13013034CAA	499571.30	3568914.00	EXEMPT	6/10/1982		150.00	150.00	8.00	80.00	0.00	AZ BOARD OF REGENTS,
597713	D13013034CAC	499373.30	3568718.00	EXEMPT	3/25/2003							DON COLIN PRESSNALL
700169	D13013027000	499680.30	3570614.00	EXEMPT	7/17/2001							
700077	D13013034BAC	499377.30	3569519.00	EXEMPT	7/17/2001							
400286	D13013027CCD	499182.10	3569925.00	EXEMPT	3/29/2001							TUCSON DEVELOPMENT
618725	D13013034CAA	499571.30	3568914.00	EXEMPT	6/10/1982		150.00	150.00	8.00	83.00	0.00	AZ BOARD OF REGENTS,
400199	D13013027CBC	498985.80	3570332.00	EXEMPT	5/8/2000							ARIZONA DEPARTMENT OF TRANSPORTATION
700115	D13013027BDC	499383.80	3570725.00	EXEMPT	7/17/2001							
700120	D13013027CDB	499381.10	3570121.00	EXEMPT	7/17/2001							
700117	D13013027CCB	498984.60	3570130.00	EXEMPT	7/17/2001							OPAL ASSOCIATES LIMITED PARTNERSHIP
700181	D13013027CBD	499184.10	3570327.00	EXEMPT	7/17/2001							
634985	D13013033CDB	497768.50	3568526.00	EXEMPT	6/7/1982		0.00	0.00	0.00	0.00	0.00	WILSON,A T
606718	D13013027CC0	499083.10	3570028.00	EXEMPT	5/4/1982		195.00	0.00	8.00	113.00	30.00	TRA-TEL TUCSON RV PK,
700116	D13013027CBB	498986.80	3570533.00	EXEMPT	7/17/2001							
700183	D13013034DAC	500159.90	3568700.00	EXEMPT	7/17/2001							
700161	D13013028ADD	498786.90	3570736.00	EXEMPT	7/17/2001							
700070	D13013034BDB	499376.30	3569319.00	EXEMPT	7/17/2001							
700121	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							

Groundwater Wells Located within One Mile Radius of Silvercroft Wash Release Site

ADWR 55 ID Number	Cadastral	UTM easting (meters)	UTM northing (meters)	Well Type	Application Date	Drill Date	Well Depth (feet)	Casing Depth (feet)	Casing Diameter (inches)	Water Level (feet bgs)	Pump Capacity (gpm)	Owner Name
800871	D13013033DDC	498579.00	3568328.00	EXEMPT	8/23/1983		165.00	0.00	12.00	103.00	33.00	THE GENESSE COMPANY LLC
630734	D13013027CC0	499083.10	3570028.00	EXEMPT	3/15/1982		250.00	250.00	8.00	255.00	23.00	ARIZONA DEPARTMENT OF TRANSPORTATION
700119	D13013027CCB	498984.60	3570130.00	EXEMPT	7/17/2001			110.00	9.00			OPAL ASSOCIATES LIMITED PARTNERSHIP
618726	D13013034CAA	499571.30	3568914.00	EXEMPT	6/10/1982		150.00	150.00	8.00	74.00	0.00	PIMA COUNTY FLOOD CONTROL DISTRICT
700095	D13013034BDC	499375.30	3569119.00	EXEMPT	7/17/2001							
700096	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
700093	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
809099	D13013033ACD	498376.30	3569130.00	EXEMPT	10/21/1959	10/21/1959	180.00	180.00	6.00	82.00		SILVERBALL NURSERY INC
700155	D13013034ACC	499769.70	3569109.00	EXEMPT	7/17/2001							
700063	D13013027CCA	499183.10	3570126.00	EXEMPT	7/17/2001							
700142	D13013033DBB	498173.60	3568929.00	EXEMPT	7/17/2001							DANIEL F WARREN
700094	D13013034CAA	499571.30	3568914.00	EXEMPT	7/17/2001							
534706	D13013034BBA	499180.30	3569724.00	MONITOR	3/10/1992	3/25/1992	150.00	145.00	4.00	121.00	10.00	UNIVERSITY OF AZ,
533288	D13013034BBB	498982.30	3569729.00	MONITOR	10/3/1991	11/19/1991	145.00	145.00	4.00	120.00	10.00	U OF A DEPT OF SAFETY & RISK MANAGEMENT
534707	D13013034BCA	499178.80	3569323.00	MONITOR	3/10/1992	4/2/1992	152.00	150.00	4.00	118.00	10.00	UNIVERSITY OF AZ,
533289	D13013034BBD	499179.60	3569524.00	MONITOR	10/3/1991	11/14/1991	150.00	150.00	4.00	119.00	10.00	U OF A DEPT OF SAFETY & RISK MANAGEMENT
509472	D13013028DCB	498173.40	3570133.00	MONITOR	10/18/1984	2/28/1991	200.00	190.00	6.00	132.00	34.00	TUCSON WATER
527396	D13013034CBD	499176.60	3568723.00	MONITOR	3/7/1990	1/16/1991	210.00	210.00	6.00	115.00	35.00	TUCSON, CITY OF,
544644	D13013033AAB	498578.90	3569732.00	MONITOR	7/25/1994	8/12/1994	170.00	170.00	4.00	128.00	0.00	TUCSON, CITY OF,
509471	D13013028DCC	498172.60	3569932.00	MONITOR	10/18/1984	2/12/1991	200.00	166.00	6.00	120.00	25.00	TUCSON WATER
509474	D13013034BBC	498981.90	3569528.00	MONITOR	10/18/1984	1/22/1985	149.00	146.00	6.00	101.00	27.00	TUCSON WATER
527397	D13013028DDD	498781.80	3569932.00	MONITOR	3/7/1990	10/23/1990	220.00	220.00	6.00	117.00	35.00	TUCSON, CITY OF,
533310	D13013028DAA	498785.70	3570535.00	MONITOR	10/11/1991	10/18/1991	200.00	200.00	6.00	127.00	25.00	CITY OF TUCSON ENVIRONMENTAL SERVICES
544645	D13013028DBA	498378.60	3570535.00	MONITOR	7/25/1994	8/12/1994	170.00	170.00	4.00	128.00	0.00	TUCSON, CITY OF,
574955	D13013033CAA	497971.00	3568928.00	MONITOR	5/11/1999							CITY OF TUCSON ENVIRONMENTAL SERVICES
587009	D13013028CDD	497969.70	3569933.00	MONITOR	5/16/2001	7/20/2001	199.00	196.00	1.00	130.00		CITY OF TUCSON
587010	D13013028CAC	497767.80	3570335.00	MONITOR	5/16/2001	7/16/2001	199.00	136.00	1.00	153.00		CITY OF TUCSON
587011	D13013028ACC	498176.00	3570736.00	MONITOR	5/16/2001	7/11/2001	198.00	136.00	1.00	143.00		CITY OF TUCSON
200449	D13013034BCB	498981.60	3569328.00	MONITOR	9/19/2003	10/9/2003	170.00	170.00	4.00	140.00		SFPP LP
200808	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/24/2003	170.00	170.00	4.00	140.00		SFPP LP
200801	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/17/2003	170.00	170.00	4.00	140.00		SFPP LP
582598	D13013028DCA	498376.60	3570133.00	MONITOR	7/27/2000	9/27/2000	188.00	88.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
200451	D13013034BCB	498981.60	3569328.00	MONITOR	9/19/2003	12/10/2003	120.00	120.00	2.00			SFPP LP
529298	D13013028DCB	498173.40	3570133.00	MONITOR	8/27/1990		0.00	0.00	0.00	0.00	0.00	TUCSON, CITY OF,
597598	D13013033AAD	498781.80	3569531.00	MONITOR	3/14/2003	4/10/2003	199.00	199.00	6.00	149.00		CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
200805	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	11/10/2003	170.00	170.00	4.00	140.00		SFPP LP
543098	D13013027CDB	499381.10	3570121.00	MONITOR	4/4/1994	4/27/1994	70.00	70.00	4.00	0.00	0.00	ADOT,
570995	D13013033AAA	498781.80	3569731.00	MONITOR	9/21/1998	11/4/1998	232.00			140.00		CITY OF TUCSON
202347	D13013033AAD	498781.80	3569531.00	MONITOR	2/5/2004	2/16/2004	170.00	170.00	4.00	139.00		SFPP LP
559774	D13013027CDB	499381.10	3570121.00	MONITOR	8/22/1996	11/4/1996	0.00	0.00	0.00	0.00	0.00	ADOT
582608	D13013033AAC	498579.00	3569531.00	MONITOR	7/27/2000	9/15/2000	190.00	90.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
200809	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/21/2003	170.00	170.00	4.00	140.00		SFPP LP
903589	D13013034BBB	498982.30	3569729.00	MONITOR	11/10/2005							STATE LAND DEPT
200802	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/23/2003	170.00	170.00	4.00	140.00		SFPP LP
201303	D13013034BCB	498981.60	3569328.00	MONITOR	11/16/2003	11/5/2003	170.00	170.00	4.00	140.00		SFPP LP
904440	D13013027CCA	499183.10	3570126.00	MONITOR	3/14/2006		180.00	175.00	5.00	155.00		ARIZONA DEPARTMENT OF TRANSPORTATION
904361	D13013027CCA	499183.10	3570126.00	MONITOR	3/3/2006		180.00	174.00	5.00	153.00		ARIZONA DEPARTMENT OF TRANSPORTATION
202059	D13013033AAD	498781.80	3569531.00	MONITOR	1/19/2004	1/25/2004	170.00	170.00	4.00	138.00		SFPP LP

Groundwater Wells Located within One Mile Radius of Silvercroft Wash Release Site

ADWR 55 ID Number	Cadastral	UTM easting (meters)	UTM northing (meters)	Well Type	Application Date	Drill Date	Well Depth (feet)	Casing Depth (feet)	Casing Diameter (inches)	Water Level (feet bgs)	Pump Capacity (gpm)	Owner Name
582599	D13013028DAC	498580.80	3570334.00	MONITOR	7/27/2000							CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
570337	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998							CONOCO PHILLIPS COMPANY
559881	D13013033AAA	498781.80	3569731.00	MONITOR	9/3/1996	10/26/1996	235.00	232.00	8.00	137.00	0.00	TUCSON, CITY OF,
200803	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/31/2003	170.00	170.00	4.00	140.00		SFPP LP
201839	D13013033AAD	498781.80	3569531.00	MONITOR	12/25/2003	1/15/2004	170.00	170.00	4.00	140.00		SFPP LP
535345	D13013027CCA	499183.10	3570126.00	MONITOR	5/18/1992	6/13/1992	153.00	153.00	4.00	128.00	0.00	ARIZONA DEPARTMENT OF TRANSPORTATION
220284	D13013034ADA	500364.20	3569295.00	MONITOR	12/7/2010	2/6/2011	55.00	55.00	2.00	45.00		CIRCLE K STORES INC.
582609	D13013033AAA	498781.80	3569731.00	MONITOR	7/27/2000	9/20/2000	188.00	88.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
574954	D13013033BAA	497970.60	3569732.00	MONITOR	5/11/1999							CITY OF TUCSON ENVIRONMENTAL SERVICES
529300	D13013028DCB	498173.40	3570133.00	MONITOR	8/27/1990	2/28/1991						TUCSON, CITY OF,
543099	D13013027CDB	499381.10	3570121.00	MONITOR	4/4/1994		0.00	0.00	0.00	0.00	0.00	ADOT,
201497	D13013027DBB	499778.70	3570515.00	MONITOR	11/25/2004							CONOCO PHILLIPS COMPANY
582605	D13013028DCD	498375.40	3569932.00	MONITOR	7/27/2000	9/22/2000	188.00	88.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
570343	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998	11/1/1998	61.00	50.00	2.00	61.00		CONOCO PHILLIPS COMPANY
200450	D13013034BCB	498981.60	3569328.00	MONITOR	9/19/2003	10/14/2003	171.00	171.00	4.00	146.00		SFPP LP
202593	D13013033ADA	498781.80	3569330.00	MONITOR	3/2/2004							SFPP LP
200807	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/15/2003	170.00	170.00	4.00	140.00		SFPP LP
574956	D13013033CAA	497971.00	3568928.00	MONITOR	5/11/1999							CITY OF TUCSON ENVIRONMENTAL SERVICES
529843	D13013027DBB	499778.70	3570515.00	MONITOR	10/17/1990	10/31/1990	232.00	220.00	4.00	140.00	16.00	ADEQ,
597788	D13013028ADC	498583.10	3570736.00	MONITOR	3/31/2003		410.00	410.00	6.00	151.00		CITY OF TUCSON/OFFICE OF ENVIRONMENTAL MGMT
212346	D13013027DCC	499776.50	3569912.00	MONITOR	6/7/2006	6/18/2006	98.00	81.00	4.00	81.00		UST
533654	D13013034AAD	500366.50	3569496.00	MONITOR	11/13/1991	12/5/1991	109.00	105.00	4.00	85.00	0.00	ADEQ,
570340	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998	11/3/1998	61.00		2.00	61.00		CONOCO PHILLIPS COMPANY
202202	D13013033AAD	498781.80	3569531.00	MONITOR	1/29/2004	2/9/2004	170.00	170.00	8.00	150.00		SFPP LP
903386	D13013028ACC	498176.00	3570736.00	MONITOR	10/19/2005							CITY OF TUCSON
530834	D13013034ADC	500164.10	3569100.00	MONITOR	2/6/1991	4/3/1991	210.00	205.00	4.00	140.00	16.00	ADEQ,
201498	D13013027DBB	499778.70	3570515.00	MONITOR	11/25/2004	8/27/2004	71.00	71.00	4.00	61.00		CONOCO PHILLIPS COMPANY
582611	D13013033AAC	498579.00	3569531.00	MONITOR	7/27/2000	9/19/2000	190.00	90.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
529293	D13013028DCC	498172.60	3569932.00	MONITOR	8/27/1990		0.00	0.00	0.00	0.00	0.00	TUCSON, CITY OF,
597787	D13013028DAD	498784.40	3570334.00	MONITOR	3/31/2003		380.00	380.00	6.00	155.00		CITY OF TUCSON/OFFICE OF ENVIRONMENTAL MGMT
570341	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998	11/4/1998	60.00	50.00	2.00	61.00		CONOCO PHILLIPS COMPANY
597599	D13013033AAD	498781.80	3569531.00	MONITOR	3/14/2003	4/13/2003	199.00	199.00	6.00	149.00		CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
582610	D13013033AAC	498579.00	3569531.00	MONITOR	7/27/2000	9/13/2000	190.00	90.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
557940	D13013027DBB	499778.70	3570515.00	MONITOR	5/24/1996	7/11/1996	73.00	73.00	4.00	62.00	0.00	CONOCO PHILLIPS COMPANY
201305	D13013034BCB	498981.60	3569328.00	MONITOR	11/16/2003	11/30/2003	170.00	170.00	4.00	140.00		SFPP LP
597597	D13013033AAD	498781.80	3569531.00	MONITOR	3/14/2003	4/8/2003	199.00	199.00	6.00	149.00		CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
912708	D13013028DDB	498579.60	3570133.00	MONITOR	11/15/2010							CITY OF TUCSON ENVIRONMENTAL SERVICES
530835	D13013034ADC	500164.10	3569100.00	MONITOR	2/6/1991		0.00	0.00	0.00	0.00	0.00	ADEQ,
200452	D13013034BCB	498981.60	3569328.00	MONITOR	9/19/2003	12/12/2003	120.00	120.00	2.00			SFPP LP
570342	D13013027DBB	499778.70	3570515.00	MONITOR	8/26/1998	11/2/1998	65.00	65.00	2.00	63.00		CONOCO PHILLIPS COMPANY
905561	D13013028ADC	498583.10	3570736.00	MONITOR	9/13/2006		320.00	270.00	5.00	160.00		CITY OF TUCSON ENVIRONMENTAL SERVICES
905559	D13013028ADC	498583.10	3570736.00	MONITOR	9/13/2006		220.00	120.00	5.00	160.00		CITY OF TUCSON ENVIRONMENTAL SERVICES
201838	D13013033AAD	498781.80	3569531.00	MONITOR	12/25/2003	1/12/2004	170.00	170.00	4.00	140.00		SFPP LP
570338	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998							CONOCO PHILLIPS COMPANY
543100	D13013027CDB	499381.10	3570121.00	MONITOR	4/4/1994		0.00	0.00	0.00	0.00	0.00	ADOT,
212347	D13013027DCC	499776.50	3569912.00	MONITOR	6/7/2006	6/14/2006	98.00	77.00	4.00	82.00		UST
200810	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	10/29/2003	170.00	170.00	4.00	140.00		SFPP LP
212349	D13013027DCC	499776.50	3569912.00	MONITOR	6/7/2006	6/19/2006	99.00	93.00	4.00	83.00		UST

Groundwater Wells Located within One Mile Radius of Silvercroft Wash Release Site

ADWR 55 ID Number	Cadastral	UTM easting (meters)	UTM northing (meters)	Well Type	Application Date	Drill Date	Well Depth (feet)	Casing Depth (feet)	Casing Diameter (inches)	Water Level (feet bgs)	Pump Capacity (gpm)	Owner Name
570339	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998							CONOCO PHILLIPS COMPANY
202348	D13013033AAD	498781.80	3569531.00	MONITOR	2/5/2004	2/10/2004	170.00	170.00	4.00	139.00		SFPP LP
201302	D13013034BCB	498981.60	3569328.00	MONITOR	11/16/2003	10/31/2003	170.00	170.00	4.00	140.00		SFPP LP
200804	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003		170.00	170.00	4.00	140.00		SFPP LP
202594	D13013033ADB	498579.00	3569330.00	MONITOR	3/2/2004							SFPP LP
556473	D13013033AAA	498781.80	3569731.00	MONITOR	9/27/1996	10/4/1996	400.00	0.00	0.00	150.00	0.00	TUCSON, CITY OF,
202060	D13013033AAD	498781.80	3569531.00	MONITOR	1/19/2004	2/1/2004	170.00	170.00	4.00	140.00		SFPP LP
557943	D13013027DBB	499778.70	3570515.00	MONITOR	5/29/1996	7/9/1996	80.00	80.00	4.00	62.00	0.00	CONOCO PHILLIPS COMPANY
533290	D13013034BCA	499178.80	3569323.00	MONITOR	10/3/1991	11/22/1991	145.00	140.00	4.00	120.00	10.00	U OF A DEPT OF SAFETY & RISK MANAGEMENT
902644	D13013033AAC	498579.00	3569531.00	MONITOR	7/15/2005							CITY OF TUCSON
202436	D13013033AAD	498781.80	3569531.00	MONITOR	2/12/2004	2/24/2004	170.00	170.00	4.00	140.00		SFPP LP
533650	D13013034AAD	500366.50	3569496.00	MONITOR	11/13/1991	12/3/1991	207.00	200.00	4.00	144.00	0.00	ADEQ,
902646	D13013033AAC	498579.00	3569531.00	MONITOR	7/15/2005							CITY OF TUCSON
582601	D13013028DDC	498578.30	3569932.00	MONITOR	7/27/2000	10/3/2000	190.00	90.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
534708	D13013034BBD	499179.60	3569524.00	MONITOR	3/10/1992	3/31/1992	150.00	145.00	4.00	120.00	10.00	UNIVERSITY OF AZ,
201304	D13013034BCB	498981.60	3569328.00	MONITOR	11/16/2003	11/30/2003	170.00	170.00	4.00	140.00		SFPP LP
582600	D13013028DDB	498579.60	3570133.00	MONITOR	7/27/2000	9/23/2000	188.00	88.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
903385	D13013033ABC	498173.50	3569531.00	MONITOR	10/19/2005							CITY OF TUCSON
570336	D13013027CAA	499580.80	3570520.00	MONITOR	8/26/1998							CONOCO PHILLIPS COMPANY
582602	D13013028DDB	498579.60	3570133.00	MONITOR	7/27/2000							CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
218744	D13013034ADA	500364.20	3569295.00	MONITOR	3/25/2009	4/23/2009	55.00	49.00	2.00	46.00		CIRCLE K STORES INC
535344	D13013027CCA	499183.10	3570126.00	MONITOR	5/18/1992	5/3/1992	150.00	114.00	4.00	128.00	0.00	ARIZONA DEPARTMENT OF TRANSPORTATION
557942	D13013027DBB	499778.70	3570515.00	MONITOR	5/24/1996	7/16/1996	69.00	69.00	4.00	62.00	0.00	CONOCO PHILLIPS COMPANY
529299	D13013028DCC	498172.60	3569932.00	MONITOR	8/27/1990	2/12/1991						TUCSON, CITY OF,
582604	D13013028DDB	498579.60	3570133.00	MONITOR	7/27/2000	9/25/2000	188.00	88.00	6.00			CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
200806	D13013034BCB	498981.60	3569328.00	MONITOR	10/15/2003	11/13/2003	170.00	170.00	4.00	140.00		SFPP LP
202203	D13013033AAD	498781.80	3569531.00	MONITOR	1/29/2004							SFPP LP
582603	D13013028DBD	498377.60	3570334.00	MONITOR	7/27/2000							CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
219096	D13013034ADA	500364.20	3569295.00	MONITOR	7/20/2009	9/11/2009	50.00	50.00	2.00	47.00		CIRCLE K STORES INC
562362	D13013034CDB	499372.30	3568518.00	MONITOR	4/25/1997	9/10/1997	145.00	120.00	4.00	130.00	0.00	LANKFORD, RAY,
220175	D13013028DDB	498579.60	3570133.00	MONITOR	10/12/2010							CITY OF TUCSON ENVIRONMENTAL SERVICES
904412	D13013027CCA	499183.10	3570126.00	MONITOR	3/9/2006		180.00	174.00	5.00	153.00		ARIZONA DEPARTMENT OF TRANSPORTATION
212348	D13013027DCC	499776.50	3569912.00	MONITOR	6/7/2006	6/16/2006	100.00	94.00	4.00	83.00		UST
618716	D13013034BAC	499377.30	3569519.00	EXEMPT	6/10/1982	7/1/1926	201.00	200.00	16.00	26.00	126.00	AZ BOARD OF REGENTS,
620311	D13013033ABB	498173.40	3569732.00	EXEMPT	6/9/1982	12/31/1948	267.00	267.00	0.00	114.00	0.00	TUCSON, CITY OF,
618708	D13013034BBA	499180.30	3569724.00	EXEMPT	6/10/1982	8/1/1965	300.00	300.00	10.00	88.00	50.00	AZ BOARD OF REGENTS,
618708	D13013034BBA	499180.30	3569724.00	EXEMPT	6/10/1982	8/1/1965	300.00	300.00	10.00	88.00	50.00	AZ BOARD OF REGENTS,
604913	D13013027CDD	499578.40	3569916.00	EXEMPT	3/7/1982	8/30/2007	802.00	800.00	10.00	157.00	450.00	SOIL CONS SERV,
604912	D13013027CDD	499578.40	3569916.00	EXEMPT	3/7/1982	12/31/1934	196.00	196.00	8.00	125.00	100.00	SOIL CONS SERV,
626043	D13013034AAD	500366.50	3569496.00	EXEMPT	7/18/1995	11/30/1946	234.00	221.00	16.00	0.00	0.00	FLOWING WELLS IRRIG,
618711	D13013034BDC	499375.30	3569119.00	EXEMPT	6/10/1982	12/31/1964	301.00	301.00	12.00	70.00	206.00	AZ BOARD OF REGENTS,
604028	D13013028ADC	498583.10	3570736.00	EXEMPT	2/9/1982	12/31/1945	200.00	200.00	16.00	48.00	1200.00	RADOS, ANGIE,
620298	D13013034CDC	499371.50	3568315.00	EXEMPT	6/9/1982	2/29/1956	468.00	468.00	12.00	110.00	0.00	TUCSON, CITY OF,
700102	D13013034DBD	499963.30	3568704.00	EXEMPT	7/17/2001	5/28/1976	350.00	324.00	16.00	123.00		
618682	D13013034CAA	499571.30	3568914.00	EXEMPT	6/10/1982		150.00	150.00	8.00	74.00	0.00	AZ BOARD OF REGENTS,
700082	D13013034ADA	500364.20	3569295.00	EXEMPT	7/17/2001							
700105	D13013027CCD	499182.10	3569925.00	EXEMPT	7/17/2001							
618715	D13013034CAA	499571.30	3568914.00	EXEMPT	6/10/1982	10/1/1966	350.00	350.00	20.00	80.00	460.00	AZ BOARD OF REGENTS,

Groundwater Wells Located within One Mile Radius of Silvercroft Wash Release Site

ADWR 55 ID Number	Cadastral	UTM easting (meters)	UTM northing (meters)	Well Type	Application Date	Drill Date	Well Depth (feet)	Casing Depth (feet)	Casing Diameter (inches)	Water Level (feet bgs)	Pump Capacity (gpm)	Owner Name
597600	D13013033AAD	498781.80	3569531.00	EXEMPT	3/14/2003	4/16/2003	199.00	199.00	6.00	149.00		CITY OF TUCSON ENVIRONMENTAL MANAGEMENT
618710	D13013034CAA	499571.30	3568914.00	EXEMPT	6/10/1982	9/1/1969	152.00	152.00	16.00	83.00	200.00	AZ BOARD OF REGENTS,
545480	D13013034ACD	499967.00	3569105.00	EXEMPT	8/16/1994		0.00	0.00	0.00	0.00	0.00	AZ BOARD OF REGENTS,
700079	D13013034ACD	499967.00	3569105.00	EXEMPT	7/17/2001							
700083	D13013034ADD	500361.90	3569095.00	EXEMPT	7/17/2001							
618709	D13013034ACC	499769.70	3569109.00	EXEMPT	6/10/1982	12/31/1915	150.00	0.00	16.00	25.00	250.00	AZ BOARD OF REGENTS,
801646	D13013033000	498071.50	3569029.00	EXEMPT	8/6/1984	2/28/1975	400.00	357.00	10.00	185.00	80.00	DIV-CENT HEALTHCARE,
700132	D13013034CC0	499078.70	3568424.00	EXEMPT	7/17/2001							
547479	D13013034ACD	499967.00	3569105.00	EXEMPT	3/9/1995	5/13/1995	525.00	510.00	20.00	134.00	350.00	AZ BOARD OF REGENTS,
700080	D13013034000	499671.30	3569010.00	EXEMPT	7/17/2001							
533739	D13013027000	499680.30	3570614.00	OTHER	11/13/1991	11/18/1991	125.00	0.00	0.00	0.00	0.00	ADOT,
598362	D14013004AAA	498780.80	3568127.00	OTHER	4/24/2003							CHEVRON USA
200448	D13013034BCB	498981.60	3569328.00	OTHER	9/19/2003							SFPP LP
543097	D13013027000	499680.30	3570614.00	OTHER	4/4/1994		0.00	0.00	0.00	0.00	0.00	ADOT,
534309	D13013034CCC	498980.30	3568327.00	OTHER	1/22/1992	3/5/1992	230.00	0.00	0.00	95.00	0.00	SOUTHWEST GAS CORP,
700220	D13013027CBD	499184.10	3570327.00	OTHER	7/17/2001							
903387	D13013034BCB	498981.60	3569328.00	OTHER	10/19/2005							CITY OF TUCSON
524721	D14013003BAC	499373.80	3567910.00	OTHER	5/26/1989	7/7/1989	220.00	0.00	0.00	0.00	0.00	SOUTHWEST GAS CORP, ARIZONA DEPARTMENT OF TRANSPORTATION, ATTN: KARIN WALSH
911852	D13013028000	498074.90	3570636.00	OTHER	3/22/2010							
700223	D13013028CCA	497564.30	3570134.00	OTHER	7/17/2001							WILLIAM & MARJORIE HARDY
202517	D14013003ABB	499765.80	3568101.00	OTHER	2/22/2004		230.00					SOUTHWEST GAS CORPORATION
534296	D13013033ACC	498173.60	3569129.00	OTHER	1/22/1992	4/14/1992	230.00	0.00	0.00	51.00	0.00	SOUTHWEST GAS CORP,
700222	D13013027DCA	499975.30	3570108.00	OTHER	7/17/2001							CHARLES & GLORIA BROWN
700198	D13013028DAA	498785.70	3570535.00	OTHER	7/17/2001							
535683	D13013027CB0	499085.30	3570430.00	OTHER	6/10/1992	5/13/1992	125.00	0.00	0.00	0.00	0.00	ADOT,
700189	D13013034ACB	499771.30	3569309.00	OTHER	7/17/2001							
700218	D13013034ADC	500164.10	3569100.00	OTHER	7/17/2001							
700197	D13013034CDD	499567.70	3568309.00	OTHER	7/17/2001							
700263	D13013034CDA	499568.80	3568513.00	OTHER	7/17/2001							INDUSTRIAL RESOURCES INC
519166	D13013034000	499671.30	3569010.00	OTHER	9/29/1987	9/20/1987	220.00	0.00	0.00	0.00	0.00	SOUTHWEST GAS CORP,
700219	D13013028ADD	498786.90	3570736.00	OTHER	7/17/2001							
519170	D13013033DCD	498376.40	3568327.00	OTHER	9/29/1987	9/9/1987	220.00	0.00	0.00	0.00	0.00	SOUTHWEST GAS CORP,
903753	D13013033AAD	498781.80	3569531.00	OTHER	12/2/2005		120.00	120.00	2.00			KINDER MORGAN ENERGY PARTNERS, L.P.
902288	D13013027000	499680.30	3570614.00	OTHER	5/31/2005							ARIZONA DEPARTMENT OF TRANSPORTATION
523057	D13013027000	499680.30	3570614.00	OTHER	12/11/1988	12/13/1988	108.00	0.00	0.00	0.00	0.00	COCA COLA BOTTLING,
593033	D13013034CBC	498980.70	3568728.00	OTHER	6/12/2002	6/2/2003	215.00					SOUTHWEST GAS CORPORATION
524720	D13013027DBB	499778.70	3570515.00	OTHER	5/26/1989	6/23/1989	220.00	0.00	0.00	0.00	0.00	SOUTHWEST GAS CORP,
903773	D13013033AAD	498781.80	3569531.00	OTHER	12/6/2005		120.00	120.00	2.00			KINDER MORGAN ENERGY PARTNERS, L.P.
903774	D13013033AAD	498781.80	3569531.00	OTHER	12/6/2005		120.00	120.00	2.00			KINDER MORGAN ENERGY PARTNERS, L.P.
562363	D13013034CDB	499372.30	3568518.00	OTHER	4/25/1997		0.00	0.00	0.00	0.00	0.00	LANKFORD, RAY,

NOTE:

Wells listed in this table are provided from the Arizona Department of Water Resources (ADWR) Well Registry Web map.

From: [John Kmiec](#)
To: [Vespalec, Thomas](#)
Subject: RE: TW Webmail (Projected Groundwater Uses)
Date: Tuesday, January 31, 2012 8:00:49 AM

Hi Tom,

I can answer for the Sweetwater Recharge Facility. Sweetwater will be adding three new recharge basins on the north side of Sweetwater Drive, north of the current Tucson Treatment Plant. This will increase recharge capacity for the facility from 10,000 ac-ft/year to 13,000 ac-ft/year. I am anticipating these will be constructed within the next 24-months.

As far as plans for the Silverbell Landfill area, I will have to direct you to the person over that area in the City of Tucson's Environmental Services Department. Her name is Molly Collins. Her e-mail is Molly.collins@tucsonaz.gov

Molly should be able to help with questions on that site.

Sincerely,
John

John Kmiec
Environmental & Regulatory Compliance Supervisor
Water Quality & Operations Division
Tucson Water
(520) 837-2433

To learn more about the future of water, please go to
www.athirstyplanet.com

>>> "Vespalec, Thomas" <Thomas.Vespalec@arcadis-us.com> 1/31/2012 7:50 AM >>>
Hi John,

This is Tom with ARCADIS and wanted to ask you a about the future development plans of the Silverbell Landfill. As part of the RI report, I need to add in "Land Use". Is there any future proposed plans? I did notice that it is zoned R-1 (residential), for urban, low density, single-family, residential development with schools, parks, and other public services necessary. If you do not know, is there someone specific that I should speak to?

Second, is the recharge facility have any plans to expand? Possibly add in another pond.

Thank you for your help in this effort.

Thomas Vespalec
Project Geologist
ARCADIS
480-905-9311

-----Original Message-----

From: John Kmiec [<mailto:John.Kmiec@tucsonaz.gov>]
Sent: Tuesday, November 01, 2011 12:58 PM
To: Vespalec, Thomas
Cc: Fernando Molina
Subject: Re: TW Webmail (Projected Groundwater Uses)

Thomas,

I may be able to help you with your inquiry. Please try to reach me at my office number at 520-837-2433. I should be in my office most of the day Wednesday.

Thanks,
John

John Kmiec
Environmental & Regulatory Compliance Supervisor
Water Quality & Operations Division
Tucson Water
(520) 837-2433

To learn more about the future of water, please go to
www.athirstyplanet.com

>>> "Vespalec, Thomas" <Thomas.Vespalec@arcadis-us.com> 11/1/2011 10:02 AM >>>
Dear Tucson Water Management Department,

I am inquiring about information for current and reasonably foreseeable uses of water within the area surrounding our Site. I am preparing a Remedial Investigation Report (RI) for the Arizona Department of Environmental Quality and under Arizona Administrative Code (AAC) R18-16-406D, the RI shall include collection of information regarding current and foreseeable use of land and water impacted by subject Site. The Site is located west of the I-10 Freeway, north of Grant Road, along Silvercroft Wash, in the City of Tucson, Pima County, Arizona. The Site lies in the NW 1/4 of the SW 1/4 of the NW 1/4 of Section 34, Township 13 South, Range 13 East, as shown on the Jaynes, Arizona 7.5 Minute U.S. Geological Survey Topographic Quadrangle.

As stated in the ACC, uses to occur within 100 years must be addressed from any well owner, written management plans, etc. I know that there is a Water Plan: 2000-2050, but would like any additional or site specific future uses of the water from the City of Tucson. Any information would be helpful to include into the RI report. Thank you for your time and assistance in this matter.

Sincerely,

Thomas J. Vespalec, P.G. | Project Geologist | Thomas.vespalec@arcadis-us.com
<mailto:firstname.lastname@arcadis-us.com>

ARCADIS U.S., Inc. | 14201 North 87th Street, Suite 135 | Scottsdale, Arizona 85260
T: 480.905.9311 | M: 562.833.2477 | F: 480.905.9353
www.arcadis-us.com <<http://www.arcadis-us.com/>>

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SWEETWATER RECHARGE FACILITIES: SERVING TUCSON FOR 20 YEARS

*John P. Kmiec, Tucson Water, Tucson, AZ, U.S.A.
Tim M. Thomure, Tucson Water, Tucson, AZ, U.S.A.*

Introduction

The City of Tucson is located in the northern semi-arid reaches of the Sonoran Desert in eastern Pima County, Arizona. Very few surface streams contain perennial flow and most of these are effluent-dominated streams located downstream from municipal wastewater treatment plants. Until the early 1990s, the Tucson community relied almost exclusively on pumped groundwater to meet water demand. Due to rapid growth in population and associated water demand following World War II, the groundwater system transitioned from an approximate state of equilibrium to one of accelerating depletion. Despite the successful implementation of water conservation programs and the “desert landscape” ethic of Tucson residents, groundwater withdrawals for municipal use continued to increase through the year 2000. Rapidly declining water levels in the metropolitan and surrounding areas have resulted in land subsidence, increased pumping costs, and the gradual loss of native riparian habitat.

Tucson Water’s need to develop renewable water supplies in order to reduce reliance on groundwater and meet projected future demand has long been recognized and is a critical goal of *Water Plan: 2000-2050* (Tucson Water, 2004). Reclaimed effluent is a renewable water supply that Tucson Water has come to rely upon to help meet the community’s growing thirst for water. The Reclaimed Water System supplies high-quality recycled water for non-potable uses. The Sweetwater Recharge Facilities are the key source of supply to this system and have served the community for two decades.

Tucson’s Reclaimed Water System

In the early 1980s, the City of Tucson constructed one of the first reclaimed water systems in the country. This system provides tertiary treatment of secondary effluent derived from Pima County Wastewater Department facilities to produce water of sufficient quality to be used for landscape irrigation and certain industrial uses. The system began operation with 10 miles of pipeline and only one customer—a destination resort golf course. Since then, the system has grown to include over 100 miles of transmission pipelines and serves almost 13,000 acre-feet per year of reclaimed effluent to about 600 customers including multiple golf course facilities, parks, schools, industrial sites, and certain residential sites. Tucson Water’s reclaimed water system remains an industry leader and serves to meet approximately eight percent of Tucson’s total water demand. This reuse of wastewater effluent reduces groundwater pumping and conserves higher quality water sources for potable supply.

The secondary effluent that is received from Pima County’s treatment facilities is either filtered at the Tucson Reclaimed Water Treatment Plant or recharged in a number of facilities. The recharge facilities include the Sweetwater Recharge Facilities (SRF), the Santa Cruz River Managed Underground Storage Facility (Santa Cruz Phase I), and the Lower Santa Cruz River Managed Recharge Project (Santa Cruz Phase II) as shown in Figure 1 (Tucson Water, 2004). While all of these facilities are essential to the successful operation of the Reclaimed Water System, the SRF are the core supply source providing high water quality, system reliability, and a beneficial public amenity.

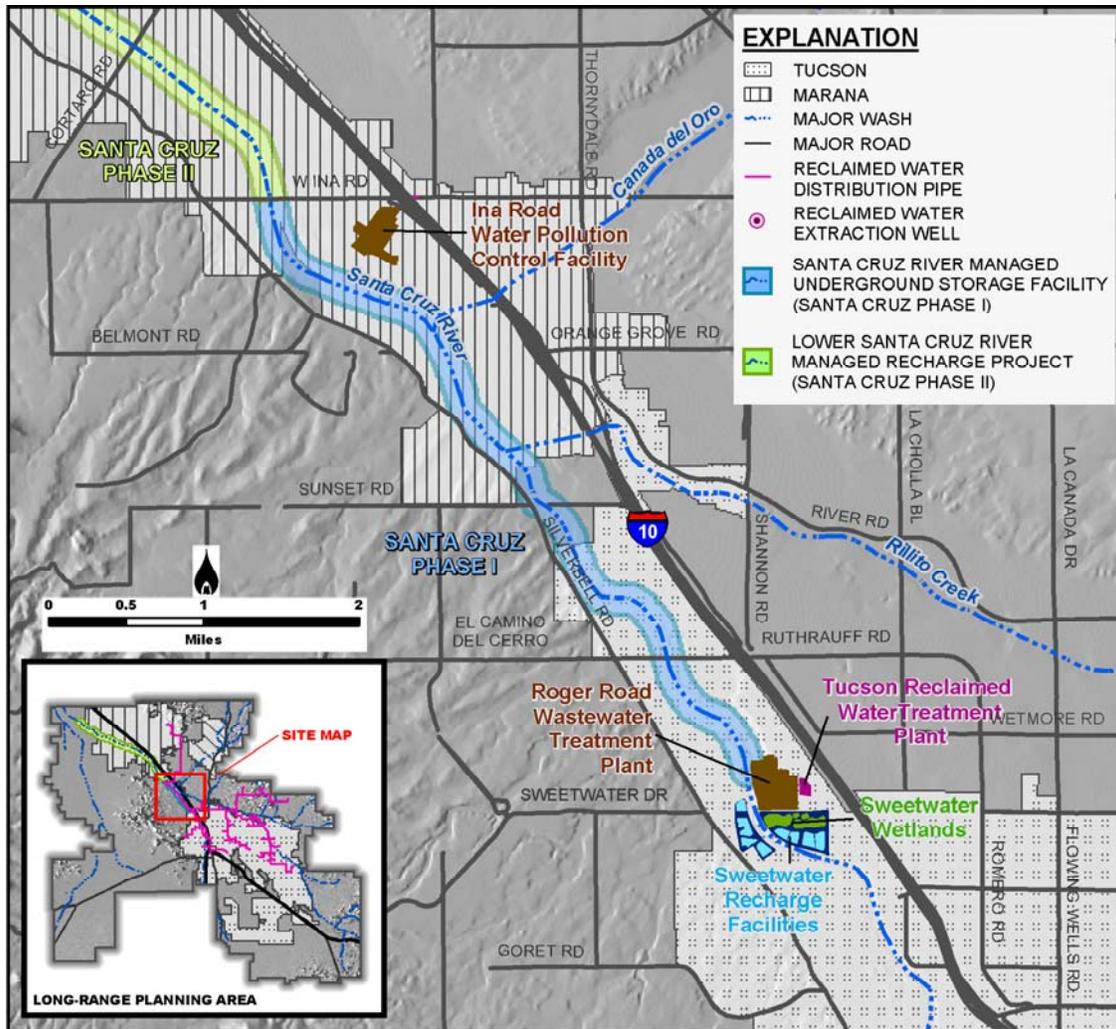


Figure 1. Sources of Supply to the Reclaimed Water System.

The Sweetwater Recharge Facilities (SRF)

Planning for reclaimed water production, recharge, and recovery officially began in 1983. It was during this time that Tucson Water, a Department of the City of Tucson, made the commitment to utilize reclaimed water in economical and feasible ways to offset water demand in the Tucson basin. At the same time, the Central Arizona Project (CAP) was nearing completion in the Tucson area. The CAP was designed to bring Colorado River water to agricultural interests, Native American communities, and municipalities in central and southern Arizona to help further reduce reliance on mined groundwater. The use of Colorado River water coupled with the new reclaimed water use program has allowed Tucson Water to be a viable desert city with a reliable water supply for years to come.

The SRF have evolved through three major phases during the last twenty years. The first (“Demonstration”) phase occurred from 1984 through 1989, the second (“Developmental”) phase occurred from 1989 through 1997, and the third (“Full-Scale”) phase has run from 1997 to the present.

Demonstration Phase 1984 – 1989

The objectives of the Demonstration Phase of the SRF were to determine the hydrologic feasibility of aquifer recharge and recovery, evaluate the potential impacts of recharge on aquifer water quality and water levels, obtain geologic information on site characteristics during construction, and gain experience in the operation and maintenance of a recharge and recovery facility. Once the decision was made to fully investigate and prepare for the use of reclaimed water, Tucson Water hydrologists and engineers, University of Arizona researchers, and consulting professionals began the process of designing and testing a small scale demonstration project.

The demonstration project was constructed on the west bank of the Santa Cruz River near Pima County's Roger Road Wastewater Treatment Plant and Tucson Water's newly constructed Reclaimed Water Treatment Plant. A group of four recharge basins, about three quarters of an acre each, were constructed for the project. Initial design intentions were to take tertiary treated reclaimed water and utilize it for recharge and recovery. Three pipelines were constructed to convey water to and from the demonstration project. The first pipeline was used to deliver potable water for testing purposes, the second pipeline delivered reclaimed water from the tertiary treatment plant to the recharge basins for storage, and the third pipeline conveyed recovered reclaimed water to the distribution reservoir located at the tertiary treatment plant.

By January 1986, potable water was delivered to the demonstration basins for testing. The testing goals were to determine infiltration rates, evaluate monitoring and measuring equipment, and study any possible water quality or groundwater level changes that would result from recharge operations. The first ("short-term") tests were designed to be conducted over a seven-day recharge event. Due to equipment failures and data logging problems, only two of the four basins completed the test. The second ("long-term") tests were conducted on all four basins between January 28, 1986 and May 23, 1986. The original intent of these tests was to operate through two wet and dry cycles for each basin. However, due to continued equipment problems, each basin was instead tested through a single long-term wetting cycle. These wetting cycles ranged between 18 and 83 days. The average of the infiltration rates recorded during the long-term tests was slightly above 1 ft/day (Tucson Water, 1990).

Between July 1984 and February 1988, ten monitoring wells and two extraction wells were installed at the site. The ten monitoring wells were placed throughout and along the perimeter of the demonstration project and were designed to measure water quality and water level changes in the vadose zone and the aquifer. The major water quality change during the demonstration phase was an initial increase in total dissolved solids. This was attributed to a flush of vadose zone salts.

The apparent success of the Demonstration Phase at this location led Tucson Water to continue to advance the growth of the reclaimed system and the SRF.

Developmental Phase 1989 – 1997

Tucson Water provided preliminary design specifications for the development of an operational underground storage and recovery facility based on the results of the Demonstration Phase. The initial design called for the construction of four recharge basins (RB-001 through RB-004) totaling 13 acres to be located in the vicinity of the demonstration project (Figure 2). By October 1988, the Arizona Department of Water Resources (ADWR) had approved the Underground Storage Facility (USF), Water Storage, and Recovery Well permits for the proposed facility. The final design was approved by the State in February 1989. In addition, the facility was required to obtain an Aquifer Protection Permit from the Arizona Department of Environmental Quality (ADEQ).

Facility construction began in June 1989 and the basins were excavated to a depth of 10 to 15 below ground surface to increase the efficiency of infiltration rates by taking advantage of more permeable sediments located at these depths. During the Developmental Phase, additional monitor wells and two additional extraction wells were added to the facility.



Figure 2. Site Map of Sweetwater Recharge Facilities

The first completed recharge basin, RB-004, began accepting secondary effluent on October 28, 1989. After operating wetting cycles that lasted for 10 to 13 days within this basin, algal flocculation was observed. Infiltration rates were directly impacted by the algal flocculation which greatly reduced the amount of water that could be infiltrated. Tucson Water facility operators reduced the wet cycle duration to less than one week while increasing the length of drying cycles. The advantage of the drying cycles was to desiccate, shrink, and crack the layer of algae and fine sediments that accumulated in the basin bottom during each wetting cycle. Operating in this way allowed the infiltration rates to maintain their optimum efficiency. Recharge basins RB-002 and RB-003 were completed in April and May 1990, respectively. By June 1990, three recharge basins were operational and the use of chlorinated recharge water was initiated. Chlorinated source water coupled with appropriate wet cycle durations were utilized to reduce the growth of algae in the basins.

Recharge basin RB-001 was under construction during 1990. This basin was selected as the location where the processes of Soil Aquifer Treatment (SAT) would be intensely studied. An intergovernmental agreement (IGA) was entered into by the City of Tucson, the University of Arizona, and the Salt River Project to provide funding, equipment, analysis, and materials to groups investigating SAT. Research

goals included determining the effectiveness of SAT in the Tucson basin and what benefits SAT could provide to the process of recharging the aquifer with reclaimed water. RB-001 did not receive recharge water until April 1991 when monitor wells and equipment were in place.

Basin infiltration rates were observed to decrease over time during the Developmental Phase. After completion of initial operations and SAT testing, RB-001 was ripped to help improve infiltration efficiency (Tucson Water, 1994). Ripping a basin refers to the process of using mechanized equipment to ‘turn over’ the basin soils at a certain depth, generally one to three feet below ground surface. The ripping process assists in breaking up or ‘fluffing’ the upper-most soils that may have been compacted, clogged with biological materials, or filled with fine sediments that can form a clogging layer and minimize infiltration rates.

Based on the results of several studies, Tucson Water determined it was feasible to start delivering secondary effluent directly from Pima County’s Roger Road Wastewater Treatment Plant to the recharge basins in January 1994. Previously, the basins were receiving tertiary-treated effluent from the Reclaimed Water Treatment Plant. During the Developmental Phase, the SRF were permitted to recharge and recover approximately 3,200 acre-feet per year.

As a condition of a judicial consent order issued by ADEQ, Tucson Water agreed to construct a wetland facility at the SRF. The wetlands were conceptualized to provide broad community benefits in addition to their core purpose of treating backwash water from the Reclaimed Water Treatment Plant. By March 1995, Tucson Water had decided to design the wetlands and incorporate four additional recharge basins to be placed on the east side of the Santa Cruz River. With the future construction of this new expanded facility, Tucson Water proceeded with major modifications to its Aquifer Protection, Underground Storage Facility, and Water Storage permits to increase the recharge capacity to 6,500 acre-feet per year thus initiating the Full-Scale Phase.

Full-Scale Phase 1997 – Current

In 1997, the Sweetwater Wetlands and recharge basins RB-005 through RB-008 were completed (Figure 2). With these additions, the SRF was now able to double the amount of recharge and recovery capacity to 6,500 acre-feet per year.

The Sweetwater Wetlands total 17.3 acres and were built with two parallel flow pathways (east and west). Each side has a pathway that consists of two settling basins followed by one polishing basin. The outflow from the wetland area is combined with secondary effluent and delivered to the newly constructed recharge basins. A small stream feature was constructed as part of the wetlands as an aesthetic enhancement. The entire project was designed in conjunction with a strong public advisory committee. The wetlands were considered a public amenity and features such as walking paths, ramadas, public restrooms, and interpretive signage were incorporated into the design. A small evaporation bed was constructed to treat sewage from the public restrooms. The evaporation bed is a closed system and does not contribute recharge water to the basins.

Recharge Basins RB-005 through RB-008 were constructed directly south of the wetland area. The area of the four additional basins is equal to that of the first four basins located on the west side of the river. With the additional basin area, the storage capacity of the SRF approximately doubled to a permitted volume of 6,500 acre-feet per year. Infiltration rates at the SRF have averaged approximately 2.3 ft/day under full-scale operations (Tucson Water, 2005). Two additional extraction wells were drilled in December 1997 through January 1998. These wells were drilled on the east side of the Santa Cruz River

to help with the recovery of stored water generated by the new recharge basins. The wells were equipped and ready for operation in 2000. With the addition of these wells, the SRF is also fully capable of recovering the volume recharged in any given year.

Operations and Storage Balance

Storage balance is defined as the recharged volume of water available for recovery to meet customer demand for non-potable use and is calculated as the basin delivery volume minus physical losses (evaporation) minus recovery. The storage balance for the SRF from 1984 through 2004 is presented on Figure 3. The volumes reported in this paper differ from those reported in Tucson Water (1991) for several reasons. First, the volume of water recharged prior to the issuance of the initial USF and Water Storage permits is not included in the storage balance shown in Figure 3 (approximately 78.9 million gallons). Secondly, evaporation losses have been quantified and subtracted from the storage balance – these volumes were not deducted in the 1991 publication. Finally, minor errors in the volumes reported as recharged and recovered have been corrected over time.

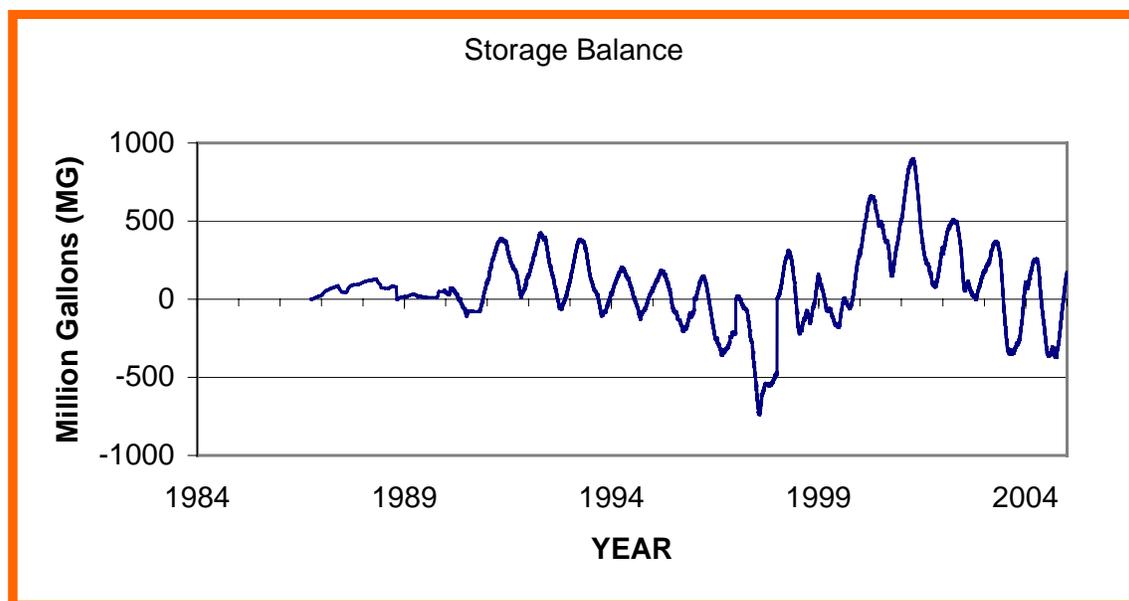


Figure 3. SRF Storage Balance (1984 – 2004)

As shown on Figure 3, the storage balance has a declining trend between 1993 and 1996 when demand was exceeding the existing capacities of the SRF and Reclaimed Water Treatment Plant. When the four additional recharge basins associated with the Full-Scale Phase were brought online, the overall storage balance increased. Prior to the Full-Scale Phase, the facility was operated so that the volume of water left in storage at the end of the peak demand season was minimal, but able to satisfy an emergency demand. Currently, the SRF is operated to store a sufficient volume of water to meet the peak season with a moderate volume left at the end.

Annual recharge operations are currently planned to recharge and recover 6,500 acre-feet each year. These trends are reflected in the annual volumes recharged and recovered for 1984-2004 (Figure 4). Also included on Figure 4 are the total annual deliveries to the Reclaimed Water System which include other sources of supply in addition to the SRF (Reclaimed Water Treatment Plant, recovery from Santa Cruz Phase I and II, potable augmentation, and the Randolph Park Reclamation Plant).

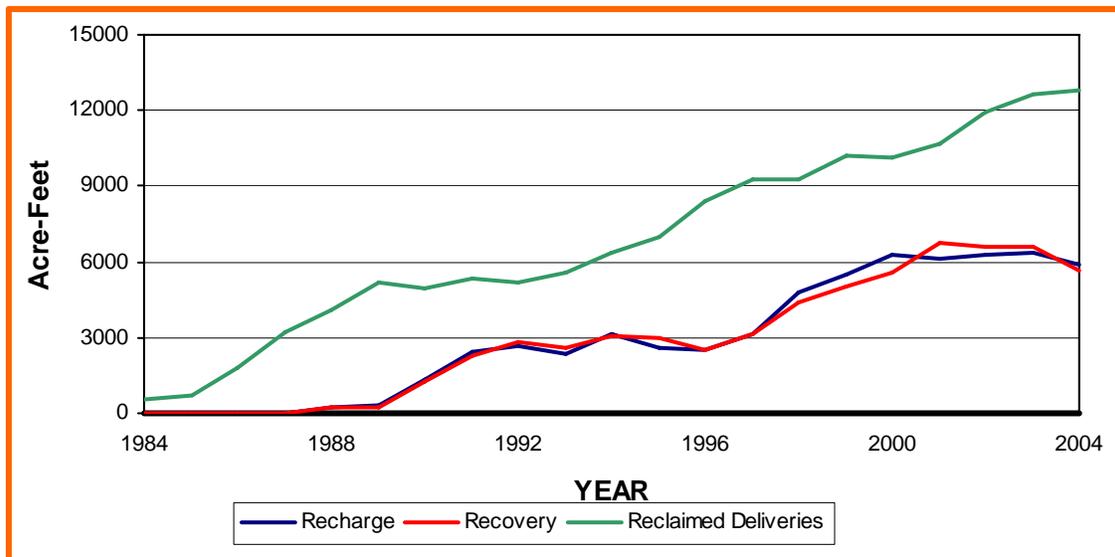


Figure 4. SRF Recharge, Recovery, and Total Reclaimed Deliveries (1984-2004)

Maintenance

The SRF are operated by using wet and dry cycles in the basins to maintain high infiltration rates. The wet portion of the cycle is operated by filling the basin to a depth of one to two feet for a period of about 3 days. At the end of each wet cycle, flow is tuned off and the remaining ponded effluent is allowed to infiltrate until the soil surface is dry. This is defined as the start of the dry cycle. The dry cycle usually lasts for a couple of days, allowing the basin to completely dry to manage algal growth. Desiccation cracks open on the basin floor which restore the infiltration pathways to the vadose zone.

Extended summer drying periods are scheduled to perform more extensive basin maintenance. The basins are typically taken offline for about one month each year and ripped to a depth of one to three feet. The upper 15 inches of the soil surface must be dry before the basin can be ripped or compaction may result. After ripping, furrows are constructed to increase the basin's exposed surface area. This process also serves to increase infiltration rates.

Due to the relatively brief duration of the wet cycles, vector control for mosquito populations is not required at the recharge basins. However, the wetlands facility provides a high potential for mosquito generation and is actively managed to reduce mosquito populations. Mosquito monitoring ("trapping") has been ongoing at the facility for a number of years and the current vector control program has evolved to a very effective combination of measures. The vector control program includes weekly monitoring throughout the year. A mosquito adulticide (*sumithrin at 2%*) is added to the wetlands one to three times per week during the mosquito season (generally May through October). A mosquito larvicide (*Bacillus thuringiensis israeliensis or Bacillus sphaericus*) is added weekly via a hydro-seeder and weekly via a miniature, remote-controlled helicopter. The hydro-seeder is most effective at reaching areas of the wetlands that underlie a vegetative canopy and the helicopter effectively treats the open water portions.

Because the wetlands provides a constant supply of water and the southern Arizona climate is quite warm, the potential growing season for vegetation at the wetlands is almost boundless. Trees that were pole-planted in 1997 have grown into tall, mature-looking stands. However, due to their ready access to

water, they typically develop shallow root systems and can topple in high winds. Periodic tree thinning is done to address this issue as well as provide adequate sight lines for operation of the vector control helicopter. Shrub and bush vegetation must be constantly cut back to provide continued access to the wetlands, recharge basins, walkways, and support facilities. A private contractor is retained to keep up with this task. Finally, the wetlands vegetation itself can quickly close off the open water portions of the settling basins if left unattended. Mechanical removal has been attempted in the past; however, the most effective means has been the use of controlled burns. The Tucson Fire Department (and surrounding fire services) performs annual controlled burns on up to 1/3 of the wetlands area to help control vegetative growth and provide wildfire training for their crews.

Finally, biosolids accumulation in the settling basins of the Sweetwater Wetlands has recently required the implementation of a management program. No solids removal was conducted from 1997 through 2004. During this time, a significant volume of biosolids accumulated which began to affect the treatment capability of the wetlands. In 2005, a program to remove these biosolids was successfully conducted utilizing a trailer-mounted centrifuge system. This effort took several weeks but resulted in the restoration of full capacity to the wetland settling basins. The solids were waste-characterized, determined to be non-hazardous, and disposed of offsite in accordance with environmental regulations. In order to maintain more continuous wetland treatment capacity and prevent such a significant accumulation in the future, current plans are to perform biosolids removal on a biennial basis.

Water Quality and Soil Aquifer Treatment

Source water quality has been continuously monitored at the SRF for two main reasons. The first is a Tucson Water goal to quantify the changes in water quality which occur during recharge operations - soil aquifer treatment (SAT). The second reason is to remain within the compliance guidelines of the Aquifer Protection Permit (APP). This State of Arizona permit requires that source water quality remain below the maximum discharge limits for a variety of parameters. In the original APP, the parameters set for source water quality were predominately metals and organic volatiles. In the current APP, source water quality sampling is conducted mainly for metals, nitrogen species, biochemical oxygen demand, total dissolved solids, sulfate, and chloride.

The source water sampling point (“510B”) is located along the pipeline that conveys secondary effluent from the Roger Road Wastewater Treatment Plant to the Reclaimed Water Treatment Plant. Water sampled at 510B reflects the quality of secondary effluent prior to tertiary treatment or delivery to the recharge basins. The main function of the Reclaimed Water Treatment Plant is to reduce the turbidity level of the effluent through dual-media pressure filtration (silica sand and anthracite coal beds). Turbidity reduction is the main qualification that provides a tertiary treatment classification. The processes of SAT that occur in the recharge basins also significantly reduce turbidity; therefore, the recovered water meets tertiary treatment standards as well.

The source water for the SRF is primarily a sodium-bicarbonate water. Major anion concentrations have remained stable over time with a few exceptions. Sulfate concentrations increased temporarily between 1992 and 1994. This source water change was related to Tucson Water’s initial use of Colorado River water in the general potable distribution system. (Tucson Water initiated the direct delivery of Colorado River water in 1992. However, due to pervasive operational problems, this system was taken offline in 1994. The Utility changed its approach for using Colorado River water to the use of recharge and recovery and successfully brought this resource back into use in 2001.) Over the time the SRF has been in operation, the average sulfate concentration has been about 106 mg/L. The average concentrations for other major anions are bicarbonate at 218 mg/L and chloride at 90 mg/L. Major cation concentrations

have been relatively stable over time. Sodium concentrations have an average of 116 mg/L. Calcium, potassium, and magnesium have averaged 48.7, 12.8, and 7.8 mg/L respectively.

Total dissolved solids (TDS) have remained somewhat stable over the duration of the facility history. During the time period of initial Colorado River water use, the average concentrations of TDS increased slightly. After the direct use of Colorado River water ceased in 1994, TDS concentrations returned to their historic patterns. The average annual concentration of TDS in the secondary effluent source water has been consistently around 550 mg/L in recent years.

The average annual total nitrogen concentration for secondary effluent entering the Reclaimed Water Treatment Plant and/or the SRF recharge basins has been 20.6 mg/L. The species contributing the largest fraction of total nitrogen is total kjeldahl nitrogen (TKN) which has an average annual concentration of 17.6 mg/L. TKN has fluctuated seasonally over the duration of the project ranging from 9.3 to 25.6 mg/L on an annual basis. Nitrite concentrations in 510B have remained very low during the project with an average annual concentration of 1.1 mg/L. The average annual concentration of Nitrate is 2.9 mg/L.

From 1987 through 1999, a bi-modal distribution trend was observed in the nitrogen species of 510B. A seasonal correlation is detected between TKN and nitrate. Nitrate values tend to increase during the warmer months of the years while TKN values tend to decline. This is attributed to the warmer climate creating an environment that is preferred by organisms that contribute to the nitrification process. As the nitrification rates increase, TKN concentrations decrease and nitrate concentrations increase (Tucson Water, 2005).

From 1993 through 2004, sample point 522 has functioned as the monitoring location for the Reclaimed Water System's Wastewater Reuse Permit. The water sampled at this point is representative of the quality of water delivered to reclaimed water customers and is a blend of plant-treated and recharged/recovered effluent from the SRF. Sample point 522 is located at the booster station that pumps the blended water to the reclaimed water delivery system. The water may be a variable mixture of both sources or from one source only depending on operational requirements.

Nitrogen species results from sample point 522 are noticeably reduced from point 510B. The average annual total nitrogen concentration at point 522 is 14.7 mg/L. The species contributing the largest fraction of total nitrogen at point 522 is also TKN; however, it is reduced to an average concentration of 8.2 mg/L. Nitrate concentrations at point 522 are greater than at point 510B, with an average annual concentration of 6.2 mg/L. Denitrification processes associated with SAT at the recharge basins have contributed greatly to the reduction of total nitrogen and conversion to nitrate species in the delivered reclaimed water. Based on overall average annual concentrations, total nitrogen reduction throughout the duration of the facility has been approximately 29%. The conversion of TKN into nitrate and eventually nitrogen gas can be recognized in the concentration changes in these constituents from pre-recharge water quality to reclaimed product water quality.

Product water from the Reclaimed Water Treatment Plant is usually blended with water recovered from the extraction wells to manage turbidity. Under the Wastewater Reuse Permit, turbidity at sample point 522 has to be 5 NTU or lower. The filters at the plant can effectively remove approximately 50% of the turbidity measured in the secondary effluent, but this can often exceed 5 NTU. The stored water that is removed through the extraction wells consistently has a low turbidity. The blending of recovered water and plant effluent continues today to be an effective formula to remain within the compliance limits.

One additional water quality transformation of note concerns total organic carbon (TOC). TOC that is present in a water supply can react with chlorine used for disinfection and result in the formation of disinfection by-products. Effluent typically contains high levels of TOC and the reclaimed water delivered by Tucson Water is disinfected to protect human health. The SAT processes that are active during recharge are highly effective at removing TOC. At the SRF, TOC concentrations have been consistently reduced from 20 mg/L to less than 1 mg/L upon recovery (Thomure and Marra, 2005).

The Future of the Sweetwater Recharge Facilities

As Tucson Water’s Reclaimed Water System grows over time, additional access to tertiary-treated effluent will be required. The increasing demand is not only within the Tucson Water service area, but also in areas served by others. For instance, Tucson Water will wheel the effluent owned by other entities such as the Town of Oro Valley through the Reclaimed Water System to their facilities. The expansion of constructed recharge facilities will be evaluated as a way to provide this additional supply. Currently, a series of possible ways to expand the existing SRF are being evaluated (Figure 5).

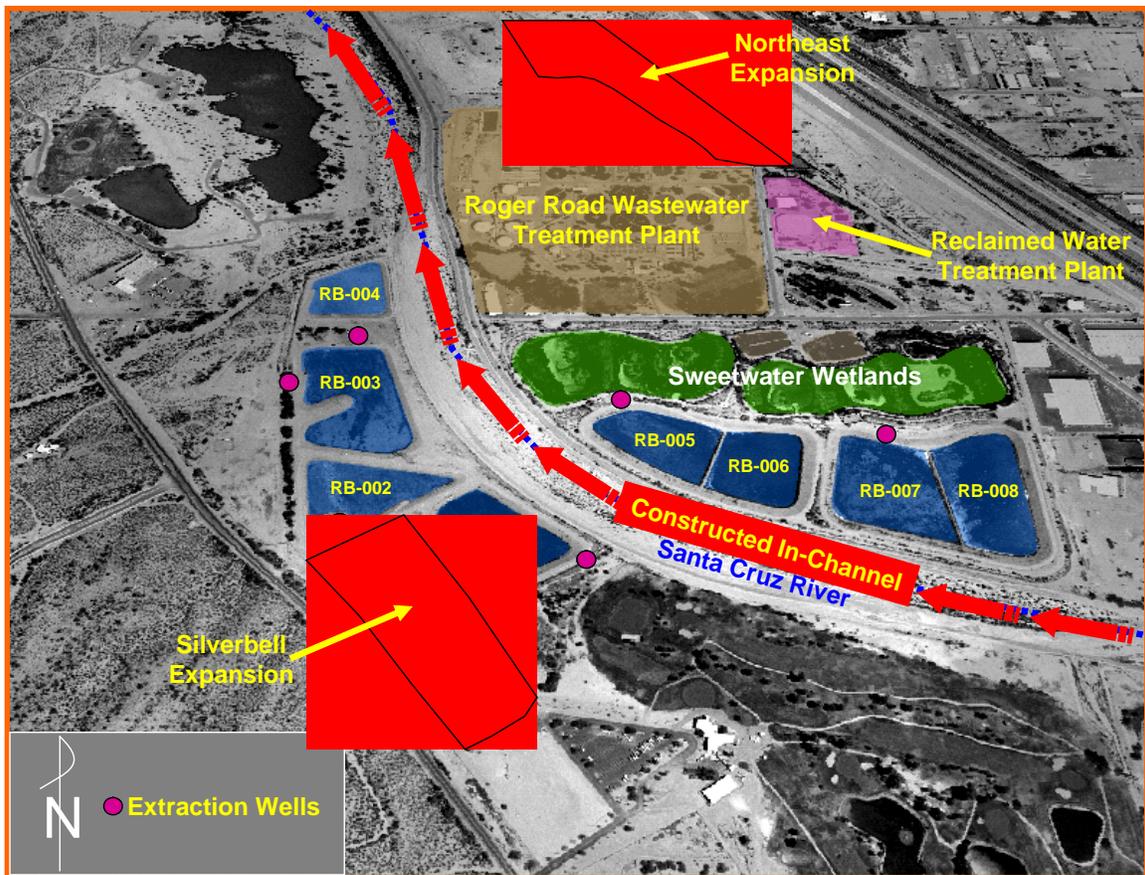


Figure 5. Potential Expansions of the SRF

Two off-channel areas have been identified for the possible construction of additional recharge basins – the Northeast Expansion and the Silverbell Expansion (Figure 5). The Northeast Expansion area has been investigated in previous years and has been determined to be a feasible location for additional recharge. In fact, an engineered design of a large recharge basin in this location was completed but never constructed. Concerns over the potential for creating perched water levels that could affect the operation

of clarifiers at the Roger Road Wastewater Treatment Plant must be alleviated before expansion in this area could proceed. To date, there is no evidence that such impacts would occur. This location is the initial area being evaluated by Tucson Water for expansion.

The Silverbell Expansion area is actually an operating driving range for the City of Tucson's Silverbell Golf Course. As part of a redesign of the golf course, this area was identified as a possible location for additional recharge and preliminary investigations have been conducted. The initial test work is positive; however, the impacts to the golf course facility would need to be mitigated. In addition, an existing groundwater contamination plume is located immediately upgradient from this area and would need to be carefully studied prior to conducting recharge. The Silverbell area is being further evaluated in conjunction with the Northeast Expansion and is considered the second highest priority location.

In addition to the construction of additional off-channel facilities, the concept of implementing in-channel constructed recharge associated with the SRF is under consideration. While there are currently two managed recharge facilities permitted along the bed of the Santa Cruz River (Santa Cruz Phase I and Phase II), these facilities only yield recharge credits for 50% of the effluent that reaches the aquifer. The conversion of parts of the river channel to a constructed facility through the use of levees, T-berms, or similar structures would greatly increase the recharge rates and generate credits for 100% of the water recharged. However, performing significant work in the bed of the Santa Cruz River would introduce a wide range of additional permitting complexities that could extend the time frame of this expansion to several years. This concept is under active consideration; however, it is likely to be dependent on the positive or negative outcomes of the off-channel options discussed above.

Finally, even though a significant portion of Tucson Water's effluent will continue to be used to meet non-potable (reclaimed) demands, a large volume of effluent will be available for use to augment the potable water supply. As Tucson Water planners project the water needs for the community into the future, it is clear that the broader use of effluent will become critical. Over time, the community will need to make critical decisions about how to develop enough water supplies for the future including the possibility of using effluent for indirect potable reuse. The recharge process will be a critical factor in making effluent available for such a use both from a water quality standpoint through SAT and from a public acceptance standpoint by providing a clear buffer between the "effluent" source and proposed end use. The SRF may play a role in the eventual indirect potable reuse of effluent in addition to its traditional and continuing role in providing high quality reclaimed effluent for non-potable uses.

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