

Cave Creek Wash

Master Development Plan Executive Summary



prepared for the
City of Phoenix, Arizona
Project # ST 80404.00
PA 80404.10



prepared by:
Wirth Associates, Inc.
Planning, Landscape Architecture and Architecture

in association with:

Evans, Kuhn and Associates, Inc.
Engineering

and:

Drake and Associates
Planning

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INTRODUCTION

Cave Creek Wash is one of the few ephemeral streams flowing into Phoenix, Arizona and offers unique riparian amenities rarely found in the local arid environment. The City of Phoenix realizes that water resources may provide valuable opportunities for the community and are making every effort to guide the Cave Creek Wash development so as to emphasize the unique natural and cultural assets of the area.

Since much of Cave Creek Wash is presently undeveloped, the City of Phoenix issued a moratorium on new construction until a master development plan is adopted, to insure the wash will provide the maximum public benefits. This master development plan should make every effort to encourage public and private cooperation by offering incentives to developers for providing wash-related amenities.

The City of Phoenix retained the planning/engineering team of Wirth Associates, Inc. and Evans, Kuhn and Associates to provide a comprehensive master development plan for the Cave Creek Wash. The purpose of the Cave Creek Wash Development Plan study is to inventory and evaluate data necessary to determine opportunities and constraints leading to the development of a phased master plan concept. The relationship of development interests, parks and open space, a trails system and flood control all must interact to create a project of optimum benefit and opportunity, with limited costs to the City of Phoenix and the owners/developers of the area.

The Cave Creek Concept Master Plan presented herein is a functional guide to the development of Cave Creek from Cave Buttes Dam to Greenway Road and East Fork from the confluence of Cave Creek to 7th Street. This master plan gives the city a tool to effect a controlled-growth pattern and provision of public recreation and open space along the wash, especially a continuation and enhancement of the hiking, bicycle and riding trails system, both existing and planned, while assuring adequate flood control along the wash. The report also includes measures for the relief of initial and continued public costs while the city still maintains control of the wash area.

It is intended that development should respond to the engineering criteria necessary to provide safe and adequate flood-control measures now and in the future. Problems such as gravel and sand extraction, and landfills are considered in terms of existing use and rehabilitation potential. Vegetation restoration or enhancement providing increased wildlife habitat and added aesthetic resources, and vehicular circulation routes are also addressed.

This Cave Creek Wash Executive Summary is a condensed report containing the ideas, information and concepts presented in the Cave Creek Master Plan Technical Report. This summary document will outline the general description, opportunities and constraints, master plan development,

implementation, recommendations for additional study, and review the resource inventory conducted for the Cave Creek Master Development Plan.

RECOMMENDATIONS

In its desire to improve flood control measures and enhance the physical quality of the Cave Creek Wash, the city staff considered both formal and informal channelization alternatives. Although a formal concrete-lined channel may provide adequate flood control, it does not provide additional public benefits and may be considered ugly by the public. An informal earth-lined channel of varying width and height may offer a more natural alternative that may enhance and blend into the wash area. Two alternative earth-lined channel concepts (greenbelt and brownbelt) were subsequently evaluated.

Creating a greenbelt along the wash was found to be too labor intensive (during operation and maintenance) and high in water consumption (for maintenance of the lawns and vegetation required in this concept). The concept of creating a brownbelt, of native vegetation, was considered more desirable due to less maintenance needs and lower water requirements. In addition, the brownbelt concept would provide additional public benefits while creating a relatively natural setting.

In order to maximize the amenities offered by a linear brownbelt park system along Cave Creek Wash, the project consultants and city staff offer the following major recommendations:

- Construct an earthen channel of variable width to preserve existing areas and to revegetate areas where the channel is re-aligned.
- Use low-flow channel drop structures to slow the velocity of flood water. The drop structures may blend into the natural setting of the wash by being constructed of rock held in place by large mesh wire fencing.
- Provide a linear trail system along Cave Creek Wash. These trails may link areas and activities occurring along the wash as well as to other local trail systems. The wash trails should consist of two distinct trail types. First, the hard surface trail for walking, biking, skating and skate boarding use. Second, a natural trail system exclusively for equestrian use.
- Cluster selected park sites along the wash so recreation facilities would consist of a combination of well related public facilities in the wash and private common spaces located outside the wash.
- Utilize the unique cultural opportunities with the portion of Cave Creek Wash encompassing the Cave Creek Dam Archaeological District by

creating interpretive visitor centers on existing Native American historic and prehistoric sites.

- Bridge structures over Cave Creek Wash should occur at major streets only.
- Encourage trade-offs with private developers through land use patterns that allow housing design and project maintenance to focus upon Cave Creek Wash as a unique project amenity.
- Greater utility should be made of the Cave Creek Wash floodplain development opportunities to the advantage of the developer and public.

CAVE CREEK CONCEPT MASTER PLAN

Project Area

Cave Creek Wash study area includes the floodplain and surrounding developed and undeveloped areas of Cave Creek Wash and a tributary, the East Fork (Figure 1, Study Area). The wash area studied extends downstream approximately seven miles from Cave Buttes Dam to below Greenway Road where the wash passes under 19th Avenue. The East Fork study area is approximately two miles long beginning at its confluence with Cave Creek Wash and ending at 7th Street.

Cave Creek Wash is a natural earth channel except for one mile of channelization between Greenway and Bell roads, and numerous gravel extraction pits. The entire wash has been extensively disturbed by off-road vehicles and trash dumping. Much of the existing vegetation, although sparse along the wash, is volunteer having established itself after some sort of disturbance along the channel bottom or edges.

Residential development has encroached on portions of the East Fork while industrial use abuts the main channel wash in some areas.

The existing channel road crossings, providing access for multiple users, are of various complexity and flood-level ratings at one-mile intervals with intermediate roadways interspersed.

There are several park sites located along the wash area, but as yet they have not been developed. Informal recreation takes place throughout the wash by off-road vehicles, motorcycles, horse riders, children at play, a few hikers and bird watchers. Cave Creek Wash contains many cultural resources (both prehistoric and historic) that are visible on the ground surface. The Cave Creek Dam Archaeological District may provide excellent historic preservation and interpretative recreation opportunities.

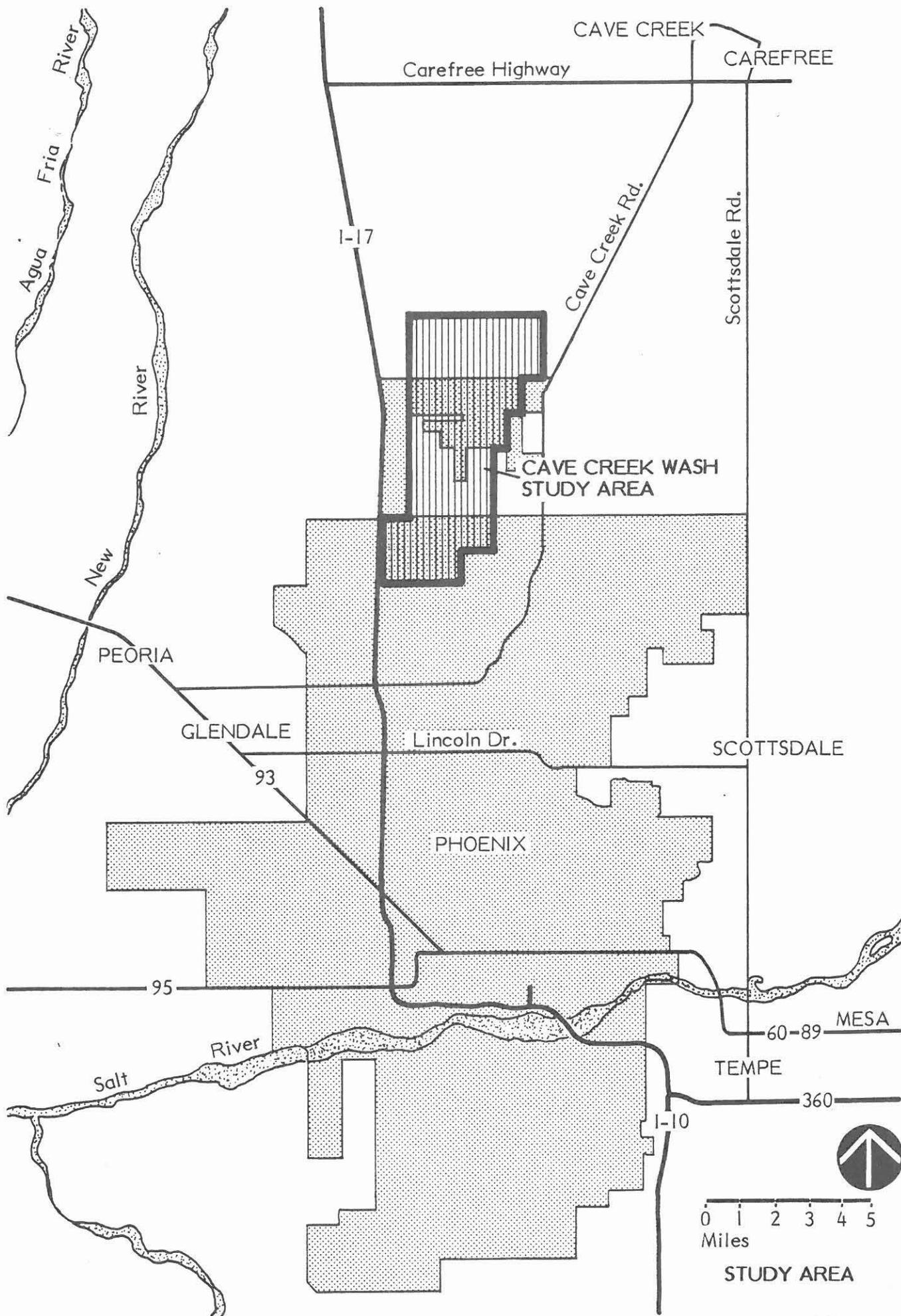


FIGURE 1

Opportunities and Constraints

The Cave Creek Wash study area was evaluated to determine opportunities and constraints potentially available according to two major issues. First, major opportunities and/or constraints presented by the existing wash in relation to the three categories: (a) natural resources and actions such as biology and soils; hydrology and hydraulics; (b) bridges, utilities and development of inhabited areas; and (c) recreation, parks, and circulation patterns. Second, opportunities and/or constraints potentially resulting from interjection of previously uninvolved land use and/or development modifications necessary for the various planning alternatives to function.

Five planning factors were identified that could be considered opportunities and constraints present or anticipated as a result of the wash's development. These factors are: (1) land use/recreation/visual; (2) hydrology/hydraulics; (3) infrastructure; (4) transportation; and (5) cultural/biological resources. The study area was divided into eight reaches defined by significant features, limits of vegetation, need for channelization and major street crossings.

Once the opportunities and constraints were recorded, allowing for comparison and development of relationships, judgments were made which took greater advantage of present opportunities and thus seems to neutralize many constraints.

Table I examines each reach and identifies significant opportunities and constraints associated with the study area. Table II gives the location of each reach of the Cave Creek study area. Tables I and II are located at the end of this report.

Master Plan Development

Based upon the identified opportunities and constraints for Cave Creek Wash and review of alternative master plan concepts by the City staff, the Cave Creek Concept Master Plan was developed (Figure 2, The Concept Master Plan, located at the back of this report). The Master Plan, consisting mostly of medium-density, multi-family housing and utilizing Cave Creek as the design backbone for planning, optimizes the objectives of the city and TAG, and encourages the private developer to pay for project implementation. The plan upholds the following guidelines:

1. Flood control measures be maintained or enhanced;
2. Significant vegetation will be preserved in all cases possible;
3. The private developer/owner will pay the cost of implementation and operation/maintenance;

4. Two contiguous trails systems for separate biking and hiking and equestrian trails will be established;
5. A system of "neighborhood" parks will be established and the parks, open space and trail system would interlock with all adjacent recreation and trails systems;
6. A development program will be established that prevents lots from backing onto the wash or that establishes a road buffer between the wash and low-density development;
7. Proposed adjacent development will relate appropriate portions of the development area interior open space with surrounding public recreation and open space in a contiguous and complementary manner.
8. Development will closely follow the density and land uses proposed in the 1985 Interim Plan and Phoenix Concept Plan 2000; and
9. Public health, safety and welfare will be enhanced by implementation of the plan.

In addition, certain assumptions concerning recreation have been made:

1. A continuous trails system will be present along Cave Creek and East Fork washes;
2. The three city parks of various sizes will be sited along the wash; and
3. The north end of the project from Deer Valley Road to the Cave Buttes Dam will remain open space to complement recreation and interpretive opportunities.

Implementation

Potential funding sources for capital improvements related to flood control, recreation facilities, and maintenance and operation were catalogued in four categories: (1) land acquisition; (2) channel improvement; (3) roadway crossings; and (4) recreation and aesthetic amenities. The most likely funding sources were found to be private sources benefitting from development of the wash. Limited funding may be available from the Flood Control District of Maricopa County (FCDMC) or the "State Alternative Assistance Program" where substantial flood control benefits can be shown. The city may furnish limited funding for operation and maintenance in some park and recreation areas. Storm drain bond monies may be used for the expansion of existing flood control measures and utilize nuisance water for irrigation of vegetation where possible. There may be new or revised Federal programs in the future.

The majority of development costs must be from private sources while operations and maintenance can be of mixed funding using such options as homeowners associations. The city should explore the possibility of negotiating private development agreements that can provide capital needed for short-term public improvements while providing developers with assurance of specified development rights over the longer term. This may be accomplished through the adoption of a Cave Creek Wash overlay district that is within the master plan boundaries and includes the floodplain. The district provisions would be in addition to existing zoning requirements. Creation of the district would encourage private section participation in flood control and recreation improvements and to encourage site planning that will focus on the wash as an amenity thereby creating a stronger area identity.

Definite commitments must be made by the city to the Bureau of Land Management (BLM) with regard to lease of property for recreational uses. The very limited city funds will be committed to contractual expenditures for recreation and park uses rather than to purchase and develop open space along the channel. Density trade-off incentives may be offered to developers so that the city may acquire existing private floodplain properties for use as recreation space.

Implementation of the Cave Creek Concept Master Plan can be expected to occur in a piecemeal manner. The most organized procedure would be to start with underground utility relocation and to begin downstream channel improvements, proceeding upstream. Land development, however, cannot be expected to take place in an orderly downstream-to-upstream pattern. Since strong reliance is to be placed on private sector involvement in improvement and maintenance of the wash, some sections may be very slow to develop, or are not developed at all. Proposed flood control protection and other wash improvements, therefore, cannot be built with the assumption that all proposed improvements will be completed. They must be built to stand alone as to the hydraulic conditions existing at the time of development. Developers should be encouraged to plan for staged development of floodplain areas to be reclaimed. This may result in increased overall project costs, but will allow assured flood control for improved areas and accommodate piecemeal development.

All road crossings are proposed to be set at or near existing grade; therefore they can precede channelization without creating adverse backwater conditions by acting as a set of dikes. Devices, such as drop structures which act to flatten the slope of the channel and reduce the amount of erosion from storm runoff, must be in place prior to development adjacent to the channel to eliminate the possibility of failure due to erosion. The upstream ends of piecemeal channel excavations must be protected to eliminate uncontrolled headcutting.

The most significant implementation problem in the main channel is eliminating the floodplain breakout north of Beardsley Road. Wash capacity

downstream to Bell Road must be increased prior to diverting waters within the breakout area back to the main channel. If land development within the breakout area is to occur prior to downstream improvements, developers who will benefit from the land reclamation must contribute to long-term solution of potential flood control problems by working with downstream owners, improvement district formation or other means.

Additional Investigation Recommended

While the Master Plan provides the city with a tool that can be implemented, details for individual parcel development must be provided on an individual basis. The following detailed design and planning investigations should be conducted and conceptual standards and plans provided to guide the developer:

1. Park, open space and trails system master plan including preliminary grading plans (to be provided to developers);
2. Impact on abandonment of sand and gravel operations relative to channel stability (includes estimated life of existing operations) and a rehabilitation plan;
3. Detailed design for road crossings and utilities within the floodplain;
4. Feasibility study to determine potential sources and availability of nonpotable water;
5. Impact of density changes on study area's water requirements; and
6. A revegetation and earthform rehabilitation program for the entire wash area.

RESOURCE INVENTORY

An inventory of existing and planned resources was completed to establish opportunity and constraint issues for the Cave Creek Wash study area. A combination of field study and secondary data review was used to collect information. Reports and updates on existing master plans, various city plans and village concepts, zoning requests and related permits, and uses were furnished by the city. Contact was made with the Corps of Engineers (COE), FCDMC, BLM and State Land Department.

The following is a brief summary of the inventory results for the resources evaluated.

Existing Land Use

The presence of large undeveloped tracts of land adjacent to the wash presents a major opportunity to guide future development in directions compatible with recreation and flood control while providing a base of economic support for the objectives of this plan. Landscape rehabilitation of Cave Creek Wash should be encouraged in cooperation with extractive users of the wash since mining operations could be coordinated in a way that may facilitate construction of flood control and recreation improvements.

Zoning

Zoning classifications describe general types of land uses presently allowed on specific parcels. Although the Cave Creek Concept Master Plan may suggest land uses and increased housing densities that differ from those allowable under present zoning and approved in the 1985 Interim Plan, these proposals are made with an awareness of their "real world" relationship to present zoning. If the plan proposes land uses only allowable with rezoning to more intensive classifications, it is likely that the land owners will support the plan in order to obtain higher development densities. If downzoning is recommended, the owners will have no extra incentives, may not support the plan and have the right to proceed with development under present zoning. Therefore, development incentives should be built into the plan to encourage effective implementation.

Land Ownership

The land ownership in the study area is divided into two general categories: public and private. The implications of land ownership are primarily that a direction for development of the property may be surmised from the type and background of the existing owner. Consideration of land ownership is basically a tool for support and prediction of land use relating to the known and/or historical goals of the owner. Use and development potential and the sequencing of such objectives often relate more directly to the interest rate, inflation and the economy than to the actual ownership; however, certain general implications as noted above, can be established. Theoretically, all uses of either public or private land will concur with the city's village plans, interim plans and long-range concept plans. The uses should also be compatible to existing neighborhood community plans such as the Deer Valley Plan for adjacent development.

Transportation

Transportation facilities inventoried include major (four, five or six lanes) and collector (two lanes) streets, wash/street crossings, bicycle paths and trails.

Roadway patterns identified in the right-of-way standards map and street classification map are recommended for inclusion in the Master Plan with the exceptions of modifications to eliminate a crossing of the East Fork at 7th Avenue and the main channel at 7th Avenue north of Bell Road. A future extension of Greenway Road as a six-lane major street from 19th Avenue to 7th Street is shown as part of the plan. The precise alignment of Greenway Road within the corridor shown is yet to be developed; therefore, for this report, it is shown as a desired general alignment corridor. All major one-mile streets are proposed as dry crossings for 100-year flood events. Interior collector streets serving developments adjacent to the wash should not cross the wash, but, should run parallel and adjacent to the channel in order to serve as a security buffer between the wash and adjacent single-family residential areas and reduce the cost of crossings. Road crossings proposed are designed to act as dry crossing bridges for vehicular traffic, flood control structures and below grade pedestrian/equestrian crossings (Figure 3, Typical Roadway and Trail Crossing) thus allowing for the possibility of a continuous set of bicycle, equestrian and hiking trails (Figure 4, Continuous Trail System).

Infrastructure

Water, gas, cable, electric, sanitary sewer and storm drains all interface with the proposed channel work. Relocations of sanitary sewers are of primary concern due to new construction grade considerations. The existing 15-inch sewer at the East Fork/7th Street crossing would be in conflict with a proposed crossing, and the sanitary sewer on 7th Avenue north of Bell Road is proposed for relocation with the roadway to avoid conflicts with recommended channel work. Nuisance water expected to be generated by these storm drains may be treated as a supplemental periodic irrigation resource.

Planned Land Use

The Cave Creek Concept Master Plan complements existing land use patterns. From major existing single-family residential areas west and south of the wash, transitional residential uses are proposed, increasing in density close to the wash. High-density residential uses are concentrated along Bell Road and Union Hills Drive, in the south part of the study area and along the proposed Greenway Road alignment. Generally, residential densities decrease north of Union Hills Drive in response to existing single-family subdivisions close to the wash and to topographic constraints east of 7th Street. A major recreation area is proposed north of Deer Valley Road, where the airport clear zone, poor soil conditions, steep slopes and the presence of historic and prehistoric sites constrain many types of development.

Most of the wash is within a medium-intensity use area, as defined by the City of Phoenix in the 1985 Interim Plan. The East Fork and the wash between 7th Street and Deer Valley Road are in low-intensity areas. The proposed Cave

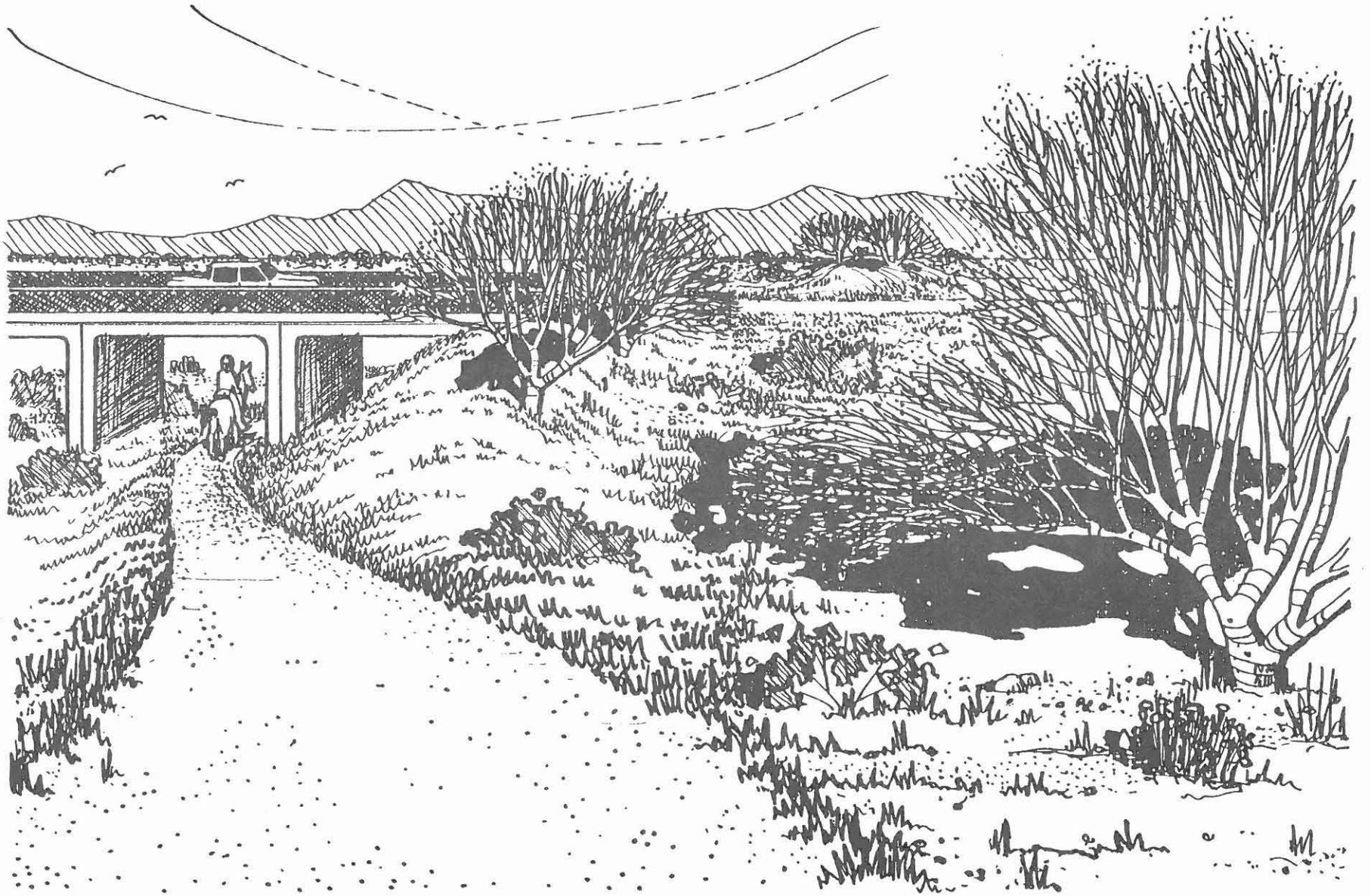
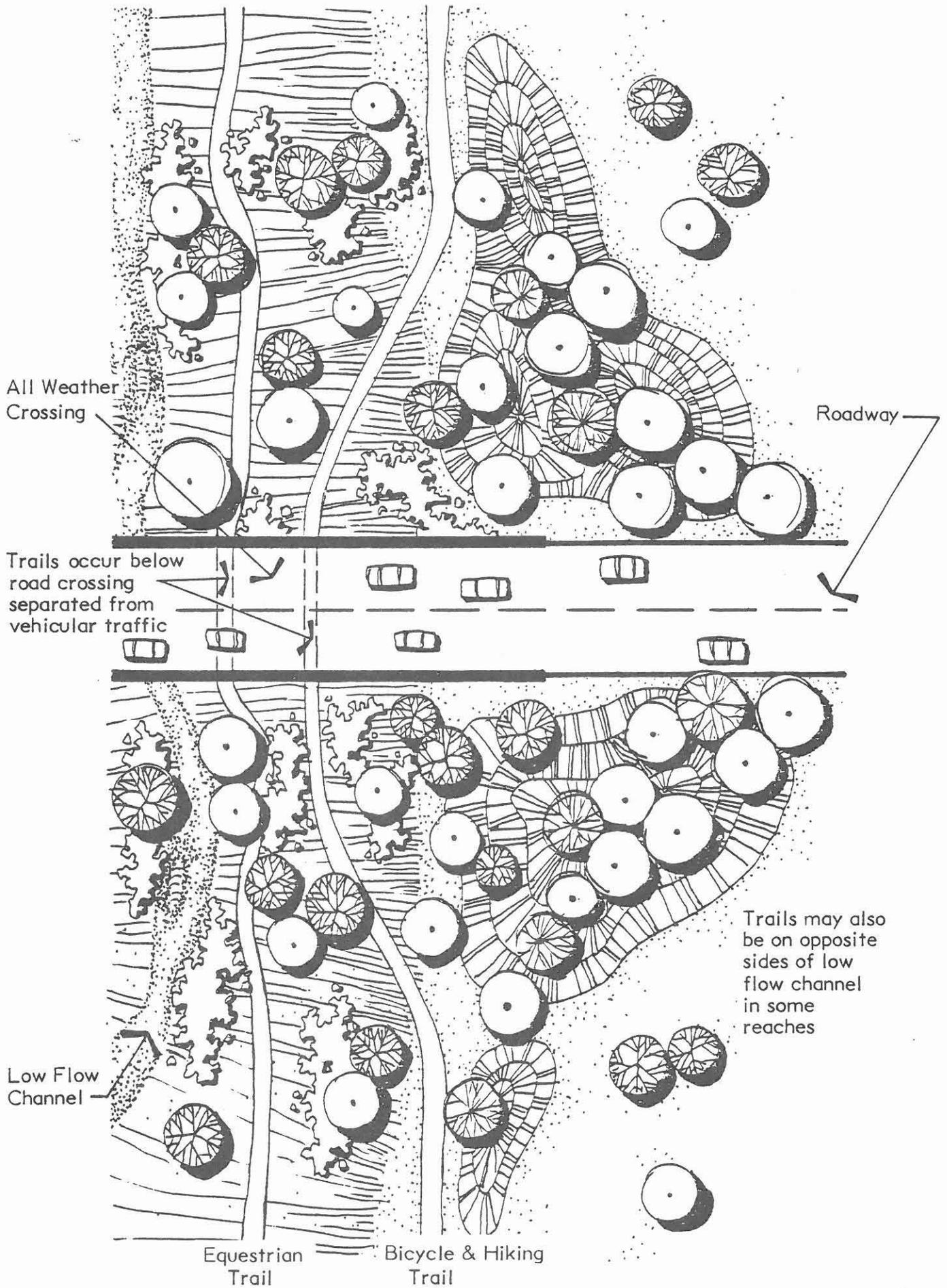


FIGURE 3

TYPICAL ROADWAY AND BELOW GRADE TRAIL CROSSING



CONTINUOUS TRAIL SYSTEM CONCEPT (PLAN VIEW)

FIGURE 4

Creek Concept Master Plan represents intensification of land use along the wash that exceeds land use intensities implied by the 1985 Interim Plan. Increased intensities, however, are necessary to support improvement and maintenance of the wash. Discussions with the city indicate that the relevant urban village plans may be amended to be compatible with the Cave Creek Concept Master Plan.

Recreation

Cave Creek Wash offers residents of the area the opportunity for recreation and, even in its presently undeveloped state, is used by many people. Informal recreation currently occurring throughout Cave Creek Wash includes horse riders, children at play, target shooters, hikers and bird watchers. There are several park sites, as yet undeveloped, throughout the wash area. The Cave Creek Dam Archaeological District includes prehistoric petroglyphs (rock paintings), pit houses, prehistoric and historic irrigation canals, and a prehistoric fortified hilltop. Many of these cultural resources need to be protected as development encroaches into the area. Indeed, the natural and cultural resources may provide the basis upon which to provide more formal recreation and interpretive facilities and opportunities.

To maximize potential recreation opportunities for residents and users, the cost of recreation should be in proportion to the benefit received by the developer, and in proportion to the cost of maintenance to be borne by the city or the homeowner associations responsible for upkeep. Thus, division of responsibility for implementation, maintenance and operation will depend largely upon density and type of dwellings adjacent to the recreational facility.

Single-family detached housing has not historically supported common space for recreation or open space. The ability of high-density, multi-family dwelling areas to establish and maintain common areas and recreation facilities has been far more successful. The continuation of maintenance in case of failure of the original owner/developer involvement potentially would become the responsibility of the city parks. To avoid this situation, careful and thorough legal evaluation of each proposed homeowner's association should be conducted to insure continued private maintenance of the facilities. Creation of an overlay district would help if facilities are abandoned by the original maintaining group.

In order to create an environment rich in amenities that enhance the experience of people living near or using the Cave Creek Wash facilities, phasing of the various stages of recreation development and open space will be necessary. The city has made it very clear that there is no possibility of channel and bridge modification without contribution from the surrounding developers. Timing of development and the interlocking of parts of trails and open space acquired and constructed at different times in different locations

will be a key consideration (Figure 5, Neighborhood Parks and Trails). At present, the final product desired by the city is a contiguous trails and open-space system throughout the wash area (Figure 6, Typical Continuous Trail). Any development for recreation within the Cave Creek Wash study area will have to interface with the COE/FCDMC needs and regulations. The overall responsibility for control of the floodway and wash from Cave Buttes Dam to Peoria Avenue rests with the COE. The COE delegates the responsibility to the FCDMC to ensure the use and maintenance of the wash to meet COE criteria for maximum flood projections.

There are minor constraints in the wash development: conflicts of use such as a field dog trial area above the dam and the riding trails which may cross it; a hot-air balloon launch pad near the Deer Valley Airport traffic pattern; reconstruction/modification of the CAP crossover spillway to allow crossing by trail users; and law enforcement along the trails and in the park areas.

The arrangement between the city parks system and the adjacent owners/developers will have to consider "special" maintenance cases and responsibility for necessary action over and above normal requirements. For example, inundation of lands and facilities along the wash during a flood period would present problems of repair and cleanup to keep the overall quality of the area high.

Another way to insure maximum benefits may be derived is the allocation of area to the various surrounding developments. Certain parks are planned as joint conglomerations of private-public maintenance, areas of trails and open space/flood channel will be shared responsibility (i.e., one side flanked by single-family residence, therefore city maintained; one side flanked by high-density multi-family residence, maintained by numerous homeowner associations) and the limitations of responsibility upstream and downstream from the actual property boundaries within the wash (Figure 7, Typical Development Along Wash). This also applies to the width of the wash for which the owner/developer is held responsible.

Visual

Vistas identified throughout the study area (including those seen from travel routes, residences and use areas) provide an opportunity for the use of various interpretation techniques of unique project features (e.g., cultural and natural resources). Identified sand and gravel operations should be screened from users of existing or proposed roads and/or trails within the study area through vegetation and landform manipulation (Figure 8, Landscape Rehabilitation Area with Trail). In addition, after abandonment of sand and gravel operations, rehabilitation of excavated areas would also be desirable through further vegetation and landform manipulation. Although a few opportunities exist for exterior views (e.g., viewing Union Hills from Cave Creek), the majority of views within the Cave Creek Wash area, including East Fork, will

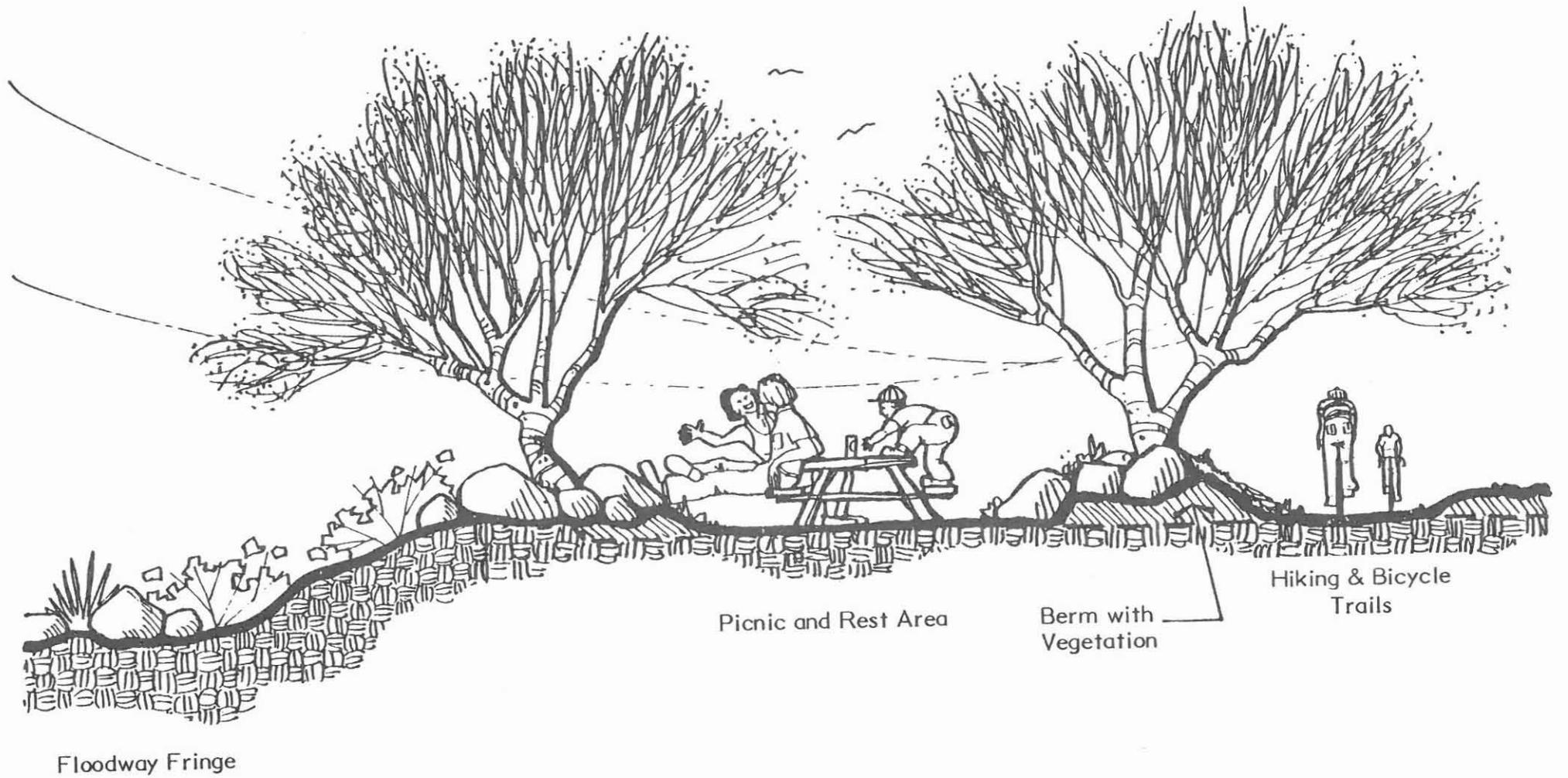


FIGURE 5

NEIGHBORHOOD PARKS AND TRAILS

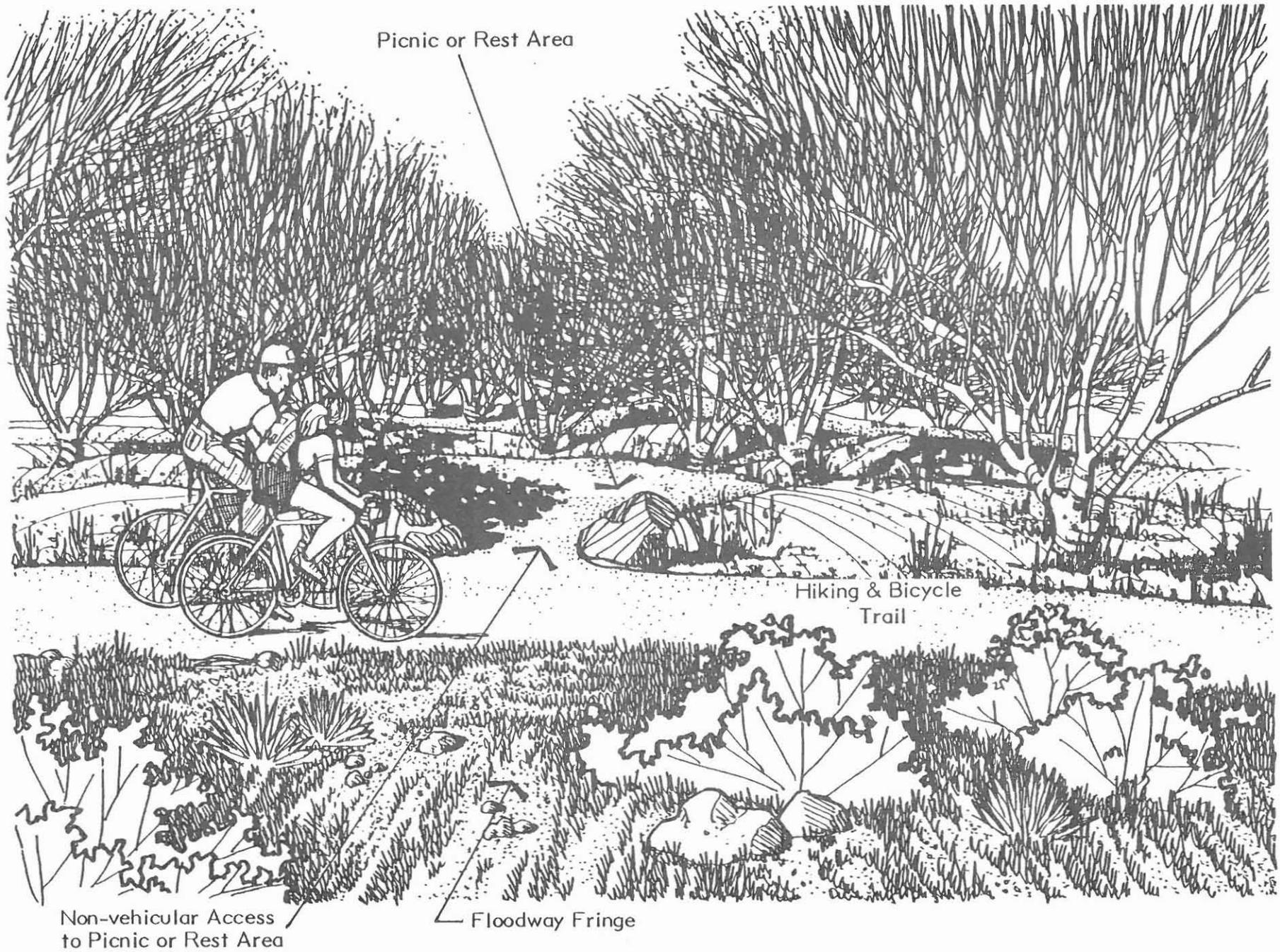
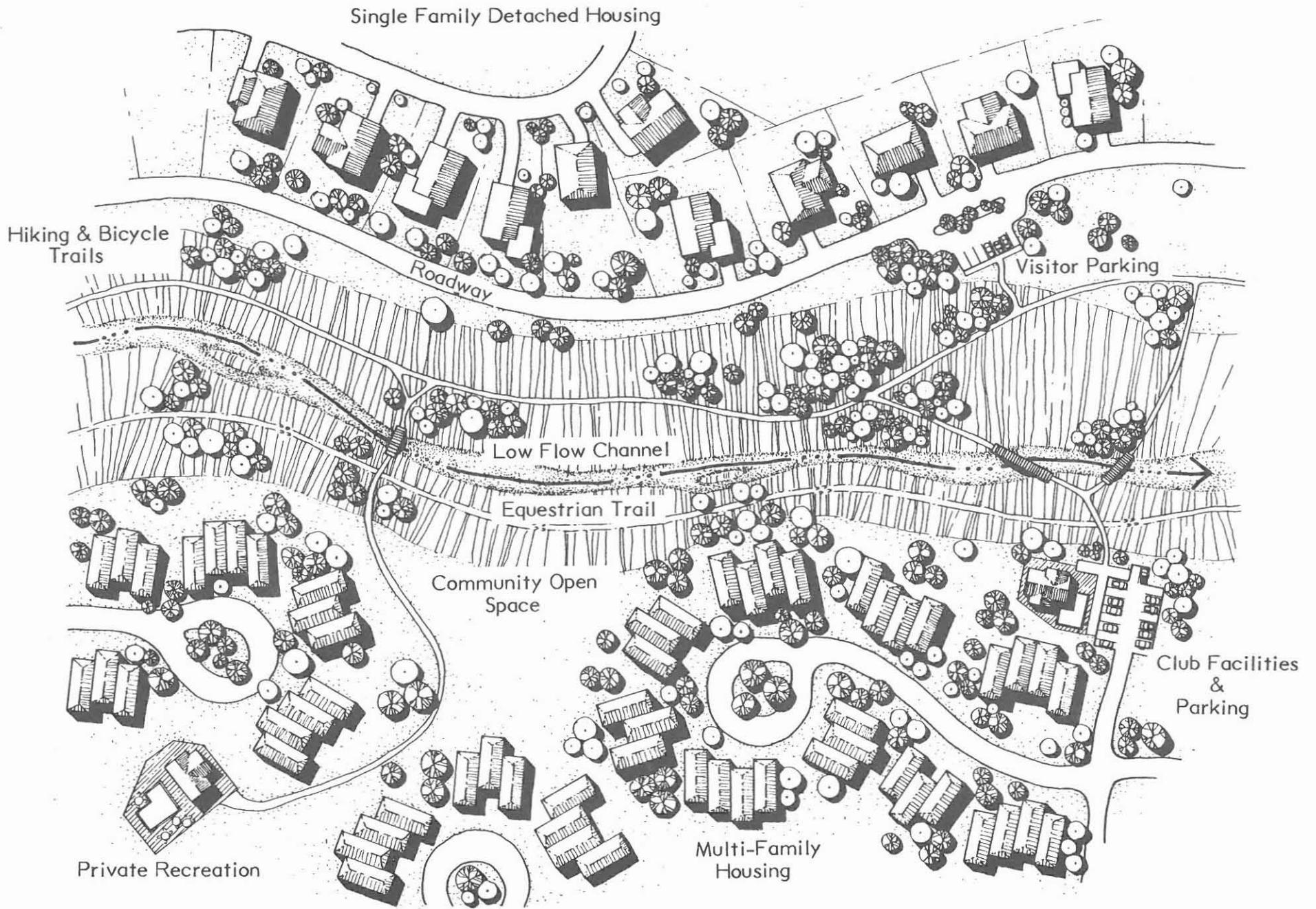


FIGURE 6

TYPICAL CONTINUOUS TRAIL SYSTEM (PERSPECTIVE)



TYPICAL DEVELOPMENT ALONG WASH

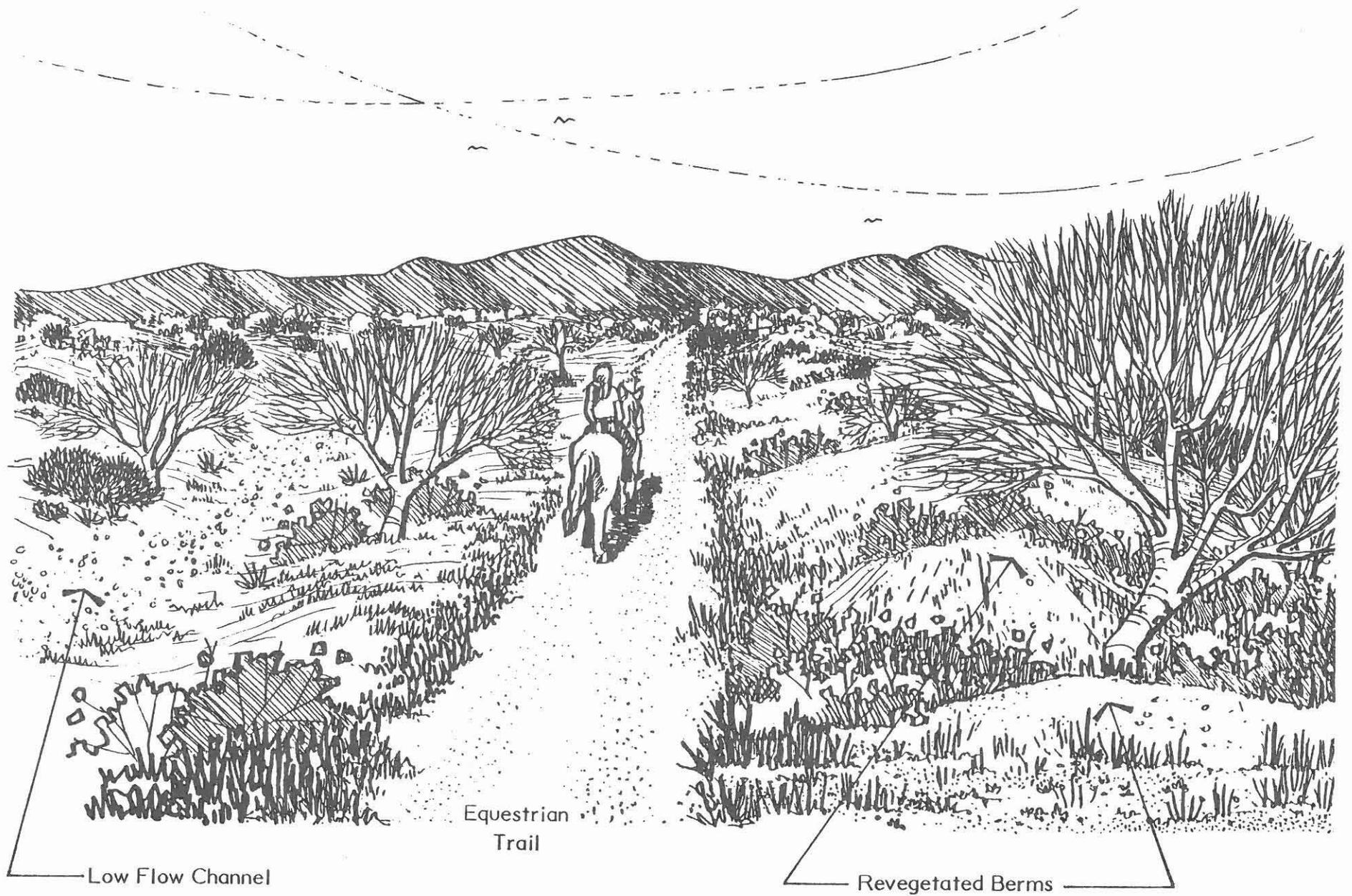


FIGURE 8

LANDSCAPE REHABILITATION AREA WITH TRAIL

be interior in orientation (e.g., views within the wash) since the surrounding landscape is presently, or will be, developed thereby screening most exterior views.

Cultural Resources

The presence of significant cultural resources should constrain development to avoid disturbance to these resources, if possible. This is especially the case on public lands, where cultural resources receive legal protection. The State Historic Preservation Office can be contacted by private developers and public agencies in the early planning stage of any specific proposal that would involve grading or other significant forms of ground disturbance.

The Arizona State Historic Preservation Office has determined that the Cave Creek Dam Archaeological District is a significant resource and has nominated it to the National Register of Historic Places (Fryman 1976). Development in this area should avoid impacts to cultural resources. For example, the COE has already avoided impacts to old Cave Creek Dam through a redesign of the spillway for the new dam. Currently, sand and gravel mining operations on state lands in the district are required to avoid such impacts.

The Fort Mountain complex within the study area demonstrates the high archaeological potential of Cave Creek Wash. Known cultural resources adjacent to the district may also constrain development.

Biological Resources

The following ranking indicates the importance of the existing wildlife habitat and diversity of plant species for maintenance. The three areas of remaining habitat are: (1) the riparian growth below Fort Mountain, north of the CAP to the gravel extraction area; (2) the East Fork from approximately one-quarter mile west of 7th Street to the confluence with Cave Creek Wash; and (3) the areas between Union Hills Drive and Bell Road.

Maintaining the riparian habitats along Cave Creek, north of the CAP crossing, in their present state would be beneficial to many wildlife species and provide a site for area residents to enjoy their presence. The natural biotic resources between Union Hills Drive and Bell Road could be greatly enhanced if trash dumping and excessive off-road vehicle use were eliminated. This area could also provide some attractive open space for area residents as well as providing improved habitat for some wildlife species. The East Fork vegetation is in good enough condition that a cessation of off-road vehicles and dumping followed by a thorough clean-up of existing trash would result in continued plant cover growth and an attractive corridor for potential trails use, as well as enhancement of the existing City Park property along the wash. The various trail uses have not historically interfered with the existence of the

nongame species now present. Introduction of arid-plant material such as desert broom and salt bush to enhance the wildlife habitat could prove very beneficial, both to wildlife and erosion problems.

The long-term effect of Cave Buttes Dam on the flora and fauna of Cave Creek Wash remains to be seen. The animal life is dependent upon the vegetation, and the vegetation is dependent upon the limited water supply available in this area. Several areas will probably benefit from the dam, specifically the immediate downstream area due to seepage should the dam ever hold a large quantity of water for a period of time. The entire Cave Creek Wash may benefit since the water will now be held and released at a given rate, probably over a longer period of time than the same amount of water would take to pass through Cave Creek Wash without the restriction of the dam. East Fork will not be affected by the dam since its runoff water comes from a different area.

Continued development along the banks of Cave Creek Wash would generally have very little adverse effect on the existing natural biotic resources. With the exception of areas mentioned above, the wash is very badly disturbed and little wildlife habitat remains. Similarly, there is virtually no chance of development conflicting with any highly sensitive wildlife species (e.g., threatened or endangered forms) or similar plant species.

Geology and Soils

Soils along the wash banks are collodial graded silts subject to erosion. Material of a significant enough size to form a natural armoring (a top layer of rocks) of the channel, which will prevent further erosion, is not present in the wash.

Hydrology

The Corps of Engineers (COE) recently completed construction of Cave Buttes Dam at the northern (upstream) end of the study area. Operation and maintenance of the dam and the floodplain below (study area) is the responsibility of the Flood Control District of Maricopa County (FCDMC). The COE requires maintenance of a floodway capable of handling the "future 100-year flood." Federal Emergency Management Agency (FEMA) delineations, however, are for a 100-year event under "present conditions." The two flow rates are approximately the same from the dam down to the main channel/East Fork junction, north of Greenway Road with one major discrepancy between the COE and FEMA numbers. The FEMA floodplain is based on a breakout occurring in the main channel downstream of 7th Street and the COE's delineation assumes this area will be protected by levees. The flow from this breakout does not reenter the wash. Instead the water flows southwest away from Cave Creek. The COE's flow rates in the main channel are, therefore,

higher than the FEMA numbers. The COE's "future" 100-year flow rates are used in the channel design since ultimately the breakout must be confined to the channel in order to eliminate flooding of the residential areas to the west of the main channel. Low-flow channel capacities on the main channel should be set at a minimum of 500 cfs due to the possibility of prolonged Cave Buttes Dam releases at this rate. Future 100-year flow rates for the East Fork should be incorporated into the channel design (when available).

Topography and Hydraulics

The area generally slopes from northeast to southwest and flows entering the west overbank on the main channel could escape from the channel and flow through adjacent residential areas between the wash and Black Canyon Freeway. Floodwater breakouts will be eliminated by the ultimate entrenchment of the main channel.

As an overview of the study area, two reaches have very ill-defined braided floodplains. The braided portion of East Fork upstream of Central Avenue is headcutting towards 7th Street from the downstream incised channel. If allowed to continue, eventually the channel upstream will take the form of the downstream channel. This process would be expected to accelerate as a result of adjacent developments, concentrating flows entering the channel. The braided portion of the main channel between Bell Road and Union Hills Drive would similarly be expected to become more well-defined by concentration of flows from adjacent developments.

Upstream of Union Hills Drive to 7th Street, on the main channel, gravel mining has significantly changed the character of the land adjacent to the channel. In the absence of any additional man-made channel protection measures, shifting of the channel can be expected to eventually occur. This will result in significant upstream headcutting since the bottom of the materials pits are well below the present channel invert.

Three alternative channel cross section shapes were considered: (1) a minimum-width channel alternative; (2) a terraced alternative with a 10-year low-flow channel within the 100-year channel; and (3) a 500 cfs low-flow channel alternative to minimize the area occupied by low-flow channel. The dam release rate, of 500 cfs, was determined as the minimum capacity necessary for erosion control purposes and, in addition, minimizes disruption of the recreation overbank areas during periods of prolonged dam releases.

Channel shape, slope and scour potential has been examined conceptually and it can be concluded that, in general on the main channel, in order to maximize the usable land within the channel (for recreation features), the 500 cfs low-flow channel shape should be considered. The low-flow channel itself can meander within the larger channel.

In the East Fork a 2- to 10-year low-flow channel should be located along the side of the 50+ foot-wide strip of existing channel to be saved (Figure 9, Typical Section - East Fork). This will minimize lateral instability problems and provide a source of water to help sustain the existing growth. The existing growth, therefore, will separate the new channel from the building pad on the south side of the channel.

Earth-lined areas will require flatter slopes than existing for stability, making drop structures necessary to control the depth of the channel. The drop structures may also be incorporated into the channel as a recreational feature such as an amphitheater (Figure 10, Drop Structures), if such a structure is placed near an active recreation site. Grassed portions of the channel can be placed on existing slopes and remain stable.

The channelization proposed will result in an entrenched channel that will add approximately 230 to 280 acres of developable land to the main channel floodplain and will allow recovery of 90 to 120 acres on the East Fork.

Utility relocations or protection will be necessary to implement the channelization and road crossing plans.

Proposed road crossings will take advantage of the deeper downstream grades and lower water surfaces to obtain a more economical constricted cross section and improved outlets for proposed storm drains.

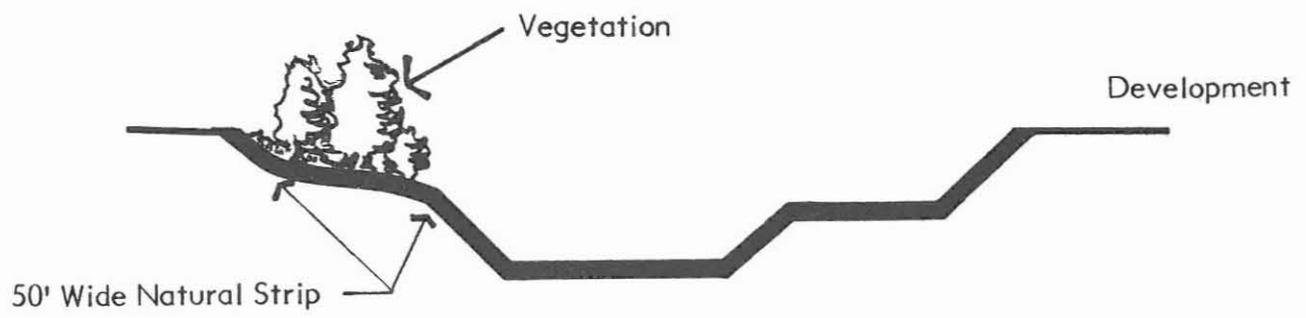
Road crossings of the channel have been minimized by planning local and minor collector streets to run parallel to the channel. The only crossings proposed, therefore, are at the major streets now crossing the wash (7th Street on the East Fork; Union Hills Drive, Beardsley Road, and Deer Valley Road on the main channel). Bell Road, 19th Avenue and 7th Street (on the main channel) have existing bridges and the crossing on 7th Avenue just north of Bell Road is proposed for relocation out of the channel.

Crossings of the channel on the proposed extension of Greenway Road at the main channel-East Fork junction and on the East Fork near Central Avenue is planned to serve as a major carrier extending from 19th Avenue to beyond 7th Street.

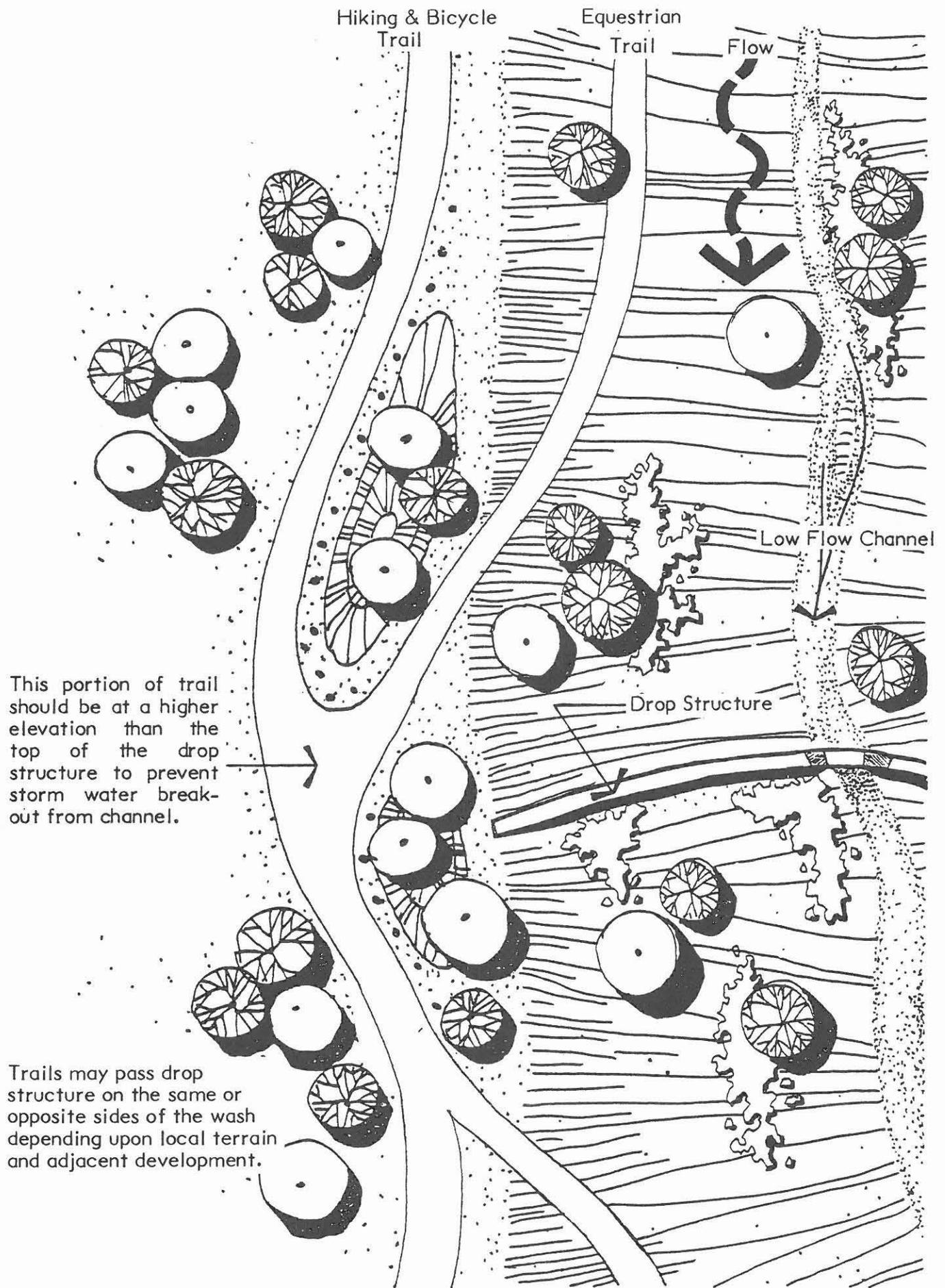
The proposed crossings will have between 8 and 15 feet of clearance with the deck near existing road grades. This will allow pedestrian, bicycle and possibly equestrian use of the structure as an underpass. Setting bridge decks at existing road grades will minimize approach work.

CONCLUSION

This Cave Creek Wash Master Development Plan Executive Summary has outlined the main points of information contained within the Cave Creek Wash



TYPICAL SECTION - EAST FORK



TYPICAL DROP STRUCTURE

FIGURE 10

Master Development Plan. While the attempt has been made to summarize, as thoroughly as possible, the Master Plan report, this document by itself is not a document suitable for comprehensive planning. In order to obtain a more detailed understanding of the information concerning the Cave Creek study area, the Cave Creek Wash Master Development Plan should be referred to.

**TABLE I
OPPORTUNITIES AND CONSTRAINTS**

<u>Land Use/Visual/Rec.</u>	<u>Hydrology/Hydraulics</u>	<u>Infrastructure</u>	<u>Transportation</u>	<u>Cultural/Biological</u>
<p>Reach A Constraints</p> <p>Airport clear zone development policy--limits people intensive use. One story only. Steep slopes, erosion, poor soil, hillside ordinance. State land jurisdiction turn over to state and be left in open space. No pedestrian crossing on CAP bridge, no crossing at overflow. Gravel operations--constraints for development.</p>	<p>Downstream erosion, lengthen time of water flow from dam, extensive floodplain, potential erosion upstream.</p>	<p>Transmission line. CAP canal access.</p>	<p>Deer Valley airport noise. No public access.</p>	<p>National Register District protection of resource from vandalism.</p>
<p>Opportunities</p> <p>No existing land use. Warehouses in industrial area. Area has been used by motorcycle park/off-road vehicles. Visual opportunity because of landform. CAP trails, BLM ownership, pathway system, open space existing. Gravel pits opportunity for open space.</p> <p>Sewage plant effluent, if treated, could be a lake in gravel pit areas.</p>	<p>Length and availability of water from dam for vegetation.</p>	<p>Transmission line--potential trails along existing right-of-way.</p>	<p>Improved access, park visibility. Large areas uninterrupted by major roadways. Good airport access.</p>	<p>Cultural interpretation program--because of location (hills) and resource quality. Potential for comparison of irrigation programs, prehistoric(?) to CAP. Undisturbed biological resources in wash and surrounding area. Best opportunity for wildlife habitat--especially if water is available.</p>

Table I (continued)
Opportunities and Constraints

<u>Land Use/Visual/Rec.</u>	<u>Hydrology/Hydraulics</u>	<u>Infrastructure</u>	<u>Transportation</u>	<u>Cultural/Biological</u>
Reach B Constraints				
Gravel pit (very large) on state land.	Major breakout from main channel--severe flooding on west side. Constraint to Master Plan--some floodplain below must be fully developed before breakout can be removed.	No major utility constraints. Above ground utility line subject to damage.	Crossing necessary at Beardsley. Main access to Village Cove.	No significant constraint.
Land between channel and 7th Street is isolated.	Potential erosion if channel breaks into gravel pit.			
Constraint to conventional development because of topography	Lateral drainage constraint on development. Channel is inadequate to contain water--must be channelized for entire reach.			
Opportunities				
North half--strong industrial development potential. South half (west side)--residential development.	Defer channelization by realigning the channel through the gravel pit.	No significant opportunity.	Potential bike path connection at Beardsley. Save bridge crossing by not extending Rose Garden Lane.	No significant opportunity.
Potential trail linkage to BLM land at Beardsley.	Removing breakout leaves large area open for development.		7th Street bridge has potential for trail crossing.	

Table I (continued)
Opportunities and Constraints

<u>Land Use/Visual/Rec.</u>	<u>Hydrology/Hydraulics</u>	<u>Infrastructure</u>	<u>Transportation</u>	<u>Cultural/Biological</u>
Reach C				
Constraints				
Extractive uses present landfill potential.	Braided channel with lateral migration potential--needs channelization.	No significant constraint.	Crossing necessary at Union Hills and Beardsley.	No significant constraint.
Opportunities				
Large amount of undeveloped land adjacent to wash.	Nuisance water at Beardsley.	No significant opportunity.	No significant opportunity.	No significant opportunity.
Large tract of city-owned land including channel.				
Landfill for recreation area.				
Reach D				
Constraints				
Development proposal for entire section does not agree with qualifications of this Master Plan.	Extremely wide, shallow floodplain. Existing channel could cause serious erosion damage to adjacent area. Tied to existing channel at Bell Road because of present channel.	7th Avenue sewer line moved.	7th Avenue realigned--connection to south. Inadequate crossing at 7th Avenue. Homes at west channel edge back up to channel.	No significant constraint.

Table I (continued)
Opportunities and Constraints

<u>Land Use/Visual/Rec.</u>	<u>Hydrology/Hydraulics</u>	<u>Infrastructure</u>	<u>Transportation</u>	<u>Cultural/Biological</u>
Reach D				
Opportunities				
Proposed neighborhood park. (Large amount of undeveloped land adjacent to the rim.)	Two points of nuisance water--one at Grovers and one at Alt.	No significant opportunity.	Trail crossing under bridge at Bell Road.	Existing vegetation.
Reach E				
Constraints				
Turf Paradise development proposed for land east of wash (prospect unlikely).	Channelized with no low-flow channel.	45" sewer line.	No significant constraint.	No significant constraint.
Landfill adjacent to channel.				
Existing mobile home park adjacent to channel.				
Opportunities				
Large areas of vacant land east of wash.	Gabion lining in channelized area.	No significant opportunity.	Greenway Road--increase park visibility of Cave Creek Wash, increase development opportunities.	No significant opportunity.
Equestrian facilities asso- ciated with Turf Paradise could be developed.			Opportunity for east-west connection.	

Table I (continued)
Opportunities and Constraints

<u>Land Use/Visual/Rec.</u>	<u>Hydrology/Hydraulics</u>	<u>Infrastructure</u>	<u>Transportation</u>	<u>Cultural/Biological</u>
Reach F Constraints				
Both sides of wash proposed for intensive development (residential). South channel boundary fixed by existing development.	Wide, shallow floodplain, undefined point of entry at 7th Street. Significant lateral drainage along channel. Unmapped flooding problem east and south of channel.	High elevation of 15" sewer crossing at 7th Street. Existing 45" sewer (constraint for channelization). 12" sewer at Central Avenue.	Greenway Road tie at 7th Street. Crossing needed at 7th Street, would require significant upstream/downstream channel work.	No significant constraint.
Opportunities				
Channel development by private developers.	Two nuisance water outlets; at 7th Street and Central Avenue.	No significant opportunity.	Roadway would provide visibility of wash. Trails under bridge.	Limited biological resource (natural) worth saving.
Reach G Constraints				
Much land south of channel is developed and does not relate to wash. Existing trailer park.	Existing lateral drains not functioning properly. Potential unstable channel-- lateral migration possible.	27" sewer line crosses in two places, goes to 30".	Main access point to property is from Bell Road. Potential roadway improvement along Greenway Road alignment.	No significant constraint.

Table I (continued)
 Opportunities and Constraints

<u>Land Use/Visual/Rec.</u>	<u>Hydrology/Hydraulics</u>	<u>Infrastructure</u>	<u>Transportation</u>	<u>Cultural/Biological</u>
Reach G				
Opportunities				
Existing park owned by city.	No significant channel work.	No significant opportunity.	Eliminate crossing at 7th Avenue and East Fork.	Good quality vegetation, good landform.
Large area of undeveloped land on north side of channel.	Soils are reasonably stable.		Increased access to existing park.	
Expand existing usable park area to include unchannelled portion of the wash.				
Reach H				
Constraints				
Steep slope/landfill limit development potential.	Lateral drainage entering through landfills.	Methane gas collection system on adjacent abandoned landfill.	Greenway Road approved.	No significant constraint.
North side constrained by mobile home park and landfill.	Unstable channel.			
Opportunities				
Linkage to golf course/Sun Circle trails.	Nuisance water at 19th Avenue.	No significant opportunity.	Existing bridge with trail crossing possibilities.	No significant opportunity.

TABLE II
CAVE CREEK WASH STUDY AREA REACHES AND LOCATIONS

Reach A - The old Cave Buttes Dam across the new Cave Buttes Dam downstream across the CAP channel to the wash intersection with 7th Street.

Reach B - 7th Street downstream to Beardsley Road.

Reach C - Beardsley Road downstream to Union Hills Drive.

Reach D - Union Hills Drive downstream to Bell Road.

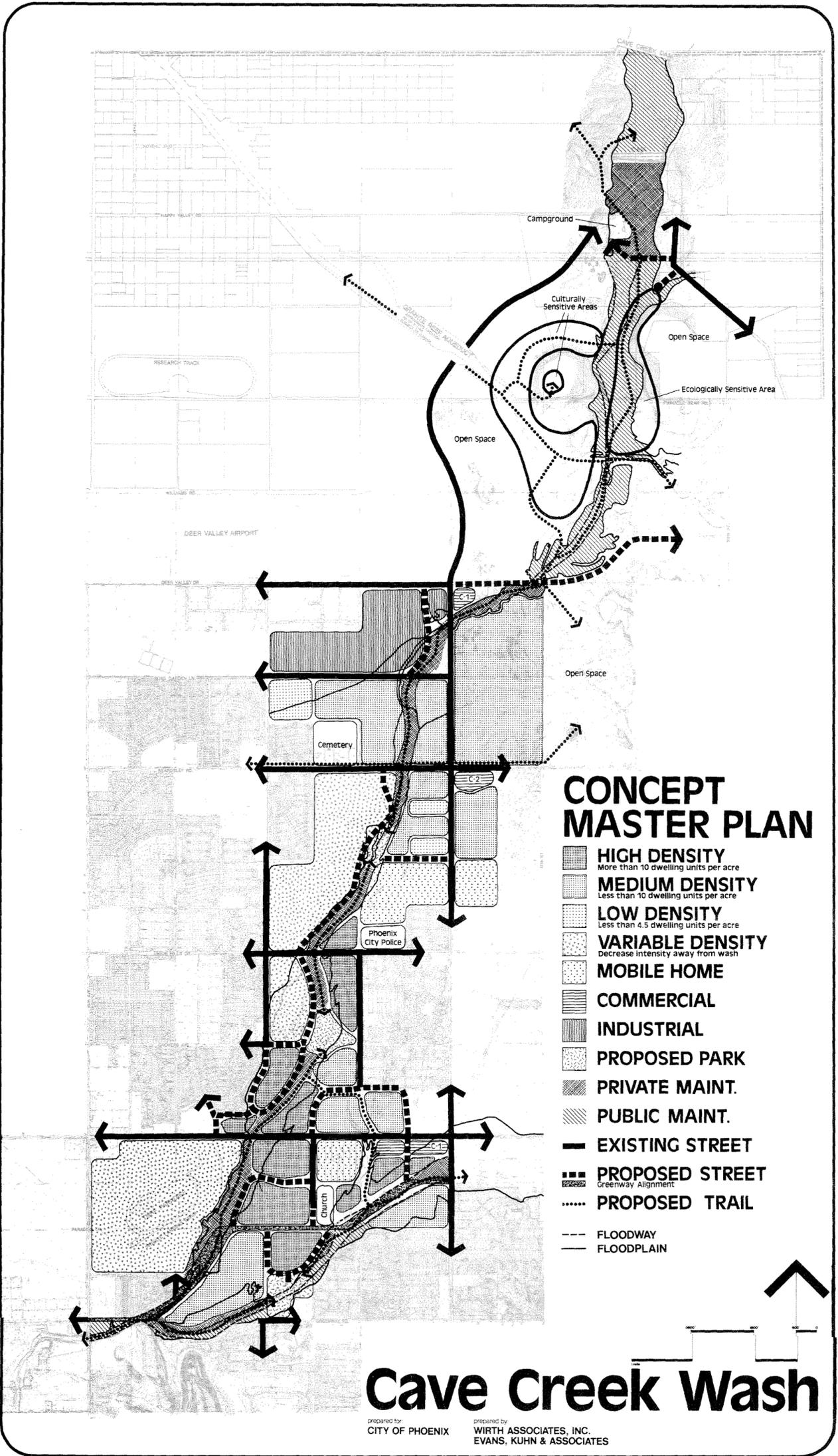
Reach E - Bell Road downstream to the confluence of the East Fork and the main Cave Creek channel.

Reach F - 7th Street downstream to the Central Avenue alignment (East Fork).

Reach G - Central Avenue alignment downstream to the confluence with the main channel of Cave Creek Wash (East Fork).

Reach H - The confluence of the East Fork of Cave Creek Wash and the main channel of Cave Creek Wash south across 19th Avenue.

FIGURE 2
THE CONCEPT MASTER PLAN



CONCEPT MASTER PLAN

- HIGH DENSITY**
More than 10 dwelling units per acre
- MEDIUM DENSITY**
Less than 10 dwelling units per acre
- LOW DENSITY**
Less than 4.5 dwelling units per acre
- VARIABLE DENSITY**
Decrease intensity away from wash
- MOBILE HOME**
- COMMERCIAL**
- INDUSTRIAL**
- PROPOSED PARK**
- PRIVATE MAINT.**
- PUBLIC MAINT.**
- EXISTING STREET**
- PROPOSED STREET**
Greenway Alignment
- PROPOSED TRAIL**
- FLOODWAY**
- FLOODPLAIN**

Cave Creek Wash

prepared for
CITY OF PHOENIX

prepared by
WIRTH ASSOCIATES, INC.
EVANS, KUHN & ASSOCIATES