Multipurpose Benefits of Regional Detention/Retention Facilities in Pima County

BY

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Paper presented at 2007 Regional Water Symposium, 20th Annual AHS Symposium,
Sustainable Water, Unlimited Growth, Quality of Life: Can We Have It All? August 29 – September 1, 2007, Tucson, AZ

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Introduction

The purpose of this paper is to:

- Provide a brief review of the multi-purpose Kino Environmental Restoration Project (KERP).
- Evaluate the potential for multi-purpose use of Pima County regional retention/detention basins
- Examine the level of effort and cost-effectiveness of multi-purpose applications
- Present conclusions and recommendations for a future range of possibilities

In 1987 Pima County and City of Tucson adopted a detention/retention manual, which envisioned regional detention basins for multiple benefits. Today, there are seven regional detention basins in the metropolitan Tucson area (Figure 1). One of them, the Kino Ecosystem Restoration Project (KERP) at Ajo Detention Basin, has incorporated recreation, wetland and riparian enhancement, and water harvesting, making it a true multi-purpose basin.

The Pima County Regional Flood Control District (PCRFCD) has examined the potential for large-scale urban water harvesting at regional and sub-regional detention basins. This paper examines the opportunities for water re-use, recharge, riparian restoration and recreation at existing regional detention basins.

Harvested water could be used in the basins, as well as outside the basins. In-basin uses and benefits include natural recharge, recreation and wildlife habitat. Outside the basins, water could be used to irrigate turf or to establish or enhance riparian vegetation along watercourses. In this paper, we evaluated these opportunities at a reconnaissance level, using the experience derived from KERP, site visits to the basins, and interviews with staff responsible for maintaining the basins.

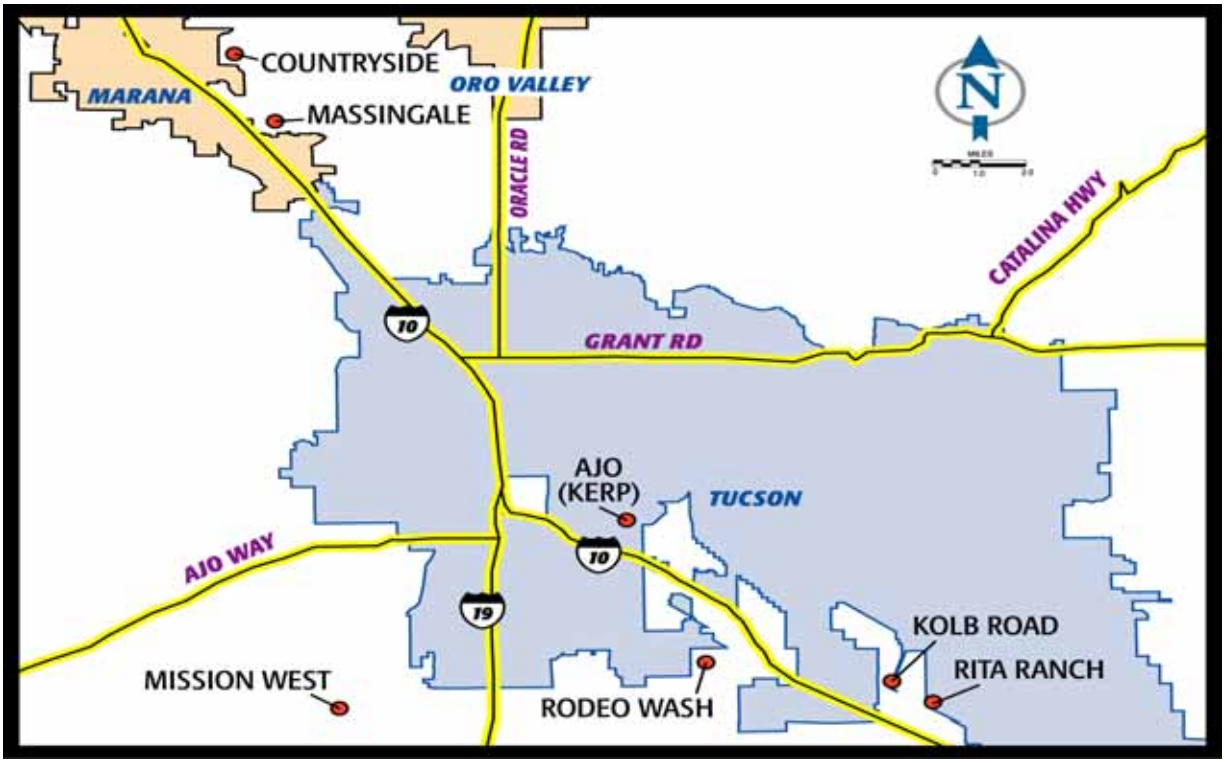

Figure 1. Location of Existing Stormwater Retention and Detention Basins

Overview of Kino Environmental Restoration Project (KERP)

The Ajo Detention Basin was originally constructed in 1966 to detain storm water draining from a 17.7 square mile mostly urbanized watershed that included Davis-Monthan Air Force Base, commercial and residential development of Tucson, Arizona. The main focus of KERP, a combined PCRFCD and US Army Corp of Engineers project, was to restore the basin with 50 acres of riparian habitat and harvest storm water for reuse on the ball fields of Tucson Electric Park and a regional park. A recharge component was considered. However, since a large amount of runoff was derived from industrial areas, water quality became an issue. KERP was completed in 2002 and has been successful at all the multi-purpose facility goals.

The 125-acre KERP facility detains and can reuse up to 1880 AF of storm water for irrigating ball fields and hydro-riparian use. Three stream courses have been established using storm water supplemented by treated effluent during dry periods. Upland meso-riparian vegetation has also been established. Trails have also been established with interpretive and educational signs. The project provides valuable habitat for resident and migratory waterfowl, shore birds, riparian obligate bird species, and upland bird species. It also provides additional habitat for reptiles, amphibians, small mammals, and invertebrates. Since the area has been heavily disturbed by urbanization and further growth is projected, this restoration effort provides a managed watercourse environment and a valuable increase in wildlife habitat for the metropolitan area.

Figure 2- Riparian area during and two years after planting at KERP

Method of Evaluation

Regional Retention/Detention Basins

Factors influencing the suitability of a basin for capture and transport of water off-site include the estimated volume and depth of harvested stormwater, the rate of infiltration in the basins, the suitability of using harvested water on turf irrigation and the estimated impact of urbanization on the water harvesting potential of the watersheds. For each basin, we located the nearest existing or projected turf facility. We also evaluated the value of on-site vegetation to wildlife and the recharge potential. In some cases, we also identified potential off-site riparian enhancement opportunities that might depend on harvested stormwater. We estimated park and riparian water demands at 3 ac-ft/ac/year. For water demands located outside the basin, the water demands can be satisfied either by harvesting stormwater from the basin or by use of reclaimed water. The distance from turf areas to reclaimed water lines was estimated using maps provided by Tucson Water.

In general, a large volume of water must be harvested to justify the cost of the infrastructure needed to

harvest stormwater and use it for turf irrigation. At KERP, for example, about $3.5 million of the original $6 million cost estimate was for water-harvesting related activities, principally lining and pump installation (Aspen Environmental Group, Nuvis and Collins/Pina Engineering, 1998). With the estimated annual water yield of 598 ac-ft /year (Tetra Tech, 2001) and reclaimed water at the retail rate ($576/ac-ft), harvested water is potentially valued at $345,000/year. Furthermore, because the sports fields at Tucson Electric Park would require about 410 ac-ft/year for irrigation, there was nearby demand for the harvested water. The Aspen evaluation suggested the value of harvested water could justify construction costs for KERP.

In order to adapt existing basins to be used for irrigating off-site turf, significant and costly modifications will be required. An upstream sediment trap will be required. Maintenance will be required. A liner to retain water will be required so that it will be available for use. Evaluation of KERP and other projects indicated that such modifications can cost tens of thousands of dollars per acre of basin to implement. In evaluating other detention basins, both the potential supply and potential demand for the water must be considered in determining whether these basins are suitable for water harvesting for off site turf irrigation.

In addition, we must evaluate the costs for alternative water sources for the turf, when the harvested water supply falls short. While it is possible to harvest 598 ac-ft /year of water in an average year at KERP, the recent drought shows that far less will be harvested in dry years.

In the case of KERP, ecosystem benefits were the primary justification for a multipurpose stormwater retention project, not the cost of the saved water. Costs of saved water would seldom be the prime motivation for a multipurpose project. Therefore, in this evaluation, we looked for ecosystem enhancement, recharge potential and recreational benefits as well.

In evaluating the basins for multipurpose use, the flood control purpose should not be compromised. Retaining water for off-site irrigation essentially changes the purposes of these basins from detention to retention, which must not limit the flood prevention function of the basins. PCRFCD staff are responsible for overseeing maintenance of regional detention basins for their flood control functions. A renewed effort is underway to maintain the basins ensuring that they properly allow for movement of floodwater into and out of these basins for public safety. The inlet and outlet channels must not be clogged with vegetation, which would impede flood flow.

Potential for Water Harvesting and Recharge in Existing Basins:

Water Harvesting Potential of Basins Under Existing Conditions

An estimate of water harvesting and recharge potential was made by calculating the water yield from two kinds of events. An event of 1" of rain or more occurs, on average, at least once a year in Tucson. For water harvesting to be successful for off-site use, it should be feasible to use runoff from this event. The 2-year, 24-hour storm (1.8") event, is a large storm by water harvesting standards, and can be useful for estimating water yield under favorable conditions. Some relevant characteristics of the basins and their potential to harvest water from these events are summarized in Table 1.

Table 1. – Characteristics of Detention Basins

Name	Rita Ranch	Kolb Road	Rodeo Wash	Mission West	Countryside	Massingale
Location (TRS)	D (15,15) 21	D (15,15) 20	D (15,14) 15	D (15,13) 20	D (12,12) 24	D (12,13) 31
Area (acres)	60	140	42	9	8	9
Watershed Size (sq. mi)[1]	4.5	15.7	2.7[2]	3	0.7	2.6
Percent Urbanized	35%	10%	20%	35%	35%	67%
Peak inflow Q100 (cfs)	6200	5970	2970	1265	2010	1715
Peak outflow	2360	2945	390	960	1755	1210
Max. Storage (ac-ft)	321	940	395	41	64	103
Depth at Pk Capacity (ft)	6	12	17	7	9	12
Estimated Water Yield for 1" Event (ac-ft)	59	127	33	41	7	37
Estimated Water Depth for 1" Event (ft)[3]	1	0.9	0.8	4.5	0.9	4.1
Estimated Water Yield for 1.8" (2yr) Event(ac-ft)	176	538	103	115	19	85
Estimated Water Depth for 1.8" (2yr) Event (ft)[3]	2.9	3.9	2.5	12.8[4]	2.4	9.5
Side-Slope	6:01	4:01	4:01	8:01	3:01	2:01
Proximity To Turf (miles)	0.5	2.3	0.25	0.75	0.02	0.02
Size of Turf Area (acres)[1]	5	8	15	7	3	11
Annual Irrigation Required (ac-ft)	15	24	45	21	9	33
Riparian Connectivity	sig.	mod.	poor	mod.	sig	sig
Infiltration Rate	mod	high	low	low	high	high
Relative Amount of Plant Cover in Basin	high	mod	low	low	high	mod

Notes

1. All values are approximate based on Pima County MapGuide and other readily-available data sources.
2. A previous engineering study estimated the drainage area for Rodeo as 4.3 sq mile with a contribution from north of I-10. Current topography indicates no contribution from the area north of I-10.
3. Assumes retention of all runoff, and water yield is divided by basin footprint to estimate depth.
4. Would overtop existing basin.

Soil characteristics were estimated using the soils maps (NRCS, 2003) and recommended Curve Numbers for soils with desert brush and herbaceous covers for those hydrologic soils groups (PCFCD, 1979). A rough estimate of the extent of urbanized areas was made using the 2002 orthophotograph. To simplify the calculations, "desert brush" areas were assumed to have a 50% cover, while "herbaceous" cover was estimated at 70%, which are numbers that are conservative (i.e. will result in less runoff). These calculations are useful for preliminary evaluation, but are not a substitute for a detailed hydrologic study of the basins.

As noted in Table 1, the estimated volumes of water are greater than the turf irrigation requirement for all basins for the 1.8" event and for four of the basins for the 1" event, in part because the turf requirements

are small. However, if stormwater were retained in these basins, four of the basins, Rita Ranch, Kolb Rd, Rodeo Wash and Countryside, would have a foot or less of water in them after a 1" storm. Even for the 1.8" storm, water would be less than three feet deep in three of the basins. Thus, excavation would be necessary to collect water in a smaller area so that it could be harvested for off-site use. Harvesting water from these shallow depths for off-site use may be infeasible without extensive modification.

Water Harvesting Potential Following Urbanization

Urbanizing watersheds can be expected to generate more runoff as permeable areas are replaced by impermeable areas. Of the contributing watersheds, Massingale is already largely urbanized, and three of the remaining watersheds, Rita Ranch, Mission West and Countryside, are about 35% urbanized. Development can be expected to continue in all the watersheds. Three of these four urbanized basins have been identified as containing lush riparian areas (Massingale, Countryside and Rita Ranch) in all likelihood because of the increased runoff from urbanized areas. Very little water is retained at the fourth watershed, Mission West, because the outlet structure is large, which prevents significant ponding of water.

The response of all watersheds to the 1" and 1.8" events can be estimated for pre-development and urbanized conditions in order to identify potential opportunities for future stormwater harvesting. For this evaluation, all urbanized areas were assumed to represent residential housing of 5 lots/acre, which result in a 50% impervious area for the urbanized portions of the watershed. A more detailed hydrologic evaluation would need to better account for actual housing density, but this evaluation is useful for understanding what could happen in the basins under similar conditions.

Table 2. – Estimated Water Yield (ac-ft) from a 1" Event and a 2yr 24-hour Event (1.8")

	Rita Ranch		Kolb Rd		Rodeo		Mission West		Countryside		Massingale	
Percent Urban	**1"**	**1.8"**	**1"**	**1.8"**	**1"**	**1.8"**	**1"**	**1.8"**	**1"**	**1.8"**	**1"**	**1.8"**
0%	33	135	127	497	24	91	19	78	2.1	11	0.1	18
25%	52	166	195	604	39	120	35	109	6	18	14	46
50%	72	196	264	710	53	148	51	141	9	26	28	73
75%	92	226	332	816	67	177	67	172	13	33	41	100
Existing Conditions	59	176	127	538	33	103	41	115	7	19	37	85

These simulations show that the relative increase in runoff as a result of urbanization will be greater on Massingale, Countryside and Mission West (greater than three-fold increase in runoff volume from 0% urbanized to 75% urbanized for 1" storm) than for Rita Ranch, Kolb or Rodeo basins. In part, this is because the soils in the Massingale, Countryside and Mission West watersheds are more permeable, so that runoff greatly increases as permeable areas become impermeable. Even though the simulations suggest that some watersheds will be less impacted by urbanization than others, the results show substantial increase in all basins for both 1" and 1.8" events. In fact, smaller events that previously were not runoff-producing events, may produce runoff as impermeable areas increase. Therefore, the net effect of urbanization is to increase the number of runoff-producing events as well as the volume of runoff from an event.

Currently, Kolb, Countryside, Massengale and Rita Ranch Basins have a higher potential to recharge

surplus storm water based on higher infiltration rates and larger storage capacity. However, site specific drilling and infiltration tests would be needed to evaluate the potential of storing additional effluent for recharge.

Characteristics and Potential Multipurpose Uses of Existing Basins:

The six regional detention/retention basins were evaluated based on their potential to serve as multipurpose facilities. In many cases, some basins already appear to serve secondary purposes, most commonly, wildlife habitat and recharge of storm water in the more permeable basins. Furthermore, the potential of each basin is described in terms of its proximity to a turf facility. The characteristics of each basin are described individually below.

Massingale Retention Basin

Existing Conditions

Massingale Retention Basin on the northwest side drains a 2.6 sq. mile watershed; about one-third of the area remains undeveloped, while the remaining two-thirds is residential housing (Figure 3). The nine-acre Massingale Basin was designed to retain water, not detain it temporarily. Reconstruction of a spillway at the northeastern entry between housing and the park to the east has resulted in considerable grubbing and vegetation removal has occurred in this area. However, farther west in the basin, significant stands of mesquite and palo verde have become established.

The basin already serves as important wildlife habitat. This basin was viewed after a significant rainfall, thereby allowing a qualitative assessment of the water-harvesting potential. A sizable shallow pond had formed at the western portion of the basin with several cottonwoods and some desert willow (Figure 3). Numerous quail and a few killdeer were present near the ponded area.

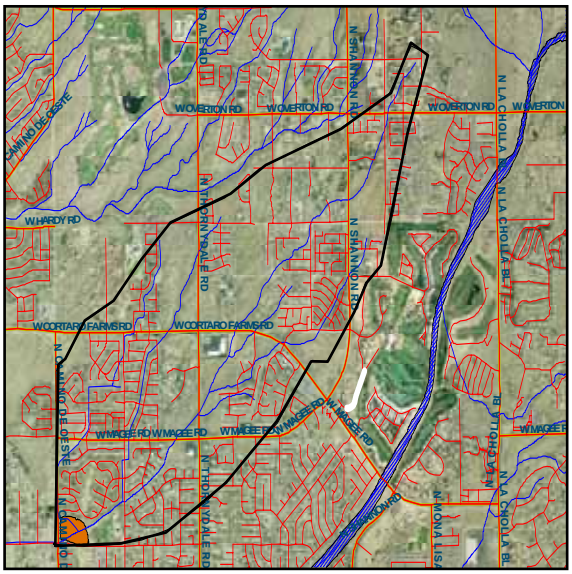

Figure 3. Massingale Basin Watershed

Figure 4. Massingale Basin, looking westerly

Potential for Additional Multipurpose Use

Some effort will be required to maintain the basin. A shrub and grass cover is desirable for wildlife habitat. However, the potential for riparian enhancement and recreation activity, such as bird and wildlife watching, is significant. The neighborhood has a plan for what vegetation could be removed at that site.

About 300 feet from the lake area is an approximately five-acre park (Denny Dunn) and an adjacent Marana school with about six acres of turf. Unlike many of the other basins evaluated, Massingale was intended to retain rather than detain water. With a storage capacity of about 103 ac-ft (Table 1), the 33 ac-ft/yr could be made available for turf irrigation. The preliminary calculation indicated that approximately four feet of water could be stored in the basin after a 1" event (Table 1). However, even after the large rainfall event prior to visiting the site, water levels in the basin appeared to be too shallow to harvest water, possibly due to high infiltration rates. Costs to implement a collection, filtering and distribution system would need to be estimated and balanced against the current practice of irrigating the fields with well water, purchased from the municipal utility. However, a reclaimed water line is located immediately west of Massingale on Camino de Oeste, and a 1,200-foot extension to the park using wheeled effluent would provide a less expensive irrigation source at about $65,700 infrastructure cost and about $72/ac-ft (Pima County Wastewater Management, 2004).

Based on the evaluation in Table 2, Massingale is more likely to be impacted by urbanization than any of the other watersheds, and it is also the most urbanized. Therefore, Massingale shows the degree to which urbanization can increase runoff and its potential for the development of in-basin and downstream riparian areas. Recharge potential of the surplus rain water may be significant due to higher infiltration rates and would add replenishment to the local aquifer benefit without added costs.

Kolb Road Detention Basin

Existing Conditions

The Kolb Road Detention Basin drains a 15.7 square mile area (Cella Barr Associates, 1983) that is largely undeveloped with the exception of a 4.5-square mile sub-watershed that drains from Rita Ranch, where there is also a detention basin (Figure 5). Taken together the two watersheds provide a contrast between the characteristics of detention basins in undeveloped areas and those in developed areas.

Vegetation in the Kolb Road Detention Basin is not nearly as rich and diverse as Rita Ranch and receives less water, as it is about 0.4 miles downstream of Rita Ranch Basin. Kolb Basin also detains runoff south of the Union Pacific Railroad tracks and an area including Julian Wash and tributaries. Currently, the basin has sparser vegetation, with mesquites and desert broom dominating (Figure 5). Grasses up to one foot high indicate that summer flows do spread out along the basin. The basin is large, and at 140 acres, makes it the largest detention basin in eastern Pima County (Table 1). Its maximum storage of 940 ac-ft makes it second only to Ajo in storage capacity. This basin has the largest potential for recharge of large amounts of surplus storm water and possibly effluent during dry periods in the early to late spring.

The basin already is associated with mapped riparian habitat. Just upstream of Kolb Detention Basin are several hundred acres of mostly xeroriparian C and some hydro-meso riparian areas in the Julian Wash Watershed. Some of the vegetation just upstream of the basin appears to have been grubbed out in 2004

aerial photography, but other areas remain intact. The vegetation upstream of the basin will continue to grow without supplemental irrigation. In addition, the basin has varying amounts of xeroriparian areas of primarily mesquite trees.

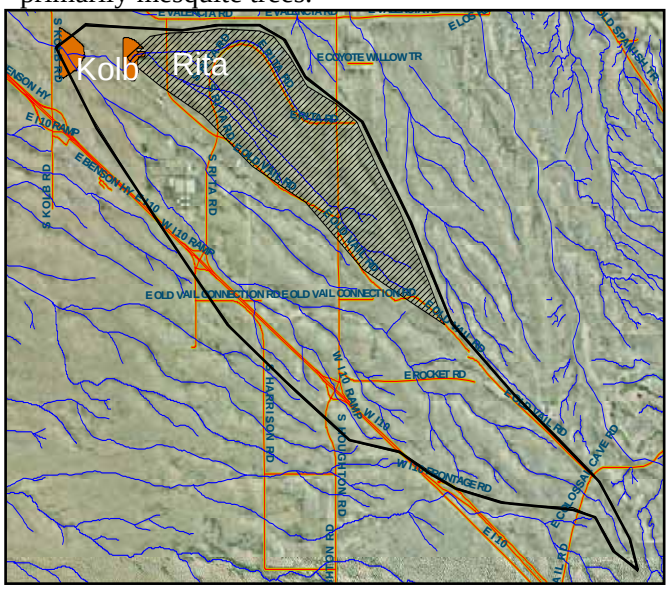

Figure 5 Kolb/ Rita Ranch Detention Basin Watersheds

Figure 6. Kolb Basin inlet

Potential for Additional Multipurpose Use

Currently the closest turf is at Littleton Park, an eight-acre county park, 2.3 miles downstream, which is too far to be irrigated with harvested water from Kolb Road. Furthermore, harvested water is expected to be less than one foot deep following a 1" event (Table 1), making it costly to harvest for off-site use. However, there may be potential to further enhance the basin for wildlife and spreading of surplus storm water without much active intervention. Currently, little of the Julian Wash watershed has been urbanized, but urban encroachment will eventually occur and increase flow into Kolb Basin. The Rita Ranch detention basin is within the Kolb Road watershed below the most urbanized portion of the watershed. The riparian area at Rita Ranch is indicative of what could happen at Kolb Road as the watershed urbanizes. Since riparian areas exist upstream and downstream of the basin, the basin has the potential it can serve as lusher habitat along the riparian corridor. This could further enhance the value of the Julian Wash as a wildlife corridor. One advantage to this proposal is that the entire area is located in the departure zone for Davis-Monthan Air Force Basin. As such, adjacent private lands are eligible for purchase and conservation using 2004 bonds. Furthermore, if this basin is to serve wildlife, then it will require cooperation with City of Tucson to protect the existing riparian areas in Julian Wash and its tributaries.

Rita Ranch Detention Basin

Existing Conditions

Rita Ranch drains a 4.5 square mile area. About half of this area is currently urbanized (Figure 6). The impact of the harvested water on development of riparian vegetation is decidedly more pronounced than at the Kolb Road Detention Basin 0.4 miles away. Rita Ranch Detention Basin, operated by the City of Tucson, has significant riparian value, harvesting significant amounts of water. Its broad inlet channel

and basin includes large stands of cottonwood, mesquite and willow (Figure 7). It serves as a model of what could happen at Kolb Road when the watershed upstream becomes more urbanized.

Figure 7. Rita Ranch Basin, looking southeasterly

Potential for Additional Multipurpose Use

There is a five-acre turf area on the University of Arizona research park 0.5 miles from the Rita Ranch Basin. A foot of water is expected to be harvested from a 1" storm (Table 1), which is too shallow to harvest and convey it to be economically viable. The City of Tucson owns the inlet channel and the basin, which is richly vegetated. According to Frank Sousa of the City of Tucson Department of Transportation Stormwater Section, almost all of the vegetation in the basin has been naturally seeded from air bourn and water moved seeds. Together with the Kolb Road Basin, the detention basin can serve in a wildlife and riparian corridor that runs throughout the Julian Wash watershed. Both Kolb and Rita Ranch basins are located in the Davis-Monthan approach and departure corridor, so development options are somewhat limited.

Rodeo Detention Basin

Existing Conditions

A previous hydrologic study (Johnson Brittain & Associates, 1983) estimated the watershed at 4.3 square miles, because they included some watershed from the area north of I-10, which no longer appears to flow toward Rodeo Basin. Staff calculated that Rodeo Basin drains a 2.6 square mile watershed that is largely undeveloped. Any future hydrologic studies should verify the watershed size.

About one-third of the area has been partitioned into lots for single-family housing, and some of this has been constructed since 2002 when the aerial orthophotograph in Figure 8 was taken. A nine-acre private park is scheduled to be built immediately east of the basin, according to Lisa Hoskin, of Meritage Homes Land Department. The park will require about 5 ac-ft/yr of irrigation water. A review of the hydrology reports for these subdivisions is in order to assess the new volumes of water generated from these sizable developments. Extensive modifications have occurred on the southeast inlet to the basin, where over 600 housing units will eventually be built.

The basin is large (42 acres) but apparently harvests smaller volumes of water than would be required to sustain a significant array of mesquites and other desert vegetation. Vegetation is sparse, consisting of small amounts of desert broom, some desert grasses and Bermuda grass (Figure 9). Maintenance practices may have reduced vegetation in the basin. Considerable erosion has occurred on the side slopes where not paved with concrete. Currently the storage capacity of the basin is 395 ac-ft (PCFCD, 1990).

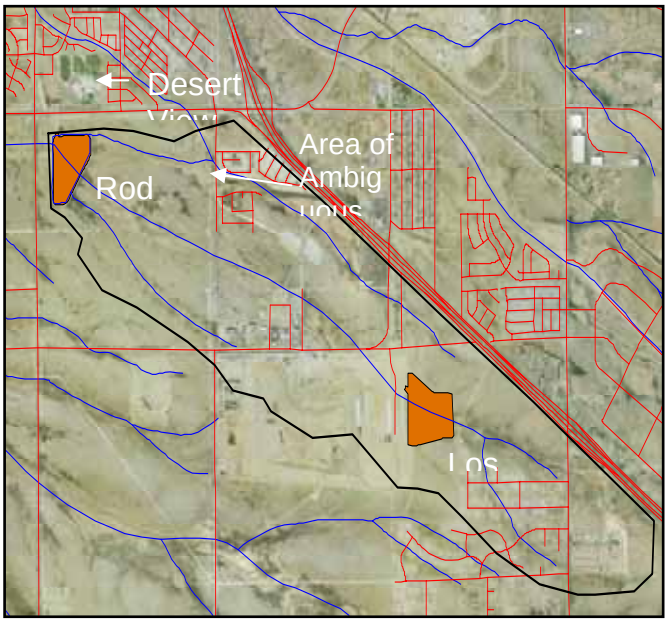

Figure 8 The Rodeo Basin Watershed

Figure 9. Rodeo Detention Basin,

Potential for Additional Multipurpose Use

The Rodeo Detention Basin appears to have the least value for water harvesting and vegetation enhancement of any basin evaluated, because it is not currently harvesting much runoff. Desert View High School of the Sunnyside School District is located about a quarter mile north of the Rodeo Basin has about 15 acres of turf, but it is unlikely that water can be economically harvested to irrigate turf. As the watershed urbanizes, runoff volumes can be expected to increase (Table 2), but the estimated runoff depth is less than a foot for a 1" storm, and only 2.5 feet for the 1.8" storm (Table 1). Under even modest infiltration rates and evaporation rates, the water cannot be expected to stay long enough to be used for off-site irrigation. The adjacent areas are mapped as xeroriparian C and D, and are therefore less lush than the vegetation in the Julian Wash watershed nearby. It may be more feasible to establish in-basin turf in this basin than the others. However, turf in detention basins requires more maintenance than other turf areas. Therefore, the county should gauge the interest of the nearby high school and neighborhoods in establishing and maintaining a turf area in Rodeo Basin.

Mission West Detention Basin

Existing Conditions

Mission West Detention Basin drains about three square miles of watershed, about one-third of which is currently developed (Figure 10). The basin itself is approximately nine acres in size, according to estimates done in 1990 (PCFCD, 1990). The basin appeared to have been graded within the last five years, as evidenced by short mesquite, palo verde and acacia tree re-growth in areas east of the spillway and north of the large culvert exit pipes (Figure 11). This basin can store about 40 acre-ft. However, because of the large culverts exiting the basin, water is not stored for very long.

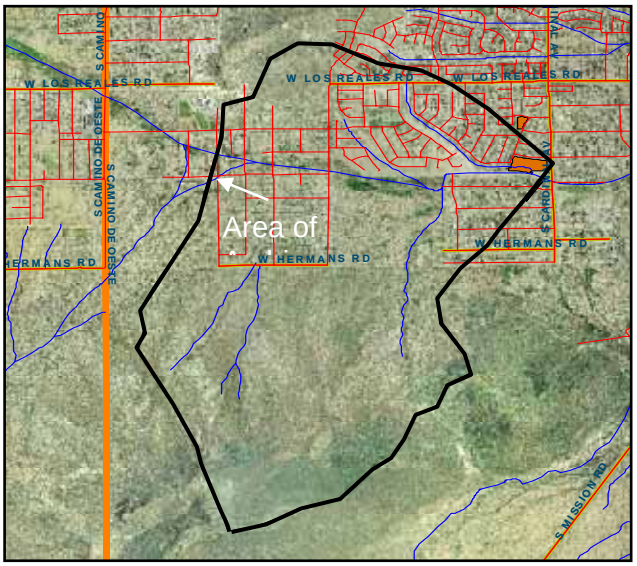

Figure 10. Mission West Watershed

Figure 11. Re-growth in Mission West

Potential for Additional Multipurpose Use

The hydrologic calculations indicate that this basin has the potential to store 4.5 feet of water in a 1" storm (Table 1). However, the outlet structure passes most of the water, so little water is retained in the basin. This basin would need to be excavated to retain water for offsite irrigation, and the distance and size of the nearest turf suggests that this would not be economically justified. Maldonado Elementary School is located within the Mission West Watershed and has about 7 acres of turf. However, it is located about 0.75 miles upgradient from the basin.

It may be feasible to redevelop the basin to support riparian vegetation. Beginning about 700-800 feet downstream of the Mission West Detention Basin is a nascent riparian area within the West Branch of the Santa Cruz River (WBSCR) that has potential for additional growth. This emerging riparian area is approximately 19 acres in size. The land was originally purchased by the PCRFCD to relocate flood-prone housing. Alternatively, either the basin or the area downstream could be maintained as a turf park. Maintenance issues in the basin and in WBSCR need resolution to balance flood safety and maintenance of multiple use functions including riparian habitat preservation and recreation.

Countryside Detention Basin

Existing Conditions

Countryside Detention Basin drains a watershed that is only 0.7 square miles (Figure 12). However the eight-acre basin packs in some of the most diverse dense riparian habitat in the Tortolita alluvial piedmont (Figures 14 and 15). The unnamed upstream tributary wash provides a rich and varied riparian habitat for at least ½-mile upstream, including large stands of blue palo verde, acacia, mesquite and some desert willow. This corresponds to the most densely urbanized uplands in the watershed, which may have increased runoff volumes over pre-development conditions. The basin has similar stand of vegetation and some reach as high as 40 feet. Portions of the wash further upstream are mapped as important riparian habitat. Observed at the basin and wash were flocks of quail and many doves. This is also prime habitat for pygmy-owl.

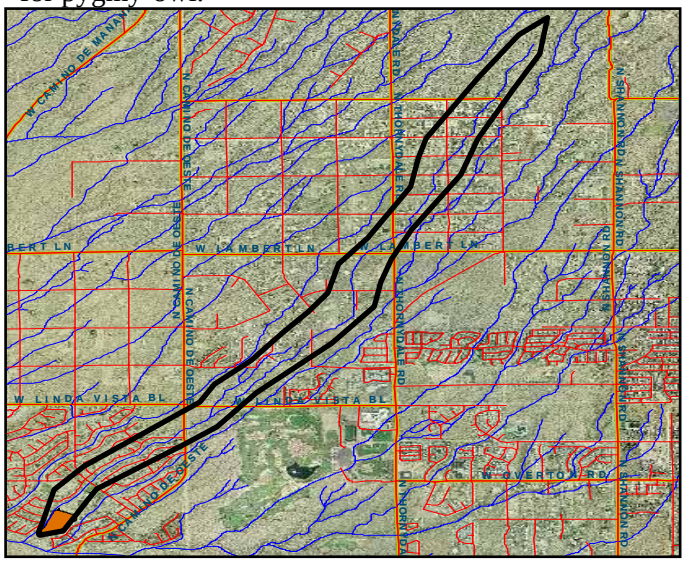

Figure 12.Countryside Detention Basin Watershed ***Figure 13.Countryside Basin, looking west***

Figure 14. Riparian area just upstream of Countrywide Basin

Potential for Additional Multipurpose Use

Although three acres of public turf and ball fields are within 700 feet at a Marana School, it is unlikely that it would be possible to irrigate this area with harvested water. The estimated runoff depth from even a 1.8" storm was only 2.5 feet (Table 1). Furthermore, infiltration rates appear high at the basin due to the significant deposits of coarse-to-fine grained sand deposited from the Tortolita Mountains. However, the high freeboard at the basin exit allows for some short-term retention, large vegetation growth and significant recharge of surplus urban runoff. Wildlife-watching opportunities abound. However, access is severely restricted by fences that surround the basin. Restricted or limited access would allow this basin to give bird and wildlife watchers opportunities to enjoy a unique area. This basin could conceivably also operate as a recharge basin for CAP or treated effluent. Reconnaissance-level study for this basin would be needed to determine if and how habitat and neighborhood amenity values could be retained if the basin were used for artificial recharge.

Conclusions:

Public safety must always remain our number one concern. Any modification that results in storage of harvested water essentially changes these basins from detention basins to retention basins and may diminish their flood-prevention capabilities. Any multi-purpose project will have to ensure that inlet and outlet channels remain clear, and that flood storage capacity is not diminished (or perceived to be diminished by the public).

Existing basins offer excellent and cost-effective opportunities for providing wildlife habitat in urban areas. In some areas, passive recreation might be accommodated in the basin at a somewhat greater cost. In all cases, the highest cost alternatives would be for capture and transport of water off-site.

In all cases, the existing turf facility demands are too low to justify capture and off-site transport of harvested stormwater. In general, the water harvested from even large storms would produce only shallow depths within the basin (e.g. less than one foot deep for a 1" storm). Costly modifications would have to be installed to allow for capture, sub-basin deepening and conveyance off-site. In addition to regarding the basins to make a point deep enough for harvesting water, an upstream sediment trap, a basin liner, and/or modifications to the basin outlet, may be required, depending on the site. In general, Massingale and Rita Ranch Basins have the most potential for water harvesting, but turf needs are too low to warrant construction of the water harvesting infrastructure.

One of the surprising results of this investigation is the degree to which hydromesoriparian vegetation is being supported in highly urbanized watersheds. Countryside, Massingale and Rita Ranch Basins have tall, shady mesquites and even cottonwood trees, despite lacking a connection to the water table. Countryside Basin and Massingale are located in pygmy-owl habitat, as well, and suggest that ecologically-friendly detention basins may contribute directly to the objectives of the Sonoran Desert Conservation Plan.

Grading the basin floors as a form of maintenance has limited the development of vegetation, as has removal of trees and shrubs. For wildlife habitat purposes, the development of tree, shrub, vine and groundcover layers is most desirable. Of groundcover forms, large, native bunchgrasses (such as sand dropseed, deergrass, and sacaton) and unpruned, thorny shrubs (wolfberry, graythorn) offer the excellent cover for ground-nesting birds, small mammals, and reptiles. Maintenance practices, which are best for wildlife, will allow development of a multiple layers of vegetation cover. In some basins, the addition of vegetation to the basin floors, via seeding or transplants, might also be used.

Only Countryside Detention Basin offers all three canopy layers (tree, shrub and groundcover) at present. Mission West, Rita and Kolb Basins have the most potential for improved vegetation enhancement through use of modifications of maintenance practices. As the watersheds urbanize, more mesic vegetation can be expected in Rodeo and Kolb basins from increased runoff volumes. Mission West Basin is unique in its potential for fostering downstream riparian growth on lands already owned by the District. This watershed is sufficiently urbanized and less destructive basin and channel maintenance is the limiting factor.

Our analysis suggests that large-scale water harvesting for off-site use is not warranted for existing regional basins due to the small scale of existing or proposed off-site turf needs. However, the District does have large water needs for its riparian restoration projects. The water demands of riparian projects are much larger than for parks, but several of the projects are located in areas so urbanized that there are few opportunities to integrate the construction of future regional retention basins with the water harvesting component. Other means of storm-water harvesting will be a critical component in assuring that these projects are self-sustaining and that future operation and maintenance costs are minimized.

Currently, Kolb, Countryside, Massengale and Rita Ranch Basins have a higher potential to recharge surplus urban storm water based on higher infiltration rates and larger storage capacity. However, site specific drilling and infiltration tests would be needed to evaluate the potential of storing additional effluent for recharge during dry periods.

To summarize, multi-purpose regional detention basins in Pima County can provide the following:

- Flood Control/Mitigation
- Water Harvesting and Subsequent Turf Irrigation
- Recharge of Surplus Stormwater/Effluent
- Riparian Restoration
- Passive and Active Recreation
- Open Space
- Increased Property Values

Recommendations:

- Site new detention/retention facilities to augment and encourage multi-purpose use
- Adapt existing detention/retention sites to encourage passive recreation and riparian restoration and recharge opportunities, while assuring public safety
- Explore potential to use existing sites for increased storm-water and possible effluent recharge

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