WITTMANN ADMSU MCMICKEN DAM LANDSCAPE COMPATIBILITY ANALYSIS

FINAL REPORT
MAY 2005

Flood Control District of Maricopa County

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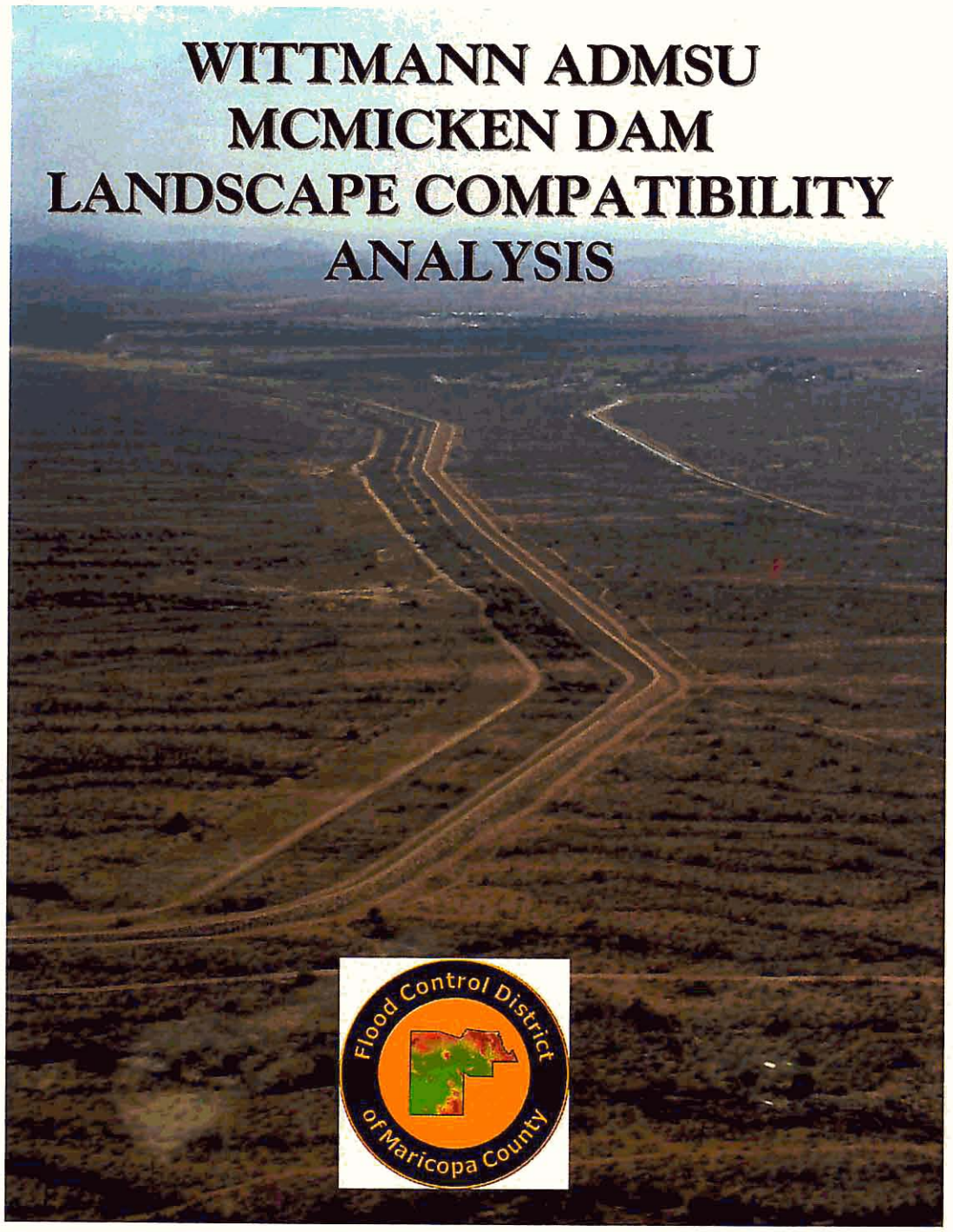

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1.0 Introduction

- Purpose

The purpose of this report is to provide an assessment of landscape character compatibility for the proposed McMicken Dam and Outlet Channel alternatives based on FCDMC's Preliminary Existing Landscape Character Assessment for Maricopa County. The report will also provide a basic opinion of probable costs for aesthetic treatments for these alternatives based upon FCDMC's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects* and FCDMC's *Aesthetic & Multiple-Use Design Guidelines for Flood Control Basins and Channels.*

- Process

The preparation of this report involved the following tasks and procedures as described below.

- Attended Alternatives Analysis meetings with project team to review the type and range of flood protection alternatives for McMicken Dam and how they relate to Landscape Compatibility.
- Reviewed and evaluated existing maps, photographs, reports and electronic data with County personnel.
- Reviewed the site with County personnel to become familiar with the project, and identify issues of concern.
- The primary source of data for this report is the *Preliminary Existing Landscape Character Assessment for Maricopa County* dated October 2, 2003. The compatibility matrix and map were prepared utilizing data and maps from this source.
- Prepared preliminary compatibility matrix and map for review by the County.
- After review meetings with the County to discuss preliminary submittals a final version of the report and maps were prepared and submitted.
- Develop Recommended Aesthetic Treatment Design Guidelines
- Prepare Opinion of Probable Costs for Aesthetic Treatments

- Reference Data

The following reference data were utilized in the preparation of this report:

- *Preliminary Existing Landscape Character Assessment for Maricopa County*, October 2, 2003, EPG.
- *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects*, December 16, 1992, FCDMC

- *Aesthetic & Multiple-Use Design Guidelines for Flood Control Basins and Channels.*, Rev. May 28, 2002, Dennis Holcomb, Senior Landscape Planner, FCDMC.
- *Assessing the Relative Ability of Flood Protection Methods to Complement and Achieve Compatibility with the Visual Character of Landscape Settings in Maricopa County – A Proposed Framework For Application to Flood Control District Planning Studies*, January 2003, Revised December 23, 2004, Dennis Holcomb, ASLA, Senior Landscape Planner, FCDMC.

- Project Backround

Originally called the Trilby Wash Detention Basin Dam and constructed by the United States Army Corps of Engineers(USACE) in 1954 and 1955, McMicken Dam is a long, earthen embankment. The 10-mile-long dam is located in the north central portion of Maricopa County and runs from Happy Valley Road to Peoria Avenue (Fig 1). Construction of McMicken Dam was authorized by Congress in 1953 to provide emergency flood protection for Luke Air Force Base, the Litchfield Park Naval Air Facility and adjacent areas. McMicken Dam functions as a flood control structure and is operated and maintained by the Flood Control District of Maricopa County (FCDMC) under the jurisdiction of the Arizona Department of Water Resources(ADWR).

Extensive repairs to McMicken Dam were completed in the mid-1980s to repair severe embankment cracking. During the repairs, studies detected the presence of earth fissures near the south end of the dam. Additional studies were conducted in 2000 to further characterize the fissures near the embankment. The results of these additional studies indicate earth fissures and conditions sufficient for fissure development adjacent to the south end of McMicken Dam. Fissure development in the area is the result of subsidence of basin soils due to groundwater withdrawal. As the water table is lowered, the basin soils consolidate.

- Project Geographic Scope

For the purpose of this report there are two areas that define the geographic scope of the project:

- Project Area is defined as the area around the McMicken Dam and Outfall structure within Maricopa County Right of Way.
- Study Area is defined as the area within an approximate 2 mile distance on either side of McMicken Dam and Outlet Channel and Outlet Wash.

Both these areas are indicated on the Project Location Map (Fig. 1)

2.0 Alternatives Evaluated

- History of alternatives
  As part of the overall Wittman Area Drainage Master Study Update project, Stantec was contracted to perform an alternatives analysis for McMicken Dam. The primary product of this analysis was to develop two basic alternatives based on the following approaches:

  - Structural Alternative 1 – Dam Rehabilitation to address all dam safety deficiencies and failure modes.
  - Structural Alternative 2 – Flood Conveyance Facility to replace McMicken Dam.

Numerous alternatives were developed within these two basic approaches. These alternatives were presented during a Preliminary Screening Meeting to the design team at the District offices. The design team included representatives from FCDMC, ADWR, USACE, Consultants for the McMicken Dam alternatives and Consultants for the overall Wittman Area Drainage Study. An Alternative Analysis System Evaluation Matrix was utilized during the meeting to determine the final alternative for each of the two basic approaches.

Alternative 1 - Dam Rehabilitation (FRS Remediation Structure)

It is assumed that this alternative will only affect the section of the project area containing McMicken Dam and that it will not affect the McMicken Dam Outlet Channel or the Outlet Wash.

This alternative includes a new emergency spillway and raising the dam embankment as necessary to provide the required freeboard. The new spillway would be located between the existing spillway and the principle outlet and be constructed using roller compacted concrete. The existing emergency spillway would be abandoned and a new end of dam segment constructed across the entrance of the approach channel. The new spillway would require relocation of the shooting ranges and modification/removal of the berms surrounding the shooting ranges. The dam embankment height would be raised to provide the required freeboard and include measures to protect against embankment cracking and earth fissures.

Flood Control Components of Dam Rehabilitation Alternative:

- Dam Embankment
- Low Flow Channel
- Emergency Spillway

- Principal Outlet
- Impoundment Area

Alternative 2 - Dam Decomissioning (Flood Conveyance Structure)

This alternative will involve construction of a conveyance facility that would replace the existing McMicken Dam and significantly expand the capacity of the McMicken Outlet Channel. The alternative includes lowering the embankment and removing portions to convert it to a levee. The outlet channel would be widened and the existing levee raised to convey the 100-year flow. FEMA freeboard criteria for riverine levees of 3-feet would be used. New bridges would be required at the US 60 highway, BNSF railroad crossings, and SR 303. Improvements to the outlet wash may include re-alignment east around the electrical substation and construction of a bifurcation structure at the Outlet Wash. No channel improvements will be considered downstream of the confluence with the Agua Fria River.

Flood Control Components of Dam Decommissioning Alternative:

- Earthen levee and Removal of Dam Embankment
- Conveyance Channel
- Drop structures
- Bifurcation Structure

3.0 Range of Flood Protection Methods

The following range of flood protection methods indicate ways in which each of the alternatives could be implemented.

- Non Structural – The non-structural method of flood protection employs the use of regulatory mechanisms such as erosion setback zones and zoning regulations as a mechanism for providing flood protection. This method generally does not introduce structural elements or facilities into the landscape setting.

- Soft structural - The soft structural method includes construction of flood protection structures, such as conveyance channels, storage basins and flood retarding structures, utilizing earthen materials. The hard structural components of these facilities are either non-existent or are buried or concealed so as not to be visually evident to the average viewer.

- Semi-soft structural - The semi-soft structural method is similar in many respects to the soft structural, except for the introduction of visible structural components that are a functional part of the flood protection facility. Examples of such components could include grade control structures, energy dissipaters, low flow features, inlet and outlet structures. These structural components can often be designed to remain visually subordinate to, and complement, the desired character of the settings in which they are located through careful placement, materials usage, and careful design of their overall form.

- Semi-hard structural - The semi-hard structural method is somewhat similar to the semi-soft structural method, but it lacks the inclusion of aesthetic features. The superstructure is constructed predominantly of earthen material. The structure is characteristically large-scale, with an overall geometric and straight form, uniform side slopes, bottom (invert) and over-bank areas. Component structures for

grade control, energy dissipation, inlets and outlets are characteristically standard engineering designs without the incorporation of aesthetic treatments.

- Hard structural with aesthetic treatments - The hard structural method with aesthetic treatment includes large-scale concrete lined channel facilities and other structural components. This method can include aesthetic treatments such as: gracefully meandering the form of a channel in the landscape; use of color, textural patterns, urban art and other architectural embellishments to establish visual and cultural context and a unique sense of place within local communities. This method also includes attractive grading and landscape planting of overbank areas to create an effective visual transition with adjacent properties and streetscapes.

- Hard structural - The hard structural method includes the construction of heavily armored concrete structures and component facilities without the inclusion of aesthetic treatment measures. These facilities are characteristically large-scale facilities with an overall geometric and straight form, uniform side slopes, bottom and over-bank areas. The hard structural method incorporates vegetation planting of over-bank areas only to the extent required for erosion control, dust control, or meeting USACE 404 permitting requirements.

4.0 Project Aesthetic Treatment Goals and Objectives

The project area is identified in the Desert Spaces Plan, the City of Surprise General Plan and the Maricopa County Open Space Element as a key open space resource with the overall goal of preserving it as a natural sonoran desert landscape that will serve as a recreation open space corridor linking White Tanks Regional Park with the West Valley Recreation Corridor (Aqua Fria River).

The overall aesthetic treatment goal for the McMicken Dam Remediation Project, therefore, is to achieve the appearance of a natural sonoran desert landscape throughout the project area. Specific landscape themes that should be applied to the project area based upon the types of landscape settings that occur therein include:

- Natural Sonoran Desert River Channel Theme
- Natural Sonoran Desert River Terrace Theme
- Natural Sonoran Desert Bajada Theme
- Natural Sonoran Desert Arroyo Theme
- Natural Sonoran Desert Valley Plain Theme
- Natural Sonoran Desert Valley Rivers Theme

Existing structures including the dam embankment, low flow channel, emergency spillway training dykes, principal spillway, McMicken Outlet Channel and levee structures and existing power lines significantly detract from the natural character of the project area and surrounding landscape. Therefore, a second aesthetic treatment goal is to improve the natural appearance of existing facilities within the project area.

5.0 McMicken Dam Study Area Landscape Character

The FCDMC's Preliminary Existing Landscape Character Assessment for Maricopa County is a baseline study of existing landscape character that identifies, describes, and delineates the type and extent of landscape character that currently exists within the County. The study defines character type as a regional area of land that has similar distinguishing visual characteristics of landform, rock form, water form, and vegetative communities and patterns. This study was divided into three main sections:

- Landscape Character Types of Maricopa County
  This section describes the large scale major character types based on physical and visual elements as described by the United States Forest Service which occur in Maricopa County.

- Landscape Character Subtypes of Maricopa County
  This section further refines the Landscape Character Types into smaller scale more specific descriptions. These subtypes are divisions of the major character types based on a difference in visual characteristics (form, line, color, texture) from each other.

- Landscape Character Units of Maricopa County
  This is the smallest division of Landscape Character Types that occur in Maricopa County. In this section, the Landscape Character Subtypes, which define primarily visual and physical characteristics, are combined with cultural features (development pattern, circulation pattern, building type, and open space) to form the Landscape Character Unit. A total of 42 Landscape Character Units were defined for Maricopa County.

- The Landscape Character Units within the study area are indicated on the Project Location Map (Fig 1)

For the purpose of this report, the study area includes the alignment of McMicken Dam, the McMicken Outlet Channel, the McMicken Outlet Wash and a two mile area on either side of these items as shown in Fig.1.

Using FCDMC's Preliminary Existing Landscape Character Assessment for Maricopa County (CLCA) as a reference, the McMicken Dam Study Area is situated within the Sonoran Desert Character Type. This character type contains the following three landscape character subtypes:

- River Lands
- Valley Lands
- Mountain Lands

While all three of the above subtypes are represented in the study area, the majority of the study area is located in the Valley Lands subtype.
The western two miles are within the Mountain Lands subtype of the White Tank mountains and the eastern mile and a half of the study area extends into the River Lands subtype of the Aqua Fria river.

In the evaluation of the McMicken Dam, nineteen (19) Landscape Character Units occur within the study area and were used to evaluate the compatibility of flood control methods. These nineteen units are indicated with their total acreage within the study area and their percentage of the total study area. As defined in the FCDMC's Preliminary Existing Landscape Character Assessment for Maricopa County, these Landscape Character Units are as follows:

1. Natural and Pastoral River Channel Unit :
   The River Channel consists of a braided network of curvilinear small shallow channels separated by undulating low linear mounds. Vegetation is characterized by xeroriparian species including Mesquites and Palo Verdes.

Adjacent Sonoran Desert plant species such as creosote and ragweed are also common.

This unit occurs primarily along the eastern portion of the study area along the Agua Fria river.

Total Acreage: 2,018 Ac.
Percentage of Study Area: 4.4%

2. Suburban River Channel Unit:
Development in this unit is typically low density residential. The spatial arrangement of structures is random resulting in a very informal appearance. The undulating hills and low linear mounds of the River Channel also affect any development and circulation adjacent to it.

This area occurs in a long strip along the Agua Fria river between Beardsley and Bell roads west of 115th Ave.

Total Acreage: 354 Ac.
Percentage of Study Area: .78%

3. Rural River Channel Unit:
In addition to the physical features of the River Channel Unit, the predominant cultural activity in this unit is agriculture. The development pattern in this unit is primarily based on a grid pattern except where physical constraints imposed by the river have resulted in modifications to the formal agricultural fields.

This occurs as isolated parcels within the study area west of the Agua Fria river and north of Beardsley Road.

Total Acreage: 195 Ac.
Percentage of Study Area: .43%

4. Industrial River Channel Unit:
The bold and formal composition of industrial facilities visually dominates this landscape unit. Development and circulation typically follow a rectilinear pattern except in less formal settings such as gravel operations.

This landscape unit is composed of numerous small clusters located west of the Agua Fria river and north of Beardsley Road.

Total Acreage: 28 Ac.
Percentage of Study Area: .06%

5. Natural and Pastoral River Terrace Unit:
The River Terrace consists of multiple elevations of linear flat lands with slight surface undulations occurring adjacent to the River Channel Physical Division. Vegetation in this unit varies primarily based on river flow. For intermittent flows typical of the Aqua Fria River, vegetation consists of xeroriparian species such as mesquite and palo verde as well as typical Sonoran Desert vegetation such as ironwood, prickly pear, and brittlebush.

Primarily located in the northeast portion of the study area, east of the McMicken Outlet Wash along the Agua Fria river.

Total Acreage: 1,462 Ac.
Percentage of Study Area: 3.23%

6. Suburban River Terrace Unit:
The River Terrace is visually subordinate to the suburban setting in this unit. The development pattern of the suburban setting is usually uniform and based upon a formal grid pattern. Development immediately adjacent to the terrace becomes more informal as a response to terrace edge.

These are isolated areas located south of Bell Rd. along the Agua Fria river and in the southeast portion of the study area east of the Agua Fria.

Total Acreage: 243 Ac.
Percentage of Study Area: .54%

7. Rural River Terrace:
The primary cultural feature of this unit is agriculture. Typically, the terrace is planted completely to the edge of the river. The grid pattern dominates except where the influence of the river or adjacent landforms create a more informal development pattern.

This unit occurs primarily in the southeast portion of the study area along Beardsley Rd. east of the Agua Fria and in the northeast portion of the study area between the Beardsley Canal and the Agua Fria.

Total Acreage: 135 Ac.
Percentage of Study Area: .30%

8. Natural and Pastoral Valley Rivers and Washes Unit:
The Valley Rivers and Washes Unit is characterized by normally dry washes which originate in the uplands and vary in character as they descend towards the Sonoran River lands. Typically, the Valley Rivers and Washes start out as wide channels punctuated with large boulders and surfaced with large river rock. As they approach the Sonoran River lands they become rather narrow and slightly more incised. Vegetation varies within the Valley Rivers and

Washes based upon the proximity of the washes to adjacent vegetation communities. The washes create conditions that enable species that require higher amounts of moisture to grow and flourish at lower elevations. The saguaro, palo verde, and ironwood associations frequently expand out of the Bajada into the Valley Plains via the washes. Other species that may occur include desert willow, desert broom, mesquite, catclaw acacia and ragweed.

These landscape units occur as small scattered areas along the dam within the project limits.

Total Acreage: 558 Ac.
Percentage of Study Area: 1.23%

9. Industrial Valley Rivers and Washes Unit:
The formal lines and forms of the industrial setting are predominant within this landscape unit. The formal arrangement of industrial facilities is often modified due to the configuration of washes resulting in a slightly informal development pattern.

These landscape units occur as small scattered areas along the dam within the project limits.

Total Acreage: 18 Ac.
Percentage of Study Area: .04%

10. Rural Valley Rivers and Washes Unit:
Again, agriculture dominates this landscape unit. The rectilinear agricultural fields associated with the rural setting are located adjacent to the curvilinear washes resulting in a landscape unit of contrasting line. Often, the washes are channelized to fit into the rectilinear grid of the fields.

These landscape units occur as small scattered areas along the dam within the project limits.

Total Acreage: 14 Ac.
Percentage of Study Area: .03%

11. Suburban Valley Rivers and Washes Unit:
Residential development is the primary cultural influence in this unit. The development pattern is usually uniform and based on the grid. Informal development patterns occur along drainages and washes.

These landscape units occur as small scattered areas along the dam within the project limits.

Total Acreage: 12 Ac.
Percentage of Study Area: .03%

12. Natural and Pastoral Valley Plains Unit:
The Valley Plains unit consists of minimally sloping, flat broad surfaces with shallow undulations where the land has not been disturbed. This landscape unit typically starts at the edge of the Bajada sloping downward toward the River Terrace. The upper elevations of this unit sustain a mixture of saguaro, palo verde, creosote, and cactus. The lower elevations consist of large areas of predominately widely spaced creosote bush.

This landscape unit comprises the majority of the study area and the project limits. It includes areas from the southern portion of the study area east of the White Tank Mountains to north of the McMicken Outlet Wash along the Agua Fria river.

Total Acreage: 22,603 Ac.
Percentage of Study Area: 50%

13. Suburban Valley Plains Unit:
The flat open nature of this unit allows this landscape unit to be dominated by the rectilinear grid of residential and commercial development. Very little of the natural character remains in this unit. Open space typically includes golf courses and neighborhood and regional parks.

While there are some isolated areas to the north, the majority of this unit occurs south of the McMicken Dam and Outlet channel and west of the McMicken Outlet Wash.

Total Acreage: 7,519 Ac.
Percentage of Study Area: 17%

14. Rural Valley Plains Unit:
This unit is characterized by large open tracts of land on a grid pattern utilized primarily for agriculture and one to two story homes adjacent to the fields or undisturbed desert.

The majority of this unit occurs east of McMicken Dam in the southern portion of the study area. There are a few scattered areas around US 60 and a sizable piece just south of the 303 alignment.

Total Acreage: 2,467 Ac.
Percentage of Study Area: 5.4%

15. Industrial Valley Plains Unit:
The uniform landscape of the Valley/Plains combined with the industrial setting results in a landscape where cultural modifications are the predominant visual element. The industrial setting is typically organized around a grid pattern resulting in a formal arrangement of facilities. This unit consists of small isolated pieces northwest of McMicken Dam with a larger portion occurring within the project limits adjacent to the Principle Outlet.

Total Acreage: 351 Ac.
Percentage of Study Area: .78%

16. Natural and Pastoral Bajada Unit:
The Bajada is a slightly sloping landform exhibiting a braided network of u-shaped shallow washes and arroyos. Typically, this physical division begins at the base of the Mountains Physical Division and extends downward to the Valley/Plains Physical Division. The vegetation is diverse and dense, characterized by saguaro, palo verde, creosote, and bursage.

Total Acreage: 6,810 Ac.
Percentage of Study Area: 15%

17. Suburban Bajada Unit:
This landscape unit often includes master planned communities with large residential lots that abut mountains and medium to small lots separated by arroyos. The development pattern is usually uniform and based on a formal grid except where drainages, characteristic of the Bajada unit, result in a more informal pattern of development.

Total Acreage: 37 Ac.
Percentage of Study Area: .08%

18. Natural and Pastoral Foothills:
The Foothills Physical Division generally consist of gentle to steep slopes bisected by u-shaped valleys, occasionally v-shaped ravines, and peaks that are smooth to angular. Saguaro, Palo Verde, and cactus occur in varying densities and compositions across the unit.

Total Acreage: 181 Ac.
Percentage of Study Area: .40%

19. Suburban Foothills Landscape Unit:
Higher end residential development dominates this landscape unit with the typical grid pattern of suburban development modified by the foothills landform to more informal circulation patterns. Open space in this setting typically includes golf courses and neighborhood and regional parks.

Total Acreage: 2 Ac.
Percentage of Study Area: .004%

6.0 Landscape Character Compatibility Categories

As described in *Assessing the Relative Ability of Flood Protection Methods to Complement and Achieve Compatibility with the Visual Character of Landscape Settings in Maricopa County, A Proposed Framework For Application to Flood Control District Planning Studies; Prepared by Dennis Holcomb,ASLA, Senior Landscape Planner, Flood Control District of Maricopa County, January 2003, Revised December 23, 2004,* the compatibility of flood protection methods refers to the relative ability of the flood protection method to be visually compatible with and complement the visual character of the landscape settings of Maricopa County. The following compatibility categories are used in this report and are defined as follows:

- Compatible – The flood protection method has the ability to complement the visual character of the landscape setting.

- Incompatible – The flood protection method will seldom, if ever, complement the landscape setting.

7.0 Application of Compatibility Categories to the McMicken Dam Alternatives and Landscape Character Units

A separate landscape character compatibility matrix was prepared for each of the alternatives (Fig. 2 & 3). Each matrix indicates the level of compatibility that is typically expected between each of the 19 landscape character units that occur within the project study area and the 6 flood protection methods that represent different ways of implementing the alternatives. The matrices, which were developed with input from representatives of both the Flood Control District and the Consultant, utilized the process outlined in the report referenced in section 6.0.

8.0 Landscape Compatibility Classes

Landscape Compatibility classes are employed to geographically depict the range of flood protection methods that will be compatible with the landscape character units found within the project study area. They are derived from the information contained in the Landscape Compatibility Matrices (Fig. 2 & 3).

The flood protection methods are defined and organized as a spectrum of activities and are listed in the landscape compatibility matrices (Fig. 2 & 3) according to their impact potential upon landscape character. The method with the least potential to disturb existing landscape character is Non-Structural. The method with the greatest

potential is Hard Structural. The Landscape Compatibility Classes range from Class 1, which would be compatible only with the first method (Non Structural) to class 6, which would be compatible with all six flood protection methods.

The range of compatible flood protection methods from application of this approach is illustrated in the Landscape Character Compatibility Classes matrices (Fig. 4 & 5). These matrices were then utilized in GIS to generate maps showing the geographic distribution of the Landscape Compatibility Classes within the project study area (Fig. 6 & 7).

A review of the Landscape Character Compatibility Classes Maps indicates the majority of the McMicken Dam study area falls within Landscape Character Compatibility Class 3. In this compatibility class there are three methods of flood protection that will be compatible with the existing character of the project study area. They are: Non Structural, Soft Structural and Semi-Soft Structural.

9.0 Recommended Aesthetic Treatment Design Guides

The following design guidelines are recommended, as a minimum, to enable the Semi Soft Flood Protection Method of implementing the alternatives to meet the aesthetic treatment goals and objectives of preserving and enhancing the natural Sonoran Desert character of the project area, as outlined in Section 4.

Alternative 1 Aesthetic Treatment Guidelines

The following recommendations apply to the dam embankment, low flow channel, emergency spillway and principal outlet structural components of the project area.

Dam Embankment Structure:

1. Design the topographic form of the embankment structure to mimic the characteristics of the natural hillforms that are found within the viewshed of the project area or the Sonoran Desert Character Type.
2. Design the overall form and alignment of the embankment to be sinuous and responsive to variations in the existing natural topography of the project area.
3. Utilize overbuild and landscape contour grading techniques to gently vary the horizontal profile of the embankment and to warp and vary the side slopes of to create a natural appearance.
    a. Gently vary the height of the landscape overbuild from 0 to 5 feet above the engineered structure to create variation in the horizontal profile.
    b. Vary the side slopes of the embankment from 4:1 to 10:1 (average of 7:1) to reduce the flat linear appearance of the engineered structure and utilize slope rounding techniques at the top and bottom to blend the structure with the ground plane.

4. Conceal all structural elements including gates and gate apparatus to the maximum degree possible. Paint all visible hard structural features with a dark color that matches the surrounding vegetation or rock outcroppings.
5. Maintain a minimum set back distance of 50 feet between the toe of the embankment structure and all District property lines.
6. Vegetate the embankment structure with a mixture of shallow rooted native plant species that naturally occur within the landscape units that comprise the project area. Arrange the plant materials to accentuate the variation in the form of the side slopes of the embankment structure and reduce the flat linear appearance of the side slopes of the embankment.
7. Utilize rock material with natural desert colors for road surfacing to reduce soil color contrast with the surrounding landscape.

Low Flow Channel:

1. Design the overall form of the low flow channel to be curvilinear and meandering and to be fully integrated with the undulations in the side slopes of the embankment structure.
2. Provide a degree of meander offset from the channel centerline equal to a minimum of 50% of the channel width. The frequency of meander should be reflective of the frequency of meander characteristic of natural stream channels found within the Sonoran Desert Character Type or, at a minimum should provide a minimum of 2 to 4 meanders (in and out) per mile of channel length.
3. Design the side slopes to undulate, using slopes that vary from 5:1 to 12:1.
4. Round off all cut slopes in the impoundment area resulting from channel excavation.
5. Utilize excess fill material to incorporate islands and variations in the topographic form of the bottom of the channel and to create low landscape berms immediately adjacent to the top of bank of the channel, to the extent feasible.
6. Design all low flow features Employ slope rounding techniques for all cut slopes within the impoundment within the bottom of the low flow channel to be meandering and variable in width and to vary from side to side within the bottom area of the channel.
7. Conceal or bury all hard structural elements to the maximum degree possible. Utilize native materials (rock) found within the viewshed of the project area or paint all visible hard structures with colors that match the natural vegetation that is predominant within the project site. Utilize curvilinear forms in the design of all visible hard structural elements wherever possible.
8. Vegetate the low flow channel with a plant species mix that is representative of natural Sonoran Desert arroyos and rivers. Arrange the plant materials to accentuate the differences in the form of the channel side slopes, bottom area and low flow features.

Principal Outlet:

1. Stain the existing concrete structure with a darker color that is complementary to the surround area.
2. Plant vegetation on either sides of the structure to reduce its visibility and soften its appearance.
3. Bury or conceal the pipe that is arched over the top of the structure.
4. Replace the existing fencing with a more aesthetically pleasing barrier type.

Emergency Spillway:

1. Bury or conceal all structural components of the emergency spillway to the maximum degree feasible, including drop structures, cutoff walls and armoring.
2. Favor the use of curvilinear forms for all visible portions of the structural components of the emergency spillway and utilize colors and materials that mimic those found in the surrounding natural landscape.
3. Completely remove all portions of the existing triangular berm system or regrade any remnants to appear as natural hillforms to add visual variety to the emergency spillway area.
4. Design the grading and treatment of the emergency spillway area to blend with the existing approach channel and mesquite bosque.
5. Extend the channel of the existing natural wash to the north along the northern edge of the emergency spillway area to connect with and supply water to the existing mesquite bosque.
6. Preserve the existing curved training dyke forming the northern limits of the emergency spillway area.
7. Vegetate the emergency spillway with a variety of natural Sonoran Desert species arranged so as to differentiate the existing training dyke, the extension of the existing wash to the north, the mesquite bosque, hill forms within the plain of the spillway (if any) and the spillway plain.

Alternative 2 Aesthetic Treatment Guidelines

The following recommendations apply to the conveyance channel, channel levee and existing dam embankment, drop structures, bifurcation structure, and detention basins.

Conveyance Channel:

1. Apply the guidelines specified for the low flow channel in Alternative 1.
2. Maintain a minimum set back of 100 feet between the top of bank of the conveyance channel and all District property lines.

Channel Levee and Existing Dam Embankment:

1. Design the overall form of the levee structure to resemble a range of low rising natural hill forms with undulating sides and top.

2. Vary the height of the levee 0-10 feet above the engineered levee structure.
3. Vary the overall width of the levee structure
4. Vary the side slopes from 4:1 to 10:1 to achieve an undulating appearance.
5. Incorporate plant materials along the sides and top of the levee that mimic the natural plant communities of the project area and surrounds.
6. Extend the existing desert wash from the north as a natural appearing channel that connects with the mesquite bosque and the conveyance channel.
7. Preserve the existing mesquite bosque and the curved elevated training dyke that forms the northern limits of the emergency spillway area.
8. Remove the existing triangular dyke structures in the emergency spillway or incorporate excess grading material to transform their exterior appearance to that of a natural hill forms.

Drop Structures:

1. Favor curved alignments (concave or convex) for drop structures over straight line alignments.
2. Design drop structures to provide a "natural" wear and erosion appearance to the structural material used for their construction.
3. Add color to all visible grouting and concrete structural components that is borrowed from naturally occurring colors in the surrounding landscape.
4. Incorporate boulders of varying sizes in the construction of drop and energy dissipation structures.
5. Vary the width and horizontal and vertical alignment of terraces of drop structures to create the appearance of falls that are found in natural water courses of the Sonoran Desert.

Bifurcation Structure:

1. Apply the guidelines listed above for Drop Structures.

10.0 Opinion of Probable Construction Costs for Aesthetic Treatments

Alternative 1 - Dam Rehabilitation (FRS Remediation Structure)

The costs for this alternative are based upon current costs utilized by the FCDMC for the White Tanks FRS#3 project and FCDMC's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects*, Tables 1 & 2 – Landscape Cost-Ceiling per Acre and Project Aesthetic Feature Costs: Maximum Cost Guidelines. These methods were used to establish a range of anticipated costs which will include the following aesthetic treatments:

- Landscape Overbuild

- Borrow Area mitigation for the landscape overbuild.
- Hydroseeding of borrow areas and landscape overbuild.
- Aesthetic treatment of component structures.
- Tall pot planting for vegetation screening

The cost rate for these treatments using the White Tank FRS #3 project costs is approximately $2 million per mile. Based on a structure length of 9 miles the total cost for aesthetic treatments would be approximately $18 million.
Utilizing the FCDMC's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects* the cost would be calculated as follows:

Project Total Cost Range: $26,581,800 to $36,031,600. Since the $2 million per mile will establish the high end of the Aesthetic Treatment range, the lower Project Total Cost figure will be used to establish the lower end of the range.

Table 1: Landscaping Cost –Ceiling per Acre
Suburban, Dam - $20,000 per acre X 360 Ac(project area) = $7,200,000
Table 2: Project Aesthetic Feature Maximum Cost
Suburban, Project Cost > $10,000,000 = 4%
4% X Project Total Cost ($26,581,800)= $1,063,272
Table 1 total - $7,200,000
Table 2 total - $1,063,272
$8,263,272

Total Cost Range for Alternative 1 Aesthetic Treatments - $8,263,272 to $18,000,000

Alternative 2 - Dam Decomissioning (Flood Conveyance Structure)

The costs for this alternative were determined by two methods. The first is based on specific input from FCDMC and the second is based on FCDMC's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects*, Tables 1 & 2 – Landscape Cost-Ceiling per Acre and Project Aesthetic Feature Costs: Maximum Cost Guidelines.
In the first method the following assumptions were made in the preparation of aesthetic treatment costs for this alternative:

- The entire project will be hydroseeded as a project cost to prevent erosion and provide dust abatement.
- Provide for tall pot planting for 50% of the 100 ft. wide strip along the bank of the conveyance channel for a distance of 26 miles at a cost of $5,000 per acre:

$$5,280 \times 26 \times 100 \times .50 = 6,864,000 \text{ sf} / 43,560 = 160 \text{ Ac.}$$

160 Ac. x $5,000/Ac. = $800,000

- Provide approximately 100 acres of tall pot planting for screening at key nodal areas and structural features at $5,000 per acre:

  100 Ac. x $5,000 = $500,000

- The following costs based on the FCDMC's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects*, Table 2 – Project Aesthetic Feature Costs: Maximum Cost Guideline. This table expresses the aesthetic feature costs as a percentage of the project costs based on the setting(urban, suburban, rural, or industrial).

  In this case we are using the total cost for the hard structural elements of this alternative (headwalls, culverts, bridges, drop structures,etc.) times a percentage for rural settings.

  Cost for hard structural elements:

Sun Valley Parkway Culvert	$ 780,000
Drop Structures	$ 720,000
U.S. 60 Bridge	$15,000,000
BNSF Bridge	$ 3,750,000
Bifurcation Structure	$ 194,400
Loop 303 Bridge	$15,000,000
Baffle Block Drop Structure	$12,041,800
Total	$47,486,200

  $47,486,200 X 3% = $1,424,586

  Total Costs for Aesthetic Treatments

  - Tall pot planting along channel - $800,000
  - Tall pot planting at key areas - $500,000
  - Aesthetic treatments for hard structural elements - $1,424,586

  Total Cost for Alternative 2 Aesthetic Treatments $2,724,586

Method 1.

Utilizing the FCDMC's *Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects* the cost would be calculated as follows:

Project Total Cost Range: $182,160,200 to $231,745,300. Since method 1 established the low end of the Aesthetic Treatment range, the higher Project Total Cost figure will be used to establish the higher end of the range.

Table 1: Landscaping Cost –Ceiling per Acre
Suburban, Channel - $40,000 per acre X 1871 Ac(project area) = $74,840,000
Table 2: Project Aesthetic Feature Maximum Cost
Suburban, Project Cost > $10,000,000 = 4%
4% X Project Total Cost ($231,745,300)= $9,269,812
Table 1 total - $74,840,000
Table 2 total - $ 9,269,812
$84,109,812

Total Cost Range for Alternative 2 Aesthetic Treatments - $2,724,586 to $84,109,812

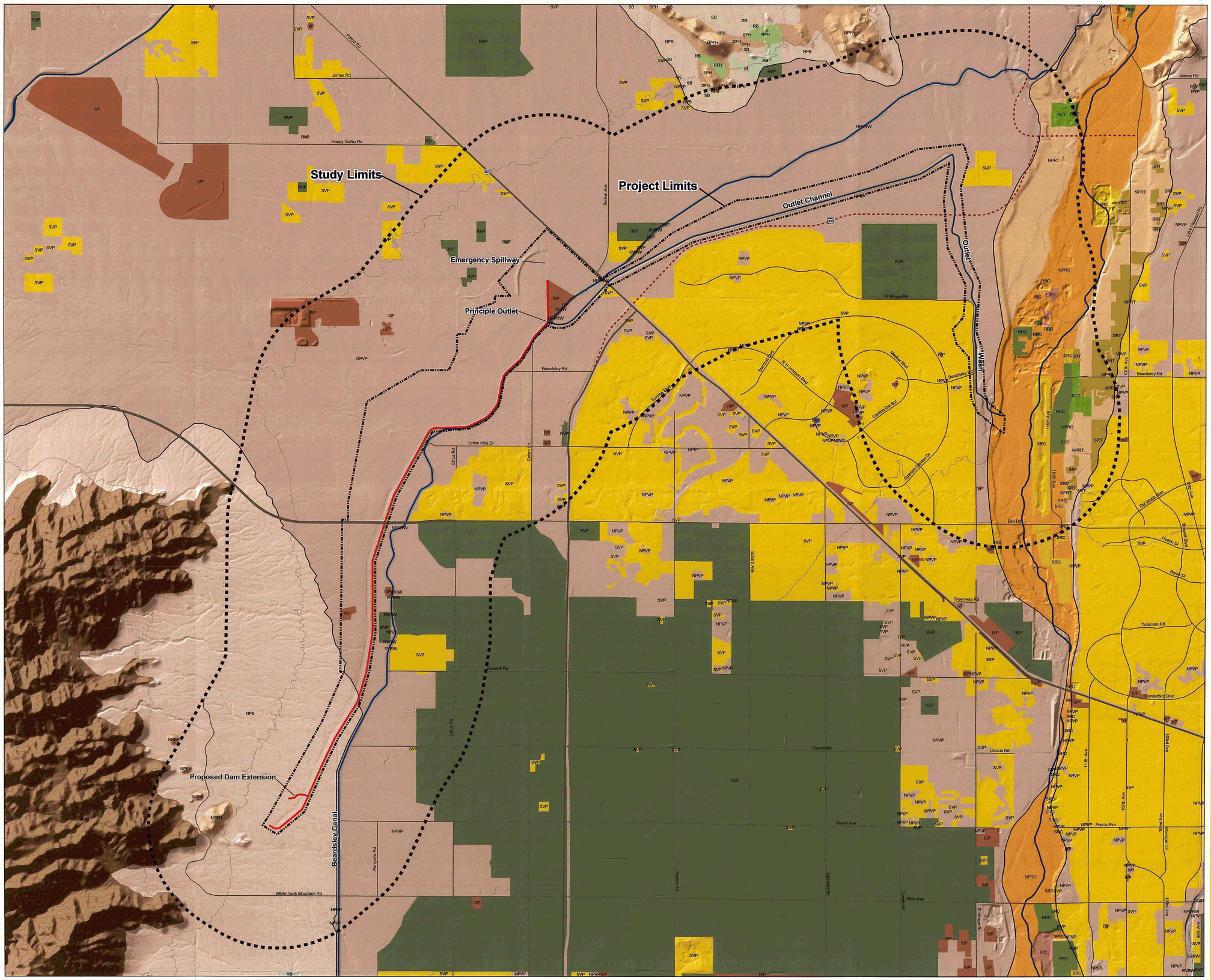

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FIGURE 1
LANDSCAPE CHARACTER UNITS MAP

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Legend

SONORAN DESERT CHARACTER TYPE

Sonoran River Lands Subtype

- NPRC — Natural and Pastoral River Channel Unit
- RRC — Rural River Channel Unit
- SRC — Suburban River Channel Unit
- IRC — Industrial River Channel Unit
- NPRT — Natural and Pastoral River Terrace Unit
- RRT — Rural River Terrace Unit
- SRT — Suburban River Terrace Unit
- IRT — Industrial River Terrace Unit

Sonoran Valley Lands Subtype

- NPVRW — Natural and Pastoral Valley Rivers and Washes Unit
- RVRW — Rural Valley Rivers and Washes Unit
- SVRW — Suburban Valley Rivers and Washes Unit
- UVRW — Urban Valley Rivers and Washes Unit
- IVRW — Industrial Valley Rivers and Washes Unit
- NPVP — Natural and Pastoral Valley Plains Unit
- RVP — Rural Valley Plains Unit
- SVP — Suburban Valley Plains Unit
- UVP — Urban Valley Plains Unit
- IVP — Industrial Valley Plains Unit

Sonoran Mountain Lands Subtype

- NPA — Natural and Pastoral Arroyo Unit
- SA — Suburban Arroyo Unit
- NPB — Natural and Pastoral Bajada Unit
- RB — Rural Bajada Unit
- SB — Suburban Bajada Unit
- UB — Urban Bajada Unit
- IB — Industrial Bajada Unit
- NPF — Natural and Pastoral Foothills Unit
- RF — Rural Foothills Unit
- SF — Suburban Foothills Unit
- UF — Urban Foothills Unit
- IF — Industrial Foothills Unit
- NPM — Natural and Pastoral Mountains Unit
- RM — Rural Mountains Unit
- SM — Suburban Mountains Unit
- UM — Urban Mountains Unit
- IM — Industrial Mountains Unit
- NVF — Natural Volcanic Field Unit
- SVF — Suburban Volcanic Field Unit

REFERENCE FEATURES

- Character Type Boundary
- Subtype Boundary
- County Boundary
- Interstates (I-10)
- Highways (87)
- Major Roads
- 200 Foot Contours
- McMicken Dam
- Canals
- Rivers & Washes
- Lakes

File Name:	BGS	CVG	MCG	07.21.04
	Dwn.	Chkd.	Dsgn.	MM.DD.YY

Wittmann ADMSU
McMicken Dam Alternative Analysis

Project No. 82000267

Scale

Figure No.

(FIG. 2) ALTERNATIVE 1 - FRS REMEDIATION COMPATIBILITY MATRIX

		LANDSCAPE CHARACTER UNITS																		
		Natural and Pastoral Foothills(NPFH)	Natural and Pastoral Bajada Unit(NPB)	Natural and Pastoral River Channel Unit(NPRC	Suburban Foothills(SFH)	Natural and Pastoral Valley Rivers and Washes Unit(NPVRW)	Rural River Channel Unit(RRC)	Suburban Bajada Unit(SB)	Natural and Pastoral River Terrace Unit(NPRT)	Rural Valley Rivers and Washes Unit(RVRW)	Suburban River Channel Unit(SRC)	Natural and Pastoral Valley Plains Unit(NPVP)	Rural River Terrace(RRT)	Suburban Valley Rivers and Washes Unit(SVRV	Rural Valley Plains Unit(RVP)	Suburban River Terrace Unit(SRT)	Industrial River Channel Unit (IRC)	Suburban Valley Plains Unit(SVP)	Industrial Valley Rivers and Washes Unit(IVRW	Industrial Valley Plains Unit(IVP)
FLOOD PROTECTION METHODS	Non-Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
	Soft Structural Method	C	C	IC	C	IC	IC	C	IC	IC	IC	C	C	IC	C	C	C	C	C	C
	Semi-Soft Structural Method	C	C	IC	C	IC	IC	C	IC	IC	IC	C	C	IC	C	C	C	C	C	C
	Semi - Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	IC	C	IC	C	IC	C	C
	Hard Structural Method with Aesthetic Treatment	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	IC	C	IC	C	IC	C	C
	Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	IC	C	C

- Landscape Character Units within Project Area

C = compatible

IC = incompatible

(FIG. 3) ALTERNATIVE 2 - CONVEYANCE CHANNEL COMPATIBILITY MATRIX

		LANDSCAPE CHARACTER UNITS																	
		Natural and Pastoral Foothills(NPFH)	Natural and Pastoral Bajada Unit(NPB)	Natural and Pastoral River Channel Unit(NPRC	Suburban Foothills(SFH)	Natural and Pastoral Valley Rivers and Washes Unit(NPVRW)	Rural River Channel Unit(RRC)	Suburban Bajada Unit(SB)	Natural and Pastoral River Terrace Unit(NPRT)	Rural Valley Rivers and Washes Unit(RVRW)	Suburban River Channel Unit(SRC)	Natural and Pastoral Valley Plains Unit(NPVP)	Rural River Terrace(RRT)	Suburban Valley Rivers and Washes Unit(SVR	Rural Valley Plains Unit(RVP)	Suburban River Terrace Unit(SRT)	Industrial River Channel Unit (IRC)	Suburban Valley Plains Unit(SVP)	Industrial Valley Rivers and Washes Unit(IVRW	Industrial Valley Plains Unit(IVP)
FLOOD PROTECTION METHODS	Non-Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
	Soft Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
	Semi-Soft Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
	Semi - Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	IC	C	IC	C	IC	C
	Hard Structural Method with Aesthetic Treatment	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	IC	C	IC	C	IC	C
	Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	IC	C

- Landscape Character Units within Project Area

C = compatible

IC = incompatible

(FIG. 4) ALTERNATIVE 1 - FRS REMEDIATION COMPATIBILITY CLASS MATRIX

FLOOD PROTECTION METHOD	LANDSCAPE CHARACTER UNITS																			
	Natural and Pastoral River Channel Unit(NPRC	Natural and Pastoral River Terrace Unit(NPRT)	Natural and Pastoral Valley Rivers and Washes Unit(NPVRW)	Rural River Channel Unit(RRC)	Rural Valley Rivers and Washes Unit(RVRW)	Suburban River Channel Unit(SRC)	Suburban Valley Rivers and Washes Unit(SVRW	Natural and Pastoral Bajada Unit(NPB)	Natural and Pastoral Foothills(NPFH)	Natural and Pastoral Valley Plains Unit(NPVP)	Suburban Bajada Unit(SB)	Suburban Foothills(SFH)	Suburban River Terrace Unit(SRT)	Suburban Valley Plains Unit(SVP)	Rural River Terrace(RRT)	Rural Valley Plains Unit(RVP)	Industrial River Channel Unit (IRC)	Industrial Valley Rivers and Washes Unit(IVRW	Industrial Valley Plains Unit(IVP)
Non-Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Soft Structural Method	IC	IC	IC	IC	IC	IC	IC	C	C	C	C	C	C	C	C	C	C	C	C	C
Semi-Soft Structural Method	IC	IC	IC	IC	IC	IC	IC	C	C	C	C	C	C	C	C	C	C	C	C	C
Semi - Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	C	C	C	C	C
Hard Structural Method with Aesthetic Treatment	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	C	C	C	C	C
Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	C	C	C

Class 1

Class 5

Class 3

Class 6

- Landscape Character Units within Project Area

(FIG. 5) ALTERNATIVE 2 - CONVEYANCE CHANNEL COMPATIBILITY CLASS MATRIX

FLOOD PROTECTION METHOD	LANDSCAPE CHARACTER UNITS																			
	Natural and Pastoral Bajada Unit(NPB)	Natural and Pastoral Foothills(NPFH)	Natural and Pastoral River Channel Unit(NPRC	Natural and Pastoral River Terrace Unit(NPRT)	Natural and Pastoral Valley Plains Unit(NPVP)	Natural and Pastoral Valley Rivers and Washes Unit(NPVRW)	Rural River Channel Unit(RRC)	Rural Valley Rivers and Washes Unit(RVRW)	Suburban Bajada Unit(SB)	Suburban Foothills(SFH)	Suburban River Channel Unit(SRC)	Suburban River Terrace Unit(SRT)	Suburban Valley Plains Unit(SVP)	Suburban Valley Rivers and Washes Unit(SVR	Rural River Terrace(RRT)	Rural Valley Plains Unit(RVP)	Industrial River Channel Unit (IRC)	Industrial Valley Rivers and Washes Unit(IVRW	Industrial Valley Plains Unit(IVP)
Non-Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Soft Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Semi-Soft Structural Method	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Semi - Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	C	C	C	C	C
Hard Structural Method with Aesthetic Treatment	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	C	C	C	C	C
Hard Structural Method	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	IC	C	C	C	C

Class 1

Class 5

- Landscape Character Units within Project Area

Class 3

Class 6

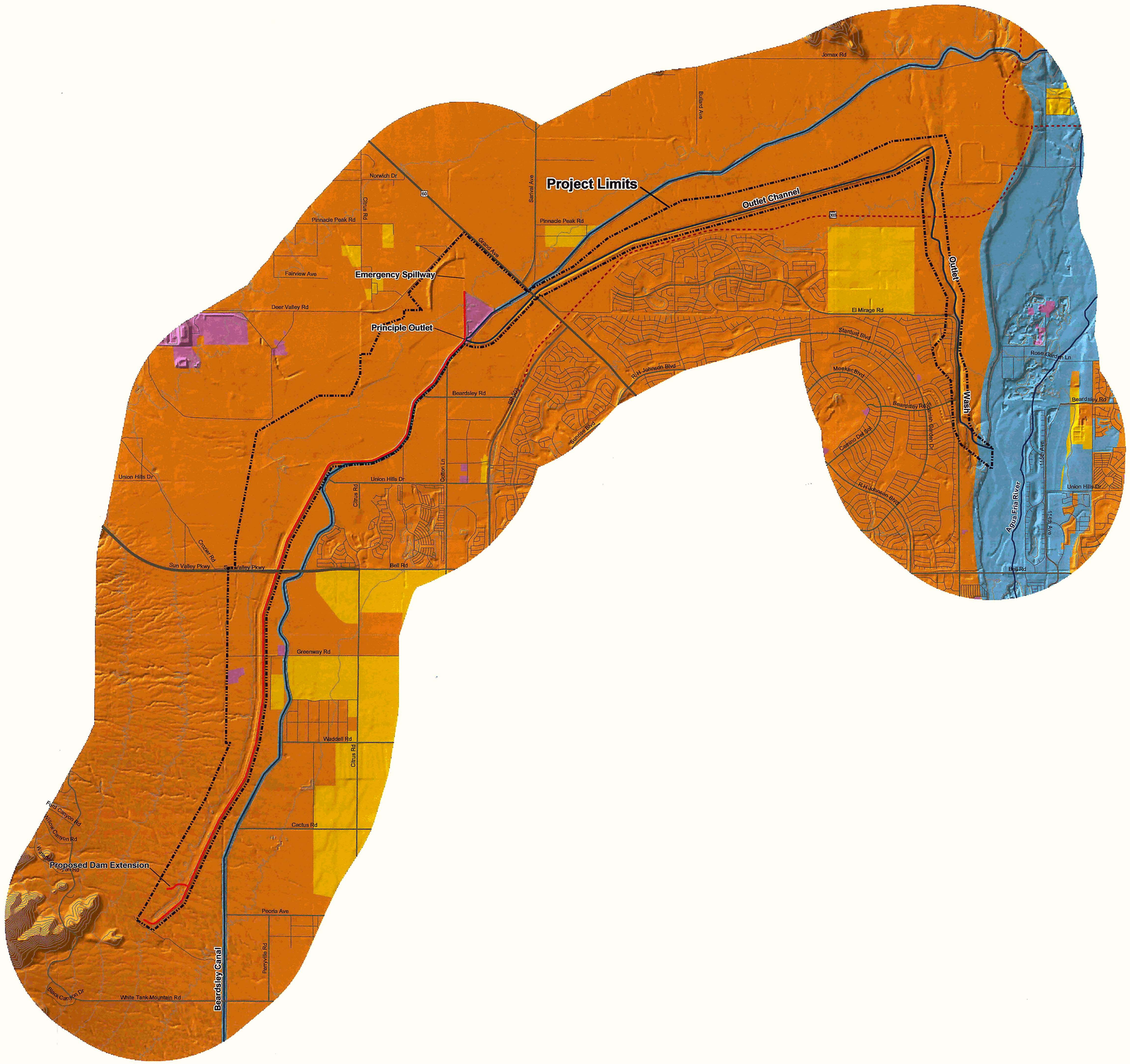

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FIGURE 6
ALTERNATIVE 1 - FRS REMEDIATION COMPATIBILITY CLASS MAP

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Legend

- Project Limits
- Local Roads
- Highway
- Divided Highway
- Rural Highway
- Arterial Road
- 50 Foot Contours
- McMicken Dam

Compatibility Classes

Flood Mitigation Method	Class 1	Class 3	Class 5	Class 6
Non-Structural	C	C	C	C
Soft Structural	IC	C	C	C
Semi-Soft Structural	IC	C	C	C
Semi-Hard Structural	IC	IC	C	C
Hard Structural with Aesthetic Treatment	IC	IC	C	C
Hard Structural	IC	IC	IC	C

File Name:	BGS	GD		01.04.05
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Project No. 82000267

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Figure No.

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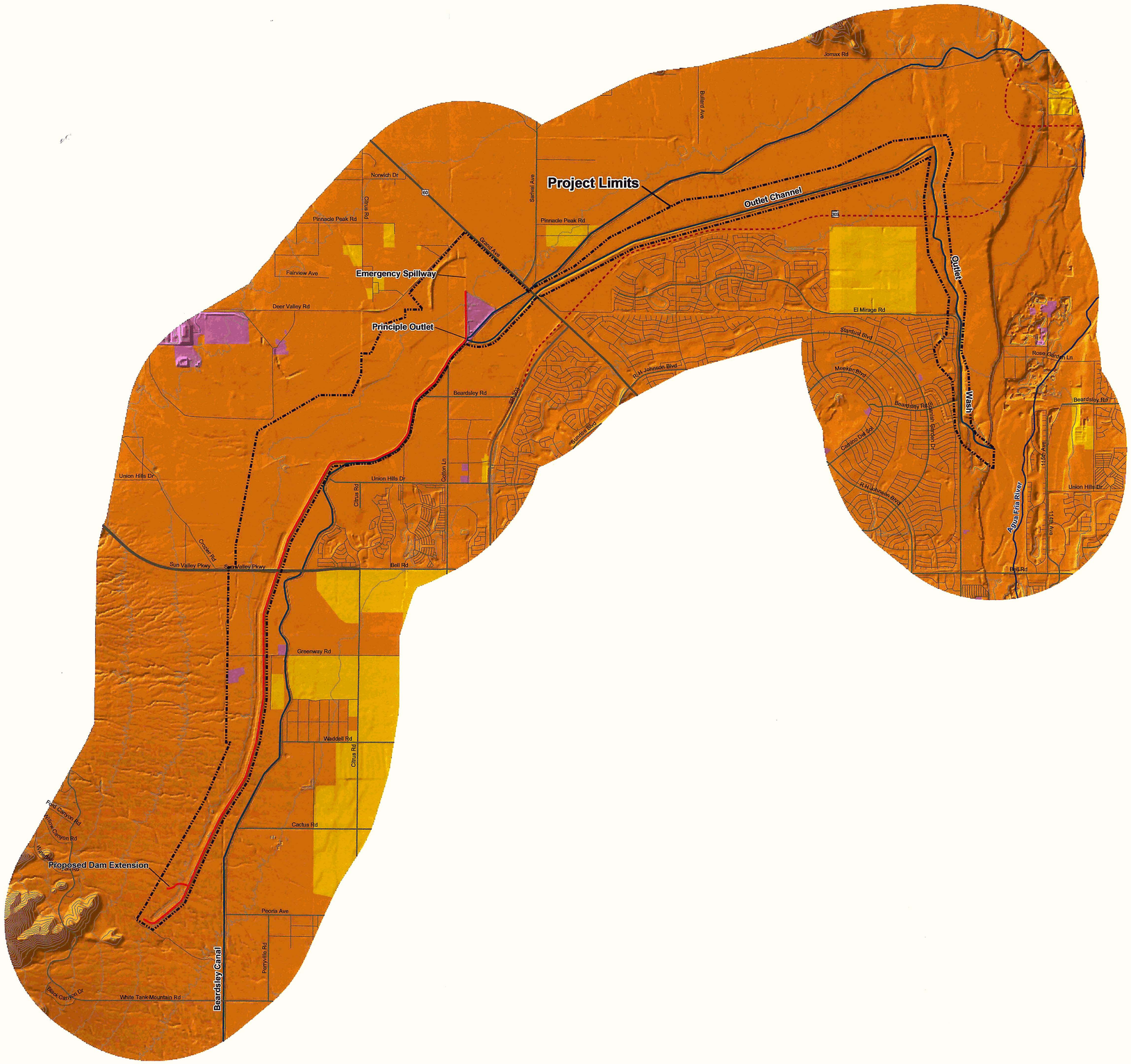

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FIGURE 7
ALTERNATIVE 2 - CHANNEL CONVEYANCE COMPATIBILITY CLASS MAP

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Legend

- Project Limits
- Local Roads
- Highway
- Divided Highway
- Rural Highway
- Arterial Road
- 50 Foot Contours
- McMicken Dam

Compatibility Classes

Flood Mitigation Method	Class 3	Class 5	Class 6
Non-Structural	C	C	C
Soft Structural	C	C	C
Semi-Soft Structural	C	C	C
Semi-Hard Structural	IC	C	C
Hard Structural with Aesthetic Treatment	IC	C	C
Hard Structural	IC	IC	C

File Name:	BGS	GD		01.04.05
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McMicken Dam Alternative Analysis

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