4. Historical Conditions of Vegetation

4.1 Introduction

Treatment facility upgrades will alter water quality and change distribution and abundance of effluent discharge, which may in turn affect vegetation. The purpose of this section of the report is to:

1. Review available datasets to describe what is and is not known about the vegetation changes in the study reach, from Roger Road to Trico Road, along the LSCR during the period of effluent discharge, with emphasis on riparian and wetland vegetation near the channel.

2. Describe conceptual models (e.g. hydrogeomorphic), if any, and what is known about factors that influence vegetative conditions, drawing on literature from other southern Arizona rivers where necessary.

The LSCR is characterized by sandy to silty alluvium deposited by the stream over the last several thousands of years. The channel is incised into its former floodplain. The terraces have been used primarily for farming and other increasingly urban land uses; the channel has been used for effluent disposal and sand-and-gravel operations.

The low elevation and the distance from high-elevation mountain ranges provides a warmer climatic setting and a hence a longer growing season than present along many other perennial and intermittent streams in Pima County, such as Cienega Creek, Rincon Creek, Sabino Creek or the upper San Pedro River.

The demise of the historical perennial reach of the Santa Cruz River at Tucson is a story well known and oft-told (Glennon 2002; Logan 2002). Groundwater pumping eliminated the springs and perennial and intermittent streamflows that characterized several of the reaches upstream of the study reach. Comparatively little attention has been given to the study reach, because it was largely ephemeral during historic times, with some evidence for intermittency near Nine Mile Water Hole near the confluence of the Rillito and Canada del Oro Wash (Huntington, 1914).

The water table in the study reach was quickly drawn down by agriculture in the Cortaro-Marana Irrigation District during the 1920s and 1930s (Schwalen and Shaw, 1957) and contributed to the local disappearance of many other plants (Mauz 2002).

By the 1970s, farming of the floodplain had reached its maximum extent and significant discharges of wastewater from municipal sewage treatment at Roger and Ina Roads had created perennial or intermittent flow in the channel, increasing the survival potential for
riparian and wetland plants species. Sand and gravel operations were in use in- and off-channel, and some former gravel pits were being used for landfills.

Following a series of floods in the late 1970s and 1980s, a number of soil-cement embankments were constructed along the river. These structures confined lateral erosion and restricted development of point bars that are typically colonized by vegetation. In places channelization and natural channel avulsion has changed the channel slope, and dramatically reduced the potential for widespread inundation of adjacent lands during infrequent large flood events.

Unlike the Upper Santa Cruz River, wastewater flows in Tucson have not re-established a permanent floodplain aquifer within the rooting zone of riparian vegetation. Effluent recharge would refill the aquifer, but continued extraction of groundwater by Cortaro-Marana Irrigation District and other water providers keeps the water table 80 to 300 feet below the land surface, beyond the rooting depth of most plants, with possible exceptions downstream of Ina (personal observation of a spring in a gravel pit) and near Orange Grove Road (Postillion, unpublished report).

### 4.2 Literature Review and Other Methods

U. S. Geological Survey (Galyean 1996) mapped vegetation in June 1993 along a 23-mile reach of the effluent-dependent Santa Cruz River for the purpose of estimating transpiration demands, primarily within the arroyo of the river. The classification used was primarily structural.

SWCA (1995) mapped and classified riparian vegetation according to dominant species and density for the river reach downstream of Avra Valley Road.

Fonseca and Wahl (1998) examined channel change and vegetation dynamics in the channel near Sanders Road.

A detailed survey of vegetation along 28 miles of the Lower Santa Cruz River was conducted in September 1999 for the Regional Effluent Planning Partnership on behalf of U. S. Bureau of Reclamation. The primary purpose of the vegetation mapping was to determine the current extent of riparian habitat along the effluent-dependent Santa Cruz River. Baker (2000) mapped vegetation to a distance of approximately 500 feet beyond the edge of the upper river terrace used the Brown, Lowe and Pase vegetation classification. This mapping was then used by Harris (2001) for the Sonoran Desert Conservation Plan riparian maps, which used the Brown, Lower and Pase system of classification.

The Regional Effluent Planning Partnership also sponsored studies of bird life (SWCA 2000) and a conceptual model of riparian dynamics (Stromberg 2001). SWCA (2000)
Chapter 4: Historical Conditions of Vegetation

included observations of vegetation at five locations within the Reviving Rivers project area. The proportion of each vegetation association (as described by Baker 2000) was measured based on large-scale aerial photographs.

Baker delineations (2000) were then converted to “Arizona cover types for the river and additional classifications of disturbed land cover were added within the Tres Rios del Norte project study area by U. S. Army Corps of Engineers (2002). Cover types included open water, parks, sand and gravel operations and other non-natural cover types, as well as vegetative cover.

U.S. Geological Survey and others collaborated to create raster-based land cover maps for Arizona and the Southwest in 1999 and again in 2002-2003. The first generation maps were called GAP vegetation maps, and the second generation was called the SouthWest ReGAP. These maps covered the entire project area and were based on the characteristics of Landsat spectral reflectance.

The Science Technical Advisory Team studied the representation of vegetation communities across Pima County for the Sonoran Desert Conservation Plan in public preserves of various types and made recommendations for protection and restoration of riparian and upland land cover (Fonseca and Connolly 2001)

In 2002 and 2003, the U. S. Army Corps of Engineers (Burks-Copes and Webb 2009) collected field data for a hydrogeomorphic assessment of the LSCR. Measurements included canopy cover for three structural layers of vegetation, and the richness of native and non-native plants, among other factors. Field data were also collected from reference reaches elsewhere in southern Arizona.

Fonseca et al. (2008) analyzed the 2001 and 1992 National Land Cover Datasets (NLCD) for changes in riparian plant cover. The NLCD classification is based on spectral reflectance from remote sensors and cover the entire area. NLCD places greater emphasis on classification of cultural land covers than does GAP or Southwest ReGAP. Areas of shrub/grassland were converted to urban land uses in the Santa Cruz Valley north of Ina, and the acreage of forested wetlands increased along the effluent-dominated Santa Cruz River. Additional NLCD classifications for 2006 are now available.

Environmental Planning Group (EPG 2004) compared plant communities present in 2002 and 2004, immediately before and after construction of the High Plains Effluent Recharge Project near Sanders Road. Measurements included plant height of dominant species, canopy and overall plant density. Saltbush increased after introduction of water into recharge basins. The study also listed all vascular plant observations, including aquatic algae.

Mauz (2002) documented the changes in vegetation diversity under conditions of groundwater depletion and cessation of agriculture at the West Branch of the Santa Cruz
Chapter 4: Historical Conditions of Vegetation

River south of downtown Tucson. Mauz 2011 identified the historic flora of the Santa Cruz and Rillito bottomlands based primarily on herbarium records.

Gormally (2002) compared the density, richness, diversity and nativity of native and non-native plants in belt transects in reaches with and without effluent, and with and without “channelization” [soil-cement embankments]. Two of the five study sites were located in the study reach. Data were collected during April and May 2002.


White (2011) compared streamside herbaceous cover and woody vegetation of the effluent-dominated Santa Cruz River to the San Pedro River. Data are available at Amado, Continental, Sahuarita in the upper Santa Cruz River, and at Hardin Road, Sasco Road, and Wheeler in the distal reaches of the Santa Cruz River in Pinal County. Field data were collected in 2007.

Villareal et al. (2011) used LANDSAT imagery to examine land use and land cover change in the watershed of the Santa Cruz River upstream of the Central Arizona Project canal crossing. The time periods analyzed included 1979, 1989, 1999, and 2009. Over this time period, palustrine forested wetlands in the watershed varied from 1335 acres in 1979 declining each decade to 866 acres in 2009. Emergent herbaceous wetlands varied from a high of 141 acres in 1999 to 54 acres in 2009.

Wetlands have been mapped by University of Arizona using remote sensing imagery for the National Wetland Inventory through a grant to Arizona Department of Environmental Quality (Jason Jones, ADEQ, Personal Communication to Julia Fonseca, 2012). Wetland classification followed the Cowardin system used by U. S. Fish and Wildlife Service, which is primarily based on physical features such as substrate and hydrology, as structural characteristics of vegetation.

4.3 Results

4.3.1 Vegetation communities and significance of vegetation communities

Vegetation communities in the project area are described using the Brown, Lowe, and Pase classification of Harris (2001) and Baker (2001), augmented by the author’s observations based on field visits and aerial photography between 1986 and 2012, and the previously cited datasets. A vegetation map based on Harris (2001) is included as a plate. A general description of the community is presented in the text below, followed by a more detailed analysis of the vegetation associations found within each community.
Chapter 4: Historical Conditions of Vegetation

The LSCR is characterized by a broad, multi-channel wetland community. The five principal wetland communities represented in the LSCR include: (1) Sonoran Riparian Deciduous Forest and Woodland, (2) Sonoran Riparian Scrubland, (3) Sonoran Interior Strand (4) Sonoran Interior Marshland and (5) Non-native Semi-desert Grassland. The upland habitat is represented by the Sonoran Desertscrub community. Associations are subcategories within the community and refer to a specific grouping of dominant plants.

The **Sonoran Riparian Deciduous Forest and Woodland** community along the LSCR is represented by three plant associations: the Sonoran cottonwood-willow association, the Sonoran Mesquite Association and the Athel Woodland Association. The first association is of Goodding willow (*Salix gooddingii*) and saltcedar (*Tamarix ramosissima, Tamarix aphylla*) with occasional velvet mesquite (*Prosopis velutina*), and cottonwood (*Populus fremontii*) (Fig. 4.1). The Sonoran cottonwood-willow stands along the Santa Cruz River are second only to Cienega Creek in total area, and because of their elevation on the landscape, retain their canopy far longer than other higher-elevation natural occurrences in Pima County. The Science Technical Advisory Team recommended that all occurrences of cottonwood-willow patches be maintained (Fonseca and Connolly, 2001). In the LSCR, this vegetation is entirely dependent upon a consistent water supply from surface flow as high groundwater levels are absent except where this plant community grows at the base of a “spring” in a gravel pit just north of Ina Road. Although cottonwoods are less common than Goodding willow along the river, cottonwoods are the dominant species present in a pond holding wastewater from gravel-washing facilities.

![Fig. 4.1 Sonoran Riparian Deciduous Forest (principally Goodding willows) and Strand along the LSCR](image)

Large areas of the **Mesquite Association** were mapped by Baker (2000) in the drier margins of the lower floodplain and tributaries. The majority of what Baker (2000) mapped on the floodplain outside of the tributaries would not classify as the true Velvet Mesquite woodlands due to the sparse cover. As mapped, the community included blue paloverde (*Parkinsonia florida*), creosote-bush (*Larrea tridentata*), saltcedar, burro-brush, desert-broom, and desert-willow (*Chilopsis linearis*), and graded into grass and forbs.
Examples of mature mesquite woodland are few, but can be found at the outfall of Silverbell (Columbus Park) Lake, and along Trico Road where they are sustained by tailwaters from other uses. Mature mesquites are also found also in the reach north of Camino del Cerro Road to Sunset Road (Fig. 4.2).

![Mesquite Woodland along the LSCR](image)

Fig. 4.2 Mesquite Woodland along the LSCR

The review of well records, photographs and place names from the late 19th century and early 20th century suggest that at times the water table was close enough to the surface to support mesquite woodland in Cortaro-Marana Irrigation District south of Avra Valley Road. As recently as the 1970s, mesquite bosque persisted in some bosques located north of Cortaro Road.

Mesquite woodland restoration of 1000 acres County-wide has been targeted for the Sonoran Desert Conservation Plan (Fonseca and Connolly, 2001), and the Tres Rios Del Norte study targeted this community type for restoration along the Santa Cruz River (ref needed). The Pima County Regional Flood Control District has targeted this plant community for establishment at the Cortaro Mesquite Bosque site near Continental Ranch.

There are also several patches of Athel Woodland Association (*Tamarix aphylla*) located primarily in former gravel pits that have been filled by floodwater deposition.
The **Sonoran Riparian Scrubland** community occurs in and along drainages where the vegetation is considered too dense to quality as a "desertscrub or strand community" and not tall or structured enough to be considered a "forest and woodland community" as described above (BOR 2002). The vegetation has adapted to the successional situations that occur in the flood-prone areas they inhabit (Brown 1982). Vegetation typical of this community type consists of burro-brush (*Hymenoclea monogyra*), desert-broom (*Baccharis sarothroides*), and seepwillow (*B. salicifolia*), as well as upland species such as wolfberry (*Lycium* sp.), acacia (*Acacia* sp.) desert hackberry (*Celtis pallida*) and mesquite (Baker 2000). Within the project area, the channel bars are predominantly burro-brush and desert-broom. Thickets of elderberry (*Sambucus*), broom and seepwillow are found along a rancher's irrigation channel crossing Sanders Road.

The **Sonoran Interior Strand** community is found in the channel where it is subject to more recent scouring. This habitat consists primarily of open stands of shrubs and weeds such as seepwillow, tree tobacco (*Nicotiana glauca*), cocklebur (*Xanthium strumarium*), nightshade (*Solanum* sp.). Some areas subject to frequent scour may only be populated with algae. Within the project area, the vegetation consists primarily of scattered burro-brush and bermuda grass (*Cynodon dactylon*) and weedy annuals.

The **Sonoran Interior Marshland** community is rare within the study reach of the LSCR, and is usually associated with depressions along or near the channel. Although not mapped by Baker (2000) several pockets of marshland and/or open water habitat occur in the project area, notably in former gravel pits, just upstream of the Ina Road grade control structure, and within the Marana Frisbee Golf basin after large flow events.

**Semi-Desert Grassland community** – There are no native grassland communities present in the study reach's wetlands, however non-native grasslands are present. The distribution of this community has not been well-studied or distinctly mapped. Bermuda grass (*Cynodon dactylon*) and arundo (*Arundo donax*) are found primarily along the channel in moister microsites, whereas buffel grass (*Pennisetum ciliensis*), *Sorghum halapense*, and *Schismus* are common outside the wetlands. One of the purer examples of a buffelgrass community is at the Camino del Cerro landfill, where it is being managed with herbicide. The **Grasses/Forbs Association** mapped by Baker (2000) occurs primarily in the uplands west of the Avra Valley airport and is composed of a variety of annual and perennial species (Bureau of Reclamation, 2002).

The **Sonoran Desertscrub** community occupies habitat on the uplands, terraces and bajadas surrounding the river corridor. A small portion of the project area consists of paloverde-cacti mixed scrub vegetation. The primary plant species found within this habitat include foothill paloverde (*Parkersonia microphylla*), saguaro (*Cereus giganteus*), mesquite, catclaw acacia (*Acacia greggii*), ocotillo (*Fouquieria splendens*), ironwood (*Olynea tesota*), barrel cactus (*Ferocactus acanthodes*), and cholla (*Opuntia*) species. The project area is predominately creosotebush-bursage vegetation, a more open
habitat type dominated by shrubs such as triangle-leaf bursage (*Ambrosia deltoidea*), creosotebush (*Larrea tridentata*) and saltbush (*Atriplex* sp.). One of the most intact examples of desert scrub is located on County-owned land south of Ina Road and east of Silverbell Road. Creosote-dominant desert scrub is abundant on the river terrace downstream of Avra Valley Road. The *Desert Saltbush Association* is particularly noteworthy as it is a plant community that used to be more widely distributed in the floodplain of the Santa Cruz River (Turner 1974). Today the distribution of this plant community in Pima County is extremely limited. The Science Technical Advisory Team recommended protection of all remaining patches in reserve design for the Sonoran Desert Conservation Plan (Fonseca and Connolly 2001). Today it occurs in relictual stands at Los Morteros (Figs. 4.3 and 4.4) and on the terrace adjacent to Silverbell Road between Camino del Cerro and Ina Road. It was successfully restored in the Continental Ranch area through dryland seeding.

Fig. 4.3 Saltbush, *Atriplex polycarpa*, along the LSCR near Ina Rd (Right)
4.3.2 Other Land Cover Types

Other land cover types listed below are based on SW ReGAP:

Agriculture – Existing agricultural lands, primarily cotton, are found downstream of Avra Valley Road, bordering the river. As used by SW ReGAP, the cover type includes fallowed lands and Bermuda-grass pasture lands irrigated with effluent from the river in the areas just upstream and downstream of Sanders Road.

Open Water- Areas of open water in and along the Santa Cruz River include former gravel pits, flooded borrow pits, recharge basins, recreational ponds, stock ponds, as well as the wetted stream itself.

Medium-High Intensity Development- As mapped by SW ReGAP this includes the treatment facilities, recreational turf.

Developed Open Space-Low Intensity- This includes bank protected sandy channel bottoms that in 2012 evidence denser ribbons of riparian vegetation along water’s edge.
4.3.3 Vegetation Structure

White (2011) classified the vegetation structure of the subject reach and beyond. At the two sites within Pima County, forest and woodland combined covered less than 20% of the floodplain. Most of the floodplain was occupied by herbaceous cover, and less than 20% of the floodplain was bare ground.

Baker (2000) determined the age class and the vegetative structure of the riparian woodland vegetation. The age of Goodding willow was estimated at six years which corresponded to the 1993 flood, however the author observed that many of the Goodding willows just downstream of the Roger Road outfall had established prior to the 1993 and resprouted through the flood deposits of 1993. A later study by White (2011) found that stem diameter of Goodding willow along the effluent-dominated Santa Cruz River declined with distance from the effluent discharge origin.

Baker (2000) estimated a range of 15 to 48 years for “salt cedar”, but it is unknown whether this refers to evergreen athel tree or the deciduous tamarisk. Although saltcedar was located adjacent to the river channel it also occurred away from the river channel making it less susceptible to flood effects.

Baker classified vegetative structure utilizing the system devised by Anderson and Ohmart (1984). The structure stage varies by tree species but most riparian trees progress in the following sequence: Stage VI, V, IV, III, I and II. Stage VI is described as short stature (< 6 ft); while Stage V begins to have some separation into a midcanopy. Stages IV and III have well developed under and mid stories, but the canopy is not well developed. Stage I has well developed under, mid and canopy layers, while the Stage II understory has been shaded out.

The Goodding Willow Association was equally split between Stages I and III. The Goodding Willow/Saltcedar association was primarily (70%) in Stage III. Stage I’s multi-layered structure correlates with higher avian diversity (MacArthur and MacArthur 1961, Carothers et al. 1974, Anderson and Ohmart 1977, Anderson et al. 1983 in USBR 2001). Stage III which has some canopy development also provides good habitat for avian species. The majority of the Saltcedar Association was nearly equally divided between Stages IV and V. Saltcedar Association Stages I and III, which provide higher wildlife value, had significantly less acreage. The Velvet Mesquite Association was overwhelmingly classified in Stage V which is typical of most non-bosque type mesquite habitat. Upland and riparian mesquite were lumped by Baker (2000) during the vegetation survey (BOR 2002).

Vegetation structure of the mesquite-palo verde association was studied by EPG (2004) at the High Plains site. Most of the canopy fell within the one to two meter range, and all of the measured values were below 6 meters). This association has a much higher estimated percent annual ground cover (42%) than for creosote-bush association (6%).
Chapter 4: Historical Conditions of Vegetation

or tamarisk-willow (2%). Per cent coverage measurements and estimates were made following normal winter rains received during the 2003-2004 winter season (EPG 2004). EPG’s observations are consistent with the findings of White and Stromberg (no date) on the depression of herbaceous cover under conditions of high streamside canopy cover along the Upper Santa Cruz River.

In comparison with reference areas selected along the Hassayampa, Salt River, and Tanque Verde Creek, transects along the LSCR similar if not better maintenance of characteristic plant community structure and composition (Burke-Copes 2009). The LSCR showed a lesser degree of maintenance of characteristic plant community structure and composition as compared to the Upper Santa Cruz (Tumacacori), and San Pedro Rivers.

4.3.4 Species diversity

Many species have been lost from the Santa Cruz River floodplain. Mauz (2002) found that about half of the species present in Thornber’s 1909 study are extirpated at that location. Mauz (2011) later documented the losses in bottomland flora of the Santa Cruz and Rillito rivers within the Tucson Basin, an area that includes the southern half of the study area. Notable extirpations of common wetland or riparian species included the disappearance of screwbean mesquite, Huachuca water umbel, and arrowweed, two species that would seem to be well-adapted to the saline soil and water of the modern LSCR. (In the mid-2000s, the author found a population of arrowweed at a sand-and-gravel pit located near Valencia, a considerable distance upstream of the study reach of the LSCR, a specimen of which was taken by Mauz to the University of Arizona Herbarium.) Soapberry, canyon hackberry, ash, walnut, coyote willow and sacaton have disappeared from the Santa Cruz bottomlands near Tucson, and no post-1970 records exist of their occurrence in the project reach where water is now abundant.

Non-native species are a prominent component of the flora of the LSCR. Gormally (2002) found giant reed, Bermuda grass and curly-leaf dock to be predominant components of some effluent-transects, and detected a significant difference between native and exotic plant species between areas with and without effluent. In general, effluent was associated with increased plant density, diversity, richness, cover and incidence of exotic plants relative to the ephemeral reaches upstream.

Athel trees (Tamarix aphylla) are more common along the Santa Cruz River than are the deciduous species of tamarisk are well-studied along the Gila, Colorado and Salt River systems. Unlike their deciduous, shrubby relatives, athel trees have tall, evergreen canopies, sheltering wildlife and homeless humans alike. Athel reproduces primarily through vegetatively, rather than by seed. The author’s observations over the past 30 years suggest that monospecific stands of T. aphylla preferentially establish in former gravel pits and borrow pits (Fig. 4.5).
Species richness, plant height, nitrogen score and percent cover of wetland indicator species declined with distance from the effluent discharge origin (White 2011). The percent of wetland pioneer species declined relative to non-pioneer species with increasing distance from effluent discharge points (White 2011).

4.4 Discussion of Conceptual Models and Relevant Factors

The primary biophysical drivers of vegetation community structure and composition are the floodplain processes of the LSCR, the discharge of effluent, groundwater pumping and the land use history (particularly mechanical disturbances due to channelization, agriculture, and extraction of sand or gravel materials).

The state and transition model for southern Arizona riparian plant communities in relation to flooding is summarized in the figure below (Gori, 1996 in Fonseca and Regan, 2001). In general, in absence of large floods, floodplain sand and gravel bars become progressively more stabilized by vegetation. Bare sand bars become colonized by strand vegetation which evolves into riparian scrub, and depending on water availability can become cottonwood-willow (C-W) forest or mesquite bosques if not eroded by larger floods.
According to a conceptual model created for the effluent-dominated Santa Cruz River, flood pulses serve to clear and create establishment sites for seedlings, as well as
causing mortality of established plants (Stromberg 2001). In the project reach, mortality occurs not only through erosion but can also be triggered by shifts in availability of the surface flows caused by sedimentation and erosion, in absence of a shallow groundwater table that might otherwise aid persistence.. Despite this additional mortality factor, the rates at which willows in the Santa Cruz project reach survived the 1990/1993 floods is similar to the rate at which similar sized trees in the Hassayampa River survived the 1993 floods (Stromberg 2001).

“No-action” scenarios associated with the development of a hydrogeomorphic model for the LSCR predicted reduced discharges of effluent, conversion of vacant and agricultural parcels to future urban development, and increased bank protection (Burks-Copes and Webb, 2009). This is predicted to cause the loss of 150 acres of river bottom, and half of the existing mesquite woodlands. The existing narrow bank of riparian vegetation supported by current effluent flows would continue to exist, but would decline over time in response to decreased effluent flow, causing a slow but complete loss of cottonwood-willow communities. Shrublands are expected to dominate the study area by 2062 under the no-action scenario (Burks-Copes and Webb 2009).

Reductions in flow would cause reduced areal extent of the aquatic and native willow forestland and aquatic habitats (Patten et al. 1998; Stromberg 2001). The effects of reduced effluent discharge would be observed first in the areas most distant from the outfalls. For the Roger outfall, the most distant locations are just upstream of the Ina Road outfall. For the Ina outfall, the distal reaches are sometimes in Pinal County, but stream gages show that even now, the reach downstream of Trico sometimes goes dry. Effluent reductions could also impair the recharge, restoration and ranching projects located in Marana. Stromberg (2001) also notes that reduced availability of water could shift the community toward an increased amount of tamarisk.

Channel straightening increases the slope and reduces meanders, and might thereby reduce the area and stability of the sites available for occupancy. Channel encroachment can increase velocities, and shift the vegetation toward species that are very resilient to these new conditions. Gormally (2002) found that channelization of the Santa Cruz River was associated with increased shrubs and fewer tree and herbaceous forms. Channelized reaches had no significant effect on plant density, diversity and cover. Channelization did, however, more than double plant richness on sites lacking effluent, perhaps due to the greater effect of flood disturbances.

Several man-made experiments offer some insights into the factors which create and encourage persistence of the more mesic plant communities along the Santa Cruz River. Pima County Regional Flood Control District and a rancher divert effluent to vegetate the floodplain and recharge water along the Santa Cruz River upstream of Sanders Road. The rancher’s water diversion into an abandoned portion of the river channel maintains and augments one of the densest riparian patches along the lower Santa Cruz River. Thickets along the rancher’s earthen canal also increase the area and diversity of the
Chapter 4: Historical Conditions of Vegetation

riparian plant community, as this is only place along the project reach where elderberries may be found. The combined effects of the diversion demonstrate that off-channel diversions of base flows from the river to areas more isolated from flooding could be used elsewhere along the effluent-dominated reach to increase the quality and breadth of the riparian corridor.

Two other examples seem to show that areas of aggradation, whether natural or induced, offer places for sustained and rapid vegetation growth, even after complete obliteration. At La Osa Ranch in adjoining Pinal County, effluent and storm flows of the Santa Cruz River spread out into a broad network of small channels bordered by mesquite woodland which is unconstrained by levees or bank protection. Although a developer removed much of the vegetation, and even filled some of the channels in 2003 (Rosen and Fonseca, 2003), recent aerial photographs demonstrate a rapid rate of natural recovery of vegetative cover in this area of net aggradation. At Ina Road and more recently at Twin Peaks, grade-control structures have artificially flattened the channel slopes upstream. The extent of wetlands above the grade control increased after the mechanical disturbance associated with construction, although it could be argued that induced scour and channel-bed degradation may have rendered some of the channel downstream of the grade control less suitable for re-growth.

4.5 Conclusions

Several plant communities such as Sonoran cottonwood-willow and mesquite forests, and saltbush desert scrub have been disproportionately diminished in areal extent by historic land use and water resource use along the LSCR. One plant community, native floodplain grasslands, is virtually absent. Native plant species diversity was also reduced following the reduction of natural baseflows and lowering of the shallow groundwater table.

Beginning in the 1970s, effluent discharged to the LSCR at Roger Road revived some of the wetland and riparian plant communities, and facilitated the spread of non-native wetland and riparian species. Today the project reach supports some of the most extensive and productive wetland plant communities in Pima County, and the structure and composition of the plant communities in the floodplain compares favorably to other southern Arizona valley bottom streams. At a time when other streams and springs in southern Arizona have gone dry or are experiencing reduced discharges, the effluent-dominated LSCR remains a unique “drought proof” stream.

In the future, however, reduction of effluent discharges, land development and additional flood control measures are predicted to reduce the extent of the wetland plant communities along the LSCR. Impacts due to effluent flow reductions could be expected to be seen first in the areas most distal from the outfalls, that is, above Ina Road and downstream of Trico Road. Reductions in effluent flows could also impair the recharge,
restoration and ranching projects located in Marana. Effects due to water quality changes would be more likely to be noticed near outfalls. Reduced nitrogen loading may cause some shifts in the composition of wetland forbs, and increasing the salt load may favor tamarisk.

Studies of the river vegetation suggest that maintaining or restoring flood-dependent cottonwood-willow forests will be easier in reaches with floodplains lacking bank protection and having effluent flows. Mesquite bosques persist or have become established in areas of infrequent bank erosion where water availability is augmented either by effluent discharge from the municipal treatment facilities or where agricultural or urban runoff is concentrated. Terraces that are no longer subject to inundation offer sites for persistence or re-establishment of saltbush and other upland desert scrub. In comparison to other plant communities, relatively little is known about the restoration potential for floodplain grasslands.

4.6 References


Chapter 4: Historical Conditions of Vegetation


Chapter 4: Historical Conditions of Vegetation


Chapter 4: Historical Conditions of Vegetation

